REPORT

April 21, 2014

MICROPILE FOUNDATION DESIGN REPORT

DESIGN OF MICROPILE FOUNDATIONS FOR LITTLE EAST RIVER BRIDGES NO. 1 TO 4 AND RAGGED CREEK BRIDGE, SITE NOs. 44-174 TO 44-178 HIGHWAY 592 MINISTRY OF TRANSPORTATION, ONTARIO GWP 5265-07-00

Submitted to:
Morrison Hershfield Limited
Suite 600, 235 Yorkland Blvd.
Toronto, Ontario
M2J 1T1

GEOCRES No: 31E-335

Report Number: 11-1111-0149-7

Distribution:

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PART A

SUMMARY OF SUBSURFACE CONDITIONS

LITTLE EAST RIVER BRIDGES NO. 1 TO 4 AND RAGGED CREEK BRIDGE, SITE NOs. 44-174 TO 44-178

HIGHWAY 592

MINISTRY OF TRANSPORTATION, ONTARIO

GWP 5265-07-00

April 21, 2014
Report No. 11-1111-0149-7

Golder Associates

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Morrison Hershfield Limited (MH) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services associated with the design of the micropile foundation systems for the replacement of Little East River Bridges No. 1 to No. 4 (Sites No. 44-174 to 44-177) and Ragged Creek Bridge (Site No. 44-178) on Highway 592.

Based on the General Arrangement (GA) drawings provided by MH on November 6, 2013 for Little East River Bridges No. 1 to 4 and on August 23, 2013 for Ragged Creek Bridge, the proposed bridges will consist of single-span, pre-cast girder structures with a span length of 12.6 m.

This report provides a summary of the subsurface conditions encountered at each bridge site.

2.0 SITE DESCRIPTION

The five bridge sites are located along Highway 592 crossing Little East River and Ragged Creek in the Township of Perry, Ontario. The detailed site description is presented in the following Foundation Investigation and Design Reports (FIDRs).

- Ministry of Transportation, Ontario. 2013a. Foundation Investigation and Design Report, Little East River Bridge No. 1, Site No. 44-174, Highway 592 – Replacement of Six Structures, GWP 5265-07-00; WP 5265-07-01, Geocres No. 31E-330, prepared by Golder Associates Ltd.
- Ministry of Transportation, Ontario. 2013b. Foundation Investigation and Design Report, Little East River Bridge No. 2, Site No. 44-175, Highway 592 – Replacement of Six Structures, GWP 5265-07-00; WP 5266-07-01, Geocres No. 31E-331, prepared by Golder Associates Ltd.
- Ministry of Transportation, Ontario. 2013c. Foundation Investigation and Design Report, Little East River Bridge No. 3, Site No. 44-176, Highway 592 – Replacement of Six Structures, GWP 5265-07-00; WP 5267-07-01, Geocres No. 31E-332, prepared by Golder Associates Ltd.
- Ministry of Transportation, Ontario. 2013d. Foundation Investigation and Design Report, Little East River Bridge No. 4, Site No. 44-177, Highway 592 – Replacement of Six Structures, GWP 5265-07-00; WP 5268-07-01, Geocres No. 31E-333, prepared by Golder Associates Ltd.
- Ministry of Transportation, Ontario. 2013e. Foundation Investigation and Design Report, Ragged Creek Bridge, Site No. 44-178, Highway 592 – Replacement of Six Structures, GWP 5265-07-00; WP 5269-07-01, Geocres No. 31E-334, prepared by Golder Associates Ltd.

In general, the topography along Highway 592 consists of rolling terrain, with the lower elevation areas occupied by lakes, low-lying swamps containing areas of standing water and sparsely to densely populated tree covered areas. Land use in some areas consists of residential/recreational communities. The existing bridges are single-span rigid frame structures with span lengths of 6.1 m. The bridge sites and associated approach embankments are situated on relatively flat, sparsely treed areas, surrounded by residential/recreational properties to the north and south.

3.0 INVESTIGATION PROCEDURES

The foundation investigation field work for the proposed bridge structures was carried out between April 29 and June 6, 2013. The detailed investigation procedure and the results of the investigation are presented in the respective FIDRs (MTO, 2013a to 2013e) for each site.

A total of 21 boreholes and three Dynamic Cone Penetration Tests (DCPTs) were advanced at the location of the proposed bridge foundation footprints and approach embankments. A summary of the respective boreholes advanced at each bridge site is presented below.

Bridge Site	Number of Boreholes	Number of DCPTs
Little East River Bridge No. 1	5	0
Little East River Bridge No. 2	4	0
Little East River Bridge No. 3	4	1
Little East River Bridge No. 4	4	1
Ragged Creek Bridge	4	1

The Borehole Locations and Soil Strata drawing for each of the bridge sites is included in Appendix A. The Record of Borehole and Drillhole sheets and laboratory testing results carried out on selected soil samples and bedrock cores for each investigated area are included in the respective FIDRs (MTO, 2013a to 2013e).

In addition to the laboratory testing carried out on soil samples and bedrock cores, groundwater samples were collected by MH during the foundation investigation and were submitted for analytical testing for parameters associated with corrosion aggressiveness (i.e. pH, sulphate, chloride and electrical resistivity). The results of the analytical testing are included in Appendix B.

4.0 SUMMARY OF SUBSURFACE CONDITIONS

The detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced during the foundation investigations are presented in Part A of the FIDRs (MTO, 2013a to 2013e) for each site.

The following sections provide brief descriptions of the subsurface conditions at each bridge site.

4.1 Little East River Bridge No. 1

The as-drilled borehole locations and the soil stratigraphy for this site are shown on Drawing A1 in Appendix A.

A layer of asphalt between about 25 mm and 90 mm thick was encountered at the ground surface at the proposed abutment locations.

A 2.2 m to 3.7 m thick fill deposit comprised of sand and gravel to gravelly sand to sand was encountered below the asphalt layer. Pieces of wood were encountered within the fill deposit at the location of the north abutment and are inferred to be remnants of a corduroy roadbed. Standard Penetration Testing (SPT) 'N'-values in the fill deposit at the abutment locations generally range from 6 blows to 20 blows per 0.3 m of penetration, indicating a loose to compact relative density.

A 0.8 m thick layer of organic sand was encountered underlying the fill deposit at the proposed north abutment. An SPT 'N'-value of 5 blows per 0.3 m of penetration was measured within this layer, indicating a loose relative density.

The organic sand is underlain by a 2.6 m thick deposit of silt and sand. The SPT 'N'-values measured within this deposit range from 4 blows to 8 blows per 0.3 m of penetration, indicating a loose relative density.

A 1.3 to 2.6 m thick clayey silt deposit was encountered underlying the silt and sand deposit and organic sand at the south and north abutment, respectively. The SPT 'N'-values measured within this deposit range from 3 blows to 7 blows per 0.3 m of penetration, suggesting a soft to firm consistency.

The clayey silt deposit is in turn underlain by a deep deposit of sand and gravel to sandy gravel with a thickness of up to 19.2 m to the termination depth of drilling. Inference from a DCPT advanced at the location of the south abutment suggests that the sand and gravel to sandy gravel deposit extends to a depth of at least 25.4 m below ground surface. Cobbles and boulders were encountered at various depths throughout this deposit with boulder sizes up to about 0.7 m thick. The SPT 'N'-values measured within the sand and gravel to sandy gravel deposit typically range from 16 blows to 36 blows per 0.3 m of penetration, suggesting a compact to dense relative density.

