



FOUNDATION INVESTIGATION AND DESIGN REPORT

for

NEW EMBANKMENTS ON HIGHWAY 40 AT CNR OVERHEAD

SITE NO. 14X-0290/B2

G.W.P. 3064-11-00

W.P. 3064-11-02

GEOGRAPHICAL TOWNSHIP OF SARNIA

LAMBTON COUNTY, ONTARIO

LATITUDE AND LONGITUDE: 42.955937, -82.345729

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Geocres No.: 40J16-92
May 4 , 2022



PART A - FOUNDATION INVESTIGATION REPORT

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ATTACHMENTS

Appendix A – Previous Borehole Logs and Drawings (GEOCRE 40J16-013)

Appendix B – Borehole Location Plan & Profile – Drawings DWGs E-1 and E-2

Explanations of Terms Used in Report

Record of Borehole Sheets:

C-2, C-3, CN-2 to CN-5, CN-7 to CN-10, RW-1, RW-2, and T-1 to T-4

Results of Grain Size Distribution Analyses:

Figures GS-1, GS-2, GS-3A to 3C, GS-4, GS-5A to 5C and GS-6

Results of Atterberg Limits Tests (Plasticity Charts):

Figures PC-1, PC-2, PC-3A to 3C, PC-4, PC-5A to 5C and PC-6

Results of One-Dimensional Consolidation Tests: Figure Nos. CT-1 to CT-3

Results of Unconfined Compressive Strength Tests on Rock

Rock Core Description Logs

Rock Core Photographs

Appendix C – Results of Chemical Tests Provided by SGS Canada Inc.

Peto MacCallum Ltd.

C O N S U L T I N G E N G I N E E R S

PART A - FOUNDATION INVESTIGATION REPORT

for

New Embankments on Highway 40 at CNR Overhead

Site No. 14X-0290/B2

G.W.P. 3064-11-00

Geographical Township of Sarnia, Lambton County, Ontario

1. INTRODUCTION

The Ministry of Transportation Ontario (MTO) has retained WSP Canada Ltd. (WSP) as the Prime Consultant to provide Foundation Engineering Services for the detail foundation investigation and design for the new embankments on Highway 40 overhead structure. WSP retained Peto MacCallum Ltd. (PML) on behalf of MTO to provide geotechnical engineering services for the assignment.

PML has carried out the foundation investigation work for the new Highway 40 alignment in the Township of Sarnia, Lambton County, Ontario. The foundation investigation work reported herein is for the new north and south embankments associated with the proposed Highway 40 and Canadian National Railway (CNR) overhead, approximately 22.0 m west of existing Highway 40 alignment.

The Scope of Work for the Foundation Engineering services are outlined in the PML proposal, dated April 17, 2020 by PML.

Foundation investigation reports for the proposed south culvert and the Canadian National Railway (CNR) Overhead will be submitted by PML under separate covers.

The purpose of the investigation was to explore the subsurface conditions to provide foundation recommendations to facilitate and support the design of the new embankments that would be constructed on the existing fill embankment. This Foundation Investigation Report summarizes the results of the foundation investigation, and laboratory testing carried out to establish subsurface soil and groundwater conditions.

The elevations (EL.) in this report are expressed in meters, unless otherwise noted.

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BARRIE, COLLINGWOOD, HAMILTON, KITCHENER, LONDON, TORONTO



2. SITE DESCRIPTION

The site is located approximately 480 m south of Confederation Line and Highway 40 intersection in Lambton County, Ontario. The general site area is typically flat except for the existing embankments. The surrounding areas include transit, industrial and commercial business areas.

Geocres Report (40J16-013) reported that the CNR had constructed a small embankment about 1.5 m (5.0 ft.) above the original ground level using a heterogeneous fill material of clayey silt, sand, gravel, boulders and cinders prior to construction of the existing Highway 40 and CNR overhead structure.

The existing Highway 40 embankments, north and south of the existing overhead, was placed more than 40 years ago during the construction of the existing overhead structure. Though there were no record of boreholes for this fill, Geocres Report 40J16-61 (1994) indicated that “this approach fill consists of clayey silt to silty clay with varying proportion of sand, boulders and cinders. The thickness of this fill varies from 2.7 m to a maximum of 9.9 m”.

