



THURBER ENGINEERING LTD.

**PRELIMINARY FOUNDATION INVESTIGATION REPORT
HIGHWAY 401 WIDENING, HIGHWAY 16 TO MAITLAND ROAD
416N-401W RAMP CULVERT REHABILITATION, SITE NO. 16X-0260/C0
GWP 4024-20-00 / ASSIGNMENT NO. 4019-E-0010.2**

Geocres No.: 31B-103

Report to:

MTO c/o AECOM Canada Ltd.

Latitude: 44.745978°
Longitude: -75.491680°

January 2023
Thurber File No.: 29381



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PART 1. FACTUAL INFORMATION

1 INTRODUCTION

Thurber Engineering Ltd. (Thurber) has been retained by AECOM Canada Ltd. (AECOM) on behalf of the Ministry of Transportation Ontario (MTO) under Assignment No. 4019-E-0010, Work Item No. 2, to carry out Foundation Investigations to support the Preliminary Design and Environmental Assessment for the widening of Highway 401 from Highway 16 to Maitland Road. The overall scope of work comprises replacement or rehabilitation of 14 existing structures, including 10 bridges and four structural culverts.

This report addresses the proposed rehabilitation of the structural culvert beneath the ramp connecting traffic coming from the north on Highway 416 to traffic traveling west on Highway 401. The culvert, Site No. 16-260/C, is located south of Cedar Grove Road, near the town of Prescott, Ontario.

This section of the report presents the factual findings obtained from a desktop study carried out based on existing subsurface information pertinent to the site, which was obtained from the MTO's Foundation Library and included:

- Report prepared by Jacques, Whitford Limited titled, "*Foundation Investigation Report for W.P. 374-89-00, Concrete Culvert, Site 16-259, Ramp W-N, Sta. 21+338.8, Site 16-260, Ramp N-W, Sta. 11+400, Hwy 401-416 Interchange, District 9, Ottawa*", dated August 17, 1992 (Geocres No. 31B-67); and,
- Letter prepared by Jacques, Whitford Limited titled, "*Addendum to Jacques Whitford Report No. 10212 dated August 17, 1992, W.P. 374-89-00, Site 16-259 and Site 16-260, Concrete Culverts, Ramps W-N and N-W, Hwy401/416 Interchange*", dated January 7, 1998 (Geocres No. 31B-67).

The purpose of the desktop study was to explore the subsurface conditions at the site based on existing data, and to provide a written description of the subsurface conditions. A model of the subsurface conditions influencing design and construction was developed during the current study.

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.



2 SITE DESCRIPTION

The site is located in the southwestern quadrant of the Highway 401 and Highway 416 Interchange. Johnstown Creek flows roughly from west to east beneath interchange ramps and Highway 401 to its outlet into the St. Lawrence River at Johnstown. The culvert addressed in this report is located beneath the ramp connecting traffic coming from Highway 416 north to Highway 401 west. The culvert is approximately 240 m southwest of Cedar Grove Road and 300 m northeast of the ramp's intersection with Highway 401. For project purposes, the ramp and culvert at the site are herein described as oriented north-south and east-west, respectively.

The land adjacent to the site typically consists of forests, wetlands, and agricultural fields. The terrain is relatively flat apart from the existing highway and interchange embankments and associated drainage ditches. Highway 401 in this area consists of a four-lane divided freeway, and the ramp consists of two travelled lanes and a wide paved outside (right) shoulder with guardrails on both sides.

A site visit was carried out on March 29, 2021, to observe the existing site conditions. At that time, the embankments did not show any visible signs of distress or other performance issues. Within the vicinity of the culvert, the embankment side slopes are sloped at approximately 2H:1V and are generally grass-covered, with bushes and small trees growing around the culvert headwalls. A subsequent site visit was carried out on May 5, 2021, to survey the top of the existing culvert and the water level in Johnstown Creek.

Based on the available project background documents, the culvert consists of a cast-in-place, rigid-frame, closed-bottom, box culvert, constructed in 1998. The culvert is approximately 56.5 m long, has an internal span width of 5.0 m, and an overall internal height of 3.0 m.

Based on published geological information in *The Physiography of Southern Ontario* by Chapman and Putnam (1984), the site lies on the border of the physiographic regions known as the Smith's Falls Limestone Plain and the Glengarry Till Plain.

The Smith's Falls Limestone Plain is characterized by typically shallow bedrock but including a few localized deep areas of highly variable soils consisting of clays, sands, and gravels. The Glengarry Till Plain is characterized by an undulating surface consisting of morainic ridges and intervening clay flats and swamps, overlying till and similar glaciofluvial deposits containing many cobbles and boulders. Both areas are known to be underlain by limestone and sandstone bedrock.

