



**Preliminary
Foundation Investigation and Design Report
Highway 11/17 Embankments
Station 41+800 to 42+200 Township of MacGregor
Station 10+700 to 11+300 Township of McTavish**

GWP 125-90-00

Geocres No.: 52A-172

**Prepared for
Engineering Northwest Limited**

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Table of Contents

PART A - FOUNDATION INVESTIGATION REPORT

1	Introduction	2
2	Site Description	3
2.1	Site 3 – Station 41+800 to 42+200 Township of MacGregor	3
2.2	Site 4 – Station 10+700 to 11+300 Township of McTavish	4
2.3	Surficial Geology For Sites 3 and 4	4
3	Investigation Procedures	5
4	Laboratory Testing	5
5	Subsurface Conditions	6
5.1	Embankment from 41+800 to 42+200 Township of MacGregor (Site 3)	6
5.1.1	Organic Material	6
5.1.2	Sand	6
5.1.3	Silt	6
5.1.1	Sand and Silt	7
5.1.2	DCPTs	7
5.1.3	Refusal	7
5.1.4	Ground Water	8
5.2	Embankment from 10+700 to 11+300 Township of McTavish (Site 4)	8
5.2.1	Organic Material	9
5.2.2	Gravel	9
5.2.3	Sand	9
5.2.4	Sand and Gravel	9
5.2.5	Refusal	10
5.2.6	Ground Water	10
6	Miscellaneous	11

PART B - FOUNDATION DESIGN RECOMMENDATIONS

7	Introduction	12
8	Embankment Analyses	13
8.1	Geotechnical Model	13
8.2	Proposed Embankments	14
8.3	Settlement Performance For Sites 3 and 4	17
9	Potential Construction Issues for Sites 3 and 4	17
10	Scope of Detailed Investigations	18
11	Limitations	19
12	Closure	20

APPENDICIES

Embankment at Station 41+800 to 42+200 Township of MacGregor (Site 3)

Appendices Series – 1

Appendix A-1, Borehole Logs

Appendix B-1, Laboratory Test Data

Appendix C-1, Borehole Locations and Soil Strata Drawing

Embankment at Station 10+700 to 11+300 Township of McTavish (Site 4)

Appendices Series – 2

Appendix A-2, Borehole Logs

Appendix B-2, Laboratory Test Data

Appendix C-2, Borehole Locations and Soil Strata Drawing

Part A - FOUNDATION INVESTIGATION REPORT

1 Introduction

TBT Engineering Limited (TBTE) has been retained by Engineering Northwest Limited a division of Hatch Mott MacDonald (ENL) to provide preliminary foundation investigation and design services for the proposed embankments on Highway 11/17 located at Sta. 41+800 to 42+200 in the Township of MacGregor and 10+700 to 11+300 in the Township of McTavish. These sites are a part of the Highway 11/17, four-laning project from 5.0 km west of Highway 587 easterly 6.5 km. The foundation investigations were conducted to provide preliminary subsurface data for the development of a new eastbound lane for Hwy 11/17.

These sites are two of several foundation sites being investigated as a part of the Hwy. 11/17 four lane project. The remaining foundation sites (Embankment on Hwy 587 and Culverts on Hwy 11/17 and 587) are addressed under separate covers. The Hwy 11/17 embankments have been designated as foundation Sites 3 (Station 41+800 to 42+200 MacGregor) and 4 (Station 10+700 to 11+300 McTavish) for the project.

These investigations consisted of 11 boreholes and 4 Dynamic cone Penetration Tests (DCPTs) at Site 3 and 11 boreholes and 1 test pit at Site 4, advanced near the proposed EBL centerline, laboratory testing and geotechnical analysis of the data. This report (Part A) describes the subsurface conditions encountered during the investigation. The test holes are labeled from test holes 3-1 to 3-15 for Site 3 and test holes 4-1 to 4-12 at Site 4.

The foundation section has assigned GEOCRES Nos. 52A-172 to these sites.

2 Site Description

The foundation investigations were carried out to investigate subsurface conditions at the embankments located from Station 41+800 to 42+200 (MacGregor) and from Station 10+700 to 11+300 (McTavish).

2.1 Site 3 – Station 41+800 to 42+200 Township of MacGregor

The embankment spanning from Station 41+800 to 42+200 is located within a relatively deep valley and also includes a waterway and culvert at 42+130. A large swamp is located in the floor of the valley surrounding the waterway. The site is heavily treed.

The maximum embankment height is 13 m (from preliminary design vertical alignment to toes of slope) and the maximum embankment fill thickness is 9 m. A bedrock outcrop was observed westerly of the site on the right side.

The new eastbound alignment will be located to a great extent over the floor of the valley with only a small side hill construction over the westerly portion of the eastbound embankment.



Site Photo 1 – Embankment 41+800 to 42+200 (MacGregor) Looking Easterly

2.2 Site 4 – Station 10+700 to 11+300 Township of McTavish

The embankment spanning from Station 10+700 to 11+300 includes an undulating topography and a waterway at 11+200. The maximum embankment height is 13 m (from preliminary design vertical alignment to toes of slope) and the maximum embankment fill thickness is 11.5 m. The site is heavily treed.

The new eastbound alignment will be located south of the existing highway. The terrain to the south of the highway typically slopes southerly (towards the lake) and the topography and undulates east to west. A private residence is located near sta. 11+000, on the median centreline.



Site Photo 1 – Embankment 10+700 to 11+300 (McTavish) Looking Easterly

2.3 Surficial Geology For Sites 3 and 4

Based on review of surface geology mapping, the site is located in an area of organic terrain overlying sand and glacial outwash plain. The area also includes bedrock knob terrain with subordinate land forms consisting of till ground moraine.

3 Investigation Procedures

A geotechnical site investigation was undertaken during the following dates:

Table 3.1: Investigation Dates

Site Number	Dates	Test Hole Investigated
3	April 2 to 8, 2013	3-1 to 3-15
4	April 16 to May 1, 2013	4-1 to 4-12

The borehole locations are illustrated on the Borehole Location Plans found in Appendix A-1 (Site 3) and Appendix A-2 (Site 4).

The borehole locations were identified in the field by TBTE personnel and service clearances were completed prior to mobilizing the drill rig to site. The boreholes were advanced using an all terrain mounted drill rig equipped hollow stem augers and a cat head used to carry out Standard Penetration Testing (SPT). Soil samples were obtained at the boreholes from the auger flights and using a split spoon sampler as a part of the SPT. In addition, four dynamic cone penetration tests (DCPT) were completed at Site 3. The test pit at Site 4 was completed using a Cat 315 CL excavator.

Surveys were conducted using North American Datum 1983, MTM CSRS Zone 15. Control was established from existing published Horizontal Control Monuments and a Geodetic Benchmark based on the Canadian Geodetic Vertical Datum 1928. The horizontal control point used is identified as HCM 00819710510, and vertical control point is identified as GBM 0011993U171 with a Geodetic Elevation of 244.800. The survey was completed using a Trimble R8 Series 3 RTK GPS.

All boreholes were backfilled with a bentonite mixture following drilling. Temporary standpipes have been removed and decommissioned.

4 Laboratory Testing

Samples which were obtained during the field investigation were subjected to routine laboratory testing. The routine testing included moisture content, Atterberg limits and grain size analysis (where appropriate). The results of this testing are shown on the

Borehole Logs (Appendix A-1 and A-2) and on the laboratory data reports (Appendix B-1 and B-2).

5 Subsurface Conditions

5.1 Embankment from 41+800 to 42+200 Township of MacGregor (Site 3)

Details of the subsurface conditions are provided on the test hole logs (Appendix A-1) and on the Soil Strata Drawings (Appendix C-1).

The subsurface soils at this site typically consist of organic material which overlies various mixtures of sand and silt. All boreholes extended to shallow practical refusal on boulders or bedrock, the DCPTs extended until 100+ blows/0.3 m were recorded.

5.1.1 Organic Material

Organic material was encountered at the ground surface of all the boreholes. The material ranges in thickness from 0.1 to 2.2 m. Based on fourteen samples the natural moisture content of this material ranges from 88 to 1162 %. Cobbles were noted in this stratum at Borehole 3-13.

5.1.2 Sand

Silty sand with some gravel to sand with trace silt and gravel was encountered beneath the organic material at Borehole 3-1, 3-3, 3-6, 3-7, 3-9, and 3-15. The sand was encountered at elevations of 238.0 to 241.4 with thicknesses ranging from 0.7 to 5.2 m. Four samples were selected for grain size distribution testing. The test results indicate a grain size distribution of 0 to 15 % gravel, 64 to 90% sand, and 9 to 29 % silt/clay sized particles. Occasional cobbles were noted within this stratum. The sand is very loose to very dense as indicated by “N” values ranging from 1 to 100+ blows/0.3 m. The sand is typically compact, with loose to very loose zones at Boreholes 3-3, 3-6, 3-7, 3-9 and 3-15 typically between elevations 338.5 and 339.5. The loose zone extends from elevation 339 to 341 at Borehole 3-15.

5.1.3 Silt

Sandy silt with some gravel to silt with trace sand and gravel was encountered beneath the organic material at Boreholes 3-4 and 3-14 and beneath the sand at Boreholes 3-3 and 3-7. The silt was encountered at elevations of 238.0 to 242.5 with thicknesses ranging from 0.4 to 2.1 m. Four samples were selected for grain size distribution testing. The test results indicated a grain size distribution of 0 to 17 % gravel, 11 to 23 % sand,

and 60 to 87 % silt/clay sized particles. Occasional cobbles were noted within this stratum. The silt is loose to compact as indicated by “N” values ranging from 4 to 12 blows/0.3 m. The silt was non-plastic.

5.1.1 Sand and Silt

Sand and silt with some to trace gravel was encountered beneath the organic material at Boreholes 3-11 and 3-12, beneath the sand at Boreholes 3-1, 3-6, 3-9 and 3-15, and beneath the silt at Boreholes 3-3, 3-4, 3-7 and 3-14. This material displays varying low degrees of plasticity as indicated by plasticity indices ranging from 3 to 5. Seven Atterburg limit tests were conducted on this material. Four samples (Boreholes 3-3, 3-9, 3-12) have a plasticity index of 3, two samples (Boreholes 3-11 and 3-14) have a plasticity index of 4, and one sample (Borehole 3-15) has a plasticity index of 5. The sand and silt was encountered at elevations of 235.9 to 246.7 with thicknesses ranging from 1.1 to 7.3 m. Twelve samples were selected for grain size distribution testing. The test results indicated a grain size distribution of 9 to 17 % gravel, 37 to 51 % sand, and 38 to 49 % silt/clay sized particles. Occasional cobbles and boulders were noted within this stratum. The silt is loose to very dense as indicated by “N” values ranging from 6 to 75 blows/0.3 m.

5.1.2 DCPTs

Four DCPTs were advanced and are as noted as DCPT 3-2, 3-5, 3-8 and 3-10 on the Soil Strata Drawings (Appendix C-1). The DCPTs reached blow counts of 100+/0.3 m at depths ranging from 4.0 to 6.6 m (Elev. 233.2 to 237.2).

5.1.3 Refusal

Auger refusal and “N” values of 100+ blows/0.3 m was encountered at all borehole and blows of 100+/0.3 m at the DCPT locations. The following table indicates the recorded refusal depths at each test hole. Refusals may be on cobbles, boulders, or bedrock. Refusal material was not sampled.

Table 5.1: Borehole Refusal Site 3

Test hole Number	Refusal Depth (m)	Refusal Elevation (m)
3-1	2.7	245.5
3-2 (DCPT)	4.0	237.2
3-3	4.2	236.1
3-4	6.3	234.1
3-5 (DCPT)	6.5	233.2
3-6	5.4	234.7
3-7	4.5	236.1
3-8 (DCPT)	6.6	233.7
3-9	7.4	233.8
3-10 (DCPT)	5.7	234.6
3-11	4.3	235.7
3-12	9.5	230.5
3-13	1.1	239.2
3-14	6.4	236.3
3-15	7.0	234.6

5.1.4 Ground Water

The ground water level was measured on May 23, 2013 at Boreholes 3-3, 3-4, 3-7 and 3-14. The area around Borehole 3-12 (Elev. 240.0) was flooded at this time. Ground water levels will vary from season to season and from the effects of heavy precipitation events.

Table 5.2: Ground Water Level Site 3

Borehole	Depth below Ground Surface (m)	Elevation (m)
3-3	0	240.3
3-4	0	240.4
3-7	0	240.6
3-12	0.2	242.5
3-14	-0.2	240.0

5.2 Embankment from 10+700 to 11+300 Township of McTavish (Site 4)

Details of the subsurface conditions are provided on the test hole logs (Appendix A-2) and on the Soil Strata Drawings (Appendix C-2).

The subsurface soils at this site typically consist of organic material which overlie various mixtures of sand and silt. Gravel layers were encountered in Boreholes 4-2, 4-6 and 4-7. All boreholes extended to shallow practical refusal on boulders or bedrock and the test pit extended until the excavator could no longer advance.

5.2.1 Organic Material

Organic material was encountered at the ground surface of all the boreholes except Borehole 4-4. The material ranges in thickness from 0.1 to 0.25 m. Based on four samples the natural moisture content of this material ranges from 48 to 102 %.

5.2.2 Gravel

Gravel with some sand and trace silt was encountered beneath the organic material at Borehole 4-2. The gravel was encountered at an elevation of 274.0 with a thickness of 1.8 m. A single sample was selected for grain size distribution testing. The test results indicate a grain size distribution of 85 % gravel, 13 % sand, and 2 % silt/clay sized particles. The gravel is loose to dense as indicated by “N” values ranging from 6 to 36 blows/0.3 m.

5.2.3 Sand

Silty sand with some gravel to silt and sand with trace gravel was encountered at ground surface at Borehole 4-4, beneath the organic material at Boreholes 4-1, 4-3, 4-5, 4-6, 4-8, 4-9, 4-10, 4-11, and 4-12 and beneath gravel at Boreholes 4-2. The sand was encountered at elevations of 268.9 to 277.3 with thicknesses ranging from 0.8 to 6.9 m. Twelve samples were selected for grain size distribution testing. The test results indicate a grain size distribution of 6 to 34 % gravel, 38 to 55% sand, and 27 to 44 % silt/clay sized particles. Occasional cobbles and boulders were also noted within this stratum. Boulders were present at the test pit and in shallow boreholes between 0.3 and 0.5 m in diameter. The sand is very loose to very dense as indicated by “N” values ranging from 1 to 100+ blows/0.3 m.

5.2.4 Sand and Gravel

Silty sand and gravel to sandy gravel with some silt was encountered beneath the organics at Test Pit 4-7, and beneath the sand at Borehole 4-6. The sand and gravel was encountered at elevations of 265.4 to 273.9 with thicknesses ranging from 1.8 to 5.8 m. Three samples were selected for grain size distribution testing. The test results

indicated grain size distribution of 40 to 61 % gravel, 22 to 40 % sand, and 13 to 23 % silt/clay sized particles. The sand and gravel is very dense as indicated by an “N” value of 100+ blows/0.3 m.

5.2.5 Refusal

Auger refusal and “N” values of 100+ blows/0.3 m was encountered at all boreholes and the test pit extended to the reach of the excavator. The following table indicates the recorded refusal depths at each test hole. Refusals may be on cobbles, boulders, or bedrock. Refusal material was not sampled.

Table 5.3: Borehole Refusal Site 4

Test hole Number	Refusal Depth (m)	Refusal Elevation (m)
4-1	6.4	267.3
4-2	7.8	260.4
4-3	5.0	264.1
4-4	3.9	266.2
4-5	5.4	268.0
4-6	8.8	263.6
4-7	6.0	268.1
4-8	3.9	266.5
4-9	3.2	270.0
4-10	1.3	273.0
4-11	1.2	276.1
4-12	1.0	276.5

5.2.6 Ground Water

The ground water levels were measured on May 23, 2013 at Borehole 4-2, 4-6, and 4-9 and are presented in Table 5.4.

Table 5.4: Ground Water Level Site 4

Borehole	Depth from Ground Surface (m)	Elevation (m)
4-2	0.3	273.9
4-6	0.9	271.5
4-9	0.2	273.0

Ground water levels will vary from season to season and from the effects of heavy precipitation events.

