Preliminary Foundation Investigation and Design Report

Highway 11 Relocation

MacLeod High Tailings
Geraldton, Ontario

SUBMITTED TO:

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APPENDICIES

Part A - FOUNDATION INVESTIGATION REPORT

1 Introduction

TBT Engineering Limited (TBTE) has been retained by Premier Gold (PG) to provide a preliminary foundation investigation and design report for the proposed realignment of Highway 11 as it crosses over the MacLeod High Tailings (MHT). The MHT is located south of Geraldton, Ontario near the intersection of Highway 11 and 584. The preliminary foundation investigations were conducted along the proposed new highway alignment with particular attention to areas where the alignment crosses the tailings pile. The proposed alignment crosses the perimeter of the tailings pile at four locations at the approximate Stations of 13+015, 13+340, 13+575, and 14+035.

This investigation consisted of twelve boreholes drilled along the proposed alignment. Six boreholes were drilled off the MHT (at approaches to the raised pile), four boreholes were advanced near the crests of the MHT perimeter and the remaining two were advanced at mid points between the perimeter crossings on the MHT. The boreholes are labeled from BH 500 to BH 511.

2 Site Description

The preliminary foundation investigations were completed to investigate subsurface conditions for the four MHT perimeter crossings, located at stations 13+015, 13+340, 13+575, and 14+035, and provide some data for areas between the crossings.

The MHT consists of a large tailings deposit placed over natural terrain, dating back to the 1930's. The perimeter of the deposit consists of shaped tailings with varying side slopes and configurations. Typically in the areas of this investigation the side slopes are roughly 2.5 horizontal to 1 vertical. Some sections of the MHT perimeter have a toe berm/drain while other sections do not. A tailings beach is also evident along much of the toe of the MHT perimeter. The height of the perimeter typically varies from 6 to 8 m. Reshaping of the perimeter, plus the construction of the toe berms (where applicable) was completed circa 2000

It is understood that the original terrain consisted of a low lying swamp which is still evident at some locations beyond the perimeter of the MHT.

Photo 2.1 – Looking North Easterly Towards Station 13+015

3 Surficial Geology

Available surficial geology mapping (OGS NOEGTS Map 5078 – Longlac) indicates the site is located in a terrain unit comprised of a peat veneer (organic terrain) over a sand (outwash plain); the area may also include a till (ground moraine) beneath the sand. The surrounding terrain is a low local relief plain.

4 Investigation Procedures

A geotechnical site investigation was undertaken from December 16, 2014 to February 4, 2015. The borehole locations are illustrated on the Borehole Location and Soil Strata Drawing found in Appendix D.

The borehole locations were identified in the field by TBTE personnel and service clearances were completed prior to mobilizing the drill rig to site. Numerous drill set ups were used to complete the boreholes and associated Standard Penetration Testing (SPT), as indicated below:

Table 4.1: Boreholes and Associated Drill Equipment

Drill Equipment	SPT Delivery Mechanism (Efficiency)	Borehole
CME 55	Automatic Hammer (0.73)	500, 501, 502, 505, 506, 507, 509, 511
CME 750	Automatic Hammer (0.67)	503, 504, 508
Tripod	Safety Hammer (0.6)*	510

*Based on published data.

SPT “N” values reported on the borehole logs and referenced in Section 6 (Sub-Surface Conditions) are uncorrected field values.

Drilling methods applied to all boreholes consisted of keeping the hollow stem augers or casing filled with water (to ground level) to reduce the possibility of the soils being “blown up” within the boreholes. Soil samples were obtained from the auger flights and using a split spoon sampler as a part of the Standard Penetration Testing . Refusal material was sampled not sampled.

Borehole locations were surveyed by TBTE and were based on North American Datum 1983, UTM CSRS CBNV6-2010 Zone 16. Control was established from existing published Horizontal Control Monuments and a Geodetic Benchmark using the Canadian Geodetic Vertical Datum

1928. The following horizontal control points and vertical control points were utilized throughout this project:

- HCM 00119753139, HCM 0011984U045
- VCM 0011984U045 VCM 00819728155

5 Laboratory Testing

Samples which were obtained during the field investigation were subjected to laboratory testing consisting of moisture content, grain size analysis (mechanical sieves and hydrometers), consolidation testing and drained direct shear testing. The results of this testing are shown on the Borehole Logs (Appendix A) and on the laboratory data reports (Appendix B).

6 Sub-Surface Conditions

Details of the subsurface conditions are provided on the borehole (Appendix A), laboratory reports (Appendix B) and on the Soil Strata Drawing (Appendix C).

The subsurface soils along the alignment on top of the MHT typically consist of fill/topsoil at surface underlain by tailings. The tailings are underlain by organic material followed by silt. The silt is underlain by a till with occasional cobbles before auger and/or SPT refusal.

The subsurface soils around the perimeter of the MHT typically consists of organic material or tailings at surface, followed by silt which is underlain by a till with occasional cobbles before auger and/or SPT refusal.

6.1 Topsoil

Topsoil was encountered within the MHT at the ground surface of Boreholes 503, 504, and 508. The topsoil's thickness varied from 1.4 to 1.8 m.

6.2 Fill

Fill was encountered at ground surface at boreholes both outside and within the MHT.

Within the MHT (BH 503, 505 and 507) fill was encountered at elevation 336.1, 338.5 and 336.8 and extended to elevations 335.3, 333.0 and 335.5 m, respectively. The fill ranges from sandy gravel with silt with trace sand to silt with trace sand. The test results indicate a grain size

distribution of 0 to 53 % gravel, 1 to 27 % sand, and 18 to 99 % silt/clay sized particles. The presence of cobbles was noted within the fill at Borehole 505. The fill is very loose to dense as indicated by "N" values ranging from 3 to 34 blows/0.3 m.

Outside of the MHT (BH 510 and 511) fill was encountered at elevation 331.1 and 332.6 and extended to elevations 330.4 at both locations. Based on a single grain size analysis this fill consists of sandy silt. The test results indicate a grain size distribution of 0 % gravel, 29 % sand, and 72 % silt/clay sized particles. The fill is very loose to compact as indicated by "N" values ranging from 2 to 13 blows/0.3 m.

6.3 Organic Material

Organic matter was encountered at all boreholes with the exception of Boreholes 508, 509, and 511. The organic material varies from being on surface to be being below topsoil or tailings.

For boreholes located outside of the MHT organic material was encountered at ground surface at Boreholes 500 and 501, beneath tailings at Boreholes 502 and 506, and beneath fill at Borehole 510. The material was encountered at elevations ranging 328.8 to 330.6 and varied in thickness from 0.8 to 2.1 m with natural moisture contents ranging from 119 to 685 %.

A consolidation test was conducted on a disturbed sample of the organic material from Borehole 505 at a depth of 10.5 m. The results of this consolidation test indicate a drained constrained modulus in the range of 0.1 to 0.9 MPa within the normal effective stress range of the test (5 to 150 kPa). The coefficient of consolidation, Cv, varied from 9.5 to 2.5 mm^2/min.

The organic material within the MHT was encountered beneath tailings at Boreholes 503, 504, 505 and 507 at elevations ranging from 328.3 to 330.0 and varied in thickness from 0.3 to 1.4 m, with natural moisture contents ranging from 119 to 325 %.

6.4 Silt

Native silt was present at all the borehole locations with the exception of Boreholes 508, 510 and 511. The native silt was encountered beneath the organics at all the boreholes with the exception of Borehole 509, where it was encountered directly beneath the tailings. The silt was encountered at elevations ranging between 327.0 to 330.6 m.

Within the MHT (BH 503, 504, 505, 507 and 509) the native silt was encountered at elevations 327.0 to 330.6 m and varied in thickness from 2.4 to 5.2 m, with Borehole 505 terminating within the silt. Based on four grain size analysis the material consists of silt with trace sand as indicate by a grain size distribution of 0 % gravel, 3 to 8 % sand, and 92 to 97 % silt/clay sized particles. The silt is loose to dense as indicated by "N" values ranging from 4 to 31 blows/0.3 m.

Outside of the MHT (BH 500, 501, 502 and 506) the native silt was encountered at elevation 327.6 and 329.6 and varied in thickness from 3.3 to 3.9 m, with Borehole 506 terminating within the silt. Based on a three grain size analysis the material consists of gravelly sandy silt to silt with trace sand. The test results indicate a grain size distribution of 0 to 30 % gravel, 3 to 24 % sand, and 47 to 97 % silt/clay sized particles. The presence of cobbles was noted within the fill at Borehole 500, 502 and 506. The silt is typically very loose to compact as indicated by "N" values ranging from 3 to 29 blows/0.3 m. The silt was very dense at a depth of 9.1 m in Borehole 506 with an "N" value of 42 blows/0.3 m

6.5 Tailings

Tailings was present at all the borehole locations with the exception of Boreholes 500, 501, 510 and 511.

Within the MHT tailings were encountered at surface (BH 509), beneath topsoil (BH 504 and 508) and beneath fill (BH 503, 505, and 507) at elevations 333.0 to 336.3 m and varied in thickness from 3.7 to 7.9 m. Based on fourteen grain size analysis the material consists of gravelly sandy silt, silt and sand with trace gravel to silt. The grain size analysis typically indicates a grain size distribution of 0 to 4 % gravel, 0 to 38 % sand, and 58 to 99 % silt/clay sized particles. A single sample from Borehole 508 has a grain size distribution of 32 % gravel, 22 % sand, and 45 % silt/clay sized particles at a depth of 4.4 m. The tailings is typically very loose, with a few instances of it being compact as indicated by "N" values ranging from 1 to 25 blows/0.3 m.

A consolidation test was conducted on a disturbed sample of the tailings material from Borehole 504 at a depth of 3.0 m. This sample consists of 5% sand and 95% silt and clay sized particles. The results of this consolidation test indicate a drained constrained modulus in the range of 6 to

17 MPa within the normal effective stress range of the test (15 to 200 kPa). The coefficient of consolidation, Cv, varied from 47 to 157 mm^2/min.

Consolidated drained direct shear testing was conducted on a sample from Borehole 504 at a depth of 3.0 m to estimate the effective stress strength parameters of the tailings. The lower bound of the shear strength points developed at low horizontal shear strain level of 2% is represented by effective stress strength parameters of c' = 0 kPa and ϕ' = 31°.

Outside of the MHT (BH 502 and 506) the tailings was encountered at ground surface at elevation 331.7 and varied in thickness from 1.2 to 3.0 m. Based on a two grain size analysis the material consists of sandy silt to silt with trace sand. The test results indicate a grain size distribution of 0 % gravel, 5 to 32 % sand, and 68 to 95 % silt/clay sized particles. The tailings is very loose to loose as indicated by "N" values ranging from 2 to 7 blows/0.3 m.

6.6 Till

Till consisting of a heterogeneous mixture of gravel, sand, silt and cobbles is encountered beneath the silt at Boreholes 500 to 504, 507, and 509, beneath the tailings at Borehole 508, beneath organic material at Borehole 510 and beneath fill at Borehole 511. Till was not encountered at Boreholes 505 and 506. The till was encountered at elevations ranging from 323.9 to 330.9 m. It should be noted that all boreholes where till was encountered, terminated within the till. The till can range from sand with trace gravel and trace silt to sandy silty gravel. Grain size analysis conducted on seven samples of the indicate the layer consist of 4 to 49 % gravel , 25 to 92 % sand and 4 to 29 % silt/clay size particles. Occasional cobbles were noted within several boreholes. The till is compact to dense as indicated by an "N" values ranging from 10 to 46 blows/0.3m.

6.7 Ground Water

The ground water levels are based on the pre-existing well data collected from 1996, 2012, 2013 and 2014. The wells reviewed are situated in close proximity to the proposed highway right of way. The wells reviewed are provided in the following table with a summation of their data from 1996, 2012, 2013, and 2014 data for all years may not have been present for all wells.

Table 6.1: Ground Water Level (elevations m)

Well ID	Average Level	Max. Level	Min. Level
96-03	331.4	332.7	330.5
96-04	330.0	337.6	324.8
96-09A1	335.4	338.3	333.3
96-09A4	335.3	338.3	333.1
96-12A	330.3	331.4	329.6

6.8 Refusal

Auger refusal and “N” values of 100+ blows/0.3 m was encountered at all borehole with the exception of Borehole 505 which extend to a maximum depth of 15 m. The following table indicates the recorded refusal depths at each borehole. Refusals may be on cobbles, boulders, or bedrock. Refusal material was not sampled.

Table 6-2: Borehole Refusal Site 3

Test hole Number	Refusal Depth (m)	Refusal Elevation (m)
500	7.8	322.8
501	8.6	322.5
502	6.3	325.4
503	12.6	324.9
504	14.6	323.0
506	10.0	321.7
507	13.7	323.1
508	9.0	327.4
509	13.5	322.8
510	3.2	327.9
511	5.9	326.7

7 Miscellaneous

Laboratory testing was carried out at the TBT Engineering Limited laboratory in Thunder Bay. The drill equipment for this investigation was operated by TBT Engineering. The field operations were supervised by Alan Finke. Laboratory testing was supervised by T. Fummerton C.E.T.

This report was prepared by Steven Seller, P.Eng and Gordon Maki, P.Eng., and reviewed by W. Hurley, P.Eng (TBTE designated principal contact identified for MTO Foundation Engineering projects).

Part B - FOUNDATION DESIGN RECOMMENDATIONS

8 Introduction

TBT Engineering Limited (TBTE) has been retained by Premier Gold (PG) to provide preliminary foundation investigation and design services for the proposed Highway 11 relocation over the MacLeod High Tailings. The preliminary foundation investigations were conducted along the proposed new highway alignment particularly attention was paid to the areas where the alignment crossed the tailings pile perimeter, with some investigation along the tailings pile. The proposed alignment crosses the perimeter of the tailings pile at four locations at the approximate Stations of 13+015, 13+340, 13+575, and 14+035.

The preliminary foundation investigations as described in Part A, was completed to investigate subsurface conditions at these sites. These investigations consisted of twelve boreholes drilled near the proposed 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 Borehole 500 to 511.

The foundation soils at these sites typically consist of organics, tailings, topsoil, or fill at surface which overlie silt, with till to termination. Cobbles are present within the native soils at numerous locations. All boreholes extended to practical refusal (100+ “N” values as determined from the Standard Penetration Test), or extend to a maximum depth of 15 m.

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.

9 Roadway Embankment Analyses

9.1 Geotechnical Model

Stability modeling was completed 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 below. The preliminary strength properties of the native soils have been based on published correlations with index tests. The preliminary strength properties of the tailings has been determined through direct shear testing, and index tests. Typical preliminary strength properties have been selected for the various potential fill materials.

Table 9-1: Assumed Soil Properties for Stability Analyses

Soil	Effective Stress Strength Properties		Unit Weight γ (kN/m^3)
	Effective Angle of Internal Friction, φ' (degrees)	Effective Cohesion Intercept, C' (kPa)	
Rock Fill	45	0	18
Compacted Granular Fill	35	0	20
Filter Material	35	0	18
Tailings	31	0	20
Organic material	28	0	11-12
Native Silts	32	0	20
Till	35	0	20

A tailings beach overlying organic material exists along the toe of the MHT perimeter. The thickness and extent of the tailings beach is likely variable. While the added weight of the tailings beach can significantly improve stability of the perimeter, for this assessment its potential presence was conservatively ignored. This would also cover a scenario where some or all of the tailings beach material is either eroded or removed in the future.

9.2 Roadway Embankment Stability

Stability analyses have been completed to investigate stability of the proposed roadway embankment crossing the MHT. For this preliminary assessment stability analyses was completed for embankment sections off the MHT, adjacent to the MHT perimeter, and for the

embankment constructed on the MHT independent of the MHT perimeter. The following factors of safety (FoS) were applied as follows:

- FoS 1.5 - For areas along the MHT perimeter both during and after construction.
- FoS 1.3 - For areas where the embankment does not influence the stability of the MHT perimeter.

Stability analyses were conducted under static long term steady state seepage conditions and under short term construction loading conditions. During construction, it is expected that porewater pressures within the existing tailings and organic subgrade will likely increase. For this preliminary assessment the increase in porewater pressure was modelled with a Bbar of 0.3 for the tailings and 0.4 for organic material. The actual increase in porewater pressures should be investigated for detailed design and/or construction (fill placement) should be controlled (with staged and monitored fill placement) to ensure porewater pressures do not exceed the assumed Bbar values.

A uniformly distributed traffic load of 20 kPa was utilized during analysis.

Seismic parameters for the stability models was not consider based on the Canadian Highway Design Bridge Code (CHBDC). The subject site has a Zonal acceleration Ratio of 0, as provided in Table A3 of the CHBDC. Assuming the roadway embankment is considered an “Emergency rout and other bridges”, the site is located in a Seismic Performance Zone 1, in accordance with Table 1 of Section 4.4.4. As per Section 4.4.5.1, structures within Seismic Performance Zone 1s do not required seismic analyses.

It is understood that the highway embankments will be constructed with rock fill with a 300 mm thick pavement structure consisting of granular fills. Where rock fill is placed along the perimeter slope of the tailing pile, a zone of filter material between the MHT and the rock fill should be considered. The design of the filter material should retain the tailings soils while not restricting seepage.

A description of the analyzed configurations and the results of the stability assessment are provided below for the various configurations. All slope models (Figures 1 to 7) are provided in Appendix D:

1. High fill embankments off the MHT:
    a. At areas where the embankment will be constructed with full removal of all existing organic material and/or tailings, the following recommendations/comments apply (Refer to Figure 1):
        i. The embankments shall be constructed with side slopes no steeper than 1.5H:1V through the rock fill and 2H:1V through the granular fills.
        ii. Since all the organic material and tailings will be removed there are no requirements for staged filling operations.
        iii. The use of mid slope benches shall be used for rock fills heights in excess of 10 m.
    b. At areas of high fill embankments off the MHT that must be constructed over existing tailings and organic material (to maintain stability of the MHT perimeter) it was assumed the tailings beach thickness is insignificant and a total thickness of 2 m of organic material exists (conservative) the following recommendations/comments apply (Refer to Figure 2):
        i. The embankments shall be constructed with side slopes no steeper than 1.5H:1V through the rock fill and 2H:1V through the granular fills.
        ii. A stepped flanking berm will be required on both sides of the embankment. The stepped flanking berm may consist of a 3.0 m thick 5.5 m wide step followed by a 1.0 m thick 4.0 m wide step.
        iii. To ensure stability during construction, staging with delays for excess porewater pressure dissipation will likely be required.
        iv. A monitoring and instrumentation plan to monitor stability and excess porewater pressures within the organic material subgrade should be considered.
        v. Staging requirements must be addressed during detailed design.
        vi. The use of mid slope benches shall be used for rock fills in excess of 10 m in height.
2. Embankments constructed on the MHT that do not influence the stability of the MHT perimeter:

    For embankments that are constructed on the MHT but away from the MHT perimeter (14 m or further) the following recommendations/comments apply (Refer to Figure 3 and Figure 4):

i. The proposed highway embankment is not expected to have a significant impact on the stability of the MHT perimeter where the embankment is located at least 14 m away
ii. The embankments shall be constructed with side slopes no steeper than 1.5H:1V through the rock fill and 2H:1V through the granular fills.
iii. During detailed design confirmation that a Bbar of 0.3 for the tailings is suitable. Should additional porewater pressures be realized, staged construction and/or the use of flanking berm may be required to improve stability during construction.