Photographs showing the existing conditions at the site at the time of the site visit are included in Appendix D for reference.

3 SITE INVESTIGATIONS AND FIELD TESTING

Several field investigations were carried out as part of the planning and design of the Highway 401 and Highway 416 Interchange. Two boreholes (92-1 and 92-2) were put down in May 1992 as part of the first investigation for the subject culvert. Following a realignment of the design of



the subject culvert some 100 southwest, two more boreholes (97-2 and 97-3) were put down as part of a subsequent investigation carried out in September 1997. Both investigations employed a track-mounted CME 55 drill rig to advance the boreholes. Standpipe piezometers were installed in each borehole following drilling.

The locations of the boreholes were surveyed by others prior to the initiation of the field work, unless they were subsequently relocated due to site constraints, in which case the as-drilled borehole location was then surveyed.

The northing, easting and elevation of the boreholes are shown on the Borehole Location and Soil Strata Drawing No. 1 in Appendix A and in Table 3-1, below. The site is located within MTM Zone 9. Note that the borehole locations were originally surveyed relative to NAD27 horizontal datum and have been converted relative to NAD83 in the drawing, on the Record of Borehole Sheets (where appropriate), and in Table 3-1, below.

Table 3-1: Borehole Summary

Borehole No.	Drilled Location	Northing¹ (Latitude)	Easting¹ (Longitude)	Ground Surface² Elevation (m)	Termination Depth (m)
92-1	Initial Inlet (West)	4 956 828.3 (44.746996)	384 678.7 (-75.491239)	84.7	11.2
92-2	Initial Outlet (East)	4 956 811.3 (44.746839)	384 714.7 (-75.490787)	84.3	10.5
97-2	Current Outlet (East)	4 956 757.3 (44.746357)	384 675.7 (-75.491288)	84.3	8.5
97-3	Current Inlet (West)	4 956 731.3 (44.746128)	384 629.7 (-75.491873)	84.0	7.9

Notes: 1) Boreholes were surveyed relative to NAD27; coordinates listed above were converted relative to NAD83.
2) All boreholes were put down prior to construction of the existing ramp and culvert.

Soil samples were obtained at selected intervals using split spoon samplers in conjunction with Standard Penetration Testing (SPT) during the investigations. In-situ vane shear testing was attempted in cohesive soils. Pocket penetrometer tests were carried out on selected split spoon samples. In Borehole 92-1, the bedrock was cored approximately 1.6 m with NQ sized coring equipment.

Standpipe piezometers were installed in each borehole prior to backfilling. It has been assumed that all standpipe piezometers were removed or abandoned prior to construction of the ramp and culvert.

4 LABORATORY TESTING

Geotechnical laboratory testing consisted of natural moisture content determination, grain size distribution testing, and Atterberg Limit determination carried out on selected samples.



The results of the geotechnical tests are summarized on the Record of Borehole sheets included in Appendix B and are presented on the figures included in Appendix C.

5 GENERAL DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix B and the Borehole Location and Soil Strata Drawing included in Appendix A. A general description of the stratigraphy based on the conditions encountered in the boreholes is given in the following sections. However, the factual data presented on the Borehole Records takes precedence over the Soil Strata Drawing and the general description. It must be recognized that the soil and groundwater conditions may vary between and beyond borehole locations. Soil classification is in accordance with ASTM D2487.

In general terms, the 1992 and 1997 investigations indicated that the site is underlain by a deposit of silty clay, overlying silty sand glacial till which is, in turn, underlain by dolostone bedrock.

The following discussions focus on Boreholes 97-2 and 97-3 which are in close proximity to the structure. The logs for Boreholes 92-1 and 92-2 are included in Appendix B for completeness and general information. Laboratory test results from the 1992 investigation have been included in the discussions where relevant.

5.1 Surficial Deposits

At the time of the 1997 investigation, 0.8 m of loose brown sand containing some silt was encountered at the ground surface at Boreholes 97-2 and 97-3. These surficial deposits would have likely been disturbed, altered, or completely removed during construction of the 416N-401W ramp and subject culvert.

5.2 Silty Clay

A native, deposit of silty clay was encountered beneath the surficial granular deposits at all borehole locations. The layer was measured to be about 6.0 m thick at the boreholes put down at the current culvert location (Boreholes 97-2 and 97-3). At these locations, the bottom of the clay deposit was at Elevations 77.5 m and 77.2 m.

