FINAL REPORT

FOUNDATION INVESTIGATION REPORT

Wabigoon River Tributary Culvert Replacement, Highway 601, Site No. 41S-253/C, Township of Van Horne, District of Kenora

Agreement No. 6014-E-0017
Assignment No. 8
GWP 6376-14-00
Geocres No. 52F-044

Prepared for:

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exp Services Inc.
December 21, 2015

Ministry of Transportation

Foundation Investigation Report
Agreement No. 6014-E-0017
Assignment No. 8
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Foundation Investigation Report for Wabigoon River Tributary Culvert Replacement
Highway 601, Site No. 41S-253/C, Township of Van Horne, District of Kenora

Project Number:
ADM-00223648-G0

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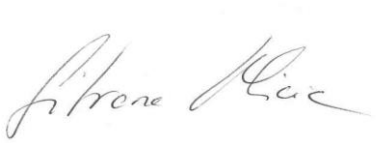

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December 21, 2015

Table of Contents

Appendices

Part I: FOUNDATION INVESTIGATION REPORT

1.1 Introduction

This foundation investigation report presents the results of a geotechnical investigation completed by **exp** Services Inc. for the replacement of two (2) structural culverts on Hwy 601, located at the Wabigoon River Tributary Crossing in the Township of Van Horne, the Ministry of Transportation (MTO) Northeastern Region. The work was undertaken under Agreement # 6014-E-0017, Assignment No. 8 (GWP 6376-14-00) The terms of reference (TOR) were as presented in the MTO letter dated August 20, 2015.

The purpose of the investigation is to evaluate the subsurface condition along the proposed culvert replacement alignment, to permit preliminary design for the culvert replacement. The site specific geotechnical investigation consisted of borings, soil sampling, borehole logging, and field and laboratory testing.

This foundation investigation report has been prepared specifically and solely for the project described herein. It contains the factual results of the investigation and the laboratory testing completed for this project.

1.2 Site Description and Geological Setting

1.2.1 Site Description

The culvert replacement site is located on Hwy. 601 in the Township of Van Horne, at the Wabigoon River Crossing (approx. Station 10+050), 0.8 km north of Hwy 17. The location of the culverts and a cross section of the existing culvert alignments are shown on Dwg. Nos. 1 and 2 in Appendix B.

The existing culverts consist of two (2) corrugated steel pipe (CSP) culverts, approximately 2.44 m in diameter and 28.0 m long. At this site, Hwy. 601 is a surface treated two lane, north/south roadway having approximately 1.0 m wide granular shoulders and cable guide rails on both sides of the roadway. The highway embankment at the investigated location is approximately 7.5 m high on the inlet side and 8.0 m high on the outlet side of the roadway, having side slopes of approximately 1.5H:1V from the top of the embankment to the toe of the embankment. Photographs of the site and existing culverts are presented in Appendix A.

The general site conditions were assessed during the drilling operations between October 21 and 26, 2015. The surrounding terrain of culvert location is generally undulating to rolling hills with a mix of low lying vegetation/shrubs, long grasses, and treed areas with both deciduous and coniferous trees. At the site location, water flows from east to west, however, the current did not appear excessive at the time of the field investigation. The embankment surrounding the culvert inlet was lined with riprap.

1.2.2 Geological Setting

The Map 2542 (Bedrock Geology of Ontario, West-Central Sheet, 1991) of the Ministry of Northern Development and Mines, indicates that the bedrock formation of the project area consists of metasedimentary rocks consisting of wacke, arkose, argillite, slate, marble, chert, iron formation, minor metavolcanic rocks. The Map 2554 (Quaternary Geology of Ontario, West-Central Sheet, 1991) of the Ministry of Northern Development and Mines, indicates that the surface conditions in the vicinity of site consist of glaciolacustrine deposits consisting of silt and clay, minor sand, basin and quiet water deposits.

1.3 Investigation Procedures

1.3.1 Site Investigation and Field Testing

The field investigation was performed between October 21, 2015 and October 26, 2015. The field program consisted of drilling four (4) sampled boreholes (BH-W1, BH-W2, BH-W3, and BH-W4). The boreholes were strategically located along the existing culvert alignment to provide subsurface information for the design of the proposed new culvert. Boreholes BH-W2 and BH-W4 were advanced within the travelled southbound lane, as close as possible to west embankment. Boreholes could not be advanced through the northbound lane due to the presence of a natural gas forcemain. Boreholes BH-W3 and BH-W1 were advanced at accessible locations near the inlet and outlet of the culverts, respectively. The borehole locations are shown on Dwg. No. 1 in Appendix B.

All of the boreholes were advanced using a track mounted CME-850 drill rig, equipped with hollow stem augers and standard soil sampling equipment operated by a specialist drilling contractor, Cartwright Drilling Inc. Each borehole was terminated approximately 10 m below the base of the existing culverts. Boulders and cobbles were encountered within the fill materials at borehole BH-W2. These materials could not be penetrated with the augers, as such, coring procedures with NW casing were used to penetrate the boulders and cobbles.

The borehole locations (referenced to the MTM NAD83 coordinate system) and their ground surface elevations were surveyed by **exp** personnel. The benchmark utilized is based on information provided on Site Plan drawings provided by the MTO. The benchmark location is shown on Dwg. No. 1 in Appendix B. Borehole locations were determined using a hand-held GPS.

For the drilling program, soil samples were obtained using a 51 mm outside diameter (O.D.) split-spoon sampler in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586) at intervals ranging from 0.75 m to 1.5 m in depth as shown on the attached borehole logs (Appendix C). The original field (uncorrected) SPT “N” values were recorded on the borehole logs as recommended in the Canadian Foundation Engineering Manual (CFEM, pg. 40) and used to provide an assessment of in-situ consistency or relative density of non-cohesive soils.

Upon completion of the boreholes, ground water level measurements were carried out within the in accordance with the Ministry of Transportation guidelines. The measured ground water levels after completion of drilling boreholes were recorded on the borehole log sheets in Appendix C. The boreholes were decommissioned by bentonite/cement mixtures in accordance with the Ministry of

the Environment Regulation 903, as amended by Regulation 128/03 (the well regulation under the *Ontario Water Resources Act)*.

The fieldwork was supervised by members of **exp**'s engineering staff who directed the drilling and sampling operation, logged borehole data in accordance with MTO and/or ASTM Standards for Soils Classification, and retrieved soil samples for subsequent laboratory testing and identification.

All of the recovered soil samples placed in labelled moisture-proof bags returned to **exp**'s Sudbury laboratory for additional visual, textual, olfactory examination and selective testing.

1.3.2 Laboratory Testing

All samples returned to the laboratory were subjected to visual examination and classification. The laboratory testing program included the determination of natural moisture content and particle size distribution for approximately 25% of the collected soil samples. Atterberg limits test were carried out for cohesive soils. All of the laboratory tests were carried out in accordance with MTO and/or ASTM Standards as appropriate.

The laboratory test results are provided on the attached borehole log sheets in Appendix C. The results of the grain size analyses and plasticity chart are presented graphically in Appendix D.

In addition, soil chemical testing was completed on one (1) as required by the TOR. The chemical testing included pH, water soluble sulphate, chloride, resistivity, sulphide, electrical conductivity analyses and redox potential. The results of the soil chemical testing are included in Appendix E.

1.4 Subsurface Conditions

The detailed subsurface conditions encountered in the boreholes advanced during this investigation are presented on the borehole log sheets in Appendix C. Laboratory test results are provided in Appendix D. The "Explanation of Terms Used in Report" preceding the borehole logs in Appendix C forms an integral part of and should be read in conjunction with this report.

A borehole location plan and stratigraphic section are provided in Appendix B. It should be noted that the stratigraphic boundaries indicated on the borehole log and stratigraphic section are inferred from semi-continuous sampling, observations of drilling progress and results of Standard Penetration Tests. These boundaries typically represent transitions from one soil type to another and should not be interpreted as exact planes of geological change. Furthermore, subsurface conditions may vary between and beyond the borehole locations.

In general, the subsurface conditions within the roadway embankment consist of granular fill overlying fine grained fill materials (silty clay, clay and silt/silty and clay). Below the fill materials, the native soils consist of a layer of clayey silt and silt and clay overlying silt and sandy silt. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections. A cross-section soil profile is included on Dwg. No. 2 in Appendix B.

1.4.1 Surface Treated Asphalt

Surface treated asphalt was encountered at the surface of boreholes BH-W2 and BH-W4 and was approximately 25 mm thick. Asphalt thicknesses may further vary beyond the borehole locations.

1.4.2 Topsoil

Topsoil was encountered at the surface of boreholes BH-W1 and BH-W3 and ranged in thickness from approximately 100 to 150 mm. Topsoil thicknesses may further vary beyond the borehole locations.

1.4.3 Fill – Sand and Gravel

Sand and Gravel fill was encountered below the asphalt at BH-W2. The layer was 5.8 m thick and extended from Elev. 366.0 to 360.2 m. The sand and gravel fill contained trace to some silt and was with cobbles and boulders (up to 300 mm diameter) below 0.7 m depth. The fill was brown in colour and damp, becoming wet with depth. Uncorrected SPT "N" values within the fill ranged from 4 to 58 blows per 300 mm, classifying the fill as very loose to very dense in compactness condition.

