



January 2014

FOUNDATION INVESTIGATION AND DESIGN REPORT

**CNR Overhead Structural Removal, Site 30-079
Highway 11, Orillia, Ontario
GWP 2177-10-00**

Submitted to:
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REPORT



Report Number: 13-1132-0078-1000-R01

Distribution:

4 Copies - Facca Inc.
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FOUNDATION INVESTIGATION AND DESIGN REPORT CNR OVERHEAD STRUCTURAL REMOVAL, SITE 30-079, ORILLIA

FIGURE 1 - Key Plan

DRAWING 1 - Borehole Locations

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**FOUNDATION INVESTIGATION AND DESIGN REPORT
CNR OVERHEAD STRUCTURAL REMOVAL, SITE 30-079, ORILLIA**

PART A

FOUNDATION INVESTIGATION REPORT

**CNR OVERHEAD STRUCTURAL REMOVAL, SITE 30-079
HIGHWAY 11, ORILLIA, ONTARIO
GWP 2177-10-00**



1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Facca Inc. (Facca) to provide foundation engineering services for the removal of the existing CNR overhead structure (Site 30-079) on Highway 11 just north of the City of Orillia in the Township of Severn, Ontario as illustrated on the Key Plan, Figure 1.

This report presents the results of our current, limited investigation and the results of the previous subsurface investigations carried out at the site.



2.0 SOURCES OF INFORMATION

The following source of information was reviewed during the preparation of this report and incorporated into the report, as appropriate:

- ““Foundation Investigation Report, CNR Overhead, Site 30-079, Replacement of Highway 11 CPR and Removal of Highway 11 CNR Structure in the Township of Severn, District: Toronto, Ontario, GWP No. 2177-10-00, Contract No. DB-2013-2019”, Geocres No. 31D-557, dated May 1, 2013.
- “Geocres Report, Foundation Investigation for CNR Overhead Widening, Geocres No. 31D-250, January 1978.



3.0 SITE DESCRIPTION

3.1 General

The existing CNR Overhead Bridge (Site 30-079) is located approximately 1.8 kilometres south of Penley Road on Highway 11 just north of the City of Orillia in the County of Simcoe, Township of Severn, Ontario. The former CNR tracks were oriented in a generally north-south direction. Highway 11, also oriented in a generally northeast-southwest direction at a skew to the tracks, was originally constructed on an embankment fill approximately 9.5 metres high with side slopes ranging from about 1.75 to 2.0 horizontal to 1 vertical. Currently, the railway has been decommissioned, the tracks removed, and the corridor is now abandoned. In general, the ground surface in the area ranges from about elevation 234 metres along the abandoned track to elevation 243 metres at the Highway 11 pavement surface. The slopes of the embankment and the immediately adjacent terrain are grass covered and stands of trees and shrubs are present throughout the area.

3.2 Project Description

The work for this project will include the removal of the existing bridge structure, filling of the space between the existing embankments and reinstatement of the highway in lieu of the existing bridge.



4.0 INVESTIGATION PROCEDURES

4.1 Current Investigation

A limited supplementary subsurface investigation program was carried out to explore the subsurface conditions at locations other than those identified in the previous investigation report provided as part of the RFP. The investigation program consisted of six test pits excavated at the locations shown on Drawing 1.

The test pits were excavated on September 17, 2013 using a rubber-tire backhoe supplied and operated by a local contractor. The subsurface conditions encountered in the test pits are summarized in Appendix A. Representative bulk samples of the major soil strata encountered were obtained, placed in sealed, labelled containers and brought to our laboratory for further examination. Groundwater conditions were observed during excavation of the test pits and these observations are also included in Appendix A.

The locations of the test pits were determined in the field by a member of our engineering staff and the ground surface elevations at the test pit locations were estimated based on the recent topographic survey of the site. The approximate locations of the test pits and the ground surface elevations at the test pit locations are summarized below. The approximate locations of the test pits are also shown on Drawing 1.

| Test Pit | MTM NAD83 Northing (m) | MTM NAD83 Easting (m) | Ground Surface Elevation (m) | Depth (m) |
|-----------------|-----------------------------------|----------------------------------|---|------------------|
| 101 | 4945018.5 | 311146.5 | 233.5 | 1.5 |
| 102 | 4945026.5 | 311138.0 | 233.5 | 1.5 |
| 103 | 4945060.5 | 311130.0 | 234.0 | 2.1 |
| 104 | 4945076.5 | 311125.5 | 234.0 | 2.0 |
| 105 | 4945068.0 | 311136.0 | 234.0 | 2.3 |
| 106 | 4945045.0 | 311141.5 | 234.0 | 2.2 |

4.2 Previous Investigation by MTO

The results of the previous investigation carried out on behalf of the Ministry of Transportation were provided in the report entitled ““Foundation Investigation Report, CNR Overhead, Site 30-079, Replacement of Highway 11 CPR and Removal of Highway 11 CNR Structure in the Township of Severn, District: Toronto, Ontario, GWP No. 2177-10-00, Contract No. DB-2013-2019”, Geocres No. 31D-557, dated May 1, 2013.” and consisted of three boreholes (designated CNR-101, CNR-102 and 1 (31D-250)) advanced in the vicinity of the bridge at the approximate locations shown on Drawing 1. The boreholes were advanced using continuous-flight solid stem augers. Soil samples were collected using standard penetration test procedures. The Records of Boreholes



FOUNDATION INVESTIGATION AND DESIGN REPORT CNR OVERHEAD STRUCTURAL REMOVAL, SITE 30-079, ORILLIA

and laboratory test data are provided in Appendix B. Groundwater conditions were observed in the open boreholes during and immediately following the drilling operations.

The locations of the boreholes were surveyed by others. The geodetic elevations of borehole 1 (31D-250) was recorded in imperial units at the time of the previous investigation and converted to metric units for this report. The previous investigation boreholes are summarized below.

| Borehole | MTM NAD83 Northing (m) | MTM NAD83 Easting (m) | Ground Surface Elevation (m) | Borehole Depth (m) |
|-----------------|-----------------------------------|----------------------------------|---|-------------------------------|
| CNR 101 | 4945025.0 | 311151.6 | 233.9 | 9.6 |
| CNR 102 | 4945075.9 | 311124.6 | 233.9 | 9.8 |
| 1 (31D-250) | 4945027.5 | 311147.5 | 234.1 | 11.0 |



5.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

5.1 Regional Geology

The site is located within the Simcoe Lowlands physiographic region as described in The Physiography of Southern Ontario (Chapman and Putnam, 1984)¹. The predominant overburden stratum consists of glaciolacustrine plain deposits comprised of sand, silt and clay. Limestone of the Simcoe Group, Bobcaygeon Formation typically underlies the overburden deposits. The subsurface conditions encountered at the site are generally consistent with the reported regional geology.

5.2 Subsurface Conditions

The locations of the test pits and boreholes from the field investigations, ground surface elevations and interpreted stratigraphic conditions are shown on Drawing 1 and the profile on Drawing CNR-1 in Appendix B. The detailed subsurface soil and groundwater conditions encountered in the test pits are given on Table I in Appendix A and the results of in situ and laboratory testing and the Record of Borehole sheets contained in Appendix B. The stratigraphic boundaries shown on the borehole records and the interpreted stratigraphic sections are inferred from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. The subsoil conditions may vary between and beyond the borehole locations. Further, post-investigation construction work after borehole 1 (31D-250) was completed in 1977 and the like may have modified the subsurface conditions in some locations. In general, the subsurface conditions encountered at the site consisted of topsoil and fill underlain by peat, sand, clayey silt and sand till and sandy silt till.