Standard Penetration Tests (SPTs) conducted within this layer gave N-values ranging from 3 to 24 but were generally between 10 and 20 blows per 0.3 m of penetration. In-situ shear vane tests were attempted but exceeded, suggesting an undrained shear strength of greater than 160 kPa near the culvert alignment, as indicated in the Geocres report (No. 31B-67). The 1992 Geocres report also described pocket penetrometer tests carried out on split spoon samples that indicated a shear strength of about 200 kPa, indicating a very stiff to hard consistency.

The moisture content of the samples tested ranged from 22 to 39%. The results of a grain size analysis test conducted on a sample of this material from Borehole 92-1 are summarized below and are illustrated on Figure C1 in Appendix C.

Table 5-1: Summary of Grain Size Distribution Testing – Clay

Soil Particle	Percentage (%)
Gravel	0
Sand	0
Silt	40
Clay	60

The results of Atterberg Limits testing carried out on the same sample of clay from Borehole 92-1 are summarized below and are illustrated on Figure C2 Appendix C. The laboratory results indicate that the material is a silty clay of intermediate plasticity (CI).

Table 5-2: Summary of Atterberg Limit Testing – Clay

Parameter	Value
Liquid Limit	47
Plastic Limit	22
Plasticity Index	25

5.3 Glacial Till (Silt, Clay, Sand and Gravel)

A deposit of glacial till was encountered beneath the silty clay. In Boreholes 92-1 and 92-2 the deposit was described as a heterogeneous mixture of sand and silt, containing some gravel and clay. In Boreholes 97-2 and 97-3 the deposit was described as a heterogeneous mixture of silt and clay, containing some sand and gravel. The thickness of the till deposit was measured to be 2.6 m at Borehole 92-1, where it was fully penetrated. At the other borehole locations, auger refusal was inferred to be the underlying bedrock surface and indicated an inferred thickness of the till ranging from 1.0 m and 1.7 m at Boreholes 97-3 and 97-2, respectively (the current culvert location), to 3.8 m at Borehole 92-2.

SPTs conducted in this layer gave N-values ranging from 22 to 83, but typically greater than 45 blows per 0.3 m of penetration, indicating a dense to very dense relative density. Refusals within this deposit were inferred to be at the bedrock surface but could also have occurred as a result of the presence of cobbles and boulders within the glacial till.

5.4 Bedrock

Bedrock was proven by coring at Borehole 92-1, located about 75 m north of the current culvert location. The bedrock encountered was described as limey dolostone with shaley partings, and some calcite. The bedrock was reported to be of excellent quality with Rock Quality Designation (RQD) values ranging from 94% to 100%. Total Core Recover (TCR) ranged from 94% to 100%.

The top of bedrock was inferred by auger refusal in Boreholes 97-2 and 97-3 at depths of 8.5 m and 7.9 m respectively (elevations 75.8 m and 76.2 m).

Photographs of the bedrock cores are provided in Appendix C.

5.5 Groundwater

The groundwater levels measured in the standpipe piezometers installed during the 1992 and 1997 field investigations are presented in Table 5-3. The Johnstown Creek level was measured during a recent site visit carried out on May 5, 2021 and is also presented in Table 5-3.

Table 5-3: Summary of Groundwater Levels

Borehole No.	Bottom of Screen Elevation (m)	Screened Unit	Depth¹ (mbgs)	Groundwater Elevation (m)	Date of Measurement
92-1	73.5	Bedrock	-1.5	86.2	1992/08/19
92-2	73.9	Till	-0.5	84.8	1992/08/19
97-2	Unknown	Unknown	0.7	83.6	1997/09/19
97-3	Unknown	Unknown	0.6	83.4	1997/09/19
Johnstown Creek Surface Level (Existing Outlet)				84.3	2021/05/05

Note: 1) Negative values indicate artesian conditions at the time of measurement.

These observations are considered short term and it should be noted that the groundwater level at the time of rehabilitation construction may be different and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater and creek level may be at a higher elevation after periods of significant and/or prolonged precipitation.

6 MISCELLANEOUS

Overall project management and direction of the field visits was provided by Matt Kennedy, P.Eng. The elevation survey of Johnstown Creek and the culvert was carried out by Jamil Pirani, EIT with reference to geodetic elevation benchmarks provided by the MTO.

It is noted that the information provided herein is based on investigations completed prior to construction of the Highway 401/416 Interchange. It is likely that conditions have changed on site during the intervening years.

Interpretation of the factual data and preparation of this report was carried out by Matt Kennedy, P.Eng. The report was reviewed by Paul Carnaffan, P.Eng. and Fred Griffiths, P.Eng., a Designated Principal Contact for MTO Foundations Projects.



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Senior Geotechnical Engineer



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



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Senior Geotechnical Engineer

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.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

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.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

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.