6 Miscellaneous

Laboratory testing was carried out at the TBT Engineering laboratory in Thunder Bay. The drill equipment for this investigation was operated by TBT Engineering Limited with the excavator provided by Don Nichols Contracting. The field operations were supervised by David Binch. Laboratory testing was supervised by T. Fummerton C.E.T. This report was prepared by Steven Seller, P.Eng, and reviewed by W. Hurley, P.Eng (TBTE designated principal contact identified for MTO Foundation Engineering projects).

Part B - FOUNDATION DESIGN RECOMMENDATIONS

7 Introduction

TBT Engineering Limited (TBTE) has been retained by Engineering Northwest Limited a division of Hatch Mott MacDonald (ENL) to provide preliminary foundation investigation and design services for the proposed embankments on Highway 11/17 located at Sta. 41+800 to 42+200 in the Township of MacGregor and 10+700 to 11+300 in the Township of McTavish. These sites are a part of the Highway 11/17, four-laning project from 5.0 km west of Highway 587 easterly 6.5 km. The foundation investigations were conducted to provide preliminary subsurface data for the development of a new eastbound lane for Hwy 11/17.

The foundation investigations as described in Part A, was carried out to investigate subsurface conditions at these sites. These investigations consisted of 11 boreholes and 4 DCPTs at Site 3 and 11 boreholes and 1 test pit at Site 4 drilled near the proposed EBL centerline, laboratory testing and geotechnical analysis of the data. The Part A report describes the subsurface conditions encountered during the investigation. The test holes are labeled from test holes 3-1 to 3-15 for Site 3 and test holes 4-1 to 4-12 at Site 4.

The foundation soils at these sites typically consist of peat/organics (thick at Site 3 up to 2.2 m and thin at Site 4 up to 0.25 m) which overlie sand and silts of various amounts. Cobbles and boulders are present at both sites. All boreholes extended to practical refusal (100+ "N" values as determined from the Standard Penetration Test), DCPTs were advanced to 100 blows and the test pit was extended to the reach of the excavator.

The purpose of this section of the report (Part B) is to provide preliminary embankment design recommendations for various embankment configurations. These are based on the conditions encountered at the test hole locations, TBTE's interpretation of the subsurface conditions at the site and analyses of embankment stability.

8 Embankment Analyses

8.1 Geotechnical Model

Stability modeling was carried out using Slope/W software and limit equilibrium analysis using the Morgenstern-Price method.

The preliminary soil properties established for the embankment and foundation soils are presented in Table 8.1 and 8.2. The preliminary strength properties of the native soils have been based on published correlations with index tests. Typical preliminary strength properties have been selected for the various potential fill materials.

Table 8.1: Preliminary Stability Analyses Soil Properties For Site 3

Soil	Effective Shear Strength Properties		Unit Weight γ (kN/m ³)
	Effective Angle of Internal Friction, ϕ' (degrees)	Effective Cohesion Intercept, C' (kPa)	
Rock Fill	40	0	19
Compacted Granular Fill	35	0	20
Sands and Silts – Loose	29	0	20
Sands and Silts – Compact	32	0	20
Sands and Silts – Dense	35	0	20

Table 8.2: Preliminary Stability Analyses Soil Properties For Site 4

Soil	Effective Shear Strength Properties		Unit Weight γ (kN/m ³)
	Effective Angle of Internal Friction, ϕ' (degrees)	Effective Cohesion Intercept, C' (kPa)	
Rock Fill	40	0	19
Compacted Granular Fill	35	0	20
Silty Sand – Very loose	28 to 29	0	20
Silty Sand – Compact to Dense	35	0	20

8.2 Proposed Embankments

Stability analyses have been carried out to investigate potential configurations for the proposed embankments. The design is based on providing a minimum calculated factor of safety (FoS) of 1.3 with a uniformly distributed traffic load of 20 kPa.

Two typical foundation soils were reviewed along with two potential fill types. The potential foundation soils reviewed consisted of granular foundation soils with varying effective angles of internal friction. The potential embankment fill materials considered were compacted granular fill or rock fill. Where granular fill was considered, a toe drain was included to ensure upslope ground water levels were lowered within the embankment, rather than exiting on the face of the slope. The removal of all organic material from beneath the embankments has been assumed.

Based on the findings of the stability analyses, the following embankment configurations will achieve the target FoS:

Table 8.3: Preliminary Embankment Slopes to Achieve FoS of 1.3 Site 3

Foundation Soils	Embankment Slope	Embankment Material	Toe Drain Required
Silty Sand - $\phi' = 29$	3(H) : 1(V)	Compacted Granular	Yes
Silty Sand - $\phi' = 29$	2(H) : 1(V)	Rock Fill	No

A typical slope stability model for Site 3 is provided below:

Rock Fill Embankment - Site 3 Station 41+840 MacGregor

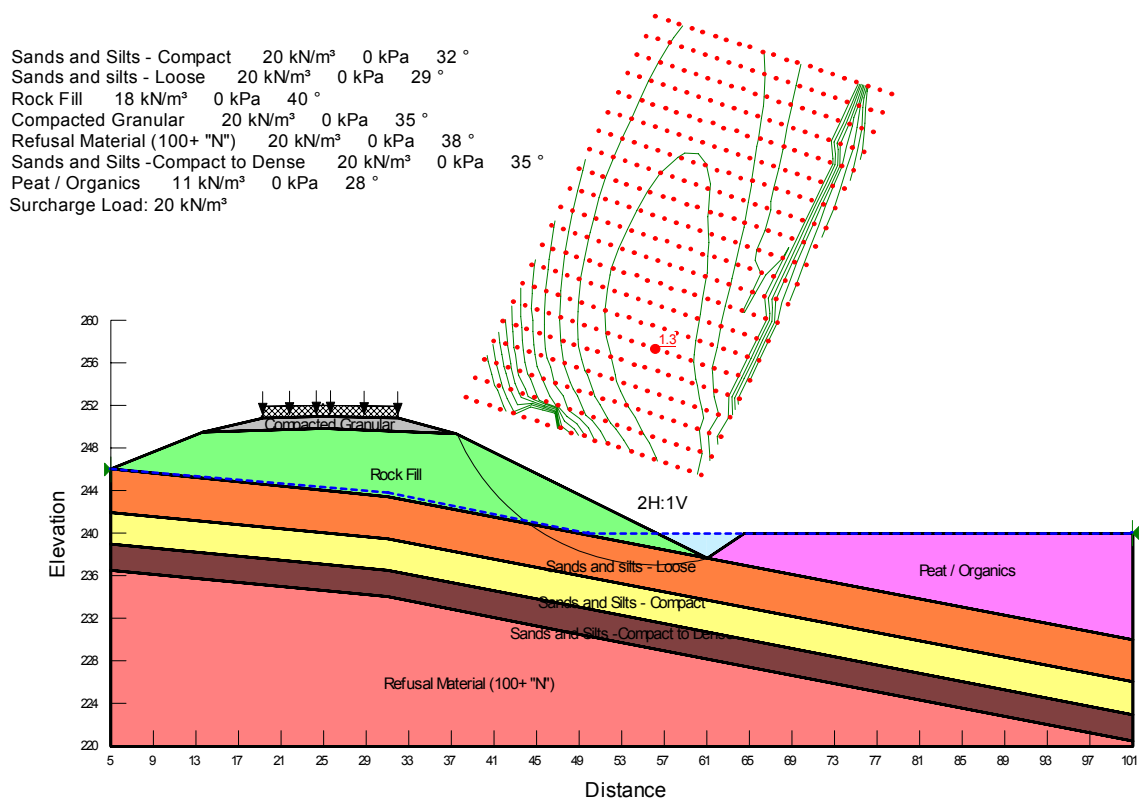


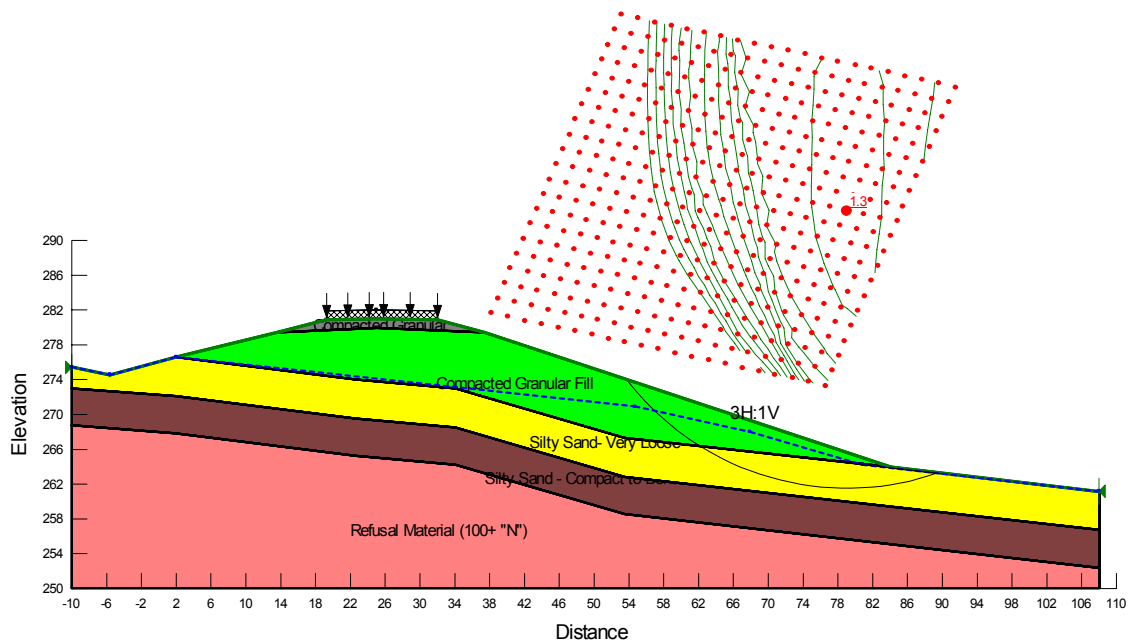
Table 8.4: Preliminary Embankment Slopes to Achieve FoS of 1.3 Site 4

Foundation Soils	Embankment Slope	Embankment Material	Toe Drain Required
Silty Sand - $\phi' = 28$	3(H) : 1(V)	Compacted Granular	Yes
Silty Sand - $\phi' = 28$	2.5(H) : 1(V)	Rock Fill	No
Silty Sand - $\phi' = 29$	3(H) : 1(V)	Compacted Granular	Yes
Silty Sand - $\phi' = 29$	2(H) : 1(V)	Rock Fill	No

A typical slope stability model for Site 4 is provided below.

Compacted Granular Fill Embankment - Site 4 Station 11+020 McTavish

Name: Silty Sand - Compact to Dense Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1
 Name: Silty Sand- Very Loose Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 28 ° Piezometric Line: 1
 Name: Compacted Granular Fill Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1
 Name: Compacted Granular Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1
 Name: Refusal Material (100+ "N") Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 38 ° Piezometric Line: 1
 Surcharge Load: 20 kN/m²



As illustrated by the stability models above, in both cases the design slope is governed to a significant extent by the strength parameters of the underlying native soils.

The use of mid slope benches shall be used for rock fills in excess of 10 m and earth/granular fills in excess of 8 m. Consideration should be given to benching of the existing slope in accordance with OPSD 208.010.

8.3 Settlement Performance For Sites 3 and 4

Settlement analysis has been carried out to estimate settlements due to consolidation of the subgrade for the proposed embankments. As per MTO policy, embankments shall be designed to not exceed a 100 mm maximum post construction settlement.

Total settlements for the proposed embankments have been estimated to be less than 200 mm, the majority of which will occur in the granular soils as the fill is placed. Post construction settlements are expected to be minimal. The estimated settlement considers the following criteria:

- All highly compressible organic material is removed from beneath the embankments.
- The embankment fill thickness is approximately 9 m.
- Maximum overburden thickness as represented at Borehole 3-12.
- Minor variability in plasticity of the sand and silt has negligible effect on settlements.

These settlements will generally be completed during the construction of the embankment.

Where rock fill is used, long term post construction settlements within the embankment itself may be up to 1% of the embankment height.

9 Potential Construction Issues for Sites 3 and 4

No major construction difficulties are foreseen at this site. Issues which may require consideration include:

- Control of surface water along the east lane during construction. The embankment can form a “dam” and obscure the current surface drainage patterns. Permanent positive drainage shall be ensured during the design phase.
- Disposal protocols for peat/topsoil/organics, fill and trees.

10 Scope of Detailed Investigations

The detailed design of the proposed embankments will require additional geotechnical investigation to complete a detailed Foundations Investigation and Design report. The scope of work should address all issues normally included in such a report and should incorporate the following items:

- Review of any existing geological and geotechnical information in the area;
- Foundation field investigation to MTO standards, to determine subsurface conditions, including depth to competent stratum and water levels;
- Confirmation of the refusal material;
- Shear testing of loose foundation soils;
- Design of the of embankment, including alternate embankment configurations;
- Confirmation of toe drain requirements, if any
- Preparation of Foundation Reports (Parts A and B) documenting factual information and recommendations on geotechnical aspects of design and construction.

11 Limitations

Conclusions and recommendations presented in this preliminary report are based on the information determined at a limited number of test hole locations. These preliminary recommendations are made on the basis that additional investigations, testing and analyses will be carried out during detail design and are not to be used for construction. Subsurface and groundwater conditions between and beyond these locations may differ from those encountered. Conditions may become apparent during detailed design investigations or construction that were not detected and could not be anticipated at the time of the preliminary site investigation.

The comments given in this report on potential construction problems and possible methods of construction are intended only for the guidance of the designer.

Groundwater levels indicated are based on the information described within the report. The presence of all conditions that could affect the type and scope of dewatering procedures which may be considered cannot readily be determined from boreholes. These include local and seasonal fluctuations of the groundwater level, changes in soil conditions between test locations, thin and/or discontinuous layers of highly permeable soils, etc.

The information contained within this report in no way reflects any environmental aspect of the site or soil.

12 Closure

We trust the above addresses your project requirements at this time. Should you have any questions or comments, please do not hesitate to contact us at your convenience.

Yours truly,
For TBT ENGINEERING

Steven Seller, P.Eng
Project Engineer

Wayne Hurley, P.Eng.
Senior Engineer
Principal Contact for MTO Foundations

APPENDIX A-1
Station 41+800 to 42+200 Township of MacGregor
Borehole Logs

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 (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

	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

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_a	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'_{v0}	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_f	1	SENSITIVITY = $\frac{C_u}{\tau_r}$

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

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						

TBT Engineering Consulting Group		RECORD OF Borehole No 3-1		1 OF 1	METRIC
W.P. 125-90-00	PROJECT Hwy 11/17 - 4 Laning	SITE NO. 3	ORIGINATED BY D.B.		
DIST 61	HWY 11/17	LOCATION MTM N5384626.284, E394055.167	TBTE JOB# 11-214	COMPILED BY T.B.	
DATE 2013 April 8	BOREHOLE TYPE Hollow Stem Auger	DATUM Geodetic	CHECKED BY S.S.		

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
								○ UNCONFINED ■ SPT (N)	✕ FIELD VANE ★ LAB VANE		W _p	W	W _L		
248.2															
248.0	ORGANICS - black														
0.2	SAND - Silty, occasional boulders, brown, compact		1	AS										0 71 (29)	
			2	SS	10										
246.7															
1.5	SAND & SILT - some gravel, occasional cobbles & boulders, brown, compact		3	SS	16									14 46 (40)	
245.5			4	SS	100+										
2.7	End of Borehole @ 2.7 m. Auger Refusal.														

\times^3, \star^3 : Numbers refer to Sensitivity
 NP Non Plastic
 ○ 3% STRAIN AT FAILURE

TBT Engineering Consulting Group		RECORD OF Borehole No 3-2		1 OF 1	METRIC
W.P. 125-90-00	PROJECT Hwy 11/17 - 4 Laning	SITE NO. 3	ORIGINATED BY D.B.		
DIST 61	HWY 11/17	LOCATION MTM N5384669.768, E394082.476	TBTE JOB# 11-214	COMPILED BY T.B.	
DATE 2013 April 2	BOREHOLE TYPE Dynamic Cone Penetration Test	DATUM Geodetic	CHECKED BY S.S.		

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	GR	SA
241.2 0.0	DCPT Testing Only																	

✕³, ★³: Numbers refer to Sensitivity
 NP Non Plastic ○ 3% STRAIN AT FAILURE

ONL_MOT_BH_MTM 11-214-3.GPJ ON_MOT_GDT 13/12/19

TBT Engineering Consulting Group			RECORD OF Borehole No 3-3			1 OF 1		METRIC	
W.P. 125-90-00			PROJECT Hwy 11/17 - 4 Laning			SITE NO. 3		ORIGINATED BY D.B.	
DIST 61 HWY 11/17			LOCATION MTM N5384661.695, E394091.678			TBTE JOB# 11-214		COMPILED BY T.B.	
DATE 2013 April 2			BOREHOLE TYPE Hollow Stem Auger			DATUM Geodetic		CHECKED BY S.S.	