During the drilling operations at the abutments, artesian groundwater conditions were noted when advancing the casing between depths of about 5.2 m and 22.3 m below ground surface. The groundwater levels measured in the open boreholes upon completion of drilling range from about 1.0 m below ground surface to 0.8 m above ground surface. A standpipe piezometer installed at the north approach embankment and screened within the sand and gravel to sandy gravel deposit measured a groundwater level at about 0.1 m above ground surface prior to decommissioning.

4.2 Little East River Bridge No. 2

The as-drilled borehole locations and the soil stratigraphy for this site are shown on Drawing A2 in Appendix A.

A layer of asphalt between about 30 mm to 40 mm thick was encountered at the ground surface at the proposed abutment locations.

A 2.2 m to 3.0 m thick fill deposit comprised of sand to sand and gravel was encountered below the asphalt layer. The SPT 'N'-values measured within the fill deposit range from 4 blows to 20 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

An upper deposit of sand and gravel was encountered below the fill deposit and contains a 2.1 m thick layer of silt to clayey silt in the borehole at the south abutment. The thickness of the overall sand and gravel deposit is between 5.8 m and 6.5 m. Cobbles and boulders were encountered within the lower portions of this deposit, between the depths of about 7.4 m and 8.5 m below ground surface. The SPT 'N'-values measured within the overall sand and gravel deposit generally range from 3 blows to 70 blows per 0.3 m of penetration, indicating a very loose to dense relative density.

The upper sand and gravel deposit is underlain by a 8.3 m to 12.2 m thick deposit of silt and sand to sand. Cobbles were encountered between the depths of 19.5 m and 20.9 m below ground surface in the borehole at the south abutment. The SPT 'N'-values measured within the silt and sand to sand deposit range from 5 blows to 18 blows per 0.3 m of penetration, indicating a loose to compact relative density.

A 7.3 m thick lower deposit of sand and gravel was encountered below the silt and sand to sand deposit at the proposed north abutment. Cobbles and boulders were encountered between the depths of 19.4 m and 21.3 m as well as between 21.7 m and 24.4 m below ground surface. SPT 'N'-values of 17 blows and 54 blows per 0.3 m of penetration were measured within this deposit, indicating a compact to very dense relative density.

Granitic gneiss bedrock was encountered in the borehole at the proposed south abutment underlying the silt and sand to sand deposit and confirmed by bedrock coring. The bedrock surface was encountered at a depth of about 20.9 m below ground surface.

The groundwater level measured in the open boreholes upon completion of drilling ranges from about 2.1 m to 2.2 m below ground surface. A standpipe piezometer installed at the north abutment and screened within the upper sand and gravel deposit measured a groundwater level at between about 2.0 m and 2.7 m below ground surface prior to decommissioning.

4.3 Little East River Bridge No. 3

The as-drilled borehole locations and the soil stratigraphy for this site are shown on Drawing A3 in Appendix A.

A layer of asphalt between 25 mm to 50 mm thick was encountered at the ground surface at the proposed abutment. A 0.5 m thick layer of asphalt fragments were encountered below the asphalt at the south abutment.

A 1.7 m to 3.0 m thick fill deposit comprised of sand and gravel to silt and sand was encountered below the layer of asphalt/asphalt fragments. The SPT 'N'-values measured within the fill deposit range from 4 blows to 41 blows per 0.3 m of penetration, indicating a very loose to dense relative density.

A 2.6 m to 3.4 m thick deposit of organic sand was encountered underlying the fill deposit at the location of the proposed abutments. The SPT 'N'-values measured within this deposit range from 3 blows to 5 blows per 0.3 m of penetration, indicating a very loose to loose relative density.

The organic sand is underlain by a 6.1 m to 6.9 m thick deposit of silt. At the south abutment, the silt deposit is underlain by a 1.6 m thick pocket of gravelly sand at a depth of 11.7 m below ground surface. The SPT 'N'-values measured within the silt deposit and sand pocket range from 0 blows (weight of hammer) to 6 blows per 0.3 m of penetration, indicating a very loose to loose relative density.

A 2.3 m to 3.8 m thick clayey silt with sand deposit was encountered below the silt deposit at the abutments. The SPT 'N'-values measured within this deposit range from 0 blows (weight of hammer) to 8 blows per 0.3 m of penetration, suggesting a very soft to firm consistency.

The clayey silt with sand deposit is in turn underlain by a deep deposit of gravelly sandy silt to sand and gravel with thicknesses ranging from about 14 m to 16.3 m to the termination depth of drilling. Inference from a DCPT advanced at the location of the south abutment suggests that the gravelly sandy silt to sand and gravel deposit extends to a depth of at least 32.1 m. Cobbles and boulders were encountered at various depths throughout this deposit with boulder sizes up to 0.5 m thick.

The groundwater levels measured in the open boreholes upon completion of drilling range from about 1.3 m to 2.3 m below ground surface. A standpipe piezometer installed at the south abutment and screened within the organic sand deposit measured a groundwater levels between about 1.9 m and 2.4 m below ground surface prior to decommissioning.

4.4 Little East River Bridge No. 4

The as-drilled borehole locations and the soil stratigraphy for this site are shown on Drawing A4 in Appendix A.

A layer of asphalt/asphalt fragments between about 300 mm to 460 mm thick was encountered at the ground surface at the proposed abutment locations.

A 0.9 m to 1.2 m thick fill deposit comprised of sand and gravel to sand was encountered below the layer of asphalt/asphalt fragment. The SPT 'N'-values measured within the fill deposit are 9 blows and 10 blows per 0.3 m of penetration, indicating a loose relative density.

At the north abutment, a 1.6 m thick pocket of organic silt was encountered underlying the fill deposit. The SPT 'N'-values measured within the organic silt pocket are 2 blows and 3 blows per 0.3 m of penetration, indicating a very loose relative density.

A deep deposit of silt to sand was encountered underlying the fill deposit at the south abutment and the organic silt at the north abutment. In general, the silt to sand deposit is comprised of an upper portion of silt and sand to silty sand to a depth of 1.3 m below ground surface and a lower portion of silt to sandy silt. The thickness of the silt to sand deposit ranges from 20.8 m to 21.7 m. The SPT 'N'-values measured within the overall silt to sand deposit range from 0 blows (weight of hammer) to 26 blows per 0.3 m of penetration, indicating a very loose to compact relative density. The silty sand to silt and sand upper portion of the deposit may be described as very loose to loose and the silt to sandy silt lower portion of the deposit may be described as very loose to compact.

The silt to sand deposit is underlain by a deposit of sand and gravel with thicknesses ranging from about 7.3 m to 7.9 m to the termination depth of drilling. Inference from a DCPT advanced at the north abutment suggests that the sand and gravel deposit extends to a depth of at least 38 m below ground surface. Cobbles were encountered within the silt to sandy silt deposit at the the south abutment between depths of 26.5 m and 27.4 m below ground surface. The SPT 'N'-values measured within the deposit range from about 12 blows to 34 blows per 0.3 m of penetration, indicating a compact to dense relative density.

The groundwater levels measured in the open boreholes upon completion of drilling range from about 1.2 m to 1.6 m below ground surface. A standpipe piezometer installed at the south abutment and screened within the silt to sand deposit measured a groundwater level between about 1.5 m and 2.2 m below ground surface prior to decommissioning.

4.5 Ragged Creek Bridge

The as-drilled borehole locations and the soil stratigraphy for this site are shown on Drawing A5 in Appendix A.

A layer of asphalt between about 75 mm to 480 mm thick was encountered at the ground surface at the proposed abutment locations.

