

Geocres No:
41K-86

**FOUNDATION INVESTIGATION AND DESIGN REPORT
CARP RIVER BRIDGE REHABILITATION**

Highway 17, Site 38S-006

G.W.P. 5273-08-00

Township of Fisher

Geocres Number: 41K-86

Report to

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PART 1: FACTUAL INFORMATION

1. INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the site of the Carp River Bridge, located on Highway 17 just south of Highway 563 in the Township of Fisher, Ontario. This investigation was undertaken for the proposed rehabilitation of the bridge at this location.

The purpose of the investigation was to explore the subsurface conditions at the site, and based on the data obtained, to provide a borehole location plan, records of boreholes, a stratigraphic profile, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the investigation.

Thurber carried out the investigation as a sub-consultant to McCormick Rankin Corporation, under the Ministry of Transportation Ontario (MTO) Agreement Number 5009-E-0032.

In the preparation of this report and in addition to the boreholes drilled under the current assignment, reference has been made to information on subsurface conditions contained in an earlier foundation report. The title of this report is listed as follows:

- Foundation Investigation Report at Carp River and the King's Highway #17 (Approx. 50 miles North-West of Sault Ste. Marie) Twp. of Fisher, District of Algoma, Dist. 18, W.J.61-F-12, W.P. 910-60, dated March 30, 1961. (Reference 1).

2. SITE DESCRIPTION

The Carp River Bridge is located on Highway 17 in the Township of Fisher, Ontario, just south of the intersection of Highway 17 and Highway 563.

At present, the highway crosses the Carp River on a five-span structure supported on steel piles. The Carp River bridge spans approximately 40.0 m across the river channel. The Carp River flows south and discharges into Batchawana Bay of Lake Superior.



The surrounding area near the site is relatively flat. Some residential dwellings are located along the north side of Highway 17 in the vicinity of the river. The area to the northwest of the site is heavily treed.

Two photographs of the site included in Appendix F show the general nature of the surrounding land:

1. General view of the site looking towards the east.
2. Existing bridge viewed from the south west.

Physiographically, the site lies within the Canadian Shield, characterized by Precambrian meta-volcanic and meta-sedimentary rocks intruded by later stage diabase dykes. In some areas the Precambrian rocks are covered by sedimentary rocks of the Huronian Supergroup. The bedrock is mantled by glaciolacustrine varved clays and sand and gravel deposits.

3. SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project was carried out on October 18, 2010 and consisted of drilling and sampling two boreholes (numbered CRP-01 and CRP-02). Borehole CRP-01 was drilled close to the existing west abutment and Borehole CRP-02 close to the existing east abutment and advanced to 19.5 m and 15.8 m depth, respectively

A Dynamic Cone Penetration Test (DCPT) was performed from the base of each borehole. The DCPT performed in CRP-01 advanced only 150 mm while the DCPT performed in CRP-02 advanced to a depth of 20.5 m.

Records of Boreholes 1 to 6 drilled during the previous investigation (Reference 1) and their respective laboratory test results are enclosed in Appendix C.

The approximate locations of the boreholes are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix G.

Prior to commencement of drilling, utility clearances were obtained for all borehole and DCPT locations. Road occupancy permits were obtained for boreholes drilled on the existing Highway 17 platform.

The drilling was carried out from the highway using a CME75 truck-mounted drill rig with hollow stem augers. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the overburden soils. In situ vane shear testing was carried out to assess the undrained shear strength of the very soft to soft cohesive deposits.

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 samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. A standpipe piezometer consisting of 19 mm diameter PVC pipe with a 1.5 m slotted tip enclosed in filter sand was installed in Borehole CRP-01. The locations and completion details of the boreholes and piezometer are shown in Table 3.1.

Table 3.1 – Borehole Completion Details

Borehole	Location	Details	
		Piezometer Tip Depth/ Elevation (m)	Completion Details
CRP-01	West Abutment	18.9/167.8	Piezometer with 1.5 m slotted screen installed with sand filter to 16.8 m, bentonite from 16.8 m to 13.1 m, cuttings from 13.1 m to 0.08 m, and asphalt to surface. Flushmount casing installed.
CRP-02	East abutment	None installed	Backfilled with bentonite to 13.7 m, then cuttings to 0.1m, and asphalt to surface.

4. LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. The results of this testing are shown on the Record of Borehole sheets in Appendix A. Selected samples were also subjected to gradation analysis and Atterberg Limits testing as required, the results of which are summarized on the Record of Borehole sheets in Appendix A and shown on the figures included in Appendix B.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A. Details of the encountered soil stratigraphy are presented in this appendix and on the “Borehole Locations and Soil Strata” drawing in Appendix G. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the soil stratigraphy encountered at the site consists of pavement structure overlying sand fill which is underlain by an extensive layer of native silty clay. Native sand and silty sand and gravel layers were encountered below the silty clay. The sand fill contains occasional cobbles. More detailed descriptions of the individual strata are presented below.

5.1 Pavement Structure

Pavement structure consisting of approximately 50 mm to 75 mm of asphalt overlying granular (sand and gravel fill) road base was encountered in Boreholes CRP-01 and CRP-02 drilled on existing Highway 17 lanes.

5.2 Fill

Granular fill was contacted below the pavement structure in both boreholes. The fill generally consists of sand, trace gravel at the west abutments and sand and gravel at the east abutment. Occasional cobbles were noted in the fill.

A 125-mm thick layer of peat was encountered below the fill at 3.3 m depth (elevation 183.4) at the west abutment in Borehole CRP-01.

The thickness of the fill was 3.5 m in both boreholes. The elevations at the base of the fill were 183.2 and 182.6 at the west abutment (Borehole CRP-01) and at the east abutment (Borehole CRP-02), respectively.

SPT 'N' values recorded in the cohesionless fill ranged from 19 to 74 blows per 0.3 m penetration indicating a compact to very dense relative density. In Borehole CRP-01, drilled at the west abutment, an SPT 'N' value of 5 blows per 0.3 m of penetration indicating a loose relative density was measured at 3.3 m depth.

The moisture content of the fill ranged from 3% to 18%. The moisture content in the peat layer was 163%.

Grain size distribution curves for samples of sand fill and sand and gravel fill (Boreholes CRP-01 and CRP-02) tested are presented on the Record of Borehole sheets and on Figures B1 and B2 of Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	Sand Fill	Sand and Gravel Fill (%)
Gravel	2 to 6	36
Sand	91 to 95	57
Silt & Clay	3	7

5.3 Upper Silty Sand

An upper layer of fine to medium silty sand was contacted in Boreholes 1 to 6, previously drilled (Reference 1).

The thickness of the upper silty sand ranged from 0.9 m to 2.7 m. The silty sand was described as loose in relative density.

5.4 Silty Clay

An extensive layer of native grey to reddish grey varved silty clay containing trace sand and occasional sand seams was encountered in below the fill in Boreholes CRP-01 and CRP-02 and below the upper silty sand in Boreholes 1 to 6.

The thickness of the silty clay layer ranged from 10.7 m to 15.2 m.

The depth to the base of the silty clay was 18.7 m (elevation 168.0) at the west abutment (Borehole CRP-01) and 15.6 m (elevation 170.5) at the east abutment (Borehole CRP-02).

In Boreholes 1 to 6 drilled for the previous investigation (Reference 1), the depth to the base of the silty clay layer ranged from 12.8 m to 16.2 m (Elevations 168.6 to 172.1)

In the silty clay layer, the SPT 'N' values ranged from 1 to 6 blows per 0.3 m of penetration, indicating a very soft to firm consistency. In situ vane shear tests indicated undrained shear strengths ranging from 20 to 50 kPa.

Grain size distribution curves for samples of silty clay (Boreholes CRP-01 and CRP-02) tested are presented on the Record of Borehole sheets and on Figure B3 of Appendix. Atterberg Limit test results are presented on Figure B4 of Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	(%)
Gravel	0
Sand	0 to 1
Silt	22 to 81
Clay	19 to 77

Index Property	(%)
Liquid Limit	28 to 67
Plastic Limit	17 to 23

The above results show that the silty clay ranges from low to high plasticity with group symbols of CL, CI and CH.

The natural moisture contents of samples recovered from the silty clay layers were 10% to 65%.

5.5 Lower Sand and Silty Sand and Gravel

A lower layer of reddish brown sand containing some gravel was encountered underneath the silty clay in Boreholes CRP-01 and CRP-02. In Boreholes 1 to 6, the layer below the silty clay was described as dense silty sand and gravel.

Borehole sampling CRP-01 and CRP-02 was terminated within the sand layer at 19.5 m and 15.8 m depth (elevations 167.2 and 170.2), respectively.

Boreholes 1 to 6 from the previous investigation were terminated in the silty sand and gravel layer at depths ranging from 16.9 m to 21.9 m (elevations 162.4 to 166.2). The thickness of the silty sand and gravel layer encountered at the borehole locations varies from at least 1.0 m to greater than 7.2 m.

SPT 'N' values measured in Boreholes CRP-01 and CRP-02 within the lower sand were 3 and 11 blows for per 0.3 m penetration, indicating very loose to compact relative density.

The sand and gravel layer encountered in Boreholes 1 to 6 was described as dense.

The natural moisture contents of samples recovered from the lower sand layer ranged from 10% to 43%.

DCPTs were performed from the bottom of Boreholes CRP-01 and CRP-02. The DCPTs were advanced only 150 mm in Borehole CRP-01 and to a depth of 20.5 m (elevation 165.6) in Borehole CRP-02. DCPTs were terminated upon refusal.

5.6 Water Levels

Water levels were monitored in the boreholes during and upon completion of drilling. A standpipe piezometer was installed in Borehole CRP-01 to monitor water levels after completion of drilling. The water levels measured in the piezometer are summarized in Table 5.1, along with the measurements in the boreholes upon completion of drilling.

Table 5.1 – Water Level Measurements

Foundation Unit	Borehole	Date	Water Level (m)		Comment
			Depth	Elevation	
West Abutment	CRP-01	November 27, 2010	0.16	186.5	In piezometer

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

Preliminary GA drawing indicates that water level in the Carp River in May 2010 was near Elevation 183.6. The high water level in the river is reported at elevation 184.1.

6. MISCELLANEOUS

Borehole locations were selected and established in the field by Thurber Engineering Ltd. Surveyors from MMM Group Limited obtained the co-ordinates and the ground surface elevations at each borehole.

Thurber obtained utility clearances for the borehole locations prior to drilling.

George Downing Estate Drilling Limited of Hawkesbury, Ontario supplied a truck-mounted CME75 drill rig and conducted the drilling, sampling and in-situ testing operations.

The drilling and sampling operations in the field were supervised on a full time basis by Ms. Eckie Siu of Thurber.

Routine laboratory testing was carried out by Thurber Engineering Ltd.

Overall supervision of the field program was conducted by Mr. Alastair E. Gorman, P.Eng. and Mr. Lukasz Gilarski, E.I.T. Interpretation of the data and preparation of the report were carried

out by Mr. Alastair E. Gorman, P.Eng., Mr. Lukasz Gilarski, E.I.T. and Ms. R. Palomeque Reyna, P.Eng.

The report was reviewed by Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundations Projects.

THURBER ENGINEERING LTD.

Rocio Palomeque Reyna, P.Eng.
Geotechnical Engineer



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



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PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7. GENERAL

This report presents interpretation of the geotechnical data in the factual report and presents geotechnical design recommendations to assist the design team to select and design a suitable roadway protection system for the proposed rehabilitation of the Carp River bridge in the Township of Fisher.

The bridge is located on Highway 17, 0.2 km south of Highway 563. One component of the staged deck replacement and rehabilitation program will involve converting the conventional abutment into a semi-integral abutment. This will necessitate a temporary excavation in the order of 1.5 m deep and roadway protection will be required adjacent to the excavation.

Based on the General Arrangement (GA) drawing provided by MRC, the existing structure is a five span structure supported on two abutments and four piers. The bridge measures approximately 42.6 m between abutments. The existing conventional abutment and piers are supported on battered driven closed end, concrete filled steel pile piles. The steel pipe piles were driven down into the dense native sand and gravel layer.

The approach slopes are approximately 3.0 m to 3.5 m high with a design inclination of 2H : 1V for the side and forward slopes.

The Carp River bridge was constructed in 1963 and has undergone rehabilitation in 1990 and 2008.

The stratigraphy encountered in the two boreholes drilled during the present investigation consists of a pavement structure overlying a 3.5-m high sand and gravel approach embankment fill that overlies an extensive 12 m to 15 m thick deposit of very soft to firm native varved clay. Sand and gravel and sand layers were contacted below the clay deposit. Occasional cobbles were noted in the fill. The water level measured in the piezometer is approximately 0.2 m below ground surface (elevation 186.5). Preliminary GA drawing indicates that water level in the Carp River in May 2010 was near Elevation 183.6. The high water level in the river is reported at elevation 184.1.

The discussions and recommendations presented in this report are based on the information provided by McCormick Rankin Corporation and on the factual data obtained in the course of this investigation.

