



**FOUNDATION INVESTIGATION AND DESIGN REPORT
for**

**SWAMP CROSSING
HIGHWAY 11
SOUTH MARY LAKE ROAD INTERCHANGE
G.W.P. 62-86-00
DISTRICT 52, TOWNSHIP OF STEPHENSON
HUNTSVILLE, ONTARIO**

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PML Ref.: 04TF007
Index No.: 069FIR and 070FDR
Geocres No.: 31E-237
May 17, 2005



FOUNDATION INVESTIGATION REPORT

for

SWAMP CROSSING

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(Golder Associates Limited Reference No. 991-8064G)

**FOUNDATION INVESTIGATION REPORT
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SWAMP CROSSING

Highway 11
South Mary Lake Road Interchange
G.W.P. 62-86-00
District 52, Township of Stephenson
Huntsville, Ontario

1. INTRODUCTION

This report summarizes the results of the foundation investigation carried out for the proposed construction of embankments through a swamp associated with the planned interchange at South Mary Lake Road/Stephenson Road 4 and Highway 11 some 14 km south of Huntsville, Ontario. This report was prepared for McCormick Rankin Corporation (MRC) on behalf of the Ministry of Transportation of Ontario (MTO).

The swamp is located at the southwest corner of Stephenson Road 4 and Lone Pine Drive (Old Highway 11) and affects the proposed Stephenson Road 4 connection to the realigned South Mary Lake Road and west ramps of the interchange. The investigations were carried out along the following embankment sections:

- Stephenson Road 4 Connection - Sta. 40+050 to Sta. 40+375
- N-E/W Ramp - Sta. 13+950 to Sta. 14+175
- E/W-S Ramp - Sta. 14+275 to Sta. 14+525
- W-S Connection - Sta. 14+423 to Sta. 14+500

The Key Plan showing the locations and lay-out of the connection road and interchange ramps is the attached Figure A.

Golder Associates Limited (GAL) carried out the Preliminary Foundation Investigation and Design Report reference No. 011-1104, and the Draft Pavement Design Report reference No. 991-8064G, both dated April 2001 for the project. Copies of the twelve geotechnical boreholes from the Draft Pavement Design Report that were used to supplement the current investigation are reproduced in Appendix A.

This report summarizes the results of the field investigation conducted at the swamp crossings identified in the RFP for this project. The subsurface conditions along the remaining portion of the



embankment sections are provided in the Pavement Design Report prepared by Peto MacCallum Ltd. (PML) reference No. 04TF005 to be issued later in 2005.

2. SITE DESCRIPTION AND GEOLOGY

The site is located south of the existing Stephenson Road 4 and between Lone Pine Drive on the east and a set of railway tracks constructed over a low embankment on the west. The swamp site is covered with grasses, brush and dead trees. A beaver dam located at the north end of the swamp dams the outflow of drainage ditches and the west roadside ditch along Lone Pine Drive and contributes to flooding of the lower parts of the swamp.

The site is located near isolated residences north of Stephenson Road 4. Commercial enterprises near the site are located east of Highway 11.

The site topography is generally flat with locally hummocky areas. The ground surface rises slightly to the southwest with a maximum relief between boreholes of 2.4 m.

The project site physiography comprises mainly sands and silts within a narrow strip of land that extends from Gravenhurst to North Bay ("The Physiography of Southern Ontario", Chapman and Putman, 1984). The site is located within the Central Gneiss Belt (Geologic Map 2544, Ministry of Northern Development and Mines) that comprises Precambrian rock formations. The typical rock types in the project area are migmatites, gneisses and felsic igneous rocks, such as granite. The soil/bedrock interface depths in the area is variable ranging from the surface to over 35 m.

3. INVESTIGATION PROCEDURES

The field work for the foundation investigation involved a total of 84 test holes including the twelve boreholes advanced by GAL Geotechnical Group. PML advanced 72 test holes, comprising 59 boreholes and 13 dynamic cone penetration tests carried out during the periods of April 5 to 15, 2004 and February 1 to 4, 2005. The test locations for each ramp are identified by a prefix corresponding to the road and ramp designation and numbered sequentially for each



embankment. The numbering of boreholes re-used from the GAL preliminary report includes the letter G. The numbering system is as follows:

- Stephenson Road 4 Connection - SR4-1 to SR4-32 and SR4-G1 to SR4-G6
- N-E/W Ramp - NEW-1 to NEW-17 and NEW-G1 to NEW-G3
- E/W-S Ramp - EWS-1 to EWS-21 and EWS-G1 to EWS-G3
- W-S Connection - WS-1 and WS-2

The test hole locations are shown on Drawing 1 attached. The PML test holes were advanced to depths ranging from 0.9 to 8.2 m below existing grade and the GAL boreholes terminated at depths ranging from 1.7 to 9.2 m. Thirty of the 84 test holes (35.7%) terminated on probable bedrock.

The test hole locations were established in accordance with the MTO requirements indicated in the RFP document and in general accordance with the requirements of the MTO Northeastern Region Pavement Design Practices and Guidelines (May 20, 1997). The access was difficult to locations under standing water that was present through the winter and a few boreholes were relocated to the nearest ground made accessible with ice bridges prepared with a backhoe. MRC laid out the reference lines of the new connection road and ramps in the field and these lines were used to lay-out the test hole locations. Geodetic elevations were referred to temporary field benchmarks.

The test holes were advanced using track-mounted drill rigs and an excavator for one borehole located under Hydro power lines. The equipment was supplied and operated by drilling and excavation contractors working under the full-time supervision of members of our engineering staff.

Representative samples of the soils were recovered at frequent depth intervals using a conventional split spoon sampler during drilling. Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata. Standard penetration test N values in the sand layer immediately below the peat deposits were disturbed by high groundwater. The soil stratigraphy in the unsampled boreholes was determined from observation of the auger cuttings. The results of the field tests and observations are reported on the Record of Borehole sheets.



The groundwater conditions at the borehole locations were assessed during drilling by visual examination of the soil, the sampler and drill rods as the samples were retrieved and by measurement of the water level in the open boreholes. Upon completion of drilling, the boreholes were backfilled with a bentonite/cement mixture in accordance with the MTO guidelines for borehole abandonment procedures.

Soils were identified in the field in accordance with the MTO Soil Classification procedures. The soil samples were returned to our laboratory for detailed visual examination and classification. Fifty-three natural moisture content determinations and thirty-one grain size distribution analyses were performed on selected soil samples from each embankment. The silty samples were assessed to be non-plastic by tactile examination. The laboratory test results are shown on the record of borehole logs and presented on Figures 1, 2 and 3.

4. SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Record of Borehole and Record of Penetration Test sheets for details of the subsurface conditions including soil classifications, inferred stratigraphy, standard and dynamic cone penetration test data. The Record of Borehole sheets also show the results of laboratory grain size distribution analyses and natural moisture content determination.

The stratigraphic profiles along the embankment centreline and toe of embankment slopes of the Stephenson Road No. 4 connection and intersection ramps (established from profile in RFP) as well as characteristic cross-sections at selected locations are presented on Drawings 2 to 10. The boundaries between soil strata have been established at the borehole locations only. Between and beyond the boreholes, the soil unit boundaries are assumed and may vary.

Standing water up to 1.0 m deep occurs throughout the swamp area and was found in several boreholes advanced during the current and preliminary field investigations.

A general description of the subsurface conditions encountered at the embankment swamp crossings is provided in Table A. A summary of the findings is given below.



4.1 Stephenson Road 4 Connection

A total of 38 test holes were advanced for the Stephenson Road 4 Connection road comprising 32 boreholes (including 6 previous GAL boreholes) and 6 dynamic cone penetration tests. The road alignment crosses the swamp between Sta. 40+050 and Sta. 40+375.

The subsurface stratigraphy generally comprises a surficial peat layer over cohesionless loose to dense sandy and/or silty deposits. The pavement of Lone Pine Drive was encountered in one of the GAL boreholes. Nine of the test holes terminated by refusal on probable bedrock.

4.1.1 Pavement

The pavement of Lone Pine drive was penetrated in borehole SR4-G2. The pavement consisted of 50 mm thick asphaltic concrete over a 500 mm thick granular layer.

4.1.2 Peat

A surficial deposit of peat is present in 30 of the 31 boreholes drilled along the proposed Stephenson Road 4 Connection alignment. The peat has a varying thickness of 0.1 to 1.8 m and a typical thickness range of 0.2 to 0.6 m. Moisture content determinations of 451 and 457% were found in the peat. This deposit was penetrated at levels ranging from elevations 308.1 to 310.9.

4.1.3 Sand

Cohesionless sand trace to with silt underlies the peat and pavement units in all boreholes. The thickness of this unit where it was fully penetrated in 18 of the 31 boreholes is 1.5 to 4.4 m extending to depths of 1.7 to 4.8 m, elevations 305.6 to 309.4. The remaining 13 boreholes and the 5 dynamic cone penetration tests were terminated in the sand deposit at depths ranging from 1.2 to 4.6 m, elevations 306.0 to 310.1.

The sand is loose to dense and typically compact (SPT N values of 12 to 20). The natural moisture content of the sand ranged from 19 to 23%. The results of grain size distribution analyses performed on the sand are presented in Figure 1.



4.1.4 Silt

Discontinuous cohesionless silt trace sand trace clay underlies the sand deposit in 10 boreholes. The unit occurs at depths of 2.7 to 4.8 m, elevations 305.6 to 307.1 and extends to the 3.5 to 5.2 m termination depths of 9 of the boreholes. Probable bedrock underlies the silt in the remaining borehole at 7.5 m depth, elevation 301.3 (borehole SR4-5). This unit is loose to very dense with N values ranging from 7 to 71 however the silt is typically compact (typical N values range from 14 to 24).

The moisture content of the silt varies from 18 to 21%. Grain size distribution charts from analyses performed on the silt are presented on Figure 2.

4.1.5 Bedrock

Bedrock was inferred by refusal to further advance in 9 of the test holes at depths of 1.7 to 7.5 m, elevations 301.3 to 308.4.

4.1.6 Groundwater

Groundwater is at depths of 0.0 to 1.3 m elevations 308.1 to 311.2, as encountered in 23 of the 31 boreholes drilled the course of the current and previous 2001 field work. The groundwater is susceptible to fluctuations due to seasonal and rainfall patterns.

4.2 N-E/W Ramp

A total of 20 test holes were advanced for the N-E/W Ramp comprising 17 boreholes (including 3 previous GAL boreholes) and 3 dynamic cone penetration tests. The ramp connects the Highway 11 southbound lanes to the realigned South Mary Lake Road. The alignment crosses the swamp from Sta. 13+950 to Sta. 14+175.



The subsurface stratigraphy generally comprises a surficial peat layer over cohesionless loose to dense sandy and/or silty deposits. Standing water is found at one current borehole location and two boreholes in 2001. The pavement of Lone Pine Drive was encountered in one of the GAL boreholes. Eleven of the twenty test holes extended to probable bedrock.

4.2.1 Pavement

The pavement of Lone Pine Drive was penetrated only in borehole NEW-G3. The pavement consisted of 40 mm thick asphaltic concrete over a 460 mm thick granular layer. Since the road embankment was constructed using the native sand, the fill was not differentiated from the native soils in the GAL borehole description. It is estimated that the fill is about 1.0 m deep.

4.2.2 Peat

A surficial deposit of peat is present or is inferred in 19 of the 20 test holes drilled on the swamp section of the N-E/W Ramp. The peat has a thickness of 0.2 to 1.2 m and was penetrated at elevations 308.0 to 309.9. The moisture content of this peat deposit is inferred to vary from 62 to over 500% based on determinations of moisture content in the same deposit under the alignments of this ramp and the adjacent E/W-S Ramp.

4.2.3 Sand

Cohesionless sand trace to with silt underlies the peat and pavement units in all boreholes and is inferred in all dynamic cone penetration tests. The thickness of this unit where it was fully penetrated in 16 of the 20 test holes is 1.4 to 3.3 m and estimated 4.0 m in borehole NEW-G3. The sand extends to depths of 2.4 to 4.5 m, elevations 305.3 to 307.3. The remaining 4 test holes terminated in the sand deposit at depths ranging from 1.5 to 3.0 m, elevations 306.3 to 308.3.

The sand is loose to compact with typical penetration resistances N values of 8 to 13. N values in the very loose range of 3 to 4 that occur immediately below the peat deposit are not considered representative due to hydraulic disturbance from high groundwater. The natural moisture content of the sand ranged from 16 to 24%, typically 19 to 21%. The particle size distribution charts of the sand are presented on Figure 1.



4.2.4 Silt and Silty Sand

Discontinuous cohesionless silt trace sand trace clay occurs beneath the sand deposit in 14 of 20 test holes. The soil is a silty sand in borehole NEW-15. The units extend to the 5.2 to 9.2 m termination depths of three of the boreholes and 4.5 m termination depth of two dynamic cone tests. The thickness of the silt ranges from 1.1 to 3.4 m where the deposit was fully penetrated at 4.5 to 6.4 m depths, elevations 303.5 to 305.3.

This unit is loose to compact with N values ranging from 8 to 29 however the silt and silty sand are typically compact (typical N values range from 10 to 16). The moisture content of the silt varies from 21 to 22%. Grain size distribution charts from analyses performed on the silt are presented on Figure 2.

4.2.5 Glacial Till

A discontinuous cohesionless glacial till unit comprising sand trace clay and variable amounts of silt and gravel occurs at boreholes NEW-8, 9 and 11 below the silt unit and extend to the underlying bedrock surface. The glacial till is found at depths ranging from 4.6 to 6.4 m, elevations 303.7 to 305.3 and extends to 5.7 to 8.2 m depths, elevations 301.6 to 304.2.

This unit is loose to compact with penetration resistance N values ranging from 9 to 18. One natural moisture content determination on the till is 13%. Grain size distribution charts from analyses performed on the glacial till are presented on Figure 3.

4.2.6 Bedrock

Bedrock was inferred by refusal in 11 of the test holes at depths of 2.6 to 8.2 m, elevations 301.6 to 307.2.

4.2.7 Groundwater

Groundwater is at depths of 0.0 to 1.2 m, elevations 308.9 to 309.8, as encountered in 16 of the 17 boreholes drilled during the course of the current and previous 2001 field work. Standing water



0.4 to 0.6 m deep occurs at three borehole locations (NEW-17, NEW-G1 and NEW-G2). The groundwater is susceptible to fluctuations due to seasonal and rainfall patterns.

4.3 E/W-S Ramp

A total of 24 test holes were advanced for the E/W-S Ramp comprising 20 boreholes (including 3 previous GAL boreholes) and 4 dynamic cone penetration tests. The ramp connects the realigned South Mary Lake Road to the Highway 11 southbound lanes. The alignment crosses a swamp from Sta.14+275 to Sta. 14+525.

The subsurface stratigraphy generally comprises a surficial peat layer over cohesionless loose to dense sandy and/or silty deposits. Ten of the 24 test holes extended to probable bedrock.

4.3.1 Peat

A surficial deposit of peat is present in all of the 20 boreholes and was inferred in the 4 dynamic cone penetration tests drilled along the swamp section of the ramp. The peat has a thickness of 0.2 to 1.5 m and was penetrated at elevation 307.8 to 309.9. The natural moisture content of this deposit ranges from 41 to 584%.

4.3.2 Sand and Silty Sand

Cohesionless sand trace to with silt and an overlying localized silty sand unit underlie or were inferred beneath the peat in all test holes. The thickness of this unit where fully penetrated in 19 of the 24 test holes is 1.7 to 4.0 m, and the materials extend to depths of 2.7 to 4.9 m, elevations 304.3 to 306.5. The remaining 5 test holes terminated in the sand deposit at depths ranging from 1.2 to 4.0 m, elevations 305.2 to 308.5.

The sand and silty sand are typically loose to compact with penetration resistance N values of 8 to 13. N values in the very loose range of 2 to 4 that occur immediately below the peat deposit are not considered representative due to hydraulic disturbance from high groundwater. The range of natural moisture content determinations on the sand and silty sand varies from 17 to 24%, typically 19 to 21%. The particle size distribution charts of the sand are presented on Figure 1.



4.3.3 Silt and Sandy Silt

Discontinuous cohesionless silt trace sand trace clay and localized sandy silt units occur beneath the sand deposit in 19 of 24 test holes. The units extend to the 3.7 to 6.7 m termination depths of 9 of the test holes. Where the silt was fully penetrated at 5.1 to 7.7 m depths, elevations 301.9 to 304.4, the thickness of the deposit ranges from 2.1 to 3.9 m.

The relative density of the silt unit ranges from loose to dense with N values from 9 to 41 however the silt is typically compact (typical N values range from 10 to 20). The moisture content of the silt ranges from 18 to 28% with typical values of 18 to 23%. Grain size distribution charts from analyses performed on the silt are presented on Figure 2.

4.3.4 Glacial Till

A localized 2.0 m thick cohesionless glacial till layer comprising sand trace clay and variable amounts of silt and gravel occurs in borehole EWS-12 below the silt unit and extends to the underlying bedrock. The glacial till unit occurs between 6.1 and 8.1 m depths, elevations 304.0 to 302.0, respectively. The unit also occurs in other nearby boreholes described in separate sections of this report.

This unit is compact to very dense with penetration resistance N values of 10 and 66. Two natural moisture content determinations on the till were 17%. Grain size distribution charts from analyses performed on the glacial till are presented on Figure 3.

4.3.5 Bedrock

Bedrock was inferred by refusal in 10 of the 24 test holes at depths of 5.1 to 8.1 m, elevations 301.9 to 304.4.

4.3.6 Groundwater

Groundwater is at depths of 0.0 to 0.3 m, elevations 308.3 to 310.1, as encountered in 18 of the 20 boreholes drilled the course of the current and previous 2001 field work. Standing water



0.3 to 1.0 m deep occurs at three borehole locations (boreholes EWS-G1, EWS-G2 and EWS-G3). The groundwater is susceptible to fluctuations due to seasonal and rainfall patterns.

4.4 W-S Connection Ramp

Two boreholes were advanced for the W-S Connection Ramp. Borehole NEW-8 was also advanced near the ramp alignment. The ramp connects the realigned South Mary Lake Road alignment to the E/W-S ramp leading to the Highway 11 southbound lanes. The entire W-S Connection is planned over a swamp approximately between Sta. 14+423 and 14+500.

The subsurface stratigraphy generally comprises a surficial peat layer over cohesionless sandy and/or silty deposits overlying glacial till underlain by probable bedrock.

4.4.1 Peat

A surficial deposit of peat is present in the three boreholes drilled along the proposed alignment. The peat thickness ranges from 0.2 to 0.5 m and was penetrated at elevations 309.0 to 309.9.

4.4.2 Sand

Cohesionless sand trace to with silt underlies the peat in the three boreholes. The thickness of this unit is 3.1 to 4.4 m extending to depths of 3.3 to 4.9 m, elevations 305.1 to 306.8.

The sand is loose to compact with penetration resistance N values ranging from 5 to 16 and typical N values from 9 to 14. The natural moisture content of the sand ranged from 18 to 20%. The results of grain size distribution analyses performed on the sand are presented on Figure 1.

4.4.3 Silt

Cohesionless silt trace sand trace clay underlies the sand at depths of 3.3 to 4.9 m, elevations 305.1 to 306.8 and extends to 5.8 to 6.7 m depths, elevations 303.3 to 303.7.



The silt unit is typically compact with most N values ranging from 10 to 17 and one local N value of 9. The moisture content determined on the silt was 24%. A grain size distribution chart from one analysis performed on the silt unit is included on Figure 2.

4.4.4 Glacial Till

A localized 0.6 to 2.4 m thick cohesionless glacial till layer comprising sand trace clay and variable amounts of silt and gravel occurs below the silt unit and extends to the underlying bedrock. The glacial till unit occurs between 5.8 and 6.7 m depths and extends to 7.0 to 8.2 m depths, elevations 301.3 to 303.1.

This unit is compact with penetration resistance N values of 18 and 25. The single natural moisture content determination on the till was 11%. Grain size distribution charts from analyses performed on the glacial till in boreholes drilled for other ramps are presented on Figure 3.

4.4.5 Bedrock

Bedrock was inferred by refusal in the three test holes at depths of 7.0 to 8.2 m, elevations 301.3 to 303.1.

4.4.6 Groundwater

Groundwater is at depths of 0.0 to 0.7 m elevations 309.4 to 310.0. The groundwater is susceptible to fluctuations due to seasonal and rainfall patterns.

5. CLOSURE

Messrs. F. Portela, Senior Technician and M. Rapsey, Senior Technician carried out the field investigation for this study under the supervision of Mr. C.M.P. Nascimento, P.Eng., Senior Foundation Engineer.

This report was prepared by Mr. C.M.P. Nascimento, P.Eng., and was reviewed by Mr. B.R. Gray, MEng, P.Eng., MTO Designated Contact. Mr. D.W. Kerr, MEng, P.Eng., Chief Foundation Engineer, conducted an independent review of the report.

Yours very truly,

Peto MacCallum Ltd.