Laboratory testing performed on selected samples consisted of moisture content and grain size distribution tests. The test results are as follows:

Moisture Content:

- 2.5% to 10.5%

Grain Size Distribution:

- 39% gravel;
- 55% sand; and
- 6% silt.

The results of the moisture content and grain size distribution tests are provided on the borehole logs in Appendix C. The results of the grain size distribution tests are also provided on Figure 1 in Appendix D.

1.4.4 Fill – Gravelly Sand

Gravelly sand fill was encountered below the asphalt at BH-W4. The layer was 4.4 m thick and extended from Elev. 365.7 to 361.3 m. The gravelly sand fill contained some cobbles, and trace to some silt. The fill was brown in colour and damp. Uncorrected SPT "N" values within the fill ranged from 19 to 70 blows per 300 mm, classifying the fill as compact to very dense in compactness condition.

Laboratory testing performed on selected samples consisted of moisture content and grain size distribution tests. The test results are as follows:

Moisture Content:

- 2.0% to 5.8%

Grain Size Distribution:

- 32% gravel;
- 61% sand; and
- 7% silt.

The results of the moisture content and grain size distribution tests are provided on the borehole logs Appendix C. The results of the grain size distribution tests are also provided on Figure 1 in Appendix D.

1.4.5 Fill – Silty Clay

A thin silty clay layer was encountered below the gravelly sand fill at BH-W4. The layer is approximately 600 mm thick and extended from Elev. 361.3 to 360.7 m. The silty clay fill was brown in colour and moist. One SPT was performed within this material with a resulting uncorrected "N" value of 8 blows per 300 mm, classifying the fill as firm in consistency.

Laboratory testing performed on the sample consisted of a moisture content test. The test results are as follows:

Moisture Content:

- 17.6%

The results of the moisture content test are provided on the borehole logs in Appendix C.

1.4.6 Fill – Sand

A thin sand fill layer was encountered below the silty clay fill at BH-W4. The layer was approximately 800 mm thick and extended from Elev. 360.7 to 359.9 m. The sand fill contained trace to some gravel, trace silt, and was brown in colour and moist. One SPT was performed within this material with a resulting uncorrected "N" value of 29 blows per 300 mm, classifying the fill as compact in compactness condition.

Laboratory testing performed on the sample consisted of a moisture content test. The test results are as follows:

Moisture Content:

- 17.9%

The results of the moisture content test are provided on the borehole logs in Appendix C.

1.4.7 Fill – Silt and Clay/Clay and Silt

Silt and Clay/Clay and Silt fill was encountered below the sand and gravel fill at BH-W2 and below the sand fill at BH-W4. The layer ranged in thickness from 800 mm (BH-W4) to 1.5 m (BH-W2) and extended from Elev. 359.9 to 359.1 m (BH-W4) and Elev. 360.2 to 358.7 m (BH-W2). The fill

contained trace to some sand, trace gravel and some wood pieces. The fill was brown and grey in colour, moist to wet, and had moderate plasticity (BH-W4). Uncorrected SPT "N" values within the fill ranged from 11 to 17 blows per 300 mm, classifying the fill as firm to stiff in consistency.

Laboratory testing performed on selected samples consisted of moisture content, grain size distribution, and Atterberg Limits tests. The test results are as follows:

Moisture Content:

- 21.1% to 30.5%

Grain Size Distribution:

- 1% gravel;
- 11% sand;
- 36% silt; and
- 52% clay.

Atterberg Limits:

- Liquid Limit: 42.2%
- Plastic Limit: 17.9%
- Plasticity Index: 24.3%

The results of the tests are provided on the borehole logs Appendix C. The results of the grain size distribution tests are also provided on Figure 2 and Atterberg Limits test on Figure 5 in Appendix D.

1.4.8 Organic Clay

A thin organic clay layer was encountered below the topsoil at BH-W3. The layer was approximately 1.4 m thick and extended from Elev. 359.6 to 358.2 m. The organic clay contained some silt and some sand, and was dark brown in colour and moist. Uncorrected SPT "N" values within the soil ranged from 6 to 7 blows per 300 mm, classifying the soil as firm in consistency.

Laboratory testing performed on the samples consisted of moisture content tests. The test results are as follows:

Moisture Content:

- 29.3% to 32.1%

The results of the moisture content tests are provided on the borehole logs in Appendix C.

1.4.9 Clayey Silt to Silt and Clay

Clayey silt to silt and clay was encountered below the upper silt layer at BH-W1, below the organic clay at BH-W3 and below the fill materials at BH-W2 and BH-W4. The clayey silt to silt and clay layer ranged in thickness from 2.3 to 3.8 m and extended from Elev. 359.1 to 355.1 m. The clayey

silt to silt and clay contained trace sand and trace to some organics and wood pieces (BH-W2) and was generally grey in colour, moist to wet, and had slight plasticity (BH-W1 to BH-W3). Uncorrected SPT "N" values within the soil ranged from 1 to 19 blows per 300 mm, classifying the soil as very soft to very stiff in consistency.

Laboratory testing performed on selected samples consisted of moisture content, grain size distribution, and Atterberg Limits tests. The test results are as follows:

Moisture Content:

- 23.5% to 64.5%

Grain Size Distribution:

- 0% gravel;
- 1 to 3% sand;
- 58 to 75% silt; and
- 22 to 41% clay.

Atterberg Limits:

- Liquid Limit: 25.1 to 32.1%
- Plastic Limit: 18.4 to 19.8%
- Plasticity Index: 5.3 to 12.6%

The results of the tests are provided on the borehole logs Appendix C. The results of the grain size distribution tests are also provided on Figure 3 and Atterberg Limits test on Figure 5 in Appendix D.

1.4.10 Silt

A thin upper layer of silt was encountered below the topsoil at BH-W1, as well at depth in each of the boreholes.

The thin upper silt layer was 600 mm thick and extended from Elev. 358.4 to 357.8 m. The upper silt layer contained some sand, some clay, trace organics and was dark brown in colour and moist to wet. One SPT was performed within this layer with a resulting uncorrected "N" value of 0 blows per 300 mm, classifying the soil as very loose in compactness condition.

Laboratory testing performed on the sample consisted of a moisture content test. The test results are as follows:

Moisture Content:

- 41.6%

Silt was also encountered at depth in borehole BH-W1 as well as in the remaining boreholes. The lower silt layer was encountered below the clayey silt to silt and clay at each of the boreholes. The lower silt layer was 3.1 m thick at BH-W1 and extended from Elev. 355.6 to 352.5 m. In the

remaining boreholes, the silt extended from approximate Elev. 355.6 m to the boreholes termination depths around approximate Elev. 347.1 to 348.4 m. The lower silt layer contained trace to some sand, trace to some clay and was grey in colour and wet. Uncorrected SPT "N" values within the silt ranged from 0 to 17 blows per 300 mm, classifying the silt as very loose to compact in compactness condition.

Laboratory testing performed on selected samples consisted of moisture content and grain size distribution tests. The test results are as follows:

Moisture Content:

- 16.6% to 38.2%

Grain Size Distribution:

- 0% gravel;
- 2 to 17% sand;
- 75 to 91% silt; and
- 3 to14% clay.

The results of the moisture content and grain size distribution tests are provided on the borehole logs Appendix C. The results of the grain size distribution tests are also provided on Figure 4 in Appendix D.

1.4.11 Sandy Silt

Sandy silt was encountered below the silt at BH-W1. The layer extended from Elev. 352.5 m to the borehole termination depth at Elev. 347.3 m. The sandy silt contained trace clay and was grey in colour and wet. Uncorrected SPT "N" values within the sandy silt ranged from 0 to 7 blows per 300 mm, classifying the soil as very loose to loose in compactness condition.

Laboratory testing performed on selected samples consisted of moisture content and grain size distribution tests. The test results are as follows:

Moisture Content:

- 14.6% to 20.3%

Grain Size Distribution:

- 0% gravel;
- 31% sand; a
- 65% silt; and,
- 4% clay.

The results of the moisture content and grain size distribution tests are provided on the borehole logs Appendix C. The results of the grain size distribution tests are also provided on Figure 4 in Appendix D.

1.5 Water Conditions

Groundwater levels were measured within the borehole upon completion of the drilling program and are shown on the borehole logs in Appendix C. Groundwater was encountered within boreholes BH-W1, W3, and W4. Since the wash boring method was used for drilling of BH-W2, an accurate groundwater level at this hole was not able to be measured in the open holes at the time of drilling operations

Groundwater was encountered at the following Elevations at the time of the investigation (October, 2015):

- BH-W1, Elev. 354.6 m;
- BH-W3, Elev. 354.2 m; and,
- BH-W4, Elev. 353.8 m.

Water levels were also measured at the culvert inlet and outlet. At the culvert inlet, the water level was at Elev. 358.5 m and at the outlet, Elev. 358.4 m.