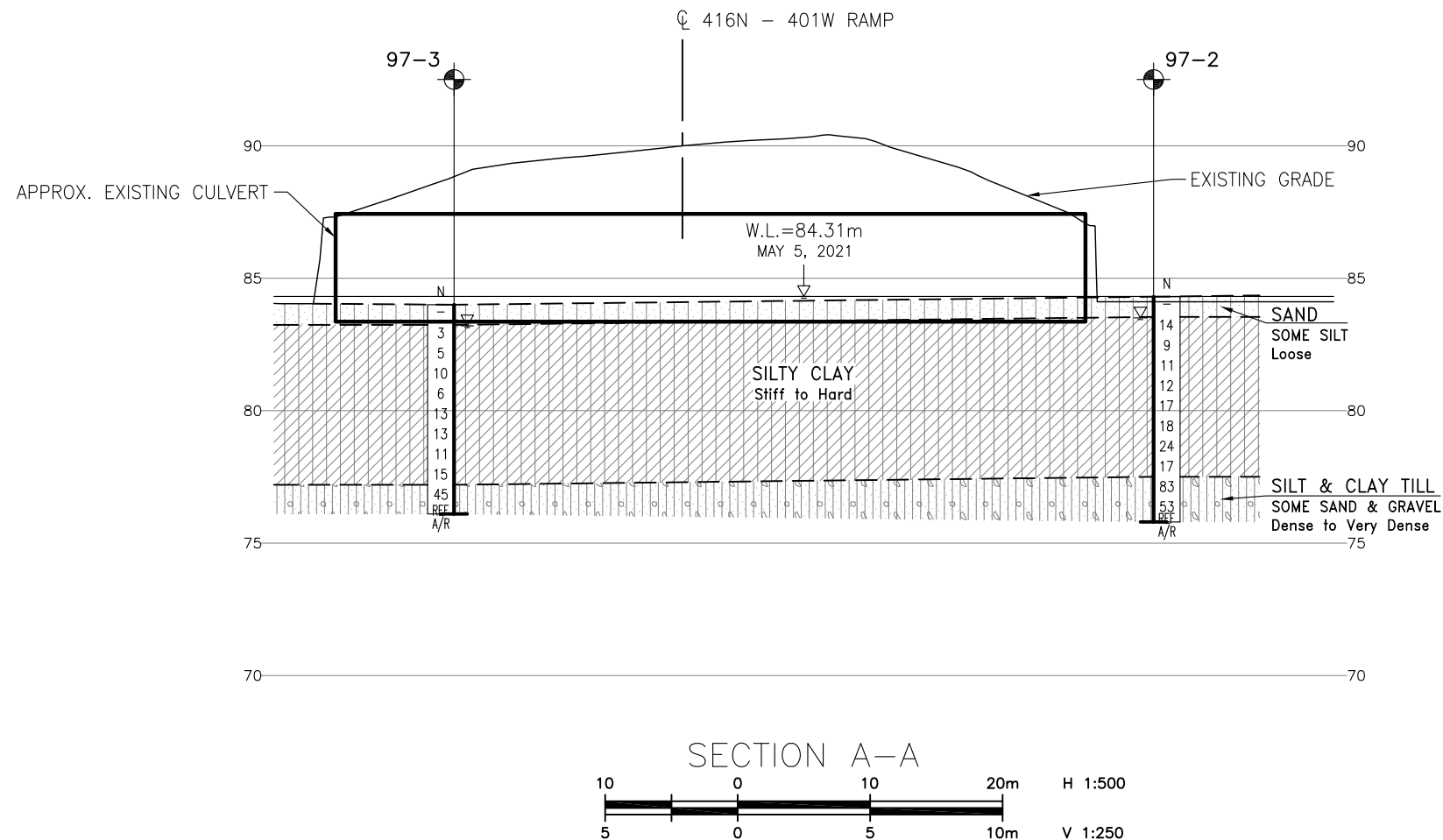
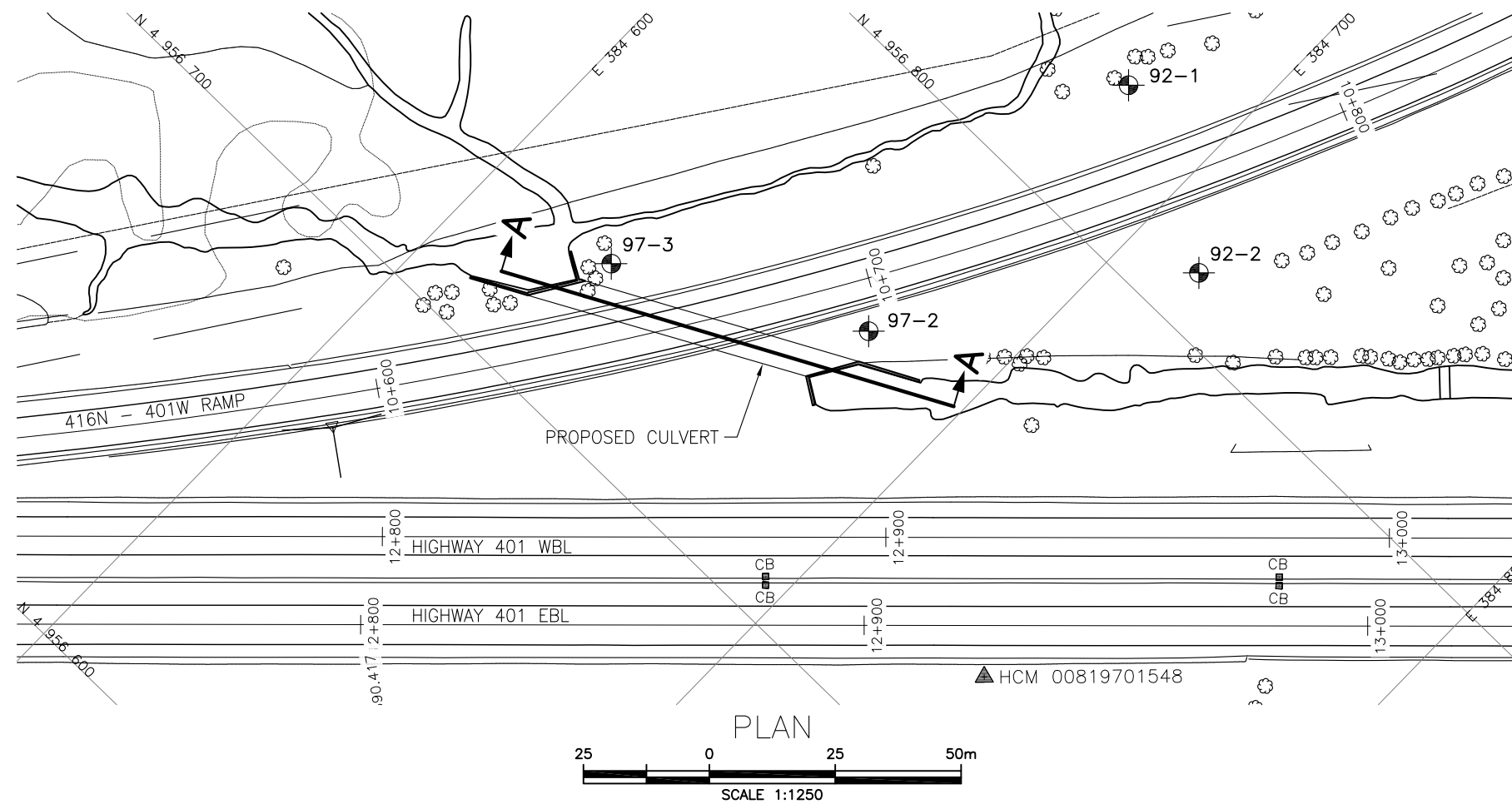
7. INDEPENDENT JUDGEMENTS OF CLIENT