C.M.P. Nascimento, P.Eng.
Senior Foundation Engineer



Brian R. Gray, MEng, P. Eng.
MTO Designated Contact



Dennis W. Kerr, MEng, P.Eng.
Chief Foundation Engineer

CN/BRG/DWK:lr-mi

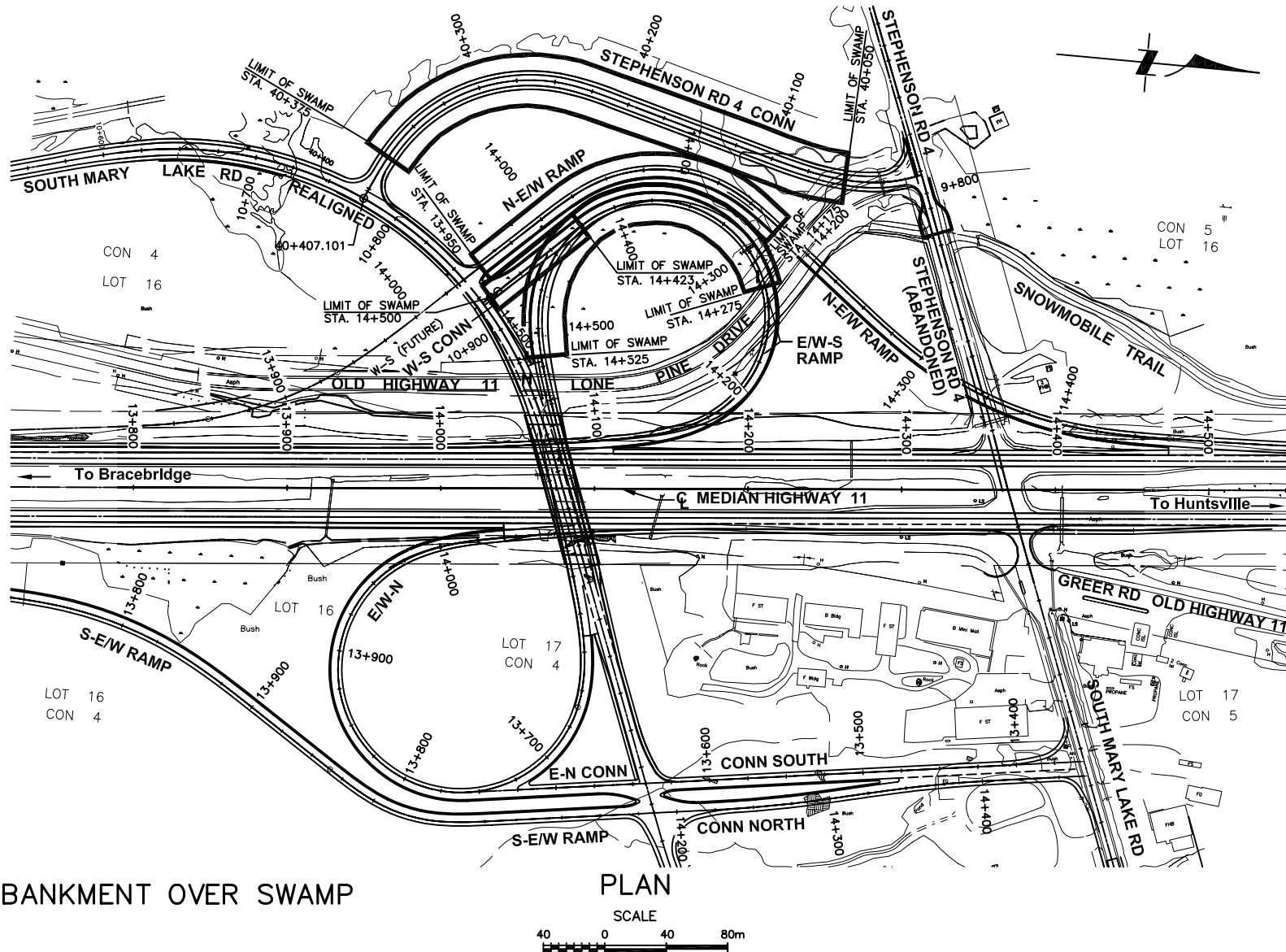


TABLE A
SUMMARY OF SUBSOIL CONDITIONS

SWAMP LOCATION	INTERCHANGE COMPONENT	NO. OF TEST HOLES ⁽¹⁾	PEAT/TOPSOIL THICKNESS ⁽²⁾ (m)	DEPTH TO BOTTOM OF CLAY ⁽²⁾ (m)	DEPTH TO PROBABLE BEDROCK ⁽³⁾ (m)	NOTES AND/OR SOIL STRATIGRAPHY
Twp of Stephenson South Mary Lake Road and Hwy 11 Interchange	<u>Stephenson Road 4 Connection</u> Sta. 40+050 to 40+375	38	0.1 - 1.8	NE	1.7 - 7.5 (El. 301.3 - 308.4)	The Lone Pine Drive pavement encountered in one borehole consists of 50 mm asphalt and 500 mm granular base material. Peat is present in all other boreholes overlying cohesionless typically compact sand underlain by typically compact to dense silt. The surface of the probable bedrock was contacted below the soil cover in 9 boreholes.
	<u>N-E/W Ramp.</u> Sta. 13+950 to 14+175	20	0.2 - 1.2	NE	2.6 - 8.2 (El. 301.6 - 307.2)	The Lone Pine Drive pavement encountered in one borehole consists of 40 mm asphalt and 460 mm granular base material. Peat overlies cohesionless loose to compact sand underlain by typically compact silt and localized silty sand. These deposits overlay a local deposit of compact cohesionless glacial till. The probable bedrock surface was contacted below the soil cover in 11 boreholes. Standing water encountered at 3 borehole locations.
	<u>E/W-S Ramp.</u> Sta. 14+275 to 14+525	24	0.2 - 1.5	NE	5.1 - 8.1 (El. 301.9 - 304.4)	Peat overlies cohesionless loose to compact sand underlain by typically compact silt. A local deposit of compact to dense cohesionless glacial till underlies the silt. Probable bedrock was contacted below the soil cover in 10 boreholes. Standing water encountered at 3 borehole locations.
	<u>W-S Connection</u> Sta. 14+423 to 14+500	2	0.2 - 0.5	NE	7.0 - 8.2 (El. 301.3 - 303.1)	Peat overlies cohesionless loose to compact sand underlain by typically compact silt and compact cohesionless glacial till. Probable bedrock was contacted below the soil cover in all boreholes.

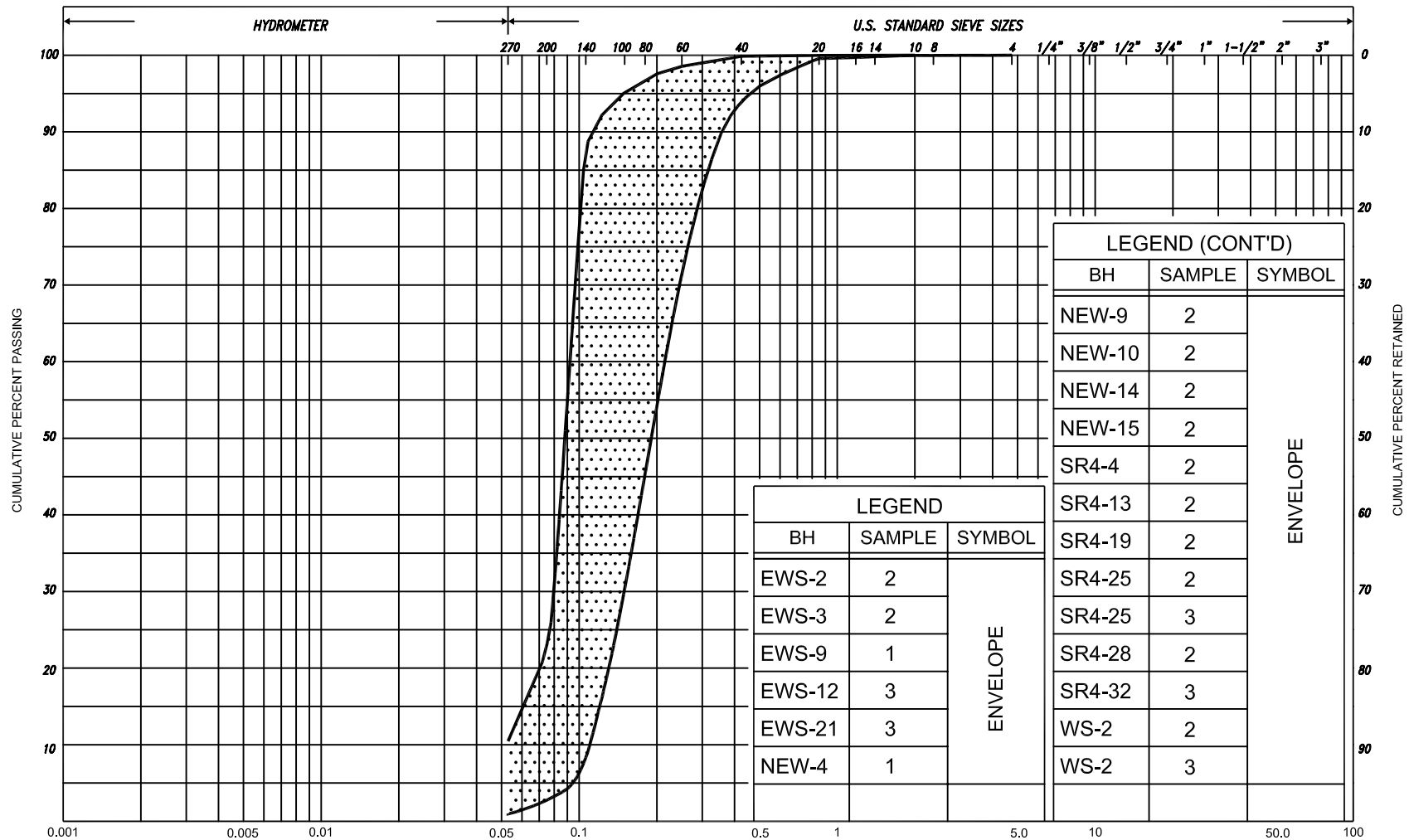
NOTES:

1. Test holes include boreholes and dynamic cone penetration tests. Adjacent ramps shared coincidental boreholes, which are counted for one of the ramps only.
2. Thickness of peat and clay was based on borehole data only.
3. Depth to probable bedrock was based on both borehole and dynamic cone penetration test data.
4. NE -denotes Not Encountered



LEGEND:

EMBANKMENT OVER SWAMP



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

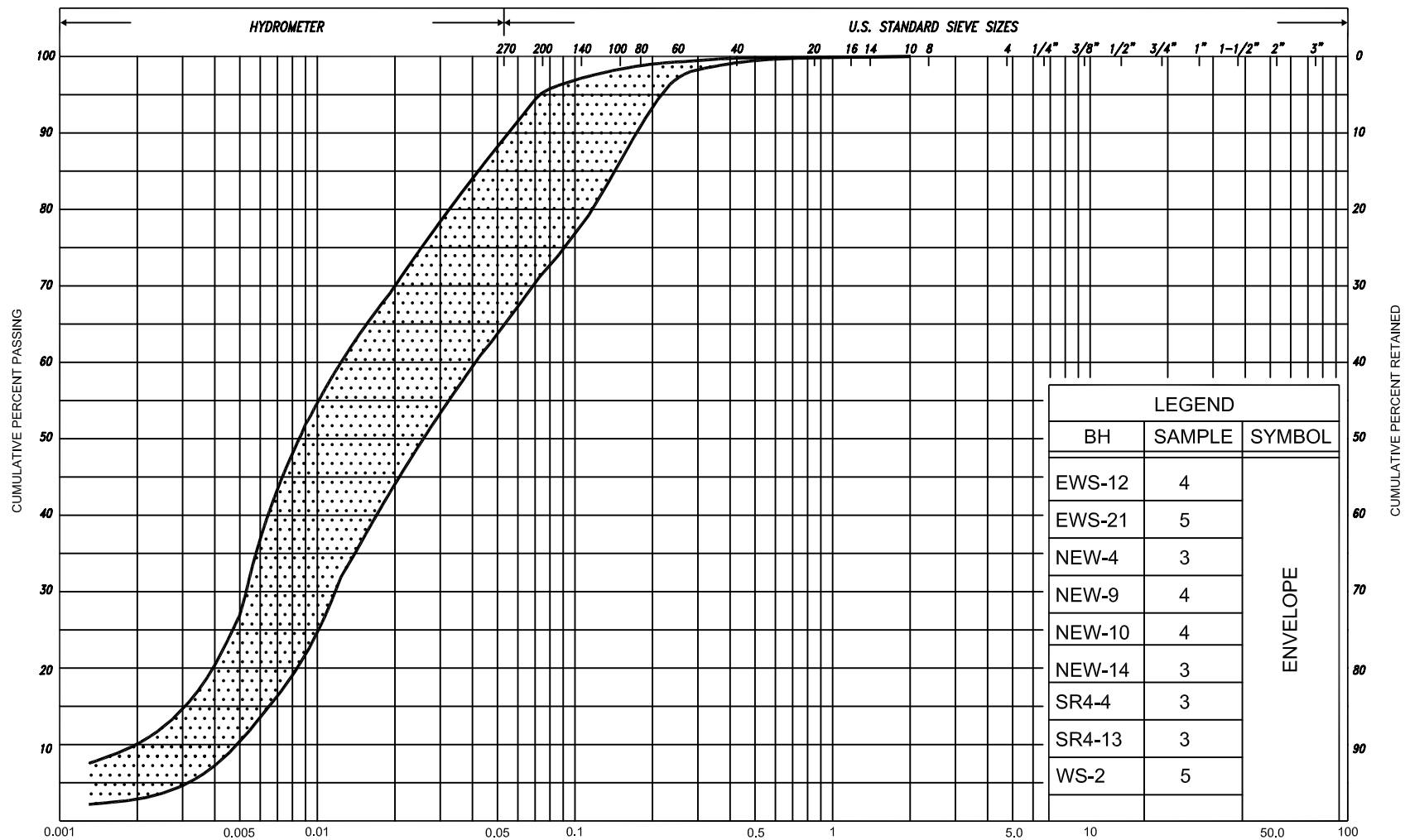
GRAIN SIZE DISTRIBUTION

SAND trace silt to SAND with SILT

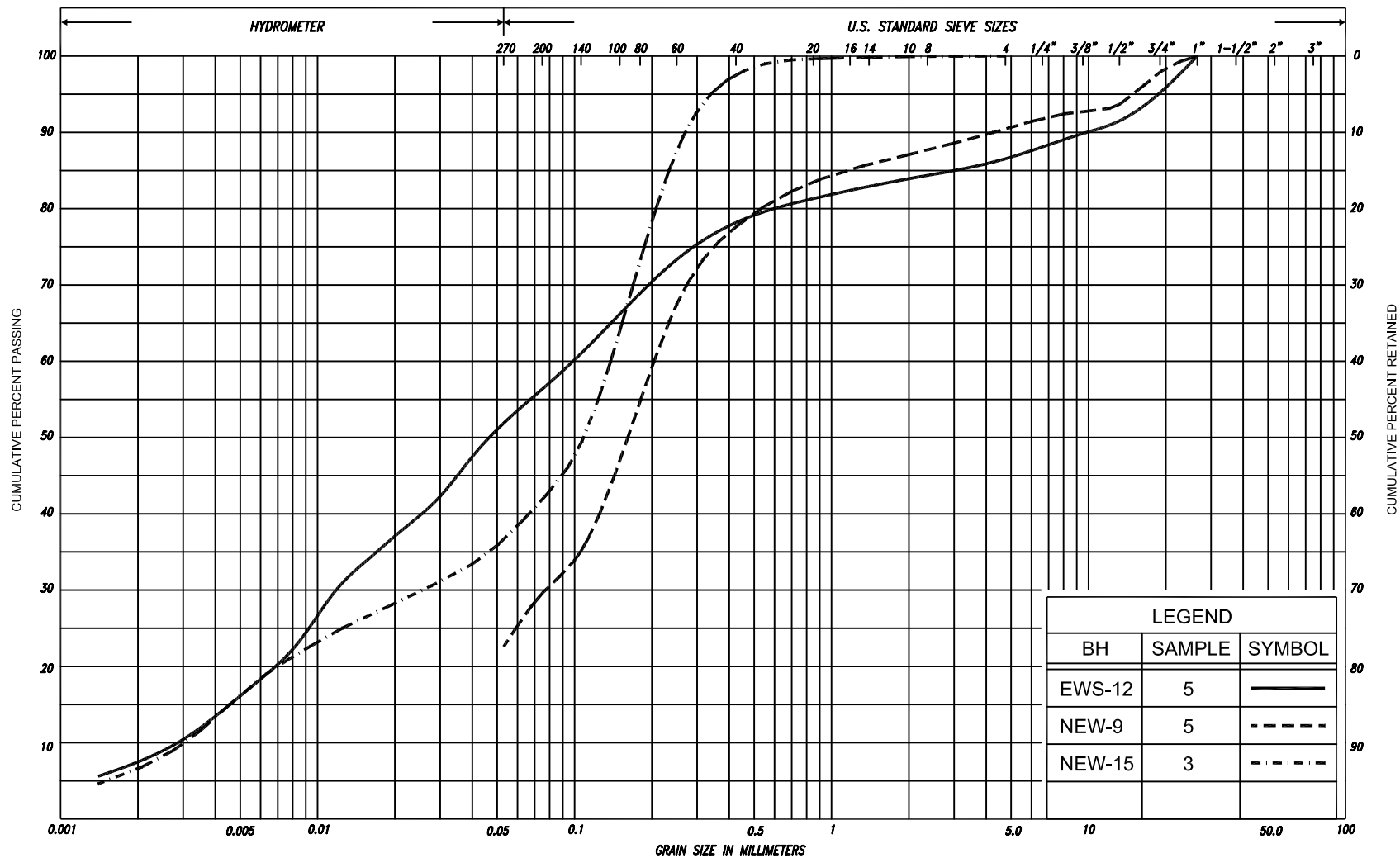
FIG No. 1

HWY 11

G.W.P. No. 62-86-00



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



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

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
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
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{\min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	KN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$
ρ_w	kg/m^3	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	KN/m^3	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	KN/m^3	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m^3/s	RATE OF DISCHARGE
γ_d	KN/m^3	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	KN/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	e_{\max}	1, %	VOID RATIO IN LOOSEST STATE	j	KN/m^2	SEEPAGE FORCE
γ'	KN/m^3	UNIT WEIGHT OF SUBMERGED SOIL						

METRIC

20
15 — 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No SR4-2										1 of 1		METRIC	
W.P. 62-86-00		LOCATION Stephenson Road No. 4 connection		ORIGINATED BY MR									
DIST 52 HWY 11		BOREHOLE TYPE Continuous Flight Hollow Stem Augers		COMPILED BY MR									
DATUM Geodetic		DATE April 13, 2004		CHECKED BY									

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	w	W _L		
308.8	Ground Surface																
0.0	Peat, coarse fibrous		1	SS	4												
0.3	Dark brown Sand, trace silt Compact Brown Wet		2	SS	11												
305.6																	
3.2	Silt, trace sand, trace clay		3	SS	71												
3.5	Very Grey Wet dense End of borehole																

* 2004 04 13

▼ Water level measured after drilling

Ground frozen to 0.3m depth










RECORD OF BOREHOLE No SR4-3										1 of 1		METRIC					
W.P. 62-86-00		LOCATION Stephenson Road No. 4 connection				ORIGINATED BY MR											
DIST 52 HWY 11		BOREHOLE TYPE Continuous Flight Hollow Stem Augers				COMPILED BY MR											
DATUM Geodetic		DATE April 13, 2004				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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
308.8	Ground Surface																
0.0	Peat, fine to coarse fibrous																
308.3	Dark brown Sand, trace silt																
0.5	Brown Wet																
306.4	End of borehole																
2.4																	
<p>* 2004 04 13</p> <p>▼ Water level measured after drilling</p> <p>NOTE: Soil description based on examination of auger cuttings</p>																	

RECORD OF BOREHOLE No SR4-4

1 of 1

METRIC

W.P. 62-86-00 LOCATION Stephenson Road No. 4 connection ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY MR
 DATUM Geodetic DATE April 13, 2004 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										W _p	W
308.9	Ground Surface							20	40	60	80	100							
0.0	Peat, fine to coarse fibrous		1	SS	14	 *	308									457	GR SA SI CL		
308.4	Dark brown Sand, trace silt																		
0.5	Compact Brown Wet		2	SS	20			307											0 93 7 0
																			
306.2	Silt, trace clay, trace sand					306													
2.7	Compact Grey Wet		3	SS	19												0 6 84 10		
305.2	End of borehole																		
3.7																			
	<div>* 2004 04 13</div> <div> Water level measured after drilling</div> <div>Ground frozen to 0.5m depth</div>																		

* 2004 04 13

▼ Water level measured after drilling

Ground frozen to 0.5m depth

RECORD OF BOREHOLE No SR4-5										1 of 1		METRIC					
W.P. 62-86-00		LOCATION Stephenson Road No. 4 connection				ORIGINATED BY MR											
DIST 52 HWY 11		BOREHOLE TYPE Continuous Flight Hollow Stem Augers				COMPILED BY MR											
DATUM Geodetic		DATE April 14, 2004				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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
308.8	Ground Surface																
0.0	Peat, coarse to fine fibrous																
308.1	Dark brown																
0.7	Sand, trace silt						308										
	Compact Brown Wet		1	SS	15		307										
							306										
305.6	Silt, trace clay, trace sand		2	SS	34		305										
3.2	Dense Grey Wet						304										
	Compact		3	SS	24		303										
							302										
301.3	End of borehole																
7.5	Refusal on probable bedrock																
	* 2004 04 13																
	▼ Water level measured after drilling																

RECORD OF PENETRATION TEST No SR4-6

1 of 1

METRIC

G.W.P. 62-86-00 LOCATION Stephenson Road No. 4 connection ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY MR
 DATUM Geodetic DATE April 14, 2004 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			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					W _p	W			W _L
							20	40	60	80	100						
309.0 0.0	Ground Surface Probable peat																
	Probable sand, trace silt Compact																
306.0 3.0	End of dynamic cone penetration test																
	NOTE: Soil descriptions are based on adjacent sampled boreholes																

RECORD OF BOREHOLE No SR4-7										1 of 1		METRIC					
W.P. 62-86-00		LOCATION Stephenson Road No. 4 connection		ORIGINATED BY MR													
DIST 52 HWY 11		BOREHOLE TYPE Continuous Flight Hollow Stem Augers		COMPILED BY MR													
DATUM Geodetic		DATE April 14, 2004		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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
309.3	Ground Surface																
0.0	Peat, fine fibrous Dark brown						309										
0.3	Sand, fine trace to with silt Brown Moist						308										
307.3	End of borehole																
2.0	Refusal on probable bedrock * Borehole dry NOTE: Soil descriptions based on examination of auger cuttings																











RECORD OF BOREHOLE No SR4-8										1 of 1		METRIC					
W.P. 62-86-00		LOCATION Stephenson Road No. 4 connection		ORIGINATED BY MR													
DIST 52 HWY 11		BOREHOLE TYPE Continuous Flight Hollow Stem Augers		COMPILED BY MR													
DATUM Geodetic		DATE April 14, 2004		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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
309.7	Ground Surface																
0.0	Peat, coarse to fine fibrous																
309.3	Dark brown																
0.4	Sand, trace to with silt																
	Compact Brown Wet		1	SS	12												
307.0	Silt, trace clay trace sand																
2.7	Loose Grey Wet		2	SS	8												
306.0	End of borehole																
3.7	* Borehole dry																

RECORD OF BOREHOLE No SR4-9

1 of 1

METRIC

W.P. 62-86-00 LOCATION Stephenson Road No. 4 connection ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY MR
 DATUM Geodetic DATE April 14, 2004 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
309.7	Ground Surface																
0.0	Peat, coarse to fine fibrous		1	SS	1												
309.3																	
0.4	Dark brown																
	Sand, trace to with silt						309										
	Compact Brown Wet																
			2	SS	12		308										
																	
																	
307.0							307										
2.7	Silt, trace clay trace sand																
	Compact Grey Wet																
306.0			3	SS	18												
3.7	End of borehole						306										

METRIC

ON_MOT VER 3A 04TF007_STEPHENSON RD REALIGNED_FINAL.GPJ ON_MOT.GDT 21/02/05 2:02:56 PM

+7, X⁵: Numbers refer to Sensitivity

20
15—○—5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No SR4-11

1 of 1

METRIC

W.P. 62-86-00 LOCATION Stephenson Road No. 4 connection ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY MR
 DATUM Geodetic DATE April 14, 2004 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE														
309.7	Ground Surface						309															
0.0	Peat, fine fibrous																					
0.2	Dark brown																					
	Sand, trace to with silt																					
	Brown Moist						308															
	Wet																					
307.3	End of borehole																					
2.4	Refusal on probable bedrock																					
	* Borehole dry																					
	NOTE: Soil descriptions based on examination of auger cuttings																					