Note that water levels measured in open boreholes might not be stabilized due to short term observation.

Seasonal variations in the water table should be expected, with higher levels occurring during wetter periods of the year and lower levels during drier periods. Some perched water over clayey silt layers could exist in the embankment fill as well.

1.6 Chemical Analyses

One (1) representative soils sample was submitted to a CALA Certified Laboratory for chemical corrosivity analysis. The samples were analyzed for chloride, sulphate, pH, electrical conductivity, resistivity, redox potential, and sulphide concentrations. The results of the corrosivity testing are summarized below, with detailed results included in Appendix E.

Borehole BH-W4, Sample SS9 (Elev. 359.1 m)

Sulphide: 0.03%;

Chloride: 174 µg/g;

Sulphate: 5 µg/g;

pH: 8.00;

Electrical Conductivity: 0.407 mS/cm;

Resistivity: 2460 ohm.cm; and,

Redox Potential: 278 mV.

1.7 Closure

A subsurface investigation is a limited sampling of a site; the subsurface conditions have been established only at the test hole locations. Should conditions at the site be encountered which differ from those reported at the test locations, we require that we be notified immediately in order to assess this additional information and our recommendations, as appropriate. It may then be necessary to perform additional investigation and analysis.

Contractors bidding on or undertaking any proposed work at this site should, relative to the subsurface conditions, decide on their own investigations, if deemed necessary, as well as their own interpretations of the factual results provided herein, so they may draw their own conclusions as to how the subsurface conditions may affect them.

This Foundation Investigation and Design Report has been prepared by Ian MacMillan, P.Eng., Nimesh Tamrakar, M.Eng, EIT., and Silvana Micic, Ph.D., P.Eng. It was reviewed by TaeChul Kim, P.Eng. and by Stan E. Gonsalves, M.Eng., P.Eng., Designated MTO Foundation Contact. The field investigation was supervised by Shane Tobias.

Yours truly,

exp Services Inc.

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Encl.

Appendix A –
Site Photographs

Photo 1. Facing south-west on outlet side of existing culvert

Photo 2. Facing east on inlet side of existing culvert

Photo 3. Culvert inlet facing west

Photo 4. Embankment slope on inlet side facing north

Photo 5. Embankment slope on inlet side facing south

Photo 6. Embankment slope outlet side facing north

Photo 7. Embankment slope on outlet side facing south

Photo 8. North CSP culvert inlet

Appendix B – Drawings

Agreement No. 6014-E-0017
Assignment No. 8
GWP 6376-14-00

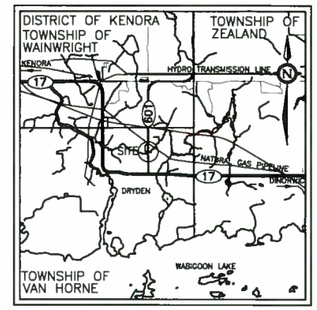
WABIGOON RIVER CULVERT

(Highway 601, Township of Van Horne)

PLAN

DWG 1

exp Services Inc.



KEY PLAN
1.0 km 0 1.0 km

LEGEND

BH–W1 358.6 — BOREHOLE LOCATION, GROUND SURFACE ELEVATION IN METRES

BH No.	APPROX. ELEV. (m)	MTM COORDINATES NORTH	MTM COORDINATES EAST
BH–W1	358.6	5,517,311	317,375
BH–W2	366.3	5,517,323	317,393
BH–W3	359.7	5,517,320	317,426
BH–W4	366.0	5,517,313	317,393

NOTES

1. ALL DIMENSIONS ARE IN METRES.
2. BASE MAP PROVIDED BY CLIENT.
3. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. THE PROPOSED STRUCTURE DETAILS/WORKS ARE SHOWN FOR ILLUSTRATION PURPOSES ONLY.

REVISIONS

DATE	BY	DESCRIPTION

GEOCRES No.52F–044 Project No.ADM–00223648–G0
Date: Dec. 17, 2015 Scale : 1:250
Drawn By: IM Checked By: IM

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PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
S.E.M. GONSALVES
21/12/15
PROVINCE OF ONTARIO

DRYDEN ← HWY 601 SURFACE TREATED

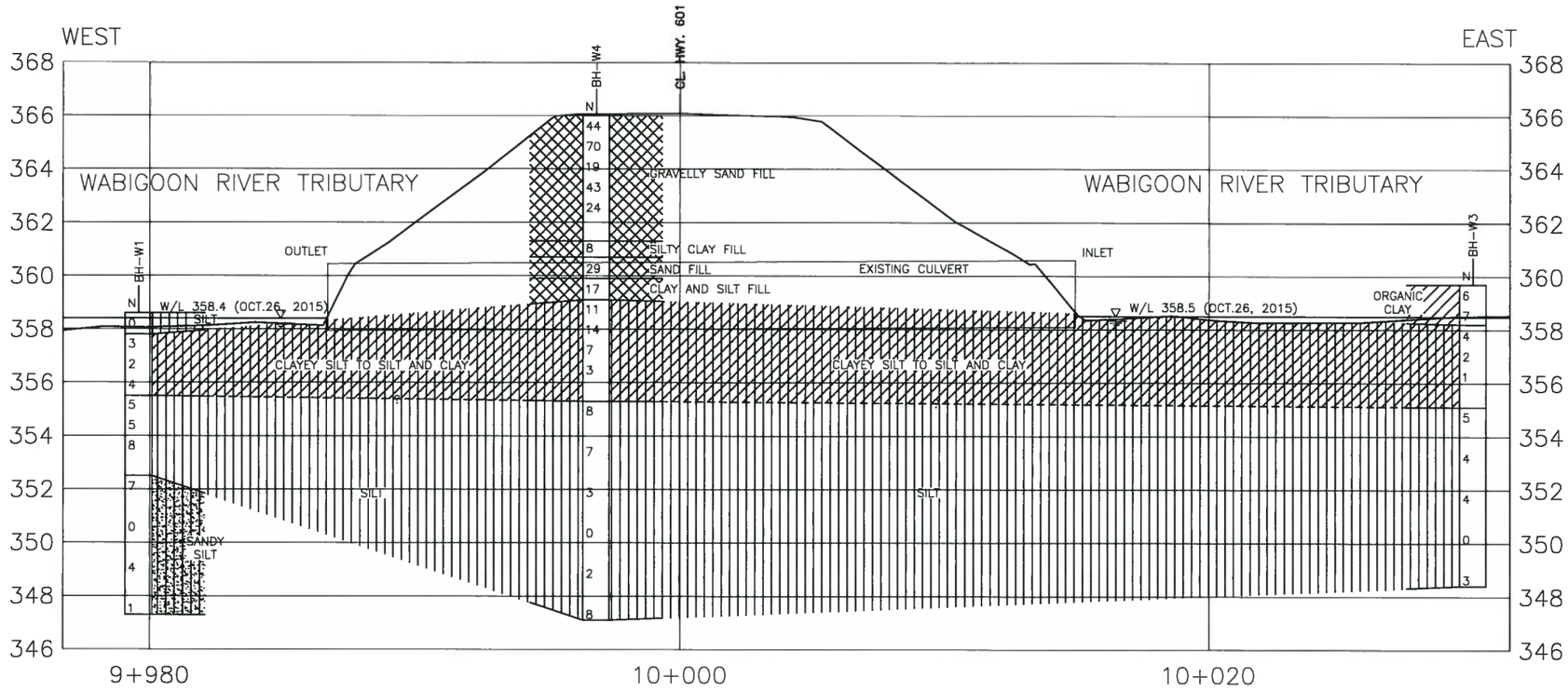
WABIGOON RIVER TRIBUTARY
W/L 358.56 JUNE 3, 2014

BH–W1 358.6
BH–W2 366.3
BH–W3 359.7
BH–W4 366.0

P&W FENCE
3CGR
EXPOSED CSP CULVERT
2500 x 28.24 CSP
2500 x 28.28 CSP
10+000 BH
10+020
10+040
10+060
10+080

BM 365.686
N 5517265.1
E 317418.9

PLAN
5 0 5



CROSS SECTION A–A

Agreement No. 6014-E-0017
Assignment No. 8
GWP 6376-14-00

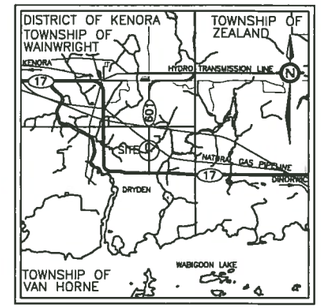
WABIGOON RIVER CULVERT

(Highway 601, Township of Van Horne)

CROSS SECTION

DWG 2

exp Services Inc.