3. SITE RECONNAISSANCE

PML staff visited the site with CNR representatives on April 9, 2020 to conduct a site reconnaissance and confirm the accessibility of the boreholes within the existing CNR track alignment and Right-of-way (ROW).

4. PREVIOUS FOUNDATION INVESTIGATION AND SUBSURFACE CONDITIONS

The general subsurface conditions presented in this section are based on the Foundation Investigation Report, GEOCRE 40J16-013, dated March 25, 1963, and GEOCRE 40J16-61, dated October 12, 1994.



The original investigation was carried out for the proposed extension of Highway 40 (Line 'A') crossing the Canadian National Railway tracks by means of an overhead structure.

The Foundation Investigation Report included the Borehole Location and Soil Strata Drawing (Drawing No. 63-F-12A), dated February 1963, which shows the location of Boreholes 1 to 8 and the inferred soil stratigraphy based on the borehole data across the site location. The previous Record of borehole sheets and drawings are provided in Appendix A.

The foundation investigation was carried out between January 29 and February 11, 1963 by Canadian Longyear Drilling Company. The field investigation comprised eight (8) boreholes that were advanced using 125 mm (5 in.) diameter flight augers to depths of 9.3 m to 38.1 m (30.5 ft. to 125.0 ft.), EL. 150.6 to 178.2 (494.0 ft. to 584.5 ft.). A summary of the subsurface soil and groundwater conditions are provided in the following paragraphs.

Very stiff to firm heterogeneous silty clay to clayey silt fill, with sand, gravel, boulders and cinders, was encountered immediately at the ground surface in Boreholes 1, 4 and 5, extending to EL. 186.1 to EL. 185.9. The thickness of the fill ranged from 2.7 m to 3.1 m. Standard Penetration Test (SPT) N values recorded varied between 4 and 24. Moisture content determinations of samples from the fill layer ranged approximately from 9.0% to 23.0%.

Hard to firm clayey silt to silty clay was encountered below the fill in Boreholes 1, 4 and 5, and immediately at the ground surface in the remaining boreholes. Borehole 8 was terminated in this deposit at a depth of 9.3 m, EL. 178.2, below ground surface. In the remaining boreholes, the cohesive deposit extended 36.2 m to 38.2 m, EL. 150.6 to EL. 150.9, below ground surface, overlying probable bedrock. The thickness of the deposit ranged from 35.0 m to 36.9 m, where fully penetrated. Moisture content determinations for the cohesive samples ranged approximately between 8.0% and 23.0%. The undrained shear strength of the till soil was measured in the field by in-situ vane testing and by unconfined compression tests in the laboratory. The field vane shear test results obtained were between approximately 45 and 132 kPa with sensitivity ranging between 1.5 and 3.0. Laboratory shear strengths obtained for clayey silt till ranged from in excess of 239 kPa (5000.0 psf) in the crust to a minimum 26 kPa (540.0 psf) at EL. 181.1 (594.0 ft.).



Groundwater was observed in all boreholes, except for Borehole 8, during the site investigation between elevations 181.3 m (595.0 ft.) and 186.5 m (612.0 ft.), about 1.1 m (3.5 ft.) to 6.1 m (20 ft.) below ground surface. No artesian water was observed at the site location. Natural gas was observed in all boreholes when contact was made with the bedrock.

For further details, refer to GEOCREs 40J16-013, dated March 25, 1963, and GEOCREs 40J16-61, dated October 12, 1994.

5. CURRENT FIELD INVESTIGATION PROCEDURES

The current fieldwork for the foundation investigation was carried out between July 20, 2020 and September 10, 2020. A total of 17 boreholes were completed for the project. Sixteen (16) boreholes were considered relevant for the new embankments (excluding Borehole C-1). The boreholes were advanced to depths ranging from 8.8 m to 48.8 m (EL. 182.1 to EL. 145.5) below the existing ground surface (EL. 196.0 to EL. 186.6). The Record of Borehole sheets are appended in Appendix B. The borehole location plan, and the soil stratigraphic profiles are presented on drawings DWGs E-1 and E-2. A summary of the depths and locations of the boreholes with respect to the proposed new structures and embankments is provided on Table 1.