3. Embankments crossing the MHT perimeter:
   a. To facilitate excavation of the existing tailings and organic material below the proposed embankment adjacent to the toe of the MHT perimeter, a steeped rock fill berm is required along the MHT perimeter toe. The berm will be constructed over organic material, removal of this organic material would destabilize the MHT perimeter. The rock fill berm must be constructed prior to the excavation of the organic material. The following recommendations/comments apply (Refer to Figure 5):
      i. The stepped flanking berm may consist of a 3 m thick 11 m wide step followed by a 1.0 m thick 4.0 m wide step. This provides a FoS of 1.5 during construction (assuming excess porewater pressures).
      ii. To ensure stability during construction, staging with delays for excess porewater pressure dissipation may be required. A monitoring and instrumentation plan to monitor stability and excess porewater pressures within the organic material subgrade should be considered.
      iii. Staging requirements must be addressed during detailed design. Refer to Figure 5.
   b. After the construction of the stepped rock fill flanking berm excavation of the organic material and tailings from the beneath the proposed embankment can begin. For this assessment it was assumed that that the excavation would be constructed in the “wet” without dewatering of the excavation. The following recommendations/comments apply (Refer to Figure 6):
      i. The porewater pressures induced from the construction of the stepped rock fill flanking berm must dissipate, prior to excavation.

ii. The excavation of the organic material cannot be within 4 m of the toe of the steeped rock fill flanking berm. This provides a calculated FoS of 1.3 for the first step of the flanking berm and an overall FoS > 1.5 for global stability of the MHT perimeter.

c. Stability perpendicular to the MHT perimeter of the tailings or parallel to the highway alignment:

The stability for potential slope failures longitudinally along the highway alignment was analized and found to be in excess of 1.5.

4. Embankments constructed on the MHT that do influence the stability of the MHT perimeter:

For embankments that are constructed on the MHT but within 14 m of the MHT perimeter the a minimum factor of safety of 1.5 for both long term steady state and short term construction conditions were considered. The following recommendations/comments apply (Refer to Figure 7 and Figure 8):

i. As a minimum, the existing tailings slope should be covered with at least 0.6 m of filter material / rock fill.
ii. The rock fill slopes may be constructed at grades of 2H:1V. In addition, a stepped flanking berm (as described in 3 a) will be required and may consist of a 3 m thick 11 m wide step followed by a 1.0 m thick 4.0 m wide step.
iii. To ensure stability during construction, staging with delays for excess porewater pressure dissipation may be required.
iv. A monitoring and instrumentation plan to monitor stability and excess porewater pressures within the organic material subgrade should be considered.
v. Staging requirements must be addressed during detailed design.
vi. The use of mid slope benches must be considered.

10 Settlement Performance

Settlement analyses have been completed for three distinct sections along the proposed alignment. The three sections include:

- Roadway embankment constructed on top of MHT,

- Roadway embankment constructed at toe of MHT perimeter over tailings and organics, and
- Roadway embankment beyond MHT perimeter toe with all tailings and organics removed

For this preliminary assessment, embankment settlements have been estimated on primary consolidation of the tailings, native silt and till subgrade, and the primary and secondary consolidation of the organics. In addition, short and long term settlement associated with rock fill construction (assuming dumped rock fill) have been included.

As per MTO Embankment Settlement Criteria (July 2, 2010), the design life established for settlement criteria for King's highways is 20 years following construction of the pavement structures. The settlement criteria over the design life for embankments on compressible soils is 200 mm total with a differential settlement rate of 100:1.

10.1 Roadway Embankment on Top of MHT

It is anticipated that the roadway embankment height will be in the order of 3.5 m in height on top of the MHT. Preliminary settlement analyses indicates the following:

Table 11-1: Estimated Settlement for Roadway Embankment on MHT

Material	Total Settlement After Construction (mm)				
	1 month	3 months	6 months	1 year	21 years
Tailings	40	55	60	70	80
Organic Material	55	90	110	130	185
Native Silt and Till	5	20	45	50	50
Rock Fill	5	20	35	40	50
Estimated Total	**105**	**185**	**250**	**290**	**365**
Remaining Settlement from 21 Year Estimate	260	180	115	75	0
Remaining Settlement meet MTO Criteria	No	Yes	Yes	Yes	Yes

In order to meet the MTO settlement performance criteria for total settlements, the embankment would need to be constructed with a delay in the order of 3 months for final grading and paving. A small preload surcharge in the order of 10 kPa (approximately 0.5 m of fill) may also be

considered to expedite settlements. Deferential settlement performance should be assessed during detailed design.

10.2 Roadway Embankment Constructed Adjacent to the Perimeter of the MHT

Where the embankment crosses the perimeter of the MHT, it is expected that settlements will be most significant near the toe of the MHT perimeter where fill heights of up to 9 m are expected and the foundation soils are expected to include up to 2 m of loose tailings and organic material. For this assessment it has been assumed that 2 m of organic material exists (no tailings). Preliminary settlement analyses indicates the following.

Table 11-2: Estimated Settlement for Roadway Embankment at Perimeter of MHT

Material	Total Settlement After Construction (mm)					
	1 month	3 months	6 months	1 year	3 years	21 years
Organic Material	210	415	545	675	875	1030
Native Silt	30	95	190	210	210	210
Rock Fill	20	60	120	135	140	155
Total	**260**	**570**	**855**	**1020**	**1225**	**1395**
Remaining Settlement from 21 Year Estimate	1135	825	540	375	170	0
Remaining Settlement meet MTO Criteria	No	No	No	No	Yes	Yes

In order to meet the MTO settlement performance criteria for total settlements, the embankment would need to be constructed with a delay in the order of 3 years for final grading and paving. In order to expedite settlements, a preload will be required. A preliminary assessment of preloading options was assessed to expedite primary and secondary consolidation within the organic material. Based on this assessment, post construction settlements are expected to meet design, with either an 18 month preload with a 20 kPa (approximately 1 m of fill) surcharge, or a 12 month preload with a 40 kPa (approximately 2 m of fill) surcharge. Where surcharge fills are considered, stability analyses should be reassessed to consider the additional fill height. Deferential settlement performance should be assessed during detailed design.

10.3 Embankments Constructed Off of MHT

Where the embankments are constructed well beyond the toe of the perimeter of the MHT, it has been assumed that any existing tailings and/or organic material will be excavated to expose native silt or till. For embankments up to 9 m in height, settlements within the native (non-organic) subgrade and within the rock fill are expected to be in the order of 360 mm. In order to meet MTO settlement criteria for total maximum settlements, a delay in the order of 3 months for final grading and paving should be considered for embankments up to 9 m in height. No delay in final grading and paving is expected for embankments 4 m in height and less.

11 Scope of Detailed Investigation and Future Considerations

The following items should be considered for detailed foundation design of the proposed highway relocation over the MHT.

- Design Criteria:
  The design of the highway must consider standard design and performance criteria for the highway as well as design criteria for the MHT. Currently, the design criterial for the existing tailings facility is not well defined. The last design report ("Tailings Area Preliminary Investigations Report (Draft)", issued July 1996) does not clearly identify the design criteria for the facility and/or demonstrate the existing facility meets the suggested levels of stability. The hazard potential classification and subsequent design criteria for the existing tailings facility should also be reviewed in light of the proposed change in conditions (as the facility will now support a public road). Consultation with the appropriate regulatory authorities is recommended. The current state of stability of the existing tailings facility may also need to be reassessed and upgraded, if required.
- Seismic Considerations:
  As per the Canadian Highway Design Bridge Code, seismic analyses is not required for the design of the highway embankment. However, design requirements for the MHT will likely require seismic analysis which will be dependent on the design criteria established for the existing facility. Any future analyses for the tailings facility should consider any potential effects associated with the proposed new highway. Depending on the design criteria established, further investigations may be required to more accurately identify and address potential liquefaction and/or stability issues.

- Stability During Construction:
  The stability of the highway embankment and perimeter of the tailings facility during construction (filling operations) will be highly dependent on the porewater pressures response within the existing tailings and organic material subgrade soils. Further study consisting of laboratory and/or field studies (eg. CPTU testing, or instrumented test fills), may be considered to identify expected porewater pressure response and dissipation properties. Additional strength testing under both drained and undrained conditions may also be considered. Based on the results of new testing data, the stability analyses should be reassessed to determine requirements for staging including instrumentation and monitoring, if required.
- Phreatic Surface Along Perimeter of Tailings Facility:
  The groundwater conditions within the perimeter of the tailings facility can have a significant impact on global stability and potential for instability due to piping. Currently, there is little data to identify the current state or fluctuations of the groundwater level through the perimeter of the existing tailings facility. A monitoring program consisting of the installation of piezometers along the perimeter of the tailings facility and the associated toe berm should be considered.
- Tailings Beach:
  The existing tailings beach beyond the toe of the MHT can have a significant impact on stability. If the existing tailings beach has a relatively consistent thickness throughout the areas of concern, stability of the existing MHT perimeter is improved. However, should the tailings beach be removed at some future time, or be highly variable in terms of thickness and extent, it may not be reliable in terms of its contribution towards stability. Further investigation to study the variability, extent and condition of the tailings beach may be considered.
- Fills On Top of Tailings Facility:
  Further investigation should be completed to identify the extent, quality and conditions of the fills on top of the tailings facility along the proposed highway alignment.
- Tailings and Organic material:
  Additional Investigation and laboratory testing should be considered to address variability within the tailings and organic material subgrade in terms of strength and consolidation properties.

- Existing Structures:

  It is understood that a buried splitter dyke, abandoned decant structures and drainage pipes may exist within the MHT along the proposed highway alignment. Additional investigation should be completed to locate and inspect these structures to identify any potential future long term settlement issues exist.

- Future Structures:

  It is understood that a future waste rock pile is planned to be constructed on the MHTs. The impacts of this structure on the roadway embankments will need to be determined and design adjustments may be required.

- Filter Material:

  The design of the filter material will need to be determined.

12 Limitations

Conclusions and recommendations presented in this report are based on the information determined at the borehole locations. Subsurface and groundwater conditions between and beyond these locations may differ from those encountered. Conditions may become apparent during construction that were not detected and could not be anticipated at the time of the 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.

13 Closure

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

Yours truly,
For TBT ENGINEERING

Gordon Maki, P.Eng
Senior Project Engineer

Steven Seller, P.Eng
Project Engineer

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

APPENDIX A

Borehole Logs

TBT Engineering Consulting Group

RECORD OF Borehole No 15-BH-500

1 OF 1 **METRIC**

W O **N/A** PROJECT **Realignment of Hwy 11** GEOCRES No **N/A** ORIGINATED BY

DIST **61** HWY **11** LOCATION **UTM Sta. 12+764 o/s 1.8 Rt N5504265.729, E504143.806** B# **14-192-2** COMPILED BY **T.B.**

DATE **2015 February 3** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
330.6							
0.0	ORGANICS - black, very loose		1	AS			
			2	SS	1		
329.1							
1.5	SILT - trace sand, grey, loose to compact		3	SS	4		
			4	SS	8		
			5	SS	13		
			6	SS	18		
	- - - - -						
325.2	- numerous cobbles & boulders						
5.4	TILL - GRAVEL - Sandy, Silty, grey, compact to very dense		7	SS	13		
322.8			8	SS	100+		
7.8	End of Borehole @ 7.8 m. Auger Refusal.						

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED ✕ FIELD VANE
■ SPT (N) ★ UNDRAINED DIRECT SHEAR
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
20 40 60

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

685.4 — Water on surface.

457.4

0 3 (97)

49 25 (27)

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

TBT Engineering Consulting Group

RECORD OF Borehole No 15-BH-501

1 OF 1 **METRIC**

W O **N/A** PROJECT **Realignment of Hwy 11** GEOCRES No **N/A** ORIGINATED BY

DIST **61** HWY **11** LOCATION **UTM Sta. 12+867 o/s 3.6 Rt N5504242.045, E504247.767** B# **14-192-2** COMPILED BY **T.B.**

DATE **2015 February 3** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
331.1							
0.0	ORGANICS - black, some grey tailings to 75 mm		1	AS			331
	- - - - -						
	- brown		2	SS	1		330
	- - - - -						
329.0	- black		3	SS	1		
2.1	SILT - Gravelly, Sandy, grey, loose to compact		4	SS	10		329
			5	SS	9		328
							327
325.7			6	SS	6		
5.4	TILL - SAND - Gravelly, Silty, grey, compact to dense						326
			7	SS	23		325
							324
			8	SS	43		
322.5	- - - - -						323
8.6	numerous cobbles & boulders End of Borehole @ 8.6 m. Auger Refusal.		9	SS	100+		

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ■ SPT (N) ✕ FIELD VANE ★ UNDRAINED DIRECT SHEAR; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

279.4

422.4

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

Water @ surface.

30 24 (47)

32 38 (29)

GR SA SI CL

✕ 3 Numbers refer to Sensitivity

NP Non Plastic

○ 3% STRAIN AT FAILURE

TBT Engineering Consulting Group

RECORD OF Borehole No 15-BH-502 1 OF 1 METRIC

W O **N/A** PROJECT **Realignment of Hwy 11** GEOCRES No **N/A** ORIGINATED BY

DIST **61** HWY **11** LOCATION **UTM Sta. 12+969 o/s 4.7 Rt N5504206.698, E504337.855** B# **14-192-2** COMPILED BY **T.B.**

DATE **2015 February 4** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS
331.7						
0.0	TAILINGS - SILT - Sandy, some organics, grey, loose		1	AS		
330.5			2	SS	7	
1.2	ORGANICS - black, very loose		3	SS	2	
329.6						
2.1	SILT - Sandy, grey, loose to compact		4	SS	7	
			5	SS	13	
	- - - - -		6	SS	19	
326.3	- numerous cobbles & boulders					
5.4	TILL - SAND & GRAVEL - grey, very dense					
325.4			7	SS	100+	
6.3	End of Borehole @ 6.3 m. Auger Refusal.					

ELEVATION SCALE: 331, 330, 329, 328, 327, 326

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ✕ FIELD VANE ■ SPT (N) ★ UNDRAINED DIRECT SHEAR; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

325.7

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

Water @ surface.

GR SA SI CL

0 32 (68)

✕ 3 Numbers refer to Sensitivity

NP Non Plastic

○ 3% STRAIN AT FAILURE

TBT Engineering Consulting Group

RECORD OF Borehole No 15-BH-503 1 OF 1 METRIC

W O **N/A** PROJECT **Realignment of Hwy 11** GEOCRES No **N/A** ORIGINATED BY **P.P.**

DIST **61** HWY **11** LOCATION **UTM Sta. 13+041 o/s 4.7 Rt N5504175.869, E504463.445** B# **14-192-2** COMPILED BY **T.B.**

DATE **2014 December 16** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
337.5							
0.0 / 336.1	TOPSOIL - SAND - brown		1	AS			
			2	SS	4		
1.4 / 335.3	FILL - SILT - trace sand, grey, very loose		3	SS	3		
2.2	TAILINGS - SILT - trace to some sand, grey, very loose to loose		4	SS	6		
			5	SS	4		
			6	SS	3		
			7	SS	5		
330.0 / 329.7	ORGANICS		8	SS	31		
7.8 / 327.3	SILT - grey, compact to dense		9	SS	12		
10.2 / 324.9	TILL - SAND - Silty, Gravelly, occasional cobbles, grey, dense		10	SS	35		
			11	SS	100+		
12.6	End of Borehole @ 12.6 m.						

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED ✕ FIELD VANE
■ SPT (N) ★ UNDRAINED DIRECT SHEAR
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
20 40 60

UNIT WEIGHT γ kN/m³

280

REMARKS & GRAIN SIZE DISTRIBUTION (%)	GR	SA	SI	CL
	0	1	(99)	
	0	0	51	48
	0	13	(87)	
	21	54	(26)	

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

ON_MTO_BH_UTM 14-192 FDTN GERALTON.GPJ ON_MOT.GDT 15/3/30

TBT Engineering Consulting Group

RECORD OF Borehole No 15-BH-504 1 OF 1 METRIC

W O **N/A** PROJECT **Realignment of Hwy 11** GEOCRES No **N/A** ORIGINATED BY **P.P.**

DIST **61** HWY **11** LOCATION **UTM Sta. 13+176 o/s 1.3 Rt N5504120.356, E504525.853** B# **14-192-2** COMPILED BY **T.B.**

DATE **2014 December 17** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ■ SPT (N), ✕ FIELD VANE, ★ UNDRAINED DIRECT SHEAR)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
337.6											
0.0	TOPSOIL - SAND - brown		1	AS							Frost to 150 mm.
336.2	- - - - - - trace tailings		2	SS	3		337				
1.4	TAILINGS - SILT - trace sand, grey, very loose to loose		3	SS	3		336				
			4	SS	2		335				0 8 72 20
			5	SS	1						0 5 76 19
							334				
			6	SS	3		333				
							332				
			7	SS	4		331				
	- - - - - - SILT & SAND		8	SS	5		330				0 36 (64)
328.3											
9.3	ORGANICS - brown		9	SS	13		329		289.3		
327.1							328				
10.5	SILT - trace sand, loose to compact		10	SS	28		327				0 8 (93)
							326				
			11	SS	9		325				
324.7											
12.9	TILL - SAND - Silty, Gravelly, grey		12	SS	46		324				
323.0			13	SS	100+			>>			
14.6	End of Borehole @ 14.6 m.										

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

TBT Engineering Consulting Group

RECORD OF Borehole No 15-BH-505

1 OF 1 **METRIC**

W O **N/A** PROJECT **Realignment of Hwy 11** GEOCRES No **N/A** ORIGINATED BY **T.P.**

DIST **61** HWY **11** LOCATION **UTM Sta. 13+323 o/s 0.6 Rt N5504056.903, E504658.373** B# **14-192-2** COMPILED BY **T.B.**

DATE **2015 January 14** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
338.5					
0.0	FILL - GRAVEL - Sandy, some silt, occasional cobbles, brown, compact to very dense	1	AS	11	
		2	AS	34	
		3	AS	32	53 29 (18)
	- - - - - - - grey	4	AS	28	
		5	AS	100+	On cobbles
333.0					
5.5	TAILINGS - SILT & SAND - trace gravel, grey, loose to compact	6	AS	12	4 38 35 23
		7	AS	8	
	- - - - - - burgundy	8	AS	5	
328.4					
10.1	ORGANICS - black	9	AS	15	
327.0					
11.5	SILT - trace sand, loose to compact	10	AS	18	
		11	AS	5	0 3 (97)
323.5		12	AS	16	
15.0	End of Borehole @ 15.0 m.				

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED ✕ FIELD VANE
■ SPT (N) ★ UNDRAINED DIRECT SHEAR
20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) 20 40 60

UNIT WEIGHT γ kN/m³

GROUND WATER CONDITIONS

ELEVATION SCALE 338 337 336 335 334 333 332 331 330 329 328 327 326 325 324

>> 306.2

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

ON_MTO_BH_UTM 14-192 FDTN GERALTON.GPJ ON_MOT.GDT 15/3/30

TBT Engineering Consulting Group

RECORD OF Borehole No 15-BH-506

1 OF 1 **METRIC**

W O **N/A** PROJECT **Realignment of Hwy 11** GEOCRES No **N/A** ORIGINATED BY

DIST **61** HWY **11** LOCATION **UTM Sta. 13+454 o/s 0.1 Rt N5504000.158, E504786.767** BOREHOLE# **14-192-2** COMPILED BY **T.B.**

DATE **2015 February 4** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
331.7							
0.0	TAILINGS - SILT, trace sand, grey, some organics, brown, very loose to loose		1	AS			
			2	SS	6		
	- - - - -						
	- burgundy		3	SS	4		
			4	SS	2		
328.8							
3.0	ORGANICS - black		5	SS	2		
327.6							
4.1	SILT - trace to some sand, grey, loose to very dense		6	SS	3		
			7	SS	10		
	- - - - -						
	- numerous cobbles & boulders		8	SS	4		
			9	SS	42		
321.7			10	SS	100+		
10.0	End of Borehole @ 10.0 m. Auger Refusal.						