KEY PLAN
1.0 km 0 1.0 km

LEGEND

N	STANDARD PENETRATION TEST (BLOWS/300 mm)
▽	MEASURED WATER LEVEL

BH No.	APPROX. ELEV. (m)	MTM COORDINATES NORTH	MTM COORDINATES EAST
BH-W1	358.6	5,517,311	317,375
BH-W2	366.3	5,517,323	317,393
BH-W3	359.7	5,517,320	317,426
BH-W4	366.0	5,517,313	317,393

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REVISIONS

DATE	BY	DESCRIPTION

GEOCRES No.52F-044 Project No.ADM-00223648-G0
Date: Dec. 17, 2015 Scale : 1:200
Drawn By: IM Checked By: IM

Appendix C –
Borehole Logs and Bedrock Core Photos

Explanation of Terms Used on Borehole Records

SOIL DESCRIPTION

Terminology describing common soil genesis:

Topsoil: mixture of soil and humus capable of supporting good vegetative growth.

Peat: fibrous fragments of visible and invisible decayed organic matter.

Fill: where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc.; none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

Till: the term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Terminology describing soil structure:

Desiccated: having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.

Stratified: alternating layers of varying material or color with the layers greater than 6 mm thick.

Laminated: alternating layers of varying material or color with the layers less than 6 mm thick.

Fissured: material breaks along plane of fracture.

Varved: composed of regular alternating layers of silt and clay.

Slickensided: fracture planes appear polished or glossy, sometimes striated.

Blocky: cohesive soil that can be broken down into small angular lumps which resist further breakdown.

Lensed: inclusion of small pockets of different soil, such as small lenses of sand scattered through a mass of clay; not thickness.

Seam: a thin, confined layer of soil having different particle size, texture, or color from materials above and below.

Homogeneous: same color and appearance throughout.

Well Graded: having wide range in grain sized and substantial amounts of all predominantly on grain size.

Uniformly Graded: predominantly on grain size.

All soil sample descriptions included in this report follow generally the ASTM D2487-11 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) with some modification to reflect current MTO practices. The system divides soils into three major categories: (1) coarse grained, (2) fine-grained, and (3) highly organic. The soil is then subdivided based on either gradation or plasticity characteristics. The system provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification. The classification excludes particles larger than 76 mm. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually in accordance with ASTM D2488-09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems. Others may use different classification systems; one such system is the ISSMFE Soil Classification.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	200

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present and as described below in accordance with Note 16 in ASTM D2488-09a:

Table a: Percent or Proportion of Soil, Pp

	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5≤Pp≤10%
Little	15≤Pp≤25%
Some	30≤Pp≤45%
Mostly	50≤Pp≤100%

The standard terminology to describe cohesionless soils includes the compactness as determined by the Standard Penetration Test 'N' value:

Table b: Apparent Density of Cohesionless Soil

	'N' Value (blows/0.3 m)
Very Loose	N<5
Loose	5≤N<10
Compact	10≤N<30
Dense	30≤N<50
Very Dense	50≤N

The standard terminology to describe cohesive soils includes consistency, which is based on undrained shear strength as measured by insitu vane tests, penetrometer tests, unconfined compression tests or similar field and laboratory analysis, Standard Penetration Test 'N' values can also be used to provide an approximate indication of the consistency and shear strength of fine grained, cohesive soils:

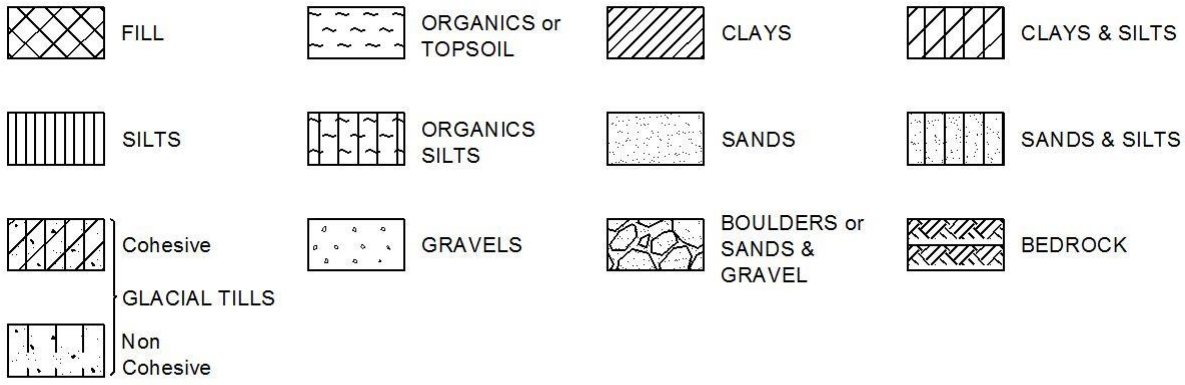
Table c: Consistency of Cohesive Soil

Consistency	Vane Shear Measurement (kPa)	'N' Value
Very Soft	<12.5	<2
Soft	12.5-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

Note: 'N' Value - The Standard Penetration Test records the number of blows of a 140 pound (64kg) hammer falling 30 inches (760mm), required to drive a 2 inch (50.8mm) O.D. split spoon sampler 1 foot (305mm). For split spoon samples where full penetration is not achieved, the number of blows is reported over the sampler penetration in meters (e.g. 50/0.15).

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols:



WATER LEVEL MEASUREMENT

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS	Split spoon sample (obtained from the Standard Penetration Test)
WS	Wash sample
BS	Bulk sample
TW	Thin wall sample or Shelby tube
PS	Piston sample
AS	Auger sample
VT	Vane test
GS	Grab sample
HQ, NQ, etc.	Rock core samples obtained with the use of standard size diamond drilling bits

STRESS AND STRAIN

u_w	kPa	Pore water pressure
r_u	1	Pore pressure ratio
σ	kPa	Total normal stress
σ'	kPa	Effective normal stress
τ	kPa	Shear stress
$\sigma_1, \sigma_2, \sigma_3$	kPa	Principal stresses
ε	%	Linear strain
$\varepsilon_1, \varepsilon_2, \varepsilon_3$	%	Principal strains
E	kPa	Modulus of linear deformation
G	kPa	Modulus of shear deformation
μ	1	Coefficient of friction

MECHANICALL PROPERIES OF SOIL

m_v	kPa^{-1}	Coefficient of volume change
c_c	1	Compression index
c_s	1	Swelling index
c_r	1	Recompression index
c_v	m^2/s	Coefficient of consolidation
H	m	Drainage path
T_V	1	Time factor
U	%	Degree of consolidation
σ'_{v0}	kPa	Effective overburden pressure
σ'_P	kPa	Preconsolidation pressure
τ_f	kPa	Shear strength
c'	kPa	Effective cohesion intercept
ϕ'	$-^\circ$	Effective angle of internal friction
c_u	kPa	Apparent cohesion intercept
ϕ_u	$-^\circ$	Apparent angle of internal friction
τ_R	kPa	Residual shear strength
τ_r	kPa	Remoulded shear strength
S_t	1	Sensitivity = c_u/τ_r

PHYSICAL PROPERTIES OF SOIL

P_s	kg/m^3	Density of solid particles
γ_s	kN/m^3	Unit weight of solid particles
ρ_w	kg/m^3	Density of water
γ_w	kN/m^3	Unit weight of water
ρ	kg/m^3	Density of soil
γ	kN/m^3	Unit weight of soil
ρ_d	kg/m^3	Density of dry soil
γ_d	kN/m^3	Unit weight of dry soil
ρ_{sat}	kg/m^3	Density of saturated soil
γ_{sat}	kN/m^3	Unit weight of saturated soil
ρ'	kg/m^3	Density of submerged soil
γ'	kN/m^3	Unit weight of submerged soil
e	1, %	Void ratio
n	1, %	Porosity
w	1, %	Water content
S_r	%	Degree of saturation
W_L	%	Liquid limit
W_P	%	Plastic limit
W_s	%	Shrinkage limit
I_P	%	Plasticity index = $(W_L - W_P)$
I_L	%	Liquidity index = $(W - W_P)/I_P$
I_C	%	Consistency index = $(W_L - W)/I_P$
e_{max}	1, %	Void ratio in loosest state
e_{min}	1, %	Void ratio in densest state
I_D	1	Density index = $(e_{max} - e)/(e_{max} - e_{min})$
D	mm	Grain diameter
D_n	mm	N percent - diameter
C_u	1	Uniformity coefficient
h	m	Hydraulic head or potential
q	m^3/s	Rate of discharge
v	m/s	Discharge velocity
i	1	Hydraulic gradient
k	m/s	Hydraulic conductivity
j	kN/m^3	Seepage force

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No BH-W1

SHEET 1 OF 1

METRIC

GWP No. 6376-14-00 **LOCATION** Wabigoon Riv. Culverts, (Site 41S-253/C), MTM-16, 5,517,318N, 317,396E **ORIGINATED BY** ST