A 1.7 m to 2.1 m thick fill deposit comprised of sand and gravel to sand was encountered underlying the asphalt. The SPT 'N'-values measured within the fill deposit generally range from 2 blows to 15 blows per 0.3 m of penetration, indicating a very loose to compact relative density, with SPT 'N'-values up to 27 m blows per 0.3 m of penetration recorded within the upper portion of the fill immediately underlying the asphalt layer, indicating a compact relative density.

The fill deposit is underlain by a 0.8 m to 1.5 m thick deposit of organic silt. The SPT 'N'-values measured within this deposit range from 2 blows to 4 blows per 0.3 m of penetration, indicating a very loose relative density.

A deep deposit comprised of silt to sand was encountered underlying the organic silt deposit with thicknesses ranging from about 27.4 m to 28.1 m to the termination depth of drilling. Inference from a DCPT advanced at the location of the north abutment suggests that the silt to sand deposit extends to a depth of at least 32 m below ground surface. The SPT 'N'-values measured within the silt to sand deposit range from 1 blow to 20 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The groundwater levels measured in the open boreholes upon completion of drilling range from about 1.7 m to 1.8 m below ground surface. A standpipe piezometer installed at the south abutment and screened within the silt to sand deposit measured a groundwater between about 1.8 m and 2.0 m below ground surface prior to decommissioning.

5.0 CLOSURE

This report was prepared by Mr. Matt Soderman, E.I.T., and was reviewed by Mr. Christopher Ng, P.Eng., a geotechnical engineer and Associate with Golder. Mr. Jorge M. A. Costa, P.Eng., Golder's Designated MTO Contact for this project and Principal with Golder, conducted an independent quality control review of the report.

Report Signature Page

Matt Soderman, E.I.T.
Geotechnical Engineering Group

Christopher Ng, P.Eng.,
Geotechnical Engineer, Associate

Jorge M. A. Costa, P. Eng.,
Designated MTO Contact, Principal

MAS/CN/JMAC/

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Ministry of Transportation, Ontario. 2013b. Foundation Investigation and Design Report, Little East River Bridge No. 2, Site No. 44-175, Highway 592 – Replacement of Six Structures, GWP 5265-07-00; WP 5266-07-01, Geocres No. 31E-331, prepared by Golder Associates Ltd.

Ministry of Transportation, Ontario. 2013c. Foundation Investigation and Design Report, Little East River Bridge No. 3, Site No. 44-176, Highway 592 – Replacement of Six Structures, GWP 5265-07-00; WP 5267-07-01, Geocres No. 31E-332, prepared by Golder Associates Ltd.

Ministry of Transportation, Ontario. 2013d. Foundation Investigation and Design Report, Little East River Bridge No. 4, Site No. 44-177, Highway 592 – Replacement of Six Structures, GWP 5265-07-00; WP 5268-07-01, Geocres No. 31E-333, prepared by Golder Associates Ltd.

Ministry of Transportation, Ontario. 2013e. Foundation Investigation and Design Report, Ragged Creek Bridge, Site No. 44-178, Highway 592 – Replacement of Six Structures, GWP 5265-07-00;
WP 5269-07-01, Geocres No. 31E-334, prepared by Golder Associates Ltd.

Commercial Software:

LPILE Plus (Version 5.0) by Ensoft Inc.

APPENDIX A

Borehole Locations and Soil Strata Drawings – Little East River Bridges No. 1 to 4 and Ragged Creek Bridge

MINISTRY OF TRANSPORTATION, ONTARIO

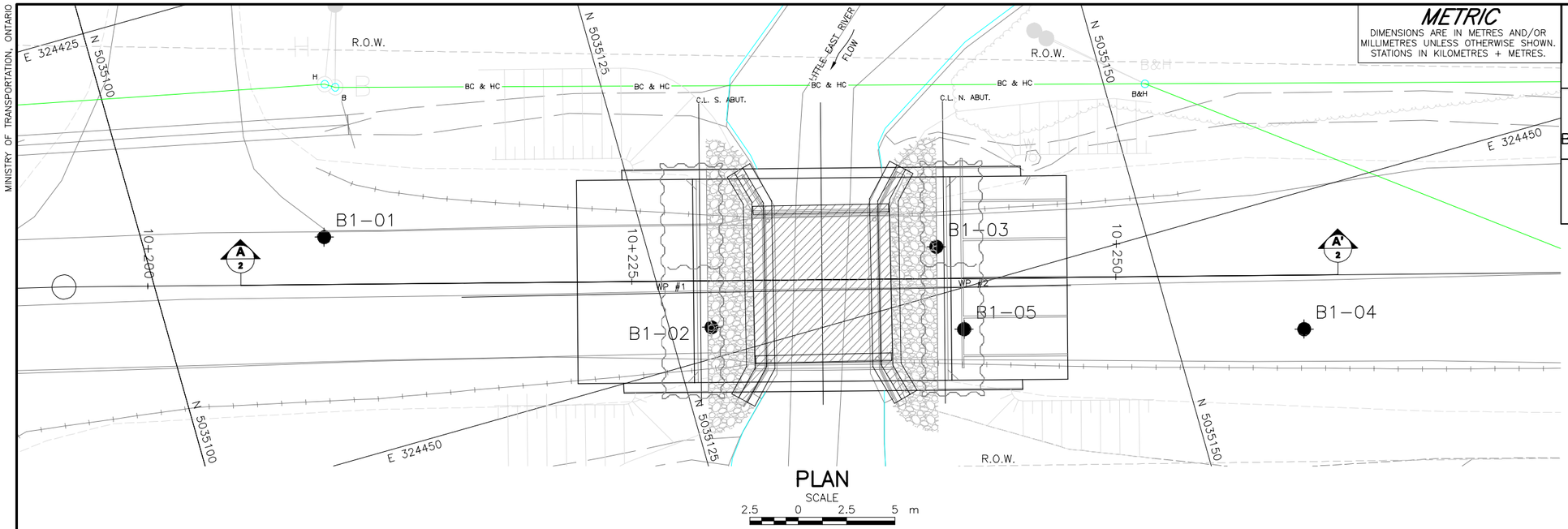
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No. 2014–5125
WP No. 5265–07–01

SHEET

HIGHWAY 592
LITTLE EAST RIVER BRIDGE #1
BOREHOLE LOCATIONS AND SOIL STRATA

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



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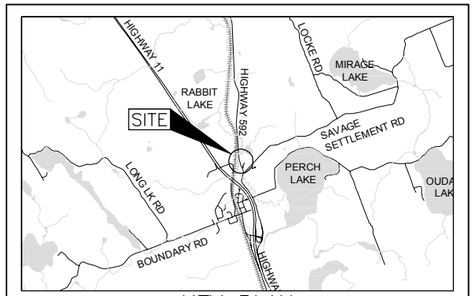