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.

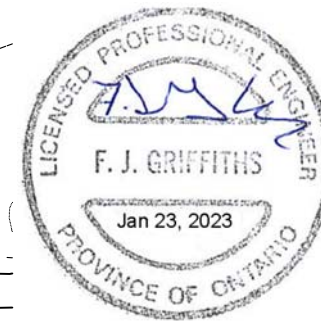


Appendix A.

Borehole Location Plan and Stratigraphic Drawing



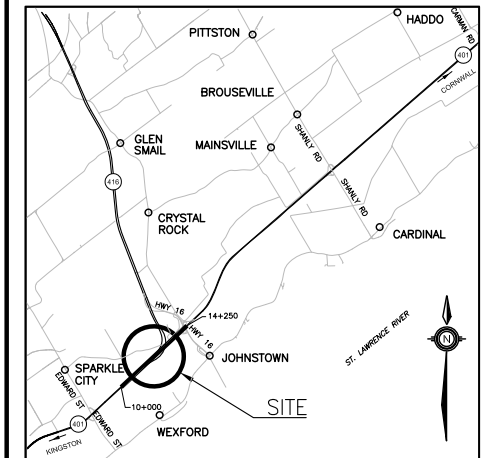
METRIC
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AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



CONT No	(
GWP No 4024-20-00	






HIGHWAY 401
416N - 401W RAMP
CULVERT REHABILITATION
BOREHOLE LOCATIONS AND SOIL STRATA

Ontario 



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
92-1	84.7	4 956 828.3	384 678.7
92-2	84.3	4 956 811.3	384 714.7
97-2	84.3	4 956 757.3	384 675.7
97-3	84.0	4 956 731.3	384 629.7

-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 Zone 9.