DIST Kenora **HWY** 601 **BOREHOLE TYPE** CME 850, 200mm Dia. HSA **COMPILED BY** KR

DATUM Geodetic **DATE** 21/10/2015 - 26/10/2015 **CHECKED BY** IM

SOIL PROFILE			SAMPLES											
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ⊗ QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT PL / NATURAL WATER CONTENT w / LIQUID LIMIT LL; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
358.6														
358.4 0.2	**TOPSOIL** (~ 150 mm thick)		1	SS	0				41.6					
357.8 0.8	**SILT,** some sand, some clay, trace organics, dark brown, moist to wet, very loose.		2	SS	3		358		43.4					
	CLAYEY SILT, trace sand, grey, moist to wet, very soft to firm slight plasticity below ~ 1.5 m depth.		3	SS	2		357				0	3	75	22
	frequent sand seams below ~ 2.3 m depth.		4	SS	4		356							
355.6 3.1	**SILT,** some sand, trace clay, grey, wet, loose.		5	SS	5	▽	355							
			6	SS	5									
	trace sand below ~ 4.6 m depth.		7	SS	8		354				0	6	88	6
352.5 6.1	**SANDY SILT,** trace clay, grey, wet, loose to very loose.		8	SS	7		353							
	saturated below ~ 7.6 m depth.		9	SS	0		352				0	31	65	4
			10	SS	4		351							
			11	SS	1		350							
347.3 11.3	END OF BOREHOLE						349							
	NOTES: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by **exp** is required before use by others.						348							

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ON_MOT (SUDBURY1) ADM-2236486 - WABIGOON CULVERT - MTO.GPJ ON_MOT.GDT 25/11/15

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No BH-W2

SHEET 1 OF 2

METRIC

GWP No. 6376-14-00 **LOCATION** Wabigoon Riv. Culverts, (Site 41S-253/C), MTM-16, 5,517,318N, 317,396E **ORIGINATED BY** ST

DIST Kenora **HWY** 601 **BOREHOLE TYPE** CME 850, 200mm Dia. HSA and Cased **COMPILED BY** KR

DATUM Geodetic **DATE** 22/10/2015 - 26/10/2015 **CHECKED BY** IM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ⊗ QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT PL / NATURAL WATER CONTENT w / LIQUID LIMIT LL — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR	SA	SI	CL
366.3 / 0.0	**SURFACE TREATED ASPHALT** (~ 25 mm thick)		1	SS	58		366							
	FILL, sand and gravel, trace to some silt, brown, damp, very dense. with cobbles and boulders below ~ 0.7 m depth.		2	SS	45		365				39	55	6	0
	Auger refusal on suspected boulders (< 300 m diameter) at ~ 2.1 m depth - Cored using NW casing. wet, dense below ~ 2.4 m depth. loose below ~ 3.1 m depth.		3	SS	34		364							
			4	SS	4		363							
			5	SS	5		362							
360.2							361							
6.1	**FILL,** silt and clay, trace sand, grey, wet, compact.		6	SS	12		360							
	some wood below ~ 6.9 m depth.		7	SS	11		359			45.4				
358.7														
7.6	**SILT AND CLAY,** some wood, some organics, black and grey, wet, very stiff to soft.		8	SS	19		358			64.5				
	trace sand, grey below ~ 8.4 m depth.		9	SS	6					40.9				
	slight plasticity, very loose below ~ 9.1 m depth.		10	SS	2		357				0	2	62	36
355.6							356							
10.7	**SILT,** some sand, trace clay, grey, wet, compact to loose.		11	SS	10		355							
			12	SS	8		354				0	11	85	4
			13	SS	12		353							
	very loose below ~ 15.2 m depth.		14	SS	3		352							
	compact to loose below ~ 16.8 m depth.		15	SS	17		351				0	17	80	3
							350							
							349							

Continued Next Page

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No BH-W2

SHEET 2 OF 2 **METRIC**

GWP No. 6376-14-00 **LOCATION** Wabigoon Riv. Culverts, (Site 41S-253/C), MTM-16, 5,517,318N, 317,396E **ORIGINATED BY** ST

DIST Kenora **HWY** 601 **BOREHOLE TYPE** CME 850, 200mm Dia. HSA and Cased **COMPILED BY** KR

DATUM Geodetic **DATE** 22/10/2015 - 26/10/2015 **CHECKED BY** IM

SOIL PROFILE			SAMPLES										
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, + FIELD VANE, ⊗ QUICK TRIAXIAL, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT PL / NATURAL WATER CONTENT w / LIQUID LIMIT LL; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
							348				
347.4			16	SS	7						
18.9	END OF BOREHOLE NOTES: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by **exp** is required before use by others. 3. No groundwater level was measured due to wash boring technique used.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Ministry of Transportation Ontario

RECORD OF BOREHOLE No BH-W3

SHEET 1 OF 1 **METRIC**

GWP No. 6376-14-00 LOCATION Wabigoon Riv. Culverts, (Site 41S-253/C), MTM-16, 5,517,318N, 317,396E ORIGINATED BY ST

DIST Kenora HWY 601 BOREHOLE TYPE CME 850, 200mm Dia. HSA COMPILED BY KR

DATUM Geodetic DATE 23/10/2015 - 26/10/2015 CHECKED BY IM

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	WATER CONTENT (%)	GR	SA	SI	CL
359.7										
359.6 0.1	**TOPSOIL** (~ 100 mm thick) **ORGANIC CLAY,** some silt, some sand, dark brown, moist, firm.	1	SS	6						
		2	SS	7						
358.2 1.5	**SILT AND CLAY,** trace sand, greyish brown, moist, firm to very soft	3	SS	4						
	grey, moist to wet, slight plasticity below ~ 2.3 m depth.	4	SS	2		41.2	0	1	58	41
		5	SS	1		43.1				
355.1 4.6	**SILT,** trace to some sand, trace to some clay, grey, wet, loose to very loose.	6	SS	5	▽					
		7	SS	4			0	2	84	14
		8	SS	4			0	16	75	9
	saturated below ~ 9.1 m depth.	9	SS	0						
		10	SS	3						
348.4 11.3	END OF BOREHOLE									

Elevation scale: 359, 358, 357, 356, 355, 354, 353, 352, 351, 350, 349

DYNAMIC CONE PENETRATION 20 40 60 80 100; SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ⊗ QUICK TRIAXIAL × LAB VANE 20 40 60 80 100; PLASTIC LIMIT PL, NATURAL WATER CONTENT w, LIQUID LIMIT LL; WATER CONTENT (%) 10 20 30; UNIT WEIGHT γ kN/m³; REMARKS & GRAIN SIZE DISTRIBUTION (%)

NOTES:
1. This drawing is to be read with the subject report and project numbers as presented above.
2. Interpretation assistance by **exp** is required before use by others.

+ ³, × ³: Numbers refer to Sensitivity ○ ³% STRAIN AT FAILURE

ON_MOT (SUDBURY1) ADM-2236486 - WABIGOON CULVERT - MTO.GPJ ON_MOT.GDT 25/11/15

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No BH-W4

SHEET 1 OF 2 **METRIC**

GWP No. 6376-14-00 **LOCATION** Wabigoon Riv. Culverts, (Site 41S-253/C), MTM-16, 5,517,318N, 317,396E **ORIGINATED BY** ST

DIST Kenora **HWY** 601 **BOREHOLE TYPE** CME 850, 200mm Dia. HSA **COMPILED BY** KR

DATUM Geodetic **DATE** 26/10/2015 - 26/10/2015 **CHECKED BY** IM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION / SHEAR STRENGTH kPa (○ UNCONFINED, ⊗ QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT PL / NATURAL WATER CONTENT w / LIQUID LIMIT LL / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
366.0								20 40 60 80 100	10 20 30					
366.0	**SURFACE TREATED ASPHALT** (~ 25 mm thick)		1	SS	44									
	FILL, gravelly sand, some cobbles, trace to some silt, brown, damp, dense. very dense below ~ 0.8 m depth.		2	SS	70		365							
	compact to dense below ~ 1.5 m depth.		3	SS	19						32	61	7	0
			4	SS	43		364							
			5	SS	24		363							
361.3							362							
4.7	**FILL,** silty clay, brown, moist, firm.		6	SS	8		361							
360.7														
5.3	**FILL,** sand, trace to some gravel, trace silt, brown, moist, compact.		7	SS	29									
359.9							360		42.2					
6.1	**FILL,** clay and silt, some sand, trace gravel, brown and grey, damp to moist, very stiff, moderate plasticity.		8	SS	17						1	11	36	52
359.1														
6.9	**CLAYEY SILT,** trace organics, trace sand, grey, moist to wet, stiff to soft. trace to some organics below ~ 7.6 m depth.		9	SS	11		359							
			10	SS	14									
			11	SS	7		358							
			12	SS	3		357				0	1	73	26
355.3							356							
10.7	**SILT,** trace clay, trace sand, grey, wet, loose.		13	SS	8		355							
			14	SS	7	▽	354				0	3	88	10
	very loose, saturated below ~ 13.7 m depth.		15	SS	3		353							
			16	SS	0		352							
			17	SS	2		351				0	6	91	3
							350							
							349							

Continued Next Page

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No BH-W4

SHEET 2 OF 2 **METRIC**

GWP No. 6376-14-00 **LOCATION** Wabigoon Riv. Culverts, (Site 41S-253/C), MTM-16, 5,517,318N, 317,396E **ORIGINATED BY** ST

DIST Kenora **HWY** 601 **BOREHOLE TYPE** CME 850, 200mm Dia. HSA **COMPILED BY** KR

DATUM Geodetic **DATE** 26/10/2015 - 26/10/2015 **CHECKED BY** IM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL WATER CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PL w LL	γ kN/m^3	GR SA SI CL
	loose below ~ 18.3 m depth.		18	SS	8				10 20 30		
347.1											
18.9	END OF BOREHOLE										

NOTES:
1. This drawing is to be read with the subject report and project numbers as presented above.
2. Interpretation assistance by **exp** is required before use by others.