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	W _p	W	W _L			
240.3 0.0	ORGANICS - 300 mm	1	AS											Water level @ surface on May 23, 2013. 1 11 (87) Temporary Standpipe installed to 2.9 m. 16 42 27(42)5 Non-Cohesive
240.0 0.3	SAND - Silty, brown, compact	2	SS		17									
238.6 1.7	SILT - some sand, trace gravel, brown, loose	3	SS		8									
		4	SS		7									
237.2 3.1	SAND & SILT - some gravel, grey, loose to compact	5	SS		9									
		6	SS		22									
236.1 4.2	End of Borehole @ 4.2 m. No Further Progress. Boulders.	7	SS		100+									

x³, *³: Numbers refer to
 NP Sensitivity
 Non Plastic
 O 3% STRAIN AT FAILURE

ONL_MOT_BH_MTM 11-214-3.GPJ ON_MOT_GDT 13/12/19



TBT Engineering Consulting Group

RECORD OF Borehole No 3-4

1 OF 1

METRIC

W.P. **125-90-00** PROJECT **Hwy 11/17 - 4 Laning** SITE NO. **3** ORIGINATED BY **D.B.**
 DIST **61** HWY **11/17** LOCATION **MTM N5384707.396, E394105.378** TBTE JOB# **11-214** COMPILED BY **T.B.**
 DATE **2013 April 2** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p	W	W _L	
240.4 0.0	ORGANICS - black		1	AS			240	○ UNCONFINED	✕ FIELD VANE				Ground water observed near ground surface upon completion. Water level @ surface on May 23, 2013.
			2	SS	1			■ SPT (N)	★ LAB VANE				
238.9 1.5	SILT - Sandy, brown, loose		3	SS	4		239						0 23 (77)
238.2 2.2	SAND & SILT - trace gravel, occasional cobbles, brown, loose to dense		4	SS	6		238						
			5	SS	9		237						Temporary Standpipe installed to 2.9 m.
			6	SS	45		236						
			7	SS	13		235						8 49 (43)
234.1 6.3	End of Borehole @ 6.3 m. Auger Refusal.		8	SS	100+								

✕³, ★³: Numbers refer to
Sensitivity
NP Non Plastic
○ 3% STRAIN AT FAILURE

ONL_MOT_BH_MTM 11-214-3.GPJ ON_MOT_GDT 13/12/19

✕³, ★³: Numbers refer to Sensitivity
 NP Non Plastic
 ○^{3%} STRAIN AT FAILURE

TBT Engineering Consulting Group **RECORD OF Borehole No 3-6** 1 OF 1 **METRIC**

W.P. **125-90-00** PROJECT **Hwy 11/17 - 4 Laning** SITE NO. **3** ORIGINATED BY **D.B.**

DIST **61** HWY **11/17** LOCATION **MTM N5384740.839, E39448.292** TBTE JOB# **11-214** COMPILED BY **T.B.**

DATE **2013 April 3** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

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											
240.1 0.0	ORGANIC- black		1	AS			20	40	60	80	100	20	40	60	Ground water observed near ground surface upon completion.				
			2	SS	1			20	40	60	80	100	20	40		633.7			
								20	40	60	80	100	20	40			611.6		
238.0 2.1	SAND - some gravel, brown, loose	3	SS	9			20	40	60	80	100	20	40	3 49 (48)					
237.3 2.8	SAND & SILT - trace to some gravel, occasional cobbles, brown, loose to compact	4	SS	13			20	40	60	80	100	20	40					12 48 (40)	
		5	SS	8			20	40	60	80	100	20	40						>>
		6	SS	9			20	40	60	80	100	20	40						
234.7 5.4	End of Borehole @ 5.4 m. Auger Refusal.	7	SS	100+															

TBT Engineering Consulting Group **RECORD OF Borehole No 3-7** 1 OF 1 **METRIC**

W.P. **125-90-00** PROJECT **Hwy 11/17 - 4 Laning** SITE NO. **3** ORIGINATED BY **D.B.**

DIST **61** HWY **11/17** LOCATION **MTM N5384795.068, E394164.97** TBTE JOB# **11-214** COMPILED BY **T.B.**

DATE **2013 April 3** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p W W _L			
240.6 0.0	ORGANICS - some sand		1	AS						1161.9	Ground water observed near ground surface upon completion. Water level @ surface on May 23, 2013.		
238.9 1.7	SAND - trace silt, trace gravel, brown, very loose to compact		2	SS	1							>>	
238.0 2.6	SILT - some sand, trace gravel, brown, compact		3	SS	12								
237.6 3.0	SAND & SILT - some gravel, brown, compact	5	SS	18									
		6	SS	23									
236.1 4.5	End of Borehole @ 4.5 m. Auger Refusal.	7	SS	100+									

✕³, ★³: Numbers refer to Sensitivity
 NP Non Plastic
 ○^{3%} STRAIN AT FAILURE

TBT Engineering Consulting Group			RECORD OF Borehole No 3-9			1 OF 1		METRIC			
W.P. 125-90-00			PROJECT Hwy 11/17 - 4 Laning			SITE NO. 3		ORIGINATED BY D.B.			
DIST 61 HWY 11/17			LOCATION MTM N5384829.771, E394184.442			TBTE JOB# 11-214		COMPILED BY T.B.			
DATE 2013 April 4			BOREHOLE TYPE Hollow Stem Auger			DATUM Geodetic		CHECKED BY S.S.			
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS		ELEVATION SCALE			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
241.2 240.0 0.1	ORGANICS - 100 mm SAND - Silty, some gravel, trace organics, brown, loose to dense		1	AS		<div style="display: flex; justify-content: space-between;"> <div> <p>DYNAMIC CONE PENETRATION RESISTANCE PLOT</p> <p>20 40 60 80 100</p> <p>SHEAR STRENGTH kPa</p> <p>○ UNCONFINED ✕ FIELD VANE</p> <p>■ SPT (N) ★ LAB VANE</p> <p>20 40 60 80 100</p> </div> <div> <p>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT</p> <p>W_p W W_L</p> <p>WATER CONTENT (%)</p> <p>20 40 60</p> </div> </div>	<p>UNIT WEIGHT</p> <p>γ</p> <p>kN/m³</p>	<p>REMARKS & GRAIN SIZE DISTRIBUTION (%)</p> <p>GR SA SI CL</p>			
241											
240			2	SS	11						
239			3	SS	8						
238			4	SS	11						
237			5	SS	26						
236			6	SS	31						
235		7	SS	14							
234		8	SS	75							
		9	SS	55							
		10	SS	100+							
235.9 5.3	SAND & SILT - trace gravel, occasional cobbles, brown, very dense										
233.8 7.4	End of Borehole @ 7.4 m. Auger Refusal.										

ONL_MOT_BH_MTM 11-214-3.GPJ ON_MOT_GDT 13/12/19

TBT Engineering Consulting Group		RECORD OF Borehole No 3-10		1 OF 1	METRIC
W.P. 125-90-00	PROJECT Hwy 11/17 - 4 Laning	SITE NO. 3	ORIGINATED BY D.B.		
DIST 61	HWY 11/17	LOCATION MTM N5384820.065, E394196.786	TBTE JOB# 11-214	COMPILED BY T.B.	
DATE 2013 April 3	BOREHOLE TYPE Dynamic Cone Penetration Test	DATUM Geodetic	CHECKED BY S.S.		

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 (%)						
						20 40 60 80 100			20 40 60						
240.3 0.0	DCPT Testing Only							<div><div><div>○ UNCONFINED</div><div>■ SPT (N)</div></div><div><div>✕ FIELD VANE</div><div>★ LAB VANE</div></div></div>	<div><div>W_p</div><div>W</div><div>W_L</div></div>						
234.6 5.7															

✕³, ★³: Numbers refer to Sensitivity NP Non Plastic ○ 3% STRAIN AT FAILURE

ONL_MOT_BH_MTM 11-214-3.GPJ ON_MOT_GDT 13/12/19

TBT Engineering Consulting Group			RECORD OF Borehole No 3-12			1 OF 1		METRIC	
W.P. 125-90-00			PROJECT Hwy 11/17 - 4 Laning			SITE NO. 3		ORIGINATED BY D.B.	
DIST 61 HWY 11/17			LOCATION MTM N5384858.341, E394221.576			TBTE JOB# 11-214		COMPILED BY T.B.	
DATE 2013 April 4			BOREHOLE TYPE Hollow Stem Auger			DATUM Geodetic		CHECKED BY S.S.	
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		UNIT WEIGHT
							SHEAR STRENGTH kPa ○ UNCONFINED ✕ FIELD VANE ■ SPT (N) ★ LAB VANE 20 40 60 80 100		PLASTIC LIMIT NATURAL MOISTURE CONTENT W _p W W _L WATER CONTENT (%) 20 40 60
240.0									γ
0.0	ORGANICS - some sand & gravel, black		1	AS					kN/m ³
			2	SS	1				
			3	SS	4				
237.8			4	SS	7				
2.2	SAND & SILT - some gravel, occasional cobbles, brown, very dense		5	SS	86				
			6	SS	22				
			7	SS	35				
			8	SS	9				
			9	SS	100+				
			10	SS	73				
230.5	End of Borehole @ 9.5 m. Auger Refusal.		11	SS	100+				
9.5									

ONL_MOT_BH_MTM 11-214-3.GPJ ON_MOT_GDT 13/12/19

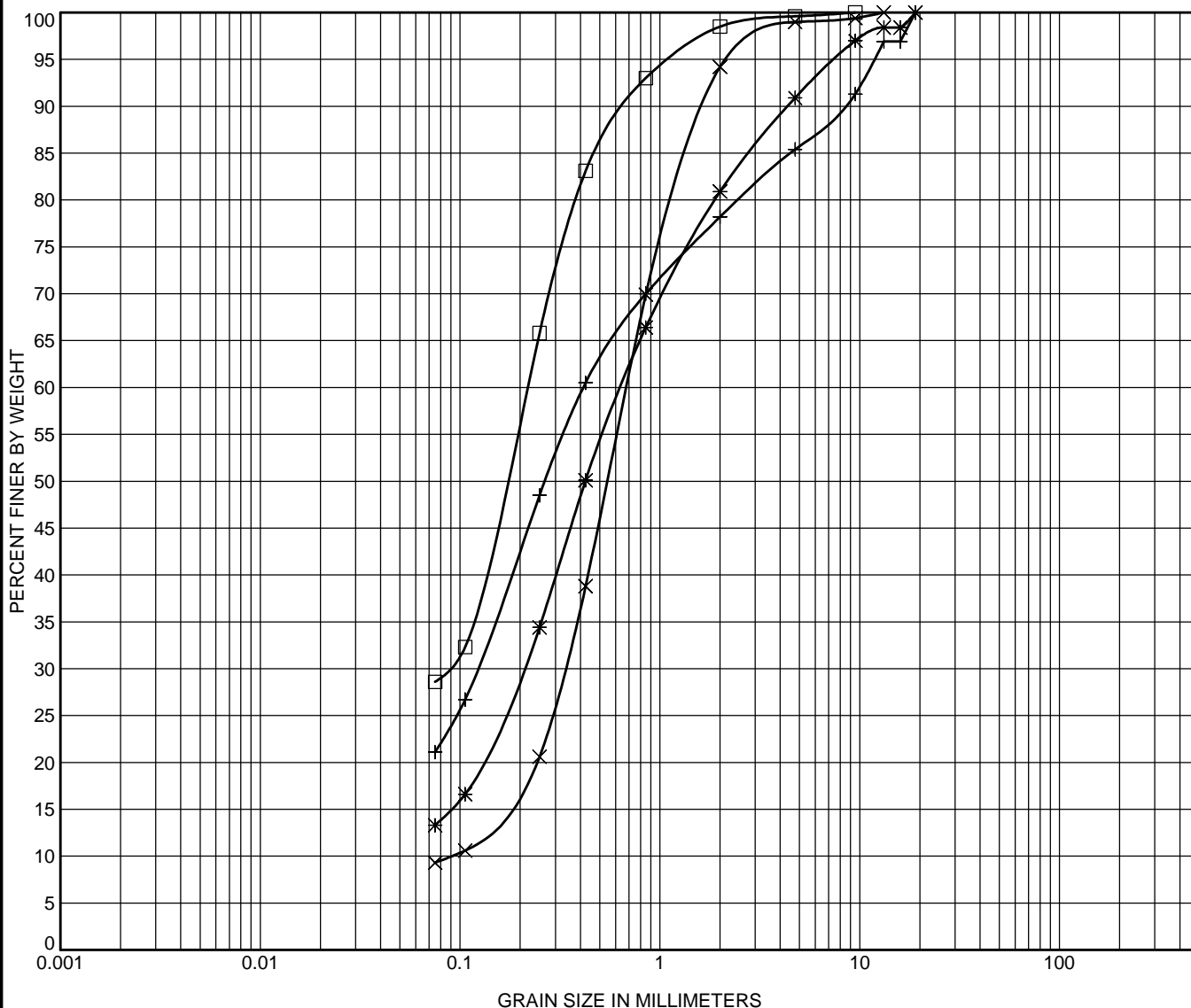
✕³, ★³: Numbers refer to Sensitivity NP Non Plastic ○ 3% STRAIN AT FAILURE

TBT Engineering Consulting Group			RECORD OF Borehole No 3-13			1 OF 1		METRIC						
W.P. 125-90-00			PROJECT Hwy 11/17 - 4 Laning			SITE NO. 3		ORIGINATED BY D.B.						
DIST 61 HWY 11/17			LOCATION MTM N5384907.479, E394249.464			TBTE JOB# 11-214		COMPILED BY T.B.						
DATE 2013 April 5			BOREHOLE TYPE Hollow Stem Auger			DATUM Geodetic		CHECKED BY S.S.						
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						
240.3 0.0	ORGANICS - 300 mm, black		1	AS		240	○ UNCONFINED ✕ FIELD VANE		20 40 60 80 100		20 40 60 262.2		143.7	Ground water observed near ground surface upon completion. On cobble
			2	SS	61		■ SPT (N) ★ LAB VANE		20 40 60 80 100		20 40 60 262.2			
239.2 1.1	----- - SAND - trace gravel, occasional cobbles, brown, very dense End of Borehole @ 1.1 m. Auger Refusal.		3	SS	100+		>>>		>>>		>>>			

ONL_MOT_BH_MTM 11-214-3.GPJ ON_MOT_GDT 13/12/19

TBT Engineering Consulting Group			RECORD OF Borehole No 3-14			1 OF 1		METRIC	
W.P. 125-90-00			PROJECT Hwy 11/17 - 4 Laning			SITE NO. 3		ORIGINATED BY D.B.	
DIST 61 HWY 11/17			LOCATION MTM N5384948.628, E394259.827			TBTE JOB# 11-214		COMPILED BY T.B.	
DATE 2013 April 5			BOREHOLE TYPE Hollow Stem Auger			DATUM Geodetic		CHECKED BY S.S.	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT (%)	UNIT WEIGHT γ
242.7 242.8 0.2	ORGANICS - 150 mm, black SILT - Sandy, some gravel, loose to compact, brown ----- - occasional cobbles		1	AS			242		
			2	SS	5				
			3	SS	10		241		
240.4 2.3	SAND & SILT - trace gravel, occasional cobbles, brown, compact to very dense		4	SS	45		240		
			5	SS	24				
			6	SS	61		239		
			7	SS	69		238		
236.3 6.4	End of Borehole @ 6.4 m. Auger Refusal.		8	SS	70		237		
			9	SS	100+				

APPENDIX B-1
Station 41+800 to 42+200 Township of MacGregor
Laboratory Test Data



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
SANDS - Silty SANDS

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 3-1	0.60	9.5	0.215	0.085		0.4	71.0	28.6	
* 3-15	0.15	19	0.647	0.202		9.1	77.6	13.3	
× 3-7	2.20	13.2	0.682	0.329	0.09	1.0	89.7	9.3	
+ 3-9	0.60	19	0.416	0.121		14.6	64.3	21.1	