Table 1: Summary of Borehole Location Details

LOCATION	BOREHOLE ID	GROUND SURFACE ELEVATION (m)	BOREHOLE DEPTH (m)	COORDINATES			
				(MTM ON-11)		DECIMAL DEGREE	
				NORTHING	EASTING	LATITUDE	LONGITUDE
North Embankment	CN-2	192.0	15.8	4 757 526.4	317 390.6	42.957429	-82.345683
Toe of North Embankment	T-1	187.0	9.8	4 757 487.3	317 361.9	42.957078	-82.346036
North Embankment	CN-3	194.7	20.4	4 757 439.1	317 381.7	42.956643	-82.345794
Toe of North Embankment	T-2	186.6	9.8	4 757 397.2	317 351.0	42.956266	-82.346172
North Approach	CN-4	195.5	20.4	4 757 383.4	317 380.4	42.956142	- 82.345811
North Abutment	CN-5	195.4	48.8	4 757 360.6	317 387.1	42.955937	- 82.345729
North Abutment / Retaining Wall	RW-2	195.4	45.7	4 757 366.4	317 373.8	42.955990	- 82.345893
Center Pier	CN-6	Borehole Cancelled					
South Abutment	CN-7	195.9	48.7	4 757 275.2	317 383.1	42.955168	- 82.345780
South Abutment/ Retaining Wall	RW-1	196.0	45.7	4 757 272.4	317 370.3	42.955144	- 82.345938
South Approach	CN-8	195.7	20.4	4 757 204.6	317 374.6	42.954533	- 82.345886
Toe of South Embankment	T-3	187.8	9.8	4 757 227.4	317 338.5	42.954738	-82.346328
South Embankment	CN-9	195.2	20.4	4 757 204.7	317 374.6	42.954953	-82.345869
Toe of South Embankment	T-4	190.9	8.8	4 757 152.5	317 341.2	42.954064	-82.346298
South Embankment	CN-10	192.2	15.8	4 757 096.6	317 375.2	42.95356	-82.345882
Culvert	C-2	188.8	11.3	4 757 293.0	317 378.9	42.955329	-82.345831
Culvert Outlet	C-3	188.4	41.5	4 757 291.0	317 350.3	42.955311	- 82.346182



Boreholes RW-1, RW-2, CN-2 to CN-5, and CN-7 to CN-10 are located on the top of the existing north and south embankments, along the proposed Highway 40 alignment. Boreholes T-1 to T4 are located at the toe of the north and south existing embankments along the proposed Highway 40 alignment. The locations and depths of the boreholes were reviewed and approved by MTO prior to field investigation. Boreholes C-2 and C-3, located at the toe of the existing south embankment along the CNR tracks were advanced at the locations approved by MTO for the culvert investigation and these boreholes supplemented the investigation of the proposed embankments.

PML staff used a portable GPS device to establish the borehole locations in the field. Subsequently, PML carried out the survey of the borehole locations as drilled and elevations using a Sokkia SHC5000 Differential GPS system, equipped with a GCX3 (Network RTK rover) GNSS Receiver. The vertical and horizontal accuracy of this equipment are within 0.1 m and 0.5 m, respectively. The survey information provided in this report are referred to in MTM NAD 83 Northing and Easting (MTM Zone – ON11) Geodetic datum and expressed in meters.

PML engineering staff arranged for the clearance of underground services through public and private utility authorities, and appropriate permit applications. The respective utility companies cleared the underground services at the borehole locations. Public and private utility authorities were informed and all of the utility clearance documents were obtained before the commencement of drilling work.

Due to accessibility issues, borehole CN-6, which was located along the centerline of the existing CNR tracks, was cancelled from the investigation program. Upon discussion and approval by WSP/MTO, borehole C-3, located at the proposed culvert outlet was extended to a depth of 41.5 m to supplement the bedrock data in lieu of borehole CN-6.