GEOCRES No. 31B-103

REVISIONS							
	DATE	BY	DESCRIPTION				
DESIGN	MJK	CHK -	CODE	LOAD	DATE	JAN 2023	
DRAWN	MFA	CHK MK	SITE 16-260/CSTRUCT		DWG	1	



Appendix B.

Record of Borehole Sheets (1992 and 1997 Investigations)

RECORD OF BOREHOLE No 97-2

1 OF 1

METRIC

W.P. 374-89-00 LOCATION Hwy 401/416 Interchange, Johnstown Creek Culvert ORIGINATED BY CL
 DIST 9 HWY 401/416 BOREHOLE TYPE Hollow Stem Auger COMPILED BY CL
 DATUM Geodetic DATE 97.09.18 & CHECKED BY PC




SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80					
84.3																
0.0	Loose, brown, SAND, some silt		1	BS												
83.5																
0.8	Very stiff to hard, brownish grey to dark grey, SILTY CLAY		2	SS	14											
			3	SS	9											
			4	SS	11											
			5	SS	12											
			6	SS	17											
			7	SS	18											
			8	SS	24											
			9	SS	17											
77.5																
6.8	Very dense, grey, heterogeneous mixture of silt and clay, some sand and gravel (glacial till)		10	SS	83											
			11	SS	53											
75.8																
8.5	End of Borehole															
	Auger Refusal on Inferred Bedrock Standpipe installed ref = >50 blows for 150mm															

RECORD OF BOREHOLE No 97-3

1 OF 1

METRIC

W.P. 374-89-00 LOCATION Hwy 401/416 Interchange, Johnstown Creek Culvert ORIGINATED BY CL
 DIST 9 HWY 401/416 BOREHOLE TYPE Hollow Stem Auger COMPILED BY CL
 DATUM Geodetic DATE 87.09.18 & CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								20 40 60 80 100						
84.0														
0.0	Loose, brown, SAND		1	BS										
83.3														
0.8	Stiff to hard, brownish grey to dark grey, SILTY CLAY		2	SS	3									
			3	SS	5									
			4	SS	10									
			5	SS	6									
			6	SS	13									
			7	SS	13									
			8	SS	11									
			9	SS	15									
77.2														
6.8	Dense, grey, heterogeneous mixture of silt and clay, some sand and gravel (glacial till)		10	SS	45									
76.2			11	SS		ref								
7.9	End of Borehole													
	Auger Refusal on Inferred Bedrock													
	Standpipe Installed													
	ref = >50 blows for 150mm													

$\times^3 \cdot \times^3$: Numbers refer to Sensitivity $\frac{20}{15 \cdot 5}$ (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 92-1

METRIC

W P 374-82-00 LOCATION Co-ords: N: 4 956 828.3 E: 384 678.7 ORIGINATED BY Y.L.
 DIST 9 HWY 416 BOREHOLE TYPE Hollow Stem Auger, N-Casing, Rock Coring COMPILED BY F.J.G.
 DATUM Geodetic DATE May 11, 1992 CHECKED BY CKK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
84.7	Ground surface																
0.1	Topsoil		1	SS	2		Seal										
0.4	Sand, some silt Brown Very Loose		2	SS	8		84										
			3	SS	15		83										
	Silty Clay Brown to Grey Very Stiff to Hard		4	SS	13		82										0 0 40 60
			5	SS	10		81										
			6	SS	12		80										
			7	SS	17		79										
			8	SS	17		78										
			9	SS	15		77										
77.7							76										
7.0	Het, Mixture of Sand and Silt, some Gravel and Clay		10	SS	54		75										
	Grey (Glacial Till) Very Dense						74										
75.1			11	SS	8/150mm		73										
9.6	Bedrock Lime Dolostone Excellent		12	NQ	REC 94%		72										RQD = 94%
73.5							71										
11.2	End of Borehole						70										
	Artesian Conditions 1.5m, Aug. 19, 1992						69										