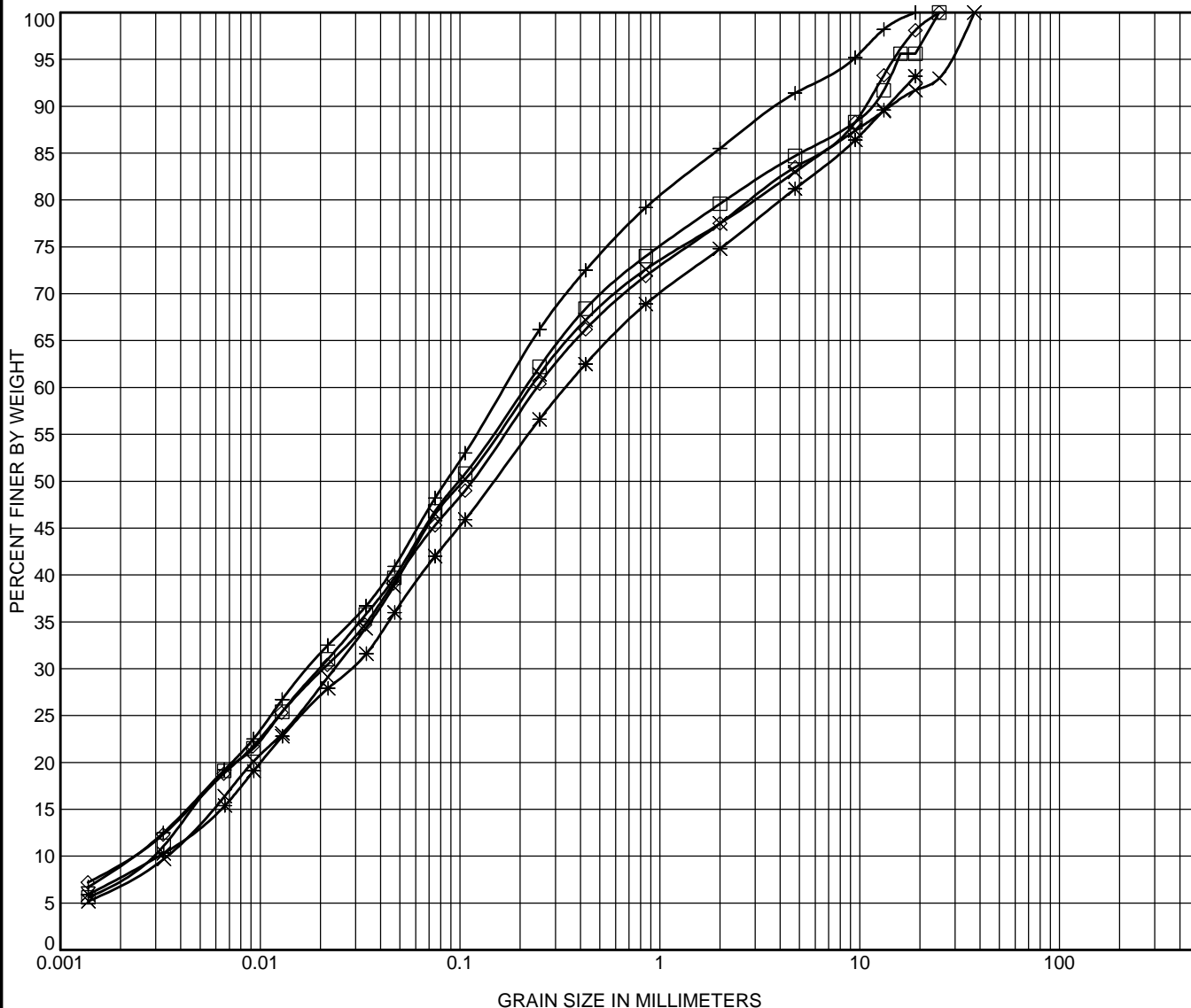
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Web: www.tbte.ca

GRAIN SIZE DISTRIBUTION

Project: Hwy 11/17 - 4 Laning

W P: 125-90-00

DIST: 61 HWY: 11/17



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
SANDS & SILTS

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 3-11	3.70	25	0.212	0.02	0.003	15.3	37.9	46.8	
* 3-12	6.00	19	0.339	0.028	0.003	12.0	39.2	42.0	
x 3-12	9.00	37.5	0.225	0.023	0.003	17.0	36.5	46.5	
+ 3-14	3.00	19	0.167	0.017	0.002	8.6	43.2	48.2	
◇ 3-15	6.30	25	0.243	0.021	0.002	16.5	38.2	45.3	



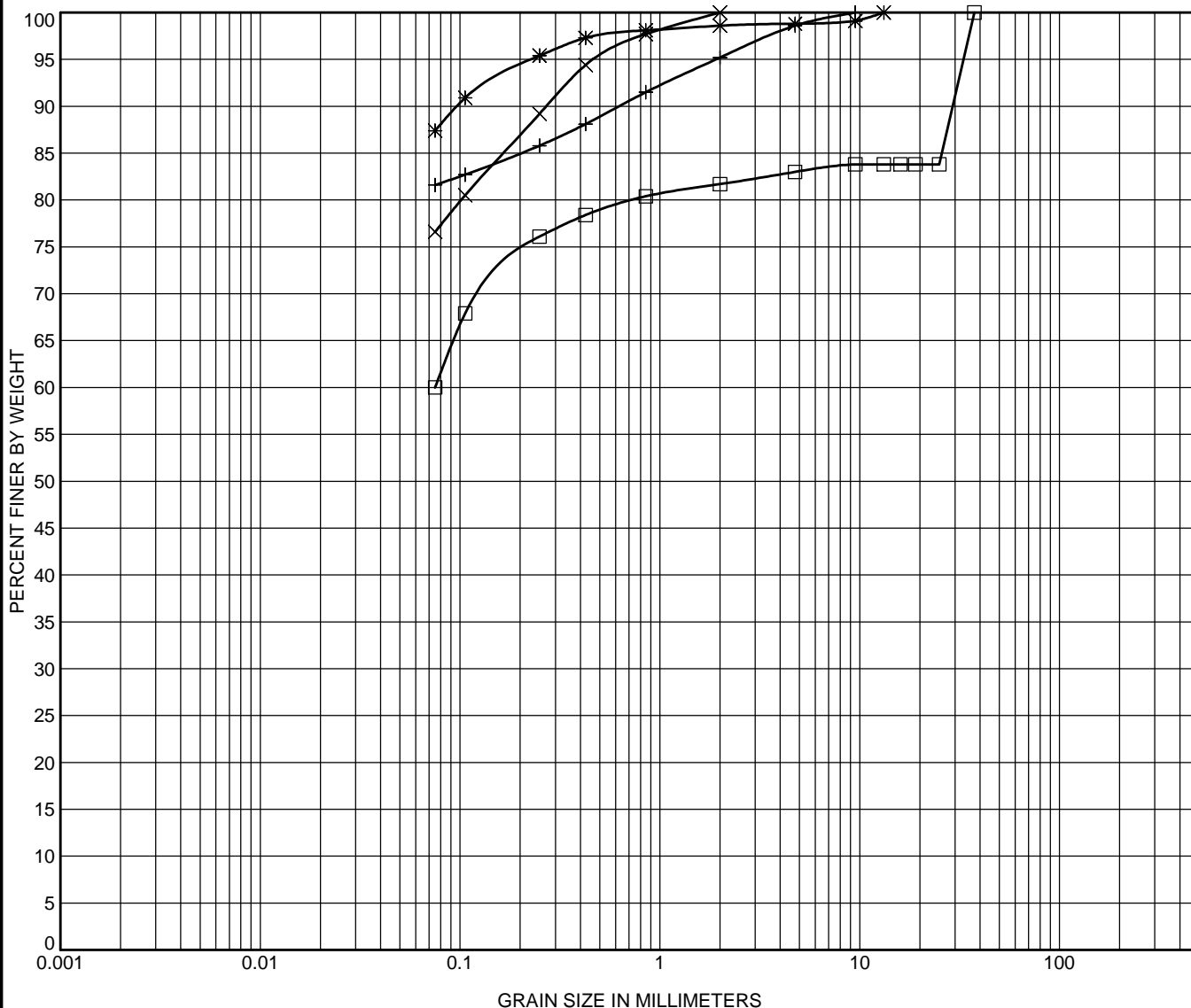
TBT Engineering Ltd.
1918 Yonge Street
Thunder Bay, Ontario P7E 6T9
PH: 807-624-5160
FX: 807-624-5161
Email: tbte@tbte.ca
Web: www.tbte.ca

GRAIN SIZE DISTRIBUTION

Project: Hwy 11/17 - 4 Laning

W P: 125-90-00

DIST: 61 HWY: 11/17



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
SILTS - Sandy SILTS

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 3-14	1.50	37.5	0.075			17.0	23.0	60.0	
* 3-3	2.10	13.2				1.2	11.4	87.4	
× 3-4	1.90	2				0.0	23.4	76.6	
+ 3-7	2.60	9.5				1.4	17.0	81.6	



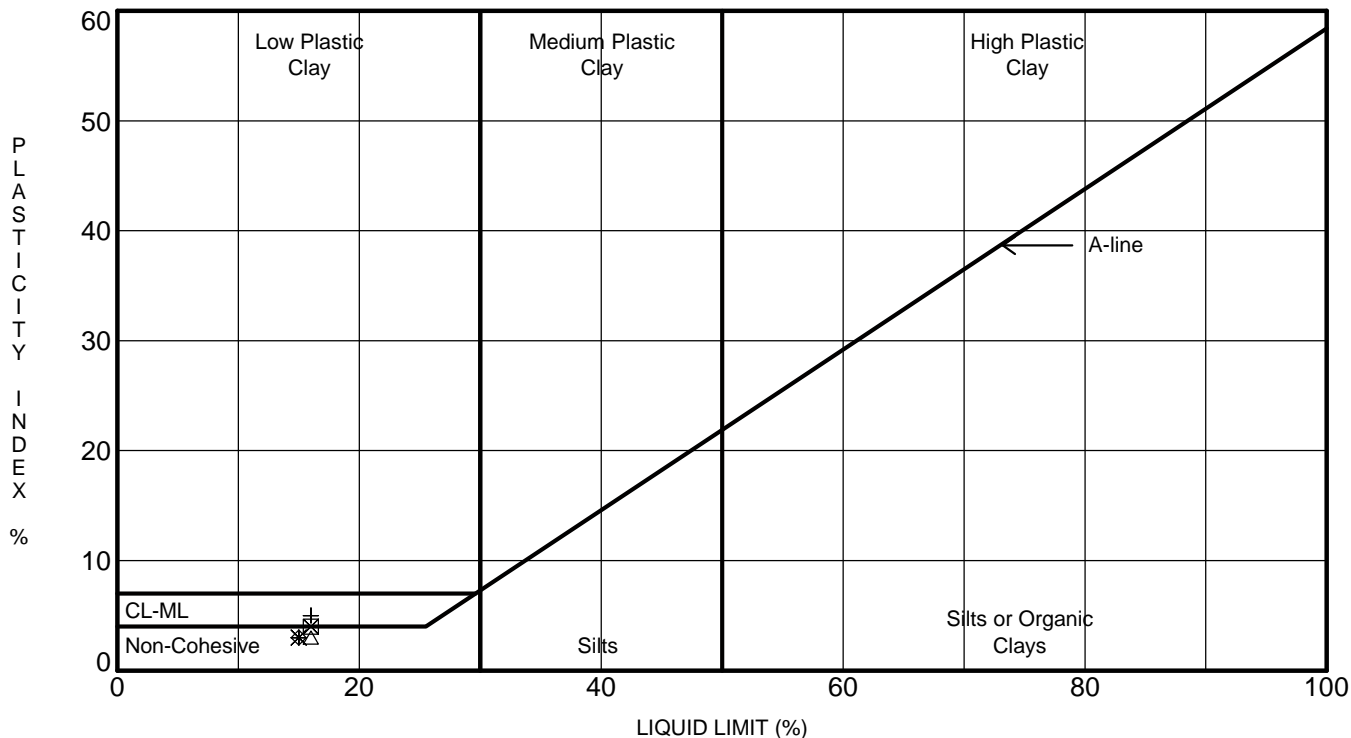
TBT Engineering Ltd.
1918 Yonge Street
Thunder Bay, Ontario P7E 6T9
PH: 807-624-5160
FX: 807-624-5161
Email: tbte@tbte.ca
Web: www.tbte.ca

GRAIN SIZE DISTRIBUTION

Project: Hwy 11/17 - 4 Laning

W P: 125-90-00

DIST: 61 HWY: 11/17



	Borehole No.	Sample No.	Depth (m)	LL%	PL%	PI%	M/C%	
□	3-11		3.70	16	12	4	11	
✱	3-12		9.00	15	12	3	7	
×	3-14		3.00	16	12	4	11	
+	3-15		6.30	16	11	5	8	
◇	3-3		0.00	15	12	3	35	
△	3-9		6.70	16	13	3	13	



TBT Engineering Ltd.
 1918 Yonge Street
 Thunder Bay, Ontario P7E 6T9
 Telephone: 807-624-5160
 Fax: 807-624-5161

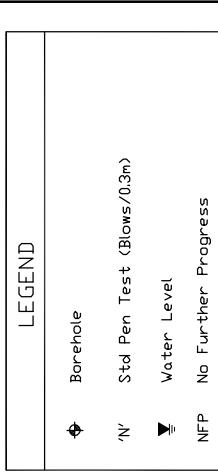
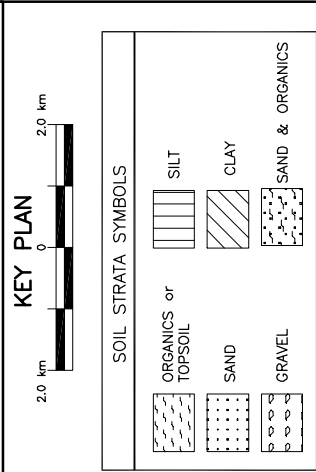
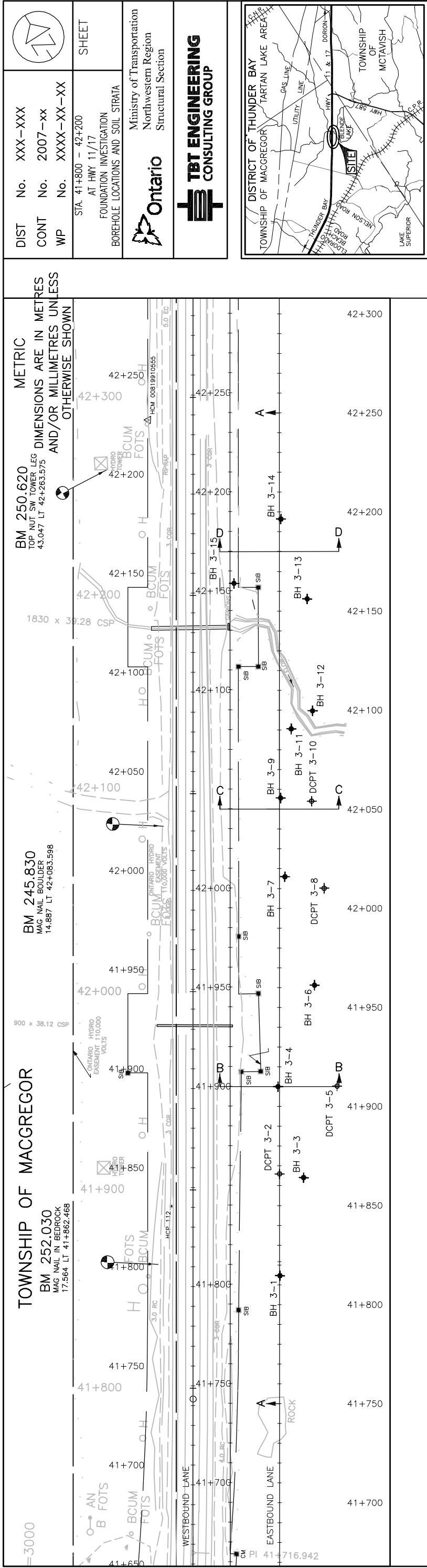
ATTERBERG LIMIT RESULTS

W P: 125-90-00

District: 61

Highway: 11/17

APPENDIX C-1
Station 41+800 to 42+200 Township of MacGregor
Borehole Locations and Soil Strata Drawing