8. ROADWAY PROTECTION

During the two stage bridge rehabilitation operations, temporary excavation of the existing embankments in the abutment area will extend approximately 1.5 m to 2.0 m depth. Therefore, roadway (Highway 17) protection will be required to support the existing Highway 17 adjacent to the excavation.

Roadway protection should be provided in accordance with OPSS 539 and designed for Performance Level 2. The alignment of the shoring must be specified on the contract drawings.

Alternatives that may be considered for roadway protection at this site are:

- Temporary soldier pile and lagging wall
- Sheet pile wall

The design of roadway protection should be the responsibility of the Contractor. All shoring systems must be designed by a Professional Engineer experienced in such designs.

The roadway protection system selected will be installed through the embankment granular fill and into the underlying very soft to firm silty clay. The 3.5 m thick embankment granular fill is in a very dense to compact state and contains occasional cobbles.

It may be difficult to install the sheet piles through the fill layer containing cobbles. Soldier piles installed through embankment fill may be a better option.

The ultimate choice of a roadway protection system should be left to the Contractor.

For a temporary cantilevered shoring system consisting of a soldier pile and lagging wall, or a sheet pile wall the lateral pressure diagram as shown on Figure 1 in Appendix D may be used for design in conjunction with the following parameter values:

γ	=	20 kN/m ³	(bulk unit weight)
γ_w	=	10 kN/m ³	(submerged unit weight under groundwater table)
K_a	=	0.33	(Active pressure coefficient for road embankment fill)
	=	0.37	(Active pressure coefficient for silty clay)
K_p	=	3.0	(Passive pressure coefficient for road embankment fill)
	=	2.7	(Passive pressure coefficient for silty clay)
h_w	=	0	(assuming that the groundwater is maintained below the base of the excavation and that there is no hydrostatic pressure build-up behind a presumably permeable wall, soldier pile and lagging)
h_w	=	186.5	(elevation for hydrostatic pressure build-up behind sheet piles)

The actual pressure distribution acting on the shoring system is a function of the construction sequence and the relative flexibility of the wall and these factors must be considered when designing the shoring system.

Construction of roadway protection will be conducted above the water level of the river reported at elevation 183.6. However, groundwater level was measured in a piezometer at elevation 186.5. The Contractor must be prepared to pump out any groundwater, seepage or surface water that accumulates in any temporary excavation.

9. BACKFILL TO ABUTMENTS

Backfill to the abutments should consist of Granular A or Granular B Type II material meeting the requirements of Special Provision 110S13 "Amendment to OPSS 1010, April 2004". The backfill must be in accordance with OPSS 902 as amended by Special Provision 902S01, and placed to the extents shown in OPSD 3101.150.

Compaction equipment to be used adjacent to retaining structures should be restricted in accordance with OPSS 501. It is assumed that there is a functioning subdrain at the base of rock embankment.

10. EARTH PRESSURE

Earth pressure acting on the structure may be assumed to be triangular and to be governed by the characteristics of the abutment backfill.

For fully drained conditions, earth pressures acting on the structure should be computed in accordance with Clause 6.9 of the CHBDC but generally are given by the expression:

$$P_h = K(\gamma h + q)$$

P_h = horizontal pressure on the wall at depth h (kPa)

K = earth pressure coefficient (see table 10.1)

γ = unit weight of retained soil (see table 10.1)

h = depth below top of fill where pressure is computed (m)

q = value of any surcharge (kPa)

In accordance with Clause 6.9.3 of the CHBDC, a compaction surcharge should be added. The magnitude should be 12 kPa at the top of fill and decreasing to 0 kPa at a depth of 2.0 m for Granular B Type I or at a depth of 1.7 m for Granular A or Granular B Type II.

Earth pressure coefficients for backfill to the abutment wall are dependent on the material used as backfill. Typical values are given in Table 10.1.

The coefficients in the Table 10.1 are ultimate values and require certain movements for the respective conditions to be mobilized. The values to use in design can be estimated from Figure C6.9.1 (a) in the Commentary to the CHBDC, 2006.

Table 10.1 – Earth Pressure Coefficients

Wall Condition	Earth Pressure Coefficient (K)			
	OPSS Granular A or OPSS Granular B Type II $\phi = 35^\circ; \gamma = 22.8 \text{ kN/m}^3$		OPSS Granular B Type I $\phi = 32^\circ; \gamma = 21.2 \text{ kN/m}^3$	
	Horizontal Surface Behind Wall	Sloping Surface Behind Wall (2H:1V)	Horizontal Surface Behind Wall	Sloping Surface Behind Wall (2H:1V)
Active (Unrestrained Wall)	0.27	0.40*	0.31	0.48*
At rest (Restrained Wall)	0.43	-	0.47	-
Passive (Movement Towards Soil Mass)	3.70	-	3.30	-

* For wing walls.

11. TEMPORARY EXCAVATION

Temporary excavation will be required at the abutments in order to conduct rehabilitation operations, including retrofitting bridge from conventional abutments to the semi-integral abutments and removal of deteriorated concrete in abutments and pile caps. The excavation is expected to extend approximately 1.5 m to 2.0 m depth into the existing fill.

All excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA) and in accordance with OPSS 902, November 2010. For the purposes of the OHSA, the fill in the existing abutments at this site may be classified as Type 3 soils.

The selection of the method of excavation is the responsibility of the contractor and must be based on his equipment, experience and interpretation of the site conditions. Excavations should be inspected regularly for evidence of instability if they have been left open for extended periods of time and following periods of heavy rain or thawing. If required, remedial actions must be taken to ensure the stability of the excavation and the safety of workers.

12. GROUNDWATER AND SURFACE WATER CONTROL

A piezometer installed in Borehole CRP-01 revealed that the groundwater level is approximately 0.2 m below ground surface, near elevation 186.5. Seepage may be experienced from perched zones in the granular fill. The level of perched water within the fill will vary between locations.

Preliminary GA drawing indicates that water level in the Carp River in May 2010 was near Elevation 183.6. The high water level in the river is reported to be at elevation 184.1.

The Contractor should be prepared to pump from sumps to remove any remaining seepage water or surface water collecting in an excavation. Unwatering must remain operational and effective until the abutment is backfilled.

The design of the dewatering system that may be required is the responsibility of the Contractor and the Contract Documents must alert him to this responsibility.

13. STRUCTURE APPROACHES

The GA drawing indicates that work on the approaches will involve construction of new approach slabs. It is expected that there will not be any grade raise at the bridge approaches.

Disturbed or regraded earth slopes must be provided with erosion protection in accordance with OPSS 804, November 2010.

14. CONSTRUCTION CONCERNS

Potential construction concerns include, but are not necessarily limited to the issues discussed below.

1. Installation of soldier piles or sheet piles

Installation of sheet piles through the existing fill containing cobbles may be difficult.

Soldier piles with lagging may be a better option.

15. CLOSURE

Engineering analysis and preparation of the report were carried out by Ms. R. Palomeque Reyna, P.Eng. and Mr. Alastair E. Gorman, P.Eng.

The report was reviewed by Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundations Projects.

THURBER ENGINEERING LTD.

Rocío Palomeque Reyna, P.Eng.
Geotechnical Engineer



P. K. Chatterji, P.Eng.
Review Principal



Appendix A

**Record of Borehole Sheets
(present investigation)**

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

NOTE: Hierarchy of Soil Strength Prediction

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



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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


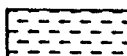



 Water Level
 Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

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

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

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

RECORD OF BOREHOLE No CRP-01

1 OF 3

METRIC

G.W.P. 5273-08-00 LOCATION N 5 200 838.9 E 260 621.6 (Carp River Bridge) ORIGINATED BY ES
HWY 17 BOREHOLE TYPE Hollow Stem Augers/NW Mud Rotary COMPILED BY AN
DATUM Geodetic DATE 2010.10.18 - 2010.10.18 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
186.7							20 40 60 80 100	FLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _p w w _L					
0.0							20 40 60 80 100	WATER CONTENT (%)					
0.1	ASPHALT: (75mm)												
	SAND, trace to some gravel, trace silt and clay, occasional cobbles Very Dense to Compact Brown Moist (FILL)		1	SS	57			o					
			2	SS	74			o					
			3	SS	25			o					2 95 3 (SI+CL)
			4	SS	20			o					
	Loose Layer of peat at 3.4m (125mm)		5	SS	5			o					6 91 3 (SI+CL)
183.2	Silty CLAY, trace sand, occasional sand seams Soft to Very Soft Grey		6	SS	3			o					
3.5			7	SS	4			o					
			8	SS	3			o					0 1 60 39
			9	SS	1			o					

Continued Next Page

+³, X³: Numbers refer to Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CRP-01

2 OF 3

METRIC

G.W.P. 5273-08-00 LOCATION N 5 200 838.9 E 260 621.6 (Carp River Bridge) ORIGINATED BY ES
HWY 17 BOREHOLE TYPE Hollow Stem Augers/NW Mud Rotary COMPILED BY AN
DATUM Geodetic DATE 2010.10.18 - 2010.10.18 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
	Continued From Previous Page							20 40 60 80 100		20 40 60				
	Silty CLAY, trace sand, occasional sand seams Very Soft Reddish Grey							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
			10	SS	1		176	+					0 1 39 60	
							175							
							174	3						
							173	2						
			11	SS	2		172							
							171	3					0 1 22 77	
							170	2.4						
	Sand seams		12	SS	1		169							
							168							
168.0														
18.7	SAND, some gravel Compact Reddish Brown Wet		13	SS	11									
167.2														
167.5	End of sampling at 19.5m and start DCPT													
19.7	END OF BOREHOLE AT 19.7m													

Continued Next Page

+ 3 X 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

ONTMT4S 1185.GPJ 12/21/11

RECORD OF BOREHOLE No CRP-01

3 OF 3

METRIC

G.W.P. 5273-08-00 LOCATION N 5 200 838.9 E 260 621.6 (Carp River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/NW Mud Rotary COMPILED BY AN
 DATUM Geodetic DATE 2010.10.18 - 2010.10.18 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page													
	UPON CONE REFUSAL. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2010.11.27 0.16 186.5													

RECORD OF BOREHOLE No CRP-02

1 OF 3

METRIC

G.W.P. 5273-08-00 LOCATION N 5 200 850.5 E 260 681.0 (Carp River Bridge) ORIGINATED BY ES
HWY 17 BOREHOLE TYPE Hollow Stem Augers/NW Mud Rotary COMPILED BY AN
DATUM Geodetic DATE 2010.10.18 - 2010.10.18 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
186.1							20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W _P NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L			
0.0	ASPHALT: (50mm)								WATER CONTENT (%)			
	SAND and GRAVEL, trace silt and clay, occasional cobbles Very Dense to Compact Brown Moist (FILL)		1	SS	54							
			2	SS	68						36 57 7 (SI+CL)	
			3	SS	51							
			4	SS	24							
			5	SS	19							
182.6			6	SS	6						0 0 81 19	
3.5	Silty CLAY, occasional sand seams Firm to Very Soft Grey to Reddish Grey											
			7	SS	2							
			8	SS	1						0 0 62 38	

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

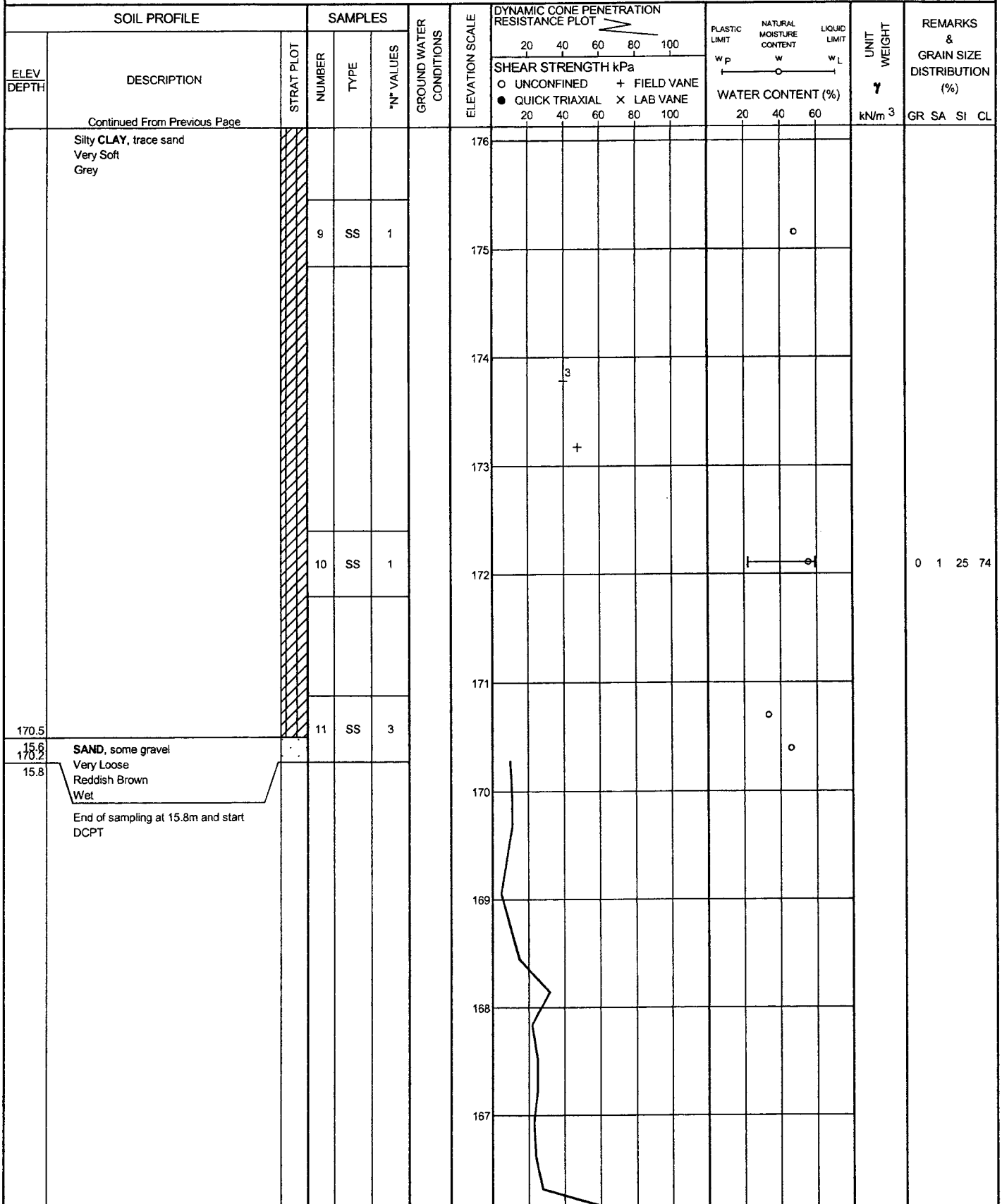
20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CRP-02