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 92-2

METRIC

W P 374-89-00 LOCATION Co-ords N: 4956 811.3 E: 384 714.7 ORIGINATED BY Y.L.
 DIST 9 HWY 476 BOREHOLE TYPE Hollow Stem, N-Casing, Rock Coring COMPILED BY F.J.G.
 DATUM Geodetic DATE May 11, 1992 CHECKED BY CKR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPo						
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE					
84.3	Ground Surface							20 40 60 80 100						
0.1	Topsoil													
0.25	Sand, some silt Brown, loose		1	SS	3									
	Silty clay Grey Very Stiff to Hard		2	SS	7									
			3	SS	9									
			4	SS	11						○			
			5	SS	12									
									>+					
			6	SS	12						○			
			7	SS	25									
77.6							Native Backfill							
	Het, Mixture of Sand and Silt, some Gravel and Clay													
	(Glacial Till) Grey Compact to Very Dense		8	SS	22						○			
			9	SS	74									
73.8							Piezometer							
10.5	End of Borehole Auger Refusal													
	Artesian Conditions 0.5m, Aug. 19, 1992													

OFFICE REPORT ON SOIL EXPLORATION



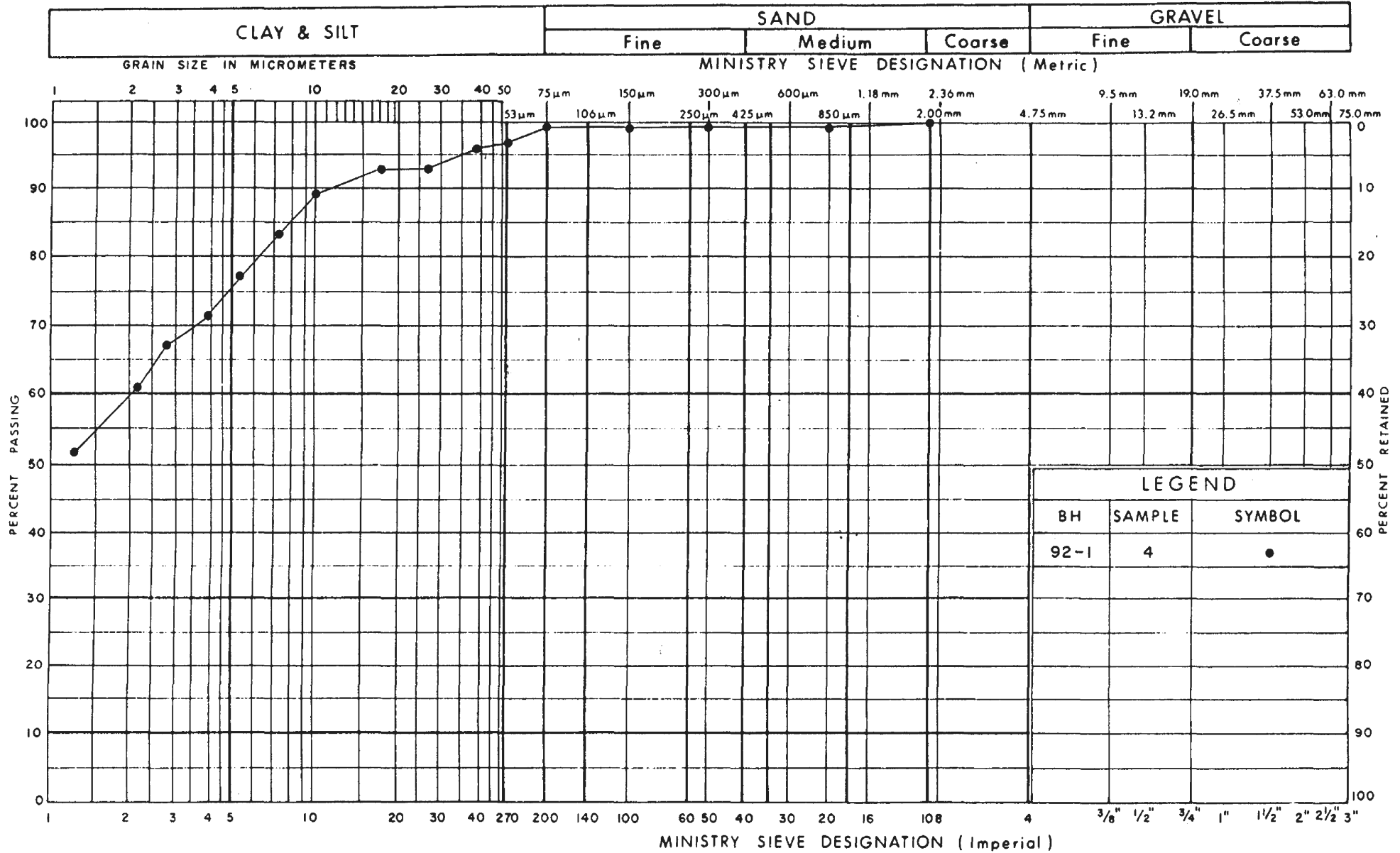
Appendix C.