RECORD OF PENETRATION TEST No SR4-12

1 of 1

METRIC

G.W.P. 62-86-00 LOCATION Stephenson Road No. 4 connection ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY MR
 DATUM Geodetic DATE April 14, 2004 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
309.7 0.0	Ground Surface Probable peat																
	Probable sand with silt Compact to dense																
306.7 3.0	End of dynamic cone penetration test																
	NOTE: Soil descriptions are based on adjacent sampled boreholes																

RECORD OF BOREHOLE No SR4-13

1 of 1

METRIC

W.P. 62-86-00

LOCATION

Stephenson Road No. 4 connection
Sta. 40+200, CL

ORIGINATED BY MR

DIST 52 HWY 11

BOREHOLE TYPE

Continuous Flight Hollow Stem Augers

COMPILED BY MR

DATUM Geodetic

DATE _____

April 14, 2004

CHECKED BY

[illegible]



RECORD OF PENETRATION TEST No SR4-14


1 of 1

METRIC

G.W.P. <u>62-86-00</u>	LOCATION <u>Stephenson Road No. 4 connection Sta. 40+227, o/s 12.6m Lt</u>	ORIGINATED BY <u>MR</u>
DIST <u>52</u> HWY <u>11</u>	BOREHOLE TYPE <u>Dynamic Cone Penetration Test</u>	COMPILED BY <u>MR</u>
DATUM <u>Geodetic</u>	DATE <u>April 14, 2004</u>	CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100			w _p
309.7 0.0	Ground Surface														
	Probable peat	~~~~~													
	Probable sand with silt	•••••													
	Compact	•••••													
306.7 3.0	End of dynamic cone penetration test	•••••													
NOTE: Soil descriptions are based on adjacent sampled boreholes															

RECORD OF BOREHOLE No SR4-15										1 of 1		METRIC					
W.P. <u>62-86-00</u>		LOCATION <u>Stephenson Road No. 4 connection</u>		ORIGINATED BY <u>MR</u>													
DIST <u>52</u> HWY <u>11</u>		BOREHOLE TYPE <u>Continuous Flight Hollow Stem Augers</u>		COMPILED BY <u>MR</u>													
DATUM <u>Geodetic</u>		DATE <u>April 14, 2004</u>		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" VALUES			SHEAR STRENGTH kPa									
309.9	Ground Surface																
0.0	Peat, fine fibrous																
0.2	Sand, with silt																
	Brown Wet																
307.5	End of borehole																
2.4	Refusal on probable bedrock																
* 2004 04 14  Water level measured after drilling NOTE: Soil descriptions based on examination of auger cuttings																	

RECORD OF BOREHOLE No SR4-16 1 of 1 METRIC																
W.P. <u>62-86-00</u>		LOCATION <u>Stephenson Road No. 4 connection</u>				ORIGINATED BY <u>MR</u>										
DIST <u>52</u> HWY <u>11</u>		BOREHOLE TYPE <u>Continuous Flight Hollow Stem Augers</u>				COMPILED BY <u>MR</u>										
DATUM <u>Geodetic</u>		DATE <u>April 14, 2004</u>				CHECKED BY _____										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
309.8	Ground Surface															
0.0	Peat, fine fibrous															
0.2	Dark brown Sand, trace silt, cobbles															
	Compact Rusty brown to brown															
	Grey															
306.3	End of borehole		2	SS	120/25cm											
3.5	Refusal on probable bedrock															
	* Borehole dry															

RECORD OF BOREHOLE No SR4-17

1 of 1

METRIC

W.P. 62-86-00 LOCATION Stephenson Road No. 4 connection ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY MR
 DATUM Geodetic DATE April 15, 2004 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" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
310.0	Ground Surface							20	40	60	80	100								
0.0	Peat, coarse to fine fibrous		1	SS	13	▼*	309													
0.3	Dark brwon Sand, trace silt																			
	Compact Dark Wet brown to brown																			
308.1	with gravel		2	SS	120/ 18cm															
1.9	End of borehole																			
	Refusal on probable bedrock																			
	 * 2004 04 15																			
	▼ Water level measured after drilling																			
	 Ground frozen to 0.3m depth																			

RECORD OF PENETRATION TEST No SR4-18

1 of 1

METRIC

G.W.P. 62-86-00 LOCATION Stephenson Road No. 4 connection ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY FP
 DATUM Geodetic DATE February 04, 2005 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
311.0 0.0	Ground Surface Probable peat Probable sand, trace silt Compact Brown Wet													
308.4 2.6	End of dynamic cone penetration test Refusal on probable bedrock <													






RECORD OF BOREHOLE No SR4-19

1 of 1

METRIC

W.P. 62-86-00 LOCATION Stephenson Road No. 4 connection ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY MR
 DATUM Geodetic DATE April 15, 2004 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
310.3	Ground Surface							20	40	60	80	100					
0.0	Peat, coarse to fine fibrous		1	SS	3		310										
0.1	Dark brown Sand, trace silt																
	Loose Brown Wet						309										
	Compact		2	SS	20												0 94 6 0
							308										
307.1																	
3.2	Silt, with sand, trace clay		3	SS	46		307										
306.6	Dense Grey Moist																
3.7	End of borehole																
	* Borehole dry																
	Ground frozen to 0.3m depth																

RECORD OF BOREHOLE No SR4-20 1 of 1 METRIC																	
W.P. <u>62-86-00</u>		LOCATION <u>Stephenson Road No. 4 connection</u>		ORIGINATED BY <u>MR</u>													
DIST <u>52</u> HWY <u>11</u>		BOREHOLE TYPE <u>Continuous Flight Hollow Stem Augers</u>		COMPILED BY <u>MR</u>													
DATUM <u>Geodetic</u>		DATE <u>April 15, 2004</u>		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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
310.5	Ground Surface																
0.0	Peat, coarse to fine fibrous																
0.3	Dark brown Sand, trace silt																
	Brown Wet																
308.4																	
2.1	End of borehole																
	Refusal on probable bedrock																
	* 2004 04 15																
	 Water level measured after drilling																
	NOTE: Soil descriptions based on examination of auger cuttings																

RECORD OF PENETRATION TEST No SR4-21

1 of 1

METRIC

G.W.P.	62-86-00	LOCATION	Stephenson Road No. 4 connection Sta. 40+277, o/s 4.4m Rt	ORIGINATED BY	MR
DIST	52	HWY	11	BOREHOLE TYPE	Dynamic Cone Penetration Test
DATUM	Geodetic	DATE	April 15, 2004	CHECKED BY	

[illegible]

RECORD OF BOREHOLE No SR4-22

1 of 1

METRIC

W.P. 62-86-00 LOCATION Stephenson Road No. 4 connection ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY MR
 DATUM Geodetic DATE April 15, 2004 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL
								○ UNCONFINED	● QUICK TRIAXIAL	+ FIELD VANE	× LAB VANE	20					40	60	80				
310.3	Ground Surface																						
0.0	Peat, coarse fibrous																						
0.1	Dark brown Sand, with silt		1	SS	7		310																
	Compact Rusty Wet brown to brown																						
							309																
			2	SS	17																		
							308																
			3	SS	19		307																
306.6	End of borehole																						
3.7																							
	* Borehole dry																						

RECORD OF PENETRATION TEST No SR4-23

1 of 1

METRIC

G.W.P. 62-86-00

LOCATION

Stephenson Road No. 4 connection
Sta. 40+325, o/s 19m Lt

ORIGINATED BY FP

DIST 52 HWY 11BOREHOLE TYPE Dynamic Cone Penetration Test

COMPILED BY FP

DATUM Geodetic

DATE February 04, 2005

— CHECKED BY _____

[illegible]

RECORD OF BOREHOLE No SR4-24

1 of 1

METRIC

W.P. 62-86-00 LOCATION Stephenson Road No. 4 connection ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 04, 2005 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" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
310.9	Ground Surface					▼* ▽*		20	40	60	80	100								
0.0	Peat, <u>fine fibrous</u> amorphous Dark brown		1	AS	-															
310.3																				
0.6	Sand, trace silt		2	AS	-		310													
309.7	Brown Wet																			
1.2	End of borehole																			
<div>* 2005 02 04</div> <div> Water level observed during drilling</div> <div> Water level measured after drilling</div>																				

RECORD OF BOREHOLE No SR4-25

1 of 1

METRIC

W.P. 62-86-00 LOCATION Stephenson Road No. 4 connection ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 04, 2005 CHECKED BY _____

SOIL PROFILE				SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100	W _p	W	W _L		
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
310.9	Ground Surface					▽* ▽*											
0.0	Peat, <u>fine fibrous</u> —		1	AS	WH**											451	
310.4	<u>amorphous</u>																
0.5	Sand, some silt																
	Loose Brown Wet						310										
			2	SS	9		309						○				0 89 11 0
	Compact Rusty — —						308										
			3	SS	16								○				0 87 13 0
307.2	End of borehole																
3.7																	

* 2005 02 04

▽ Water level observed
during drilling

▽* Water level measured
after drilling

WH** Refers to penetration
under weight of rods
and hammer

METRIC

ON_MOT VER 3A 04TF007_STEPHENSON RD REALIGNED_FINAL.GPJ ON_MOT.GDT 21/02/05 2:03:12 PM

+7, X⁵: Numbers refer to Sensitivity

20
15—○—5 (%) STRAIN AT FAILURE
10





RECORD OF BOREHOLE No SR4-27

1 of 1

METRIC

W.P. 62-86-00 LOCATION Stephenson Road No. 4 connection ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 04, 2005 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100	W _p	w	W _L		
311.1	Ground Surface															
0.0	Peat, fine fibrous		1	SS	6											
310.6	Dark brown															
0.5	Sand, with silt															
	Compact Brown Wet		2	SS	10											
	trace silt															
			3	SS	15											
307.1	Silt, trace sand, trace clay															
4.0	Compact Grey Wet		4	SS	17											
305.9	End of borehole															
5.2																
	* 2005 02 04 ▽ Water level observed during drilling ▼ Water level measured after drilling															

RECORD OF BOREHOLE No SR4-28 1 of 1 METRIC																
W.P. <u>62-86-00</u>		LOCATION <u>Stephenson Road No. 4 connection</u>				ORIGINATED BY <u>FP</u>										
DIST <u>52</u> HWY <u>11</u>		BOREHOLE TYPE <u>Hollow Stem Augers</u>				COMPILED BY <u>FP</u>										
DATUM <u>Geodetic</u>		DATE <u>February 04, 2005</u>				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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
311.2	Ground Surface															
0.0	Peat, amorphous		1	SS	3											
310.6	Dark brown															
0.6	Sand, with silt															
	Compact Brown Wet		2	SS	15											
	trace silt															
	Grey		3	SS	14											
306.4	Silt, trace sand, trace clay		4	SS	16											
4.8	Compact Grey Wet															
306.0	End of borehole															
5.2																

RECORD OF BOREHOLE No SR4-29

1 of 1

METRIC

W.P. 62-86-00 LOCATION Stephenson Road No. 4 connection ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 03, 2005 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" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									WATER CONTENT (%)			GR
311.2	Ground Surface					▼* ▽*		20	40	60	80	100								
0.0	Peat, amorphous						311													
	Dark brown																			
310.1																				
1.1	End of borehole																			
	<div>* 2005 02 03</div> <div>▽ Water level observed during drilling</div> <div>▼ Water level measured after drilling</div> <div>NOTE: Soil descriptions based on examination of auger cuttings</div>																			

RECORD OF BOREHOLE No SR4-30

1 of 1

METRIC

W.P.	<u>62-86-00</u>	LOCATION	<u>Stephenson Road No. 4 connection Sta. 40+375, CL</u>	ORIGINATED BY	<u>FP</u>
DIST	<u>52</u>	HWY	<u>11</u>	BOREHOLE TYPE	<u>Hollow Stem Augers</u>
COMPILED BY	<u>FP</u>	DATUM	<u>Geodetic</u>	DATE	<u>February 03, 2005</u>
CHECKED BY					

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60	W _p W W _L	WATER CONTENT (%)		GR SA SI CL						
311.2 0.0	Ground Surface Peat, amorphous Dark brown		1	AS	-	* *	311													
							310													
309.4 1.8 309.1 2.1	Silty sand, organics Brown Wet End of borehole		2	AS	-															
<div>* 2005 02 03</div> <div> Water level observed during drilling</div> <div> Water level measured after drilling</div> <div>NOTE: Soil descriptions based on examination of auger cuttings</div>																				

RECORD OF BOREHOLE No SR4-31

1 of 1

METRIC

W.P. 62-86-00 LOCATION Stephenson Road No. 4 connection ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 03, 2005 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
311.2	Ground Surface					▽* ▽*											
0.0	Peat, amorphous Dark brown						311										
310.3	End of borehole																
0.9	<p>* 2005 02 03</p> <p>▽ Water level observed during drilling</p> <p>▽* Water level measured after drilling</p> <p>NOTE: Soil description based on examination of auger cuttings</p>																

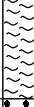


RECORD OF BOREHOLE No SR4-32

1 of 1

METRIC

W.P. 62-86-00 LOCATION Stephenson Road No. 4 connection ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 03, 2005 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" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
311.2	Ground Surface							20	40	60	80	100					
0.0	Peat, amorphous		1	SS	4		311										
0.3	Dark brown																
	Sand, trace silt																
	Very loose Brown Wet						310										
	to loose		2	SS	5												
							309										
							308										
	Compact		3	SS	12												0 94 6 0
							307										
306.5			4	SS	50/3cm												
4.7	End of borehole																
	Refusal on probable bedrock																
	* 2005 02 03																
	▽ Water level observed during drilling																
	▼ Water level measured after drilling																



RECORD OF BOREHOLE No NEW-1 1 of 1 METRIC														
W.P. <u>62-86-00</u>		LOCATION <u>South Mary Lake Road Interchange</u>		ORIGINATED BY <u>MR</u>										
DIST <u>52</u> HWY <u>11</u>		BOREHOLE TYPE <u>Hollow Stem Augers</u>		COMPILED BY <u>MR</u>										
DATUM <u>Geodetic</u>		DATE <u>April 13, 2004</u>		CHECKED BY _____										
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS ∇^* \blacktriangledown^*	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE WATER CONTENT (%)						
309.8	Ground Surface							20 40 60 80 100						
0.0	Peat, amorphous Dark brown						309							
308.8	Sand, fine trace silt		1	SS	7		308							
1.0	Loose Brown Wet						307							
	Compact Grey		2	SS	20		306							
305.5	Silt, trace sand trace clay		3	SS	9		305							
4.3	Loose Grey Wet						304							
303.6	End of borehole													
6.2	Refusal on probable bedrock													
	* 2004 04 13 ∇ Water level observed during drilling \blacktriangledown Water level measured after drilling													

RECORD OF BOREHOLE No NEW-2

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange
N-E/W Ramp Sta. 13+951, o/s 12.9m Lt of Lt EP ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MR
 DATUM Geodetic DATE April 13, 2004 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
309.8 0.0	Ground Surface Peat, amorphous Dark brown		1	SS	1	▽* ▽*	309										
309.0 0.8	Sand, trace silt Compact Brown Wet																
307.2 2.6	End of borehole Refusal on probable bedrock		2	SS	13		308										
				</													

* 2004 04 13

▽ Water level observed
during drilling

▽* Water level measured
after drilling

RECORD OF BOREHOLE No NEW-3

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange ORIGINATED BY MR
DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MR
DATUM Geodetic DATE April 13, 2004 CHECKED BY _____

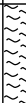




SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+ FIELD VANE								
309.7	Ground Surface					▽* ▽*	20	40	60	80	100						
0.0	Peat, amorphous Dark brown						309										
308.7	Sand, trace silt Brown Wet						308										
307.3	Silt, with fine sand trace clay Compact Grey Wet						307										
2.4	Dense						306										
303.9	End of borehole Refusal on probable bedrock						305										
5.8	* 2004 04 13 ▽ Water level observed during drilling ▽ Water level measured after drilling NOTE: Soil descriptions are based on examination of auger cuttings						304										

RECORD OF BOREHOLE No NEW-4

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange
N-E/W Ramp Sta. 13+951, o/s 8.6m Rt of Lt EP ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MR
 DATUM Geodetic DATE April 13, 2004 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L					
309.6	Ground Surface					▽* ▽*		20	40	60	80	100								
0.0	Peat, amorphous Dark brown						309													
308.6																				
1.0	Sand, fine, trace silt Compact Brown Wet		1	SS	13		308												0 93 3 0	
							307													
	Grey		2	SS	20		306													
							305													
305.3																				
4.3	Silt, trace sand, trace clay Compact Grey Wet		3	SS	24		305								Non-plastic				0 6 90 4	
							304													
303.5																				
6.1	End of borehole Refusal on probable bedrock																			
	<div>* 2004 04 13</div> <div>▽ Water level observed during drilling</div> <div>▽ Water level measured after drilling</div>																			

METRIC

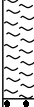


20
15 — 5 (%) STRAIN AT FAILURE
10




RECORD OF PENETRATION TEST No NEW-6

1 of 1

METRIC

G.W.P. 62-86-00 LOCATION South Mary Lake Road Interchange
N-E/W Ramp Sta. 14+003, o/s 23.7m Lt of Lt EP ORIGINATED BY MR
DIST 52 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY MR
DATUM Geodetic DATE April 13, 2004 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40					
309.6 0.0	Ground Surface Probable peat													
	Probable sand, trace silt Compact													
	Probable silt, trace sand, trace clay Dense													
305.1 4.5	End of dynamic cone penetration test													
	NOTE: Soil descriptions are based on adjacent sampled boreholes													

RECORD OF BOREHOLE No NEW-7 1 of 1 METRIC														
W.P. <u>62-86-00</u>		LOCATION <u>South Mary Lake Road Interchange</u>		ORIGINATED BY <u>MR</u>										
DIST <u>52</u> HWY <u>11</u>		BOREHOLE TYPE <u>Hollow Stem Augers</u>		COMPILED BY <u>MR</u>										
DATUM <u>Geodetic</u>		DATE <u>April 13, 2004</u>		CHECKED BY _____										
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa	W _p	W	W _L			
309.6	Ground Surface					▽* ▽*		20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
0.0	Peat, amorphous Dark brown						309							
308.4	Sand, trace silt						308							
1.2	Loose Brown Wet to compact						307							
306.6	Silt, trace sand, trace clay						306							
3.0	Compact Grey Wet													
305.1	End of borehole													
4.5	Refusal on probable bedrock * 2004 04 13 ▽ Water level observed during drilling ▽ Water level measured after drilling NOTE: Soil descriptions based on examination of auger cuttings													

RECORD OF BOREHOLE No NEW-8

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange
N-E/W Ramp Sta. 14+000, o/s 21m Rt of Lt EP ORIGINATED BY RE
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 01, 2005 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" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
310.1	Ground Surface						20	40	60	80	100						
0.0	Peat, coarse fibrous																
0.2	Dark brown		1	SS	1												
	Sand, trace silt organics to 1.0 m																
	Very loose Brown Moist																
	Loose Wet																
			2	SS	5												
	Compact — — — —																
306.8																	
3.3	Silt, with sand		3	SS	15												
	Compact Grey Wet																
	trace clay, — — — — fine sand seams		4	SS	10												
303.7																	
6.4	Sand, trace silt, with gravel		5	SS	18												
303.1																	
7.0	Compact Grey Wet (GLACIAL TILL)																
	End of borehole																
	Refusal on probable bedrock																

* 2005 02 01

▼ Water level measured
after drilling

RECORD OF BOREHOLE No NEW-9

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange ORIGINATED BY RE
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 01, 2005 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" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
309.8	Ground Surface																			
0.0	Peat, coarse fibrous		1	SS	3															
0.3	Dark brown Sand, trace silt, organics to 1.5 m																			
	Loose Dark brown Wet																			

	Brown		2	SS	6											0 96 4 0				
306.3	_____																			
	Compact Grey _____																			
306.3			3	SS	16															
3.5	Silt, trace clay, trace sand																			
	Compact Grey Wet																			
305			4	SS	14											0 3 89 8				
303.7																				
6.1			5	SS	17											10 61 (29)				
303.7	Sand, with silt, trace clay, some gravel																			
	Compact Grey Moist																			
	(GLACIAL TILL)																			
302			6	SS	12															
301.6																				
8.2	End of borehole																			
301.6	Refusal on probable bedrock																			

<div style="display: flex; justify-content: space-between;"> RECORD OF BOREHOLE No NEW-10 1 of 1 METRIC </div>																
W.P. 62-86-00		LOCATION South Mary Lake Road Interchange				ORIGINATED BY RE										
DIST 52 HWY 11		BOREHOLE TYPE Hollow Stem Augers				COMPILED BY FP										
DATUM Geodetic		DATE February 01, 2005				CHECKED BY										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W _p W W _L			
309.8	Ground Surface															
0.0	Peat, fine fibrous		1	SS	3	↓*										0 96 4 0
0.2	Sand, trace silt															
	Loose to compact Brown Moist to wet		2	SS	9											
306.3	Silt, trace sand, trace clay		3	SS	13											
3.5	Compact Grey Wet															
			4	SS	10											0 2 92 6
304.0	End of borehole															
5.8	Refusal on probable bedrock															
* 2005 02 01 Water level measured after drilling																

METRIC

W.P.	<u>62-86-00</u>	LOCATION	<u>South Mary Lake Road Interchange N-E/W Ramp Sta. 14+075, o/s 3m Rt of Lt EP</u>	ORIGINATED BY	<u>RE</u>
DIST	<u>52</u> HWY <u>11</u>	BOREHOLE TYPE	<u>Hollow Stem Augers</u>	COMPILED BY	<u>FP</u>
DATUM	<u>Geodetic</u>	DATE	<u>February 01, 2005</u>	CHECKED BY	

[illegible]

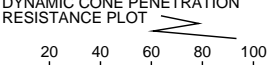
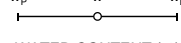

RECORD OF PENETRATION TEST No NEW-12

1 of 1

METRIC

G.W.P. 62-86-00 LOCATION South Mary Lake Road Interchange
N-E/W Ramp Sta. 14+100, o/s 10m Lt of Lt EP ORIGINATED BY RE
 DIST 52 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY FP
 DATUM Geodetic DATE February 01, 2005 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p	W	W _L		
309.8 0.0	Ground Surface Probable peat Probable sand, trace silt Loose to compact													
304.8 5.0	End of dynamic cone penetration test Refusal on probable bedrock NOTE: Soil descriptions are based on adjacent sampled boreholes													



RECORD OF BOREHOLE No NEW-13 1 of 1 METRIC																
W.P. <u>62-86-00</u>		LOCATION <u>South Mary Lake Road Interchange</u>		ORIGINATED BY <u>RE</u>												
DIST <u>52</u> HWY <u>11</u>		BOREHOLE TYPE <u>Hollow Stem Augers</u>		COMPILED BY <u>FP</u>												
DATUM <u>Geodetic</u>		DATE <u>February 01, 2005</u>		CHECKED BY _____												
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
309.8	Ground Surface															GR SA SI CL
0.0	Peat, fine fibrous		1	AS	-											
0.2	Sand, with silt															
	Rusty brown Wet															
308.3			2	AS	-											
1.5	End of borehole															
	* Borehole dry															