2 OF 3

METRIC

G.W.P. 5273-08-00 LOCATION N 5 200 850.5 E 260 681.0 (Carp River Bridge) ORIGINATED BY ES
HWY 17 BOREHOLE TYPE Hollow Stem Augers/NW Mud Rotary COMPILED BY AN
DATUM Geodetic DATE 2010.10.18 - 2010.10.18 CHECKED BY JL



Continued Next Page

+ 3 . × 3 : Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CRP-02

3 OF 3

METRIC

G.W.P. 5273-08-00 LOCATION N 5 200 850.5 E 260 681.0 (Carp River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/NW Mud Rotary COMPILED BY AN
 DATUM Geodetic DATE 2010.10.18 - 2010.10.18 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
	Continued From Previous Page						20 40 60 80 100	20 40 60					
165.6						166							
20.5	END OF BOREHOLE AT 20.5m UPON CONE REFUSAL. BOREHOLE BACKFILLED WITH HOLEPLUG TO 13.7m, THEN CUTTINGS TO 0.1m AND ASPHALT TO SURFACE.												

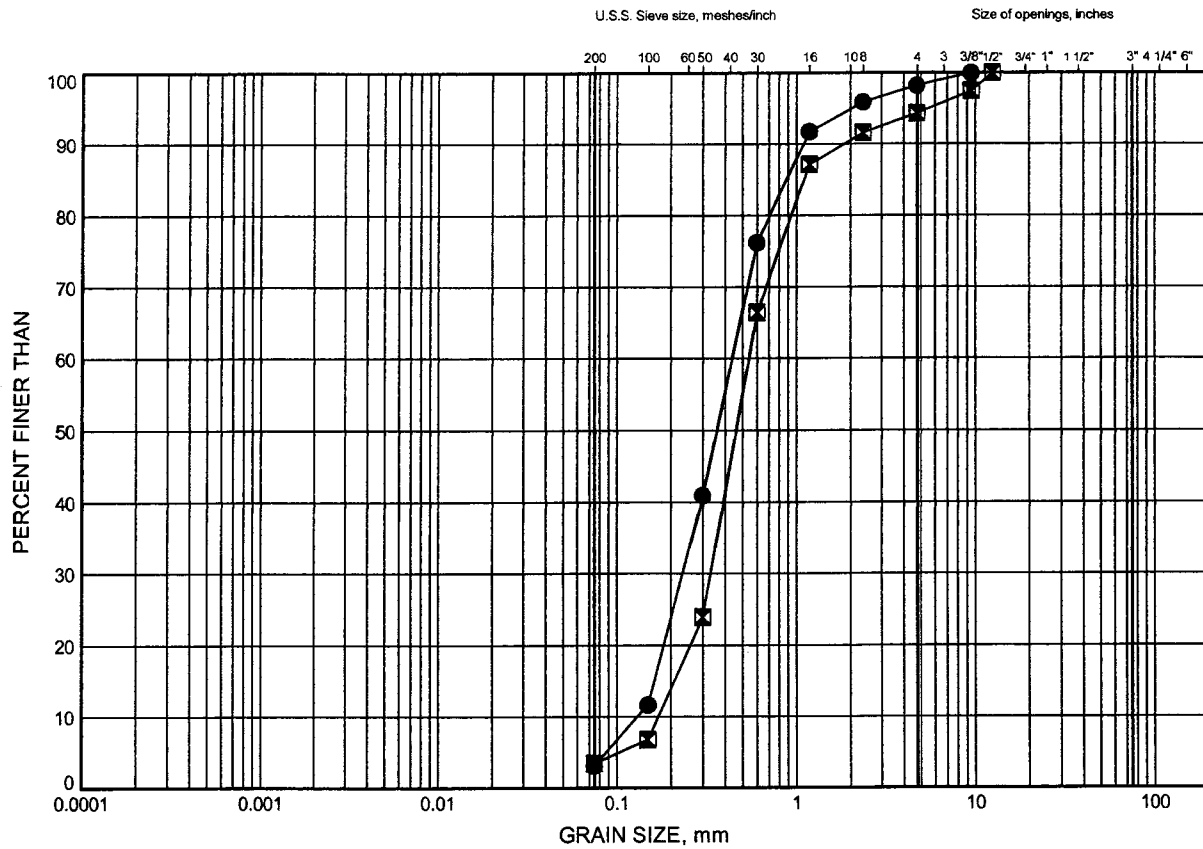
Appendix B

**Laboratory Test Results
(present investigation)**

Oxtongue Lake Bridge Replacement GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND FILL



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

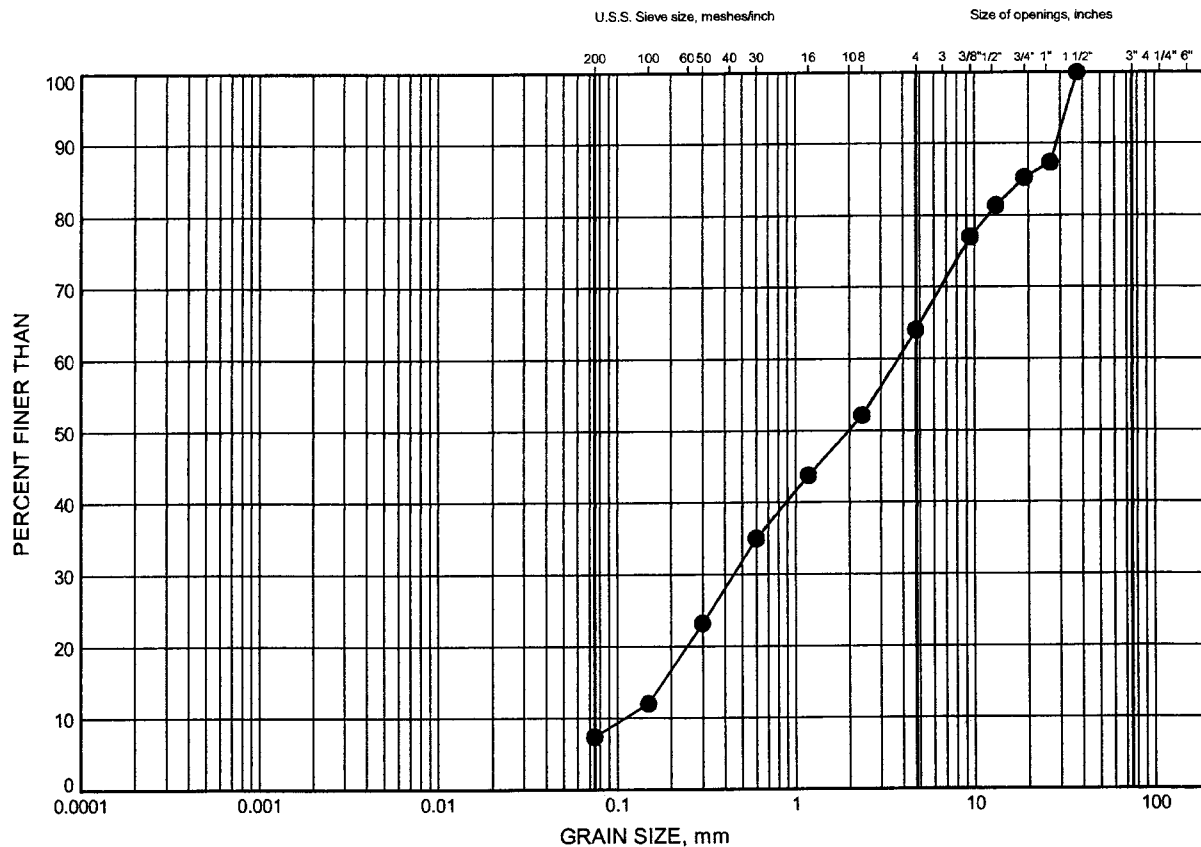
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CRP-01	1.83	184.83
■	CRP-01	3.28	183.38

Oxtongue Lake Bridge Replacement GRAIN SIZE DISTRIBUTION

FIGURE B2

SAND & GRAVEL FILL



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

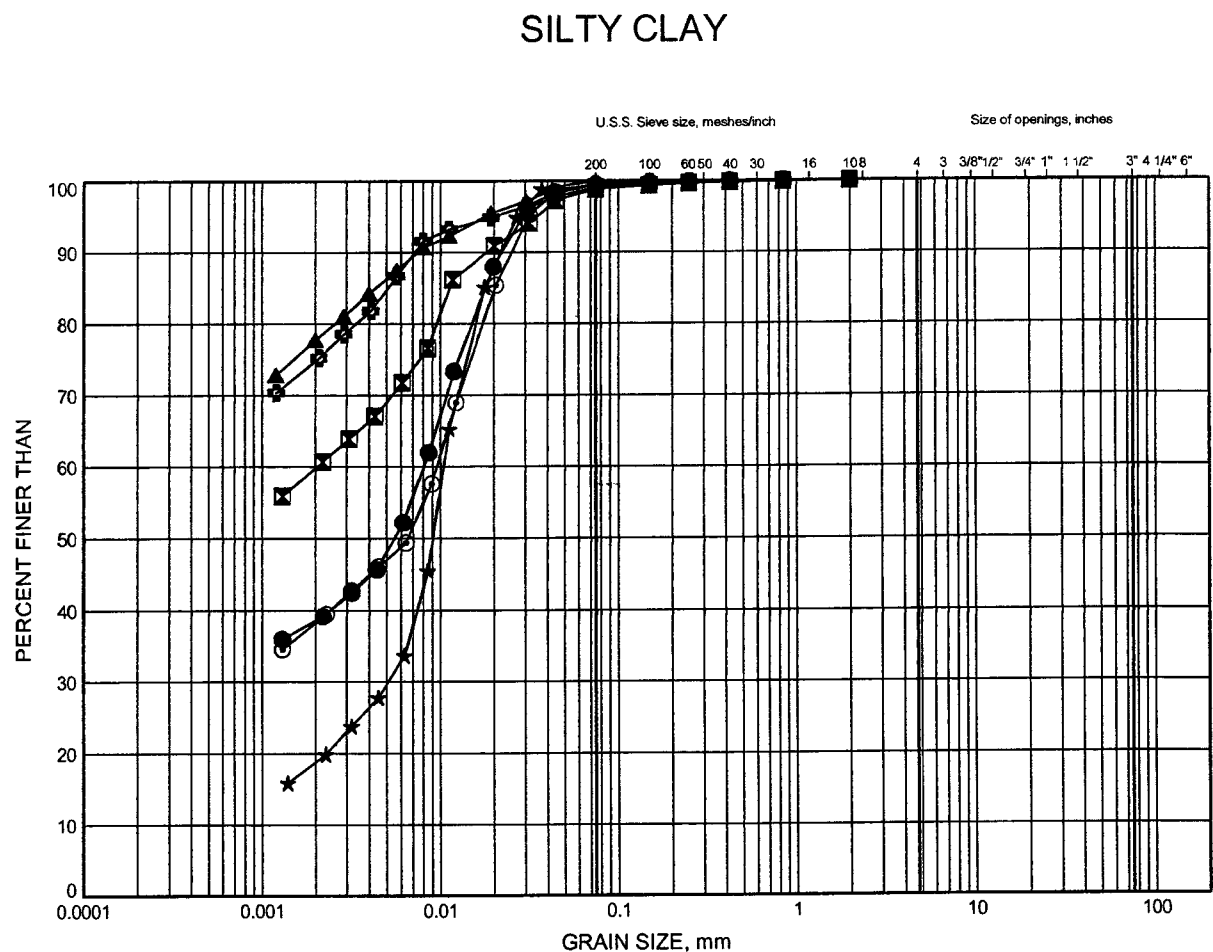
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CRP-02	1.07	185.02