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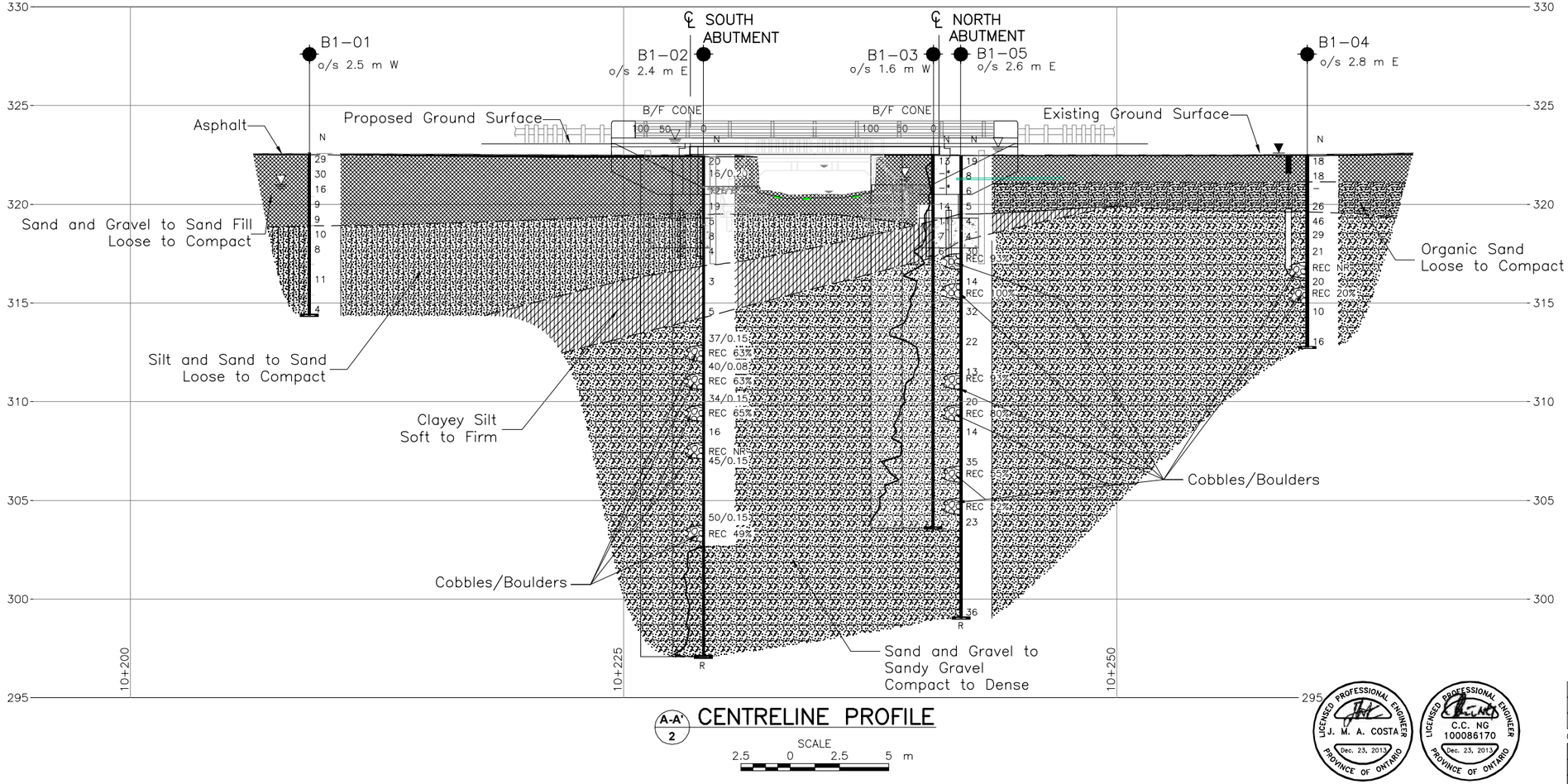

A-A'
2
CENTRELINE PROFILE
SCALE
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LEGEND

- Borehole – Current Investigation
- Seal
- Piezometer
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- REC — Total core recovery
- WL in piezometer, measured on May 14, 2013
- WL upon completion of drilling
- R — Refusal

BOREHOLE CO–ORDINATES

No.	ELEVATION	NORTHING	EASTING
B1–01	322.6	5035109.1	324438.5
B1–02	322.5	5035127.1	324448.4
B1–03	322.5	5035139.4	324447.6
B1–04	322.5	5035156.5	324456.9
B1–05	322.5	5035139.6	324452.1

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by MH, drawing file nos. X1114246_44–174_44–175_44–176align.dwg, x1114246_44177align.dwg, x1114246_44178_44166align.dwg and X1114246_44–174_44–175_44–176base.dwg, x1114246_44177base.dwg and x1114246_44178_44166base.dwg, received June 11, 2013 and General Arrangement Plan and Profile file no. 44174–01.dwg, received November 07, 2013.

LICENSED PROFESSIONAL ENGINEER
J. M. A. COSTA
Dec. 23, 2013
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
C.C. NG
100086170
Dec. 23, 2013
PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 31E–330

HWY. 592		PROJECT NO. 11–1111–0149	DIST.
SUBM'D. AV	CHKD. TVA	DATE: Dec. 2013	SITE: 44–174
DRAWN: JFC	CHKD.	APPD. CN/JMAC	DWG. 2

PLOT DATE: April 2, 2014
FILENAME: I:\Projects\2011\11-1111-0149 (MH, Huntsville)_AD-Little East River Bridge #1 (Contract No.)\11111101484D002.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

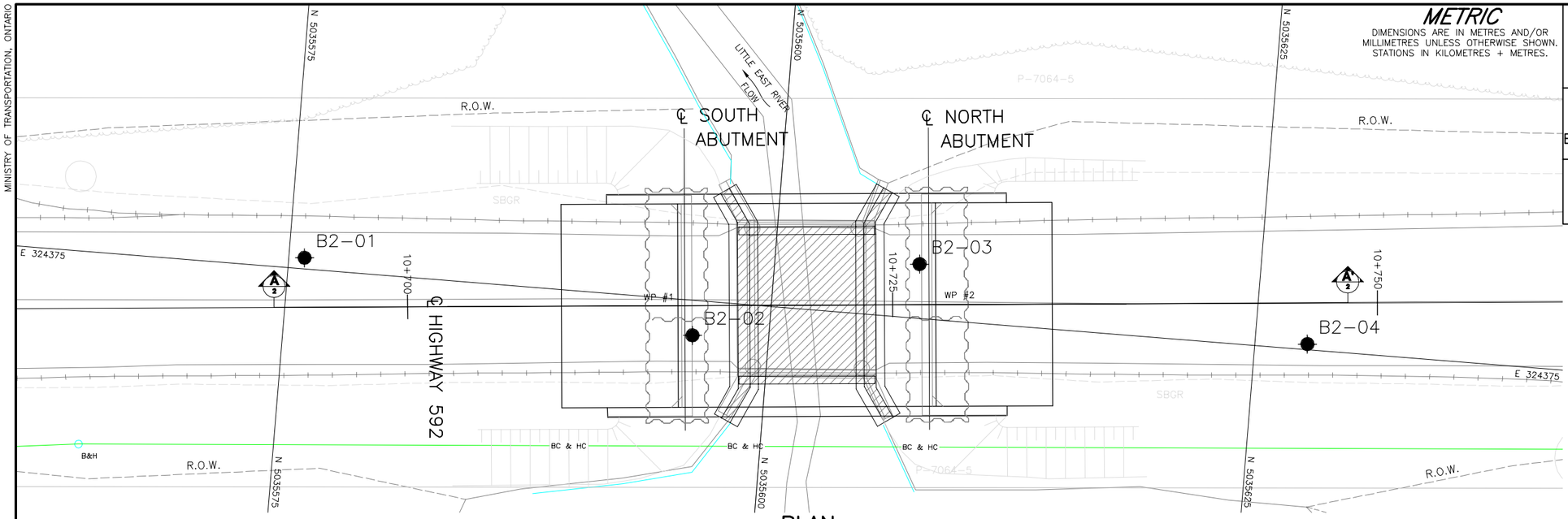
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No. 2014-5125
WP No. 5266-07-01

HIGHWAY 592
LITTLE EAST RIVER BRIDGE #2
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