DYNAMIC CONE PENETRATION 20 40 60 80 100
SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
⊗ QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

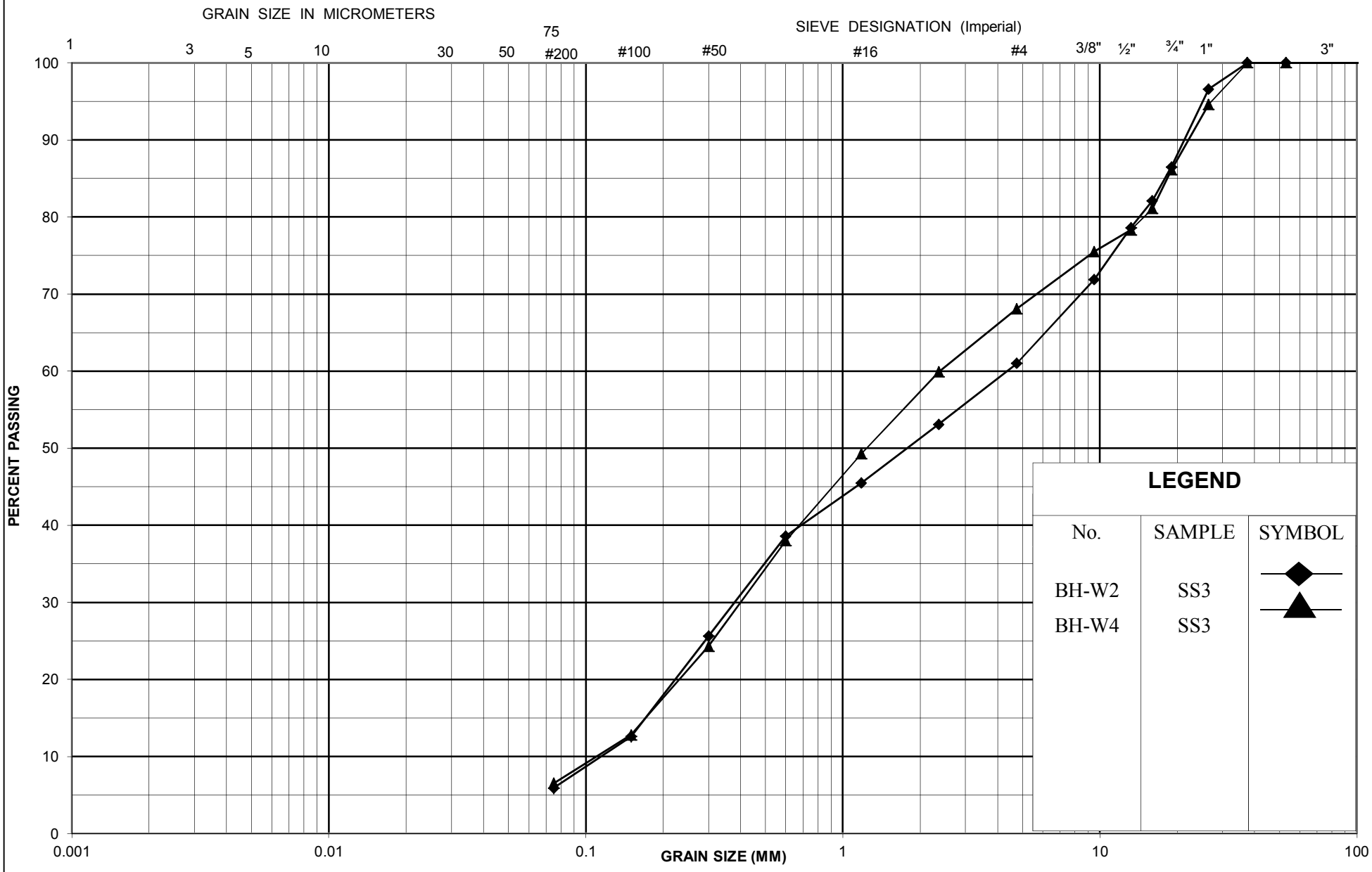
PLASTIC LIMIT PL — NATURAL WATER CONTENT w — LIQUID LIMIT LL
WATER CONTENT (%) 10 20 30

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Appendix D – Laboratory Data

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



GRAIN SIZE DISTRIBUTION

Granular Fill Materials

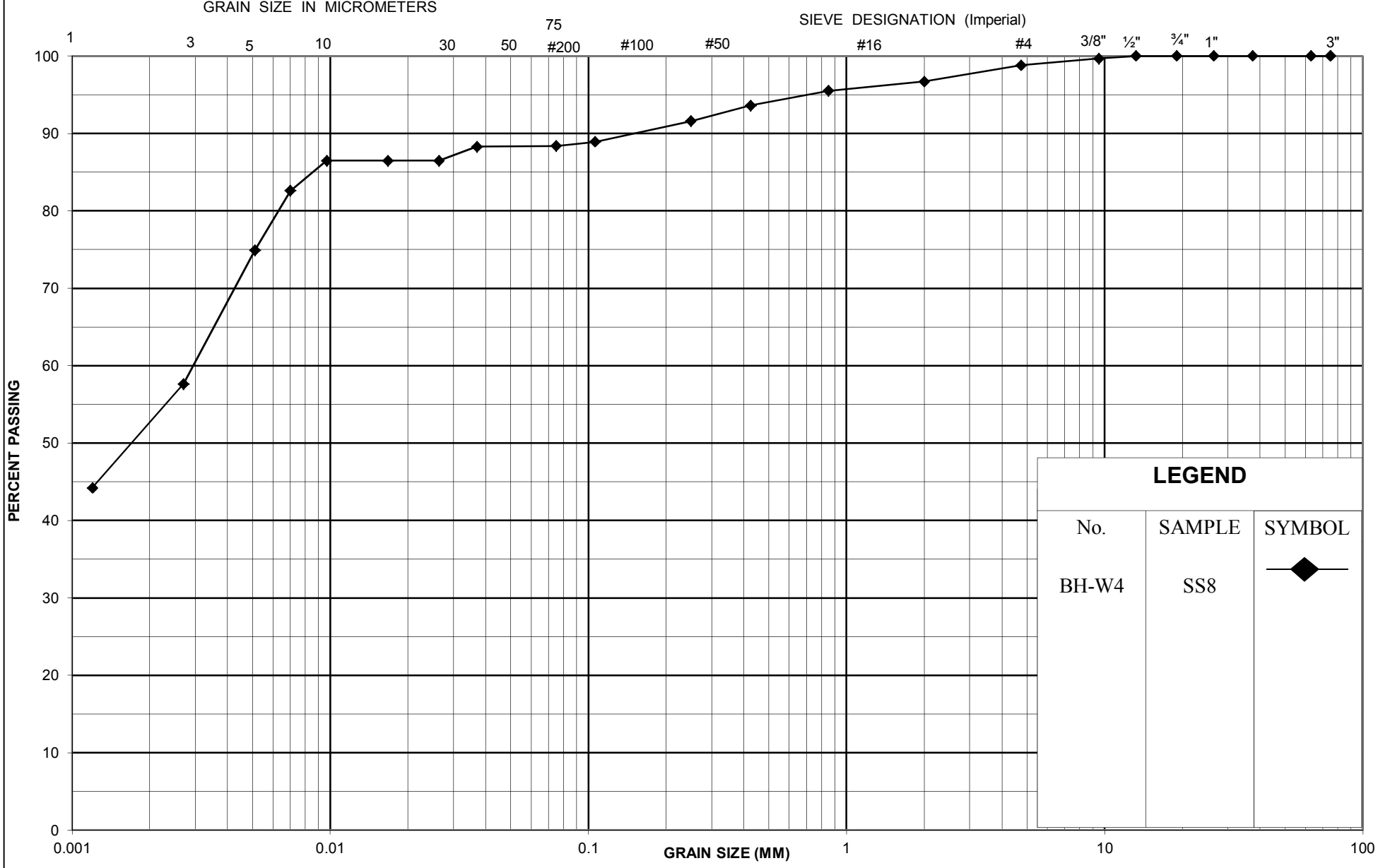
FIGURE No. 1

AGREEMENT No. 6014-E-0017

DATE: 17/11/2015

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



exp.