Oxtongue Lake Bridge Replacement

GRAIN SIZE DISTRIBUTION

FIGURE B3



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CRP-01	5.64	181.02
⊠	CRP-01	10.97	175.69
▲	CRP-01	15.54	171.11
★	CRP-02	4.11	181.97
⊙	CRP-02	7.92	178.16
⊕	CRP-02	14.02	172.06

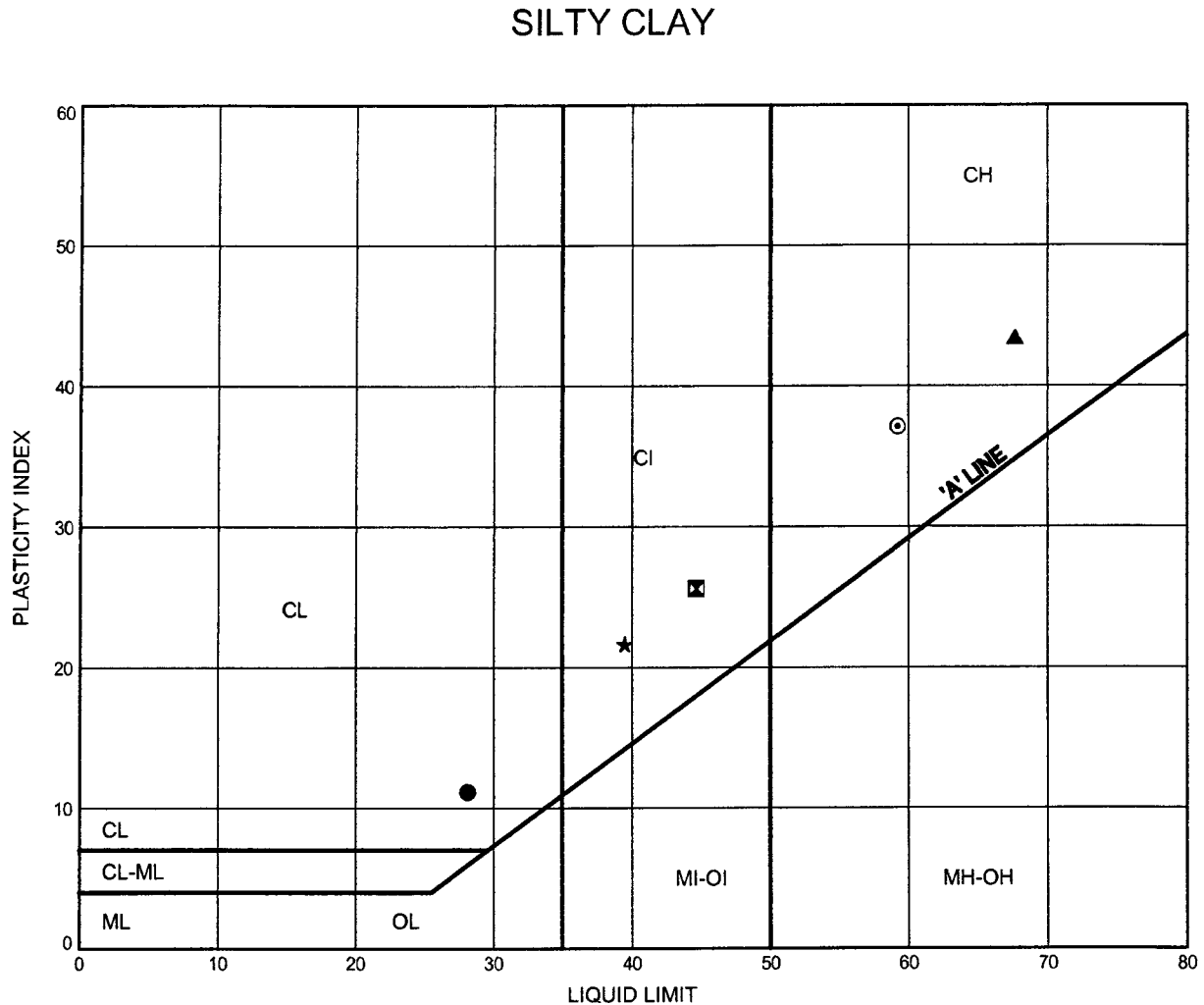
GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 12/21/11

G.W.P.# 5273-08-00
 Prepared By AN
 Checked By RPR



Oxtongue Lake Bridge Replacement
ATTERBERG LIMITS TEST RESULTS

FIGURE B4



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	CRP-01	5.64	181.02
⊠	CRP-01	10.97	175.69
▲	CRP-01	15.54	171.11
★	CRP-02	7.92	178.16
⊙	CRP-02	14.02	172.06

Appendix C

**Record of Borehole Sheets and Laboratory Results
(previous investigation)**

SUMMARY OF FIELD & LABORATORY TESTS

JOB 61-F-12

W.P. 910-60

HOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
1	S1	3'-4.5'	Loose fine to med. silty sand.	6	21.9	-	-	-	-	No Recovery.
	S2	6'-7.5'	Loose fine to med. silty sand.	8	21.0	-	-	-	-	
	S3	10'-11.5'	Very soft varved clay.	1	45.2	18.5	40.8	-	-	
	T4	15'-16.5'	Very soft varved clay.	P	-	-	-	-	-	
	S5	16.5'-18'	Very soft varved clay.	P	36.0	16.4	33.4	-	-	
	T6	20'-21.7'	Soft varved clay.	P	20.2 67.4	-	-	-	-	
	S7	25'-26.5'	Soft varved clay.	P	41.8	15.7	38.0	-	-	
	T8	30'-31.5'	Medium hard varved clay.	P	43.3	19.9	52.9	TR=758	108.2	
	S9	35'-36.5'	Medium hard varved clay.	P	48.8	17.7	44.1	-	-	
	T10	40'-41.5'	Medium hard varved clay.	P	43.7	16.2	37.8	TR=730	110.5	
	S11	45'-46.5'	Medium hard varved clay.	P	44.2	-	-	-	-	

SUMMARY OF FIELD & LABORATORY TESTS

JOB 61-F-12

W.P. 910-60

HOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH P.S.F.	UNIT WEIGHT D.C.F.	REMARKS
1	SL2	50'-51.5'	Dense silty sand and gravel.	48	10.8	-	-	-	-	
	SL3	55'-56.5'	Med. dense silty sand and gravel.	27	22.3	-	-	-	-	
	SL4	65'-66.5'	Very dense silty sand and gravel.	92	9.7	-	-	-	-	
	RC15	67.8'-69.8'	Very dense gravel and boulders.	-	-	-	-	-	-	
2-5	cone penetrations only									
6	S1	5'-6.5'	Loose fine to med. silty sand.	9	19.8	-	-	-	-	
	S2	10'-11.5'	Very soft varved clay.	2	28.0	-	-	-	-	
	T3	15'-16.7'	Very soft varved clay.	P	73.0	22.6	73.6	-	-	
	S4	20'-21.5'	Very soft varved clay.	2	29.3	-	-	-	-	
	T5	25'-27'	Soft varved clay.	P	50.8	-	-	-	-	
					46.7	23.9	65.9	V=517 TR=590	109.2	

JOB 61-F-12

W.P. 910-60

HOLE NO	SAMP NO	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS FT	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH P.S.F.	UNIT WEIGHT P.C.F.	REMARKS
6	S6	30'-31.5'	Soft varved clay.	P	39.4	-	-	-	-	
	T7	35'-37'	Soft varved clay.	P	27.3 35.6 51.3	16.3	49.8	V=270 TR=515	113.6	
	S8	40'-41.5'	Soft varved clay.	P	49.4	-	-	-	-	
	S9	45'-46.5'	Med. dense silty sand and gravel.	27	16.2	-	-	-	-	
	S10	50'-51.5'	Med. dense silty sand and gravel.	48	16.8	-	-	-	-	
	S11	60'-61.5'	Very dense silty sand and gravel.	96	14.4	-	-	-	-	
			S denotes split spoon sample T " shelby tube sample RC " rock core							

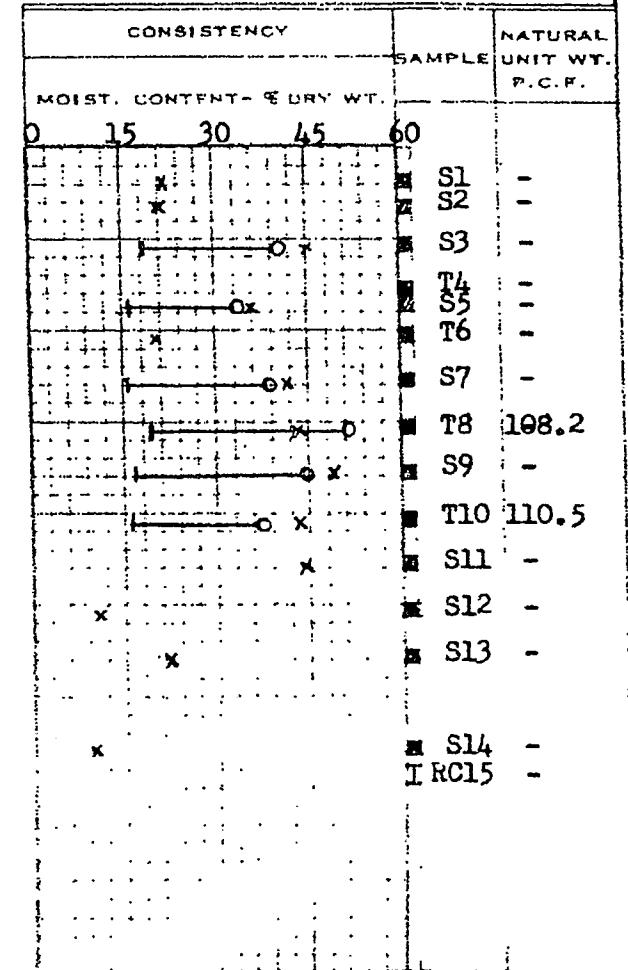
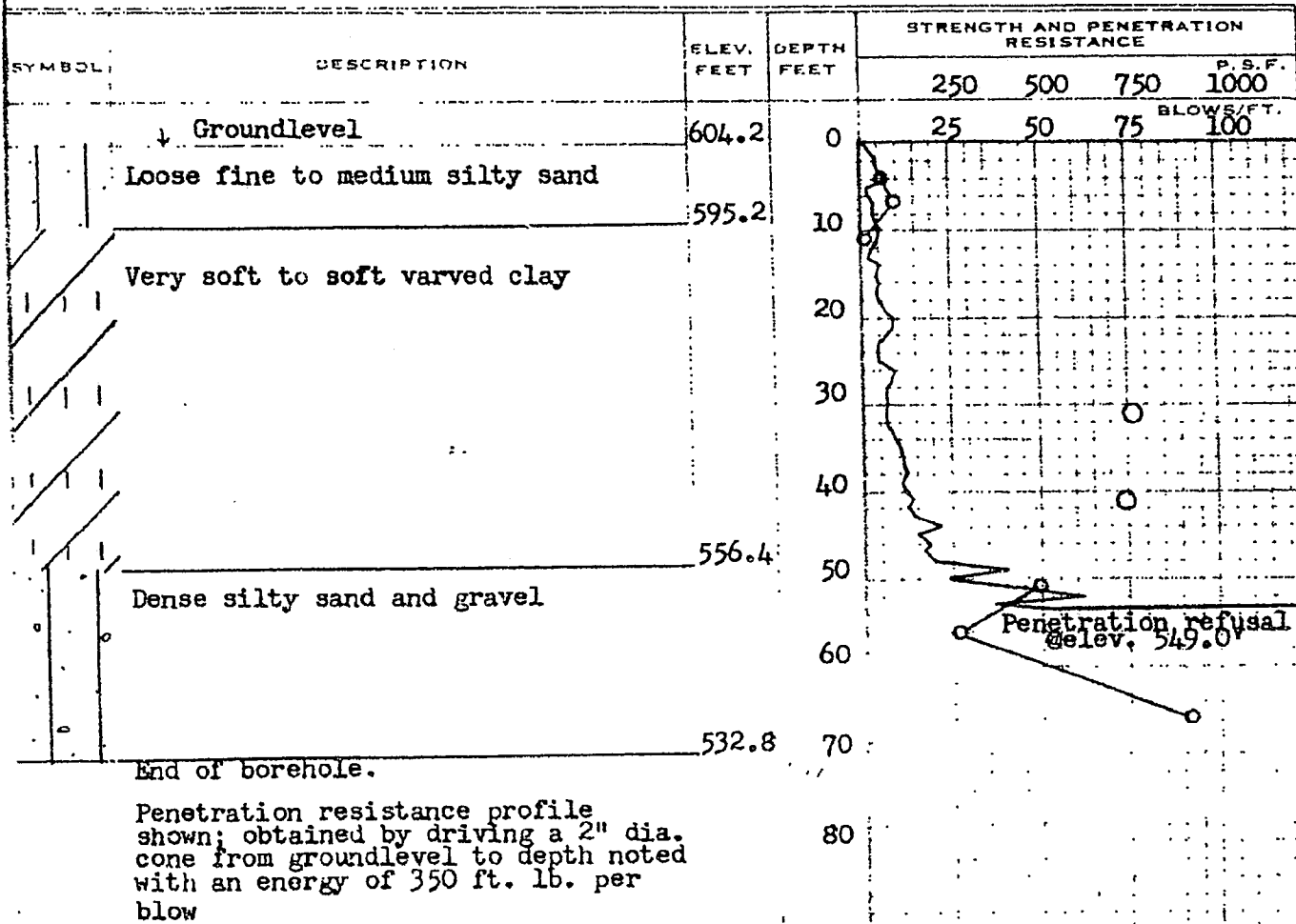
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 910-60 BORE HOLE NO. 1
 JOB 61-F-12 STATION 2404/18 (56' Lt.)
 DATUM 604.17 COMPILED BY B.K.
 BORING DATE Feb. 27/61 CHECKED BY W.W.K.