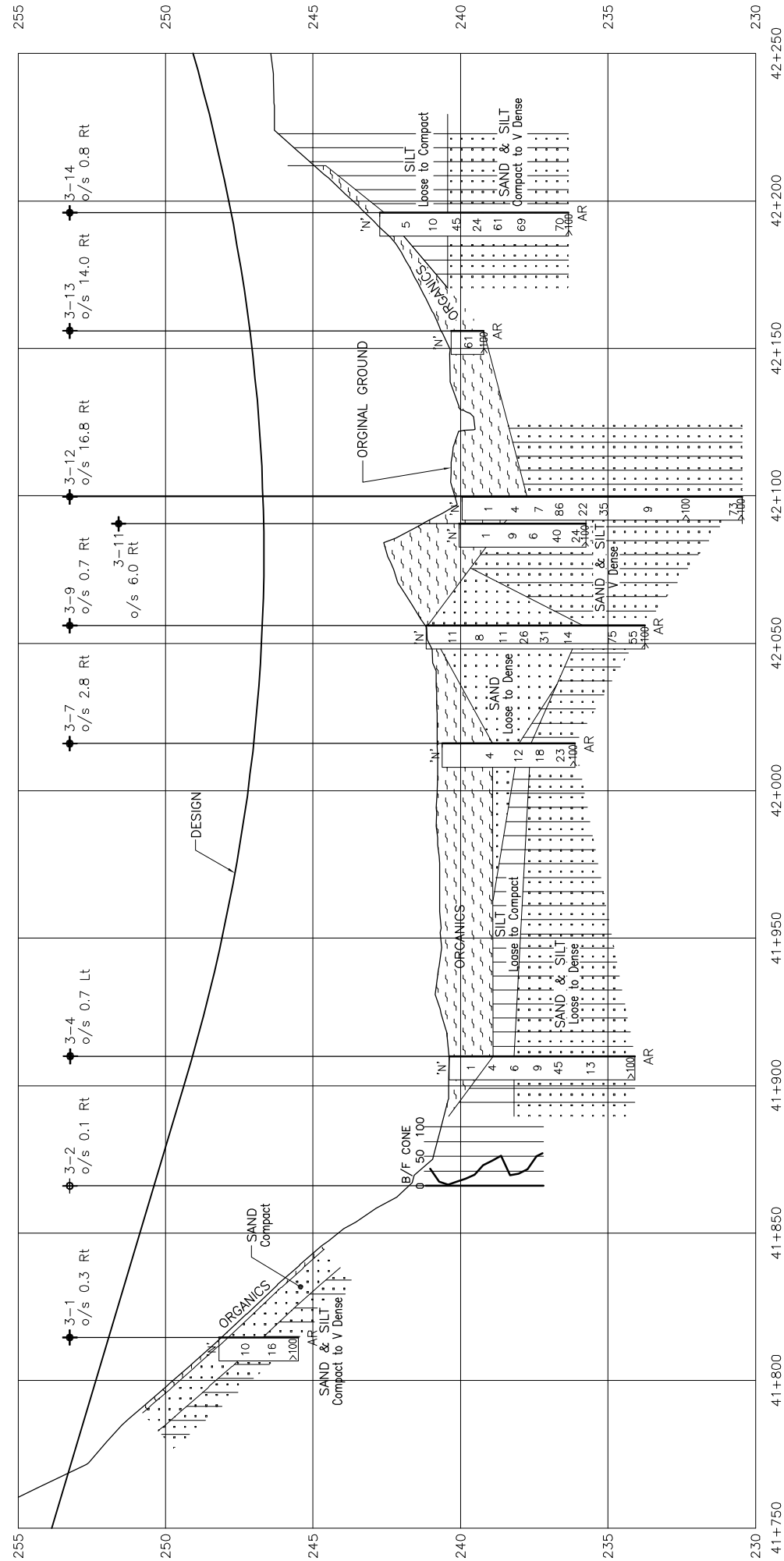


No	ELEVATION	CO-ORDINATES (MTM)	
		NORTH	EAST
3-1	2482	15 5 384 626	394 095
3-2	2412	15 5 384 670	394 082
3-3	2403	15 5 384 662	394 092
3-4	2504	15 5 384 692	394 105
3-5	2504	15 5 384 692	394 115
3-6	2301	15 5 384 741	394 148
3-7	2405	15 5 384 795	394 165
3-8	2403	15 5 384 179	394 175
3-9	2412	15 5 384 630	394 184
3-10	2403	15 5 384 820	394 197
3-11	2400	15 5 384 856	394 208
3-12	2400	15 5 384 858	394 222
3-13	2403	15 5 384 907	394 249
3-14	2427	15 5 384 949	394 260
3-15	2416	15 5 384 934	394 223
3-16	2427	15 5 384 933	394 162

-NOTE-

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

ID/NAME		BY	REVISION	DESCRIPTION	
DESIGN	XX	CHK	XX	XXXX-XX	LOAD W-XX-X DATE XXXXXXX
DRAWN	XX	CHK	XX	XX SITE	DWG X
				XX-XXX	



SECTION A - A



REFERENCE DRAWING SUPPLIED BY HATCH MOTT MACDONALD.


DIST No. XXX-XXX

CONT No. 2007-xx


WP No. XXXX-XX-XX

STA 41+800 – 42+200
AT HWY 11/17


FOUNDATION INVESTIGATION
BOREHOLE LOCATIONS AND SOIL STRATA



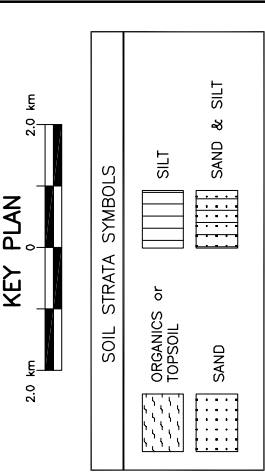
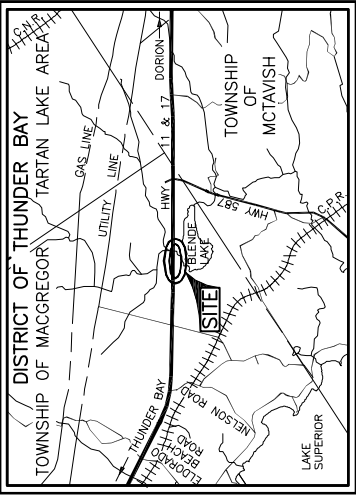
Ministry of Transportation
Northwestern Region
Structural Section




TBT ENGINEERING
CONSULTING GROUP




SHEET



LEGEND

 Borehole

'N' Std Pen Test (Blows/0.3m)

 Water Level

NFP No Further Progress

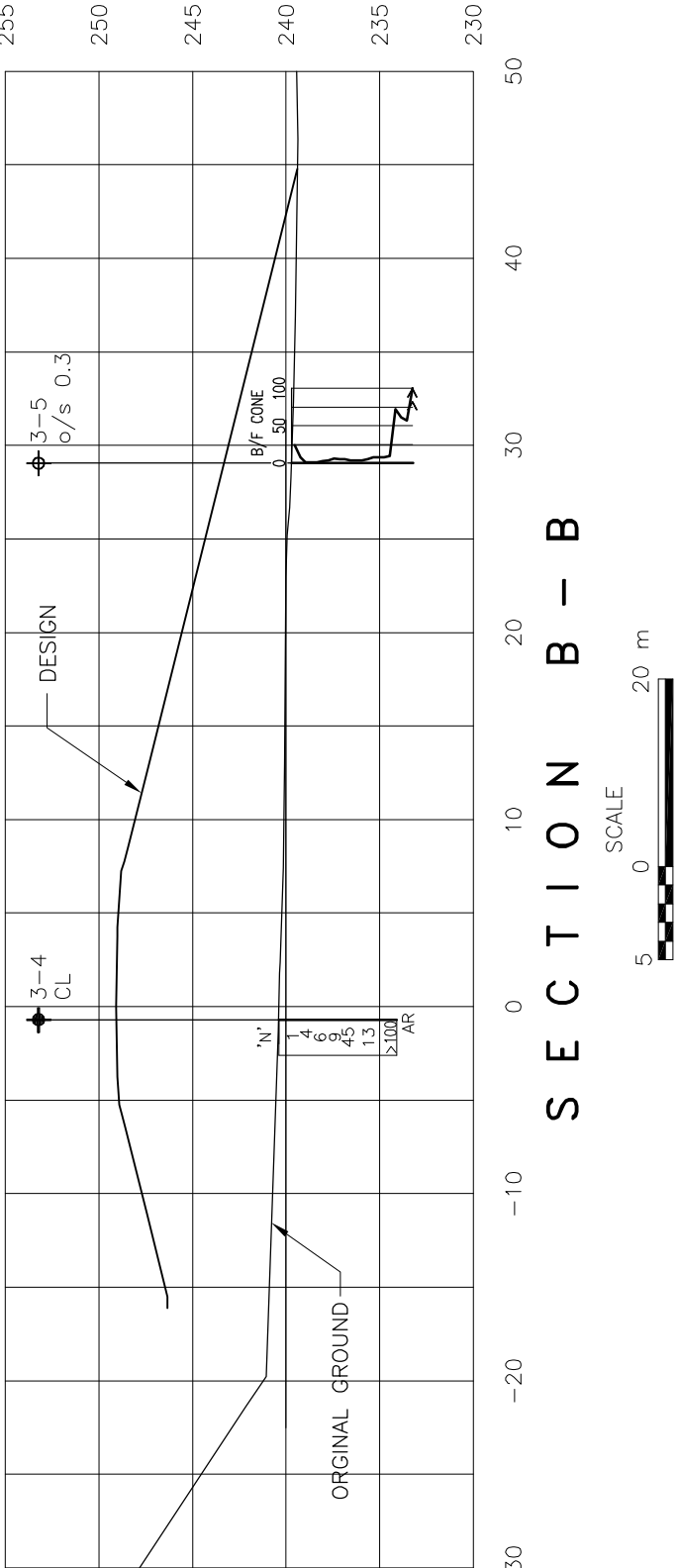
No	ELEVATION	CD-ORDINATES (MTM)	
		NORTH	EAST
3-1	248.2	15 5 384 626	394 055
3-2	241.2	15 5 384 670	394 082
3-3	240.3	15 5 384 762	394 092
3-4	239.7	15 5 384 777	394 103
3-5	240.1	15 5 384 692	394 131
3-6	240.6	15 5 384 741	394 148
3-7	240.3	15 5 384 795	394 165
3-8	240.3	15 5 384 780	394 179
3-9	241.2	15 5 384 830	394 184
3-10	240.3	15 5 384 820	394 197
3-11	240.0	15 5 384 856	394 208
3-12	240.0	15 5 384 858	394 222
3-13	240.3	15 5 384 907	394 249
3-14	242.7	15 5 384 949	394 260
3-15	241.6	15 5 384 934	394 223
3-16	242.7	15 5 384 933	394 162

—NOTE—

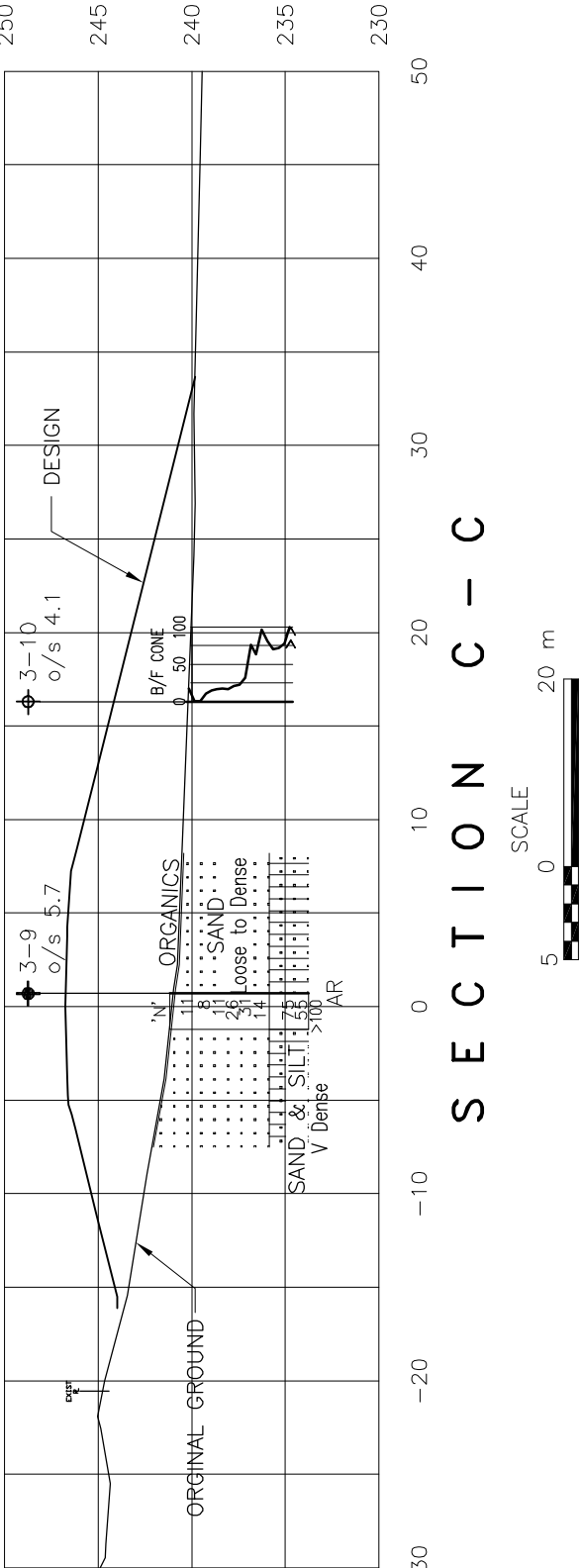
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

METRIC

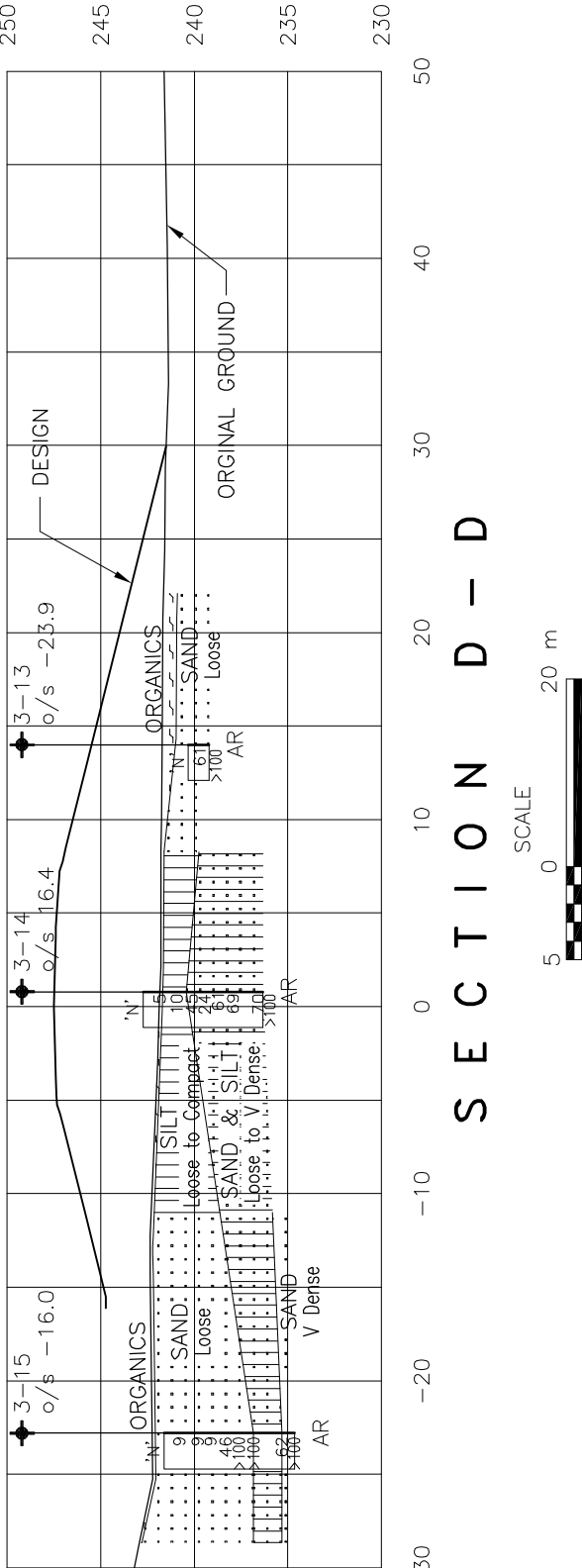
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN



SECTION B – B



SECTION C – C



SECTION D – D

APPENDIX A-2
Station 10+700 to 11+300 Township of McTavish
Borehole Logs

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 (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

	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

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_a	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_i	1	SENSITIVITY = $\frac{C_u}{\tau_r}$

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

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						

TBT Engineering Consulting Group		RECORD OF Borehole No 4-1		1 OF 1	METRIC
W.P. 125-90-00	PROJECT Hwy 11/17 - 4 Laning	SITE NO. 4	ORIGINATED BY D.B.		
DIST 61	HWY 11/17	LOCATION MTM 15 395204, 5386424	TBTE JOB# 11-214	COMPILED BY M.K.	
DATE 2013 April 17	BOREHOLE TYPE Hollow Stem Auger	DATUM Geodetic	CHECKED BY S.S.		