The descriptions provided on the test pits records used the Golder system for describing soil as approved by the MTO. The borehole soil descriptions were completed by Peto MacCallum Inc. and remain unchanged in this report.

5.2.1 Topsoil

Layers of topsoil were encountered at the ground surface in test pits 102, 104 and 105. The topsoil layers were about 0.2 to 0.5 metres thick at the test pit locations. Materials designated as topsoil in this report were classified solely based on visual and textural evidence. Testing of organic content or for other nutrients was not carried out. Therefore, the use of materials classified as topsoil cannot be relied upon for support and growth of landscaping vegetation.

¹ Chapman, L.J and Putnam, D.F., 1984. The Physiography of Southern Ontario, Ontario Geological Society, Special Volume 2, Third Edition. Accompanied by Map p. 2715, Scale 1:600,000.



5.2.2 Fill

The surficial soils in boreholes CNR-101 and CNR-102, located near the toe of the cut slopes, are described as a granular fill between 0.7 and 0.9 metres thick. The surficial granular fill had measured N^2 values of 9 and 17 blows per 0.3 metres and water contents of about 14 and 18 per cent. A layer of silty clay fill with organics was encountered in borehole CNR-102 beneath the granular fill. The silty clay and organics fill layer was about 0.5 metres thick with an N value of 5 blows per 0.3 metres. The silty clay and organics had a water content of 17 per cent.

Layers of fill were encountered at the ground surface in test pits 101, 103 and 106 and beneath the surficial topsoil in test pits 102 and 105. The fill generally consisted of sand, sand and gravel and silty sand with varying amounts of topsoil and rootlets. The fill layers were about 0.3 to 1.3 metres thick at the test pit locations.

During the previous borehole investigations and current test pit explorations, the full extent and/or character of the fill materials beneath the former railway tracks was not defined. Therefore, the fill materials may be highly variable in extent and composition and could include materials such as old railroad ties or other debris.

5.2.3 Peat

A layer of peat was encountered beneath the surficial topsoil in test pit 104. The fibrous peat layer was about 0.8 metres thick.

5.2.4 Sandy Silt Till

Sandy silt till was encountered beneath the fill in test pits 101 to 103 and 106, beneath the peat in test pit 104 and beneath the silty sand in test pit 105. All test pits were terminated in the sandy silt till after exploring the layer for about 0.5 to 1.5 metres. Cobbles and boulders were encountered in the till during excavation of the test pits.

5.2.5 Clayey Silt and Sand Glacial Till

Brown to grey clayey silt and sand glacial till was encountered below the fill in boreholes CNR-101 and CNR-102 at elevations 233.2 and 232.5 metres, respectively and at the ground surface in borehole 1 (31D-250). Borehole 1 (31D-250) was terminated in the clayey silt and sand till layer after exploring it for 11.0 metres. Where fully penetrated, the clayey silt and sand till layers were 4.4 to 6.6 metres thick.

² The SPT N value is defined as the number of blows required by a 63.5 kilogram hammer dropped from a height of 760 millimetres to drive a split spoon sampler a distance of 300 millimetres into the soil after having first penetrated 150 millimetres.



The N values in the clayey silt and sand till ranged from 24 to greater than 100 blows per 0.3 metres and the till is of very stiff to hard consistency. Samples of the clayey silt and sand till had natural water contents of about 5 to 14 per cent. Atterberg limits determinations for four selected samples indicated plastic limits between 9 and 11 per cent, liquid limits between 14 and 16 per cent and plasticity indices between 5 and 7 per cent. These data are provided on Figure CNR-PC-1 in Appendix B and indicate a clayey silt of low plasticity. Grain size distribution curves for samples of the clayey silt and sand till are shown on Figure CNR-GS-1 in Appendix B. The presence of cobbles and boulders was recorded on the Record of Boreholes.

5.2.6 Sand, some silt

Sand, some silt with gravel was encountered beneath the clayey silt and sand till in boreholes CNR-101 and CNR-102 at elevations 226.6 and 228.1 metres, respectively. Boreholes CNR-101 and CNR-102 were terminated in the sand at depths of 9.6 to 9.8 metres below ground surface. The thickness of the sand layers ranged from 2.3 to 4.0 metres.

The sand had N values from 85 to greater than 100 blows per 0.3 metres. The sand with gravel had natural water contents of about 6 to 18 per cent. Grain size distribution curve for two samples of the sand recovered from the standard penetration testing are provided on Figure CNR-GS-2 in Appendix B.

5.3 Groundwater Conditions

Details of the water levels observed in the open boreholes at the time of drilling are summarized on the Record of Boreholes contained in Appendix B. The water levels measured in the open boreholes upon completion of drilling are summarized below:

| Borehole | Ground Surface Elevation (m) | Depth to Water Level (m) | Groundwater Elevation (m) | Date |
|-----------------|-------------------------------------|---------------------------------|----------------------------------|---------------------------|
| CNR-101 | 233.9 | 4.7 | 229.2 | January 10, 2013 |
| CNR-102 | 233.9 | 0.2 | 233.7 | January 10, 2013 |
| 1 (31D-250) | 234.1 | 4.9 | 229.2 | September 22 and 23, 1977 |



FOUNDATION INVESTIGATION AND DESIGN REPORT CNR OVERHEAD STRUCTURAL REMOVAL, SITE 30-079, ORILLIA

Groundwater seepage was observed in test pits 105 and 106 at depths of about 0.6 metres or about elevation 233.4 metres and minor groundwater seepage was observed in test pits 101 and 102 at depths of about 0.4 to 0.9 metres or between about elevation 233.1 and 232.6 metres. Test pits 103 and 104 remained dry during excavation on September 17, 2013. A summary of groundwater seepage elevations is provided in the table below.

| Test Pit | Ground Surface Elevation (m) | Encountered Water Level (m) |
|----------|------------------------------|-----------------------------|
| 101 | 233.5 | 232.6 |
| 102 | 233.5 | 233.1 |
| 103 | 234.0 | Dry |
| 104 | 234.0 | Dry |
| 105 | 234.0 | 233.4 |
| 106 | 234.0 | 233.4 |

The groundwater levels are expected to fluctuate seasonally and are expected to rise during wet periods of the year.



6.0 CLOSURE

This report was prepared by Mr. Brett Thorner and reviewed by Dr. Storer J. Boone, P.Eng. Mr. Fintan J. Heffernan, P.Eng., Golder's Designated MTO Foundations Contact, conducted an independent quality control review of this report.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Storer J. Boone, Ph. D., P.Eng.
Associate

ORIGINAL SIGNED

Fintan J. Heffernan, P.Eng.
Designated MTO Contact

BT/SJB/FJH/cr

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PART B

FOUNDATION INVESTIGATION REPORT

**CNR OVERHEAD STRUCTURAL REMOVAL, SITE 30-079
HIGHWAY 11, ORILLIA, ONTARIO
GWP 2177-10-00**



7.0 ENGINEERING RECOMMENDATIONS

7.1 General

This section of the report provides our foundation engineering design recommendations for the proposed removal of the existing CNR overhead structure. These recommendations are based on our interpretation of the factual data obtained from the boreholes and test pits advanced during the current and previous subsurface investigations. The discussion and recommendations provided are intended to provide the designers with sufficient information to carry out the design of the work. Where comments are made on construction, they are provided to highlight those aspects that could affect the design of the project. The designers should satisfy themselves as to the sufficiency of the information provided.