2" DIA. SPLIT TUBE
 2" SHELBY TUBE
 2" SPLIT TUBE
 2" DIA. CONE
 2" SHELBY
 CASING

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) — O
 VANE TEST (C) AND SENSITIVITY (S) — +
 NATURAL MOISTURE AND LIQUIDITY INDEX — X
 LIQUID LIMIT — —
 PLASTIC LIMIT — —



W.P. 910-60 _____ BORE HOLE NO. _____ 2 _____
JOB 61-F-12 _____ STATION 2404-02 (45'-0" F) _____
DATUM 606.25' _____ COMPILED BY _____ B.K. _____
BORING DATE Mar. 1/61 _____ CHECKED BY _____ W.W.K. _____

1/2 UNCONFINED COMPRESSION (Qu)	---	0
VANE TEST (C) AND SENSITIVITY (S)	---	+6
NATURAL MOISTURE AND		
LIQUIDITY INDEX	---	X
LIQUID LIMIT	---	0
PLASTIC LIMIT	---	---

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				P.S.F.	
	↓ Groundlevel	606.3	0	25	50 75 100
	Loose fine to med. silty sand	598.3	10		
	Very soft to soft varved clay		20		
			30		
			40		
		553.3	50		
	Dense silty sand and gravel		60		
			70		
		534.3	80		
	Penetration resistance profile shown; obtained by driving a 2" dia. cone from groundlevel to depth noted with an energy of 350 ft. lb. per blow				

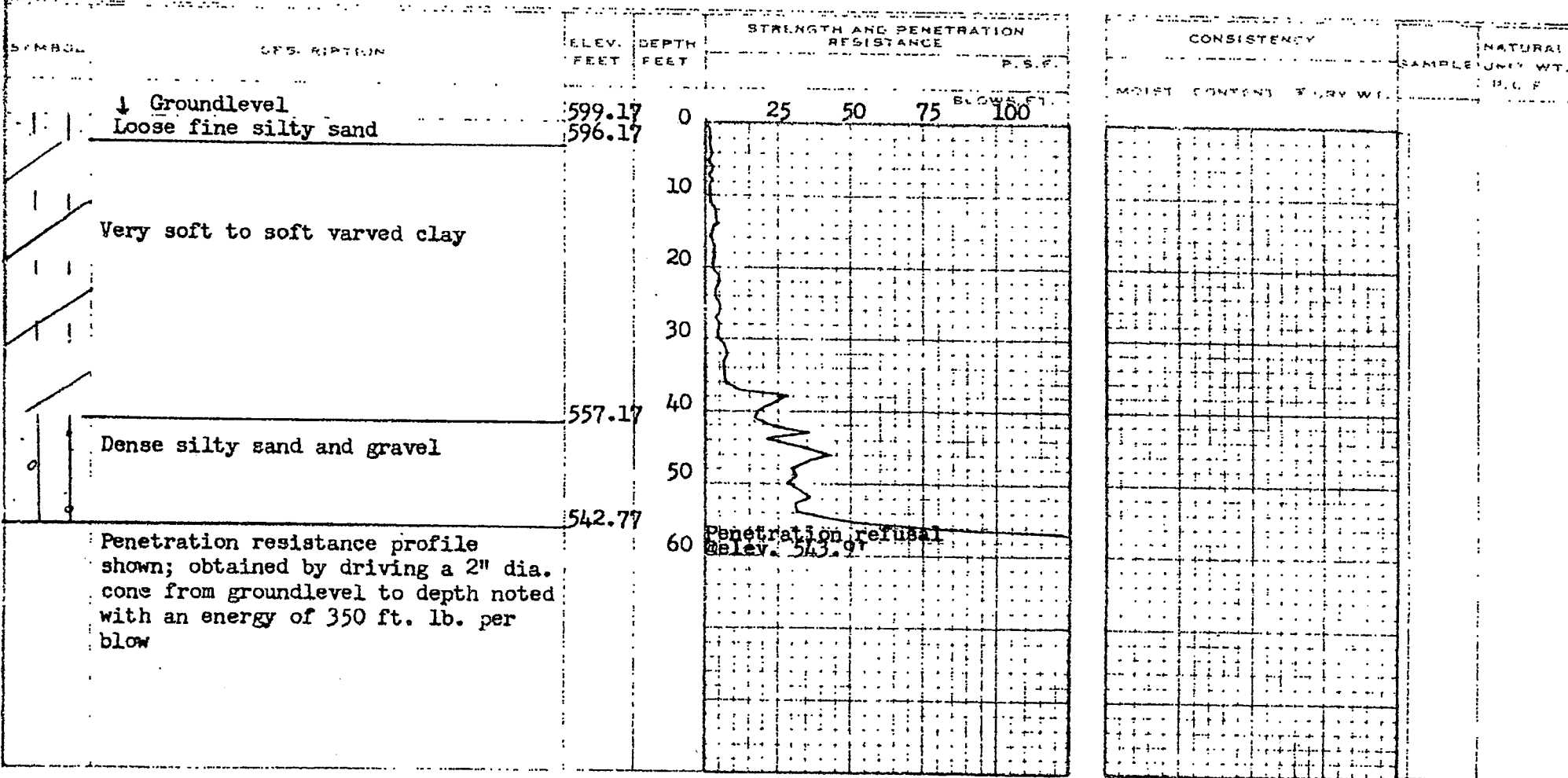
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 910-60 BORE HOLE NO. 4
JOB 61-F-12 STATION 2404+65 (16'-0" Lt)
DATUM 599.17 COMPILED BY B.K.
BORING DATE Mar. 2/61 CHECKED BY W.W.K.

2" DIA SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA CONE
2" SHELBY
CASING

LEGEND

1/20 UNCONFINED COMPRESSION (QU) ---
VANE TEST (C) AND SENSITIVITY (S) ---
NATURAL MOISTURE AND LIQUIDITY INDEX ---
LIQUID LIMIT ---
PLASTIC LIMIT ---



DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 910-60 _____ BORE HOLE NO. 5 _____

JOB 61-F-12 STATION 2405+44 (29'-0" Lt)

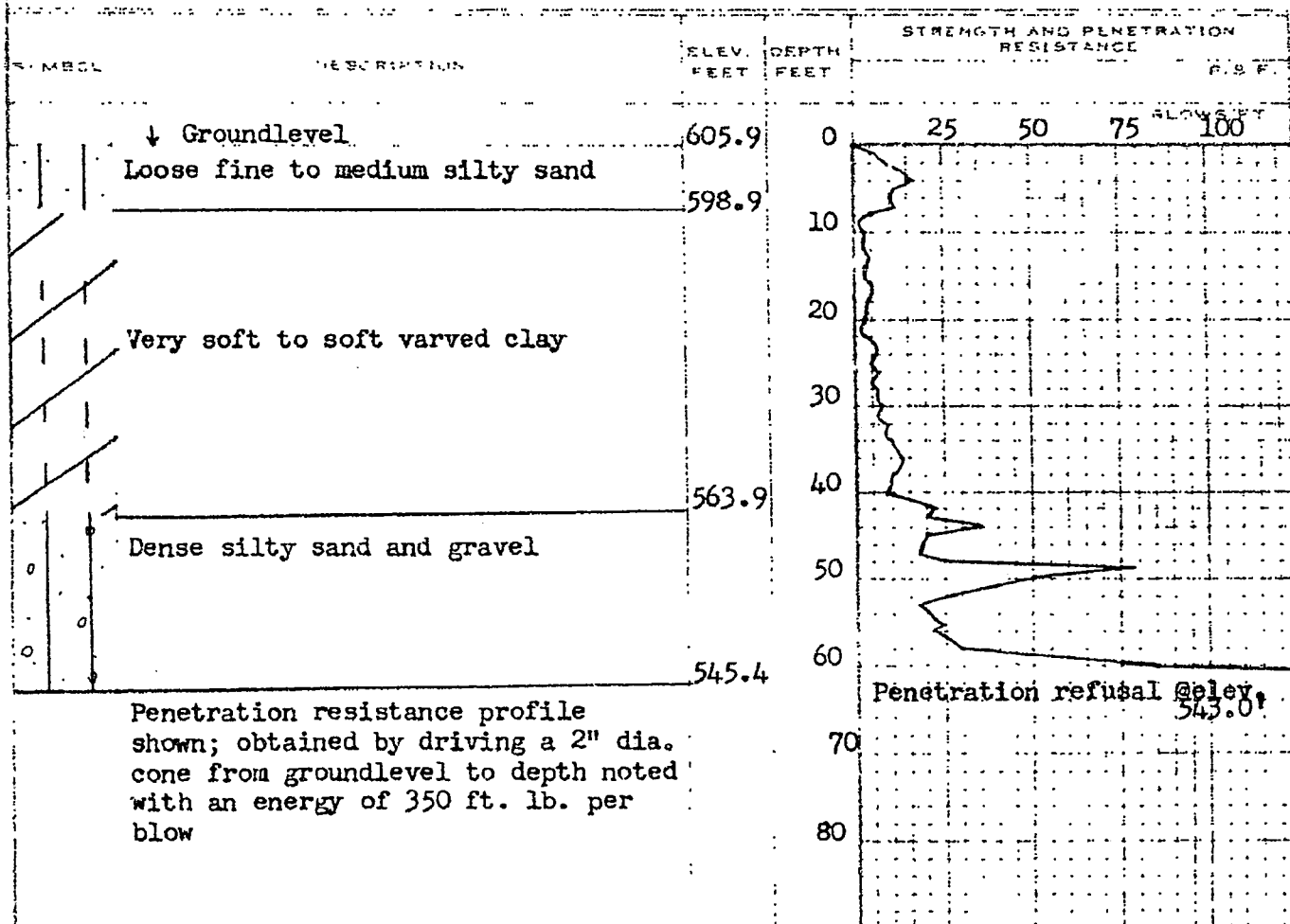
DATUM 605.9' COMPILED BY B.K.

BORING DATE Mar. 5/61 CHECKED BY W.W.K.

2" DIA SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA CONE
2" SHELBY
CASING

LEGEND

1/2 UNCONFINED COMPRESSION (Qu)	0
VANE TEST (C) AND SENSITIVITY (S)	+3
NATURAL MOISTURE AND	
LIQUIDITY INDEX	X
LIQUID LIMIT	
PLASTIC LIMIT	



CONSISTENCY

INATURAL

UNIT WT.