The equipment used for drilling were owned and operated by London Soil Test Ltd. of London, Ontario, Aardvark drilling Inc. of Guelph, Ontario) and Drilling Tech of Newmarket, Ontario. All specialist drilling contractors worked under the full-time supervision of a PML engineering field supervisor. The boreholes were advanced using DIEDRICH D50T track-mounted drilling rig, CME 75 truck-mounted drilling rig and MARL M5T Track-mounted drilling rig. The drill rigs were



equipped with 200 mm diameter hollow stem augers and rotary drilling capable of coring HQ size bedrock core samples. Traffic control was provided by Facca Inc. during the investigation of boreholes CN-5, CN-7, RW-1 and RW-2. Water trucks were provided by the respective drillers during bedrock coring. A CNR flag personnel was provided by Facca Inc. during the investigation of boreholes C-2 and C-3.

Representative soil samples were recovered from the boreholes at 0.75 m intervals to 6.0 m depth, at 1.5 m intervals to 20.0 m depth, and at 3.0 m intervals beyond 20.0 m depth using a conventional 51 mm OD split spoon sampler in accordance with the SPT procedure. SPTs were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata. In-situ field vane tests were carried with MTO vane, where the SPT N value recorded was less than 8 blows for 300 mm penetration. Undisturbed samples were recovered by utilizing Shelby (thin wall) tubes, where possible. The recovered soil and rock samples were returned to the PML laboratory for detailed visual examination, and testing.

During drilling, natural methane gas was encountered in Borehole CN-7 from EL. 149.2 to EL. 150.2, in Borehole CN-5 from EL. 148.6 to EL. 149.6, in Borehole C-3 at EL. 171.7, in Borehole RW-1 from EL. 149.3 to EL. 150.3 and in Borehole RW-2 from EL. 148.7 to EL. 149.7. The drilling activity was immediately stopped when natural gas was encountered, and the gas level was immediately measured in the borehole using RKL Eagle 2. Once the natural gas completely dissipated from the borehole, confirmed by gas reading, drilling activity commenced to the termination depth of the borehole.

The groundwater conditions at the borehole locations were observed during the drilling by visual examination of the soil samples, sampler and drill rods as the samples were retrieved. In addition, water level measurements were taken, using a Solinst flat tape water level reader, in the open boreholes upon completion of drilling. Monitoring wells, consisting of 50 mm diameter PVC pipe, were installed in Boreholes CN-3, CN-5, CN-7, CN-9, T-1, and T-4.

Upon completion of drilling and monitoring of groundwater levels in the monitoring wells, the boreholes and monitoring wells were decommissioned in accordance with the MTO guidelines and R.R.O. 1990, Reg. 903: Wells under Ontario Water Resources Act, as amended. The monitoring wells installed in



Boreholes CN-5 and CN-7 were decommissioned on August 17, 2020 and the monitoring wells installed in Boreholes CN-3, CN-9, T-1 and T-4 were decommissioned on September 11 and 12, 2020.

6. LABORATORY TEST PROCEDURES

6.1 Soil and Rock Testing

Laboratory tests on representative SPT and Shelby (thin wall) samples recovered during the fieldwork were conducted by PML laboratory, located in Toronto. The laboratory testing program included the following:

- Natural moisture content determinations (279)
- Grain size distribution analysis/Hydrometer tests (71)
- Atterberg limit tests (72)
- One Dimensional Consolidation Test (3)
- Unconfined compressive strength tests on rock (6)

All laboratory tests to determine the index properties were performed in accordance with the MTO test procedures, which follow the American Society for Testing Materials (ASTM) standards, with the exception of specific gravity (LS-705) and hydrometer test (LS-702). All the test results are summarized on the attached Record of Borehole Logs provided in Appendix B. The results of the grain size distribution analyses are presented on Figures GS-1, GS-2, GS-3A/B/C, GS-4, GS-5A/B/C, and GS-6. The results of the Atterberg limit tests are presented on Figures PC-1, PC-2, PC-3A/B/C, PC-4, PC-5A/B/C, and PC-6. The one-dimensional consolidation (ODC) test was conducted in accordance with ASTM D2435. The unconfined compressive strength (UCS) test on rock core samples was carried out in accordance with ASTM D4543. All the test results are summarized on the attached Record of Borehole Logs and provided in Appendix B.