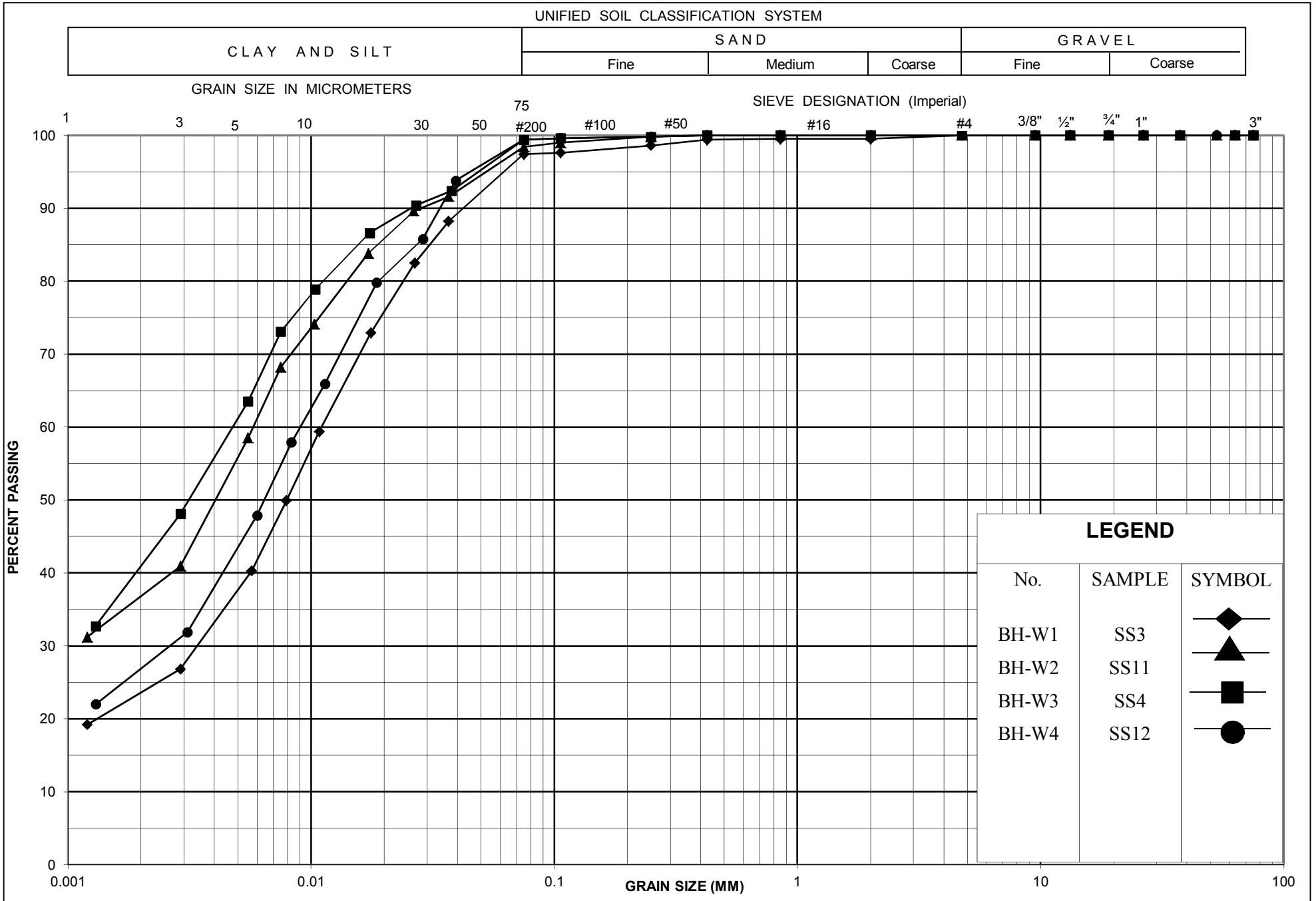
GRAIN SIZE DISTRIBUTION

Clay and Silt Fill

FIGURE No. 2

AGREEMENT No. 6014-E-0017

DATE: 17/11/2015



exp.