PERCENT

VERY W.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS AND RESEARCH SECTION

W.P. 910-60

BORE HOLE NO. 6

JOB 61-F-12

STATION 2405+27 (39'-6" Rt)

DATUM 607.7'

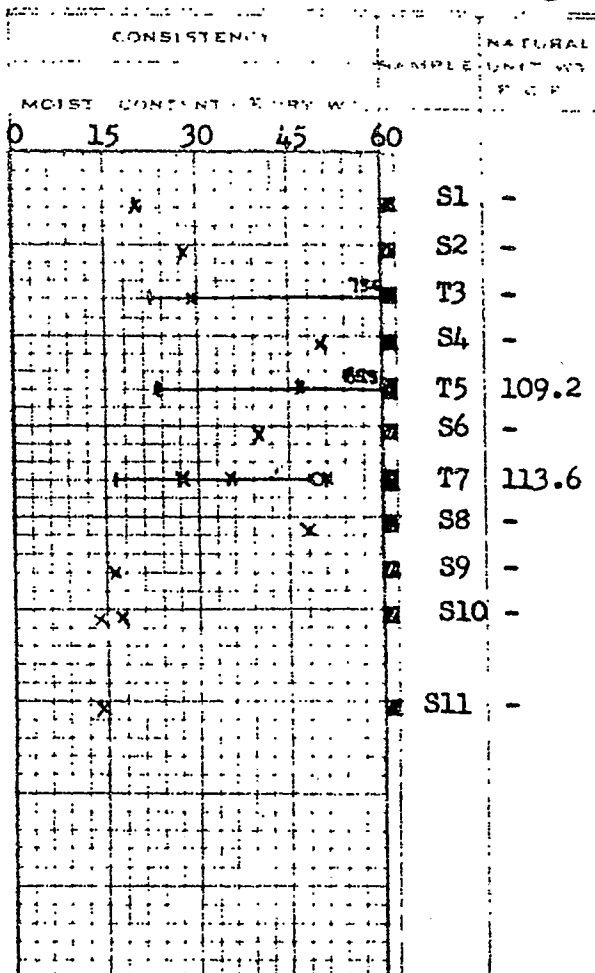
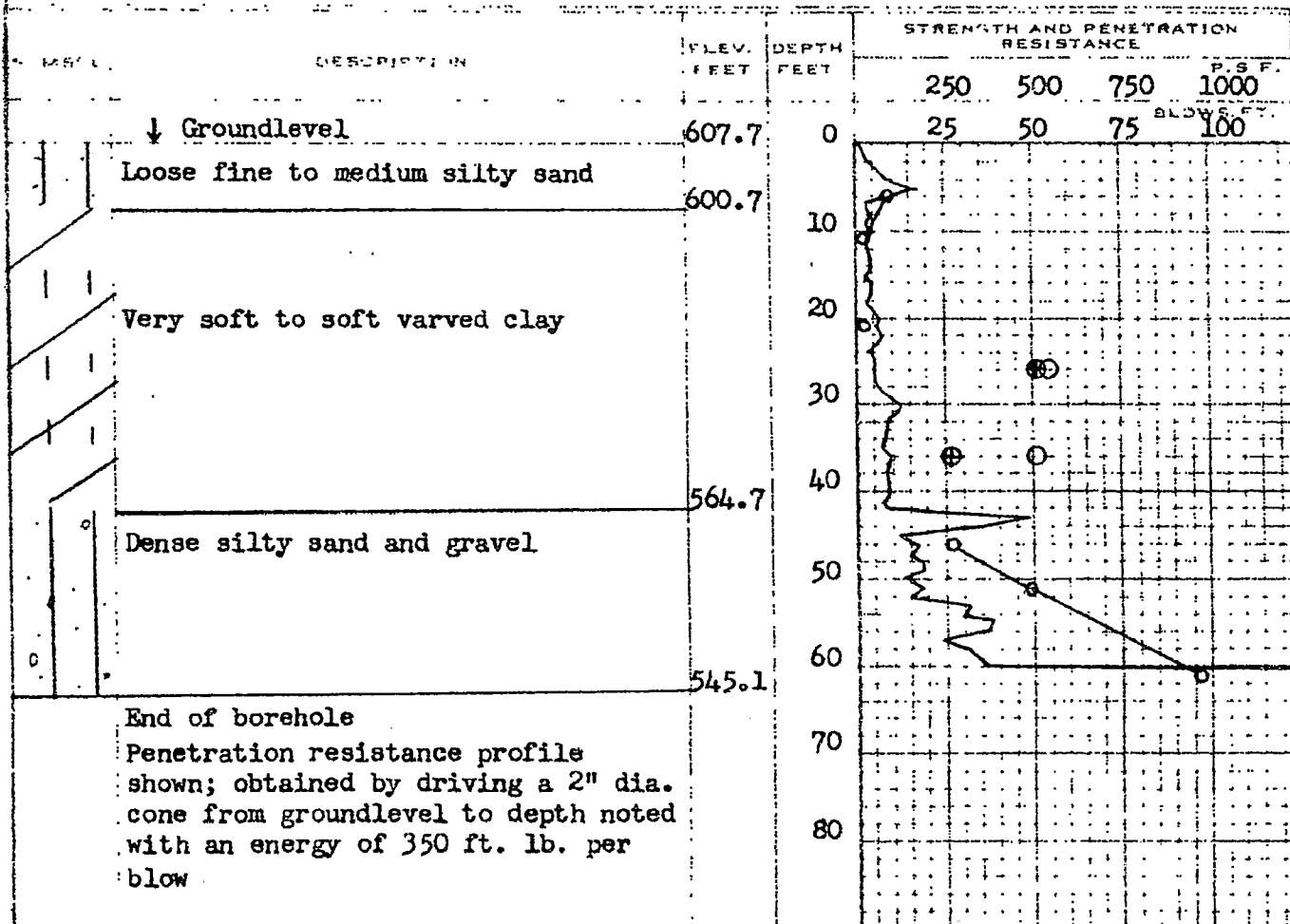
COMPILED BY B.K.

BORING DATE Mar. 2/61

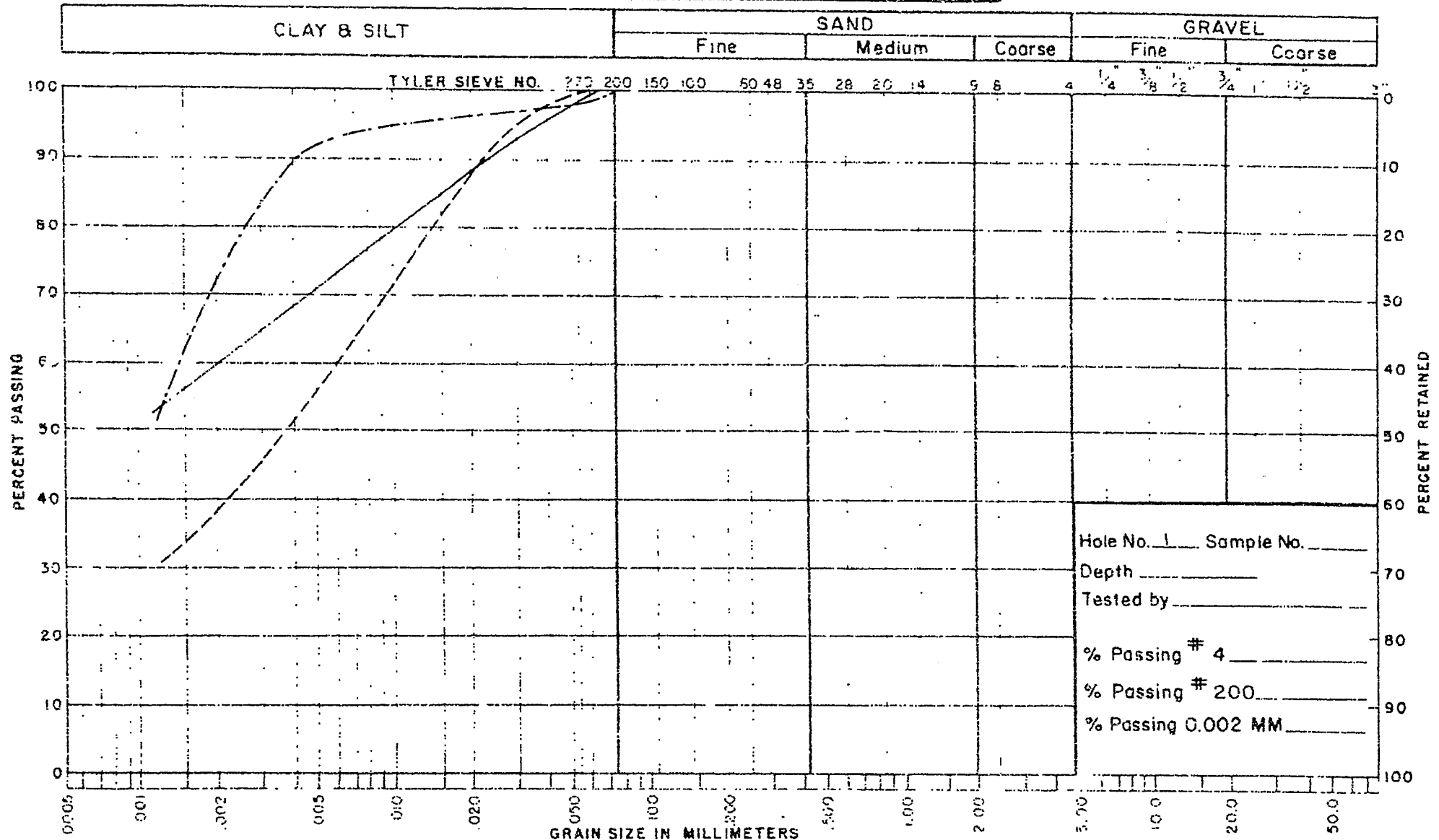
CHECKED BY W.W.K.

2" DIA SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA CONE
2" SHELBY
CASING

LEGEND

1/2 UNCONFINED COMPRESSION (QU) \bigcirc
VANE TEST (C) AND SENSITIVITY (S) \oplus
NATURAL MOISTURE AND
LIQUIDITY INDEX \times
LIQUID LIMIT \bigcirc
PLASTIC LIMIT \bigcirc
Lab vane \oplus


UNIFIED SOIL CLASSIFICATION SYSTEM

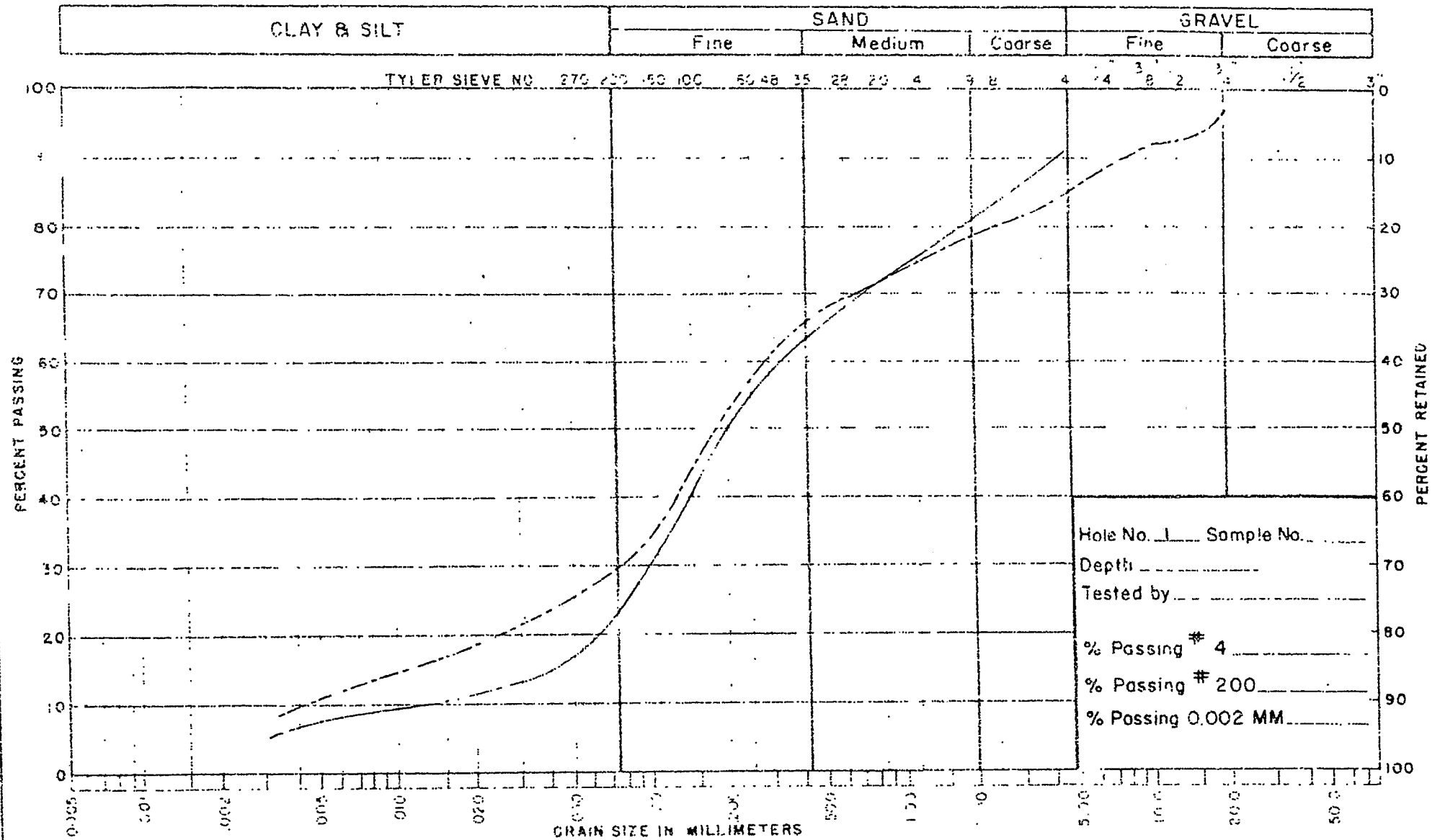


NOTES _____ SAMPLE DEPTH 30'-0" TO 31'-8"
 _____ SAMPLE DEPTH 40'-0" TO 41'-8"
 _____ SAMPLE DEPTH 45'-0" TO 46'-6"

DEPARTMENT OF HIGHWAYS - ONTARIO
 MATERIALS & RESEARCH SECTION
GRAIN SIZE DISTRIBUTION

Job No. 61-F-12 W.P. No. 910-60
 Location CARP RIVER

UNIFIED SOIL CLASSIFICATION SYSTEM



NOTES SAMPLE DEPTH 50'-0" TO 51'-6"