The work for this project will include the removal and disposal of the existing overhead structure, filling of the space between the existing embankments and reinstatement of the highway in lieu of the existing bridge. The height of the embankment at the area of the CNR overhead structure is approximately 9.5 metres.

7.2 Subgrade Preparation and Embankment Construction

Embankment fill is required to fill the gap between the existing ground surface near the abandoned CNR rail line and the existing Highway 11 road surface. All topsoil, softened/loosened materials, peat, and/or fill materials should be stripped from the proposed embankment footprint and the subgrade should be graded to drain to local sump locations or drainage ditches outside of the embankment footprint. The subgrade should be proofrolled under the direction of the geotechnical engineer prior to fill placement to identify any loose/softened areas requiring subexcavation or additional compaction. Embankment fill should consist of Granular B Type II placed and compacted in accordance with OPSS 501 (Compacting) and 206S03 (Earth Excavation and Grading). If groundwater conditions are such that the base of the excavations is wet, proofrolling should not be undertaken and the first 0.5 metres should be Granular B Type II and should be spread in relatively thin lifts using only the compaction effort impacted by the spreading equipment. The fill should be benched into the existing cut slopes consistent with OPSD 208.010 (Benching of Earth Slopes).

Following construction of the new embankment, the side slopes should be trimmed to a final inclination of 2 horizontal to 1 vertical or flatter. In accordance with MTO standard practice, a minimum 2 metre wide bench should be provided at mid-height in areas where the fill is greater than 8 metres. Following completion of filling and trimming, the slopes should be appropriately vegetated. The embankment fill will be founded on very stiff to hard till and the factor of safety of the slopes will be in excess of 1.3.

Settlements of the completed embankments are expected to be less than 25 millimetres and the settlement will be mainly occurring during filling/construction.



7.3 Construction Considerations

Temporary subexcavation for the construction of the embankment fill is expected to extend through the existing topsoil, peat, fill and compact to very dense clayey silt and sand to sandy silt till deposit. Cobbles and boulders should be expected in the till. The excavations will also extend below the long term groundwater level, which was typically at about elevation 233.3 metres in the boreholes closest to the abandoned tracks. The recent test pits did not indicate that groundwater would be problematic and can likely be handled by pumping from properly constructed and filtered sumps in the base of the excavation outside the embankment footprint, as required.

All open cut excavations should be carried out in accordance with the guidelines outlined in the current Ontario Occupational Health and Safety Act (OHSA) for Construction Activities. The existing fill materials would be classified as Type 3 soils and the clayey silt and sand to sandy silt till would be classified as Type 1 soil. Temporary excavations should be made with side slopes inclined no steeper than 1 horizontal to 1 vertical.



8.0 CLOSURE

This report was prepared by Mr. Brett Thorner and reviewed by Dr. Storer J. Boone, P.Eng. Mr. Fintan J. Heffernan, P.Eng., Golder's Designated MTO Foundations Contact, conducted an independent quality control review of this report.

GOLDER ASSOCIATES LTD.

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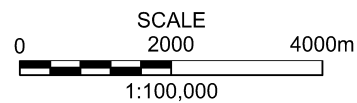
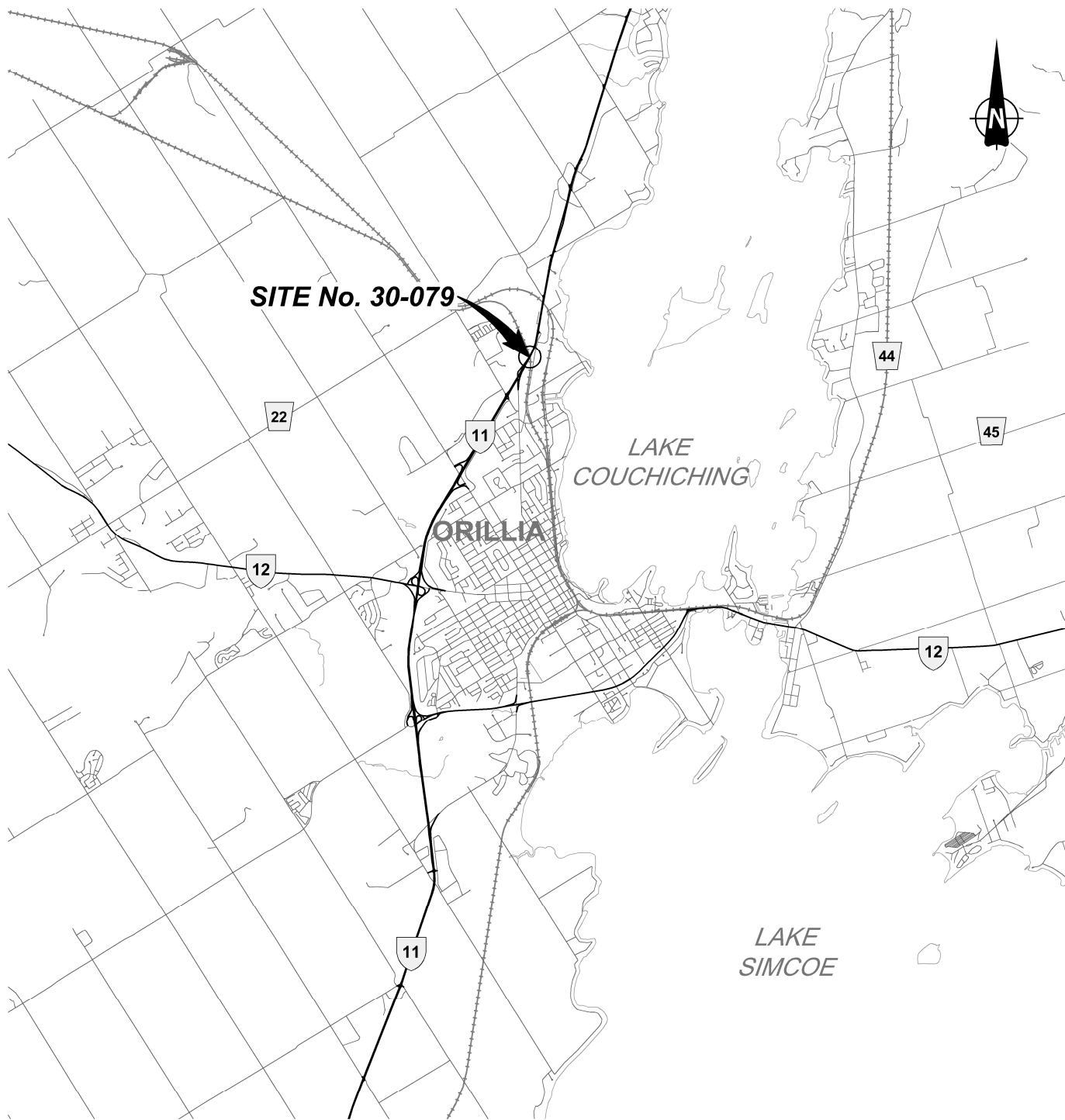
Storer J. Boone, Ph. D., P.Eng.
Associate

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Fintan J. Heffernan, P.Eng.
Designated MTO Contact

BT/SJB/FJH/cr

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REFERENCE

PLAN BASED ON CANMAP STREETFILES V.2008.5.