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED ✕ FIELD VANE
■ SPT (N) ★ UNDRAINED DIRECT SHEAR

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (20 40 60)

119.4

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)	GR	SA	SI	CL
	0	5		(95)
	0	11		(89)
	0	4		(95)

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

ON_MTO_BH_UTM 14-192 FDTN GERALTON.GPJ ON_MOT.GDT 15/3/30

TBT Engineering Consulting Group

RECORD OF Borehole No 15-BH-507

1 OF 1 **METRIC**

W O **N/A** PROJECT **Realignment of Hwy 11** GEOCRES No **N/A** ORIGINATED BY **T.P.**

DIST **61** HWY **11** LOCATION **UTM Sta. 13+603 o/s 6.6 Rt N5503929.485, E504967.652** B# **14-192-2** COMPILED BY **T.B.**

DATE **2015 January 17** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ■ SPT (N), ✕ FIELD VANE, ★ UNDRAINED DIRECT SHEAR)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
336.8											
0.0	FILL - SILT - Sandy, brown, loose		1	SS	7		336				0 25 (75)
335.5											
1.3	TAILINGS - SILT - trace sand, grey, very loose		2	SS	2		335				
			3	SS	1						0 3 66 31
							334				
			4	SS	1						0 4 (97)
							333				
			5	SS	1		332				
			6	SS	4		331				
329.4							330				
329.4	ORGANICS - black									119	
7.7	SILT - trace sand, grey, loose to compact		7	SS	15		329				
			8	SS	13		328				0 4 (96)
							327				
			9	SS	9						
							326				
			10	SS	14		325				
323.9											
12.9	TILL - SAND & GRAVEL						324				
323.1			11	SS	100+			>>			
13.7	End of Borehole @ 13.7 m. Auger Refusal.										

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

TBT Engineering Consulting Group

RECORD OF Borehole No 15-BH-508 1 OF 1 METRIC

W O **N/A** PROJECT **Realignment of Hwy 11** GEOCRES No **N/A** ORIGINATED BY **P.P.**

DIST **61** HWY **11** LOCATION **UTM Sta. 13+823 o/s 5.6 Lt N5503847.034, E505112.597** BOREHOLE# **14-192-2** COMPILED BY **T.B.**

DATE **2014 December 21** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ■ SPT (N), ✕ FIELD VANE, ★ UNDRAINED DIRECT SHEAR)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
336.4											
0.0	TOPSOIL - brown		1	AS			336				Frost to 300 mm.
			2	SS	7						
334.6							335				
1.8	TAILINGS - SILT, trace sand to Sandy, very loose		3	SS	9						
			4	SS	1		334				
			5	SS	1		333				0 6 (94)
	- - - - -										
	- Gravelly, compact		6	SS	25		332				32 22 (45)
330.9											
5.5	TILL - SAND - trace silt, trace to some gravel, occasional cobbles, very dense		7	SS	100+		331				12 81 (8) On cobbles
			8	SS	100+		330	>>			4 92 (4)
327.4							329	>>			
9.0	End of Borehole @ 9.0 m.		9	SS	100+		328	>>			

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

ON_MTO_BH_UTM 14-192 FDTN GERALTON.GPJ ON_MOT.GDT 15/3/30

TBT Engineering Consulting Group

RECORD OF Borehole No 15-BH-509 1 OF 1 METRIC

W O **N/A** PROJECT **Realignment of Hwy 11** GEOCRES No **N/A** ORIGINATED BY **T.P.**

DIST **61** HWY **11** LOCATION **UTM Sta. 14+017 o/s 21.7 Rt N5503772.957, E505295.367** FILE# **14-192-2** COMPILED BY **T.B.**

DATE **2015 January 13** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS
336.3						
0.0	TAILINGS - SILT, trace to some sand, grey, very loose to compact		1	SS	11	
			2	SS	2	
			3	SS	1	
			4	SS	2	
			5	SS	2	
330.6						
5.7	SILT - some gravel, trace sand, grey, compact		6	SS	17	
			7	SS	13	
			8	SS	11	
326.5						
9.8	TILL - SAND & GRAVEL - some silt, grey, dense		9	SS	34	
			10	SS	22	
322.8			11	SS	100+	
13.5	End of Borehole @ 13.5 m. Auger Refusal.					

ELEVATION SCALE: 336, 335, 334, 333, 332, 331, 330, 329, 328, 327, 326, 325, 324, 323

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ■ SPT (N) ✕ FIELD VANE ★ UNDRAINED DIRECT SHEAR; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)	GR	SA	SI	CL
	0	6	(94)	
	0	9	(91)	
	0	16	69	15
	0	7	(93)	
	36	49	(15)	

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

ON_MTO_BH_UTM 14-192 FDTN GERALTON.GPJ ON_MOT.GDT 15/3/30

TBT Engineering Consulting Group

RECORD OF Borehole No 15-BH-510

1 OF 1 **METRIC**

W O **N/A** PROJECT **Realignment of Hwy 11** GEOCRES No **N/A** ORIGINATED BY

DIST **61** HWY **11** LOCATION **UTM Sta. 14+098 o/s 13.5 Rt N5503774.878, E505378.041** FILE# **14-192-2** COMPILED BY **T.B.**

DATE **2015 February 5** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS
331.1						
0.0 / 330.4	FILL - SILT - Sandy, grey		1	SS		
0.7 / 329.6	ORGANICS - black		2	SS	5	
1.5	TILL - SAND & GRAVEL - grey, compact to very dense		3	SS	10	
	- - - - -		4	SS	18	
327.9	- GRAVEL & COBBLES - Silty		5	SS	100+	
3.2	End of Borehole @ 3.2 m. Auger Refusal.					

ELEVATION SCALE: 331, 330, 329, 328

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: 20 40 60 80 100
- ○ UNCONFINED
- ■ SPT (N)
- ✕ FIELD VANE
- ★ UNDRAINED DIRECT SHEAR

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

463.9

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)	GR	SA	SI	CL
	0	29	(72)	

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

ON_MTO_BH_UTM 14-192 FDTN GERALTON.GPJ ON_MOT.GDT 15/3/30

TBT Engineering Consulting Group

RECORD OF Borehole No 15-BH-511 1 OF 1 METRIC

W O **N/A** PROJECT **Realignment of Hwy 11** GEOCRES No **N/A** ORIGINATED BY **T.P.**

DIST **61** HWY **11** LOCATION **UTM Sta. 14+139 o/s 16.7 Rt N5503771.72, E505420.353** B# **14-192-2** COMPILED BY **T.B.**

DATE **2015 January 19** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **S.S.**

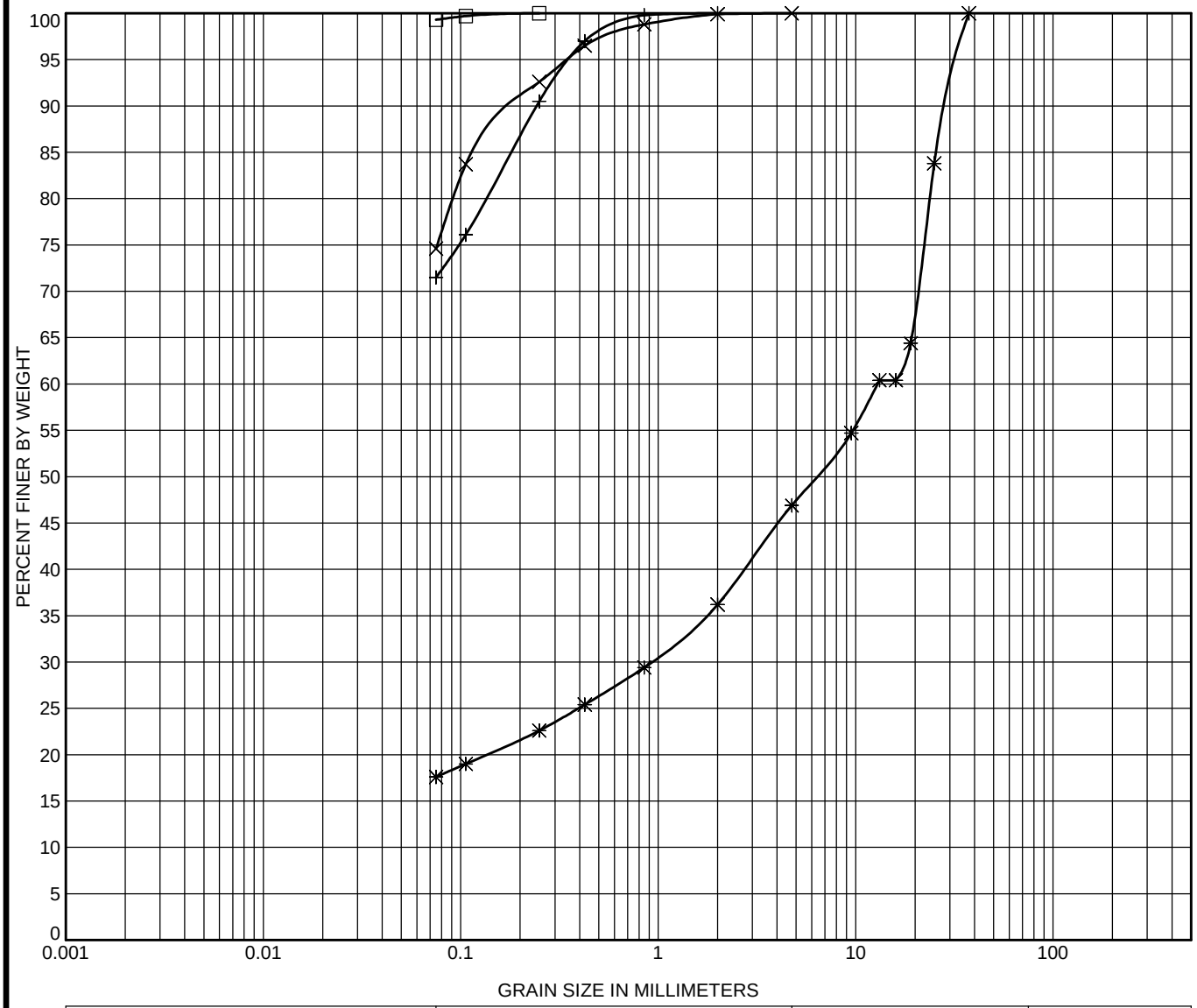
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ■ SPT (N), ✕ FIELD VANE, ★ UNDRAINED DIRECT SHEAR)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
332.6											
0.0	FILL - SAND - very loose to compact - - - - - - grey		1	AS			332				
			2	SS	13						
330.4	- - - - - - Silty, some organics, black		3	SS	2		331				
2.2	TILL - SAND - Gravelly, trace silt, grey, compact to dense		4	SS	27		330				23 74 (3)
			5	SS	13		329				
			6	SS	32		328				
326.7			7	SS	100+		327	>>			
5.9	End of Borehole @ 5.9 m. Auger Refusal.										

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

ON_MTO_BH_UTM 14-192 FDTN GERALTON.GPJ ON_MOT.GDT 15/3/30

APPENDIX B

Laboratory Test Data



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
FILL

	Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□	**15-BH-503**	**1.50**	**0.25**				**0.0**	**0.7**	**99.3**	
✳	**15-BH-505**	**2.30**	**37.5**	**12.899**	**0.917**		**53.1**	**29.3**	**17.6**	
×	**15-BH-507**	**0.60**	**4.75**				**0.0**	**25.4**	**74.6**	
+	**15-BH-510**	**0.30**	**2**				**0.0**	**28.5**	**71.5**	

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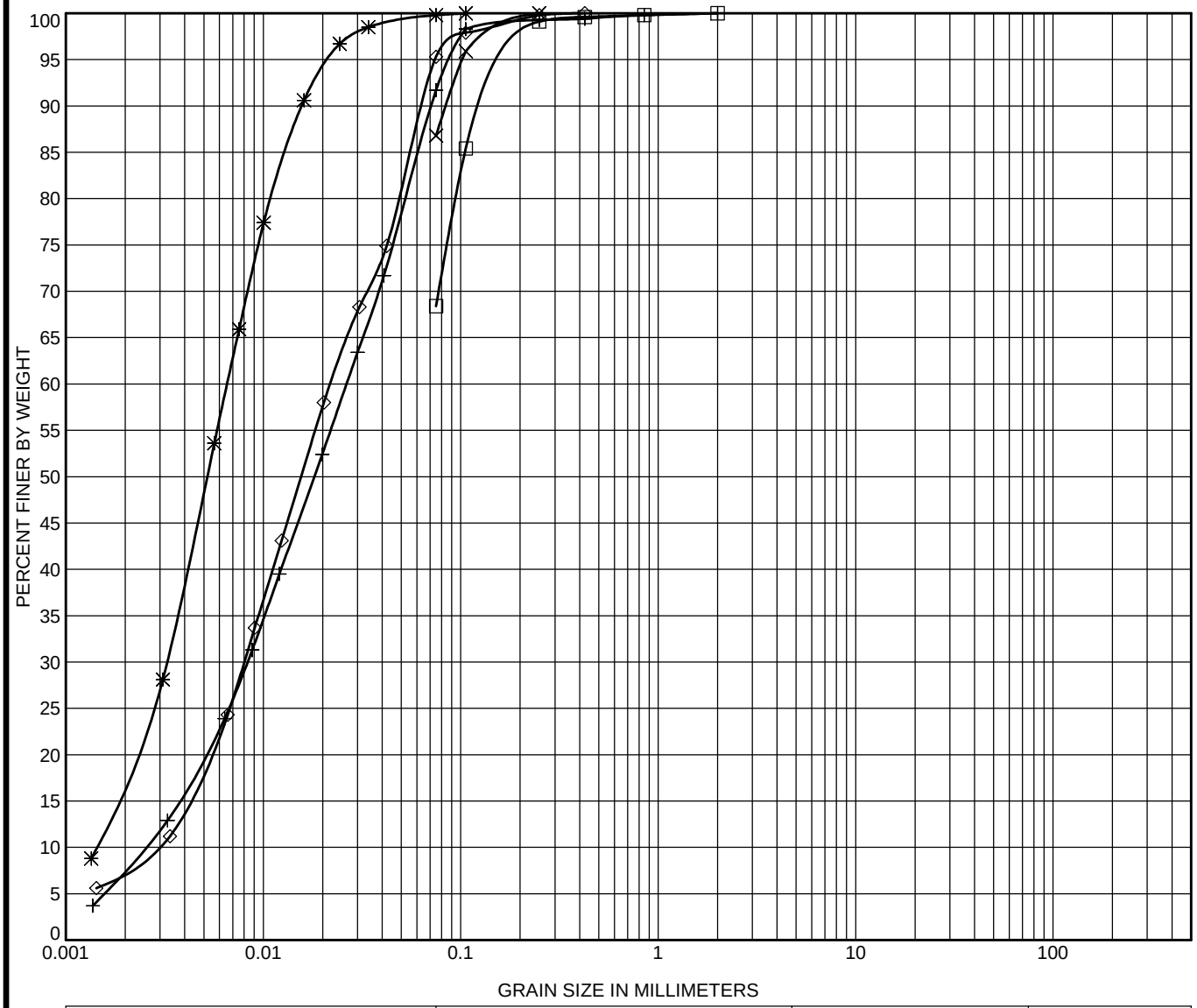
FX: 807-624-5161
Email: tbte@tbte.ca
Web: www.tbte.ca

GRAIN SIZE DISTRIBUTION

Project: Realignment of Hwy 11

W P: N/A

DIST: 61 HWY: 11



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
TAILINGS

	Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□	**15-BH-502**	**0.75**	**2**				**0.0**	**31.6**	**68.4**	
✳	**15-BH-503**	**3.00**	**0.106**	**0.007**	**0.003**	**0.001**	**0.0**	**0.2**	**99.8**	
×	**15-BH-503**	**4.60**	**0.25**				**0.0**	**13.2**	**86.8**	
+	**15-BH-504**	**2.30**	**2**	**0.026**	**0.008**	**0.002**	**0.0**	**8.3**	**91.7**	
◇	**15-BH-504**	**3.00**	**0.425**	**0.022**	**0.008**	**0.003**	**0.0**	**4.7**	**95.3**	

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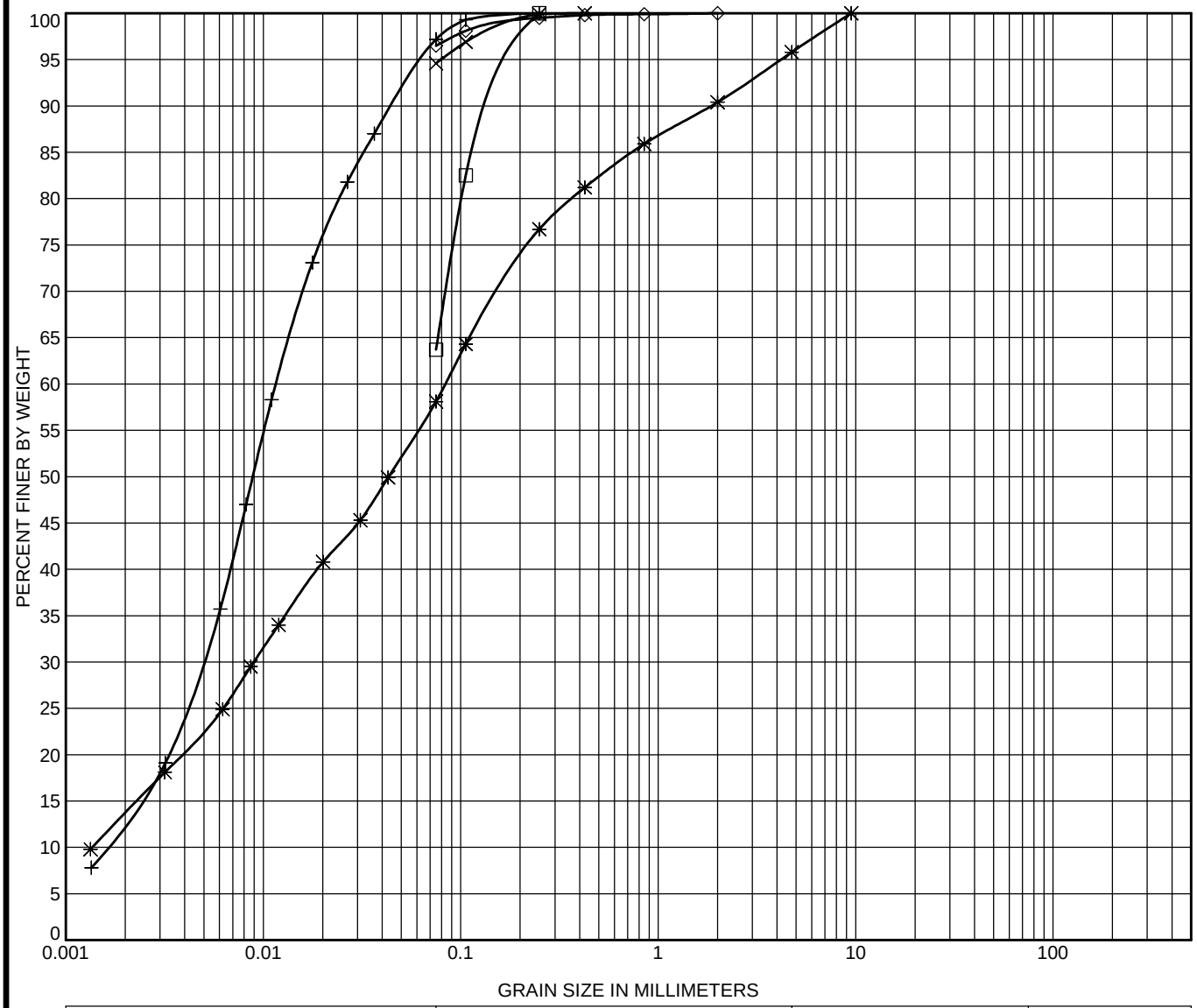
GRAIN SIZE DISTRIBUTION