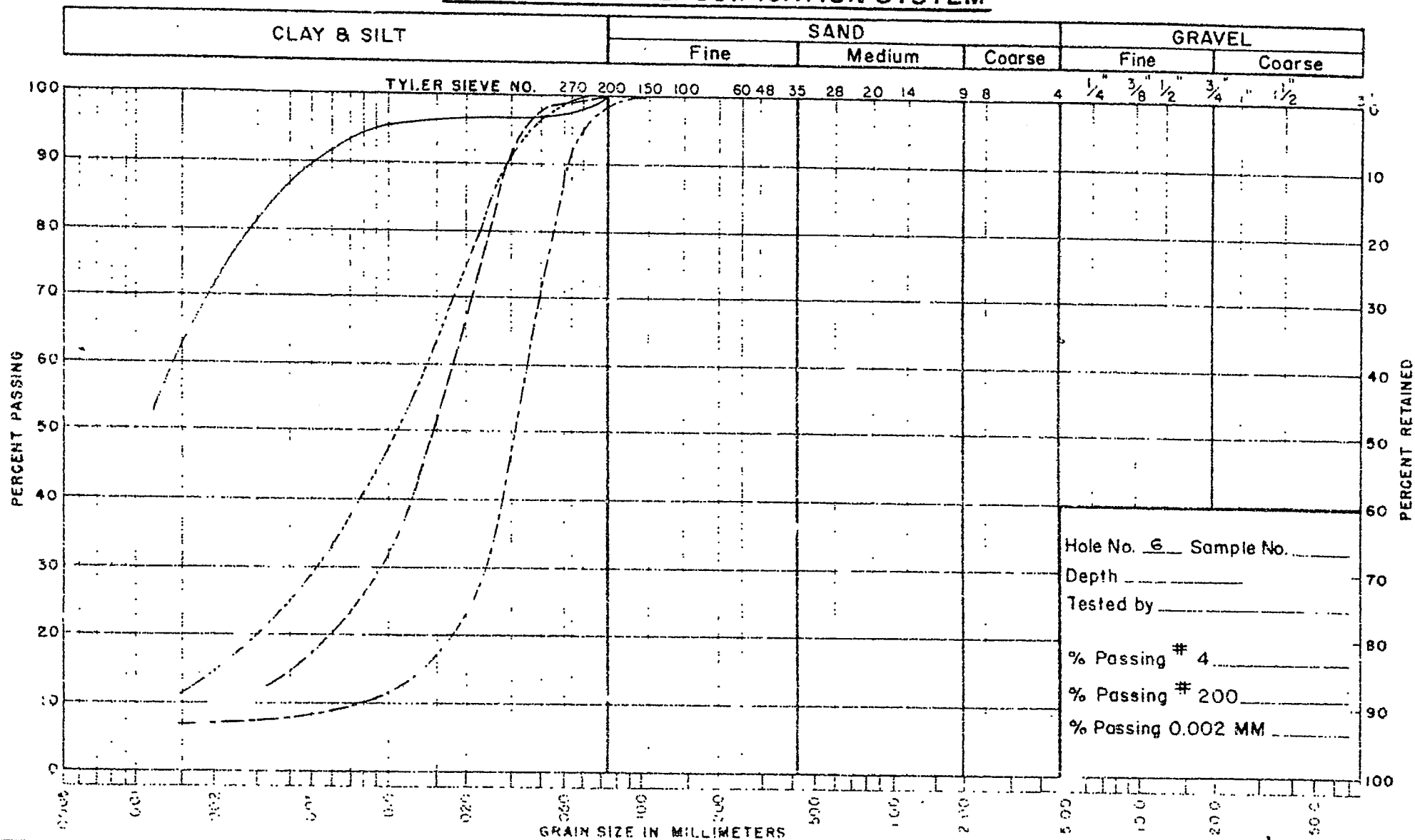
 SAMPLE DEPTH 65'-0" TO 66'-6"

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION
GRAIN SIZE DISTRIBUTION

Job No. 61-E-12 W.P. No. 910-60

Location CARP RIVER

UNIFIED SOIL CLASSIFICATION SYSTEM

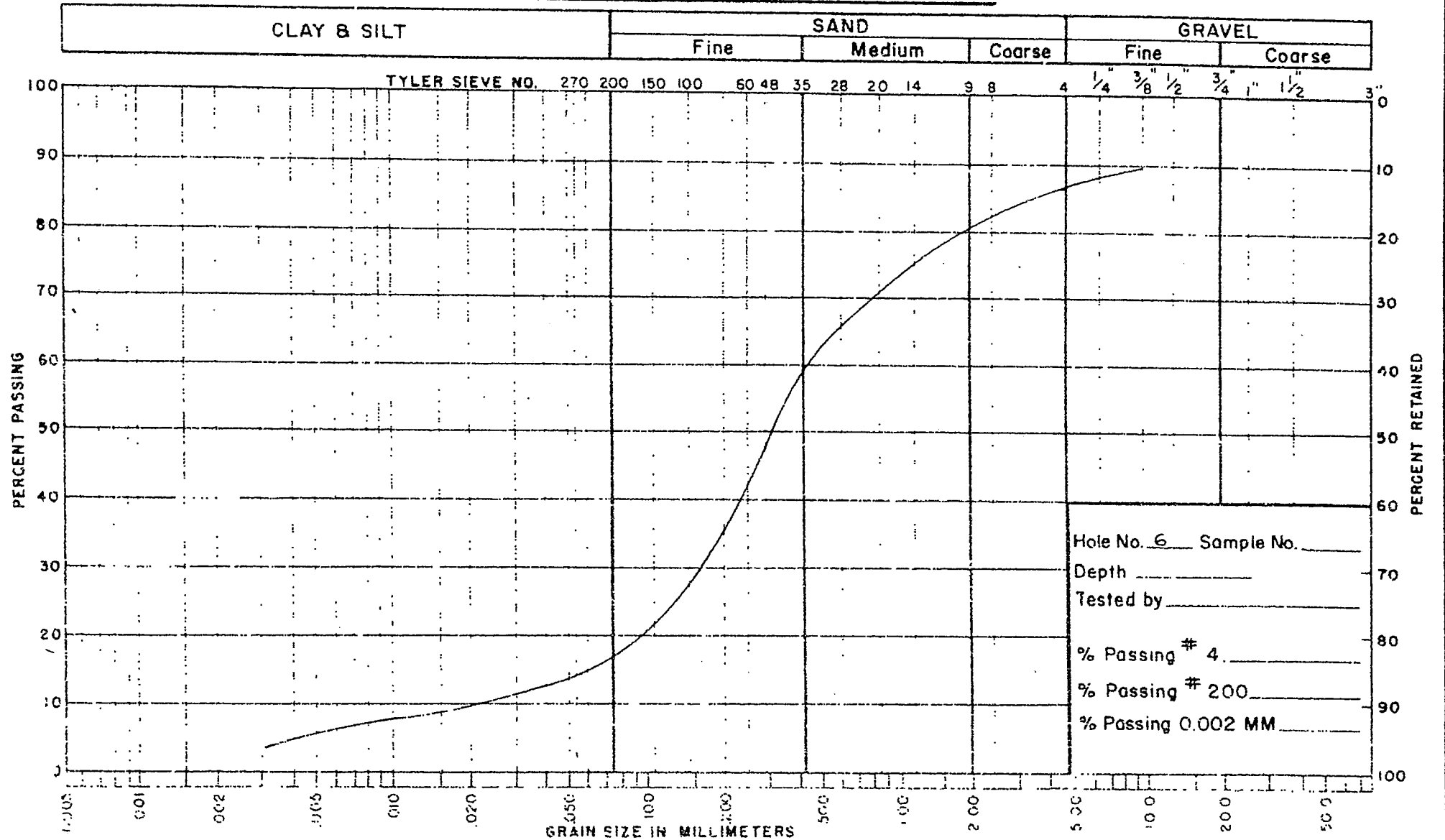


NOTES _____ SAMPLE DEPTH 10'-0" TO 11'-6"
 _____ SAMPLE DEPTH 15'-0" TO 16'-6"
 _____ SAMPLE DEPTH 25'-0" TO 27'-0"
 _____ SAMPLE DEPTH 35'-0" TO 37'-0"

DEPARTMENT OF HIGHWAYS - ONTARIO
 MATERIALS & RESEARCH SECTION
GRAIN SIZE DISTRIBUTION

Job No. 61-F-12 W.P. No. 910-60
 Location CASP RIVER

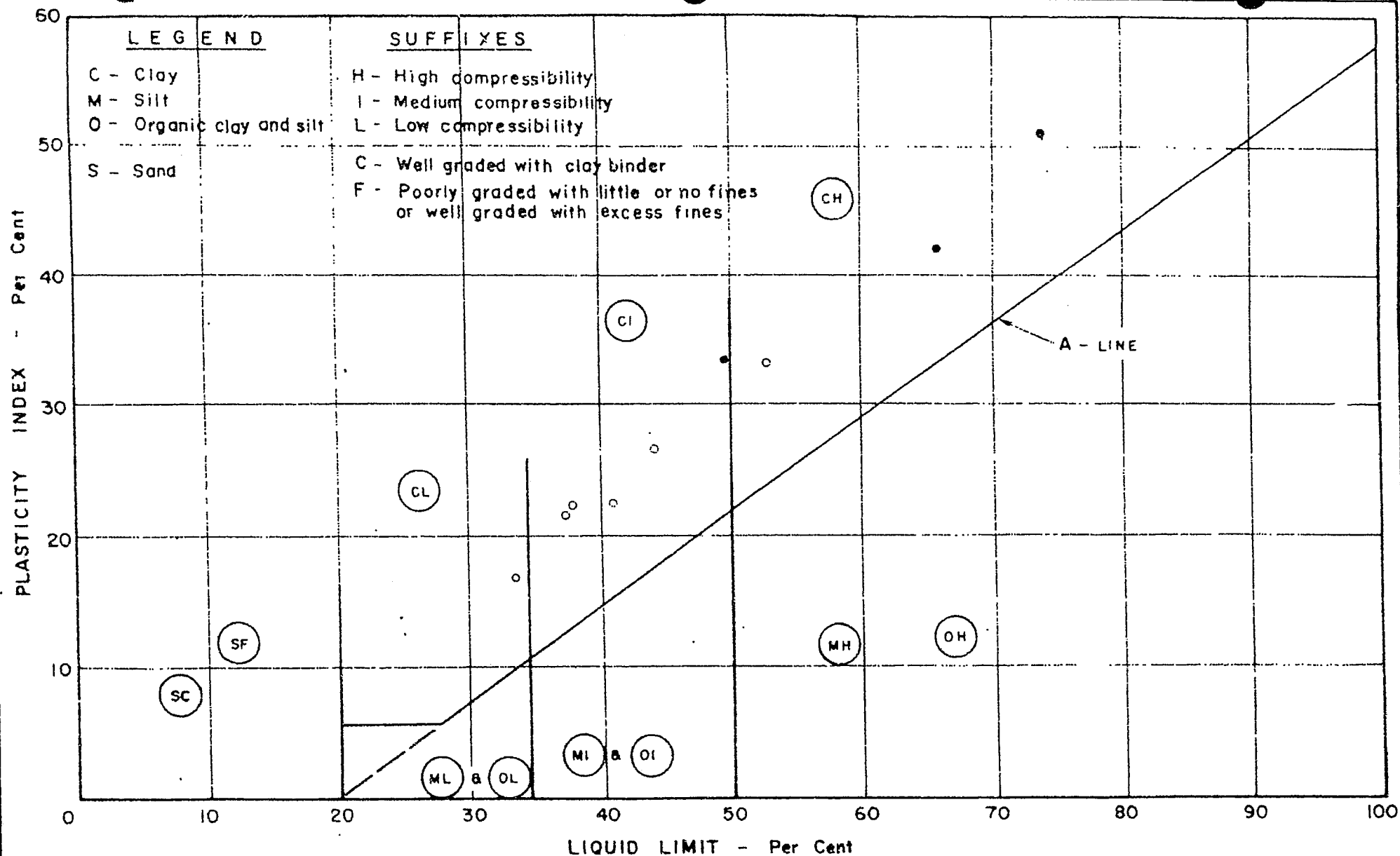
UNIFIED SOIL CLASSIFICATION SYSTEM



NOTES: SAMPLE DEPTH 50'-0" TO 51'-6"