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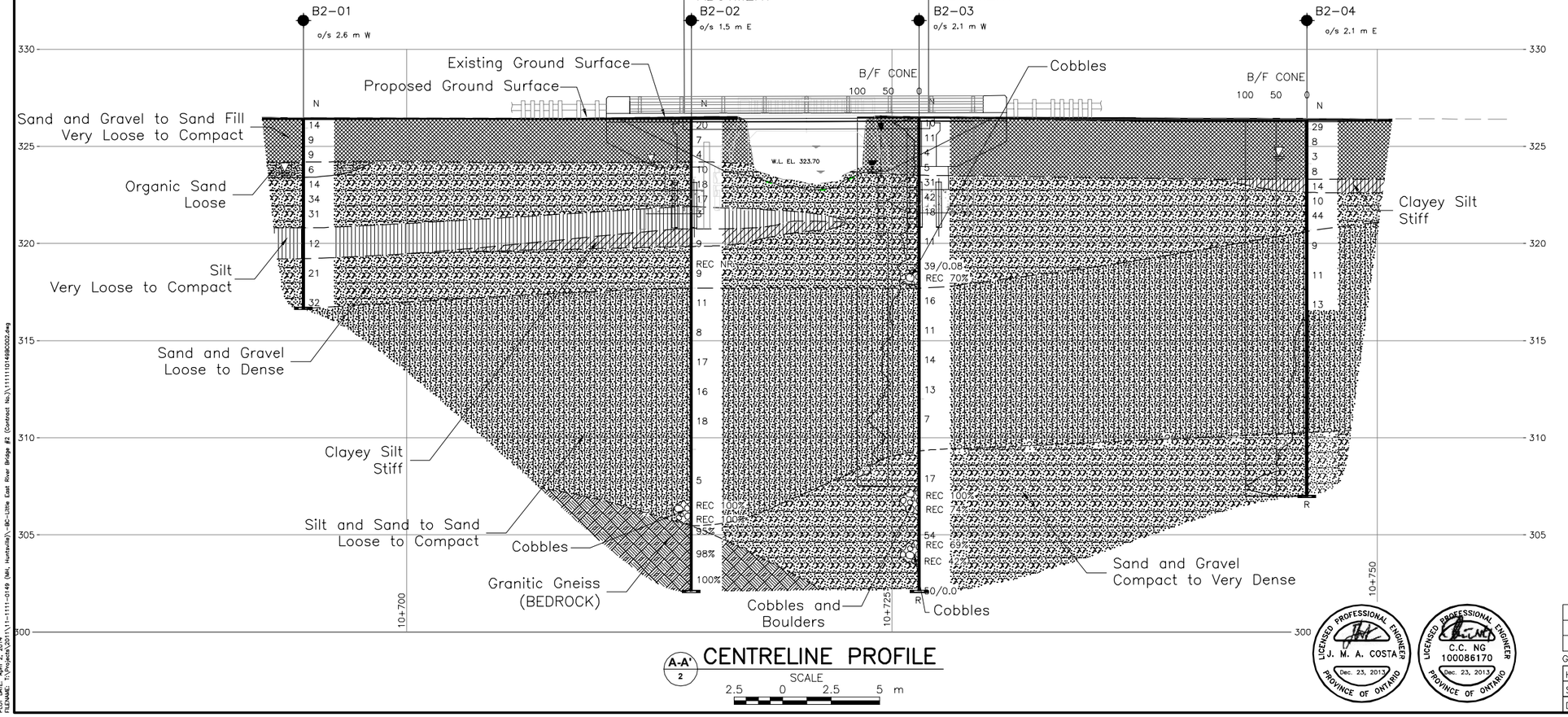

A-A' 2 CENTRELINE PROFILE
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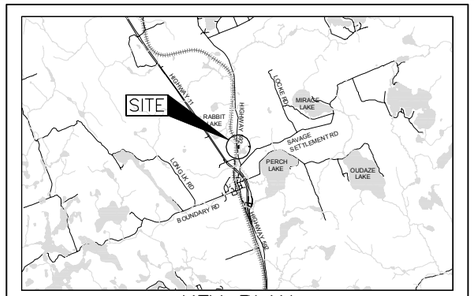

KEY PLAN
SCALE
2 0 2 4 km

LEGEND

- Borehole – Current Investigation
- Seal
- Piezometer
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% — Rock Quality Designation (RQD)
- REC — Total core recovery
- WL in piezometer, measured on June 26, 2013
- WL upon completion of drilling
- R — Refusal

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
B2-01	326.4	5035575.8	324374.4
B2-02	326.4	5035596.1	324376.8
B2-03	326.5	5035607.5	324372.2
B2-04	326.3	5035627.7	324374.7

NOTES

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The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by MH, drawing file nos. X1114246_44-174_44-175_44-176align.dwg, x1114246_44177align.dwg, x1114246_44178_44166align.dwg and X1114246_44-174_44-175_44-176base.dwg, x1114246_44177base.dwg and x1114246_44178_44166base.dwg, received June 11, 2013 and General Arrangement Plan and Profile file no. 44175-01.dwg, received November 7, 2013.

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA Dec. 23, 2013 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 Dec. 23, 2013 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 31E-331

HWY. 592	PROJECT NO. 11-1111-0149		DIST.
SUBM'D. AV	CHKD. CN	DATE: Dec. 2013	SITE: 44-175
DRAWN: JFC	CHKD. TVA	APPD.	DWG. 2

PLOT DATE: April 2, 2014
FILENAME: T:\Projects\2011\11-1111-0149 (MH, Huntsville)\-GEC-Little East River Bridge #2 (Contract No.)\11111101498GB002.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

METRIC

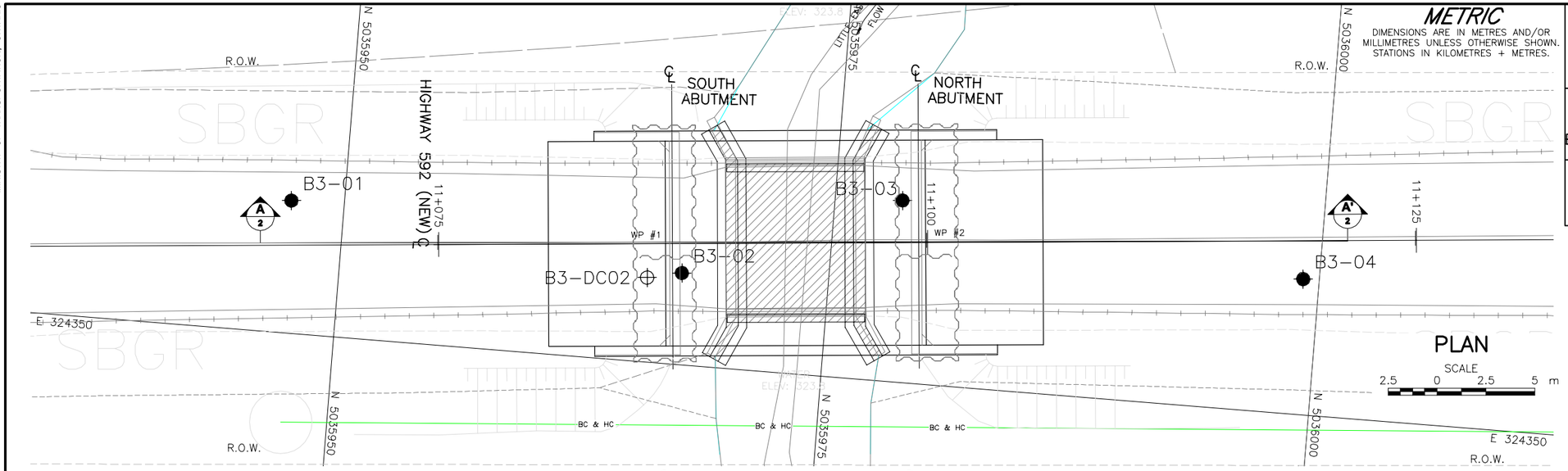
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