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 (%)				
								○ UNCONFINED ■ SPT (N)	✕ FIELD VANE ★ LAB VANE		W _P	W	W _L		
273.7															
0.0															
273.5	ORGANICS - 200 mm, black														
0.2	SAND & SILT - some gravel to Gravelly, brown, loose to very dense		1	AS											
			2	SS	7										
	----- - occasional cobbles & boulders														
			3	SS	29										21 42 (36)
			4	SS	60										
			5	SS	100+										17 47 (36) On Cobble.
			6	SS	100+										On Cobble.
			7	SS	100+										
			8	SS	100+										
267.3															
6.4	End of Borehole @ 6.4 m. Auger Refusal.														

\times^3, \star^3 : Numbers refer to Sensitivity
 NP Non Plastic
 ○ 3% STRAIN AT FAILURE

ONL_MOT_BH_MTM 11-214-4.GPJ ON_MOT.GDT 13/10/10

TBT Engineering Consulting Group			RECORD OF Borehole No 4-2			1 OF 1		METRIC	
W.P. 125-90-00			PROJECT Hwy 11/17 - 4 Laning			SITE NO. 4		ORIGINATED BY D.B.	
DIST 61 HWY 11/17			LOCATION MTM 15 395215, 5386466			TBTE JOB# 11-214		COMPILED BY M.K.	
DATE 2013 April 18			BOREHOLE TYPE Hollow Stem Auger			DATUM Geodetic		CHECKED BY S.S.	

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 (%)					
274.2														
0.0														
274.0														
0.2	ORGANICS - 200 mm, black													
	GRAVEL - some sand, trace silt, brown, loose to dense		1	AS										Water level @ 0.3 m on May 23, 2013.
			2	SS	35									85 13 (2)
			3	SS	6									
272.2														
2.0	SAND & SILT - some gravel, occasional cobbles, brown, compact to very dense		4	SS	21									
			5	SS	82									Temporary Standpipe installed to 2.9 m.
			6	SS	76									
			7	SS	32									13 48 (40)
			8	SS	100+									19 45 (36)
266.4			9	SS	100+									
7.8	End of Borehole @ 7.8 m. Auger Refusal.													

ONL_MOT_BH_MTM 11-214-4.GPJ ON_MOT_GDT 13/10/10

TBT Engineering Consulting Group **RECORD OF Borehole No 4-3** 1 OF 1 **METRIC**

W.P. **125-90-00** PROJECT **Hwy 11/17 - 4 Laning** SITE NO. **4** ORIGINATED BY **D.B.**

DIST **61** HWY **11/17** LOCATION **MTM 15 395258, 5386509** TBTE JOB# **11-214** COMPILED BY **M.K.**

DATE **2013 April 26** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

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								WATER CONTENT (%)		
								○ UNCONFINED ■ SPT (N)	✕ FIELD VANE ★ LAB VANE									
269.1																		
0.0	ORGANICS - 200 mm, black																	
268.9																		
0.2	SAND & SILT - trace gravel, brown, loose to very dense		1	AS														
			2	SS	20													
			3	SS	17													
	----- - occasional cobbles		4	SS	8													
			5	SS	9													
			6	SS	81													
			7	SS	100+													
264.1																		
5.0	End of Borehole @ 5.0 m. Auger Refusal.																	

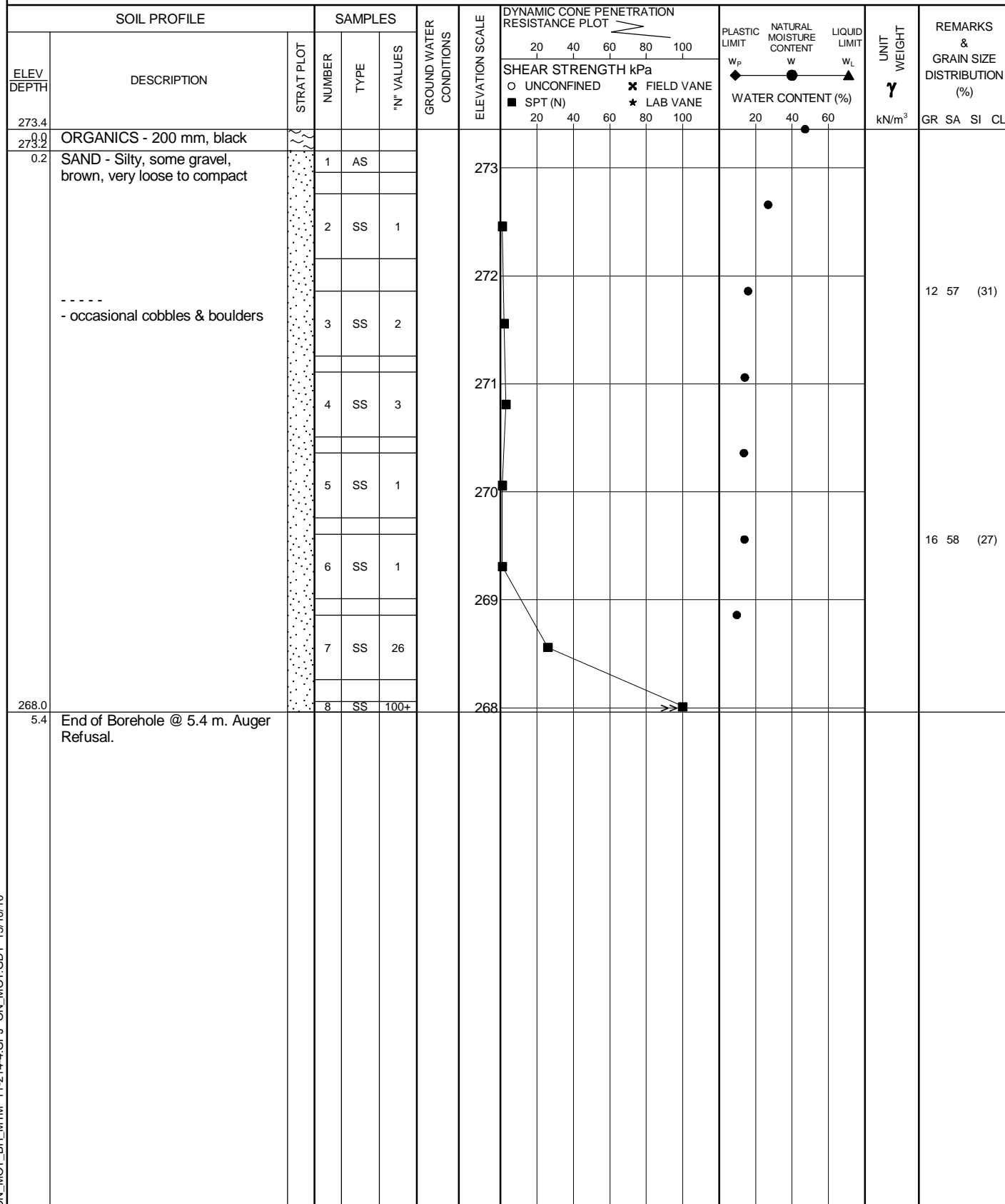
✕³, ★³: Numbers refer to Sensitivity
NP Non Plastic
○ 3% STRAIN AT FAILURE

ONL_MOT_BH_MTM 11-214-4.GPJ ON_MOT.GDT 13/10/10

TBT Engineering Consulting Group			RECORD OF Borehole No 4-4			1 OF 1		METRIC	
W.P. 125-90-00			PROJECT Hwy 11/17 - 4 Laning			SITE NO. 4		ORIGINATED BY D.B.	
DIST 61 HWY 11/17			LOCATION MTM 15 395286, 5386544			TBTE JOB# 11-214		COMPILED BY M.K.	
DATE 2013 April 17			BOREHOLE TYPE Hollow Stem Auger			DATUM Geodetic		CHECKED BY S.S.	
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS		ELEVATION SCALE	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				
270.1									
0.0	SAND - Silty, some gravel to Gravelly, brown, very loose to dense		1	AS					
			2	SS	8				
			3	SS	3				
			4	SS	26				
			5	SS	34				
			6	SS	100+				
266.2									
3.9	End of Borehole @ 3.9 m. Auger Refusal.								

DYNAMIC CONE PENETRATION RESISTANCE PLOT		SHEAR STRENGTH kPa		WATER CONTENT (%)		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
20	40	60	80	100	20		
		UNCONFINED \circ FIELD VANE \times SPT (N) \blacksquare LAB VANE \star		PLASTIC LIMIT W_p NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L			
270							
269							
268							
267							

TBT Engineering Consulting Group		RECORD OF Borehole No 4-5		1 OF 1	METRIC
W.P. 125-90-00	PROJECT Hwy 11/17 - 4 Laning	SITE NO. 4	ORIGINATED BY D.B.		
DIST 61	HWY 11/17	LOCATION MTM 15 395296, 5386598	TBTE JOB# 11-214	COMPILED BY M.K.	
DATE 2013 April 16	BOREHOLE TYPE Hollow Stem Auger	DATUM Geodetic	CHECKED BY S.S.		



x³, *³: Numbers refer to Sensitivity
 NP Non Plastic
 O 3% STRAIN AT FAILURE

ONL_MOT_BH_MTM 11-214-4.GPJ ON_MOT.GDT 13/10/10

TBT Engineering Consulting Group		RECORD OF Borehole No 4-6		1 OF 1 METRIC	
W.P. 125-90-00		PROJECT Hwy 11/17 - 4 Laning		SITE NO. 4	
DIST 61 HWY 11/17		LOCATION MTM 15 395342, 5386630		TBTE JOB# 11-214	
DATE 2013 April 17		BOREHOLE TYPE Hollow Stem Auger		DATUM Geodetic	
				ORIGINATED BY D.B.	
				COMPILED BY M.K.	
				CHECKED BY S.S.	

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			SHEAR STRENGTH kPa	W _p	W	W _L			
272.4 270.0 0.1	ORGANICS - 100 mm SAND - some silt, some gravel, occasional boulders & cobbles, brown, compact		1	AS									Water level @ 0.9 m on May 23, 2013.	
			2	SS	14									
			3	SS	14									
			4	SS	27									
			5	SS	16									
268.7 3.7	SAND & SILT - Gravelly, occasional cobbles, brown, dense to very dense		6	SS	53								Temporary Standpipe installed to 2.9 m.	
			7	SS	62									
			8	SS	100+									
265.4 7.0	SAND & GRAVEL - some silt, occasional cobbles, brown		9	SS	100+								On Cobble.	
			10	SS	100+									
263.6 8.8	End of Borehole @ 8.8 m. Auger Refusal.													

✕³, ★³: Numbers refer to Sensitivity

NP Non Plastic

○ 3% STRAIN AT FAILURE

ONL_MOT_BH_MTM 11-214-4.GPJ ON_MOT.GDT 13/10/10

TBT Engineering Consulting Group			RECORD OF TESTPIT No 4-7				1 OF 1		METRIC				
W.P. 125-90-00			PROJECT Hwy 11/17 - 4 Laning				SITE NO. 4		ORIGINATED BY D.B.				
DIST 61 HWY 11/17			LOCATION MTM 15 395355, 5386681				TBTE JOB# 11-214		COMPILED BY M.K.				
DATE 2013 April 25			EQUIPMENT Excavator				DATUM Geodetic		CHECKED BY S.S.				
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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 <div style="display: flex; justify-content: space-between; font-size: small;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between; font-size: x-small;"> ○ UNCONFINED ✕ FIELD VANE ■ SPT (N) ★ LAB VANE </div>					
274.1	ORGANIC - 150 mm, black GRAVEL & SAND - to Sandy, some silt to Silty, occasional cobbles & boulders, brown		1	GS		274							Borehole attempted, no penetration due to boulders.
274.0			2	GS									
0.2			3	GS									
			4	GS									
			5	GS									
			6	GS									
			7	GS									
			8	GS									
			9	GS									
268.1	End of Testpit @ 6.0 m.												



W.P. 125-90-00 PROJECT Hwy 11/17 - 4 Laning SITE NO. 4 ORIGINATED BY D.B.
DIST 61 HWY 11/17 LOCATION MTM 15 395410, 5386711 TBTE JOB# 11-214 COMPILED BY M.K.
DATE 2013 April 29 BOREHOLE TYPE Hollow Stem Auger DATUM Geodetic CHECKED BY S.S.

[illegible]

ON MOT_BH_MTM 11-214-4.GPJ ON MOT.GDT 13/10/10

✕³, ★³: Numbers refer to Sensitivity
 NP Non Plastic
 ○^{3%} STRAIN AT FAILURE

TBT Engineering Consulting Group		RECORD OF Borehole No 4-9		1 OF 1	METRIC
W.P. 125-90-00	PROJECT Hwy 11/17 - 4 Laning	SITE NO. 4	ORIGINATED BY D.B.		
DIST 61	HWY 11/17	LOCATION MTM 15 395412, 5386768	TBTE JOB# 11-214	COMPILED BY M.K.	
DATE 2013 April 30	BOREHOLE TYPE Hollow Stem Auger	DATUM Geodetic	CHECKED BY S.S.		

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						
273.2	ORGANICS - 200 mm													
273.0														
0.2	SAND - Gravelly, Silty, occasional boulders & cobbles, brown, dense to very dense		1	AS										Water level @ 0.2 m on May 23, 2013.
			2	SS	79									20 55 (25)
			3	SS	48									
			4	SS	100+									
			5	SS	100+									Temporary Standpipe installed to 2.9 m.
270.0	End of Borehole @ 3.2 m. Auger Refusal.													
3.2														

✕³, ★³: Numbers refer to Sensitivity
 NP Non Plastic
 ○ 3% STRAIN AT FAILURE

ONL_MOT_BH_MTM 11-214-4.GPJ ON_MOT.GDT 13/10/10

TBT Engineering Consulting Group			RECORD OF Borehole No 4-10				1 OF 1		METRIC					
W.P. 125-90-00			PROJECT Hwy 11/17 - 4 Laning				SITE NO. 4		ORIGINATED BY D.B.					
DIST 61 HWY 11/17			LOCATION MTM 15 395441, 5386806				TBTE JOB# 11-214		COMPILED BY M.K.					
DATE 2013 May 1			BOREHOLE TYPE Hollow Stem Auger				DATUM Geodetic		CHECKED BY S.S.					
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						
274.3								20 40 60 80 100						
274.0	ORGANICS - 200 mm, black													
0.2	SAND - some gravel, some silt, occasional boulders, brown, very dense		1	AS			274							Boulders 300 - 400 mm
			2	SS	100+									
273.0			3	SS	100+									
1.3	End of Borehole @ 1.3 m. Auger Refusal.													