NOTES

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH
ACCOMPANYING TEXT.
ALL LOCATIONS ARE APPROXIMATE ONLY.

PROJECT

**SITE 30-079 CNR OVERHEAD STRUCTURAL REMOVAL
HIGHWAY 11, ORILLIA, ON
GWP 2177-10-00**

TITLE

KEY PLAN



| | | | | |
|--------------------------|-----|-------------|---------------------------------|--------|
| PROJECT No. 13-1132-0078 | | | FILE No. 1311320078-1000-F01001 | |
| CADD | LMK | Sept. 26/13 | SCALE AS SHOWN | REV. 0 |
| CHECK | | | FIGURE 1 | |

METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No. Oct. 2/13
WP No. 2177-10-00

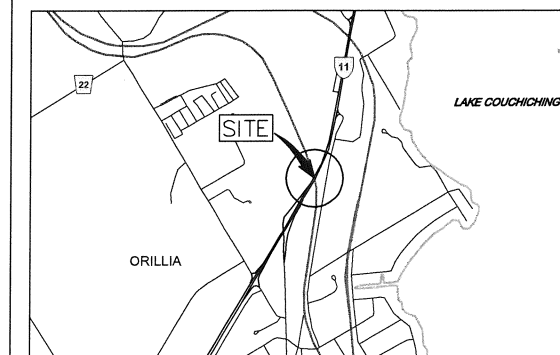


CNR OVERHEAD STRUCTURAL
REMOVAL
HIGHWAY 11 IMPROVEMENTS
BOREHOLE LOCATIONS

SHEET



Golder Associates Ltd.
LONDON, ONTARIO, CANADA



KEY PLAN

SCALE IN KILOMETRES
0 2 4

LEGEND

- Test Pit - Current Investigation
- Borehole (Geocres 31D-557)
- Borehole (Geocres 31D-250)

| No. | ELEVATION | CO-ORDINATES (MTM ZONE 10) | |
|-------------------|-----------|----------------------------|-----------|
| | | NORTHING | EASTING |
| 101 | 233.5 | 4 945 018.5 | 311 146.4 |
| 102 | 233.5 | 4 945 026.6 | 311 138.2 |
| 103 | 234.0 | 4 945 060.6 | 311 130.1 |
| 104 | 234.0 | 4 945 076.5 | 311 125.5 |
| 105 | 234.0 | 4 945 067.9 | 311 135.8 |
| 106 | 234.0 | 4 945 045.0 | 311 141.3 |
| (Geocres 31D-557) | | | |
| CNR-101 | 233.9 | 4 945 025.0 | 311 151.6 |
| CNR-102 | 233.9 | 4 945 075.9 | 311 124.6 |
| (Geocres 31D-250) | | | |
| 1 | 234.1 | 4 945 027.7 | 311 147.3 |

NOTES

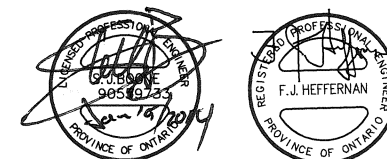
This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

Elevations have been interpolated from existing contour data.

REFERENCE

Base plans provided in digital format by Facca.

| NO. | DATE | BY | REVISION |
|-------------|---------|-------------|------------------|
| | | | |
| Geocres No. | | | |
| HWY. | 11 | PROJECT NO. | 13-1132-0078 |
| SUBM'D. | BT | CHKD. | DATE: Oct. 21/13 |
| DRAWN: | LMK\WDF | CHKD. | APPD. |
| SITE: | | 30-079 | |
| DWG. | | 1 | |



PLAN

SCALE
0 10 m



APPENDIX A

Record of Test Pits, Current Investigation

APPENDIX A - TABLE I

RECORDS OF TEST PITS

CNR Overhead Structural Removal (Site No. 30-079)
 Highway 11, Orillia, Ontario
GWP 2177-10-00

| <u>TEST PIT</u> | <u>GROUND SURFACE ELEVATION (m)</u> | <u>DEPTH (m)</u> | <u>STRATIGRAPHY</u> | <u>REMARKS</u> |
|-----------------|---|--|--|--|
| 101 | 233.5 | 0.00 to 0.15 0.15 to 1.05 1.05 to 1.50 | Brown and black sand and gravel, some silt trace topsoil (FILL) Grey to brown fine to medium sand, trace silt (FILL) Brown and grey SANDY SILT , some gravel, trace clay with cobbles (TILL) | Minor seepage at 0.85 metres depth. Practical refusal at 1.50 metres. |
| 102 | 233.5 | 0.00 to 0.20 0.20 to 0.45 0.45 to 1.50 | Brown sandy TOPSOIL with rootlets Brown and grey silty sand, with rootlets (FILL) Brown and grey SANDY SILT , some gravel, trace clay with cobbles (TILL) | Minor seepage at 0.35 metres depth. Practical refusal at 1.50 metres. |
| 103 | 234.0 | 0.00 to 1.30 1.30 to 2.10 | Grey silty sand, trace clay with rootlets and organics (FILL) Brown and grey SANDY SILT , some gravel, trace clay with cobbles (TILL) | Test pit remained dry. Practical refusal at 2.10 metres. |
| 104 | 234.0 | 0.00 to 0.50 0.50 to 1.30 1.30 to 2.00 | Brown sandy TOPSOIL , trace gravel Black fibrous PEAT Grey SANDY SILT , some gravel, trace clay with cobbles (TILL) | Test pit remained dry. Practical refusal at 2.00 metres. |

RECORDS OF TEST PITS

| TEST PIT | GROUND SURFACE ELEVATION (m) | DEPTH (m) | STRATIGRAPHY | REMARKS |
|----------|---------------------------------------|--|---|---|
| 105 | 234.0 | 0.00 to 0.25 0.25 to 0.40 0.40 to 0.95 0.95 to 1.60 1.60 to 2.30 | Brown sandy TOPSOIL with rootlets Black fine to medium sand, trace gravel (FILL) Brown fine to medium sand some silt (FILL) Grey SILTY SAND trace clay, slight odour Grey SANDY SILT , some gravel, trace clay with cobbles (TILL) | Major seepage at 0.60 metres depth. Practical refusal at 2.30 metres. |
| 106 | 234.0 | 0.00 to 0.35 0.35 to 0.75 0.75 to 2.20 | Brown and black sand and gravel (FILL) Brown fine to medium sand, some silt (FILL) Brown and grey SANDY SILT , some gravel, trace clay with cobbles (TILL) | Major seepage at 0.55 metres depth. Practical refusal at 2.20 metres. |

NOTES: 1. Test pits excavated September 17, 2013.
 2. For test pit locations, see Drawing 1.
 3. Table to be read in conjunction with accompanying report.