Project: Realignment of Hwy 11

W P: N/A

DIST: 61 HWY: 11



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
TAILINGS

	Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□	**15-BH-504**	**7.50**	**0.25**				**0.0**	**36.3**	**63.7**	
✳	**15-BH-505**	**6.00**	**9.5**	**0.083**	**0.009**	**0.001**	**4.2**	**37.7**	**58.1**	
×	**15-BH-506**	**1.50**	**0.425**				**0.0**	**5.4**	**94.6**	
+	**15-BH-507**	**2.30**	**0.25**	**0.012**	**0.005**	**0.002**	**0.0**	**2.8**	**97.2**	
◇	**15-BH-507**	**3.00**	**2**				**0.0**	**3.5**	**96.5**	

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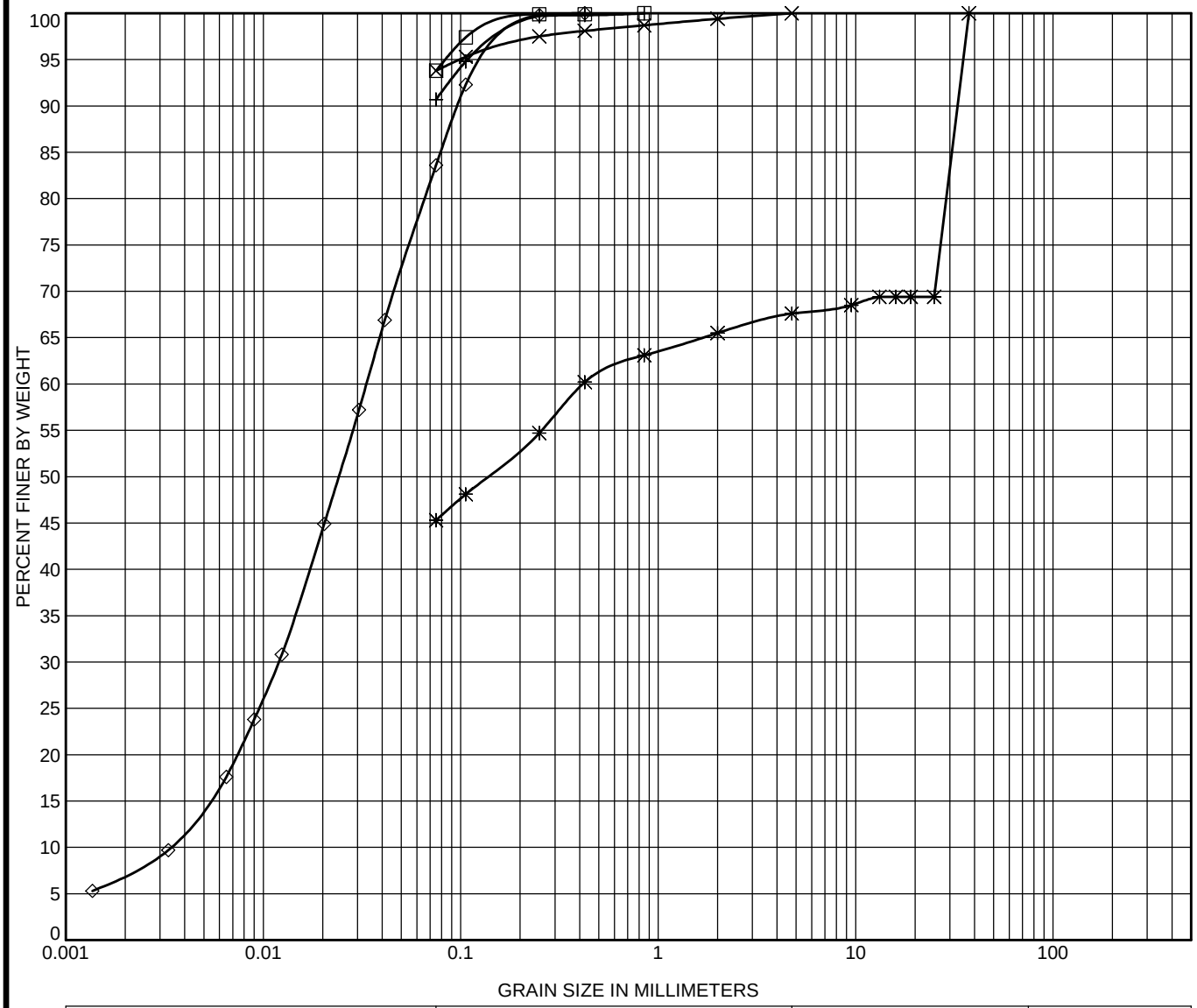
GRAIN SIZE DISTRIBUTION

Project: Realignment of Hwy 11

W P: N/A

DIST: 61 HWY: 11



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
TAILINGS

	Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□	**15-BH-508**	**3.00**	**0.85**				**0.0**	**6.2**	**93.8**	
✳	**15-BH-508**	**4.50**	**37.5**	**0.417**			**32.4**	**22.3**	**45.3**	
×	**15-BH-509**	**1.50**	**4.75**				**0.0**	**6.2**	**93.8**	
+	**15-BH-509**	**3.00**	**0.85**				**0.0**	**9.3**	**90.7**	
◇	**15-BH-509**	**4.50**	**0.425**	**0.033**	**0.012**	**0.003**	**0.0**	**16.4**	**83.6**	

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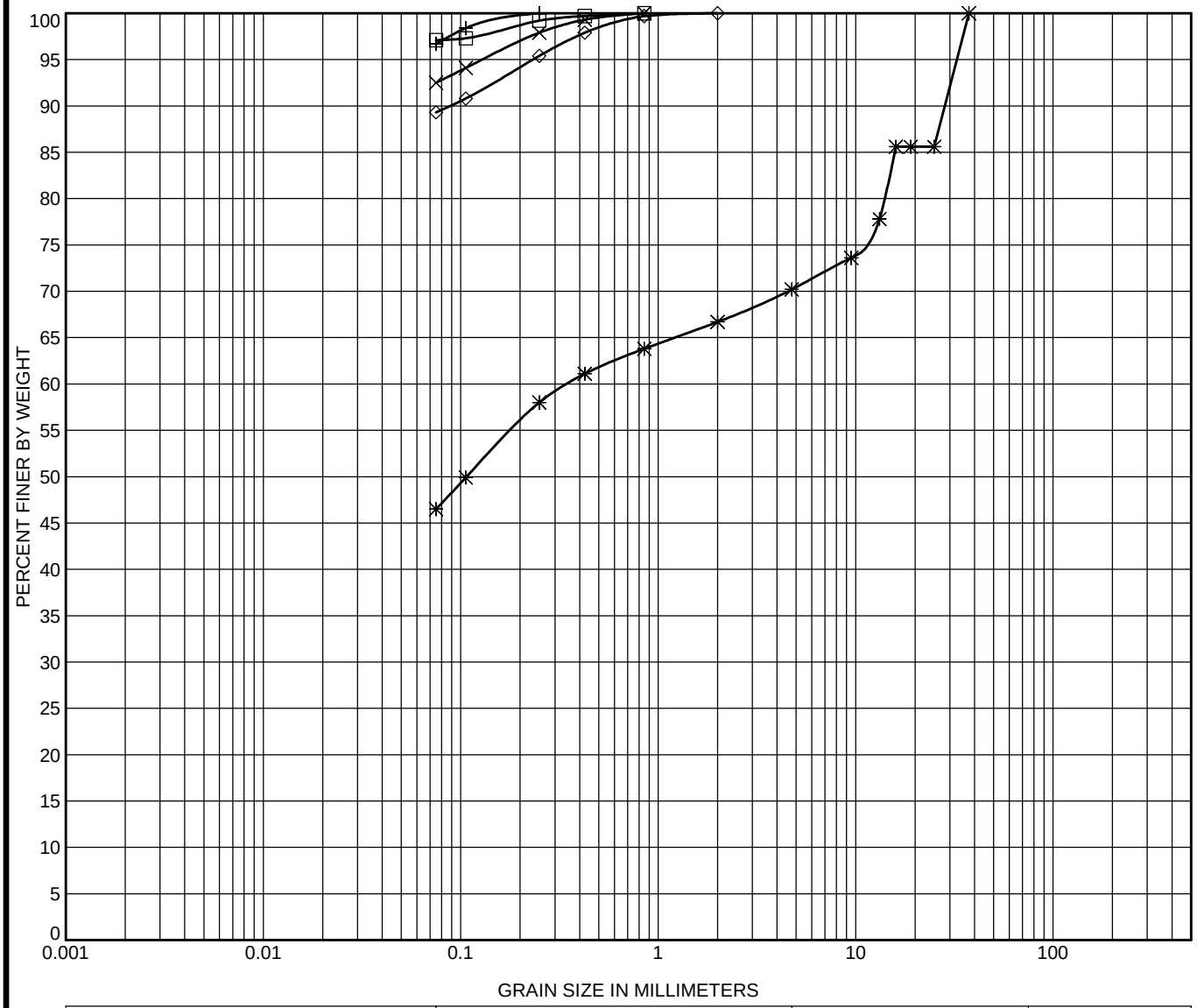
GRAIN SIZE DISTRIBUTION

Project: Realignment of Hwy 11

W P: N/A

DIST: 61 HWY: 11



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
SILT

	Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□	**15-BH-500**	**3.00**	**0.85**				**0.0**	**2.9**	**97.1**	
✳	**15-BH-501**	**4.60**	**37.5**	**0.352**			**29.8**	**23.7**	**46.5**	
×	**15-BH-504**	**10.50**	**0.85**				**0.0**	**7.5**	**92.5**	
+	**15-BH-505**	**13.50**	**0.25**				**0.0**	**3.3**	**96.7**	
◇	**15-BH-506**	**6.10**	**2**				**0.0**	**10.7**	**89.3**	

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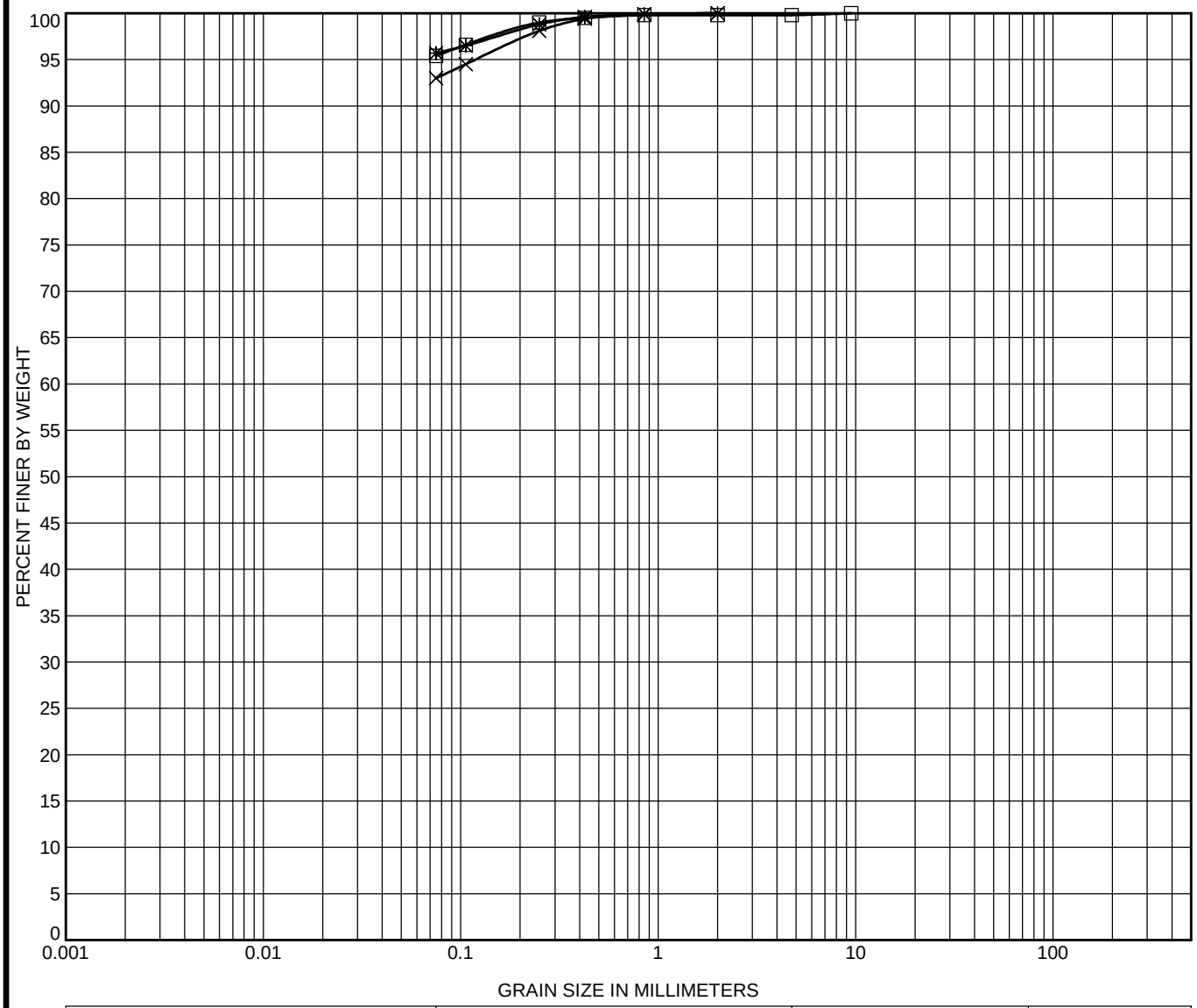
GRAIN SIZE DISTRIBUTION

Project: Realignment of Hwy 11

W P: N/A

DIST: 61 HWY: 11



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
SILT

	Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□	**15-BH-506**	**9.10**	**9.5**				**0.2**	**4.4**	**95.4**	
✳	**15-BH-507**	**9.00**	**2**				**0.0**	**4.3**	**95.7**	
×	**15-BH-509**	**7.50**	**2**				**0.0**	**7.0**	**93.0**	

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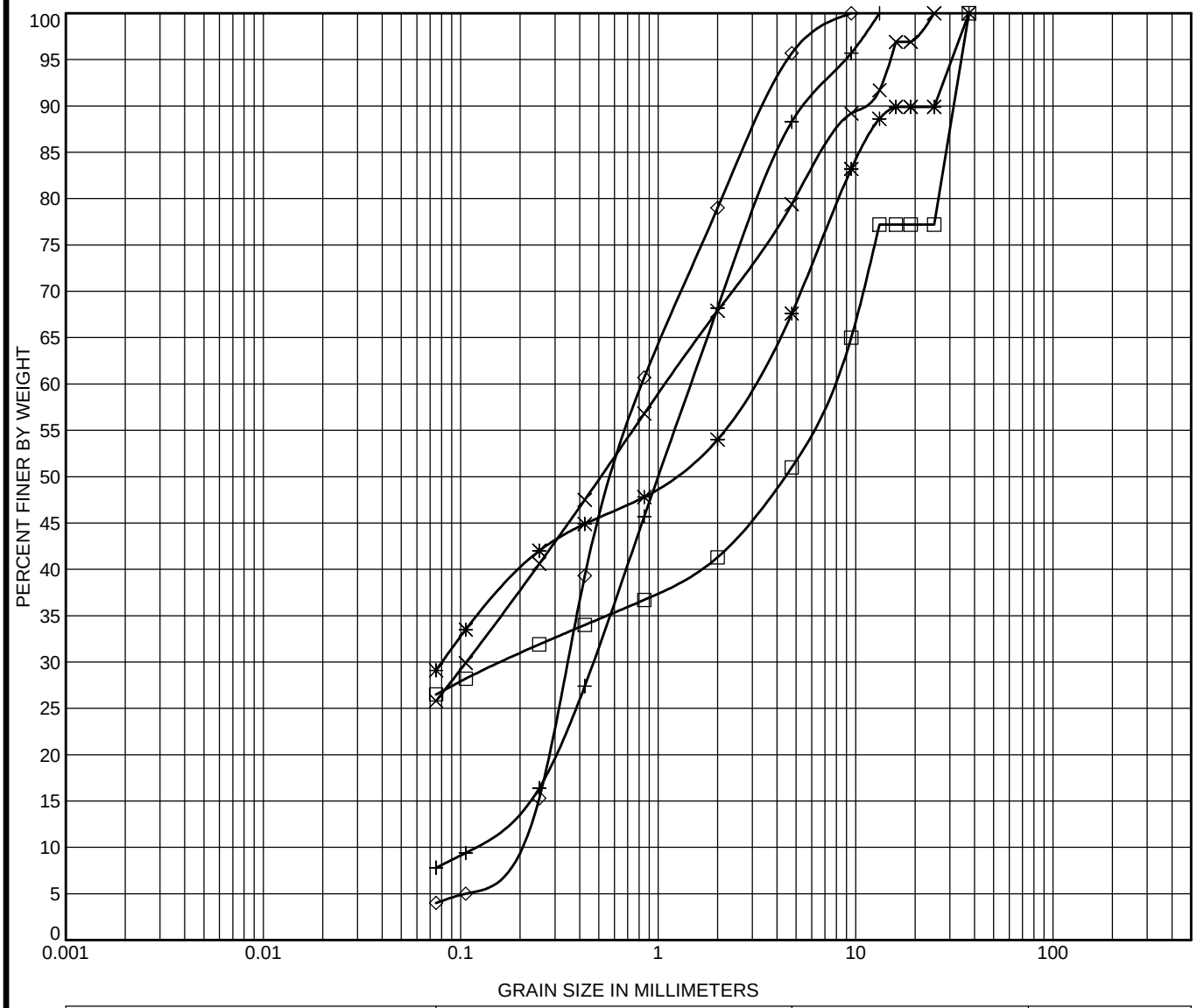
GRAIN SIZE DISTRIBUTION

Project: Realignment of Hwy 11

W P: N/A

DIST: 61 HWY: 11



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
TILL

	Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□	**15-BH-500**	**6.00**	**37.5**	**7.417**	**0.161**		**49.0**	**24.5**	**26.5**	
✳	**15-BH-501**	**6.10**	**37.5**	**2.929**	**0.08**		**32.4**	**38.5**	**29.1**	
×	**15-BH-503**	**10.50**	**25**	**1.088**	**0.107**		**20.6**	**53.6**	**25.8**	
+	**15-BH-508**	**6.00**	**13.2**	**1.464**	**0.469**	**0.114**	**11.7**	**80.5**	**7.8**	
◇	**15-BH-508**	**7.50**	**9.5**	**0.831**	**0.346**	**0.161**	**4.3**	**91.7**	**4.0**	