ONL_MOT_BH_MTM 11-214-4.GPJ ON_MOT.GDT 13/10/10

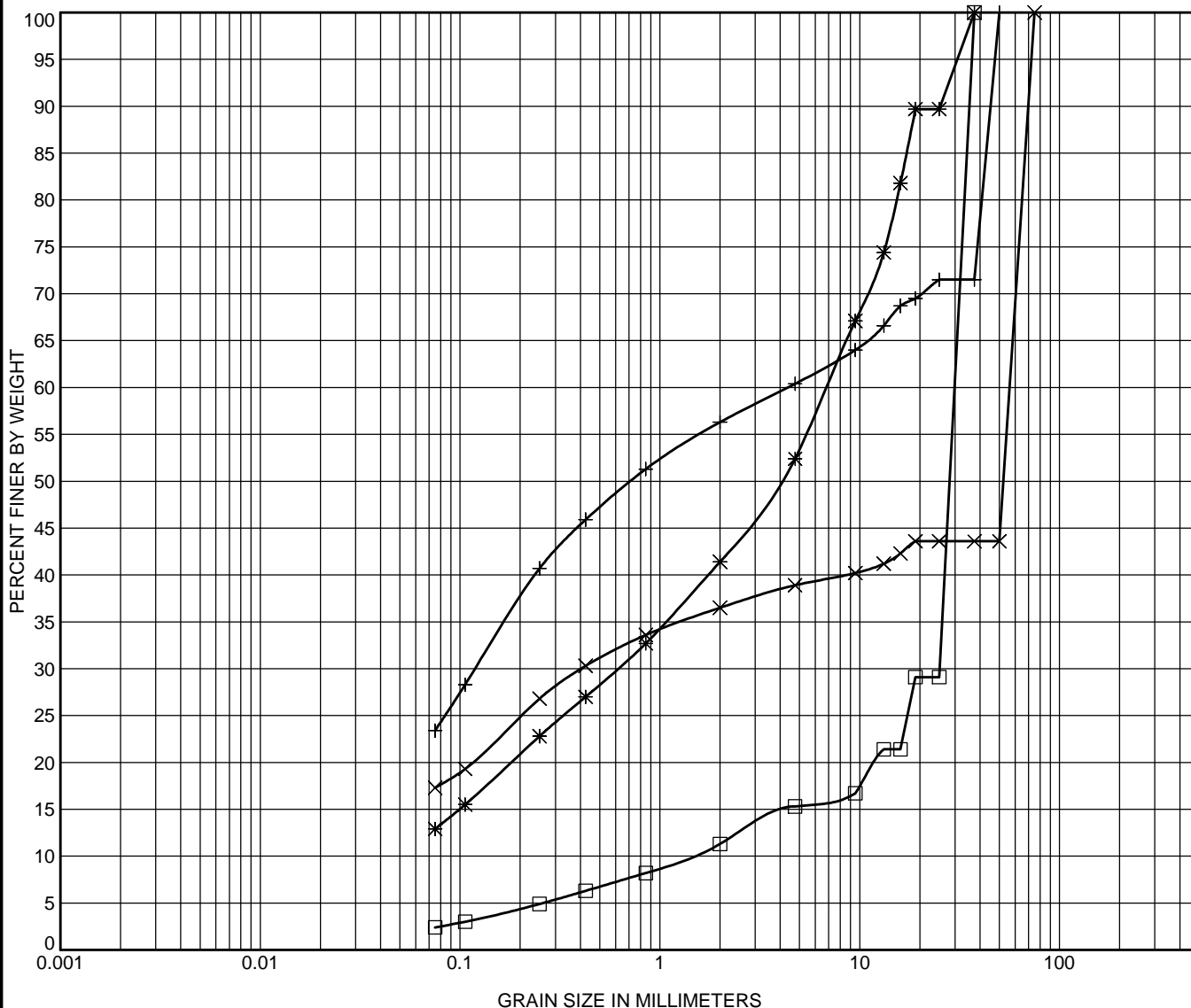
TBT Engineering Consulting Group			RECORD OF Borehole No 4-11				1 OF 1		METRIC					
W.P. 125-90-00			PROJECT Hwy 11/17 - 4 Laning				SITE NO. 4		ORIGINATED BY D.B.					
DIST 61 HWY 11/17			LOCATION MTM 15 395476, 5386880				TBTE JOB# 11-214		COMPILED BY M.K.					
DATE 2013 May 1			BOREHOLE TYPE Hollow Stem Auger				DATUM Geodetic		CHECKED BY S.S.					
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						
277.3 0.0 277.0 0.3	ORGANICS - 250 mm													
	SAND - Gravelly, Silty, occasional boulders & cobbles, brown, very dense		1	AS										
			2	SS	100+									
			3	SS	100+									
276.1 1.2	End of Borehole @ 1.2 m. Auger Refusal.													

ONL_MOT_BH_MTM 11-214-4.GPJ ON_MOT.GDT 13/10/10

TBT Engineering Consulting Group			RECORD OF Borehole No 4-12				1 OF 1		METRIC					
W.P. 125-90-00			PROJECT Hwy 11/17 - 4 Laning				SITE NO. 4		ORIGINATED BY D.B.					
DIST 61 HWY 11/17			LOCATION MTM 15 395518, 5386924				TBTE JOB# 11-214		COMPILED BY M.K.					
DATE 2013 May 1			BOREHOLE TYPE Hollow Stem Auger				DATUM Geodetic		CHECKED BY S.S.					
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						
277.5								20 40 60 80 100						
277.3	ORGANICS - 200 mm													
0.2	SAND - some gravel, some silt, occasional boulders & cobbles, brown, very dense		1	AS			277							Boulders 300 - 500 mm
			2	SS	100+									
276.5			3	SS	100+									
1.0	End of Borehole @ 1.0 m. Auger Refusal.													

ONL_MOT_BH_MTM 11-214-4.GPJ ON_MOT.GDT 13/10/10

APPENDIX B-2
Station 10+700 to 11+300 Township of McTavish
Laboratory Test Data



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
Sandy GRAVELS - SANDS & GRAVELS - Silty SANDS & GRAVELS

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 4-2	0.70	37.5	29.832	25.129	1.397	84.7	12.9	2.4	
* 4-6	7.50	37.5	6.797	0.612		47.6	39.5	12.9	
× 4-7	2.40	75	56.257	0.406		61.1	21.6	17.3	
+ 4-7	5.40	50	4.366	0.119		39.6	37.0	23.4	



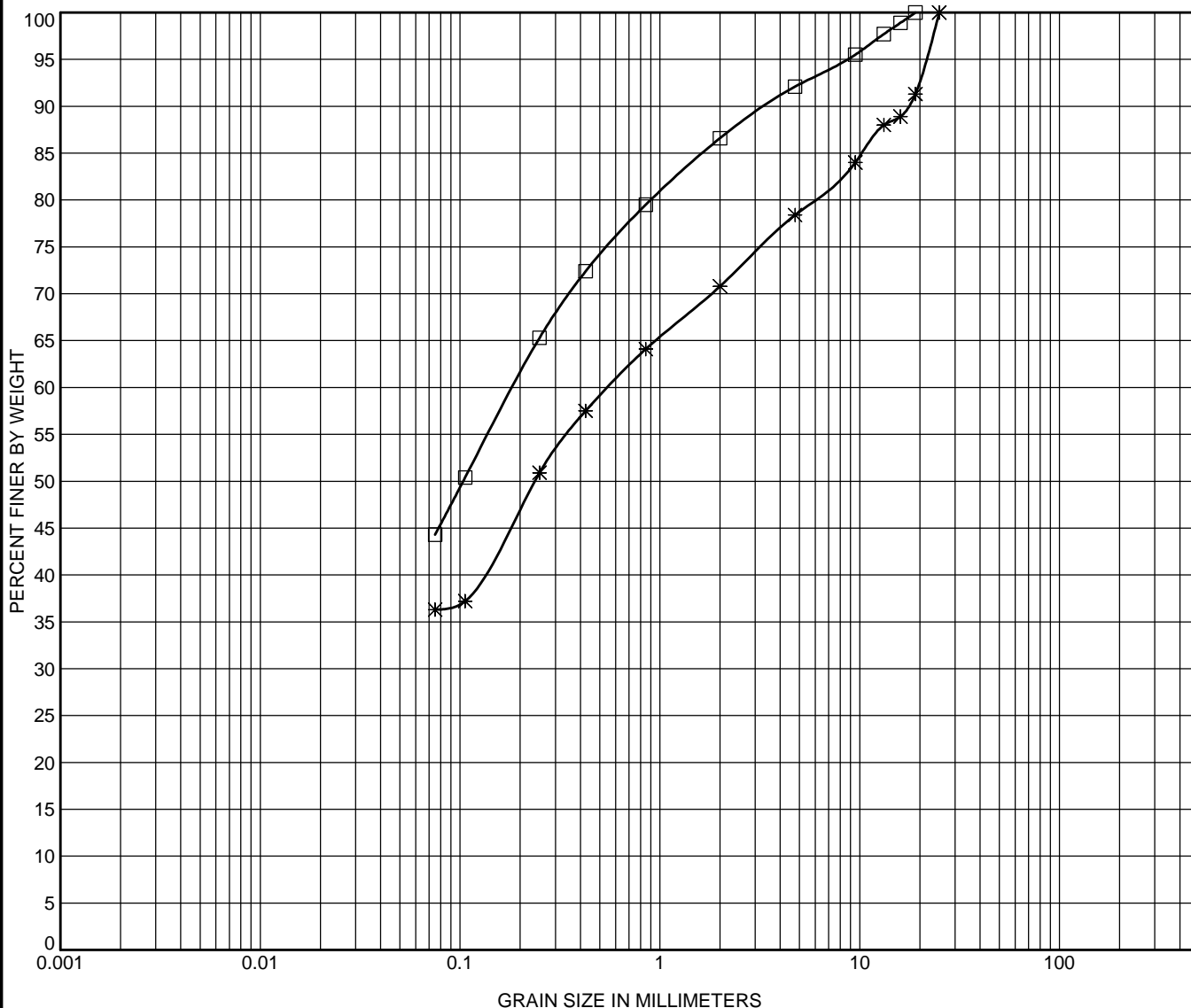
TBT Engineering Limited
1918 Yonge Street
Thunder Bay, Ontario P7C 6T9
PH: 807-624-5160
FX: 807-264-5161
Email: tbte@tbte.ca
Web: www.tbte.ca

GRAIN SIZE DISTRIBUTION

Project: Hwy 11/17 - 4 Laning

W P: 125-90-00

DIST: 61 HWY: 11/17



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
SANDS & SILTS

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 4-3	4.50	19	0.184			7.9	47.8	44.3	
* 4-6	4.50	25	0.553			21.6	42.1	36.3	



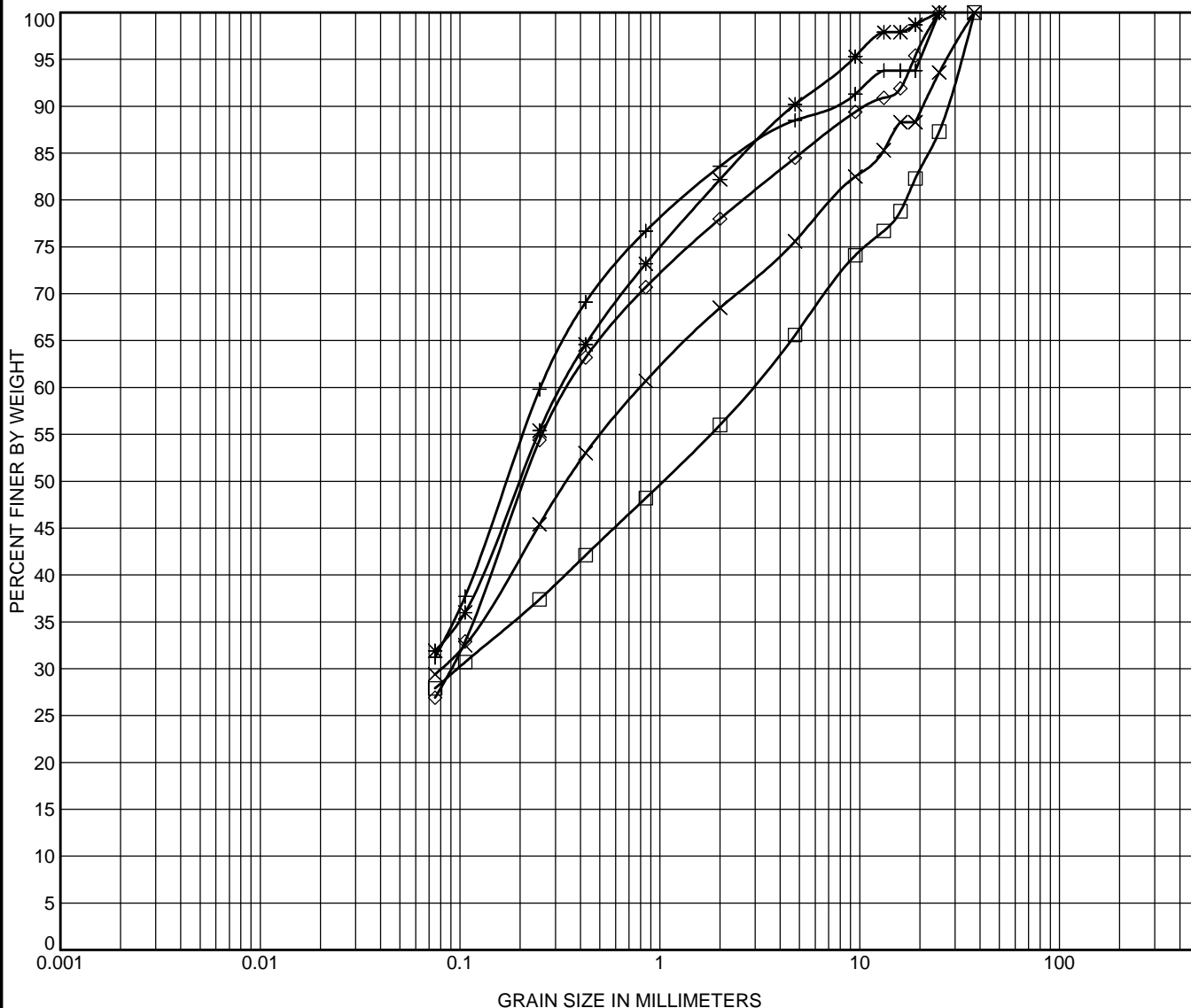
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Email: tbte@tbte.ca
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GRAIN SIZE DISTRIBUTION

Project: Hwy 11/17 - 4 Laning

W P: 125-90-00

DIST: 61 HWY: 11/17



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
SAND - Silty or Gravelly

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 4-11	0.60	37.5	2.868	0.097		34.4	37.7	27.9	
* 4-4	0.00	25	0.326			9.8	58.3	31.9	
x 4-4	3.00	37.5	0.798	0.08		24.4	46.2	29.4	
+ 4-5	1.50	25	0.253			11.5	57.3	31.2	
◇ 4-5	3.80	25	0.35	0.09		15.5	57.6	26.9	



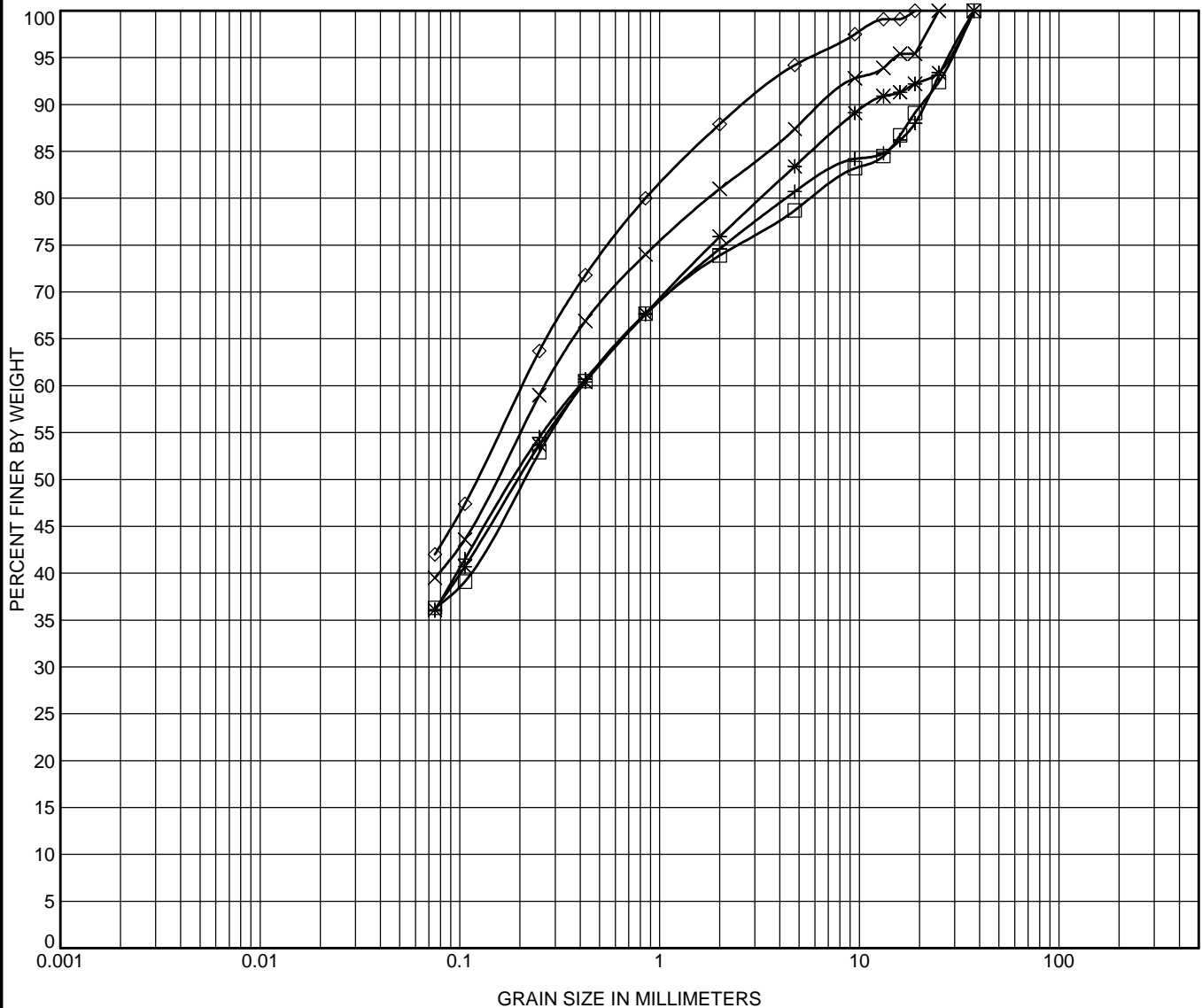
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Web: www.tbte.ca