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION
GRAIN SIZE DISTRIBUTION

Job No. 61-F-12 W.P. No. 910-60
Location CARP RIVER



NOTES

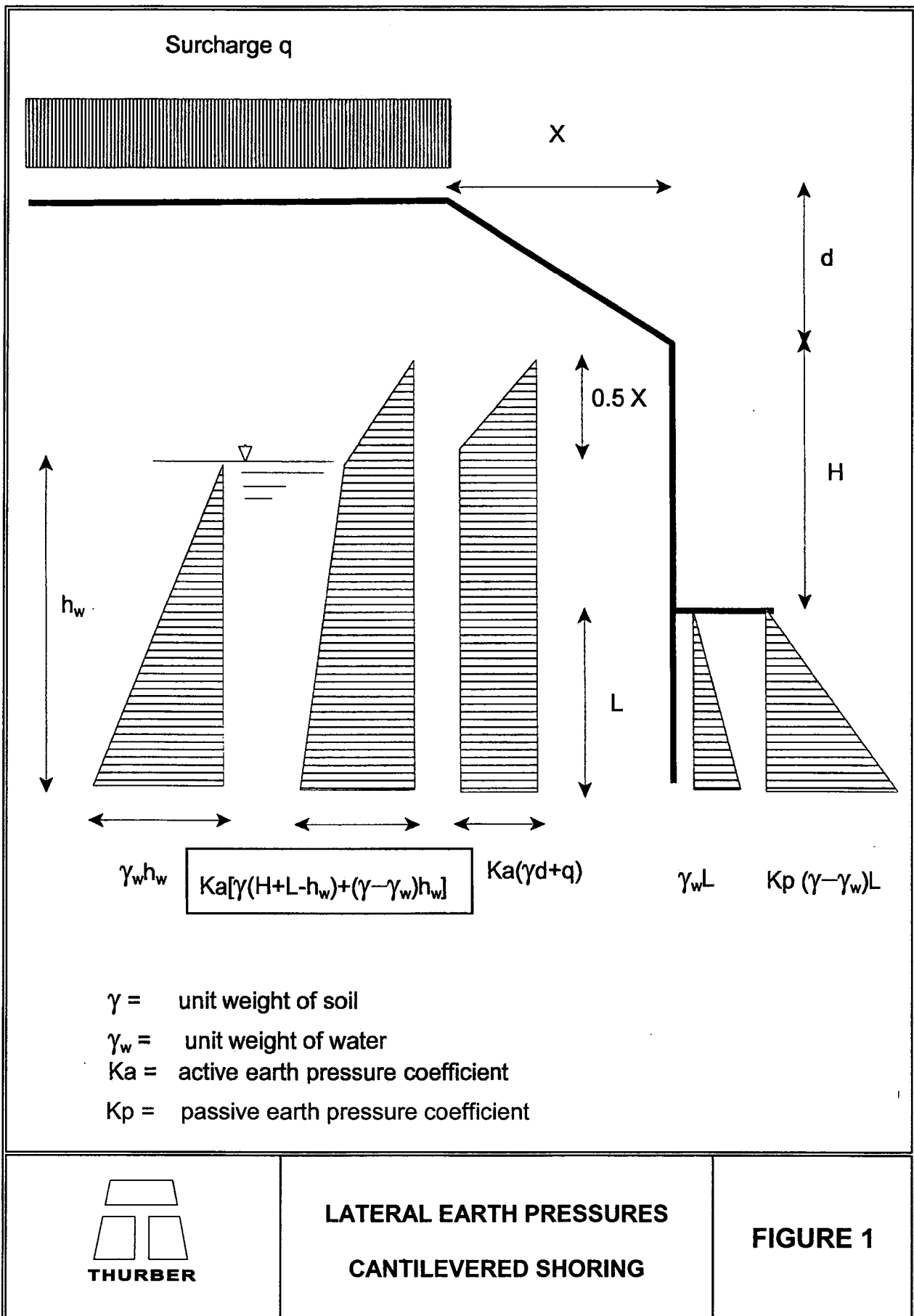
- - BOREHOLE N°1
○ - BOREHOLE N°2

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION
PLASTICITY CHART

Job No. GL-E-12 W.P. No. 910-60
Location CARP RIVER

Appendix D

Figure 1



Appendix E
List of SPs and OPSS

The following OPSS and OPSD documents are referenced in this report:

- OPSS 804, November 2010
- OPSS 902, November 2010
- OPSS 1010
- OPSD 3101.150
- OPSS 539
- OPSS 501
- SP 110S13 amendment to OPSS, April 2004

Appendix F
Site Photographs



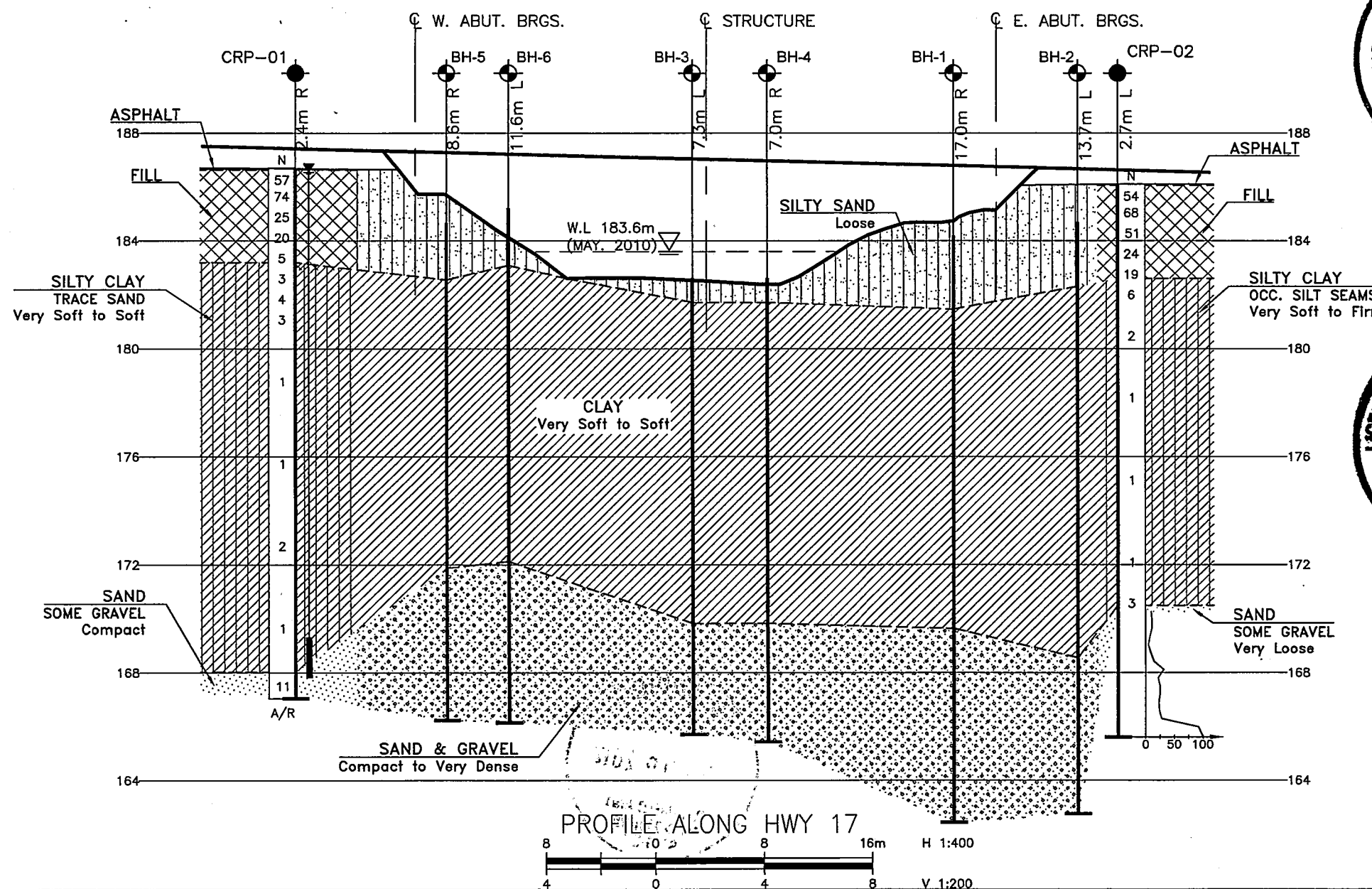
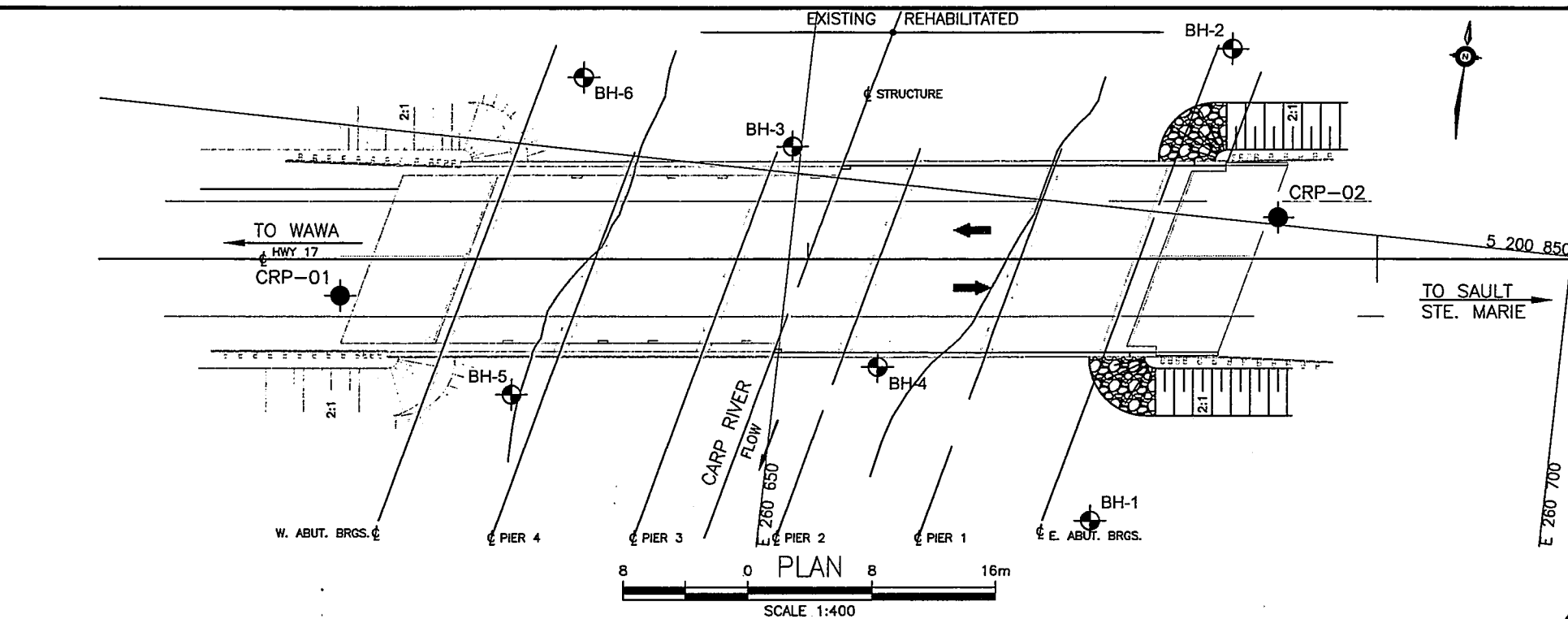
Photograph 1 – General view of bridge/site (from west side looking east)



Photograph 2 – Existing bridge viewed from the south west.

Appendix G

Drawing “Borehole Locations and Soil Strata”



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

GWP No 5723-08-00	(
CONT No	
WP No	

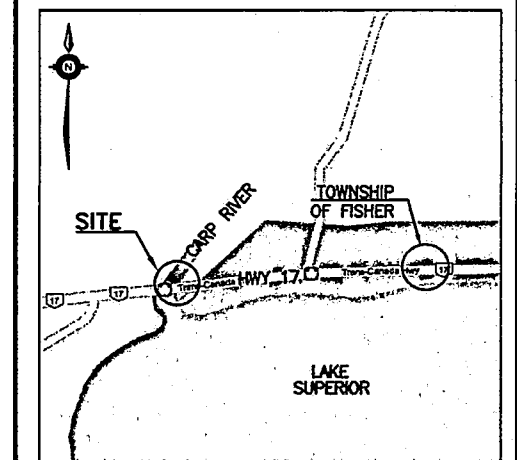
CARP RIVER BRIDGE
REHABILITATION HWY 17
TOWNSHIP OF FISHER
BOREHOLE LOCATIONS AND SOIL STRATA



**McCORMICK RANKIN
CORPORATION**








THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

- | | |
|---|---------------------------------------|
|  | Borehole (Current Investigation) |
|  | Borehole (Previous Investigation) |
| 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
CRP-01	186.7	5 200 838.9	260 621.6
CRP-02	186.1	5 200 880.5	260 681.0
*BH-1	184.2	5 200 829.5	260 671.1
*BH-2	184.7	5 200 861.1	260 676.8
*BH-3	182.6	5 200 851.7	260 649.4
*BH-4	182.6	5 200 838.0	260 636.4
*BH-5	184.6	5 200 833.6	260 633.2
*BH-6	185.2	5 200 854.7	260 635.5

				* Approx. Borehole Locations of Previous Investigation
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-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.

GEOCRES No. 41K-86

REVISIONS								
	DATE	BY				DESCRIPTION		
DESIGN	RPR	CHK		CODE		LOAD	DATE	DEC. 2011
DRAWN	AN	CHK RPR	SITE		STRUCT	DWG 1		

PLOTDATE: 12/21/2011 10:58 AM