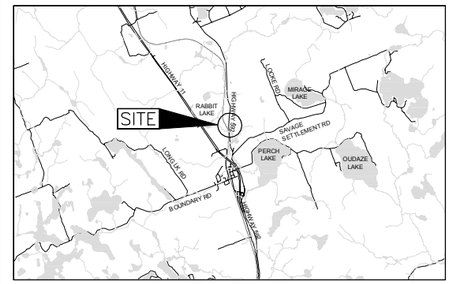
CONT No. 2014-5125
WP No. 5267-07-01

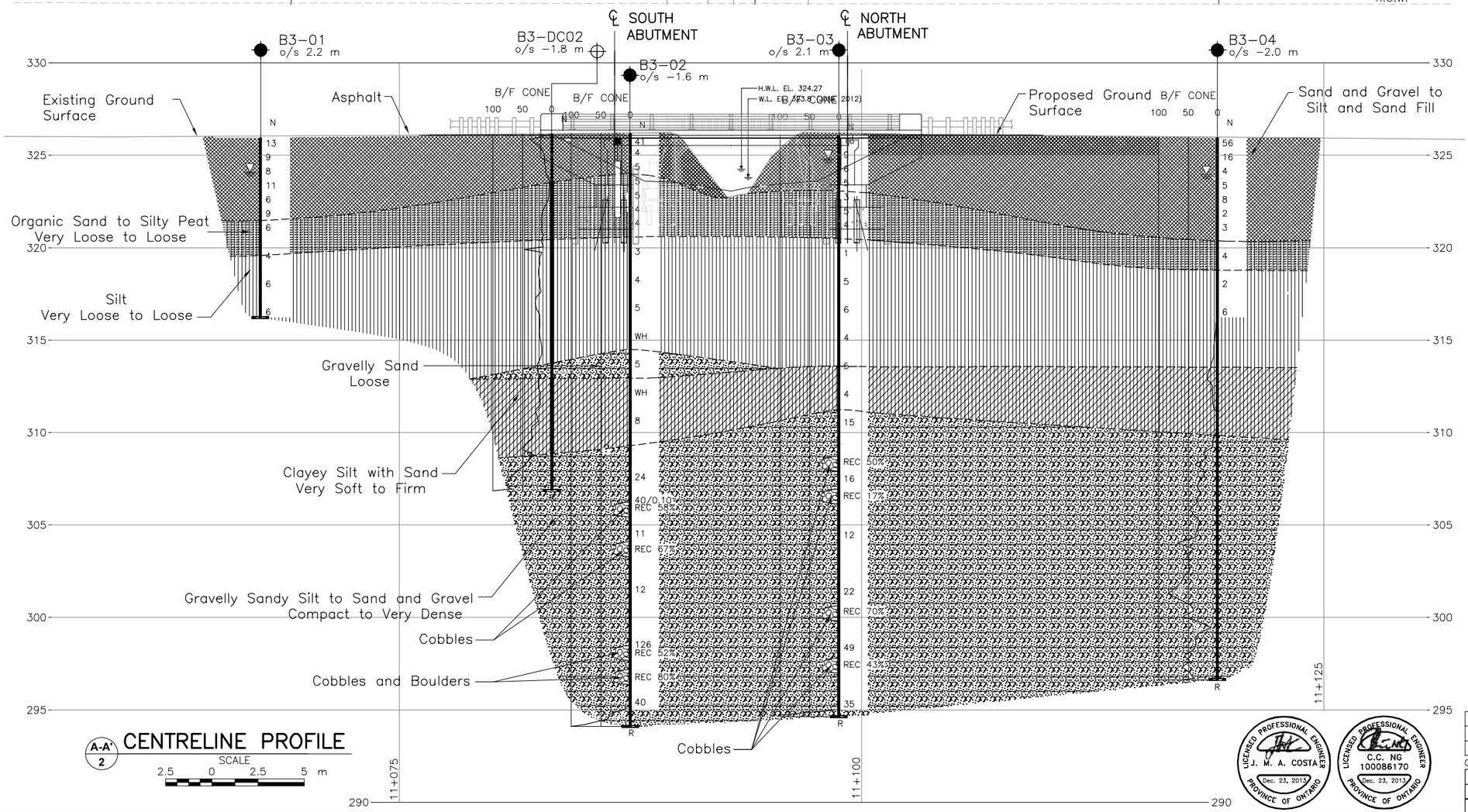
HIGHWAY 592
LITTLE EAST RIVER BRIDGE #3
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA







LEGEND

- Borehole – Current Investigation
- Dynamic Cone Penetration Test
- Seal
- Piezometer
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- REC — Recovery
- WL in piezometer, measured on June 26, 2013
- WL upon completion of drilling
- R — Refusal

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
B3-01	326.0	5035947.3	324343.2
B3-02	326.2	5035967.5	324345.3
B3-03	326.1	5035978.4	324340.7
B3-04	326.0	5035999.2	324343.1
B3-DC02	326.2	5035965.7	324345.7

NOTES

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The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by MH, drawing file nos. X1114246_44-174_44-175_44-176align.dwg, x1114246_44177align.dwg, x1114246_44178_44166align.dwg and X1114246_44-174_44-175_44-176base.dwg, x1114246_44177base.dwg and x1114246_44178_44166base.dwg, received June 11, 2013 and General Arrangement file Plan and Profile no. 44176-01.dwg, received November 7, 2013.

NO.	DATE	BY	REVISION

Geocres No. 31E-332

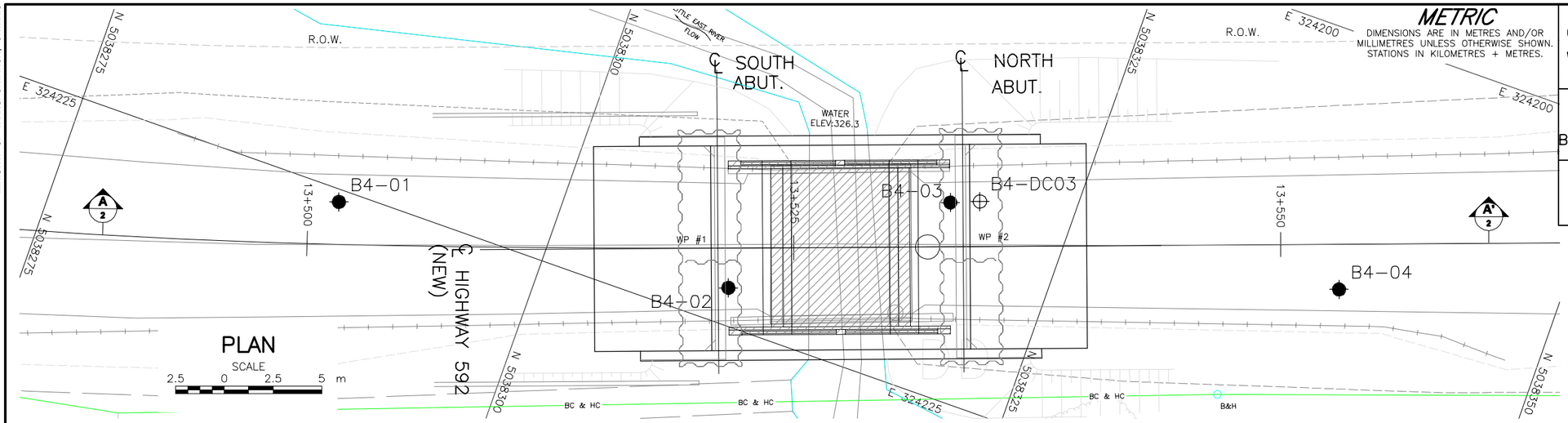
HWY. 592	PROJECT NO. 11-1111-0149		DIST.
SUBM'D. AV	CHKD. CN	DATE: Dec. 2013	SITE: 44-176
DRAWN: JFC	CHKD. TVA	APPD.	DWG. 2