GRAIN SIZE DISTRIBUTION

Project: Hwy 11/17 - 4 Laning

W P: 125-90-00

DIST: 61 HWY: 11/17



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
SANDS & SILTS

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 4-1	1.50	37.5	0.41			21.3	42.4	36.3	
✱ 4-1	3.00	37.5	0.412			16.6	47.3	36.1	
✕ 4-2	4.50	25	0.267			12.6	47.9	39.5	
+ 4-2	6.00	37.5	0.4			19.3	44.7	36.0	
◇ 4-3	2.20	19	0.206			5.8	52.2	42.0	



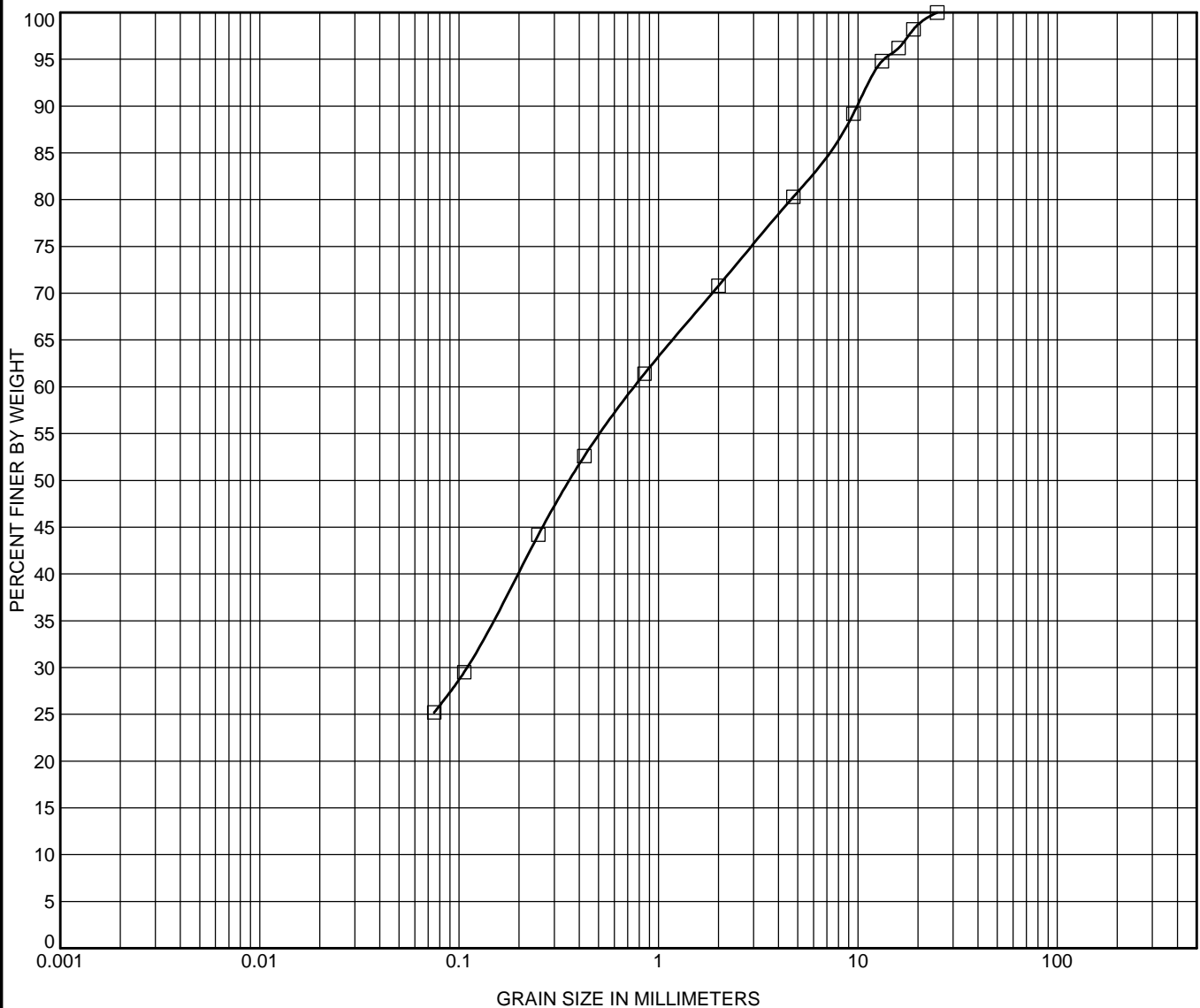
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GRAIN SIZE DISTRIBUTION

Project: Hwy 11/17 - 4 Laning

W P: 125-90-00

DIST: 61 HWY: 11/17



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
SAND - Silty or Gravelly

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
4-9	0.60	25	0.761	0.109		19.7	55.1	25.2	



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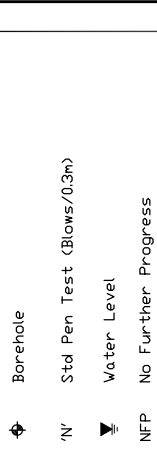
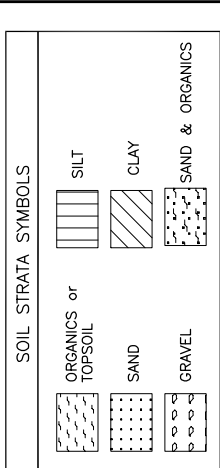
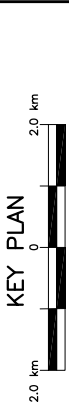
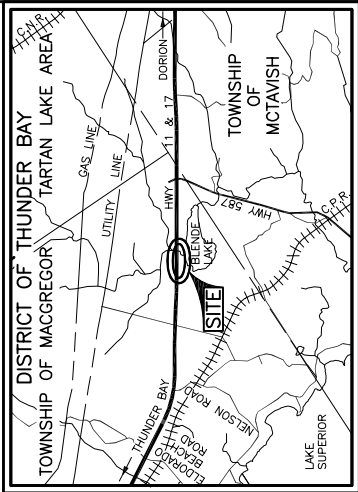
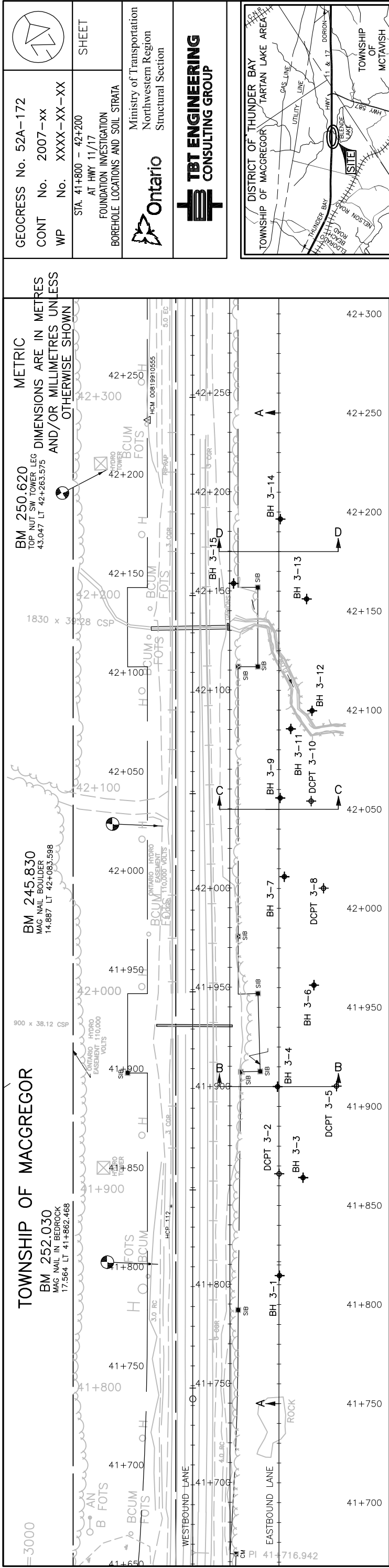
GRAIN SIZE DISTRIBUTION

Project: Hwy 11/17 - 4 Laning

W P: 125-90-00

DIST: 61 HWY: 11/17

APPENDIX C-2
Station 10+700 to 11+300 Township of McTavish
Borehole Locations and Soil Strata Drawing

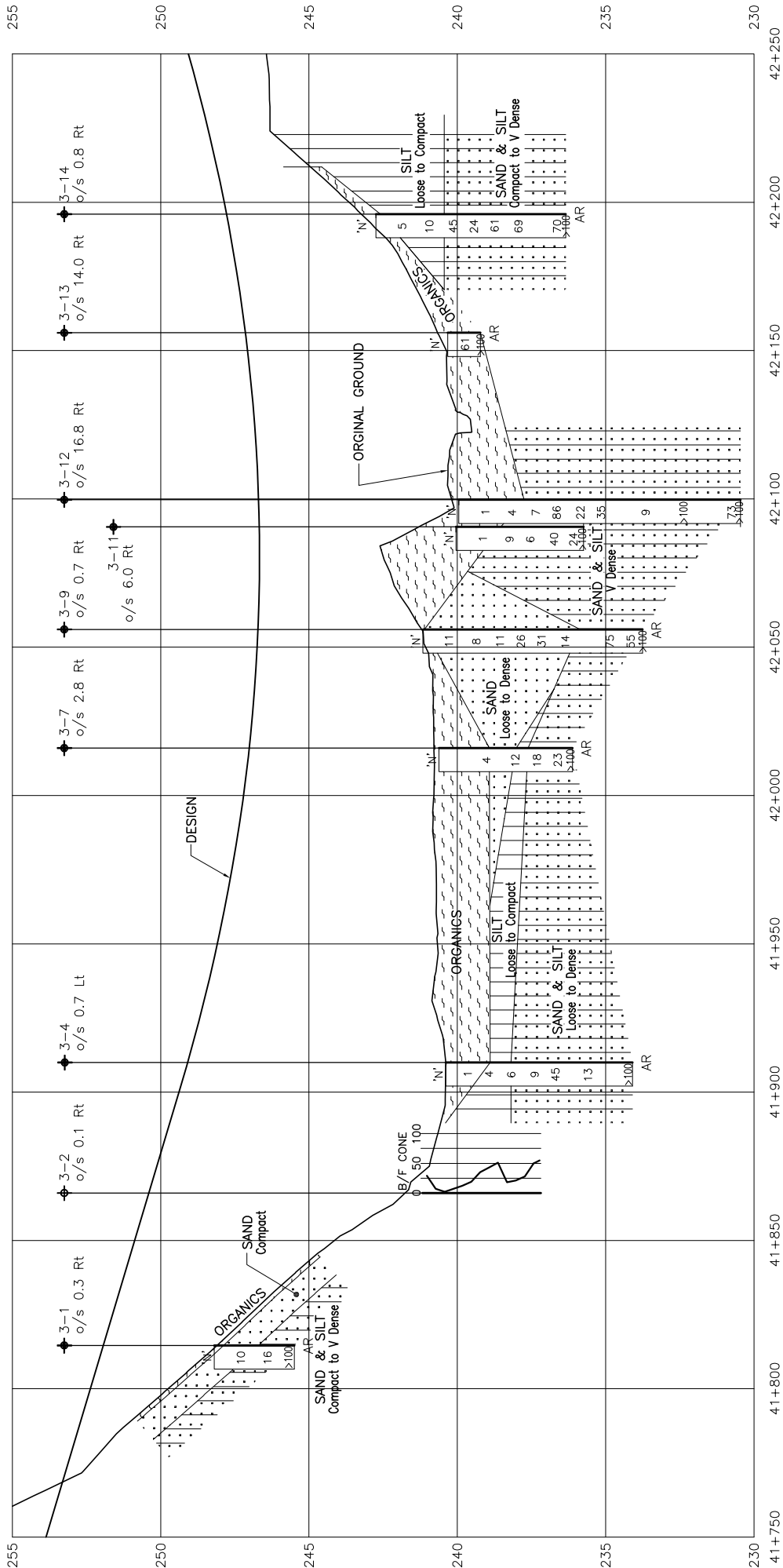


No	ELEVATION	CO-ORDINATES (UTM)	
		NORTH	EAST
3-1	2482	15 5 384 626	394 055
3-2	2412	15 5 384 670	394 082
3-3	2403	15 5 384 662	394 092
3-4	2404	15 5 384 707	394 105
3-5	2397	15 5 384 692	394 131
3-6	2401	15 5 384 741	394 148
3-7	2406	15 5 384 795	394 155
3-8	2403	15 5 384 780	394 179
3-9	2412	15 5 384 830	394 184
3-10	2403	15 5 384 820	394 197
3-11	2400	15 5 384 856	394 208
3-12	2400	15 5 384 858	394 222
3-13	2403	15 5 384 907	394 249
3-14	2427	15 5 384 949	394 260
3-15	2416	15 5 384 933	394 223
3-16	2427	15 5 384 933	394 162

-NOTE-

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

REVISIONS					
	DD/MM/YY	BY	REVISION	DESCRIPTION	
DRAWN	XX	CHK	XX	CODE XXXXX-XX	LOAD XX-XX-X DATE XXXXXXXX
CHECKED	XX	CHK	XX	SITE XXX-XXX	DWG X



SECTION A - A



REFERENCE DRAWING SUPPLIED BY HATCH MOTT MACDONALD.

GEORESS No. 52A-172

CONT No. 2007-xx

WP No. XXXX-XX-XX

STA. 41+800 – 42+200

AT HWY 11/17

FOUNDATION INVESTIGATION

BOREHOLE LOCATIONS AND SOIL STRATA

Ontario

TBT ENGINEERING

CONSULTING GROUP

SHEET

2.0 km

0

2.0 km

SOIL STRATA SYMBOLS

ORGANICS or TOPSOIL

SAND

SILT

SAND & SILT

LEGEND

⬮

Borehole

'N'

Std Pen Test (Blows/0.3m)

▼

Water Level

NFP

No Further Progress

No	ELEVATION	CD-ORDINATES (MTM)	
		NORTH	EAST
3-1	248.2	15 5 384 626	394 055
3-2	241.2	15 5 384 670	394 082
3-3	240.3	15 5 384 762	394 092
3-4	239.7	15 5 384 779	394 109
3-5	239.7	15 5 384 692	394 131
3-6	240.1	15 5 384 741	394 148
3-7	240.6	15 5 384 795	394 165
3-8	240.3	15 5 384 780	394 179
3-9	241.2	15 5 384 830	394 184
3-10	240.3	15 5 384 820	394 197
3-11	240.0	15 5 384 856	394 208
3-12	240.0	15 5 384 858	394 222
3-13	240.3	15 5 384 907	394 249
3-14	242.7	15 5 384 949	394 260
3-15	241.6	15 5 384 934	394 223
3-16	242.7	15 5 384 933	394 162

NOTE

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

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

REFERENCE DRAWING SUPPLIED BY HATCH MOTT MACDONALD.

PR-0-707 86-05 MINISTRY OF TRANSPORTATION, ONTARIO

Dec 20, 2015, 2:25pm Login name: blundem V:\Projects\2011\11-214 EML Pass Lake 4 Inlet\Foundations\CD\Foundations Site 5 Environmental.dwg