RECORD OF BOREHOLE No NEW-14

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 02, 2005 CHECKED BY _____


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L					
309.5	Ground Surface					▽* ▽*														
0.0	Peat, fine fibrous		1	SS	3															
0.3	Dark brown Sand, with silt Very loose Brown Wet trace silt Loose																			
			2	SS	6															
306.1	Compact																			
3.4	Silt, trace clay, trace sand Compact Grey Wet		3	SS	29															
304.3			4	SS	12															
5.2	End of borehole																			
	<div>* 2005 02 02</div> <div>▽ Water level observed during drilling</div> <div>▽ Water level measured after drilling</div>																			

RECORD OF BOREHOLE No NEW-15

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 04, 2005 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
309.3	Ground Surface					▼* ▽*										GR SA SI CL	
0.0	Peat, fine fibrous		1	SS	5												
0.3	Dark brown Sand, some silt																
	Loose Brown Wet		2	SS	9												
	Compact Grey																

* 2005 02 04

▽ Water level observed
during drilling

▼ Water level measured
after drilling

RECORD OF PENETRATION TEST No NEW-16

1 of 1

METRIC

G.W.P. 62-86-00 LOCATION South Mary Lake Road Interchange
N-E/W Ramp Sta. 14+150, o/s 15m Rt of Lt EP ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY FP
 DATUM Geodetic DATE February 04, 2005 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
309.3 0.0	Ground Surface Probable peat Probable sand, trace silt Loose to compact						309										
							308										
							307										
							306										
	Probable silt, trace clay, trace sand Compact						305										
304.1 5.2	End of dynamic cone penetration test																
	NOTE: Soil descriptions are based on adjacent sampled boreholes																

METRIC

W.P.	<u>62-86-00</u>	LOCATION	<u>South Mary Lake Road Interchange N-E/W Ramp Sta. 14+175, o/s 3m Rt of Lt EP</u>	ORIGINATED BY	<u>FP</u>
DIST	<u>52</u> HWY <u>11</u>	BOREHOLE TYPE	<u>Excavator</u>	COMPILED BY	<u>FP</u>
DATUM	<u>Geodetic</u>	DATE	<u>February 01, 2005</u>	CHECKED BY	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	w _p	w	w _L		
309.3 0.0	Top of Ice Ice/water					▽* ▽*											
308.7 0.6	Peat, amorphous		1	GS	-												
308.4 0.9	Dark brown Sandy silt, organic		2	GS	-												
308.2 1.1	Dark brown Wet Sand, trace silt Loose Brown Wet		3	GS	-												
306.9 2.4	End of testpit																
* 2005 02 02 ▽ Water level observed during drilling ▽ Water level measured after drilling																	

METRIC

W.P.	<u>62-86-00</u>	LOCATION	<u>South Mary Lake Road Interchange E/W-S Ramp Sta. 14+280, o/s 25m Lt of Lt EP</u>	ORIGINATED BY	<u>FP</u>
DIST	<u>52</u> HWY <u>11</u>	BOREHOLE TYPE	<u>Hollow Stem Augers</u>	COMPILED BY	<u>FP</u>
DATUM	<u>Geodetic</u>	DATE	<u>February 04, 2005</u>	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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100									
SHEAR STRENGTH kPa								20										40			
309.1	Ground Surface					▼* ▼*	309														
0.0	Peat, <u>fine fibrous</u> Amorphous Dark brown		1	SS	6																
308.3																					
0.8	Sand, trace silt Compact Brown Wet		2	SS	10																
	Grey		3	SS	11																
304.3																					
4.8	Silty sand		4	SS	22																
303.9	Compact Grey Wet																				
5.2	End of borehole																				
* 2005 02 04																					
▽ Water level observed during drilling																					
▼ Water level measured after drilling																					

METRIC

ON_MOT VER 3A 04TF007_EWS REALIGNED.GPJ ON_MOT.GDT 21/02/05 2:15:53 PM

METRIC

ON_MOT VER 3A 04TF007_EWS REALIGNED.GPJ ON_MOT.GDT 21/02/05 2:15:58 PM

RECORD OF BOREHOLE No EWS-4

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 02, 2005 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" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
309.4	Ground Surface																			
0.0	Peat, amorphous		1	AS	-															
0.2	Dark brown Sand, trace silt																			
	Brown Wet		2	AS	-															
308.2																				
1.2	End of borehole																			
</																				

RECORD OF BOREHOLE No EWS-5

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MR
 DATUM Geodetic DATE April 14, 2004 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+	FIELD VANE							
308.6	Ground Surface		1	SS	2	▼*	20	40	60	80	100	20	40	60	GR SA SI CL		
0.0	Peat, fine fibrous																
0.3	Dark brown Sand, with silt																
	Compact Brown Wet		2	SS	18												
305.9	Silt, trace clay, trace sand						20	40	60	80	100	20	40	60			
2.7	Compact Grey Wet		3	SS	23												
304.9	End of borehole																
3.7																	
	* 2004 04 14																
	▼ Water level measured after drilling																

METRIC

ON_MOT VER 3A 04TF007_EWS REALIGNED.GPJ ON_MOT.GDT 21/02/05 2:16:02 PM

+ , X⁵ : Numbers refer to Sensitivity

20
15 — 5 (%) STRAIN AT FAILURE
10

METRIC

MOT_DCPT R2004 04TF007_EWS REALIGNED.GPJ ON_MOT.GDT 21/02/05 2:27:06 PM

7, X 5: Numbers refer to Sensitivity

20
15—○—5 (% STRAIN AT FAILURE)
10

RECORD OF BOREHOLE No EWS-8

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 02, 2005 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" VALUES			20	40	60	80	100					
309.7	Ground Surface					▽* ▽*											
0.0	Peat, <u>fine fibrous</u> Dark brown																
0.3	<u>Amorphous</u> Sand, trace silt Brown Wet						309										
308.5																	
1.2	End of borehole																
* 2005 02 02 ▽ Water level observed during drilling ▽ Water level measured after drilling NOTE: Soil descriptions based on examination of auger cuttings																	

RECORD OF BOREHOLE No EWS-9

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange
E/W-S Ramp Sta. 14+413, o/s 2m Lt of Lt EP ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MR
 DATUM Geodetic DATE April 12, 2004 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																
								○ UNCONFINED	+ FIELD VANE															
								● QUICK TRIAXIAL	× LAB VANE										WATER CONTENT (%)					
309.1 0.0	Ground Surface Peat, amorphous Dark brown						309																	
308.3 0.8	Sand, trace silt Loose Brown Wet						308																	
			1	SS	9		307											0 96 4 0						
							306																	
305.9 3.2	Silt, trace clay, trace sand Compact Grey Wet		2	SS	28		305																	
							304																	
			3	SS	14																			
303.3 5.8	End of borehole Refusal on probable bedrock * 2004 04 12  Water level measured after drilling																							

METRIC

ON_MOT VER 3A 04TF007_EWS REALIGNED.GPJ ON_MOT.GDT 21/02/05 2:15:42 PM

METRIC

MOT_DCPT R2004 04TF007_EWS REALIGNED.GPJ ON_MOT.GDT 21/02/05 2:27:03 PM

+7, X 5: Numbers refer to Sensitivity

20
15—○—5 (% STRAIN AT FAILURE)
10

RECORD OF BOREHOLE No EWS-12

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 02, 2005 CHECKED BY _____

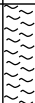


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
310.1	Ground Surface					▽*											
0.0	Peat, amorphous																
0.2	Dark brown Silty sand, Very loose Brown Wet to loose		1	SS	1		310										
							309										
			2	SS	6		308										
308.0	Sand, trace silt						307										
2.1	Compact Brown Wet						306										
	Grey		3	SS	15		305										0 90 10 0
306.1	Silt, trace sand, trace clay						304										
4.0	Compact Grey Wet		4	SS	11		303										0 5 88 7
							302										
304.0	Silt with sand, some gravel, trace clay		5	SS	10												14 30 48 8
6.1	Compact Grey Wet to very dense (GLACIAL TILL)																
302.0	End of borehole		6	SS	66												
8.1	Refusal on probable bedrock																
	* 2005 02 02																
	▽ Water level observed during drilling																
	▼ Water level measured after drilling																

RECORD OF PENETRATION TEST No EWS-13

1 of 1

METRIC

G.W.P. 62-86-00 LOCATION South Mary Lake Road Interchange
E/W-S Ramp Sta. 14+452, o/s 13.9m Lt of Lt EP ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY MR
 DATUM Geodetic DATE April 12, 2004 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
309.4 0.0	Ground Surface Probable peat						309								
	Probable sand, trace silt Compact						308								
	Probable silt, trace sand, trace clay Compact						307								
							306								
							305								
							304								
303.3 6.1	End of dynamic cone penetration test														
	NOTE: Soil descriptions are based on adjacent sampled boreholes														

METRIC

ON_MOT VER 3A 04TF007_EWS REALIGNED.GPJ ON_MOT.GDT 21/02/05 2:15:45 PM

+ , X⁵ : Numbers refer to Sensitivity




20
15—○—5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No EWS-15

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange
E/W-S Ramp Sta. 14+478, o/s 15m Lt of Lt EP ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MR
 DATUM Geodetic DATE April 12, 2004 CHECKED BY _____

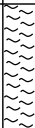



SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L					
309.2	Ground Surface		1	SS	1		309													
0.0	Peat, amorphous Dark brown																			
308.0							308													
1.2	Sand, trace silt Loose Brown Wet		2	SS	6															
							307													
306.3																				
2.9	Silt, with sand Loose Grey Wet to compact		3	SS	10		306													
							305													
	trace sand, trace clay		4	SS	9		304													
303.0																				
6.2	End of borehole Refusal on probable bedrock						303													
	* Borehole dry																			

RECORD OF PENETRATION TEST No EWS-16

1 of 1

METRIC

G.W.P. 62-86-00 LOCATION South Mary Lake Road Interchange
E/W-S Ramp Sta. 14+479, o/s 9.1m Rt of Lt EP ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY MR
 DATUM Geodetic DATE April 12, 2004 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
309.5 0.0	Ground Surface Probable peat													
	Probable sand, trace silt Compact													
	Probable silt, trace sand, trace clay Compact													
304.4 5.1	End of dynamic cone penetration test Refusal on probable bedrock													
	NOTE: Soil descriptions are based on adjacent sampled boreholes													

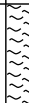


RECORD OF BOREHOLE No EWS-17 1 of 1 METRIC																	
W.P. <u>62-86-00</u>		LOCATION <u>South Mary Lake Road Interchange</u>		ORIGINATED BY <u>MR</u>													
DIST <u>52</u> HWY <u>11</u>		BOREHOLE TYPE <u>Hollow Stem Augers</u>		COMPILED BY <u>MR</u>													
DATUM <u>Geodetic</u>		DATE <u>April 12, 2004</u>		CHECKED BY _____													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ	GR SA SI CL
								20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100			
309.2	Ground Surface					▽* ▽*											
0.0	Peat, coarse fibrous with wood pieces Dark brown						309										
308.0							308										
1.2	Sand, trace silt Compact Brown Wet		1	SS	10		307										
							306										
306.2							305										
3.0	Silt, trace clay, trace sand Compact Grey Wet		2	SS	19		304										
			3	SS	11												
303.1																	
6.1	End of borehole Refusal on probable bedrock																
	* 2004 04 12 ▽ Water level observed during drilling ▽ Water level measured after drilling Sand back-up 1.20m inside auger at 3.6 m depth																

RECORD OF BOREHOLE No EWS-18

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 04, 2005 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" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
309.9	Ground Surface					▽* ▽*		20	40	60	80	100						
0.0	Peat, fibrous Dark brown		1	AS	2		309											
308.9							308											
1.0	Sand, with silt, trace organic to 2.4 m		2	SS	4		307											
	Very loose Brown Wet						306											
	trace silt						305											
	Compact						304											
							303											
	Grey																	
305.0			4	SS	17													
4.9	Silt, trace sand, trace clay																	
	Compact Grey Wet																	
			5	SS	20													
302.2			6	SS	50/5cm													
7.7	End of borehole																	
	Refusal on probable bedrock																	

RECORD OF BOREHOLE No EWS-19

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange ORIGINATED BY MR
DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MR
DATUM Geodetic DATE April 05, 2004 CHECKED BY _____

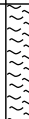




SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL
								○ UNCONFINED	● QUICK TRIAXIAL	+ FIELD VANE	× LAB VANE	20					40	60	80				
309.2	Ground Surface																						
0.0	Peat, coarse fibrous Dark brown		1	SS	9																		
308.0																							
1.2	Sand, with silt																						
	Loose Brown Wet to compact		2	SS	10																		
			3	SS	7																		
304.5																							
4.7	Silt, with sand trace clay		4	SS	28																		
	Compact Grey Wet																						
	trace sand																						
			5	SS	25																		
301.9																							
7.3	End of borehole																						
	Refusal on probable bedrock																						
	* Borehole dry																						
	Ground frozen to 0.6 m depth																						
	Sand back-up 1.0 m inside auger at 4.5 m depth																						

RECORD OF BOREHOLE No EWS-20

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MR
 DATUM Geodetic DATE April 12, 2004 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	● QUICK TRIAXIAL	+ FIELD VANE	× LAB VANE									
309.2	Ground Surface					▽* ▽*		20	40	60	80	100		20	40	60	GR SA SI CL			
0.0	Peat, coarse fibrous with wood pieces Dark brown						309													
308.0							308													
1.2	Sand, with silt Compact Brown Wet		1	SS	15		307													
							306													
305.8			2	SS	15		305													
3.4	Silt, trace sand Compact Grey Wet						304													
	Clayey silt lenses Dense		3	SS	41		303													
							302													
	Compact		4	SS	18															
301.9																				
7.3	End of borehole																			
	Refusal on probable bedrock																			
	* 2004 04 12																			
	▽ Water level observed during drilling																			
	▽ Water level measured after drilling																			

RECORD OF BOREHOLE No EWS-21

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange ORIGINATED BY MR
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MR
 DATUM Geodetic DATE April 12, 2004 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
309.3	Ground Surface					▽* ▽*		20	40	60	80	100					
0.0	Peat, coarse fibrous Dark brown		1	SS	4		309									584	
308.1																	
1.2	Sand, with silt Loose Grey Wet		2	SS	9		308										
							307										
	Compact		3	SS	11		306										
305.1																	
4.2	Silt, trace sand, trace clay Compact Grey Wet		4	SS	18		305										
							304										
	Silty sand layers Dense		5	SS	41		303										
302.6																	
6.7	End of borehole Refusal on probable bedrock																
	* 2004 04 12																
	▽ Water level observed during drilling																
	▽ Water level measured after drilling																

RECORD OF BOREHOLE No WS-1

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 04, 2005 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
309.5	Ground Surface					▽* ▽*		20	40	60	80	100					
0.0	Peat, coarse to fine fibrous		1	AS	2		309										
309.0	Dark brown Sand, trace silt																
0.5	Compact Brown Wet		2	SS	14		308										
							307										
			3	SS	16		306										
305.4	Silt, trace sand, trace clay						305										
4.1	Loose Grey Wet		4	SS	9		304										
303.7	Silty sand, trace gravel						303										
5.8	Compact Grey Wet (GLACIAL TILL)		5	SS	22		302										
301.3			6	SS	23												
8.2	End of borehole																
	<div>* 2005 02 04</div> <div>▽ Water level observed during drilling</div> <div>▽ Water level measured after drilling</div>																

RECORD OF BOREHOLE No WS-2

1 of 1

METRIC

W.P. 62-86-00 LOCATION South Mary Lake Road Interchange ORIGINATED BY FP
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FP
 DATUM Geodetic DATE February 03, 2005 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED	● QUICK TRIAXIAL	+ FIELD VANE	× LAB VANE					
310.0	Ground Surface					20	40	60	80	100						
0.0	Peat, coarse to fine fibrous		1	SS	WH**											
309.5	Dark brown Sand, trace silt, organics to 1.0m															
0.5	Loose Brown Wet		2	SS	9											
	Compact Grey															
			3	SS	13											
305.1	Silt, some sand, some clay		4	SS	17											
4.9	Compact Grey Wet															
			5	SS	17											
303.3	Silty sand, trace gravel cobbles to 7.6 m															
6.7	Compact Grey Wet (GLACIAL TILL)		6	SS	25											
301.8	End of borehole															
8.2																
	* 2005 02 03															
	▽ Water level observed during drilling															
	▼ Water level measured after drilling															
	WH** Refers to penetration under weight of rods and hammer															

* 2005 02 03

▽ Water level observed during drilling

▽ Water level measured after drilling

WH** Refers to penetration under weight of rods and hammer

(Legend Continued)

BH No	ELEVATION	STA	o/s Lt EP
EWS-14	309.5	14+466	4m Lt
EWS-15	309.2	14+478	15m Lt
EWS-16	309.5	14+479	9.1m Rt
EWS-17	309.2	14+492	4.6m Lt
EWS-18	309.9	14+500	10m Rt
EWS-19	309.2	14+506	4.6m Lt
EWS-20	309.2	14+505	15.6m Lt
EWS-21	309.3	14+518	4.1m Lt

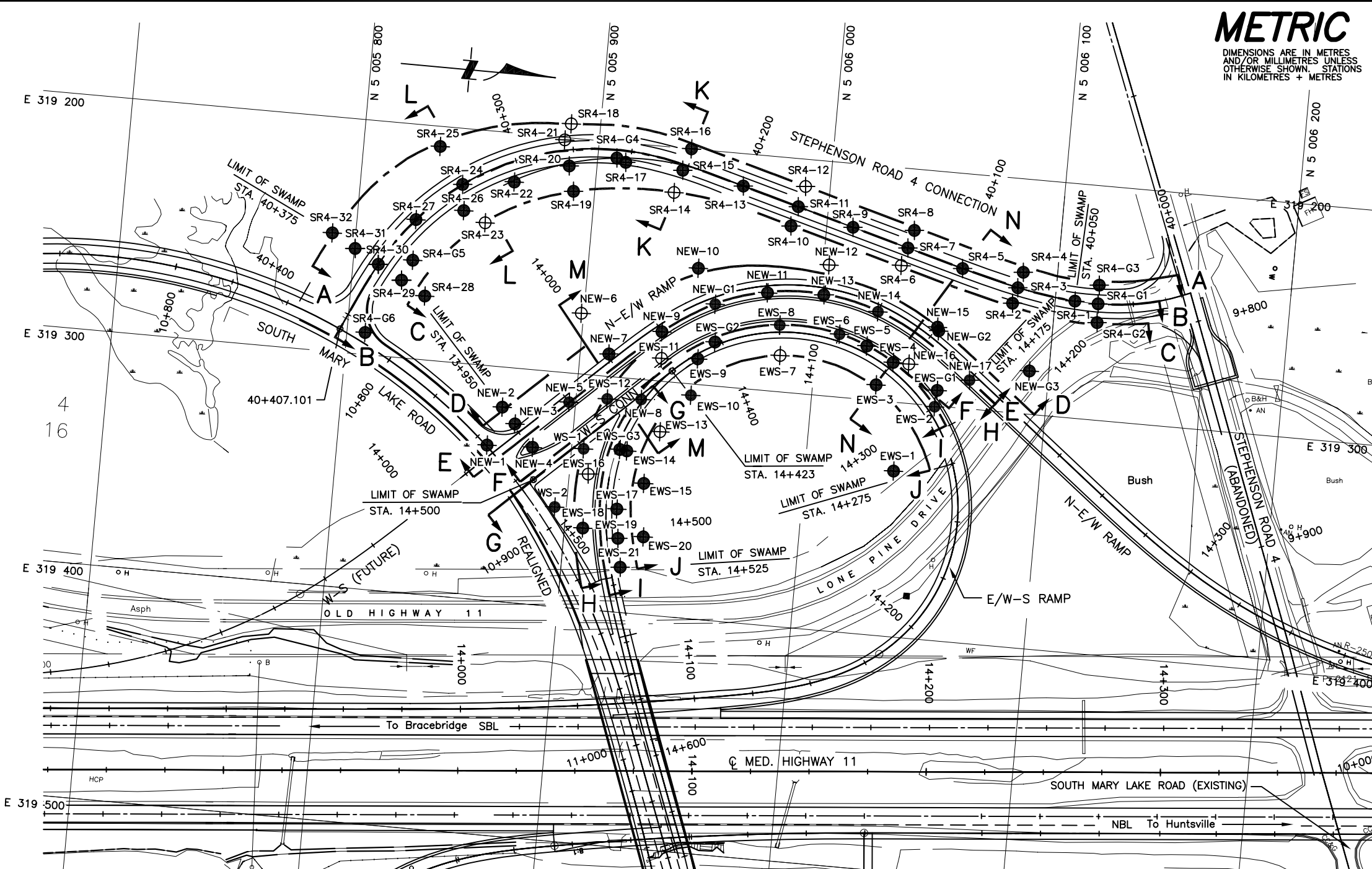
NEW-1	309.8	13+936	4.1m Lt
NEW-2	309.8	13+951	12.9m Lt
NEW-3	309.7	13+951	3.9m Lt
NEW-4	309.6	13+951	8.6m Rt
NEW-5	310.3	13+975	3m Rt
NEW-6	309.6	14+003	23.7m Lt
NEW-7	309.6	14+001	2.8m Lt
NEW-8	310.1	14+000	21m Rt
NEW-9	309.8	14+025	3m Rt
NEW-10	309.8	14+050	14m Lt
NEW-11	309.9	14+075	3m Rt
NEW-12	309.8	14+100	10m Lt
NEW-13	309.8	14+100	3m Rt
NEW-14	309.5	14+125	3m Rt
NEW-15	309.3	14+150	5m Lt
NEW-16	309.3	14+150	15m Rt
NEW-17	309.3	14+175	3m Rt

WS-1	309.5	14+475	3m Rt
WS-2	310.0	14+500	15m Lt

BH No	ELEVATION	STA	o/s CL
SR4-1	309.2	40+050	CL
SR4-2	308.8	40+075	7m Lt
SR4-3	308.8	40+075	CL
SR4-4	308.9	40+075	7m Rt
SR4-5	308.8	40+100	CL
SR4-6	309.0	40+125	8m Lt
SR4-7	309.3	40+125	CL
SR4-8	309.7	40+125	8m Rt
SR4-9	309.7	40+150	CL
SR4-10	309.8	40+175	9m Lt
SR4-11	309.7	40+175	CL
SR4-12	309.7	40+175	9m Rt
SR4-13	309.8	40+200	CL
SR4-14	309.7	40+227	12.6m Lt
SR4-15	309.9	40+227	2.6m Lt
SR4-16	309.8	40+227	7.3m Rt
SR4-17	310.0	40+252	5m Lt
SR4-18	311.0	40+275	11m Rt
SR4-19	310.3	40+277	17.8m Lt
SR4-20	310.5	40+277	7m Lt
SR4-21	311.0	40+277	4.4m Rt
SR4-22	310.3	40+304	8.4m Lt
SR4-23	310.9	40+325	19m Lt
SR4-24	310.9	40+325	CL
SR4-25	310.9	40+325	19m Rt

(Legend Continued)

BH No	ELEVATION	STA	o/s CL	BH No	ELEVATION	STA	o/s Lt EP
SR4-26	310.0	40+331	9.8m Lt	EWS-G1	309.2	14+305	8m Rt
SR4-27	311.1	40+350	CL	EWS-G2	309.7	14+403	1.5m Rt
SR4-28	311.2	40+375	24m Lt	EWS-G3	309.7	14+466	1.3m Lt
SR4-29	311.2	40+375	12m Lt	NEW-G1	309.8	14+051	2.9m Rt
SR4-30	311.2	40+375	CL	NEW-G2	309.3	14+151	4m Lt
SR4-31	311.2	40+375	12m Rt	NEW-G3	310.1	14+191	17.4m Lt
SR4-32	311.2	40+375	24m Rt	SR4-G1	310.0	40+040	CL
				SR4-G2	310.5	40+040	8m Lt
				SR4-G3	309.6	40+040	8m Rt
				SR4-G4	311.1	40+257	3.5m Lt
				SR4-G5	311.1	40+366	11m Lt
				SR4-G6	310.9	40+403	10m Lt

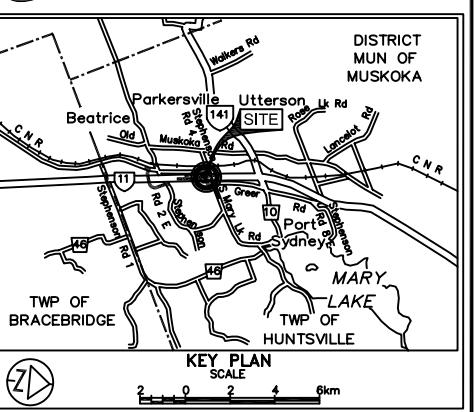


- NOTES:
- PRELIMINARY INVESTIGATION BOREHOLES WERE DRILLED BY GOLDER ASSOCIATES LIMITED IN 2001. GROUND ELEVATION AT THESE BOREHOLES WERE DERIVED FROM CENTRE LINE AND LEFT EDGE-OF-PAVEMENT PROFILES REVISED OCTOBER/NOVEMBER 2004.
 - REFER TO DRAWING NOS. 2 TO 10 FOR SECTIONS A-A TO N-N.