Prepared By: BT
 Checked By: SJB



APPENDIX B

**Record of Boreholes and Laboratory Test Data
(MTO Investigation, 2013, Geocres No. 31D-557)**

RECORD OF BOREHOLE No CNR-101

1 of 1

METRIC

G.W.P. 2177-10-00 **LOCATION** Coords: 4 945 025.0 N; 311 151.6 E **ORIGINATED BY** F.P.
DIST Central **HWY** 11 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** B.R.
DATUM Geodetic **DATE** January 10, 2013 **CHECKED BY** B.R.G.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | | | |
|---------------|--|------------|---------|------|------------|----------------------------|--|--|--|--|--|------------------------------------|-------------------------------------|-----------------------------------|--|--|-------------------|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | SHEAR STRENGTH kPa | | | | | | | | | | WATER CONTENT (%) | | |
| | | | | | | | 20 40 60 80 100 | | | | | | | | | | 20 40 60 | | |
| | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE | | | | | | | | | | | | |
| 233.9 | Ground Surface | | | | | | | | | | | | | | | | | | |
| 0.0 | Gravelly sand, trace clay | | 1 | SS | 17 | | | | | | | ○ | | | | | | | |
| 233.2 | Compact Black Moist | | | | | | | | | | | | | | | | | | |
| 0.7 | (FILL) | | | | | | | | | | | | | | | | | | |
| | Clayey silt and sand trace to some gravel wet seams | | 2 | SS | 30 | | | | | | | ○ | | | | 21 42 25 12 | | | |
| | Hard Brown Moist to grey | | 3 | SS | 87 | | | | | | | ○ | | | | | | | |
| | (TILL) | | | | | | | | | | | | | | | | | | |
| | wet seams at 2.0 m depth | | 4 | SS | 55 | | | | | | | ○H | | | | 12 43 29 16 | | | |
| | cobbles and boulders at 3.0 m depth | | 5 | SS | 49 | | | | | | | ○ | | | | | | | |
| | | | 6 | SS | 69 | | | | | | | ○ | | | | | | | |
| | cobbles and boulders at 4.4 m depth | | 7 | SS | 35 | | | | | | | ○ | | | | | | | |
| | | | 8 | SS | 107 | | | | | | | ○ | | | | 10 37 35 16 | | | |
| | | | 9 | SS | 118 | | | | | | | ○ | | | | | | | |
| 226.6 | Sand, with gravel some silt, trace clay | | | | | | | | | | | | | | | | | | |
| 7.3 | Very dense Grey Moist to wet | | 10 | SS | 113 | | | | | | | ○ | | | | 21 60 15 4 | | | |
| | wet seams at 8.8 m depth | | | | | | | | | | | | | | | | | | |
| 224.3 | | | 11 | SS | 106 | | | | | | | ○ | | | | | | | |
| 9.6 | End of borehole | | | | | | | | | | | | | | | | | | |
| | * 2013 01 10 ▽ Water level observed during drilling ▼ Water level measured after drilling Borehole open upon completion of drilling. | | | | | | | | | | | | | | | | | | |

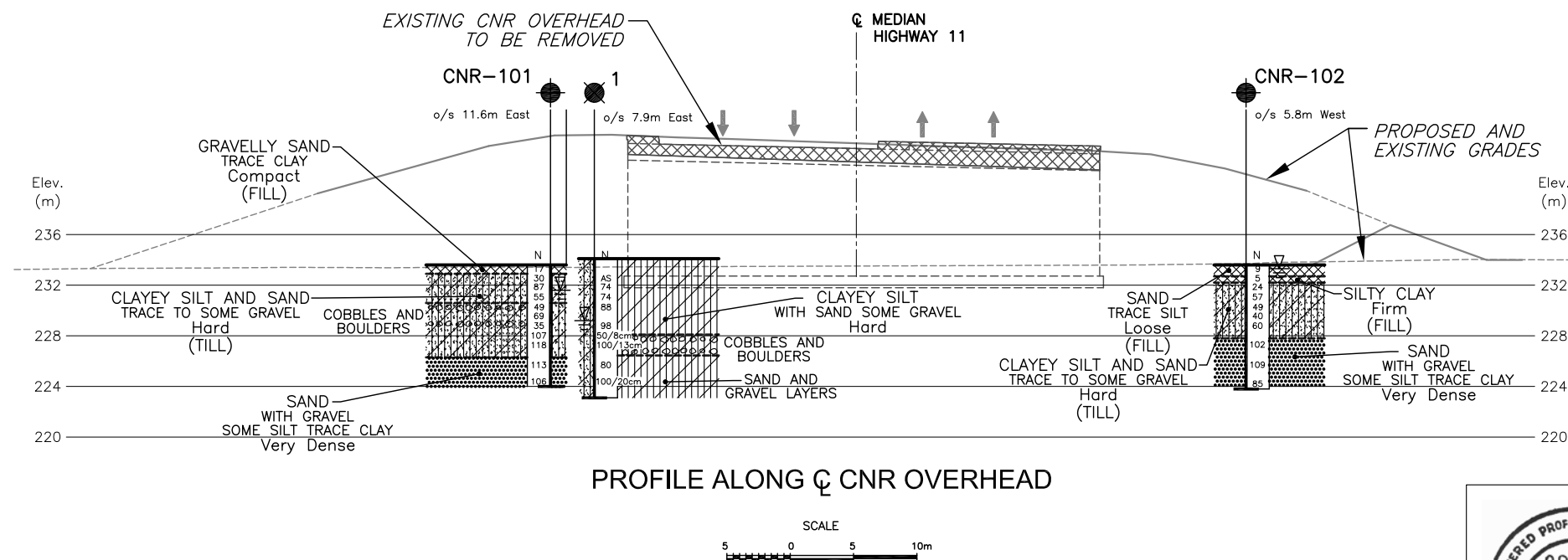
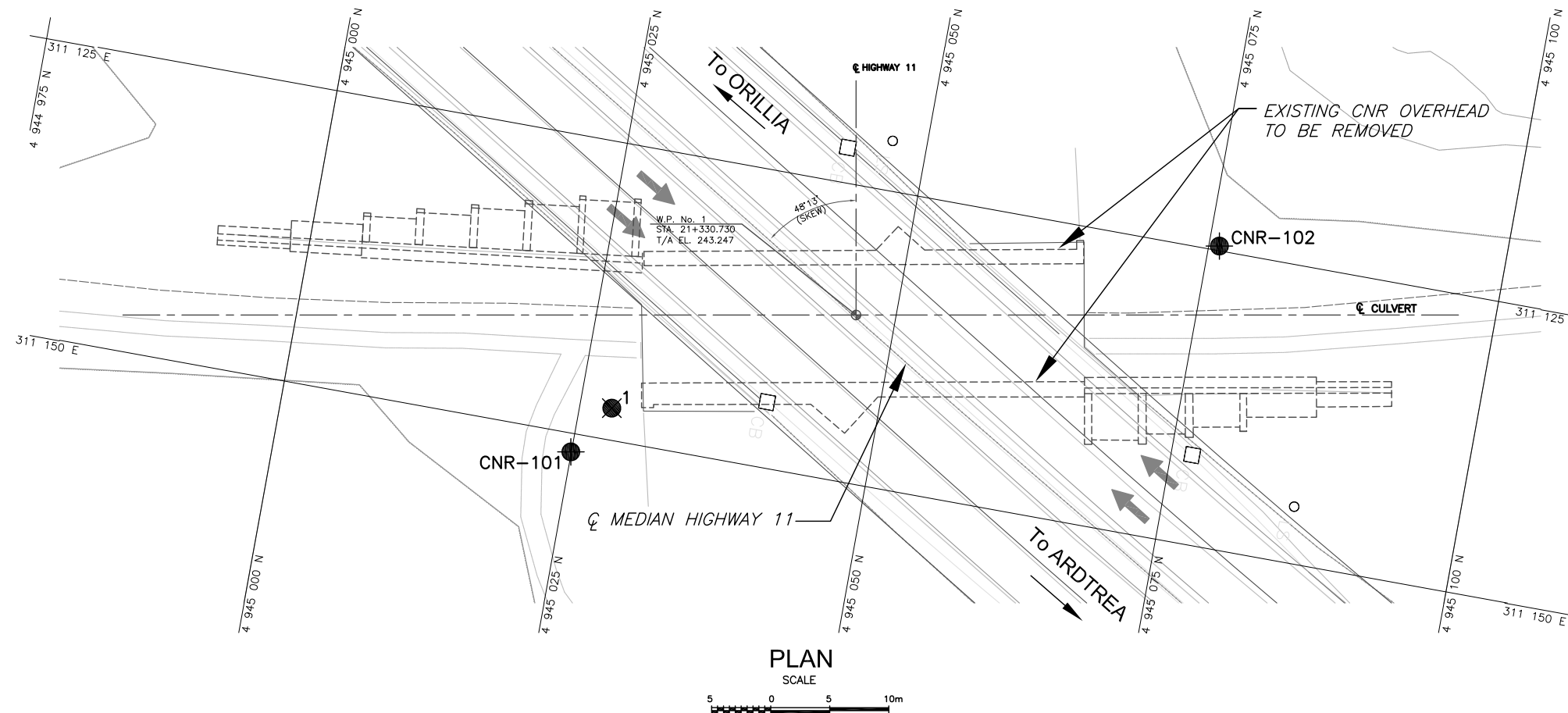
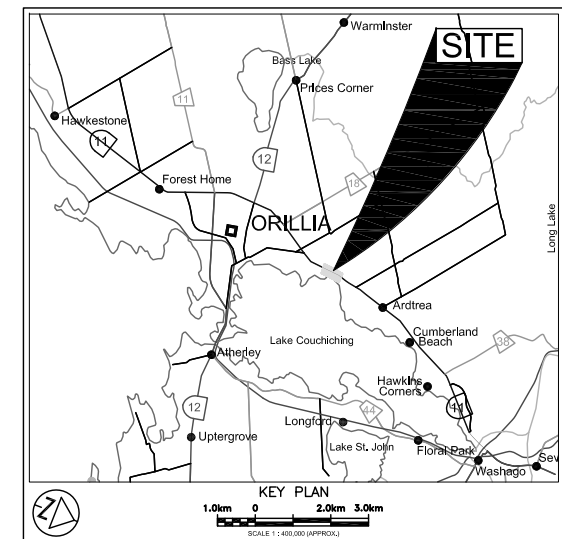
RECORD OF BOREHOLE No CNR-102