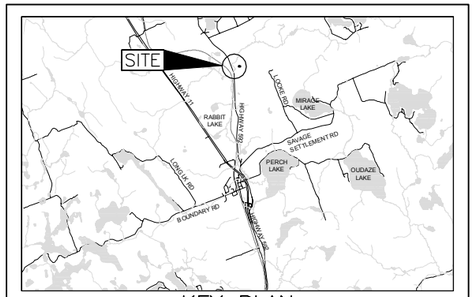
LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA Dec. 23, 2013 PROVINCE OF ONTARIO

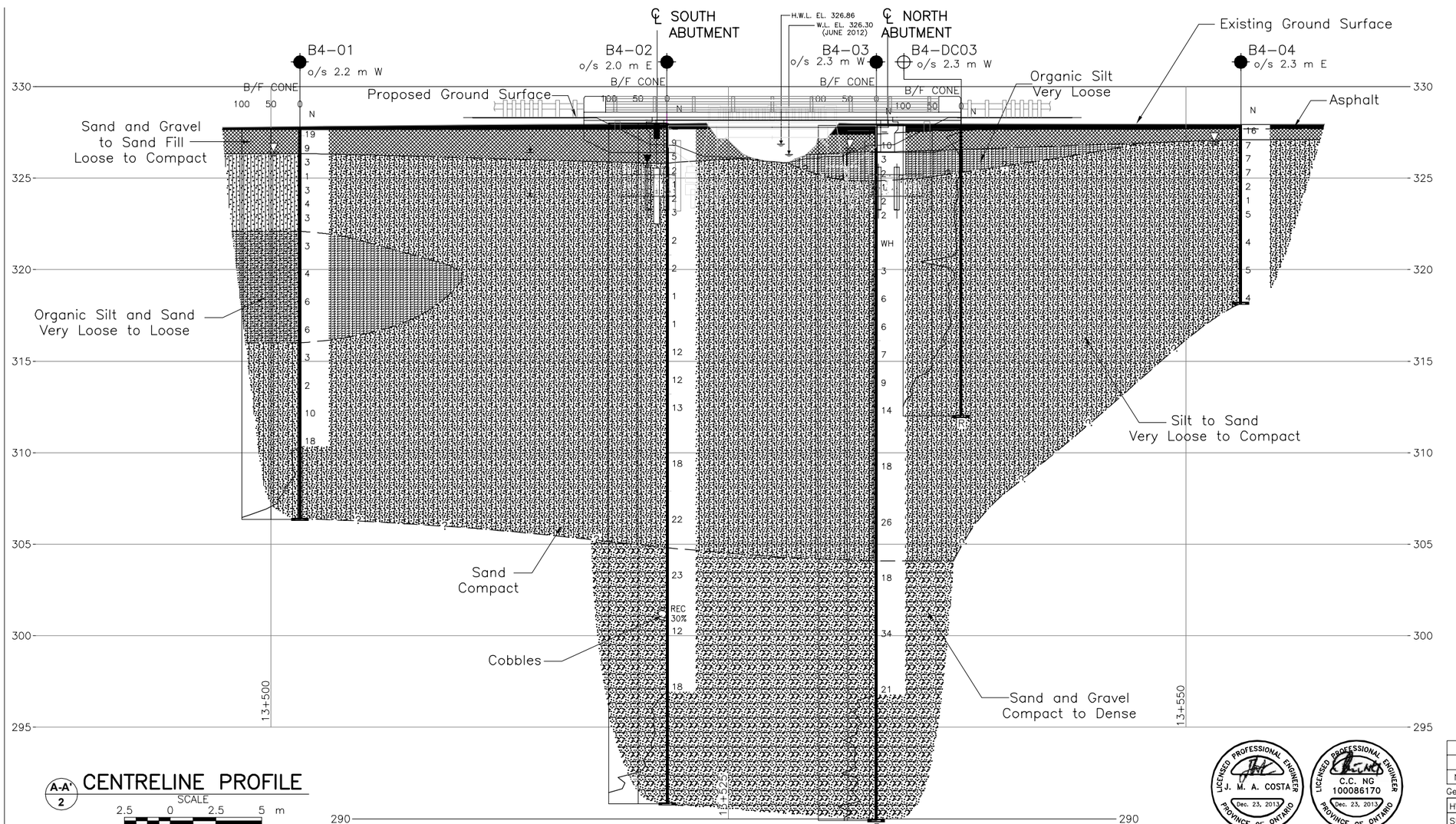
LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 Dec. 23, 2013 PROVINCE OF ONTARIO

PLOT DATE: April 3, 2014
FILENAME: P:\Projects\2011\11-1111-0149 (MK, Huntsville)\-DC-Little East River Bridge #3 (Contract No.)\11111191BOR002.dwg

MINISTRY OF TRANSPORTATION, ONTARIO







METRIC

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

CONT No. 2014-5125
WP No. 5268-07-01

HIGHWAY 592

LITTLE EAST RIVER BRIDGE #4

BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA

LEGEND

- Borehole – Current Investigation
- Dynamic Cone Penetration Test
- Seal
- Piezometer
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- REC — Total core recovery
- WL in piezometer, measured on June 26, 2013
- WL upon completion of drilling
- R — Refusal

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
B4-01	327.7	5038289.2	324225.6
B4-02	328.0	5038309.5	324223.1
B4-03	327.9	5038318.8	324215.2
B4-04	327.9	5038339.1	324212.7
B4-DC03	327.9	5038320.2	324214.6

NOTES

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REFERENCE

Base plans provided in digital format by MH, drawing file nos. X1114246_44-174_44-175_44-176align.dwg, x1114246_44177align.dwg, x1114246_44178_44166align.dwg and X1114246_44-174_44-175_44-176base.dwg, x1114246_44177base.dwg and x1114246_44178_44166base.dwg, received June 11, 2013 and General Arrangement Plan and Profile file no. 44177-01.dwg, received November 7, 2013.

LICENSED PROFESSIONAL ENGINEER J. J. M. A. COSTA Dec. 23, 2013 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 Dec. 23, 2013 PROVINCE OF ONTARIO