6.2 Chemical Analysis

A total of 14 representative soil samples were sent to SGS Canada Inc. (SGS) in Toronto, Ontario, which is accredited by Canadian Analytical Laboratory Association (CALA) for corrosivity analyses. The



corrosivity test results provided by SGS are presented in Appendix C. A summary of the test results is also presented in Table 4.

7. SITE GEOLOGY AND SUBSURFACE CONDITIONS

7.1 Site Geology

In general, the project area is located within the Lambton Clay Plains of the St. Clair Clay Plains physiographic region, which consists of lacustrine clay over the underlying glacial till, as outlined in The Physiography of Southern Ontario (Chapman and Putnam, 1984).

The Quaternary Geology map published by the Ontario Ministry of Northern Development and Mines (MNDM), indicates that the surface conditions in the area consist of St. Joseph Till clays. Based on the Bedrock Geology map (MRD126-REV1, 2011) published by the MNDM, the embankment site lies within Upper Devonian black shale of the Kettle Point formations.

7.2 Subsurface Conditions

Generally, the subsurface soil and groundwater conditions encountered during the current investigation are consistent with the conditions encountered during the previous investigation. The subsurface conditions encountered during the current investigation along with the field and laboratory test results are shown on the attached Record of Borehole Sheets. The boundaries between soil strata have been established at the borehole locations only. The boundaries of soil strata between and beyond the boreholes are assumed and may vary from location to location.

7.2.1 North Embankment

In general, the subsoil conditions consist of 5.4 m to 9.1 m of fill, which is underlain by approximately 36.6 m to 37.5 m thick firm to very stiff silty clay/clayey silt deposit, which in turn overlaid shale bedrock. For classification purposes, the subsurface conditions encountered at this site can be divided into three (3) distinct zones:

- a) Fill
 - i. Sandy Silt



- ii. Silty Clay/Clayey Silt, Some Sand, Trace Gravel
- b) Silty Clay/Clayey Silt, Some/Trace Sand, Trace Gravel
- c) Shale bedrock

7.2.1.1 Fill

- i. Sandy Silt

The sandy silt fill layer was encountered immediately below the existing ground surface in Borehole RW-2, extending to a depth of 0.8 m (EL. 194.6) below the existing ground surface.

A SPT N value recorded in this layer was 11 blows for 30 cm penetration, indicating compactness condition of compact. The moisture content of one (1) sample tested from this layer was 15.2%.

- ii. Silty Clay/Clayey Silt, Some Sand, Trace Gravel

The silty clay/clayey silt fill layer was encountered immediately below the existing ground surface in Boreholes CN-2 to CN-5, and below the sandy silt fill in Borehole RW-2. The silty clay/clayey silt fill ranges from 5.4 m to 8.8 m in thickness, extending to depths ranging from 5.4 m to 9.1 m (EL. 187.2 to EL. 185.9) below the existing ground surface.

The SPT N values in this layer ranged from 4 blows to 22 blows for 30 cm penetration, indicating soft to very stiff consistency. The moisture content of samples tested from this layer vary from 13.0% to 30.9%, with an average value of 16.8%.

In-situ vane shear tests were carried out at depths where low 'N' values were observed. A vane test was performed at three (3) locations between EL. 192.6 and EL. 189.7 within this fill layer in Boreholes CN-3, CN-5 and RW-2. The vane shear strengths (C_u) measured exceeded 120 kPa, indicating very stiff consistency.

The results of the sieve and hydrometer analysis test performed on seven (7) representative samples from this layer are provided on Figure GS-1. The test results indicate that this deposit consists of 0% to 3% gravel, 16% to 39% sand, 26% to 46% silt, and 31% to 37% clay sized particles, with the



exception of one (1) sample tested in Borehole RW-2; Sample 8, having values of 0% gravel, 1% sand, 65% silt and 34% clay sized particles. Atterberg limits tests were performed on the same samples selected for sieve analysis and the results are provided on Figure PC-1. The test results indicate liquid limit values ranging from 29 to 38, plastic limit values ranging from 15 to 19, and the corresponding plasticity index values range from 10 to 21. Based on the test results, this fill may be classified as Clayey Silt (CL) / Silty Clay (CI) in the MTO classification system.