1 of 1

METRIC

G.W.P. 2177-10-00 **LOCATION** Coords: 4 945 075.9 N; 311 124.6 E **ORIGINATED BY** F.P.
DIST Central **HWY** 11 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** B.R.
DATUM Geodetic **DATE** January 10, 2013 **CHECKED BY** B.R.G.

| 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/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | | | |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----|----|-----|--|------------------------------------|-------------------------------------|-----------------------------------|--------------------------------------|--|-------------------|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | | WATER CONTENT (%) | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE | | | | | | | | | | ○ | | |
| | | | | | | | | ● QUICK TRIAXIAL × LAB VANE | | | | | | | | | | | | |
| 233.9 | Ground Surface | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | | | | |
| 0.0 | Sand, trace silt | | 1 | SS | 9 | ▽* ▼* | | | | | | | ○ | | | | | | | |
| | Loose Black Wet (FILL) | | | | | | | | | | | | | | | | | | | |
| | Silty clay, organics | | 2 | SS | 5 | | 233 | | | | | | ○ | | | | | | | |
| 232.5 | Firm Dark Moist grey | | | | | | | | | | | | | | | | | | | |
| 1.4 | Clayey silt and sand trace to some gravel | | 3 | SS | 24 | | 232 | | | | | | ○ | | | | | | | |
| | Very stiff Grey Moist to hard | | | | | | | | | | | | | | | | | | | |
| | (TILL) | | 4 | SS | 57 | | 231 | | | | | | ○H | | | 12 44 28 16 | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | 5 | SS | 49 | | 230 | | | | | | ○ | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | 6 | SS | 40 | | 229 | | | | | | ○ | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | 7 | SS | 60 | | 228 | | | | | | ○ | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| 228.1 | Sand, with gravel some silt, trace clay | | 8 | SS | 102 | | 227 | | | | | | ○ | | | 28 55 13 4 | | | | |
| 5.8 | Very dense Grey Wet | | | | | | | | | | | | | | | | | | | |
| | | | | | | | 226 | | | | | | ○ | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | 225 | | | | | | | | | | | | | |
| | | | 10 | SS | 85 | | | | | | | | ○ | | | | | | | |
| 224.1 | End of borehole | | | | | | | | | | | | | | | | | | | |
| 9.8 | | | | | | | | | | | | | | | | | | | | |
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| LEGEND | | | |
|---|--|-------------|-----------|
|  | Borehole | | |
|  | Previous Borehole from Geocres Report | | |
|  | Auger Probe | | |
| N | Blows/0.3m (Std. Pen Test, 475 J/blow) | | |
| CONE | Blows/0.3m (60 Cone, 475 J/blow) | | |
|  | WL at time of investigation Sept. 1977 and Jan. 2013 | | |
| * | Water level not established | | |
|  | Head | | |
|  | ARTESIAN WATER | | |
|  | Encountered | | |
|  | PIEZOMETER | | |
| BH No | ELEVATION | NORTHINGS | EASTINGS |
| CNR-101 | 233.9 | 4 945 025.0 | 311 151.6 |
| CNR-102 | 233.9 | 4 945 075.9 | 311 124.6 |
| GEOCRES REPORT BOREHOLES | | | |
| 1 | 234.1 | 4 945 027.7 | 311 147.3 |

- NOTES:
- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
 - THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
 - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.