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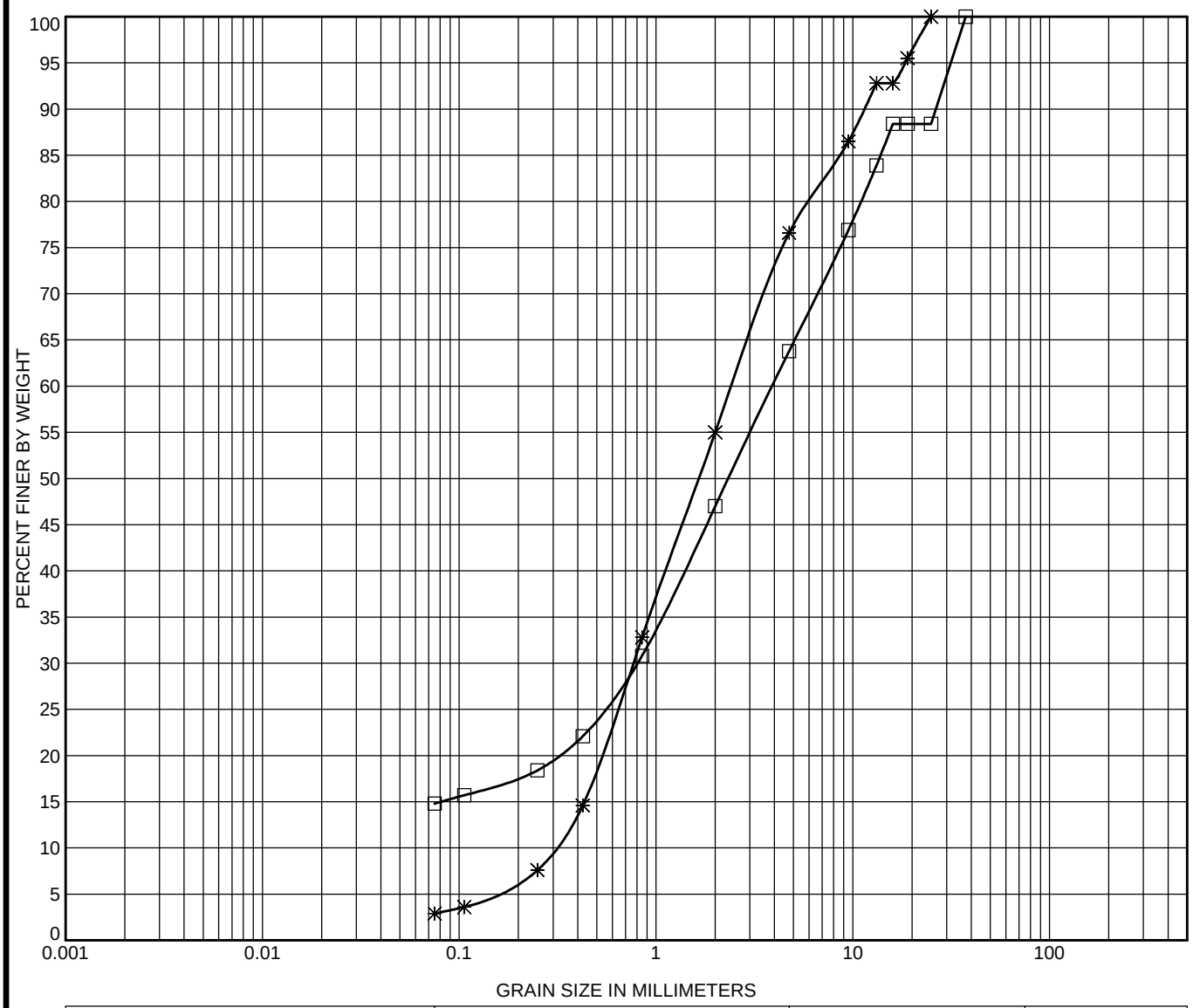
GRAIN SIZE DISTRIBUTION

Project: Realignment of Hwy 11

W P: N/A

DIST: 61 HWY: 11



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
TILL

	Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□	**15-BH-509**	**10.50**	**37.5**	**3.906**	**0.798**		**36.2**	**49.0**	**14.8**	
✳	**15-BH-511**	**3.00**	**25**	**2.443**	**0.764**	**0.3**	**23.4**	**73.7**	**2.9**	

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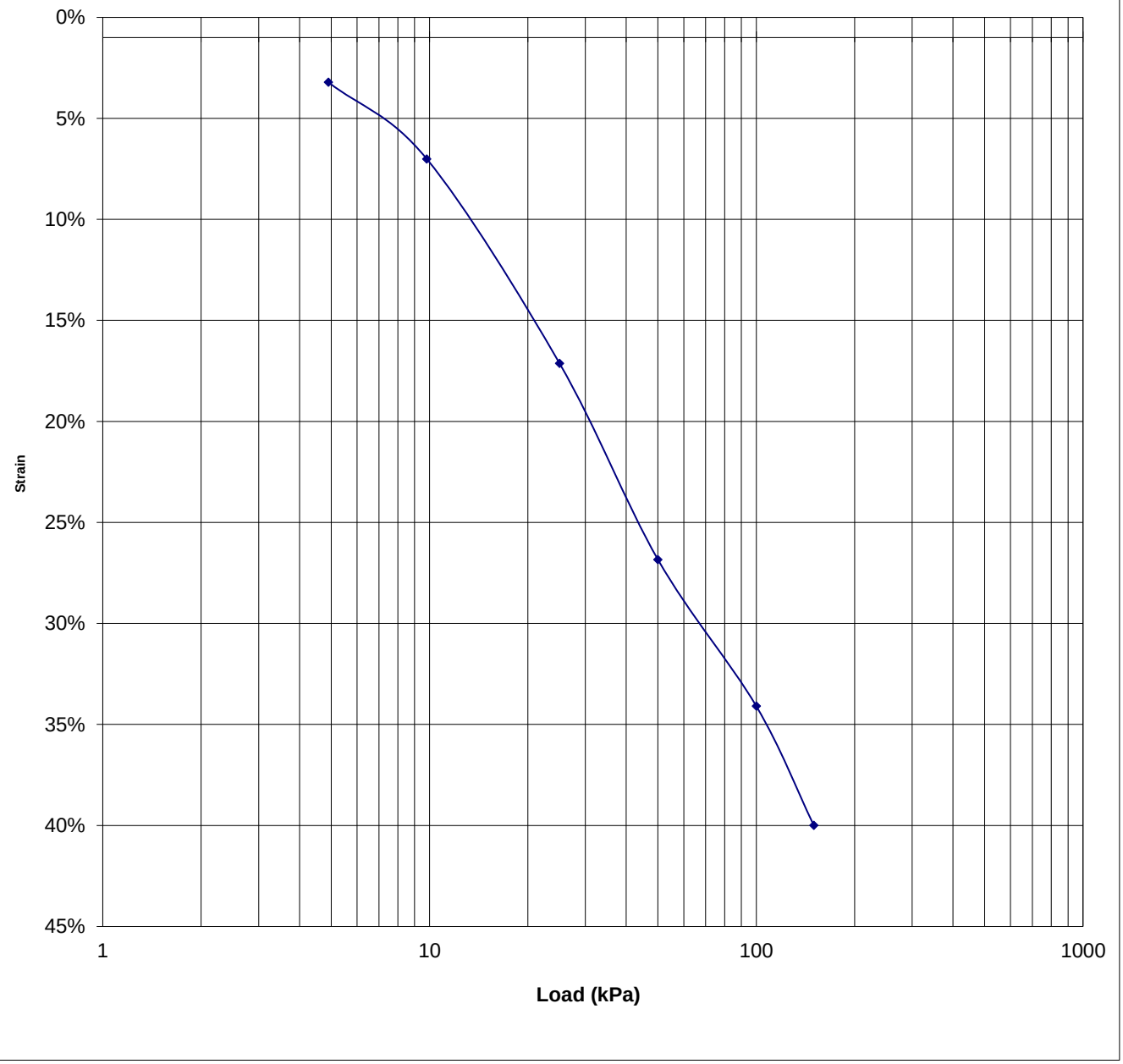
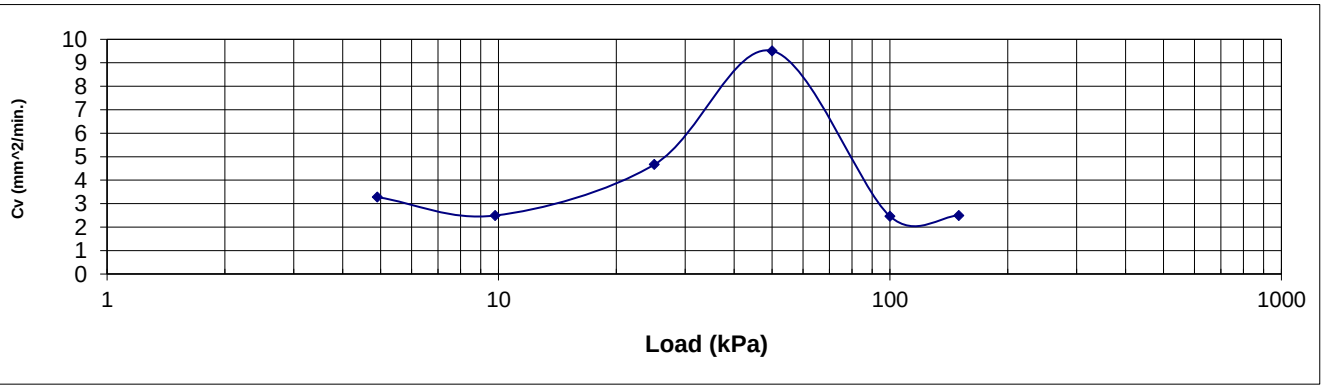
GRAIN SIZE DISTRIBUTION

Project: Realignment of Hwy 11

W P: N/A

DIST: 61 HWY: 11

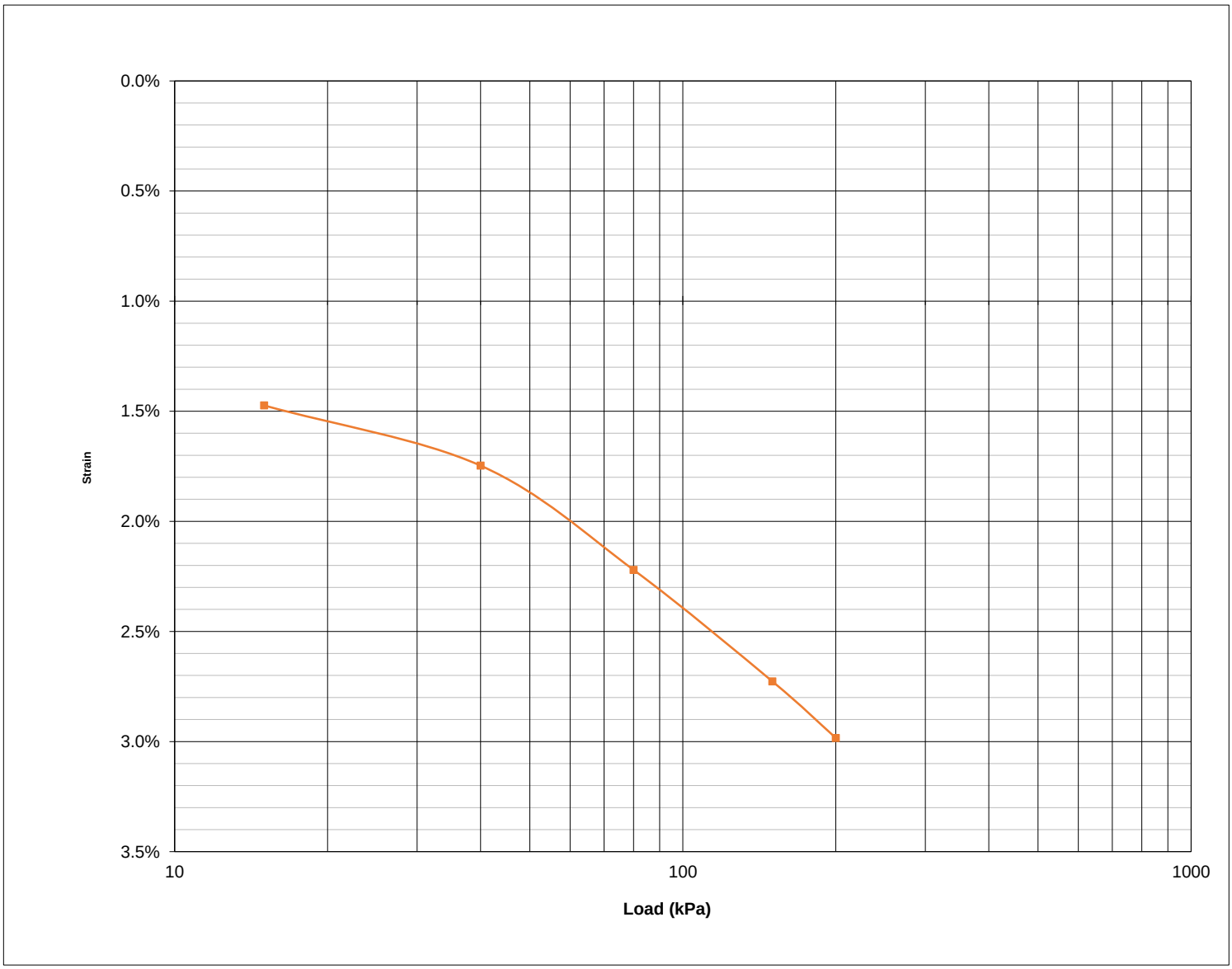


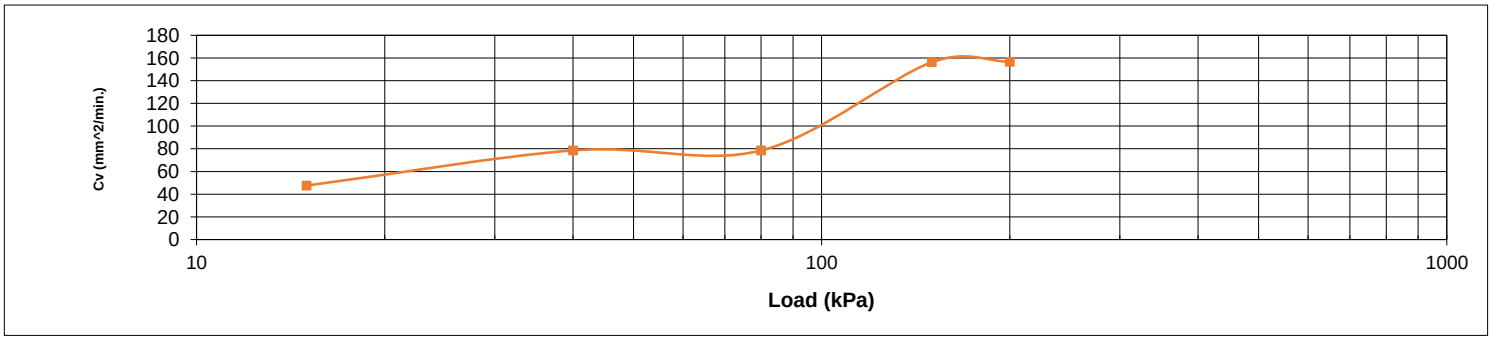


CONSOLIDATION TEST
Peat

Project No.: 14-192-2

Borehole 505 Depth: 10.5 Lab No.: 23044



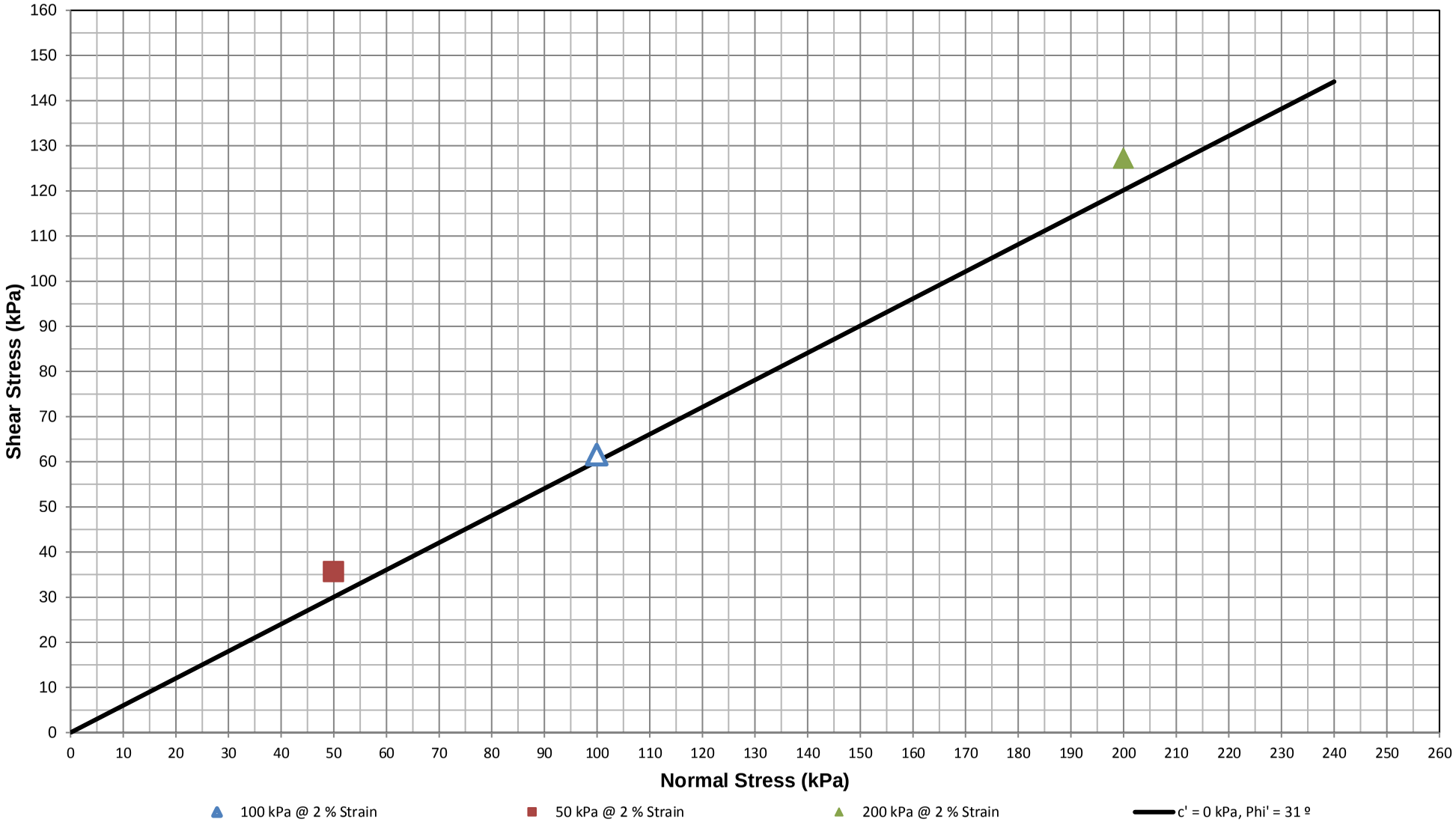


CONSOLIDATION TEST
Tailings

Borehole 504 Depth: 3 Lab No.:

Project No.: 14-192-2

Drained Direct Shear Test - Tailings
BH 504, Depth 3.0 m



APPENDIX C

Borehole Locations, and Soil Strata Drawing

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

REALIGNMENT OF HIGHWAY 11
FOUNDATION INVESTIGATION

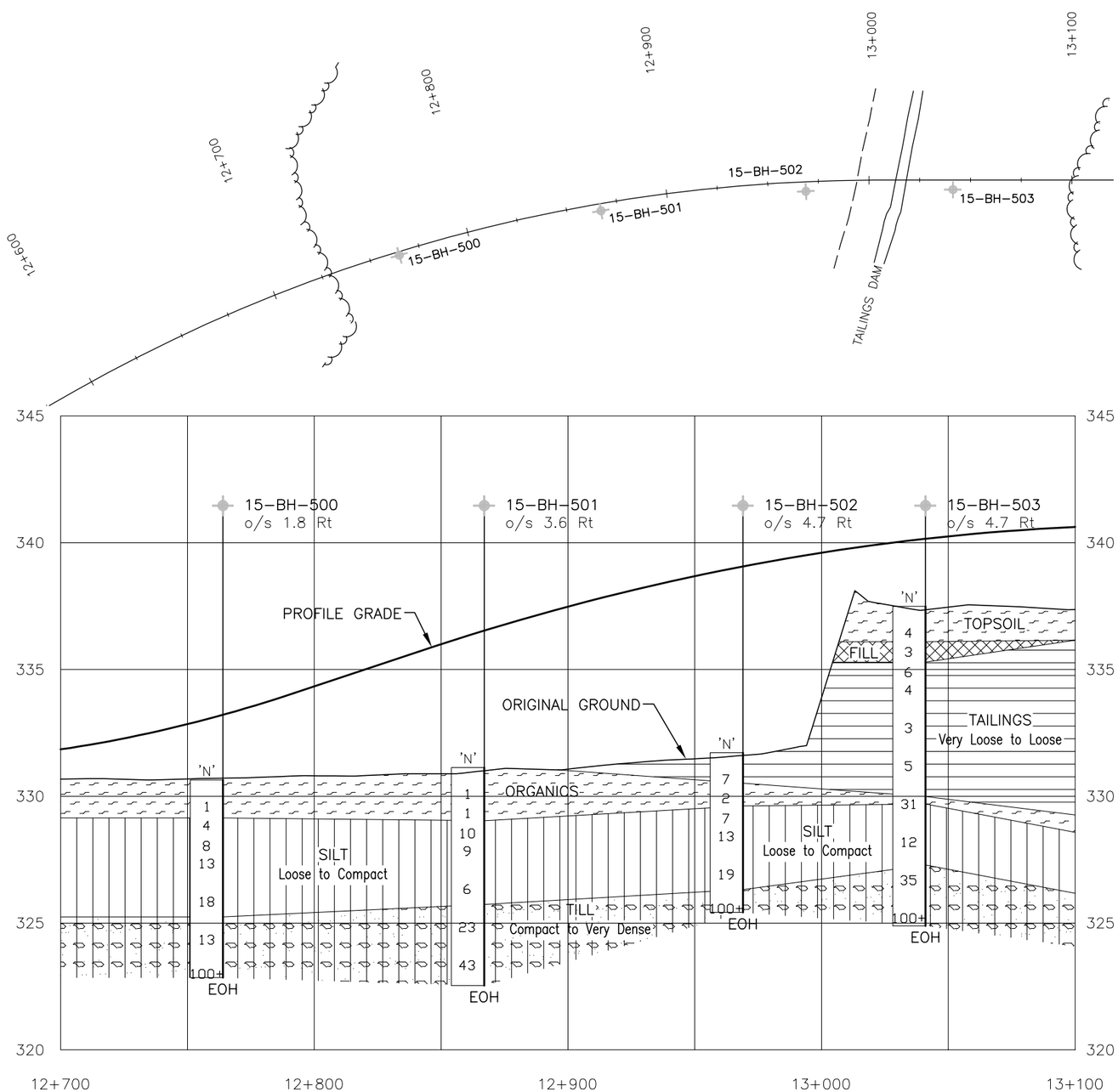
BOREHOLE LOCATIONS AND SOIL STRATA

PREMIER Gold Mines Limited

TBT ENGINEERING CONSULTING GROUP

LICENSED PROFESSIONAL ENGINEER
J. R. HURLEY
100123503
Mar 30/15
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
S.W.S. SELLER
100043505
Mar 30/15
PROVINCE OF ONTARIO

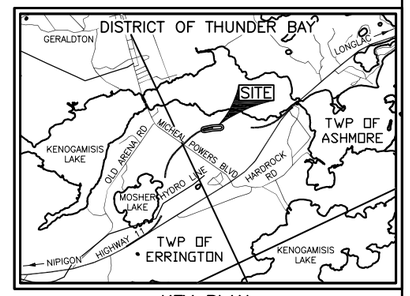


PROFILE

SCALE

HOR 50 0 100 m

VERT 5 0 10 m



KEY PLAN

2.0 km 0 2.0 km

SOIL STRATA SYMBOLS

- TOPSOIL/ ORGANICS
- SILT
- FILL
- TILL – NON–COHESIVE
- TAILINGS

LEGEND

- Borehole
- 'N' Std Pen Test (Blows/0.3m)
- EOH End of Hole

No	ELEVATION	CO–ORDINATES (UTM) NORTH	EAST
15-BH-500	330.645	16 5 504 266	504 144
15-BH-501	331.137	16 5 504 242	504 243
15-BH-502	331.720	16 5 504 207	504 338
15-BH-503	337.491	16 5 504 176	504 403

–NOTE–

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

REVISIONS							
			DESCRIPTION				
DESIGN	SS	CHK	WH	CODE	XXXXX–XX	LOAD XX–XXX–XXX	DATE 2015/03/24
DRAWN	TB	CHK	WH	SITE	N/A		DWG 2

MINISTRY OF TRANSPORTATION, ONTARIO PR–D–707 88–05

Mar 30 , 2015 , 1:52pm Login name: tblunden
Drawing Name: Y:\Projects\2014\14-192-2 Premier Gold – PDR\14-192-2 Prelim FNDN\TBT AutoCAD\Hwy 11 Realignment FNDN.dwg

METRIC

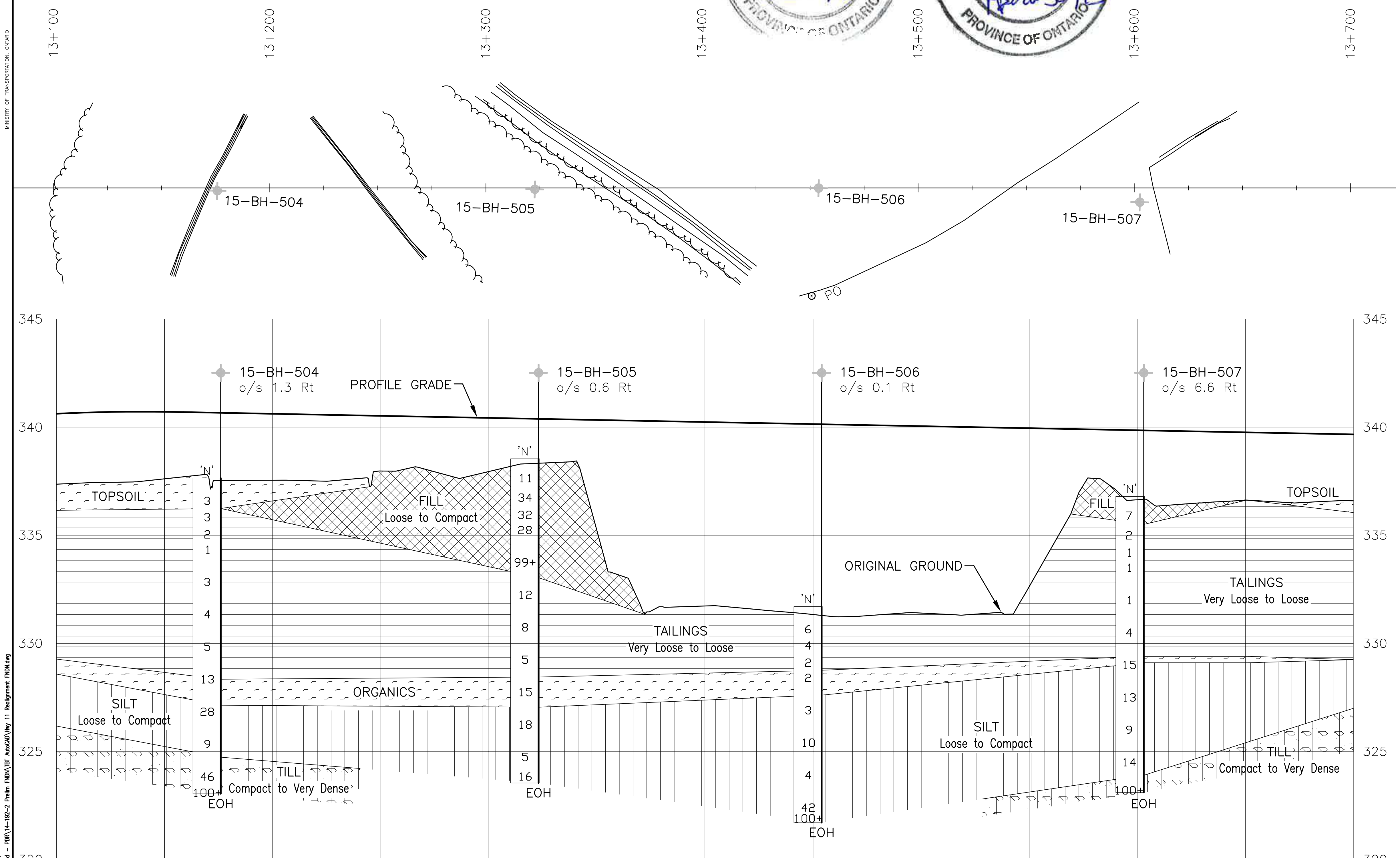
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

REALIGNMENT OF HIGHWAY 11
FOUNDATION INVESTIGATION

BOREHOLE LOCATIONS AND SOIL STRATA

PREMIER Gold Mines Limited

TBT ENGINEERING CONSULTING GROUP

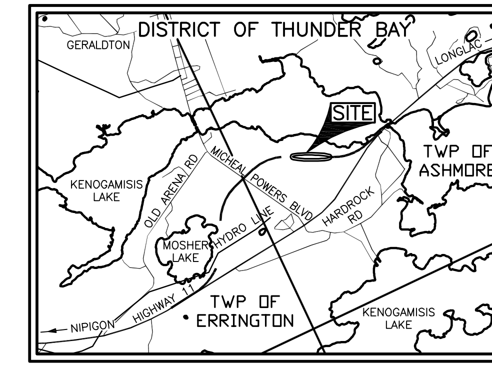


PROFILE

SCALE

HOR 50 0 100 m

VERT 5 0 10 m



KEY PLAN

2.0 km 0 2.0 km

SOIL STRATA SYMBOLS

TOPSOIL/ORGANICS
SILT
FILL
TILL – NON–COHESIVE
TAILINGS

LEGEND

Borehole
'N' Std Pen Test (Blows/0.3m)
EOH End of Hole

No	ELEVATION	CO–ORDINATES (UTM) NORTH	EAST
15-BH-504	337.636	16 5 504 120	504 526
15-BH-505	338.539	16 5 504 057	504 658
15-BH-506	331.702	16 5 504 000	504 777
15-BH-507	336.797	16 5 503 929	504 908

–NOTE–

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

REVISIONS

DESCRIPTION

DESIGN SS	CHK WH	CODE XXXXX–XX	LOAD XX–XXX–XXX	DATE 2015/03/24
DRAWN TB	CHK WH	SITE N/A		DWG 2

METRIC

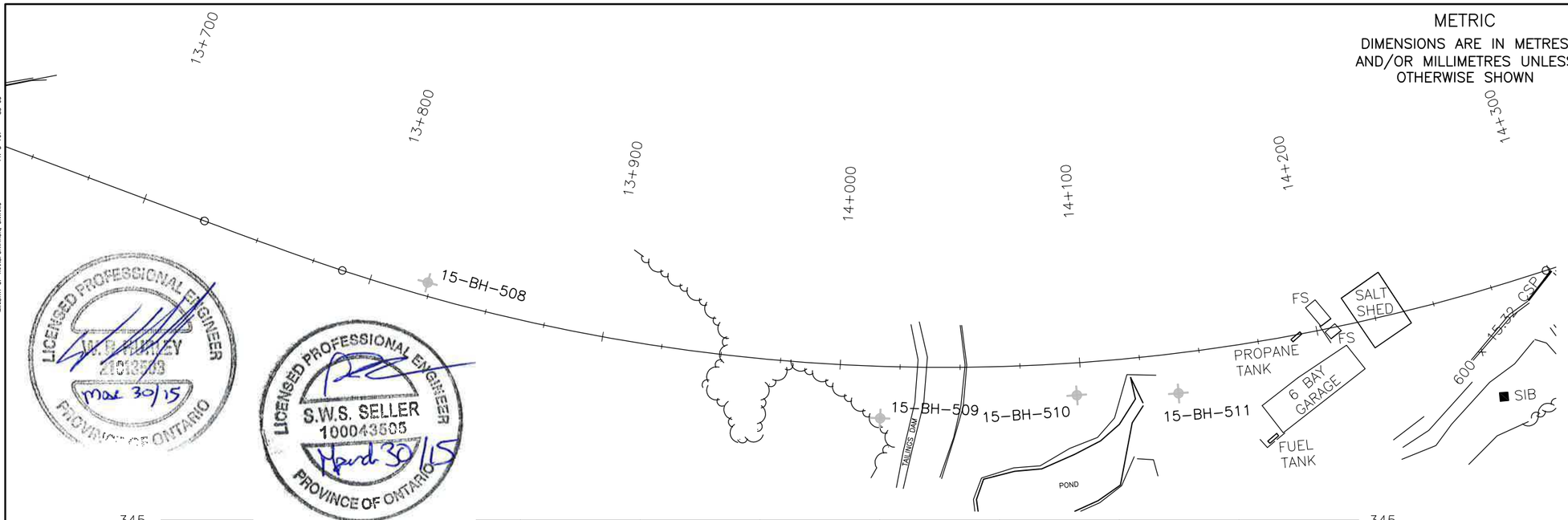
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

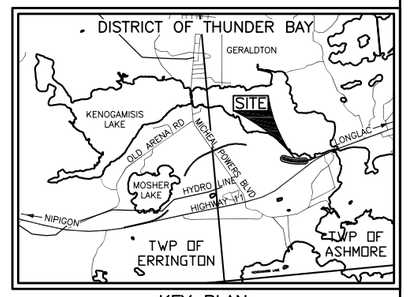
REALIGNMENT OF HIGHWAY 11
FOUNDATION INVESTIGATION

BOREHOLE LOCATIONS AND SOIL STRATA

PREMIER Gold Mines Limited

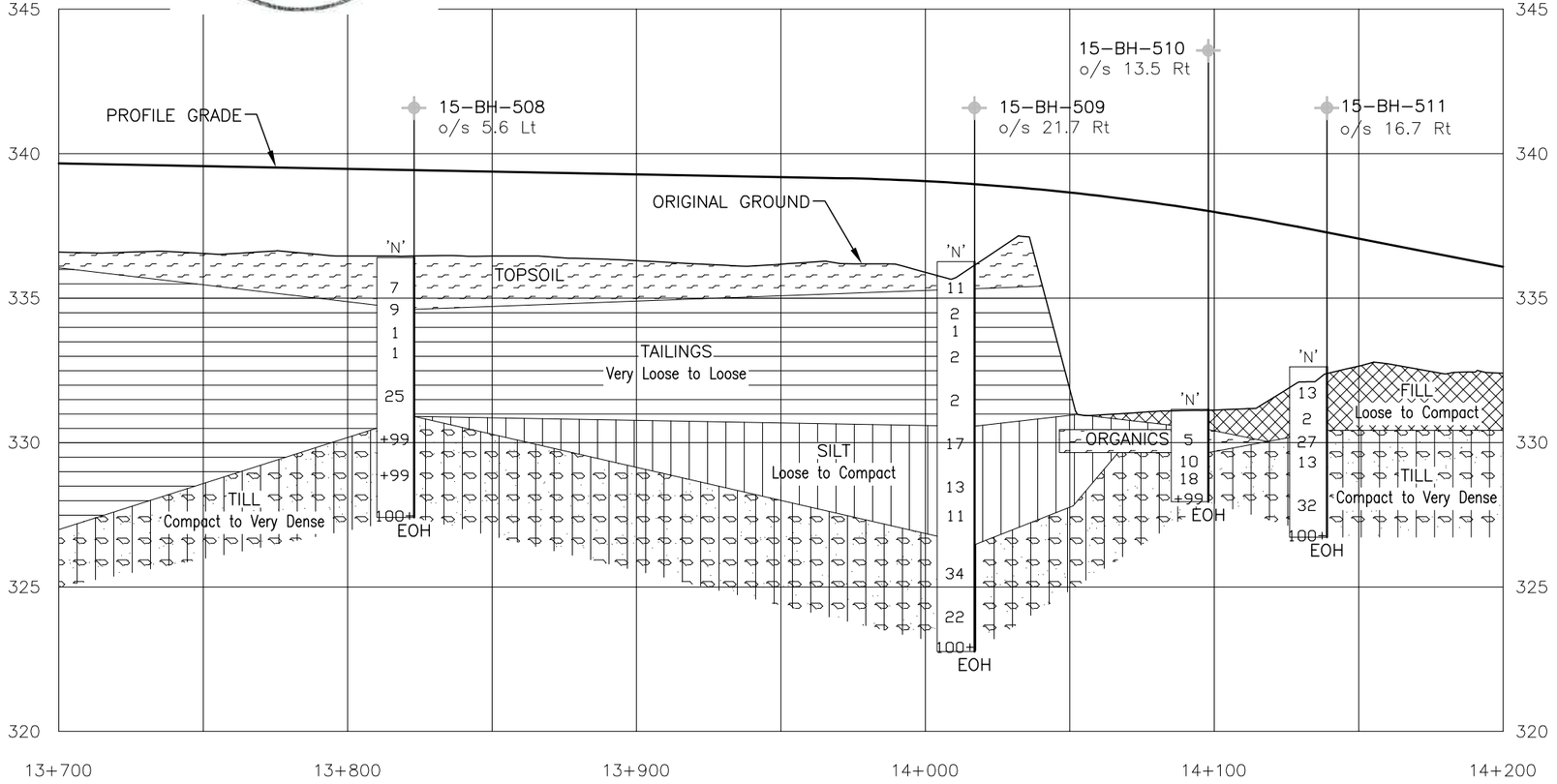
TBT ENGINEERING CONSULTING GROUP





KEY PLAN

2.0 km 0 2.0 km



PROFILE

SCALE

HOR 50 0 100 m

VERT 5 0 10 m

SOIL STRATA SYMBOLS

- TOPSOIL/ ORGANICS
- SILT
- FILL
- TILL – NON–COHESIVE
- TAILINGS

LEGEND

- Borehole
- 'N' Std Pen Test (Blows/0.3m)
- EOH End of Hole

No	ELEVATION	CO–ORDINATES (UTM) NORTH	EAST
15–BH–508	336.407	16 5 503 847	505 113
15–BH–509	336.262	16 5 503 773	505 295
15–BH–510	331.147	16 5 503 775	505 378
15–BH–511	332.623	16 5 503 772	505 420