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

CONT No	GWP No	62-86-00	SHEET
HIGHWAY 11 INTERCHANGE AT SOUTH MARY LAKE ROAD 2.2 Km South of Hwy 141, Huntsville BOREHOLE LOCATIONS			

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS



LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J / blow)
- CONE Blows/0.3m (60° Cone, 475 J / blow)
- W L at time of investigation April 2004 & February 2005; 'G' Boreholes 2001

BH No	ELEVATION	STA	o/s Lt EP
EWS-1	309.1	14+280	25m Rt
EWS-2	309.3	14+300	3m Rt
EWS-3	309.4	14+325	9m Lt
EWS-4	309.4	14+325	3m Rt
EWS-5	308.6	14+338	3m Rt
EWS-6	309.6	14+350	3m Rt
EWS-7	309.7	14+375	10m Lt
EWS-8	309.7	14+375	3m Rt
EWS-9	309.1	14+413	2m Lt
EWS-10	309.9	14+425	13m Lt
EWS-11	309.9	14+425	7m Rt
EWS-12	310.1	14+450	13m Rt
EWS-13	309.4	14+452	13.9m Lt

(Legend Continues)

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. 31E-237

HWY No	11	DIST	52
SUBM'D	FP	CHECKED	CN
DRAWN	MM	CHECKED	CN
DATE	MAY 12, 2005	SITE	
APPROVED	BRG	DWG	1

METRIC

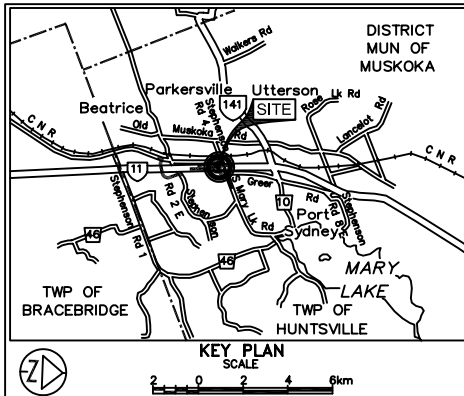
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES

CONT No
GWP No 62-86-00

HIGHWAY 11
INTERCHANGE AT SOUTH MARY LAKE ROAD
2.2 Km South of Hwy 141, Huntsville
SOIL STRATA

SHEET

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS



LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J / blow)
- CONE Blows/0.3m (60° Cone, 475 J / blow)
- W L at time of investigation April 2004
February 2005; 'G' Boreholes 2001
- Head
- ARTESIAN WATER
Encountered
- PIEZOMETER

BH No ELEVATION STA o/s Lt EP

(Refer to Drawing 1 for co-ordinates)

NOTE

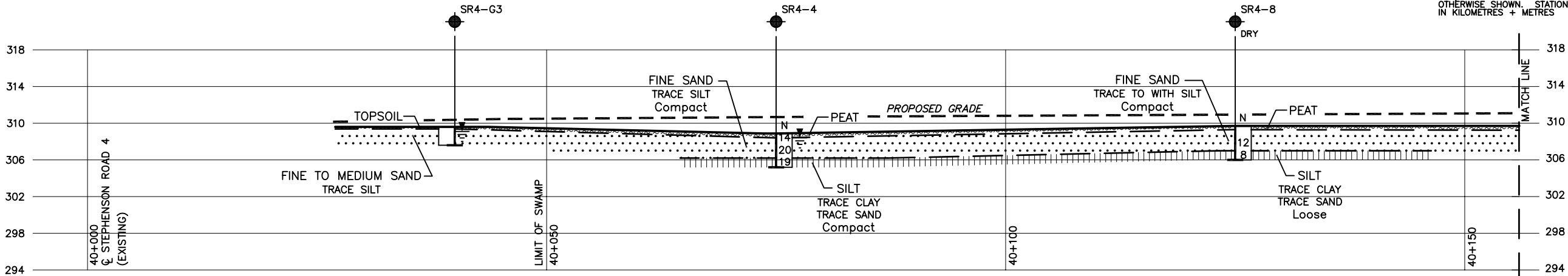
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

DATE	BY	DESCRIPTION

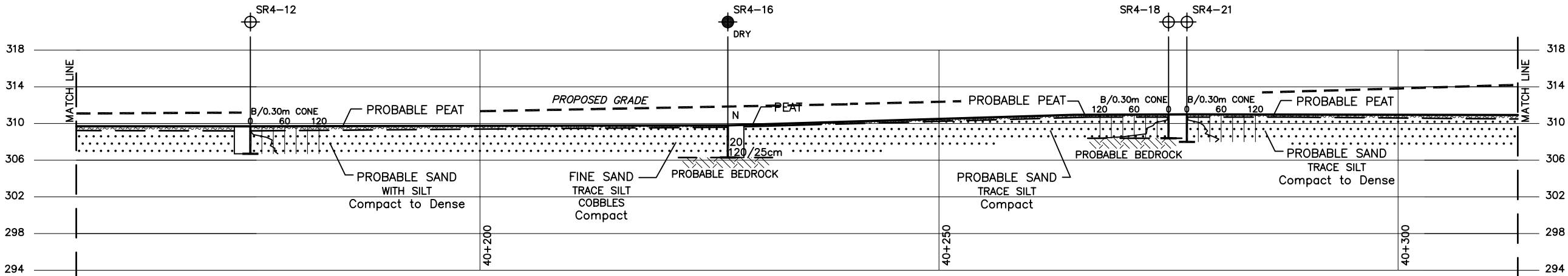
Geocres No. 31E-237

HWY No 11			DIST 52
SUBM'D FP	CHECKED CN	DATE MAY 12, 2005	SITE
DRAWN NA/MM	CHECKED CN	APPROVED BRG	DWG 2

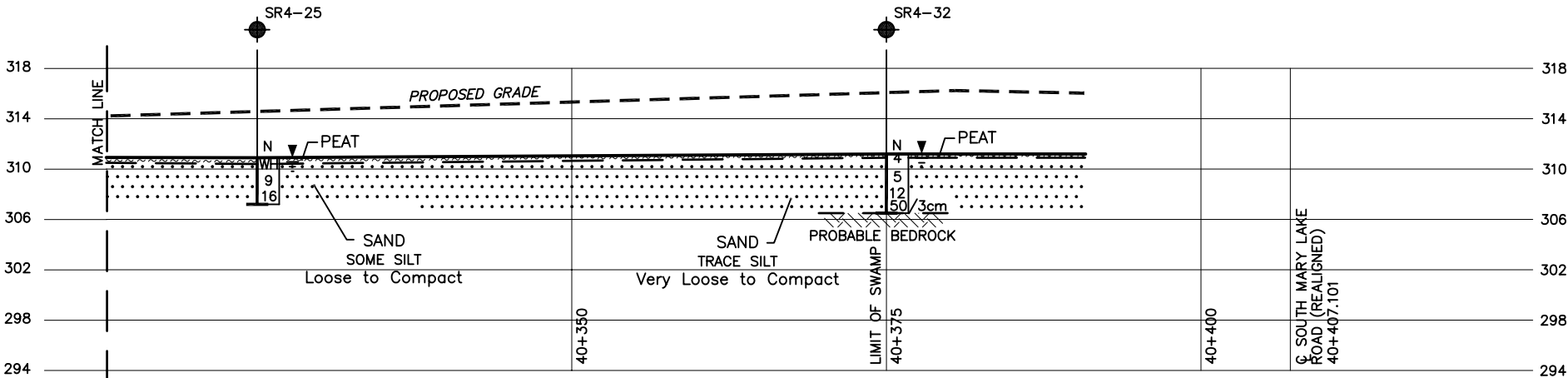
REF No E-04-005.dwg; Aug 2004



A-A



A-A (Continued)



A-A (Continued)

SECTIONS
SCALE



NOTES:

- REFER TO DRAWING NO.1 FOR PLAN; DRAWING NOS. 3 TO 10 FOR SECTIONS B-B TO N-N.
- SECTIONS ARE PROVIDED SOLELY FOR ILLUSTRATIVE PURPOSES. REFER TO RECORD OF BOREHOLES FOR DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS, IN-SITU TEST DATA AND LABORATORY TEST RESULTS.

METRIC

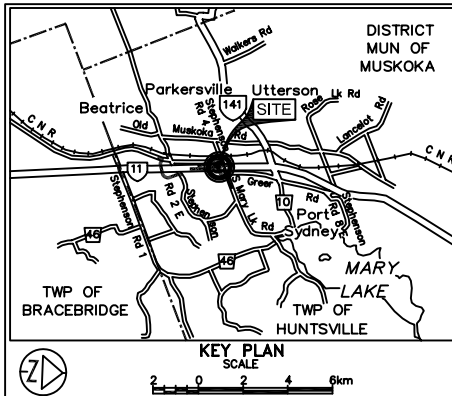
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES

CONT No
GWP No 62-86-00

HIGHWAY 11
INTERCHANGE AT SOUTH MARY LAKE ROAD
2.2 Km South of Hwy 141, Huntsville
SOIL STRATA

SHEET

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS



LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J / blow)
- CONE Blows/0.3m (60° Cone, 475 J / blow)
- W L at time of investigation April 2004
February 2005; 'G' Boreholes 2001
- Head
- ARTESIAN WATER
Encountered
- PIEZOMETER

BH No ELEVATION STA o/s Lt EP

(Refer to Drawing 1 for co-ordinates)

NOTE

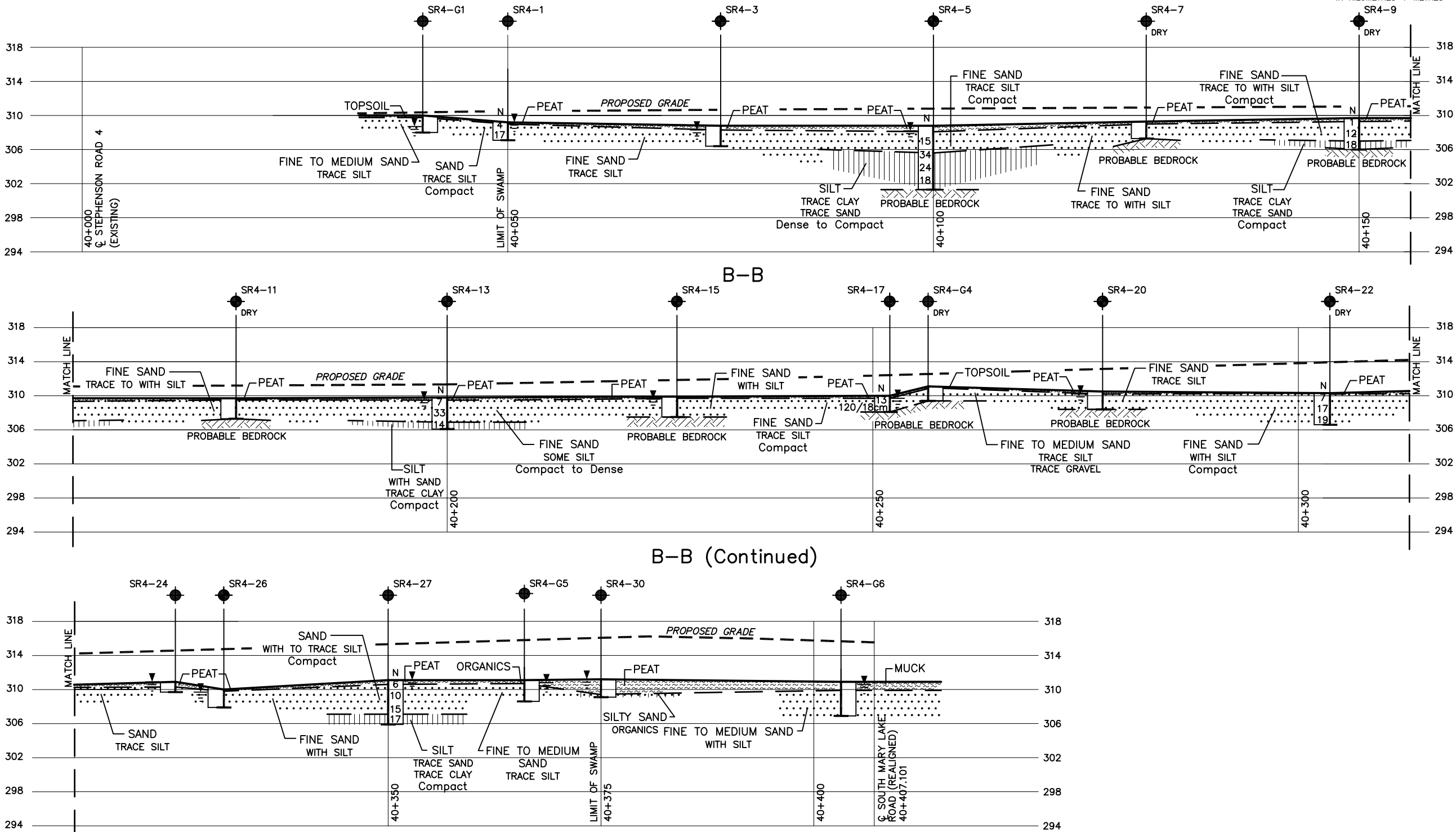
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

DATE	BY	DESCRIPTION

Geocres No. 31E-237

HWY No 11	DIST 52
SUBM'D FP	CHECKED CN
DATE MAY 12, 2005	SITE
DRAWN NA/MM	CHECKED CN
APPROVED BRG	DWG 3

REF No E-04-005.dwg; Aug 2004



B-B (Continued)

SECTIONS
SCALE



NOTES:

- REFER TO DRAWING NOS. 1 AND 2 FOR PLAN AND SECTION A-A; DRAWING NOS. 4 TO 10 FOR SECTIONS C-C TO N-N.
- SECTIONS ARE PROVIDED SOLELY FOR ILLUSTRATIVE PURPOSES. REFER TO RECORD OF BOREHOLES FOR DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS, IN-SITU TEST DATA AND LABORATORY TEST RESULTS.

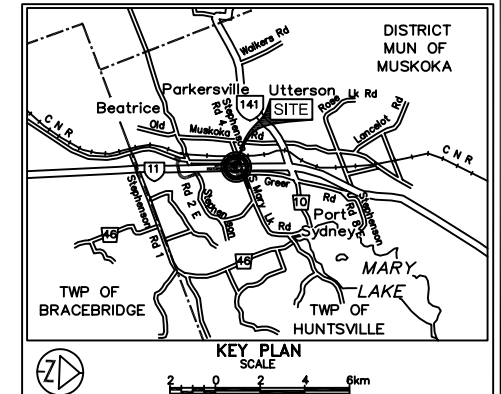
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES

CONT No
GWP No 62-86-00

HIGHWAY 11
INTERCHANGE AT SOUTH MARY LAKE ROAD
2.2 Km South of Hwy 141, Huntsville
SOIL STRATA

SHEET

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS



LEGEND			
	Borehole		Dynamic Cone Penetration Test (Cone)
	Borehole & Cone		
N	Blows/0.3m (Std. Pen Test, 475 J / blow)		
CONE	Blows/0.3m (60° Cone, 475 J / blow)		
	W L at time of investigation April 2004 February 2005; 'G' Boreholes 2001		
	Head		
	ARTESIAN WATER Encountered		
	PIEZOMETER		

BH No	ELEVATION	STA	a/s Lt EP
(Refer to Drawing 1 for co-ordinates)			

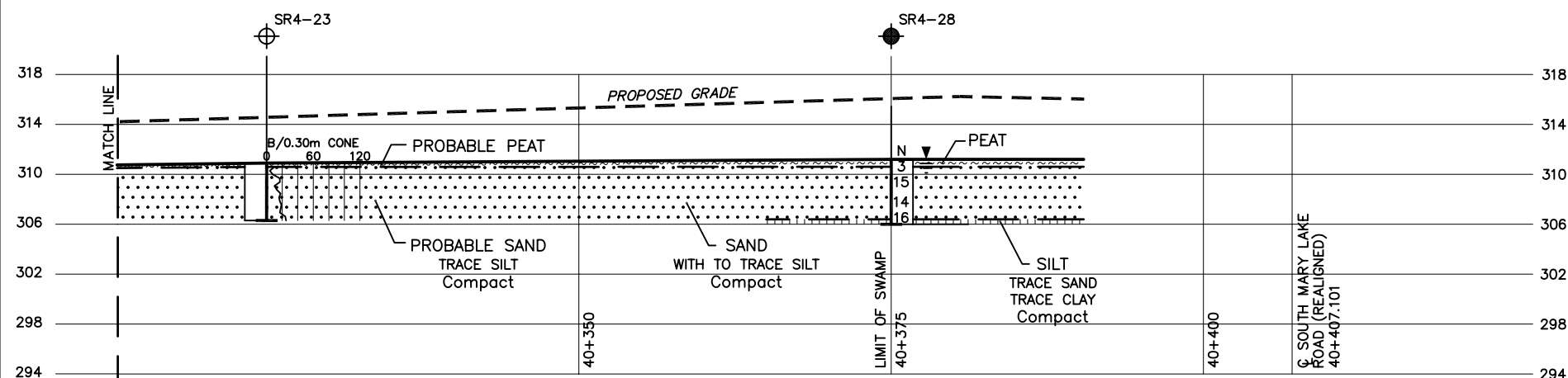
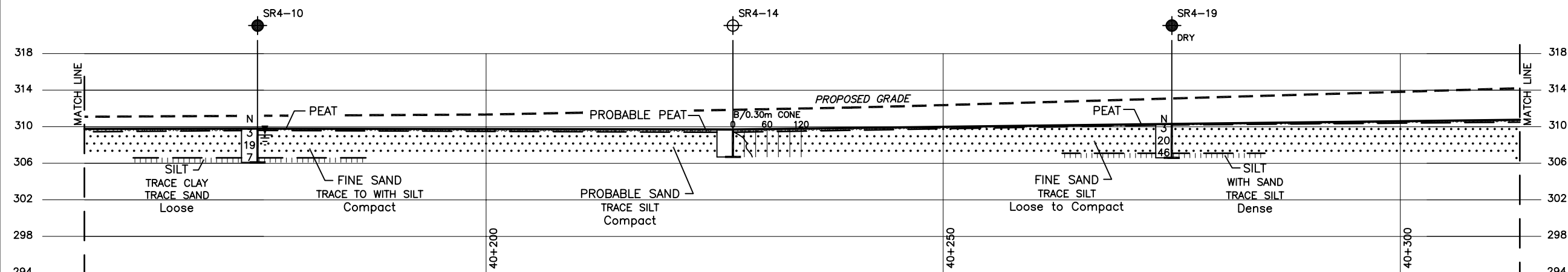
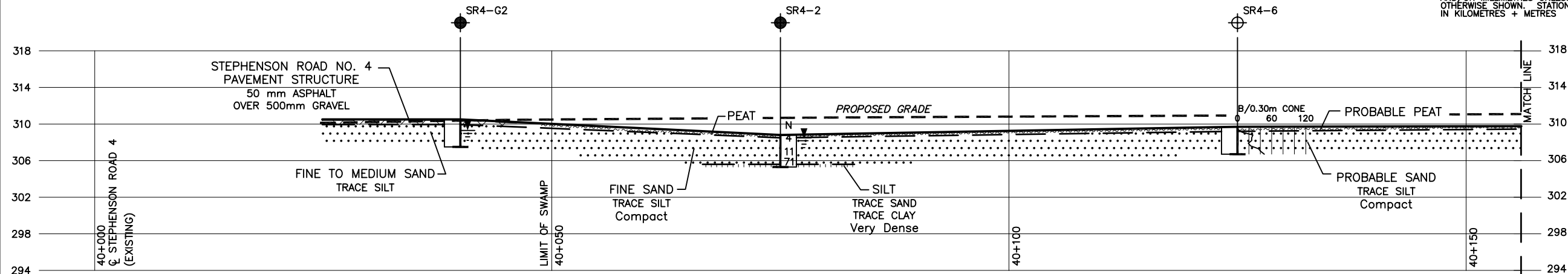
— NOTE —
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 31E-237