REF AECOM Drawings:
60282808-ST-CULVERT_30-079_GA_Precast-Alt3&4.dwg dated Jan. 2013
and B-189-11-120932.dwg

— NOTE —
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

| DATE | BY | DESCRIPTION |
|------|----|-------------|
| | | |
| | | |
| | | |
| | | |

| | | | |
|---------------------|-------------|-------------------|-----------------|
| Geocres No. 31D-557 | | | |
| HWY No 11 | CHECKED BR | DATE MAY 01, 2013 | DIST North Bay |
| SUBM'D NA | CHECKED BRG | APPROVED CN | SITE 30-079/1/2 |
| DRAWN NA | CHECKED BRG | APPROVED CN | DWG CNR-1 |

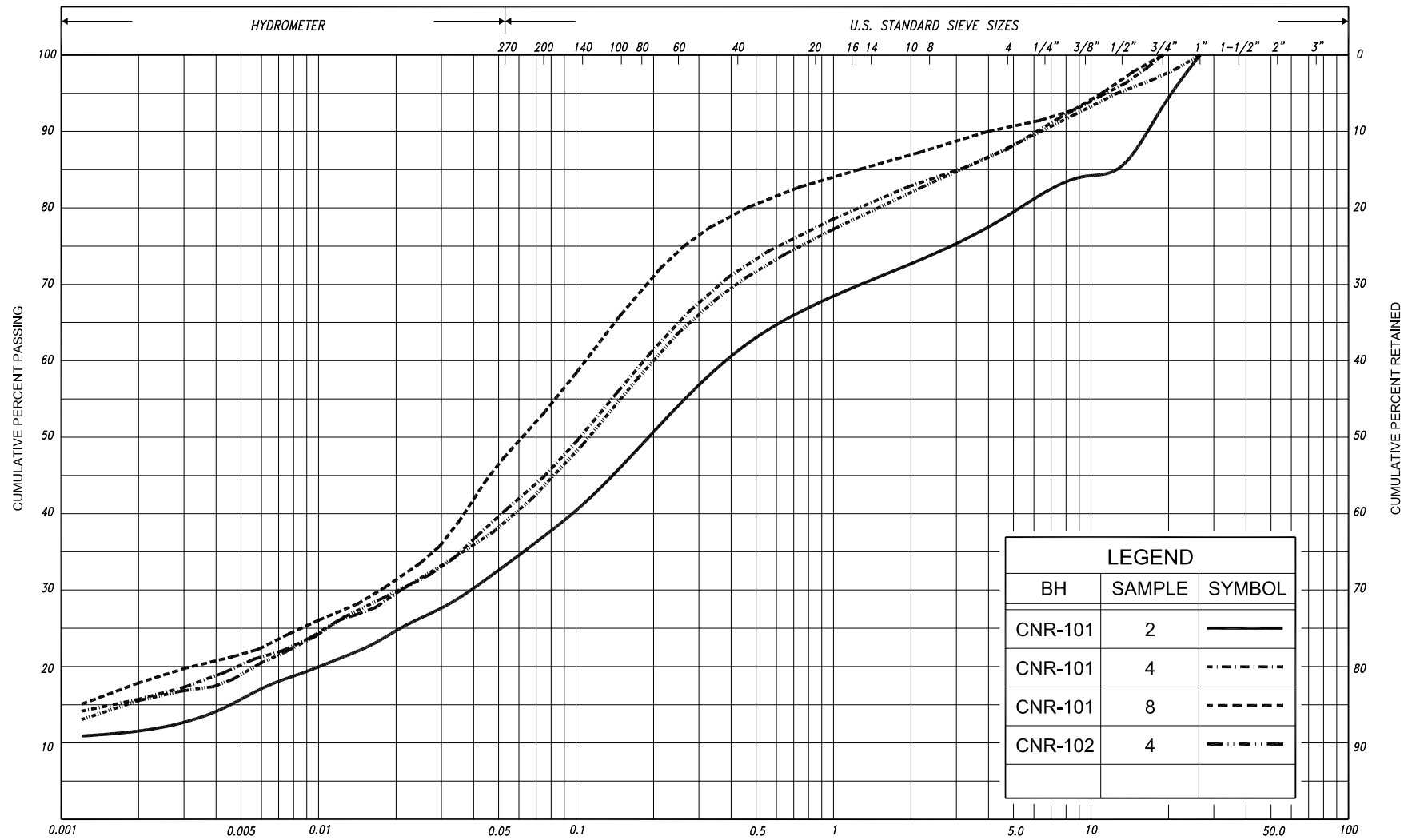
RECORD OF BOREHOLE No 1

W P 162-75-03 LOCATION Co-ords N 16 223 118; E 1 020 795 ORIGINATED BY JM
 DIST 5 HWY 11 BOREHOLE TYPE Continuous Flight Auger COMPILED BY JM
 DATUM Geodetic DATE September 22, 23, 1977 CHECKED BY _____

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|---|------------|---------|------|-----------------------|----------------------------|--------------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | N ^o VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 768.0 | Ground Level | | | | | | | | | | | | | | | | GR SA SI CL |
| 0.0 | | | 1 | AS | | | | | | | | | | | | | 5 45 38 12 |
| | Clayey Silt with Sand Some Gravel | | 2 | SS | 74 | | 760 | | | | | | | | | | 17 39 30 14 |
| | | | 3 | SS | 74 | | | | | | | | | | | | |
| | | | 4 | SS | 88 | | | | | | | | | | | | |
| | | | 5 | SS | 98 | | 750 | | | | | | | | | | 8 59 24 9 |
| | Occasional Boulders | | 6 | SS | 107 | 3" | | | | | | | | | | | 32 50 (18) |
| | | | 7 | SS | 100 | 5" | 740 | | | | | | | | | | |
| | Sand and Gravel Layers | | 8 | SS | 80 | | | | | | | | | | | | |
| 731.8 | Hard | | 9 | SS | 100 | 8" | 730 | | | | | | | | | | 24 60 (16) |
| 36.2 | End of Borehole | | | | | | | | | | | | | | | | |