NOTE

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

REVISIONS				
				DESCRIPTION
DESIGN	SS	CHK	WH	CODE XXXXX–XX LOAD XX–XXX–XXX DATE 2015/03/24
DRAWN	TB	CHK	WH	SITE N/A DWG 3

MINISTRY OF TRANSPORTATION, ONTARIO PR–D–707 88–05

Mar 30, 2015 - 1:52pm Login name: tblunden
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APPENDIX D

Stability Models

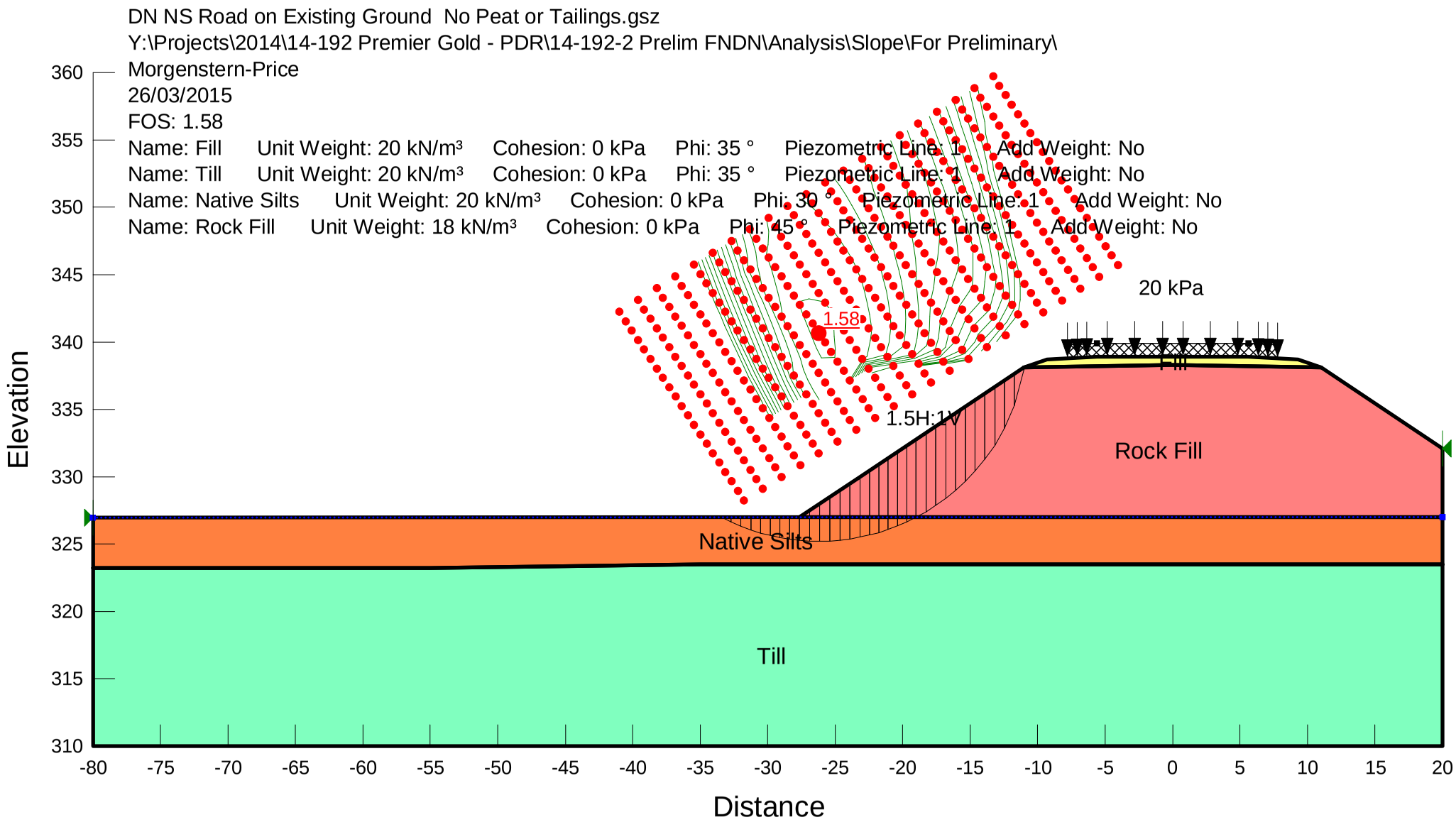

DN NS Road on Existing Ground No Peat or Tailings.gsz
Y:\Projects\2014\14-192 Premier Gold - PDR\14-192-2 Prelim FNDN\Analysis\Slope\For Preliminary\
Morgenstern-Price
26/03/2015
FOS: 1.58
Name: Fill Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1 Add Weight: No
Name: Till Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1 Add Weight: No
Name: Native Silts Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 30 ° Piezometric Line: 1 Add Weight: No
Name: Rock Fill Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 45 ° Piezometric Line: 1 Add Weight: No
20 kPa
1.58
Fill
1.5H:1V
Rock Fill
Native Silts
Till
Elevation
Distance
360
355
350
345
340
335
330
325
320
315
310
-80
-75
-70
-65
-60
-55
-50
-45
-40
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20

Figure 1

DN NS Road on Existing Ground - No Ex with BBar lower check.gsz
Y:\Projects\2014\14-192 Premier Gold - PDR\14-192-2 Prelim FNDN\Analysis\Slope\For Preliminary\
Morgenstern-Price
26/03/2015
FOS: 1.39
Name: Fill Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1 Add Weight: Yes
Name: Peat Unit Weight: 12 kN/m³ Cohesion: 0 kPa Phi: 28 ° Piezometric Line: 1 B-bar: 0.4 Add Weight: No
Name: Till Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1 Add Weight: No
Name: Native Silts Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 30 ° Piezometric Line: 1 Add Weight: No
Name: Rock Fill Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 45 ° Piezometric Line: 1 Add Weight: Yes

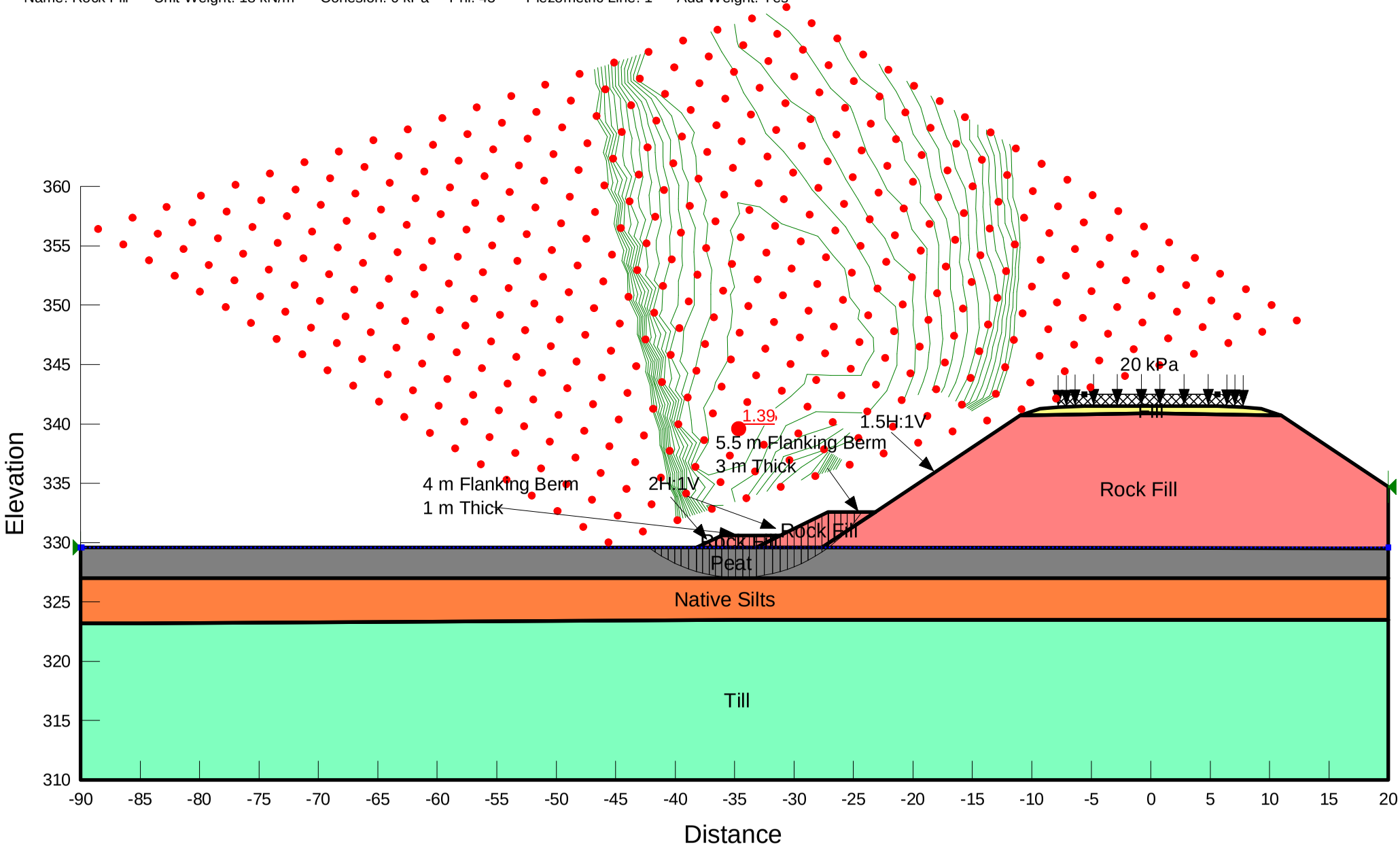


Figure 2

DN NS slope with No Bench Slope on top.gsz
Y:\Projects\2014\14-192 Premier Gold - PDR\14-192-2 Prelim FNDN\Analysis\Slope\For Preliminary\
Morgenstern-Price
26/03/2015
FOS: 1.51
Name: Fill Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 32 ° Piezometric Line: 1 Add Weight: Yes
Name: Tailings Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 31 ° Piezometric Line: 1 B-bar: 0.3 Add Weight: No
Name: Peat Unit Weight: 12 kN/m³ Cohesion: 0 kPa Phi: 28 ° Piezometric Line: 1 B-bar: 0.4 Add Weight: No
Name: Till Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1 Add Weight: No
Name: Native Silts Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 30 ° Piezometric Line: 1 Add Weight: No
Name: Rock Fill Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 45 ° Piezometric Line: 1 Add Weight: Yes

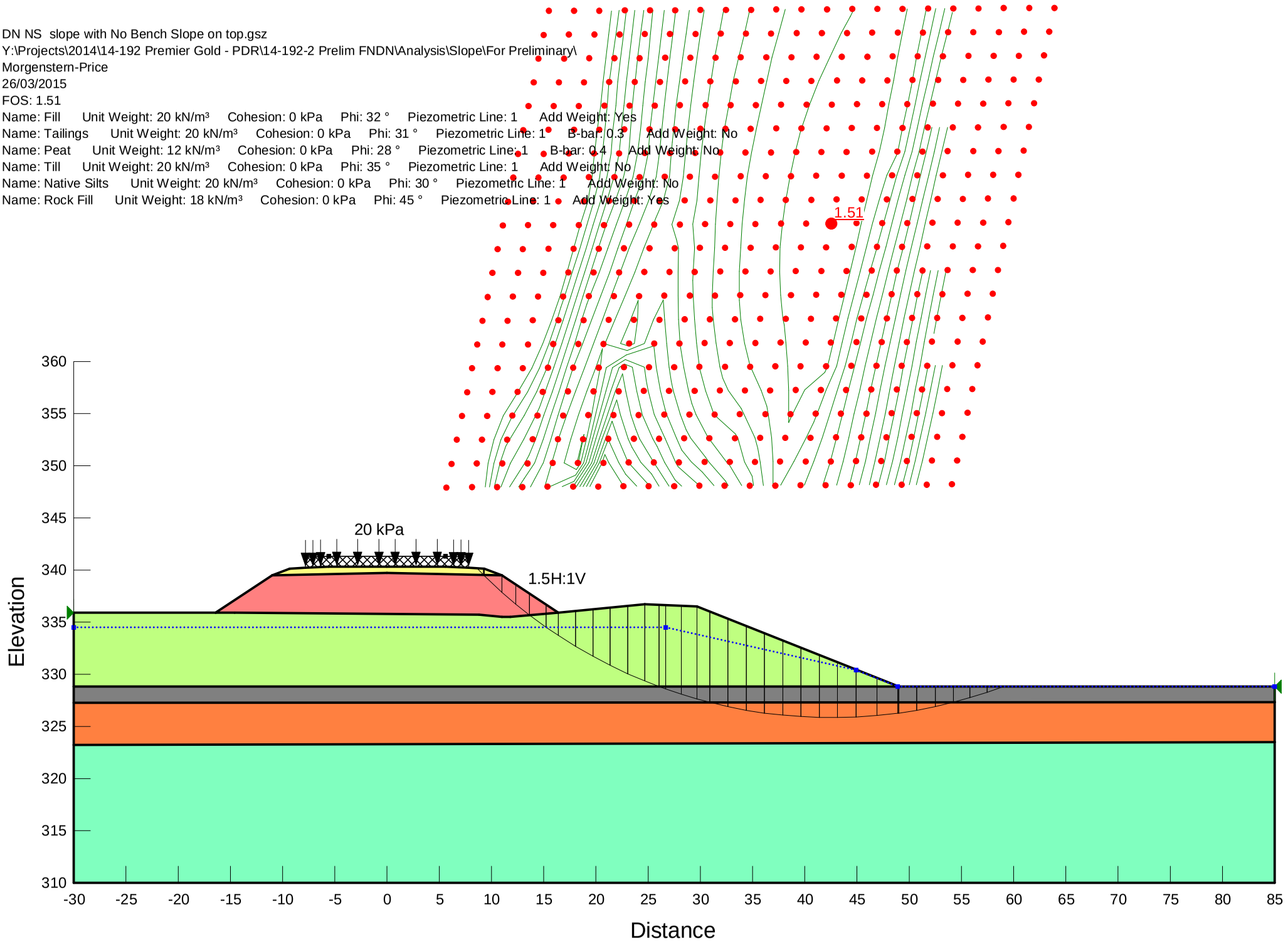


Figure 3

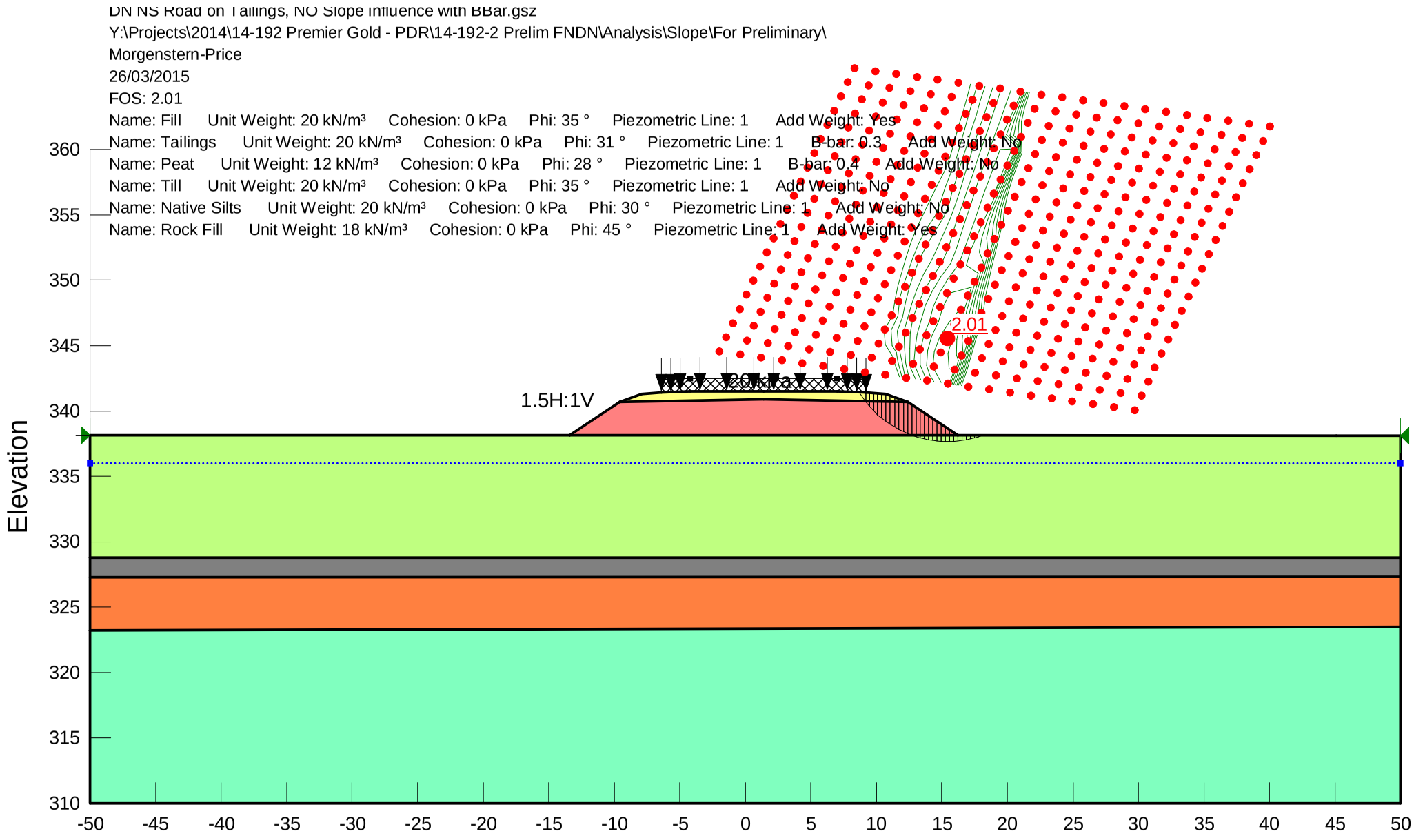
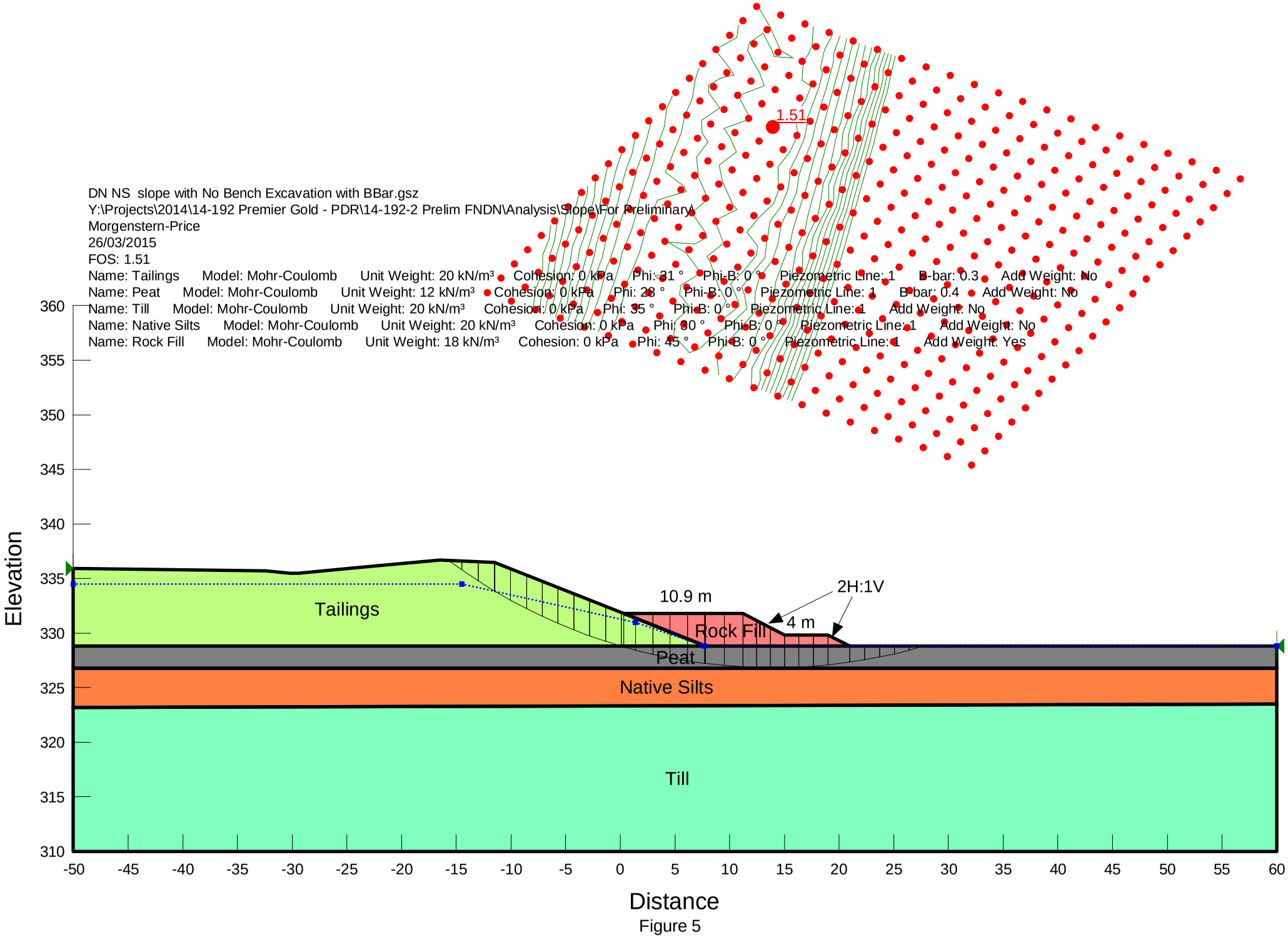