The results of the sieve and hydrometer analysis tests performed on one (1) representative sample from the clayey sand seam are provided on Figure GS-2. Atterberg limits tests performed on the same samples, and the results are provided on Figure PC-2.

7.2.1.2 Silty Clay/Clayey Silt

The silty clay/clayey silt deposit was encountered immediately below the fill layer and immediately below the existing ground surface in Boreholes T-1 and T-2. The deposit extends to depths of 9.8 m to 45.8 m (EL. 177.2 to EL. 149.6) below the existing ground surface. The thickness of this layer was 37.5 m and 36.6 m in boreholes CN-5 and RW-2, respectively, where this layer was fully penetrated. The layer was not fully penetrated in boreholes CN-2 to CN-4, T-1, and T-2. At approximate elevations ranging from EL. 149.7 to EL. 148.6, near the bedrock surface, natural gas was encountered in boreholes CN-5 and RW-2.

The SPT N values in this layer ranged from 4 blows to over 100 blows for 30 cm penetration, indicating soft to hard consistency. Within the clayey silt and silty clay deposit, a total of 21 in-situ vane shear tests were carried out. In general, the vane shear strengths (C_u) measured between 56 kPa and 117 kPa, with a sensitivity ratio value between 1 and 2, indicating stiff to very stiff consistency. However, four (4) in-situ vane shear tests exceeded 120 kPa, which occurred in Boreholes T-2 (EL. 178.1), CN-4 (EL. 180.9), CN-5 (EL. 176.2), and RW-2 (EL. 169.5) indicating very stiff consistency compared to the soft to hard consistency based on SPT N values.

The moisture content of samples tested from the Silty Clay/Clayey Silt layer range from 12.4% to 31.1%, with an average value of 20.4%. The results of the sieve and hydrometer analysis tests performed on 24 representative samples from this layer are provided on Figures GS-3A/B/C. The test



results indicate that this deposit consists of 0% to 8% gravel, 7% to 29% sand, 40% to 50% silt, and 26% to 49% clay sized particles. Atterberg limits tests were performed on the same samples selected for grain size analysis, and the results are provided on Figures PC-3A/B/C. The test results indicate liquid limit values of 23 to 41, plastic limit values of 12 to 22, and the corresponding plasticity index values of 11 to 23. Based on the test results, this layer may be classified as as Clayey Silt (CL) / Silty Clay (CI) in the MTO classification system.

One-dimensional consolidation testing was conducted on two (2) Shelby tube samples obtained from Boreholes CN-5, and RW-2, and the test results are summarized in Table 2A and provided in Appendix B. As part of the one-dimensional consolidation and particle size analysis of soils (LS-702), specific gravity and unit weight tests were performed on the selected samples. Specific gravity and unit weight tests were conducted on one (1) additional Shelby tube sample selected from Borehole CN-4. The specific gravity of all tested samples ranged from 2.740 to 2.755, with an average value of 2.741. The unit weights of the tested samples ranged from 16.8 kN/m³ to 20.7 kN/m³, with an average value of 19.3 kN/m³.

Table 2A: Summary of One-Dimensional Consolidation Test

LOCATION	BOREHOLE ID	GROUND SURFACE ELEVATION (m)	SAMPLE DEPTH (m)	ESTIMATED σ'_{vo} (kPa)	ESTIMATED σ'_p (kPa)	c_c	c_{cr}
North Abutment	CN-5	195.4	15.2 – 15.8	215	430	0.33	0.05
North Abutment	RW-2	195.4	18.3 – 18.9	254	254	0.22	-

σ'_{vo} – Effective Overburden Pressure; σ'_p – Preconsolidation Pressure; c_c – Compression Index;
 c_{cr} – Recompression Index

The virgin consolidation curves including σ'_{vo} , σ'_p , c_c and c_{cr} are presented in Appendix B, Figure Nos. CT-1 and CT-3.