HWY No 11	DIST 52
SUBM'D FP	CHECKED CN
DATE MAY 12, 2005	SITE
DRAWN NA/MM	CHECKED CN
APPROVED BRG	DWG 4

REF No E-04-005.dwg; Aug 2004



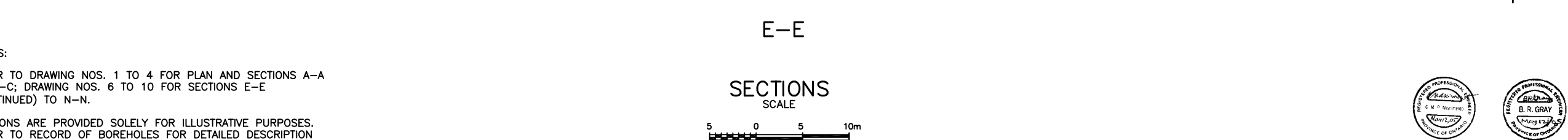
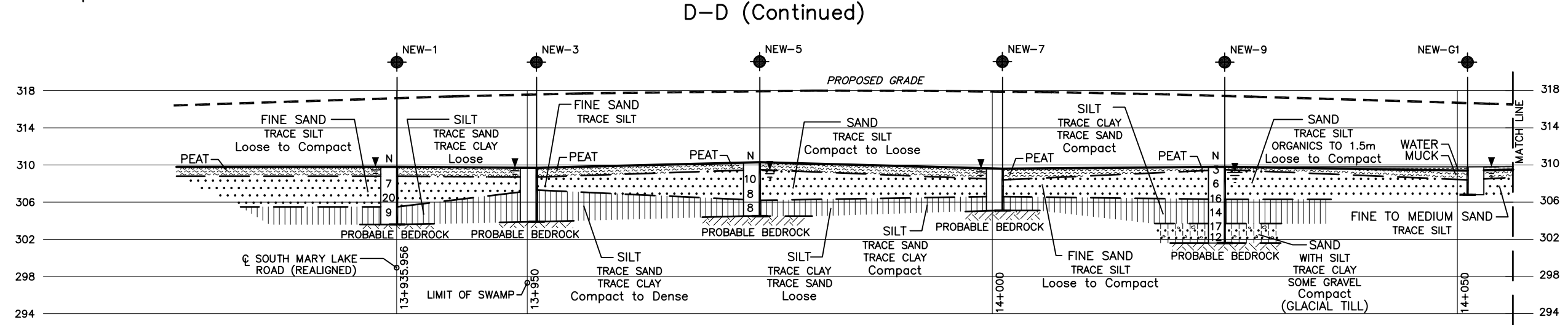
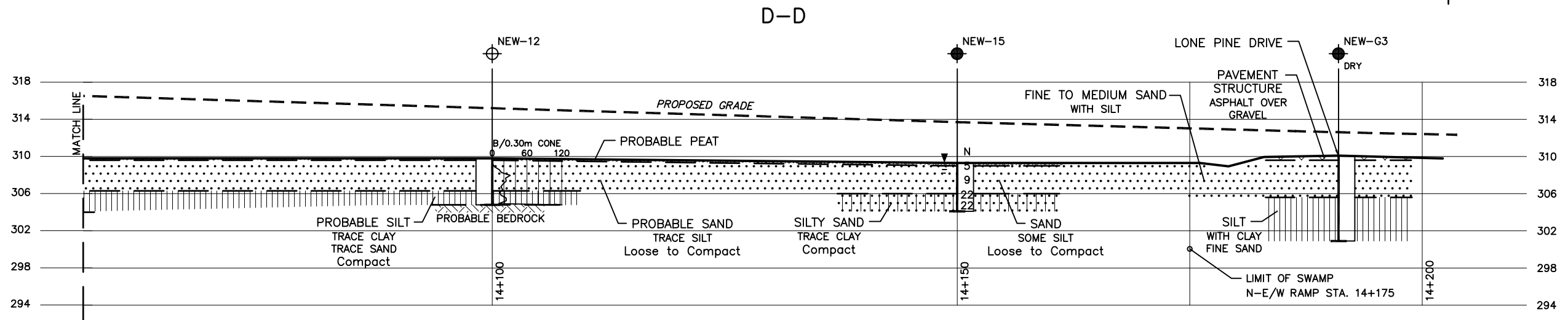
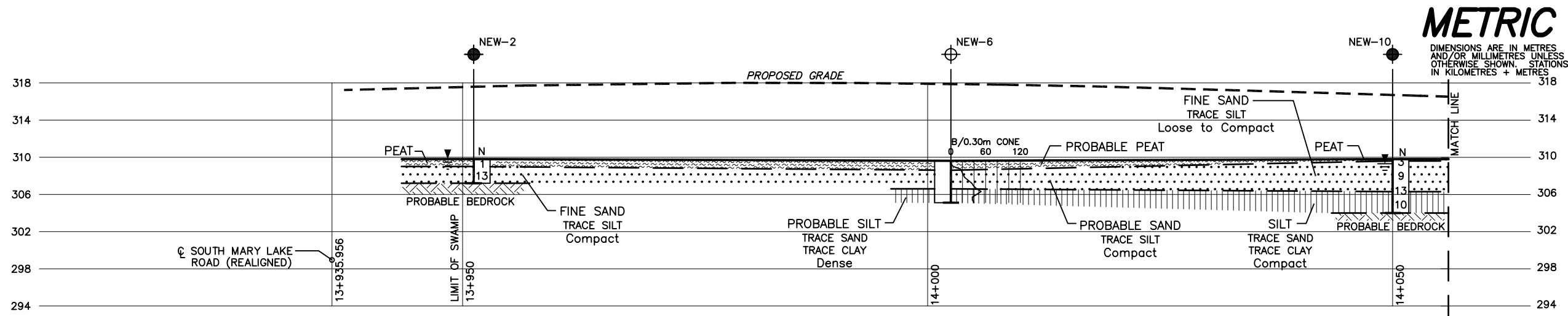
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C-C (Continued)

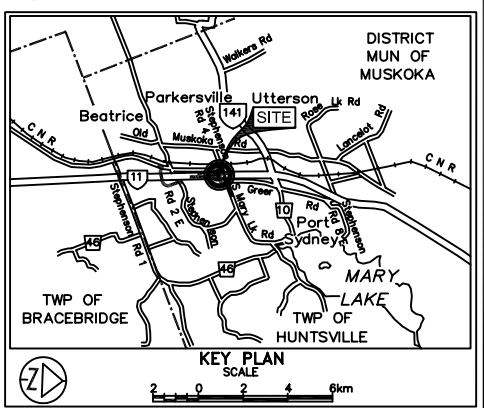
SECTIONS
SCALE





- NOTES:
- REFER TO DRAWING NOS. 1 TO 4 FOR PLAN AND SECTIONS A-A TO C-C; DRAWING NOS. 6 TO 10 FOR SECTIONS E-E (CONTINUED) TO N-N.
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CONT No	
GWP No	62-86-00
HIGHWAY 11 INTERCHANGE AT SOUTH MARY LAKE ROAD 2.2 Km South of Hwy 141, Huntsville SOIL STRATA	
SHEET	



LEGEND			
	Borehole		
	Dynamic Cone Penetration Test (Cone)		
	Borehole & Cone		
N	Blows/0.3m (Std. Pen Test, 475 J / blow)		
CONE	Blows/0.3m (60° Cone, 475 J / blow)		
	W.L. at time of investigation April 2004 February 2005; 'G' Boreholes 2001		
	Head		
	ARTESIAN WATER Encountered		
	PIEZOMETER		

BH No	ELEVATION	STA	a/s Lt EP
(Refer to Drawing 1 for co-ordinates)			

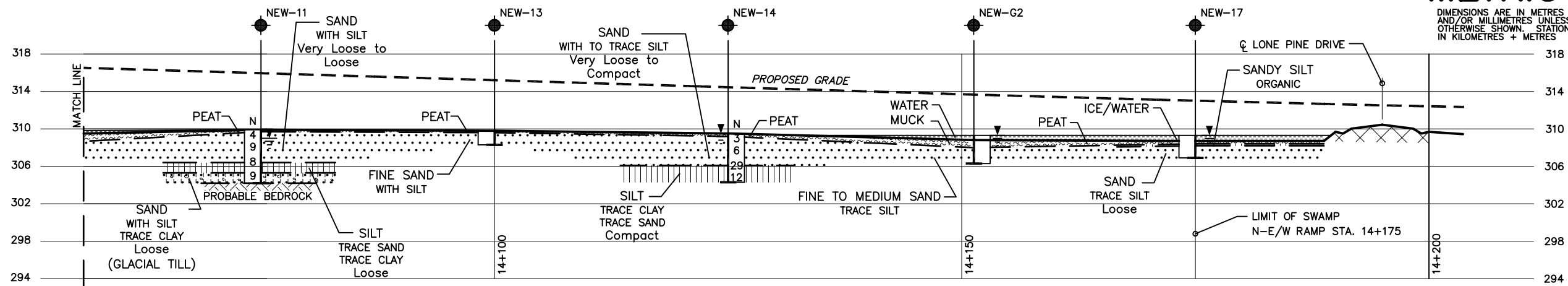
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REVISIONS									
	DATE	BY					DESCRIPTION		

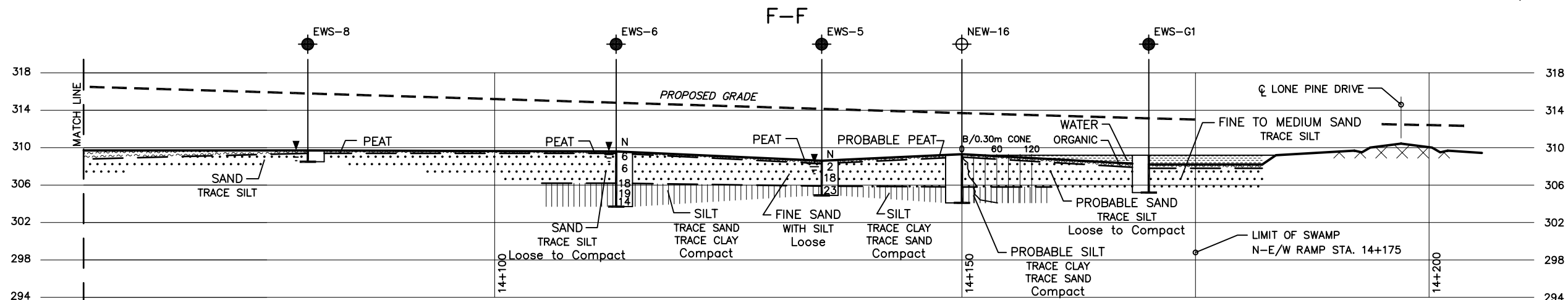
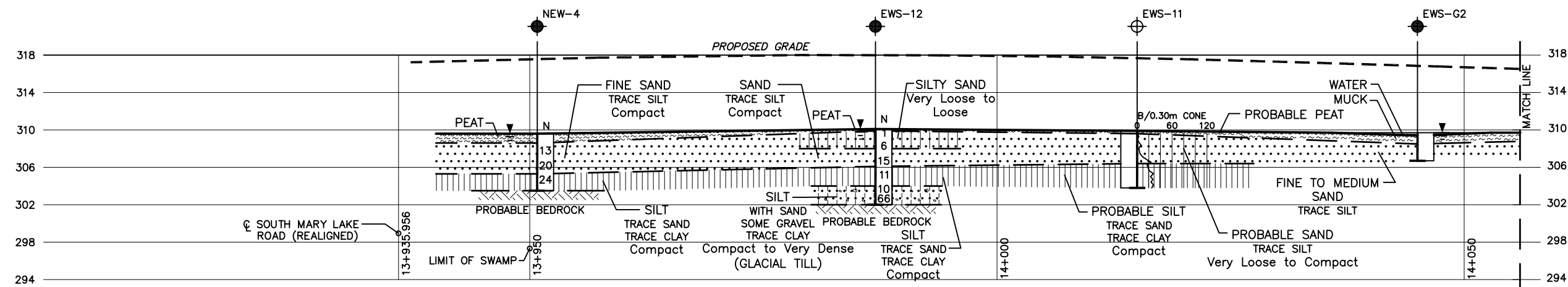
Geocres No. 31E-237

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SUBM'D	FP	CHECKED	CN	DATE	MAY 12, 2005		SITE	
DRAWN	NA/MM	CHECKED	CN	APPROVED	BRG		DWG	5

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



E-E (Continued)



F-F (Continued)

NOTES:

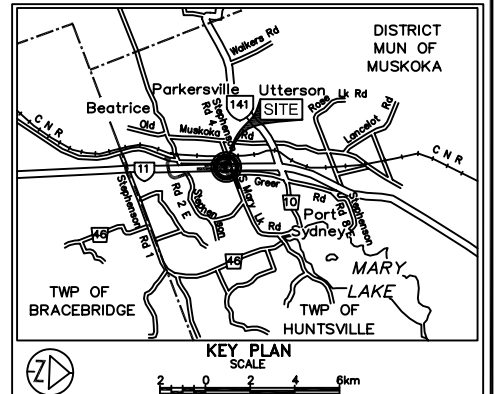
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2. SECTIONS ARE PROVIDED SOLELY FOR ILLUSTRATIVE PURPOSES. REFER TO RECORD OF BOREHOLES FOR DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS, IN-SITU TEST DATA AND LABORATORY TEST RESULTS.

SECTIONS
SCALE



CONT No
GWP No 62-86-00
HIGHWAY 11
INTERCHANGE AT SOUTH MARY LAKE ROAD
2.2 Km South of Hwy 141, Huntsville
SOIL STRATA
SHEET

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS



LEGEND			
	Borehole		Dynamic Cone Penetration Test (Cone)
	Borehole & Cone		Blows/0.3m (Std. Pen Test, 475 J / blow)
	CONE		Blows/0.3m (60° Cone, 475 J / blow)
	W.L. at time of investigation April 2004 February 2005; 'G' Boreholes 2001		Head
	ARTESIAN WATER Encountered		PIEZOMETER

BH No	ELEVATION	STA	a/s Lt EP
(Refer to Drawing 1 for co-ordinates)			

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DATE	BY	DESCRIPTION

Geocres No. 31E-237			
HWY No 11	FP	CHECKED CN	DIST 52
SUBM'D	NA/MM	CHECKED CN	DATE MAY 12, 2005 SITE
DRAWN	NA/MM	CHECKED CN	APPROVED BRG DWG 6

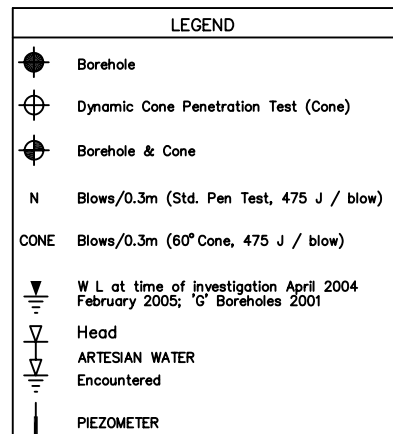
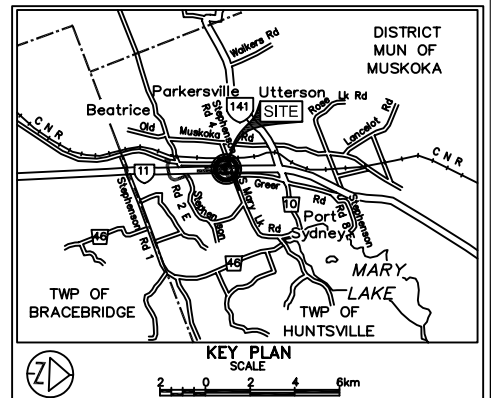
REF No E-04-005.dwg; Aug 2004



<p align="center"><u>HIGHWAY 11</u></p> <p>INTERCHANGE AT SOUTH MARY LAKE ROAD 2.2 Km South of Hwy 141, Huntsville SOIL STRATA</p>	
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CONSULTING ENGINEERS

[illegible]

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	DATE	BY	DESCRIPTION

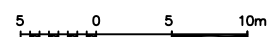
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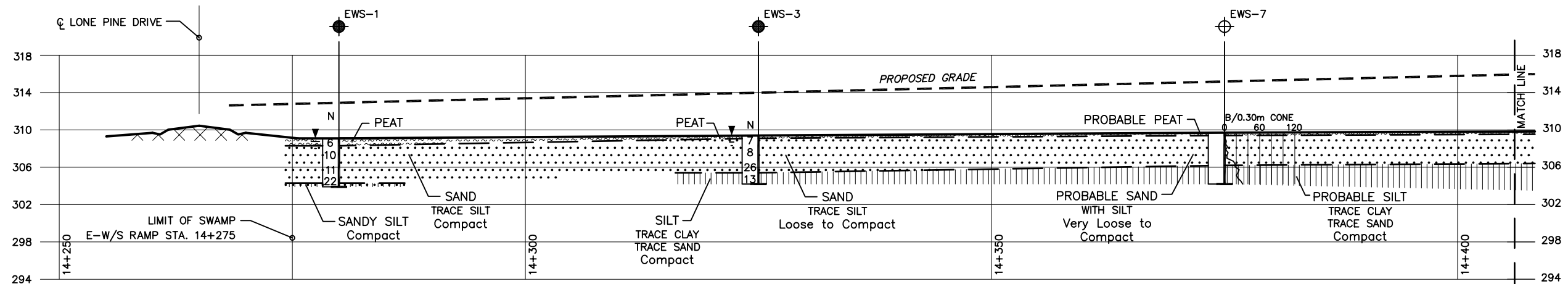
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SUBM'D FP	CHECKED CN	DATE MAY 12, 2005	SITE
DRAWN NA/MM	CHECKED CN	APPROVED BRG	DWG 7

REF No E-04-005.dwg; Aug 2004

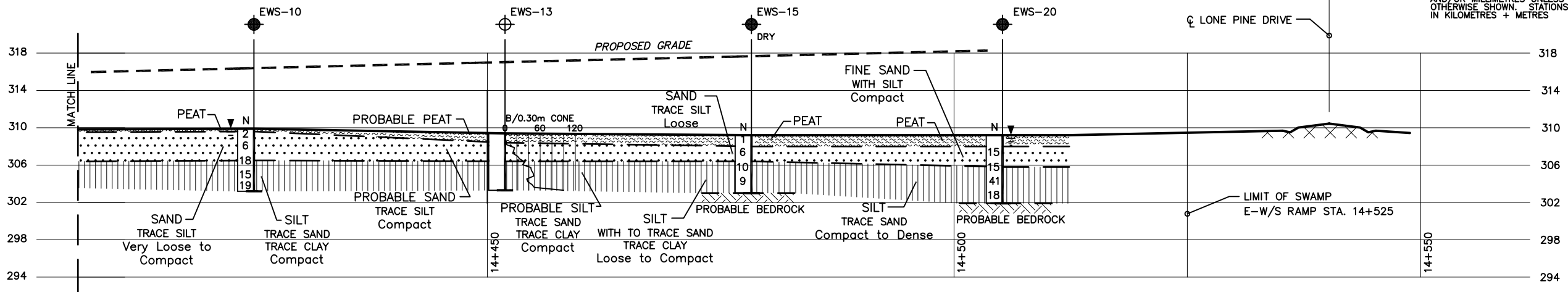
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SECTIONS
SCALE

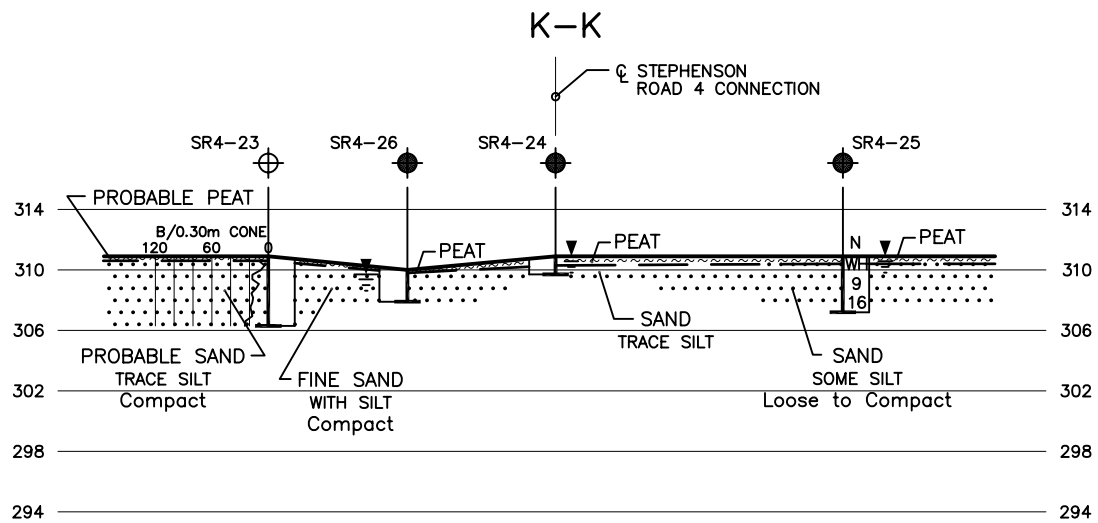
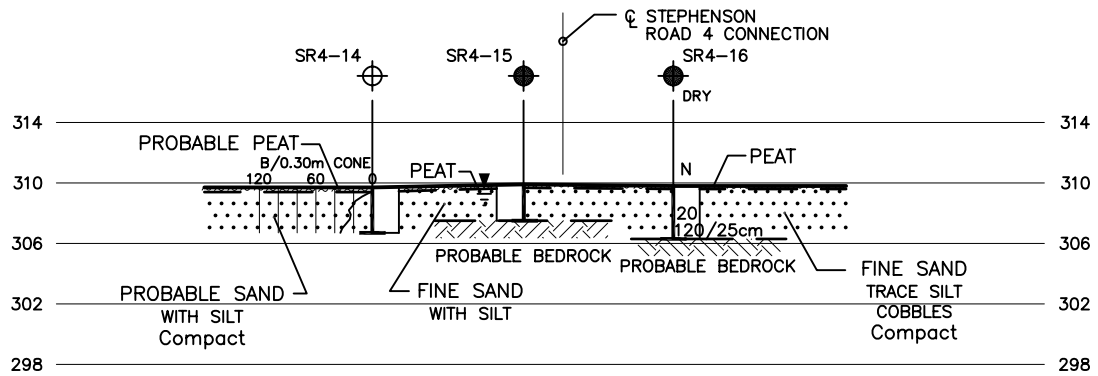




METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES



J-J (Continued)



L-L
SECTIONS
SCALE



NOTES:

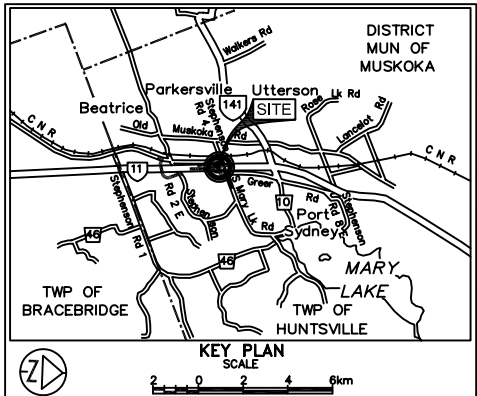
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CONT No
GWP No 62-86-00

HIGHWAY 11
INTERCHANGE AT SOUTH MARY LAKE ROAD
2.2 Km South of Hwy 141, Huntsville
SOIL STRATA

SHEET

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS



LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J / blow)
- CONE Blows/0.3m (60° Cone, 475 J / blow)
- W L at time of investigation April 2004 February 2005; 'G' Boreholes 2001
- Head
- ARTESIAN WATER Encountered
- PIEZOMETER

BH No	ELEVATION	STA	a/s Lt EP
(Refer to Drawing 1 for co-ordinates)			