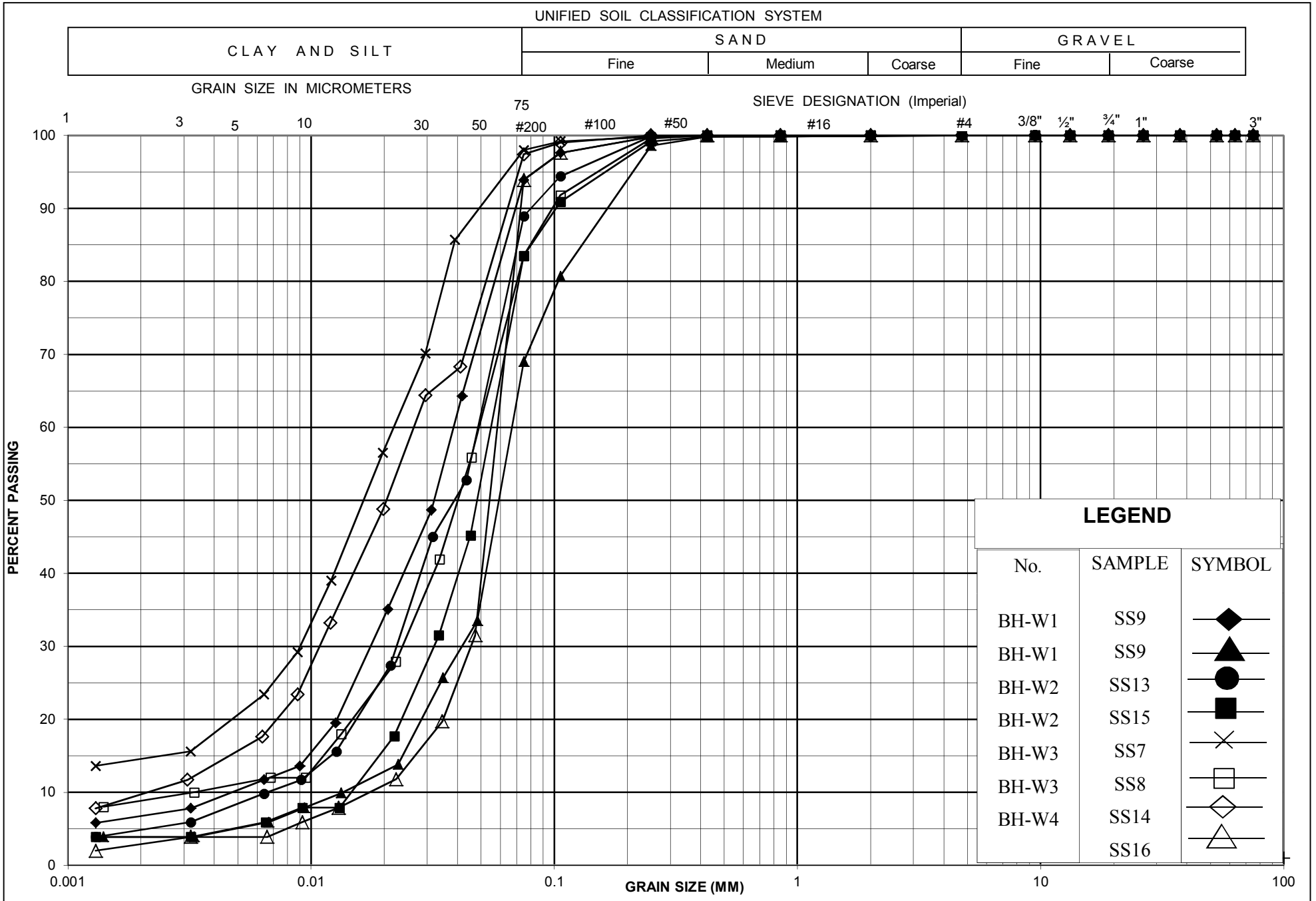
GRAIN SIZE DISTRIBUTION

Clayey Silt to Silt and Clay

FIGURE No. 3

AGREEMENT No. 6014-E-0017

DATE: 17/11/2015



GRAIN SIZE DISTRIBUTION

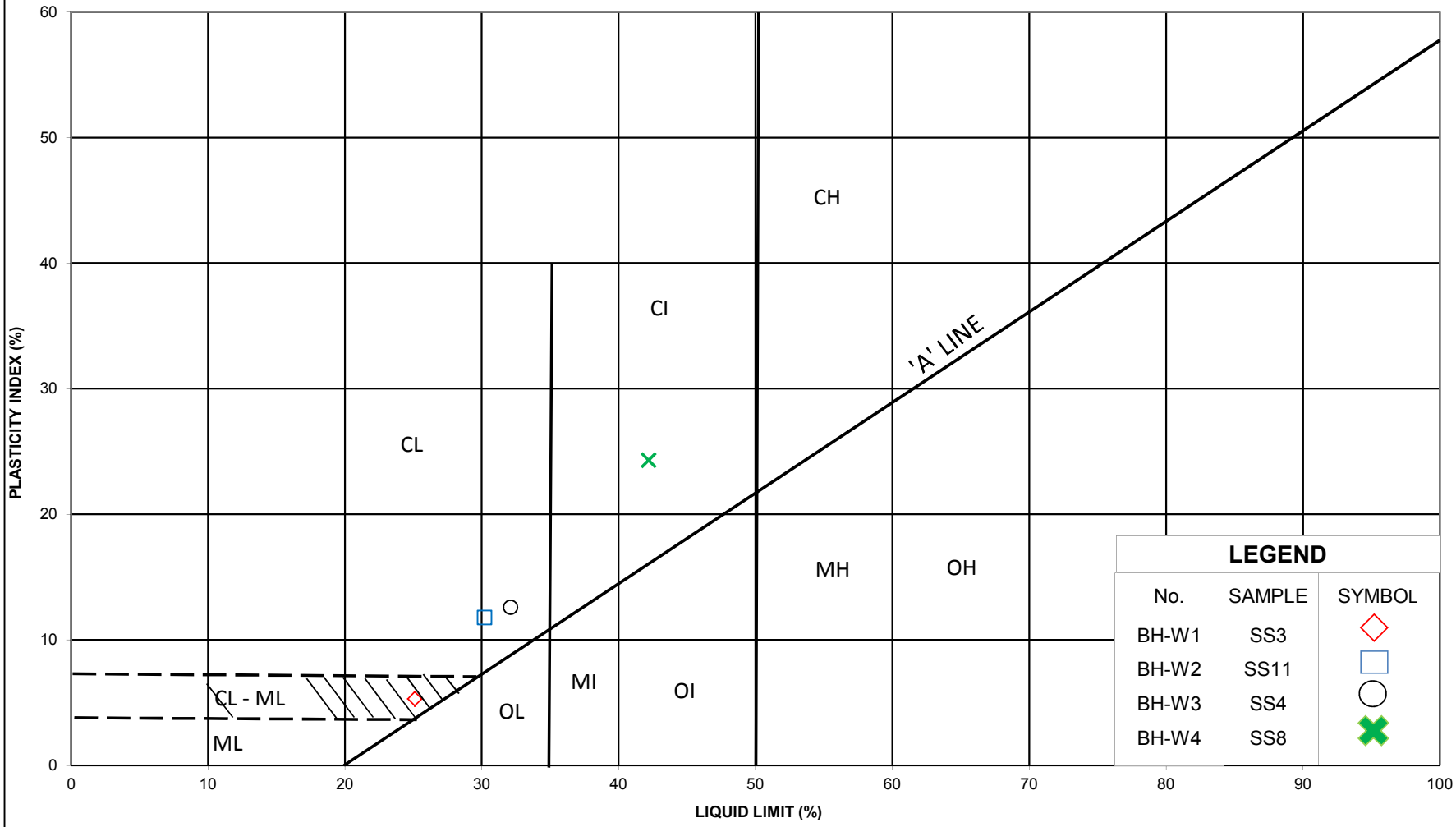
Sandy Silt to Silt

FIGURE No. 4

AGREEMENT No. 6014-E-0017

DATE: 17/11/2015

Wabigoon River Tributary Culverts, Hwy. 601, Van Horne Township



exp. (MTO)

PLASTICITY CHART

FIGURE 5

AGREEMENT No, 6014-E-0017

DATE 18/11/2015

Appendix E – Chemical Analyses

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: EXP. SERVICES INC.
885 REGENT ST
SUDBURY, ON P3E5M4
(705) 674-9681

ATTENTION TO: Ian MacMillan

PROJECT: ADM-00223648

AGAT WORK ORDER: 15U040280

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Nov 16, 2015

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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Certificate of Analysis

AGAT WORK ORDER: 15U040280

PROJECT: ADM-00223648

CLIENT NAME: EXP. SERVICES INC.

ATTENTION TO: Ian MacMillan

SAMPLING SITE:

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2015-11-06

DATE REPORTED: 2015-11-16

Parameter	Unit	G / S	RDL	BH-W4, SAMPLE SS9, 22 1/2 - 24 1/2 Soil 10/26/2015 7181054	BH-M1, Sample SS7, 15-17 Ft Soil 10/19/2015 7181063	BH-A4, Sample SS5, 10-12 Ft Soil 10/29/2015 7181065
Sulfide	%		0.01	0.03	0.02	0.03
Chloride (2:1)	µg/g	NA	2	174	10	66
Sulphate (2:1)	µg/g		2	5	15	12
pH (2:1)	pH Units		NA	8.00	8.91	7.10
Electrical Conductivity (2:1)	mS/cm	0.57	0.005	0.407	0.113	0.195
Resistivity (2:1)	ohm.cm		1	2460	8850	5130
Redox Potential (2:1)	mV		5	278	237	328

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use

7181054-7181065 * Sulphide analyses were performed at AGAT Laboratories Vancouver.

EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

Certified By: Amanjot Bhela

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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Quality Assurance

CLIENT NAME: EXP. SERVICES INC.

AGAT WORK ORDER: 15U040280

PROJECT: ADM-00223648

ATTENTION TO: Ian MacMillan

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Nov 16, 2015			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Corrosivity Package															
Sulfide	7181043		0.03	0.03	NA	< 0.01	108%	80%	120%						
Chloride (2:1)	7181065	7181065	66	68	3.0%	< 2	94%	80%	120%	102%	80%	120%	104%	70%	130%
Sulphate (2:1)	7181065	7181065	12	13	8.0%	< 2	92%	80%	120%	101%	80%	120%	100%	70%	130%
pH (2:1)	7181065	7181065	7.10	7.00	1.4%	NA	101%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	7181065	7181065	0.195	0.199	2.0%	< 0.005	98%	90%	110%	NA			NA		
Redox Potential (2:1)	7181065	7181065	328	331	0.9%	< 5	105%	70%	130%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Amanjot Bhela

AGAT Laboratories

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Method Summary

CLIENT NAME: EXP. SERVICES INC.

AGAT WORK ORDER: 15U040280

PROJECT: ADM-00223648

ATTENTION TO: Ian MacMillan

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulfide			GRAVIMETRIC
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION
Redox Potential (2:1)		McKeague 4.12 & SM 2510 B	REDOX POTENTIAL ELECTRODE

AGAT Laboratories

5835 Coopers Avenue
Mississauga, ON
L4Z 1Y2
www.agatlabs.com · webearth.agatlabs.com
P: 905.712.5100 · F: 905.712.5122

1 med

Chain of Custody Record

Laboratory Use Only
Arrival Temperature: 15V 040280
AGAT WO #:
Lab Temperature: 6.4 / 6.1 / 6.6
Notes:

Client Information

Company: exp
Contact: Ian MacMillan
Address: 885 Regent St. Sudbury
Phone: 705 674 9681 Fax: 705 674 8271
Project: ADM-00223648
PO:
AGAT Quotation #: S.O.A.

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements

- [x] Regulation 153/04 (reg. 511 Amend.) — Table 1 (Indicate one)
  - [x] Ind/Com
  - [ ] Res/Park
  - [ ] Agriculture
  - Soil Texture (check one): [ ] Coarse [ ] Fine
- [ ] Sewer Use — Region (Indicate one)
  - [ ] Sanitary
  - [ ] Storm
- [ ] Regulation 558
- [ ] CCME
- [ ] Other (specify)
- [ ] Prov. Water Quality Objectives (PWQO)
- [ ] None

Turnaround Time Required (TAT) Required*

Regular TAT
- [x] 5 to 7 Working Days

Rush TAT (please provide prior notification)
Rush Surcharges Apply
- [ ] 3 Working Days
- [ ] 2 Working Days
- [ ] 1 Working Day

OR
Date Required (Rush surcharges may apply):

*TAT is exclusive of weekends and statutory holidays

Invoice To

Same: Yes [x] No [ ]
Company:
Contact:
Address:

Is this a drinking water sample? (potable water intended for human consumption) [ ] Yes [x] No
If "Yes", please use the *Drinking Water Chain of Custody Form*

Is this submission for a **Record of Site Condition?** [ ] Yes [ ] No

Legend Matrix

GW	Ground Water	**O**	Oil
SW	Surface Water	**P**	Paint
SD	Sediment	**S**	Soil

Report Information – reports to be sent to:

1. Name: Ian MacMillan
   Email: ian.macmillan@exp.com
2. Name: Yves Beauparlant
   Email: yves.beauparlant@exp.com

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: B-HWS, Cl-, CN-, EC, FOC, Cr+6, SAR, N-Total, Hg, pH	Nutrients: TP, NH_3, TKN, NO_3, NO_2, NO_3/NO_2	VOC: VOC, THM, BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	Corrosivity Package
BH-W4, SAMPLE 559, 22½-24½ Ft	Oct 26/15	N/A	S	1																	x
BH-M1, Sample 557, 15-17 Ft	Oct 19/15	↓	↓	↓																	x
BH-A4, Sample 555, 10-12 Ft	Oct 29/15																				x

Samples Relinquished By (Print Name and Sign)	Date/Time	Samples Received By (Print Name and Sign)	Date/Time
Phil Lafranboise	Nov 6/15 1100	Katerina Dekayer	Nov 6 11:30am
		Shazmin	NOV 7/15 10:00 am

Pink Copy - Client
Yellow Copy - AGAT
White Copy - AGAT

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N°: 40738