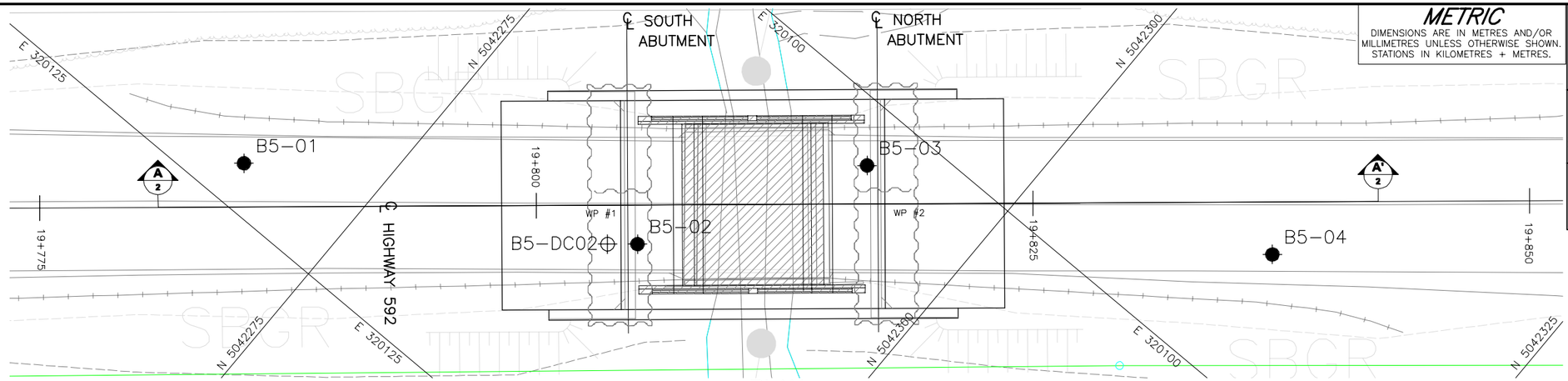
NO.	DATE	BY	REVISION

Geocres No. 31E-333

HWY. 592	PROJECT NO. 11-1111-0149		DIST.
SUBM'D. AV	CHKD. CN	DATE: Dec. 2013	SITE: 44-177
DRAWN: JFC	CHKD.	APPD.	DWG. 2

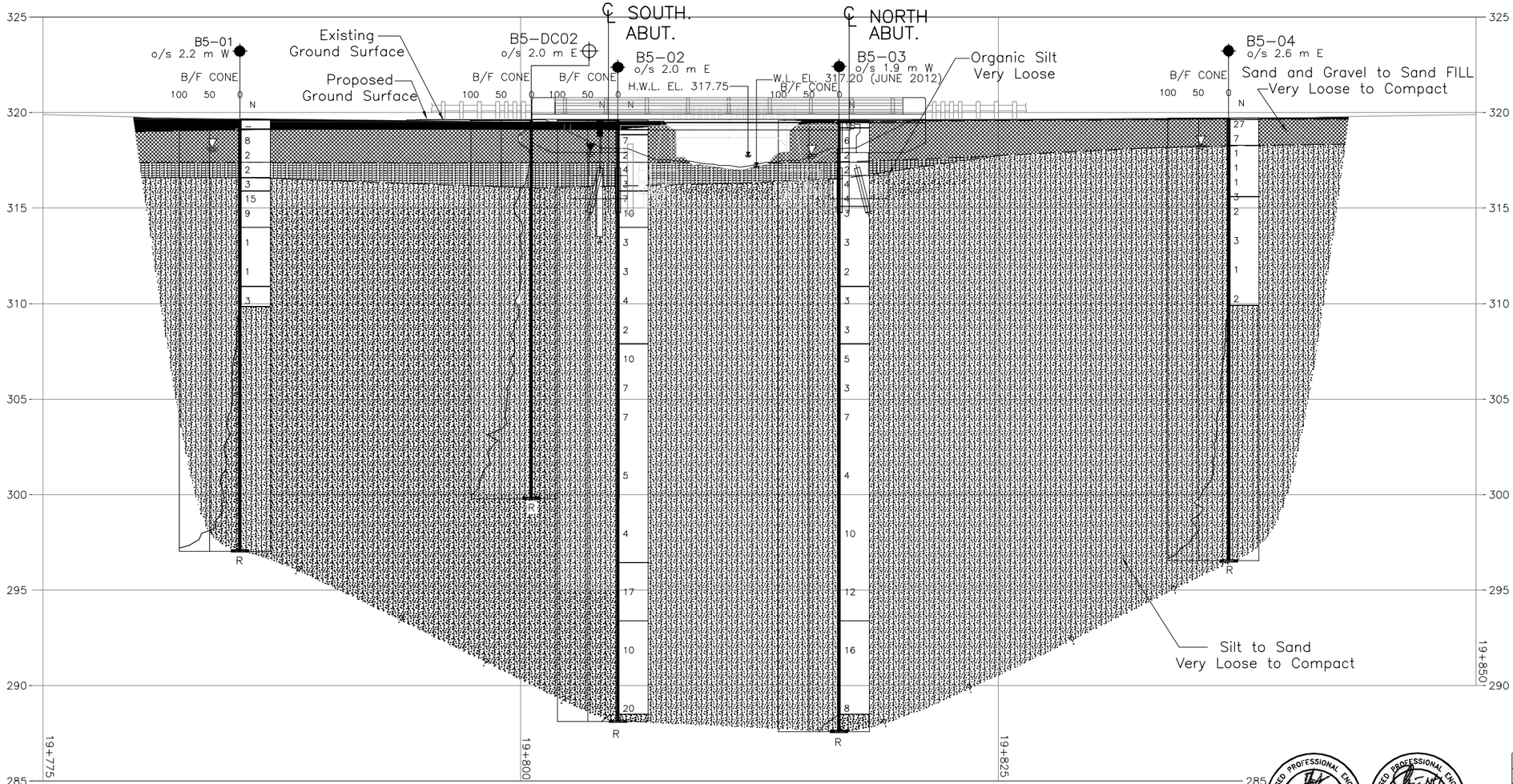
PLOT DATE: April 3, 2014
FILENAME: F:\Projects\2011\11-1111-0149 (MH, Huntsville)_DC-Little East River Bridge #4 (Contract No.)\11111101490D002.dwg

MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

SCALE 2.5 0 2.5 5 m



CENTRELINE PROFILE

A-A'

SCALE 2.5 0 2.5 5 m

METRIC

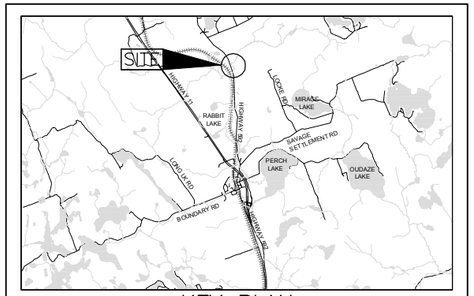
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 5269-07-01

SHEET

HIGHWAY 592
RAGGED CREEK BRIDGE
BOREHOLE LOCATIONS AND SOIL STRATA

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN

SCALE 2 0 2 4 km

LEGEND

- Borehole – Current Investigation
- Dynamic Cone Penetration Test
- Seal
- Piezometer
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL in piezometer, measured on June 21, 2013
- WL upon completion of drilling
- R — Refusal

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
B5-01	319.6	5042269.0	320122.8
B5-02	319.6	5042286.8	320113.2
B5-03	319.6	5042293.1	320102.8
B5-04	319.7	5042311.6	320093.1
B5-DC02	319.6	5042285.6	320114.2

NOTES

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REFERENCE

Base plans provided in digital format by MH, drawing file nos. X1114246_44-174_44-175_44-176align.dwg, x1114246_44177align.dwg, x1114246_44178_44166align.dwg and X1114246_44-174_44-175_44-176base.dwg, x1114246_44177base.dwg and x1114246_44178_44166base.dwg, received June 11, 2013 and General Arrangement Plan and Profile file no. 44178-01.dwg, received August 26, 2013.

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA Dec. 23, 2013 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 Dec. 23, 2013 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 31E-334

HWY. 592	PROJECT NO. 11-1111-0149		DIST.
SUBM'D. AV	CHKD. CN	DATE: Jan. 2014	SITE: 44-178
DRAWN: JFC	CHKD. TVA	APPD.	DWG. 2

PLOT DATE: April 3, 2014
FILENAME: T:\Projects\2011\11-1111-0149 (M, Huntsville)\-EB-Ragged Creek Bridge #5 Stamped\11111101496B002.dwg

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. 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 who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario, L5N 7K2
Canada
T: +1 (905) 567 4444

Golder Associates