NOTE

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DATE	BY	DESCRIPTION

Geocres No. 31E-237

HWY No 11				DIST 52
SUBM'D FP	CHECKED CN	DATE MAY 12, 2005		SITE
DRAWN NA/MM	CHECKED CN	APPROVED BRG		DWG 9

REF No E-04-005.dwg; Aug 2004

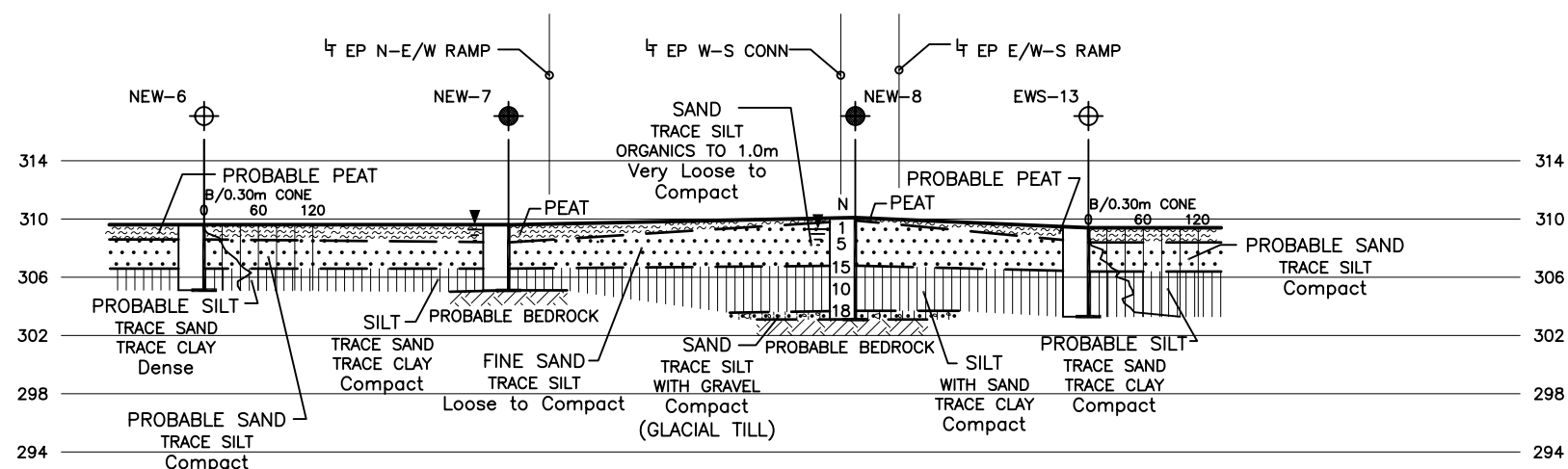
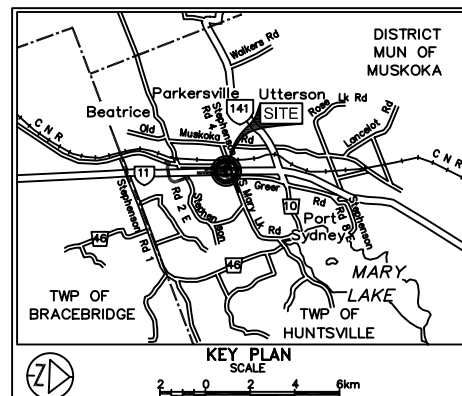
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HIGHWAY 11
INTERCHANGE AT SOUTH MARY LAKE ROAD
2.2 Km South of Hwy 141, Huntsville
SOIL STRATA

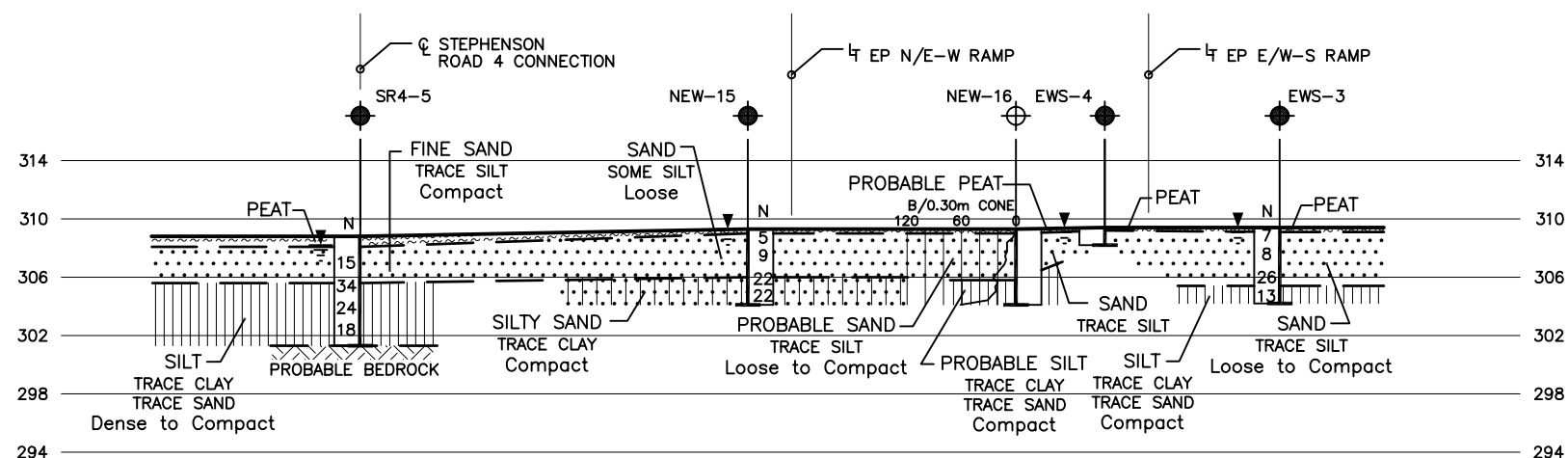
SHEET



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M—M


$$\text{N}-\text{N}$$









NOTES:

1. REFER TO DRAWING NOS. 1 TO 9 FOR PLAN AND SECTIONS A-A TO L-L.
2. SECTIONS ARE PROVIDED SOLELY FOR ILLUSTRATIVE PURPOSES. REFER TO RECORD OF BOREHOLES FOR DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS, IN-SITU TEST DATA AND LABORATORY TEST RESULTS.

SECTIONS
SCALE



LEGEND

- | | |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
|  | Borehole |
|  | Dynamic Cone Penetration Test (Cone) |
|  | Borehole & Cone |
| N | Blows/0.3m (Std. Pen Test, 475 J / blow) |
| CONE | Blows/0.3m (60° Cone, 475 J / blow) |
|  | W L at time of investigation April 2004
February 2005; 'G' Boreholes 2001 |
|  | Head |
|  | ARTESIAN WATER |
|  | Encountered |
|  | PIEZOMETER |

[illegible]

- NOTE -

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REVISIONS			
	DATE	BY	DESCRIPTION

Geocres No. 31E-237

HWY No 11				DIST 52
SUBM'D	FP	CHECKED CN	DATE MAY 12, 2005	SITE
DRAWN NA/MM		CHECKED CN	APPROVED BRG	DWG 10

REF No E-04-005.dwg; Aug 2004



APPENDIX A

Geotechnical Boreholes from Draft Pavement Design Report
(Golder Associates Limited Reference No. 991-8064G)

ABBREVIATIONS FOR BORING AND TEST DATA

Accep	Acceptable	Gry	Grey	Psty	Polystyrene
Agg	Aggregate	H	Heavy	Poss	Possible
Amor	Amorphous	Hi	Highly	PST	Prime & Surface Treatment
Asph	Asphalt	HP	High Plasticity	Quant	Quantity
BR	Bedrock	HM	Hot Mix	Reinf	Reinforced
Blk	Black	Lt	Light	RSS	Remoulded Shear Strength
Bl	Blue	Liq	Liquid	RF	Rock Fill
BH	Borehole	W _L	Liquid Limit	Sa	Sand
Bld (y)	Boulder (y)	Lo	Loam	Sal	Saturated
Blds	Boulders	L	Loose	SH	Shale
BU	Break Up	Mrl	Marl	St	Sensitivity
Br	Brown	Matl	Material	SSM	Select Subgrade Material
CF	Channel Face	Max	Maximum	Sh Rk	Shot Rock
Cl	Clay	MDD	Maximum Dry Density	Si (y)	Silt (y)
Co	Coarse	MWD	Maximum Wet Density	Sl (y)	Slight (ly)
Cob	Cobbles	Med	Medium	SP	Slight Plastic
Comp	Compact	MP	Medium Plasticity	Stn (y)	Stone (y)
Conc	Concrete	Mod	Moderate	D _n	Relative Density
Contam	Contaminated	Mott	Mottled	Stks	Streaks
Cord	Corduroy	Mul	Mulch	Surf	Surface
Cr	Crushed	NFP	No Further Progress	Temp	Temperature
Dk	Dark	NFP (Blds)	No Further Progress (Boulders)	TH	Test Hole
Decomp	Decomposed	Num	Numerous	TP	Test Pit
D	Dense	OCC	Occasional	Tps	Topsoil
E	Earth	Wopt	Optimum Moisture Content	Tr	Trace
Fib	Fibrous	Ora	Orange	USS	Undisturbed Shear Strength
w	Field Moisture Content	Org	Organic	Unreif	Unreinforced
F	Fine	Org M	Organic Matter	Varv	Varved
Fr Wat	Free Water	Ob	Overburden	VF	Very Fine
FB	Frost Boil	Pavl	Pavement	WT	Water Table
FH	Frost Heave	Pedo	Pedological	Weath	Weathered
Gran	Granular	Pen Mac	Penetration Macadam	W	With
Gr	Gravel (y)	W _p	Plastic Limit	Wd (y)	Wood (y)
Grn	Green	I _p	Plasticity Index	Yel	Yellow

SUSCEPTIBILITY TO FROST HEAVING

HSFH - High
MSFH - Medium
LSFH - Low

ONTARIO PROVINCIAL STANDARD DRAWING

ABBREVIATIONS

GEOTECHNICAL

Date 1996 07 18 Rev

Date

OPSD - 100.06

Stephenson Road 4 Connection
Station 10+000 to 10+392, Referenced to C/L

991-8064G
December, 2001

SR4-G1
(Revised Station 40+040 C/L EL.310.0)
10+040 C/L D-0 HA

0 - 240 Dk Br Si Tps
240 - 2.00 Gry Br F-Med Sa Tr Si, Wet, Fr Wat @
1.30, Sat, Comp

SR4-G2
(Revised Station 40+040 8.00 Lt C/L EL.310.5)
10+040 8.00 Lt C/L D+500 PA

0 - 050 Asph
050 - 560 Br Cr Gr
560 - 3.00 Gry F-Med Sa Tr Si, Wet, Fr Wat @
1.20, Sat, Comp

SR4-G3
(Revised Station 40+040 8.00 Rt C/L EL.309.6)
10+040 8.00 Rt C/L D-400 HA

0 - 220 Dk Br Si Tps
220 - 2.00 Gry Br F-Med Sa Tr Si, Wet, Fr Wat @
500, Sat, Comp

SR4-G4
(Revised Station 40+257 3.50 Lt C/L EL.311.1)
10+250 C/L D-0 HA

0 - 250 Dk Br Si Tps
250 - 1.70 Br F-Med Sa Tr Si Tr Gr, Wet, Comp
- 1.70 NFP BR

SR4-G5
(Revised Station 40+366 11.00 Lt C/L EL.311.1)
10+350 C/L D-0 HA

0 - 400 Blk Org, Fr Wat @ 300
400 - 2.50 Br F-Med Sa Tr Si, Sat, Comp
- 2.50 NFP Sloughing

SR4-G6
(Revised Station 40+403 10.00 Lt C/L EL.310.9)
10+392 C/L D-0 HA

0 - 1.00 Muckamor, Fr Wat @ 300
1.00 - 4.00 Br F-Med Sa W Si, Sat, Comp
- 4.00 NFP Sloughing

NOTE: Added Revised Stations and Borehole Identifications

N-E/W Ramp

Station 13+958 to 14+775, Referenced to Lt E/P

991-8064G

December, 2000

NEW-G1

(Revised Station 14+051 2.90 Rt of Lt EP EL.309.8)
14+075 3.00 Rt of Lt E/P D-0 HA

0 - 400 Stding Water
400 - 1.40 Muckamor
1.40 - 3.00 Br F-Med Sa Tr Si, Sat, Comp
- 3.00 NFP Sloughing

NEW-G2

(Revised Station 14+151 4.00 Lt of Lt EP EL.309.3)
14+175 3.00 Rt of Lt E/P D-0 HA

0 - 500 Stding Water
500 - 1.30 Muckamor
1.30 - 3.00 Br F-Med Sa Tr Si, Sat, Comp
- 3.00 NFP Sloughing

NEW-G3

(Revised Station 14+191 17.40 Lt of Lt EP EL.310.1)
14+217 3.00 Rt of Lt E/P D-0 PA

0 - 040 Asph
040 - 500 Br Cr Gr*
500 - 4.50 Gry Br F-Med Sa W Si, Wet, Fr Wat @
1.20, Sat, Comp
4.50 - 9.20 Gry Si W Cl W F Sa, Wet, Loose**

* Sample Depth = 100 - 400

Passing 26.5 mm = 100 %

19.0 mm = 100 %

13.2 mm = 97 %

9.5 mm = 93 %

4.75 mm = 80 %

1.18 mm = 58 %

300 um = 38 %

75 um = 14 %

w = 6 %

Unacceptable Granular A

(All sieve sizes too fine)

Unacceptable Granular B, Type I

(14% Passing 75 um)

** Sample Depth = 6.00 - 6.30

Passing 4.75 mm = 99 %

2.00 mm = 99 %

425 um = 99 %

75 um = 86 %

5 um = 29 %

2 um = 15 %

w = 22 %

Plasticity = Non-plastic

Classification = ML

Frost Susc. = HSFH

'K' Factor = 0.50

NOTE: Added Revised Stations and Borehole Identifications

E/W-S Ramp

Station 13+665 to 14+565, Referenced to Lt E/P

991-8064G

December, 2000

EWS-G1

(Revised Station 14+305 8.00 Rt of Lt EP EL.309.2)

14+315 3.00 Rt of Lt E/P D-0 HA

0	- 1.00	Stding Water
1.00	- 1.40	Blk Org
1.40	- 4.00	Br F-Med Sa Tr Si, Sat, Comp
	- 4.00	NFP Sloughing

EWS-G2

(Revised Station 14+403 1.50 Rt of Lt EP EL.309.7)

14+415 3.00 Rt of Lt E/P D-0 HA

0	- 300	Stding Water
300	- 1.20	Muckamor*
1.20	- 3.00	Br F-Med Sa Tr Si, Sat, Comp
	- 3.00	NFP Sloughing

* Sample Depth = 300 - 600

w = 213 %

EWS-G3

(Revised Station 14+466 1.30 Lt of Lt EP EL.309.7)

14+475 3.00 Rt of Lt E/P D-0 HA

0	- 300	Stding Water
300	- 1.80	Muckamor
1.80	- 3.20	Br F-Med Sa Tr Si, Sat, Comp
	- 3.20	NFP Sloughing

NOTE: Added Revised Stations and Borehole Identifications**Golder Associates**



**FOUNDATION DESIGN REPORT
SWAMP CROSSING**

for

**HIGHWAY 11
SOUTH MARY LAKE ROAD INTERCHANGE
G.W.P. 62-86-00
DISTRICT 52, TOWNSHIP OF STEPHENSON
HUNTSVILLE, ONTARIO**

PETO MacCALLUM LTD.
165 CARTWRIGHT AVENUE
TORONTO, ONTARIO
M6A 1V5
Phone: (416) 785-5110
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May 17, 2005



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Table 1 - Summary of Subsoil and Groundwater Conditions, Alternative Treatment Options and Recommended Treatment

Table 2 - Computed Settlements of Embankment Platform for Recommended Treatment Options

Table 3 - List of Standard Specifications Referenced in Report

Figure A - Key Plan

Ontario Provincial Standard Drawing - OPSD-203.010

**FOUNDATION DESIGN REPORT
SWAMP CROSSING**

for

Highway 11
South Mary Lake Road Interchange
G.W.P. 62-86-00
District 52, Township of Stephenson
Huntsville, Ontario

1. INTRODUCTION

1.1 General

The planned interchange at South Mary Lake Road/Stephenson Road 4 and Highway 11 some 14 km south of Huntsville, Ontario requires the construction of embankments through a swamp. This report was prepared for McCormick Rankin Corporation (MRC) on behalf of the Ministry of Transportation of Ontario (MTO).

The report provides recommendations for construction of embankments in the swamp crossings identified in the RFP for this project where special construction procedures are required to minimize postconstruction settlement of the roadway surface due to consolidation of the subgrade materials as well as comments on the stability of the embankments and construction methods. Recommendations for construction of the remaining embankments within the project limits are dealt with in the Pavement Design Report that was prepared by Peto MacCallum Ltd. (PML) under separate cover (reference No. 04TF005 to be issued later in 2005).

The swamp is located at the southwest corner of Stephenson Road 4 and Lone Pine Drive and affects the proposed Stephenson Road 4 connection road to the realigned South Mary Lake Road and west ramps of the interchange from/to Highway 11 southbound lanes. The investigations were carried out along the following embankment crossing swamp sections:

- Stephenson Road 4 Connection - Sta. 40+050 to Sta. 40+375
- N-E/W Ramp - Sta. 13+950 to Sta. 14+175
- E/W-S Ramp - Sta. 14+275 to Sta. 14+525
- W-S Connection - Sta. 14+423 to Sta. 14+500

The locations of the Stephenson Road 4 connection road and interchange ramps are shown on Drawing 1.



The embankment height within the designated swamp limits provided with the RFP documents ranged from about 1.0 to 6.5 m. The proposed road grades were last revised by MRC in October/November 2004. The latest revised embankment height at the reference lines ranges from about 1.5 to 8.5 m (higher at the intersections with the realigned South Mary Lake Road). The ranges of embankment fill height for Stephenson Road 4 connection road and each of the interchange ramps are listed on Table 1.

The subsurface stratigraphy in the swamp is uniform and comprises a continuous 0.1 to 1.8 m thick peat layer overlying deposits of sand and silt and discontinuous layers of silty sand and cohesionless glacial till. The soil cover is cohesionless, typically loose to compact and mantles probable bedrock throughout the swamp. The groundwater is high, and standing water up to 1.0 m deep occurs in the lower areas of the swamp. A summary of the subsurface soil conditions under the alignment of each of the embankments crossing the swamp is compiled in Table 1.

It is considered that only removal of the surficial highly compressible organic soils (peat) will be required to adequately prepare the subgrade for the proposed road embankments.

1.2 Earthquake Parameters

The site seismic coefficient for the conditions at the site is 2.0 (Type IV soil profile as per clause 4.4.6 of the Canadian Highway Bridge Design Code (CHBDC), CAN/CSA-S6-00).

The site is located in Seismic Performance Zone 1. The liquefaction potential of the silts and sands at the site was assessed using the procedure suggested by Seed and Idriss (1971) and, on this basis, it is considered that liquefaction of the granular soils is unlikely (clause 4.6.2 of the CHBDC).



2. SWAMP CROSSING TREATMENTS

2.1 Site Constraints

Based on the subsurface soils and groundwater conditions and planned embankment heights, the constructability constraints for this site comprise highly compressible organic soils (peat) and working below the water table where it is impractical to place and compact earth and/or pit-run granular materials. Large-volume dewatering is not considered to be feasible at this site due to environmental impacts including effects to existing wells and economic constraints.

The site constraints indicate that rockfill should be employed to construct the portion of the embankment below existing grade and/or below the water level to satisfy constructability as well as to minimize postconstruction embankment settlements. Rockfill can be adequately placed under water without construction dewatering. As an alternative to full height rockfill embankments, earth, SSM and/or granular material could be employed from 2.0 m above the water level. Further comments are provided in Section 3 of this report.

2.2 Embankment Treatment

The following methods of construction of embankment fills at swamp crossings were considered:

- Excavation of compressible soils
- Preloading of embankments
- Partial excavation and preloading
- Construction of a bridge to span the swamp/compressible soil
- Lengthening the construction schedule and/or advance contracts to increase the time period between construction of the embankment and construction of the roadway to minimize postconstruction settlements of the road surfaces.
- Use of lightweight fill to minimize the stress imposed on the underlying soil
- Installation of wick drains to increase the rate of consolidation and minimize the magnitude of postconstruction settlement

A brief discussion of each treatment option is provided in the following paragraphs.



2.2.1 Excavation of Compressible Soil

The standard method of construction of embankments normally employed by MTO in areas where low strength compressible soils exist is to excavate these soils to firm bottom and backfill the excavation following the procedures noted in OPSD-203.010. A copy of the Ontario Provincial Standard Drawing (OPSD) is provided with the report.

For the purposes of this report, "firm bottom" was generally defined as loose to compact cohesionless sands or silts ($N > 7$ blows/0.30 m) cognizant of the embankment height and expected settlements. Further comments in this regard are provided in subsequent paragraphs.

The existing peat is highly compressible and generally not capable of supporting the weight of embankment fill to be placed. The cohesionless deposits of sand/silt and local glacial till that underlie the peat are deemed to be competent and capable of supporting the proposed rockfill embankments (taking into account the local embankment height), since settlement of these materials occurs rapidly and mostly during construction.

Excavation for construction of the rockfill embankments using this treatment option would extend through the 0.1 to 1.8 m thick peat deposit.

Advantages	Disadvantages
<ul style="list-style-type: none">- minimal postconstruction settlement due to consolidation of the cohesionless subgrade soils	<ul style="list-style-type: none">- disposal of large quantities of peat- environmental impacts- significant postconstruction settlement of rockfill

2.2.2 Preloading of Embankments

This treatment option involves excavation of the surficial peat and placement of the rockfill embankment and a surcharge load directly on the cohesionless soil. This option is not considered applicable for consolidation of the native soils due to the anticipated short time for substantial completion of these settlements (less than 2 months).

The treatment could be used to reduce postconstruction settlement of the rockfill. The analysis carried out for this purpose indicates, however that preloading the full embankment with a 2 to 4 m high surcharge for periods of 3 to 6 months will only induce 10 to 20% of the settlement which would otherwise occur under the original embankment load without surcharge after 1 year. The reduction to the long-term "consolidation" of the rockfill would be similar and would not be significant (in the order of 3 mm). This option is therefore considered not cost effective for this site.



Advantages	Disadvantages
- reduced postconstruction settlement of rockfill	- extended construction period required for consolidation

2.2.3 Partial Excavation and Preloading

This treatment option involves excavation of the surficial peat and other compressible soil to a selected depth followed by placement of the rockfill and surcharge. The excavation depth and surcharge height are strategically selected to achieve the requisite consolidation within the time period available for construction. Consequently, the depth of excavation/height of surcharge load is optimized in locations where an extensive thickness of compressible soils exists.

This treatment is not considered applicable to this swamp site since the depth of required excavation is limited to the thickness of the peat only.

2.2.4 Construction of Bridges

This treatment option involves construction of a structure to span the area of compressible soils and is not considered cost effective for this site.

Advantages	Disadvantages
- negligible postconstruction settlements - rockfill not required - minimal environmental impacts - no need for disposal of excavated peat	- high cost

2.2.5 Lengthened Construction Schedule and Advance Contracts

This treatment option would normally be employed in conjunction with options 2.2.2 (Preloading) and 2.2.3 (Partial Excavation and Preloading). It involves selective scheduling of the time for construction of embankments in the swamp/high fill crossings within the overall roadway construction period to allow for consolidation of the subgrade material below the fill or issuing advance contracts for this work to be carried out prior to issuance of the contract for construction of the overall roadway.