+³, x⁵: Numbers refer to
Sensitivity

20
15 \diamond 5 (%) STRAIN AT FAILURE
10

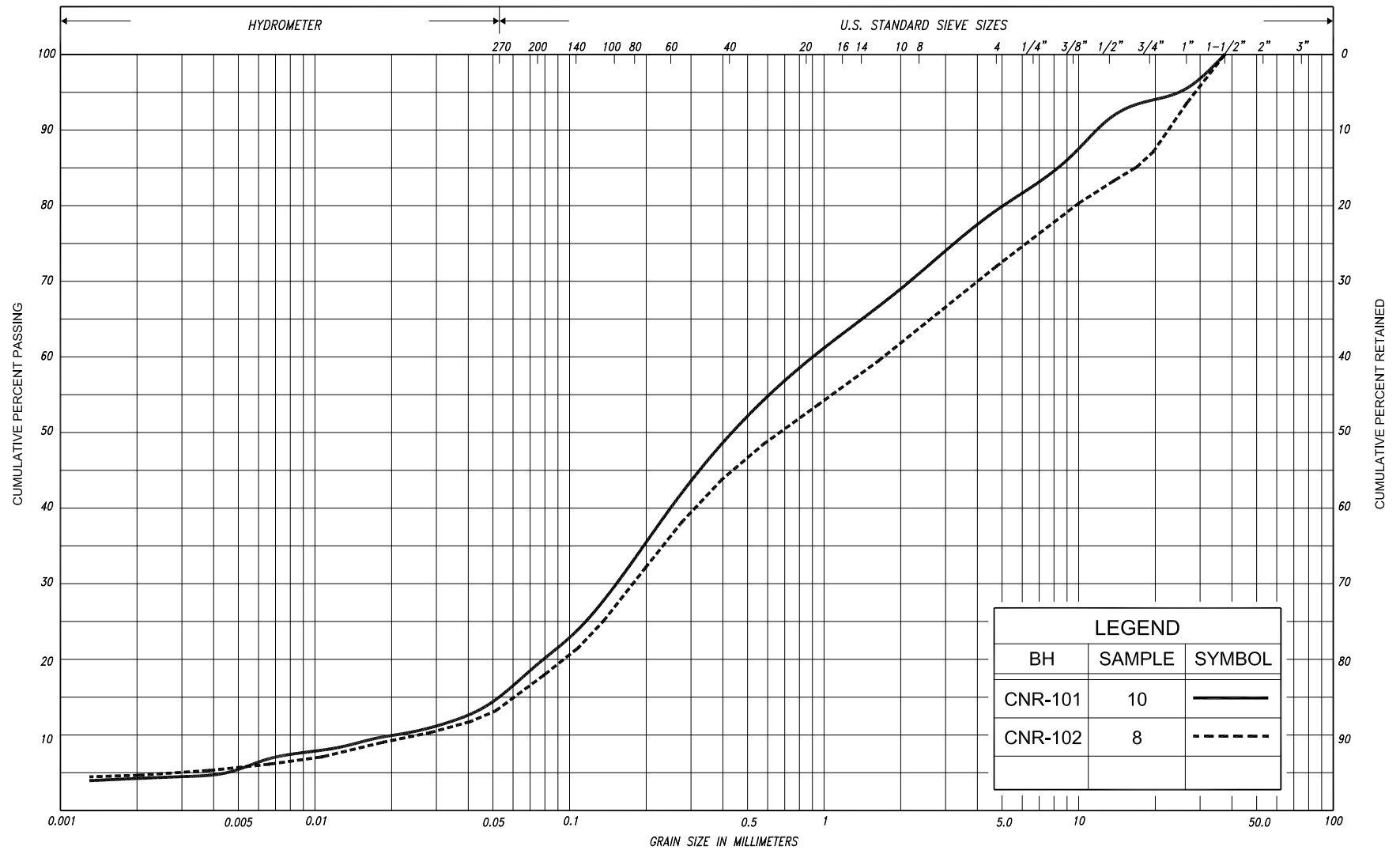


| | | | | | | | | | | |
|-------------|------|--------|--------|-----------|--------|--------|-------------|---------|-------------|---------|
| SILT & CLAY | | | | FINE SAND | | | COARSE SAND | GRAVEL | COBBLES | UNIFIED |
| CLAY | FINE | MEDIUM | COARSE | FINE | MEDIUM | COARSE | GRAVEL | COBBLES | M.I.T. | |
| CLAY | SILT | | | V. FINE | FINE | MED. | COARSE | GRAVEL | U.S. BUREAU | |

GRAIN SIZE DISTRIBUTION CLAYEY SILT and SAND, some gravel (TILL)

FIG No. CNR-GS-1
HWY: 11
G.W.P. No. 2177-10-00



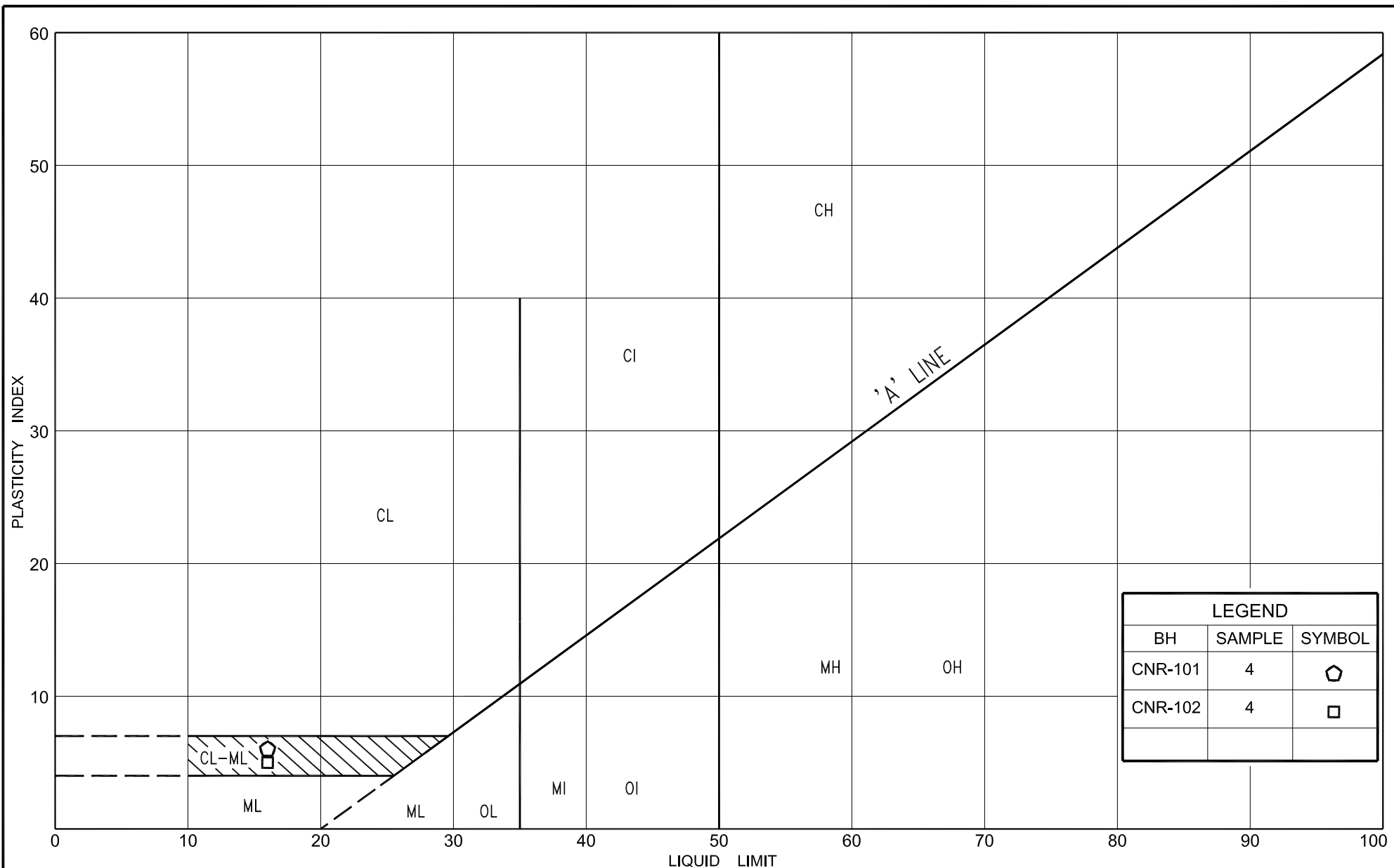


| | | | | | | | | | | | | | | | |
|-------------|------|------|--------|------|---------|--------|------|--------|--|--------|--|--|--------|---------|-------------|
| SILT & CLAY | | | | FINE | | MEDIUM | | COARSE | | GRAVEL | | | | COBBLES | UNIFIED |
| CLAY | FINE | | MEDIUM | | COARSE | | SAND | | | | | | GRAVEL | COBBLES | M.I.T. |
| | | | | | | | | | | | | | | | |
| CLAY | | SILT | | | V. FINE | FINE | MED. | COARSE | | GRAVEL | | | | | U.S. BUREAU |
| | | | | | SAND | | | | | | | | | | |



GRAIN SIZE DISTRIBUTION
SAND with gravel, some silt, trace clay

FIG No. CNR-GS-2
HWY: 11
G.W.P. No. 2177-10-00



PLASTICITY CHART
CLAYEY SILT and SAND, some gravel
(TILL)

FIG No. CNR-PC-1

HWY: 11

W.P. No. 2177-10-00

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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