DN NS Road on Tailings, NO Slope Influence with BBar.gsz
Y:\Projects\2014\14-192 Premier Gold - PDR\14-192-2 Prelim FNDN\Analysis\Slope\For Preliminary\
Morgenstern-Price
26/03/2015
FOS: 2.01
Name: Fill Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1 Add Weight: Yes
Name: Tailings Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 31 ° Piezometric Line: 1 B-bar: 0.3 Add Weight: No
Name: Peat Unit Weight: 12 kN/m³ Cohesion: 0 kPa Phi: 28 ° Piezometric Line: 1 B-bar: 0.4 Add Weight: No
Name: Till Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1 Add Weight: No
Name: Native Silts Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 30 ° Piezometric Line: 1 Add Weight: No
Name: Rock Fill Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 45 ° Piezometric Line: 1 Add Weight: Yes
2.01
20 kPa
1.5H:1V
Elevation
360
355
350
345
340
335
330
325
320
315
310
-50
-45
-40
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
35
40
45
50
Distance

Figure 4


1.51
DN NS slope with No Bench Excavation with BBar.gsz
Y:\Projects\2014\14-192 Premier Gold - PDR\14-192-2 Prelim FNDN\Analysis\Slope\For Preliminary\
Morgenstern-Price
26/03/2015
FOS: 1.51
Name: Tailings Model: Mohr-Coulomb Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 31 ° Phi-B: 0 ° Piezometric Line: 1 B-bar: 0.3 Add Weight: No
Name: Peat Model: Mohr-Coulomb Unit Weight: 12 kN/m³ Cohesion: 0 kPa Phi: 28 ° Phi-B: 0 ° Piezometric Line: 1 B-bar: 0.4 Add Weight: No
Name: Till Model: Mohr-Coulomb Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Phi-B: 0 ° Piezometric Line: 1 Add Weight: No
Name: Native Silts Model: Mohr-Coulomb Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 30 ° Phi-B: 0 ° Piezometric Line: 1 Add Weight: No
Name: Rock Fill Model: Mohr-Coulomb Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 45 ° Phi-B: 0 ° Piezometric Line: 1 Add Weight: Yes
Tailings
10.9 m
2H:1V
4 m
Rock Fill
Peat
Native Silts
Till
Elevation
Distance
360
355
350
345
340
335
330
325
320
315
310
-50
-45
-40
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
35
40
45
50
55
60
Figure 5

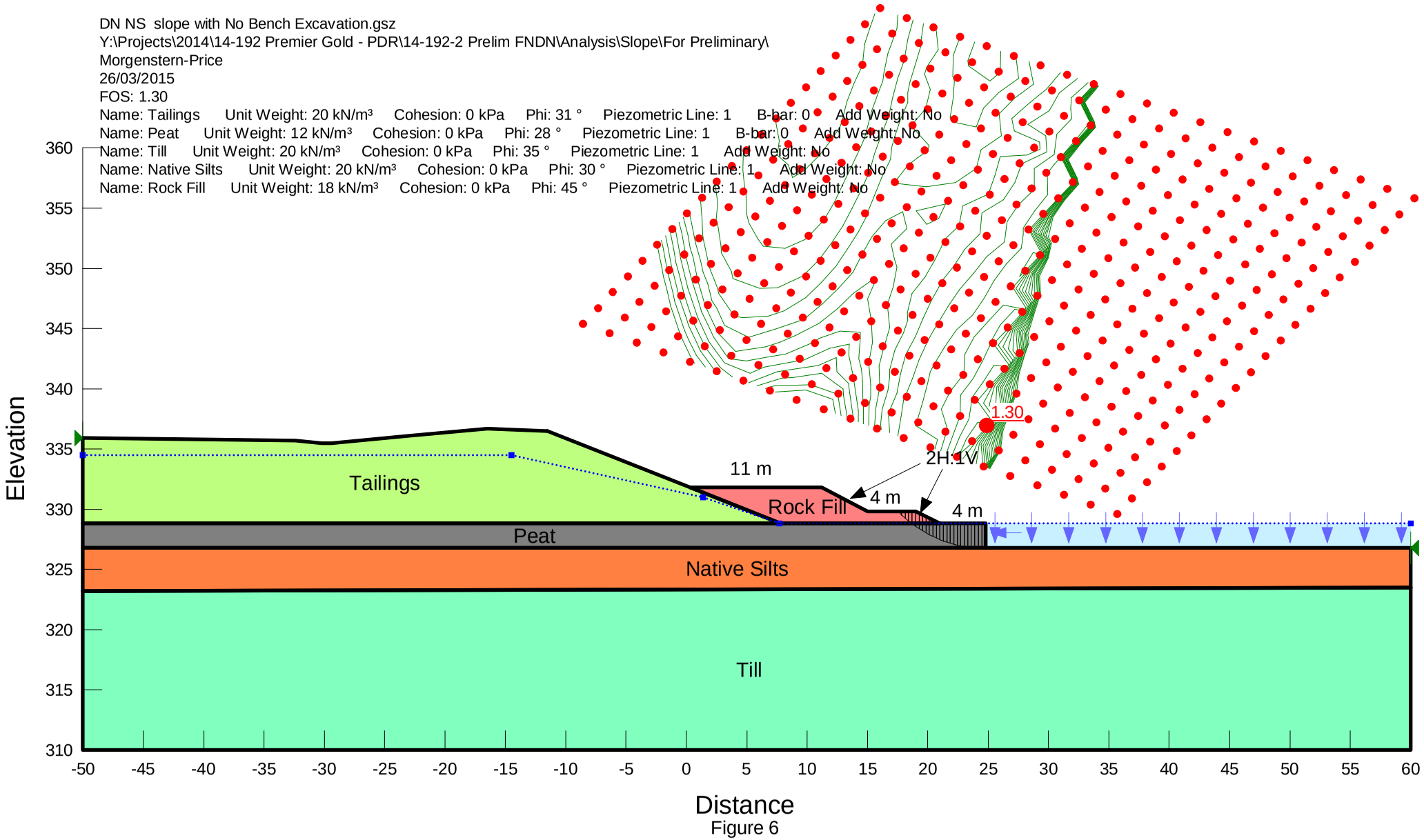

DN NS slope with No Bench Excavation.gsz
Y:\Projects\2014\14-192 Premier Gold - PDR\14-192-2 Prelim FNDN\Analysis\Slope\For Preliminary\
Morgenstern-Price
26/03/2015
FOS: 1.30
Name: Tailings Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 31 ° Piezometric Line: 1 B-bar: 0 Add Weight: No
Name: Peat Unit Weight: 12 kN/m³ Cohesion: 0 kPa Phi: 28 ° Piezometric Line: 1 B-bar: 0 Add Weight: No
Name: Till Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1 Add Weight: No
Name: Native Silts Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 30 ° Piezometric Line: 1 Add Weight: No
Name: Rock Fill Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 45 ° Piezometric Line: 1 Add Weight: No
1.30
2H:1V
11 m
4 m
4 m
Tailings
Rock Fill
Peat
Native Silts
Till
Elevation
Distance
360
355
350
345
340
335
330
325
320
315
310
-50
-45
-40
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
35
40
45
50
55
60

Figure 6

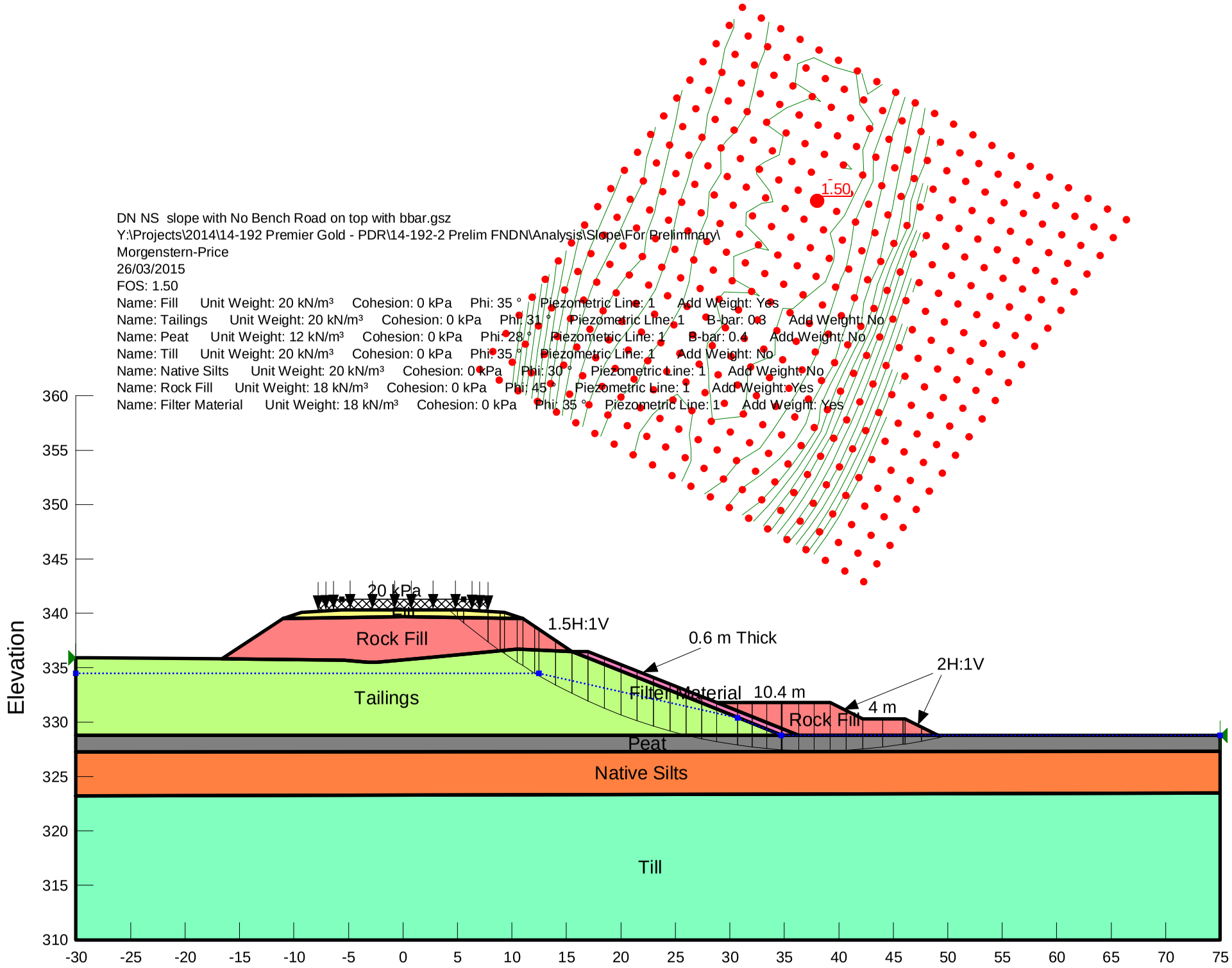

DN NS slope with No Bench Road on top with bbar.gsz
Y:\Projects\2014\14-192 Premier Gold - PDR\14-192-2 Prelim FNDN\Analysis\Slope\For Preliminary\
Morgenstern-Price
26/03/2015
FOS: 1.50
Name: Fill Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1 Add Weight: Yes
Name: Tailings Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 31 ° Piezometric Line: 1 B-bar: 0.3 Add Weight: No
Name: Peat Unit Weight: 12 kN/m³ Cohesion: 0 kPa Phi: 28 ° Piezometric Line: 1 B-bar: 0.4 Add Weight: No
Name: Till Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1 Add Weight: No
Name: Native Silts Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 30 ° Piezometric Line: 1 Add Weight: No
Name: Rock Fill Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 45 ° Piezometric Line: 1 Add Weight: Yes
Name: Filter Material Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1 Add Weight: Yes
1.50
20 kPa
Fill
Rock Fill
1.5H:1V
0.6 m Thick
2H:1V
Tailings
Filter Material
10.4 m
4 m
Rock Fill
Peat
Native Silts
Till
Elevation
Distance
360
355
350
345
340
335
330
325
320
315
310
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75

Figure 7

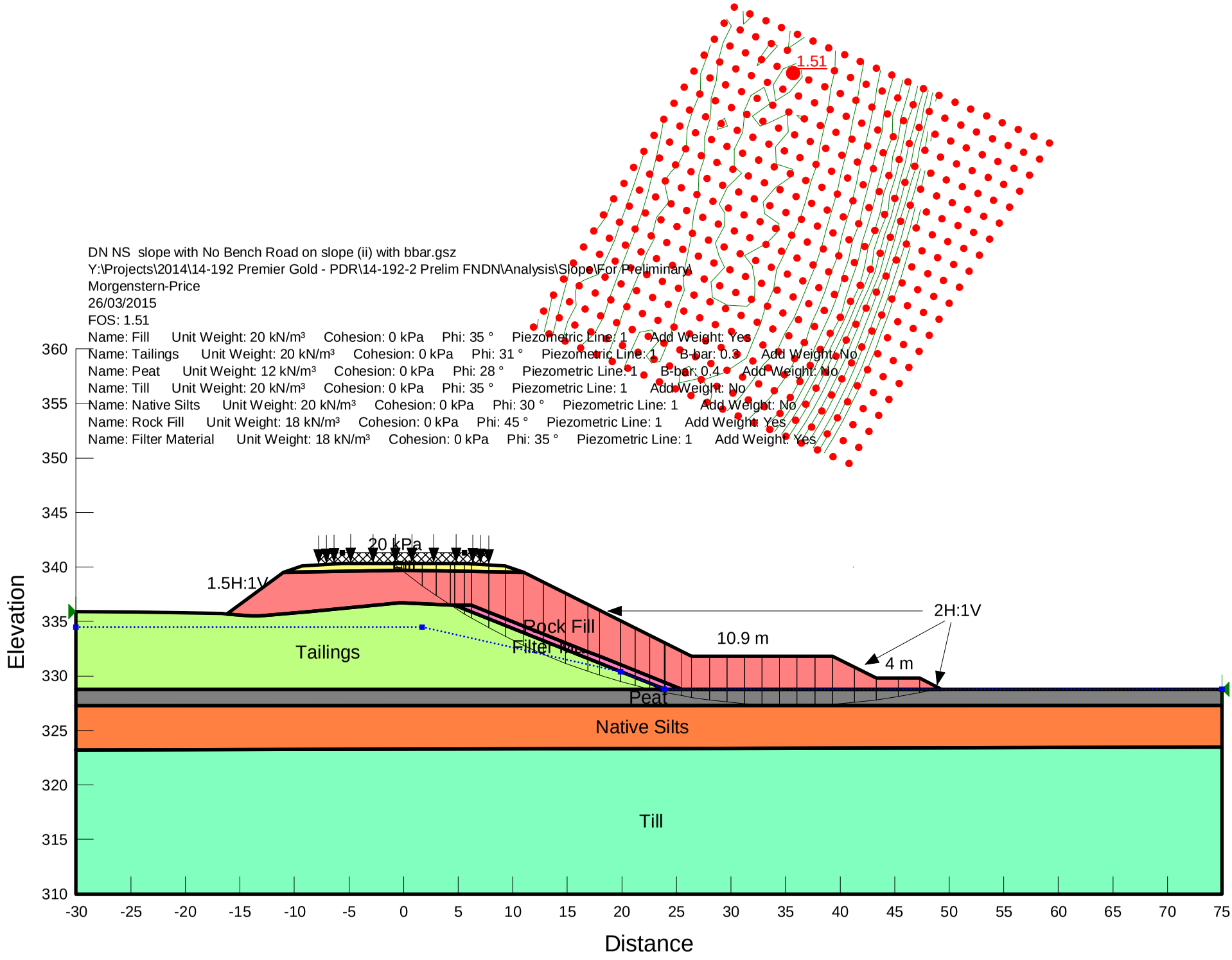

1.51
DN NS slope with No Bench Road on slope (ii) with bbar.gsz
Y:\Projects\2014\14-192 Premier Gold - PDR\14-192-2 Prelim FNDN\Analysis\Slope\For Preliminary\
Morgenstern-Price
26/03/2015
FOS: 1.51
Name: Fill Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1 Add Weight: Yes
Name: Tailings Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 31 ° Piezometric Line: 1 B-bar: 0.3 Add Weight: No
Name: Peat Unit Weight: 12 kN/m³ Cohesion: 0 kPa Phi: 28 ° Piezometric Line: 1 B-bar: 0.4 Add Weight: No
Name: Till Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1 Add Weight: No
Name: Native Silts Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 30 ° Piezometric Line: 1 Add Weight: No
Name: Rock Fill Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 45 ° Piezometric Line: 1 Add Weight: Yes
Name: Filter Material Unit Weight: 18 kN/m³ Cohesion: 0 kPa Phi: 35 ° Piezometric Line: 1 Add Weight: Yes
20 kPa
1.5H:1V
2H:1V
10.9 m
4 m
Rock Fill
Filter Mat
Tailings
Peat
Native Silts
Till
Elevation
Distance
360
355
350
345
340
335
330
325
320
315
310
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75

Figure 8