Advantages	Disadvantages
Same as option 2.2.2	Same as option 2.2.2



2.2.6 Lightweight Fill

Use of lightweight fill to reduce the pressure imposed on the subgrade soils and thereby reduce the magnitude of postconstruction settlements is a suitable treatment option in some situations. For the subject site however the loads imposed by rockfill or earthfill would be adequately supported therefore this treatment is not required or cost effective.

Advantages	Disadvantages
- no perceived advantages	- lightweight fill not locally available - environmental impacts during transportation to site - impact to existing pavement system during transportation to site - cost

2.2.7 Wick Drains

Installation of wick drains are used to increase the rate of consolidation of the native cohesive subsoil and minimize the magnitude of postconstruction settlement of the embankment surface. This method does not apply to the project site since all of the native subsoil comprises cohesionless soils in the swamp area.

2.3 Selection Criteria and Preferred Treatment

The recommended swamp treatment method for each section of the roadway embankments under consideration for the site was established using the following criterion:

- i) Minimize the postconstruction settlement of the embankment surface due to consolidation of the embankment fill and subgrade material (further comments in this regard are provided in subsequent paragraphs)

The preferred treatment option will be dictated by the soil profile at the swamp crossing, the accepted postconstruction performance (settlement), environmental considerations, design requirements, the construction schedule, construction constraints and economic considerations.

The environmental considerations primarily relate to the impact to natural systems on and adjacent to the construction corridor which is dictated in part by the depth and width of excavation



required to remove the compressible soils to enable construction of the embankments, as well as a suitable area to dispose of the excavated material. This will be controlled at this site by the engineering properties of the peat which govern the natural inclination of cut slopes, the stable inclination of the rockfill slopes and the inclination of the excavated peat at the disposal site(s).

The preferred treatment option from a foundation engineering perspective to construct the proposed embankments over the swamp is to excavate the compressible soils (peat). It is considered that the remaining options are not applicable to the site, as briefly discussed on the previous subsections. Recommendations for the design and construction of the preferred treatment are provided in Section 3.

2.4 Embankment Settlements

The magnitude of postconstruction settlement of the embankment platform and the time required for essential completion of the settlement during construction for each treatment option will be a function of the embankment height and the composition, thickness and pertinent engineering properties of the cohesionless subgrade soil since full depth excavation (to bedrock) is not anticipated at this site.

Engineering analysis was carried out to evaluate the magnitude of postconstruction settlement due to consolidation of the subgrade soils and the rockfill for each embankment section. Refer to Section 3 for detailed comments in this regard.

Settlement resulting from consolidation of the rockfill was based on the following criteria established from review of research documents prepared by MTO (RR229 dated March 1983) and discussions with the Pavement and Foundation Section of MTO.

- **Rockfill Above Grade**

Total settlement is about 0.5% of the rockfill height provided the fill is placed in accordance with SP 206S03.



- Rockfill Below Grade

Total settlement up to 2% of the rockfill thickness since the rockfill is end dumped and placed in relatively large lift thicknesses with minimal or no compaction effort.

- Rate of Rockfill Settlement

About 50% of the total settlement occurs during the first year following placement of the rockfill and the remaining 50% at a progressively decreasing rate during the following 5 to 10 year period.

Settlement resulting from compression of the cohesionless sandy and silty subgrade soils was computed using the method developed by Drs. E. Schultze and E. Menzenbach (Proceedings from the 5th International Conference on Soil Mechanics and Foundations - Volume I, 1961). Settlements of the typical soils at the site were assessed using the following modules of compression, k (kPa):

Loose sand	6,000	kPa
Compact Sand	12,100	kPa
Compact Silt	9,900	kPa

Settlement of the native soils is expected to be completed within one to two months after completion of the construction of the embankments.

3. RECOMMENDED TREATMENT

A brief summary of the discussion of the suitability of the treatment options noted in the previous Section 2.2 is provided in Table 1 for each crossing along with the recommended treatment option(s). Excavation of the surficial peat and organic deposits is a requirement for all treatment options.

A list of the MTO standard specifications referenced in this report with the issued dates is provided in Table 3.

The preferred swamp treatment comprises excavation of compressible soils (peat) and backfill the excavation according to OPSD-203.010.



As discussed previously in Section 2.1, large volume dewatering is not recommended at the site and the lower sections of the embankments will need to be constructed underwater after removal of the peat. It is recommended that the embankments be constructed with rockfill through the swamp for constructability purposes. The use of SSM or Granular B Type I is not recommended since these materials will not retain sufficient internal friction under water and consequently cannot be adequately compacted.

A composite rockfill and earthfill embankment may be considered as an alternative to a full height rockfill embankment. For stability and constructability considerations rockfill is recommended in the lower zone of the composite embankment to a height about 2.0 m above the level of the standing water, or elevation 312.0. Adequately chinked rockfill surface is considered adequate to receive the remaining earthfill height composed of SSM or Granular B Type I aggregates. It is not anticipated that excess native soils from the swamp area will be available for construction of the embankments. Where the boundary between the rockfill and earthfill is lower than 2.0 m above the water level a non-woven geotextile fabric should be placed to separate the two embankment fill materials. It is recommended that the geotextile conforms to OPSS 1860 Class II and have a maximum filtration opening size of 0.15 mm.

The suggested excavation type for the subsoil preparation is swamp excavation that is considered to be appropriate if a substantial proportion of the excavation depth (approximately 25%) consists of peaty soils that will essentially act as slurry. The excavations should be shaped according to the Occupational Health and Safety Act. To this end, the peat is considered Type 4 soil, as well as all cohesionless soils below the groundwater table. The rockfill for the embankments should be placed by the end-dumping method, following closely the excavation of the peat and the construction equipment should operate from the top of the newly placed rockfill, in view of the high water table and cohesionless nature of the native soils.

Embankments placed on firm ground should be constructed in accordance with OPSD-201.010, OPSD-202.010, OPSD-203.010 and SP 206S03. The side slopes of the embankments should be inclined no steeper than 2 horizontal to 1 vertical (2H:1V) for earth fill and 1.25H:1V for rockfill. A 2 m wide mid-height berm should be provided so that uninterrupted slope heights are 10 m for rockfill and 8 m for earthfill in accordance with OPSD-202.010. Where a composite earthfill/rockfill embankment is used the 8 m height limit is recommended.



Excavated swamp and/or inorganic soil could be placed on the rockfill below grade if the inclination of the slope flattening material is not steeper than 3.5H:1V.

It is considered that the rockfill or combined rockfill/earthfill embankments constructed in accordance with these recommendations will be stable. The minimum factor of safety for the critical short-term conditions is 1.3 and higher for long-term conditions.

Settlement of the embankment fill surface, both during and following completion of construction, due to consolidation of the subgrade soils and "consolidation" of the rockfill (or rockfill/earthfill in combined embankment) is likely to occur. Total settlement of embankments constructed on silty/sandy subgrade soil is expected to be in the order of 20 to 135 mm. Typically, 60 to 70% of the settlements (15 to 95 mm) are expected to occur during construction of the embankments and be completed within 1 to 2 months following construction. Additional 20% (2 to 20 mm) are expected to occur within the first 12 months following completion of construction and the remaining 10 to 20% (3 to 20 mm) within 5 to 10 years of completion. For practical purposes in this project the settlement of the combined rockfill/earthfill embankments are considered of similar magnitude as the rockfill embankments. The magnitude of total settlement of the native soils and rockfill embankments is summarized in Table 2 for the recommended treatment at each crossing.

It is noted from Table 2 that total settlement of the embankment surface during the five year period following completion of construction is generally expected to be within 20 mm.

Some "loss of rockfill" is likely to occur as a result of the rockfill "punching" into the very loose to loose sandy soil below the recommended peat excavation depths. For volume calculation purposes, the "loss of rockfill" is considered to be 300 mm.

The embankment platform should be widened a minimum of 1 m on each side according to Northeastern Region Engineering Directive NRE 98-200. The widening allows for foundation and geotechnical components of the design including the anticipated postconstruction settlement of the embankment, the side slope flattening specified by MTO and the accommodation of a 200 mm thick cumulative pavement overlay in future. Refer to the Pavement Design Report for additional comments in this regard.

5. CLOSURE

Messrs. F. Portela, Senior Technician and M. Rapsey, Senior Technician carried out the field investigation for this study under the supervision of Mr. C.M.P. Nascimento, P.Eng., Senior Foundation Engineer.

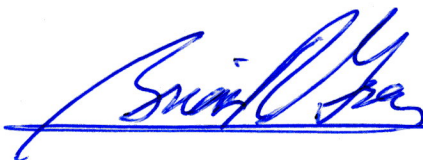
This report was prepared by Mr. C.M.P. Nascimento, P.Eng., and was reviewed by Mr. B.R. Gray, MEng, P.Eng., MTO Designated Contact. Mr. D.W. Kerr, MEng, P.Eng., Chief Foundation Engineer, conducted an independent review of the report.

Yours very truly,

Peto MacCallum Ltd.



C.M.P. Nascimento, P.Eng.
Senior Foundation Engineer



Brian R. Gray, MEng, P. Eng.
MTO Designated Contact



Dennis W. Kerr, MEng, P.Eng.
Chief Foundation Engineer

CN/BRG/DWK:lr-mi





TABLE 1
SUMMARY OF SUBSOIL AND GROUNDWATER CONDITIONS, ALTERNATIVE TREATMENT OPTIONS
AND RECOMMENDED TREATMENT

SWAMP LOCATION.	INTERCHANGE COMPONENT	FILL HEIGHT (²) (m)	DEPTH TO "FIRM BOTTOM" (m) (³)	UNDERLYING MATERIAL (⁴)	DEPTH TO PROBABLE BEDROCK (m) (³)	GROUNDWATER DEPTH (m) (⁵)	EXCAVATION PROCEDURE	TREATMENT OPTION AND DISCUSSION		RECOMMENDED TREATMENT
Township of Stephenson South Mary Lake Road and Hwy 11 Interchange	<u>Stephenson Road 4 Connection</u> Sta. 40+050 to 40+375	1.5 - 5.0	0.1 - 1.8	Compact cohesionless sand overlying silt deposits extending to bedrock.	1.7 - 7.5 (El. 301.3 - 308.4)	0.0 - 1.3 (El. 308.1 - 311.2)	SE	1. Excavation of compressible soil	Suitable treatment option	Excavation of compressible soil
	<u>N-E/W Ramp</u> (¹) Sta. 13+950 to 14+175	3.5 - 8.0	0.2 - 1.2	Loose to compact cohesionless sand overlying compact silt and/or local compact glacial till extending to bedrock.	2.6 - 8.2 (El. 301.6 - 307.2)	0.0 - 1.2 (El. 308.9 - 309.8) Standing water in 3 boreholes	SE	2. Preloading	Not efficient to reduce long term "consolidation" of rockfill.	
	<u>E/W-S Ramp</u> (¹) Sta. 14+275 to 14+525	3.0 - 8.5	0.2 - 1.5	Loose to compact cohesionless sand overlying compact silt and/or local compact glacial till extending to bedrock.	5.1 - 8.1 (El. 301.9 - 304.4)	0.0 - 0.3 (El. 308.3 - 310.1) Standing water in 3 boreholes	SE	3. Partial excavation/surcharge	Not applicable due to short settlement period anticipated.	
	<u>W-S Connector</u> (¹) Sta. 14+423 to 14+500	6.5 - 7.5	0.2 - 0.5	Loose to compact cohesionless sand overlying compact silt and compact glacial till extending to bedrock.	7.0 - 8.2 (El. 301.3 - 303.1)	0.0 - 0.7 (El. 309.4 - 310.0)	SE	4. Bridge	Not cost effective	
								5. Lengthen construction schedule/advance contract	Possible treatment option in conjunction with option 2.	
								6. Lightweight Fill	Not cost effective or applicable	
								7. Wick drains	Not cost effect or useful	

SE - Swamp Excavation

NOTES:

- (1) N-E/W, S-E/W and W-S Connector ramps share a common embankment.
- (2) Fill height along reference line provided in October and November 2004.
- (3) Depth to "firm bottom" and probable bedrock may vary between reference test holes.
- (4) Only cohesionless materials comprise the soil cover at the swamp site.
- (5) Based on water levels measured in 2001 (by GAL), April 2004 and February 2005. Levels fluctuate seasonally and with rainfall patterns.



TABLE 2
COMPUTED SETTLEMENTS OF EMBANKMENT PLATFORM
FOR RECOMMENDED TREATMENT OPTIONS

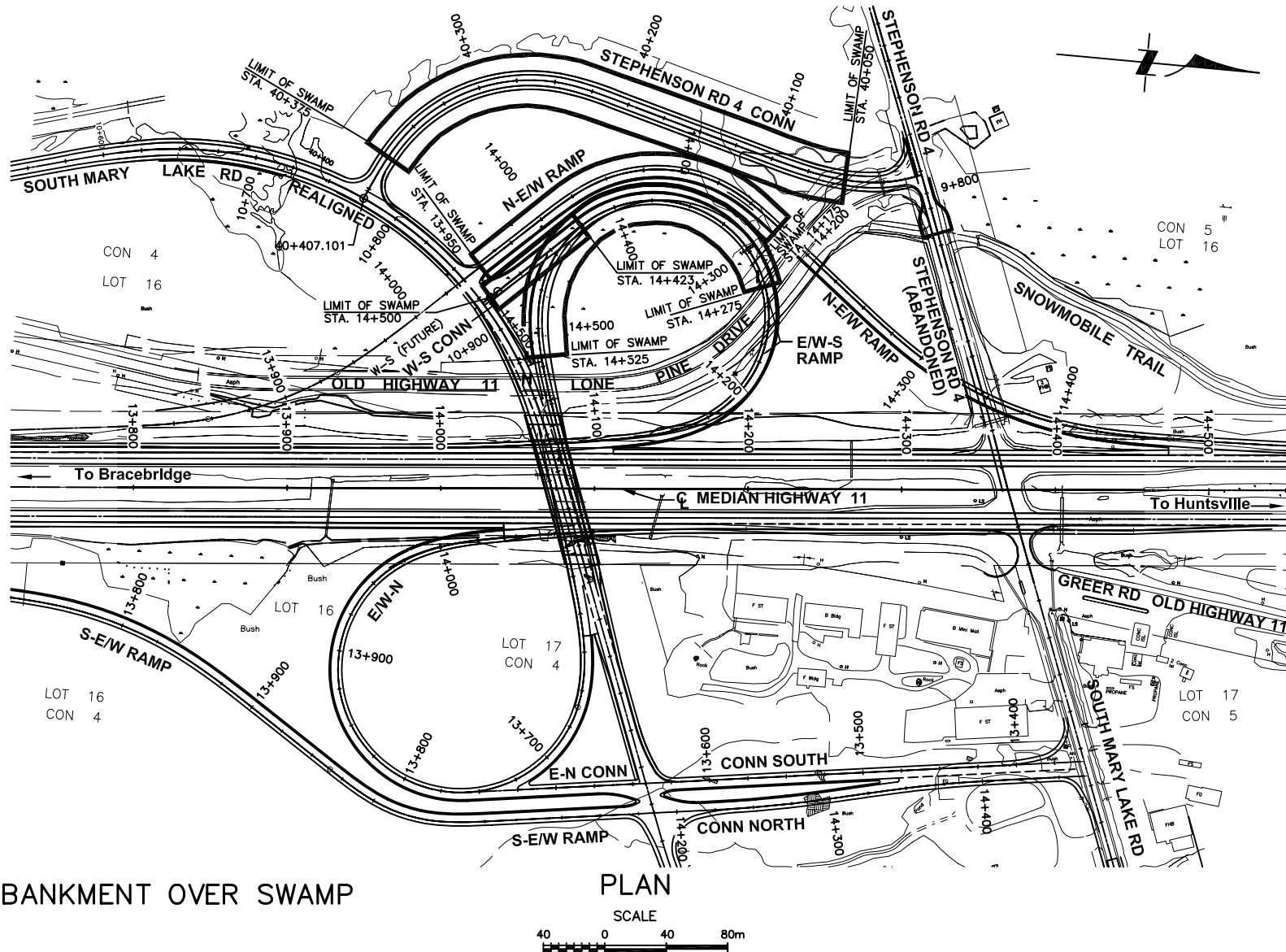
SWAMP LOCATION.	INTERCHANGE COMPONENT	TREATMENT OPTION	NATIVE SOIL		ROCKFILL			TOTAL PLATFORM SETTLEMENT (mm)
			DEPTH TO PROBABLE BEDROCK (m) ⁽²⁾	AVERAGE SETTLEMENT (mm) ⁽³⁾	MAXIMUM HEIGHT ⁽⁴⁾ (m)	SETTLEMENT (mm)		
						1 YEAR	FOLLOWING 5 TO 10 YEARS	
Township of Stephenson South Mary Lake Road and Hwy 11 Interchange	<u>Stephenson Road 4 Connection</u> Sta. 40+050 to 40+250	Excavation of compressible soil	1.7 - 7.5	15	2.0	2	3	20
	Sta.40+250 to 40+375	As above	1.7 - 7.5	40	5.0	12	13	65
	<u>N-E/W Ramp</u> ⁽¹⁾ Sta. 13+950 to 14+075	Excavation of compressible soil	2.6 - 8.2	75	8.0	20	20	115
	Sta.14+075 to 14+175	As above	2.6 - 8.2	55	6.0	15	15	85
	<u>E/W-S Ramp</u> ⁽¹⁾ Sta. 14+275 to 14+400	Excavation of compressible soil	5.1 - 8.1	65	6.0	15	15	95
	Sta. 14+400 to 14+525	As above	5.1 - 8.1	90	8.0	20	20	130
	<u>W-S Connector</u> ⁽¹⁾ Sta. 14+423 to 14+500	Excavation of compressible soil	7.0 - 8.2	95	7.5	20	20	135

- NOTES:** (1) N-E/W, S-E/W and W-S Connector ramps share a common embankment
(2) Depth to probable bedrock may vary between reference test holes
(3) Anticipated completion of settlement of native materials is 1 to 2 months after embankment construction
(4) Fill height along reference line provided in October and November 2004



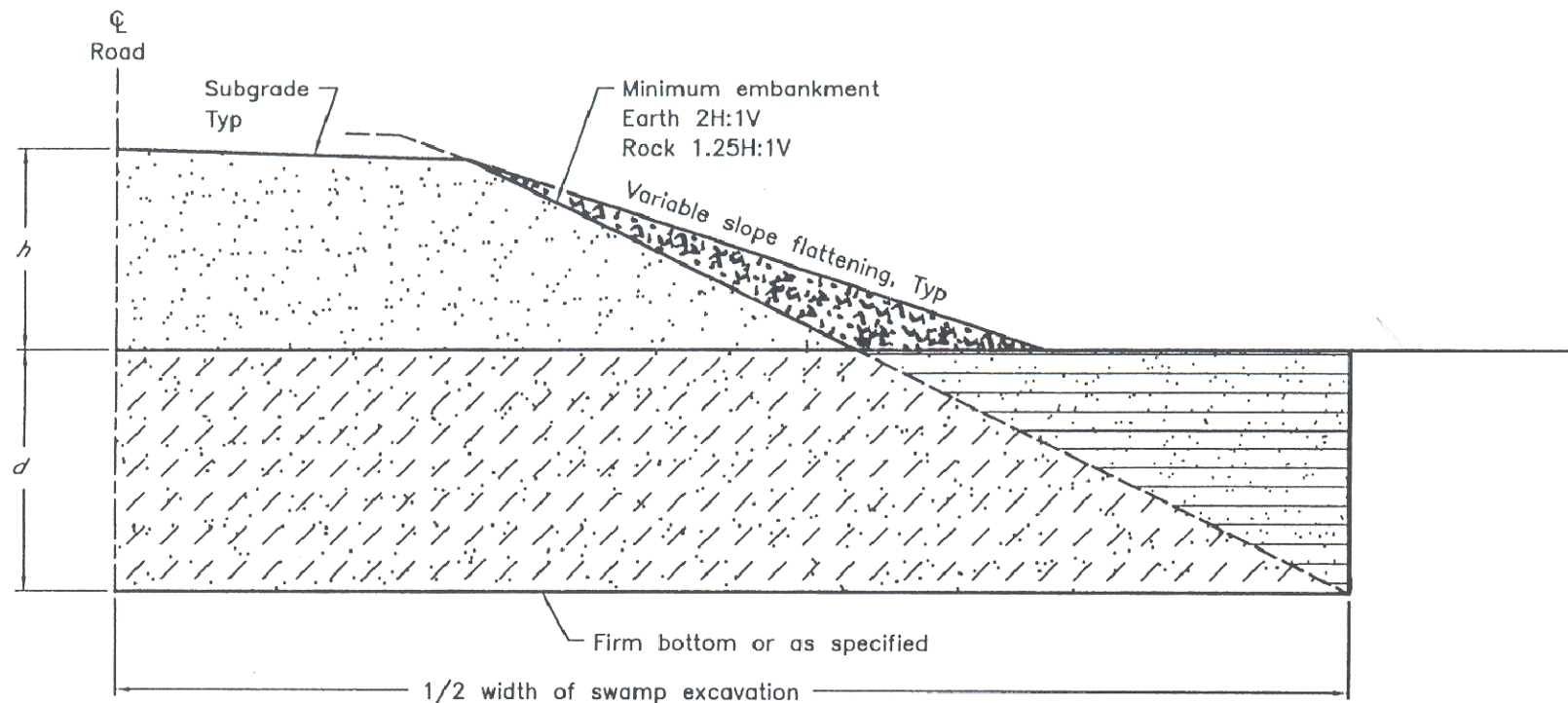
TABLE 3
LIST OF STANDARD SPECIFICATIONS REFERENCED IN REPORT

TITLE	NO.	DATE
Material Specification for Geotextiles	OPSS 1860	November 2004
Rock Grading Undivided Highway	OPSD-201.010	April 1999
Embankment Construction Using Excess Materials Outside of Earth or Rockfill	OPSD-202.010	March 1, 1998
Embankments Over Swamp - New Construction	OPSD-203.010	November 2004
Construction Specification for Grading	SP 206S03	January 2004
Embankment Design Guidelines (Northeastern Region)	NRE 98-200	October 28, 1998



LEGEND:

EMBANKMENT OVER SWAMP



LEGEND:

	Embankment materials as specified
	Excavated swamp material
	Excavate and backfill
	Excavate and backfill with swamp material

h - Height of fill
 d - Depth of sub-excitation

NOTES:

- A For given limits of height $h \leq 4.5\text{m}$ and depth $d \leq 6.0\text{m}$, both requirements shall be met in order to apply.
- B Height of fill is the vertical difference between top of subgrade and top of swamp elevation measured at new road centreline.
- C For divided roads with median $< 10\text{m}$, excavate swamp material full width.
- D For divided roads with median $\geq 10\text{m}$, excavate swamp material to limits as specified.
- E All dimensions are in millimetres unless otherwise shown.

F Drawing modified on May 17, 2005 for GWP 62-86-00.

ONTARIO PROVINCIAL STANDARD DRAWING

**EMBANKMENTS OVER SWAMP
NEW CONSTRUCTION**

Nov 2004 Rev 1



OPSD - 203.010