Laboratory Test Results (1992 Investigation)



Appendix C.1
Particle Size Analysis Figure
Atterberg Limit Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM

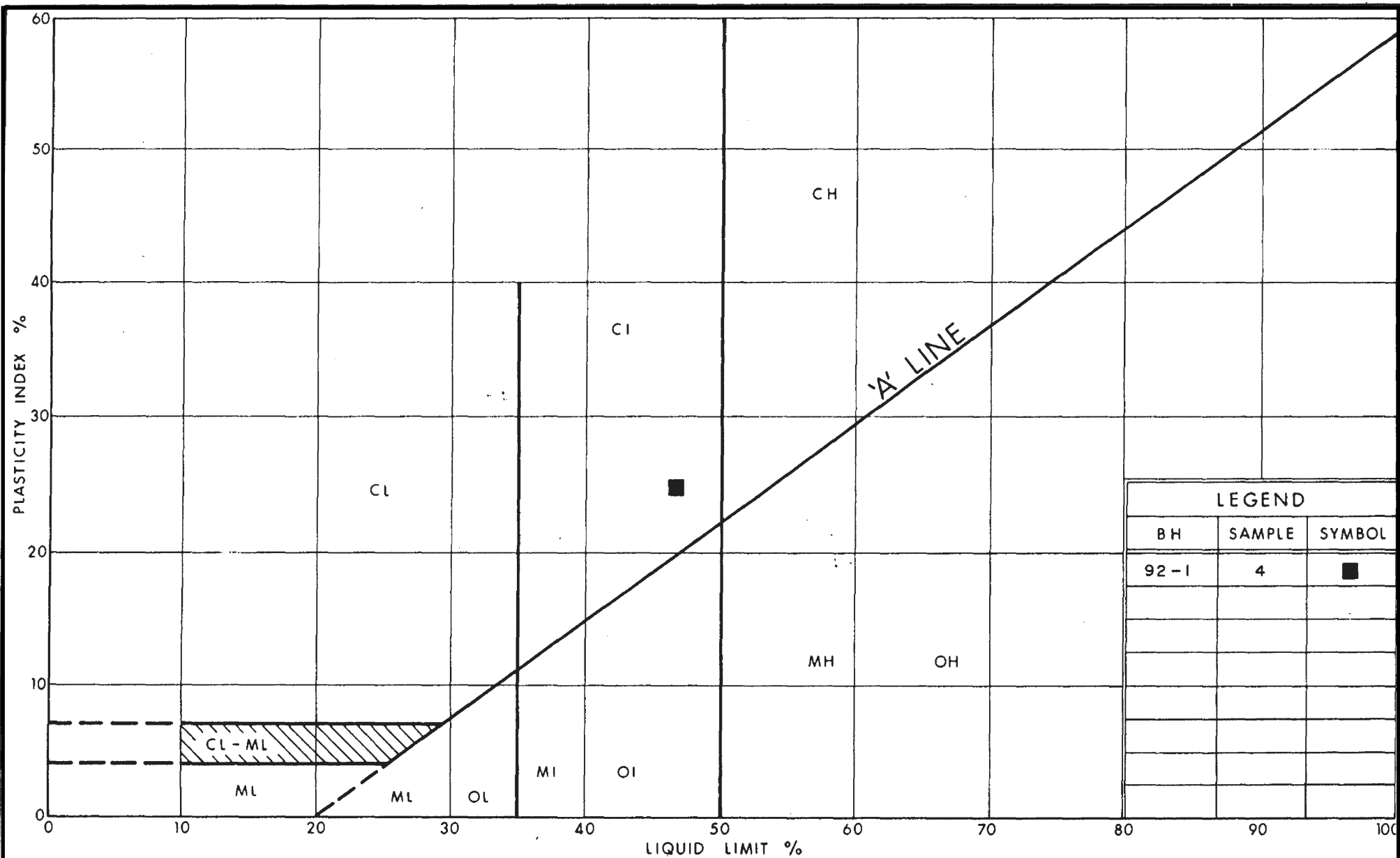


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GRAIN SIZE DISTRIBUTION
SILTY CLAY

FIG No C1

W P 374 -89- 00



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PLASTICITY CHART SILTY CLAY

FIG No C2

W P 374-89-00



Appendix D.

Site Photographs



Photo 1. Looking southwest at the east (outlet) culvert headwall (2021/03/29).



Photo 2. Looking northeast at east (outlet) culvert headwall (2021/03/29).



Photo 3. Looking southwest at west (inlet) culvert headwall (2021/03/29).



Photo 4. Looking northeast at west (inlet) culvert headwall (2021/03/29).