7.2.1.3 Shale Bedrock

Borehole RW-2 was terminated on probable bedrock at 45.7 m (EL. 149.7). Bedrock was encountered in Borehole CN-5, at a depth of 45.8 m below the existing ground (EL. 149.6). The presence of bedrock was confirmed by obtaining a 3.0 m of rock core from the borehole. This borehole was advanced using an HQ sized core barrel. The rock core recovery of Run 1 and Run 2 was 74% and 100%, respectively, and the Rock Quality Designation (RQD) of the rock cores were 72% and 100%, respectively. Based on the RQD value, the quality of the bedrock at this site may be described as fair to excellent. The unconfined compressive strength (UCS) of rock core specimens tested from Run 1 and Run 2 from Borehole CN-5 was 71.7 MPa and 84.0 MPa, respectively. Based on the unconfined compression test values, the bedrock may be classified as Type R4 (strong) with respect to strength. The bedrock was identified as unweathered shale bedrock. For complete description of the bedrock, refer to the Rock Core Photographs and the Rock Core Description logs provided in Appendix B.

7.2.2 South Embankment

In general, the subsoil conditions consist of 0.8 m to 9.2 m of general fill, which is underlain by approximately 36.5 m to 36.7 m thick firm to very stiff silty clay/clayey silt deposit, which in turn overlaid shale bedrock. For classification purposes, the subsurface conditions encountered at this site can be divided into three (3) distinct zones:

- a) Fill
 - i. Sand and Gravel/Gravelly Sand
 - ii. Silty Clay/Clayey Silt, Some Sand, Trace Gravel
- b) Silty Clay/Clayey Silt, Some/Trace Sand, Trace Gravel
- c) Shale Bedrock



7.2.2.1 Fill

i. Sand and Gravel/Gravelly Sand

The sand and gravel/gravelly sand layer was encountered immediately below the existing ground surface in Boreholes C-2 and C-3, extending to depths of 1.5 m (EL. 187.3) and 0.8 m (EL. 187.7), respectively, below the existing ground surface.

The SPT 'N' value in the fill layers ranged from 26 blows to 31 blows for 30 cm penetration, indicating compactness condition ranging from compact to dense.

The moisture contents of three (3) fill samples obtained were 2.2%, 4.4%, and 7.4%.

ii. Silty Clay/Clayey Silt, Some Sand, Trace Gravel

This silty clay/clayey silt fill was encountered immediately below the sand and gravel/gravelly sand fill in Boreholes C-2, C-3, and below the existing ground surface in Boreholes CN-7 to CN-10, RW-1, T-3, and T-4. The deposit ranges from 0.7 m to 9.2 m in thickness, extending to depths ranging from 0.8 m to 9.2 m (EL. 187.0 to EL. 186.2) below the existing ground surface.

The SPT N values recorded in this layer ranged from as low as 6 blows to 25 blows for 30 cm penetration, indicating firm to very stiff consistency.

In-situ vane shear tests were carried out at depths where low SPT N values were observed. Vane tests were performed at seven (7) locations between EL. 195.1 and EL. 188.7 within the fill layer in Boreholes CN-7, RW-1, CN-8 and CN-10. The vane shear strengths (C_u) measured exceeded 120 kPa, indicating very stiff consistency.

The moisture content of samples tested from the fill layer varied from 4.5% to 23.9%, with an average value of 14.9%. The results of the sieve and hydrometer analysis tests performed on 12 representative samples from this layer are provided on Figure GS-4. The test results indicate



that this deposit consists of 0% to 6% gravel, 17% to 34% sand, 29% to 47% silt, and 31% to 38% clay sized particles. Atterberg limits tests were performed on the same samples selected for sieve analysis and the results are provided on Figure PC-4. The test results indicate liquid limit values ranging from 30 to 41, plastic limit values ranging from 15 to 17, and the corresponding plasticity index values range from 15 to 24. Based on the test results, this fill may be classified as Clayey Silt (CL) / Silty Clay (CI) in the MTO classification system.

7.2.2.2 Silty Clay/Clayey Silt, Some/Trace Sand, Trace Gravel

The silty clay/clayey silt deposit was encountered immediately below the fill layer in all investigated boreholes. In this deposit, the field investigation extended, to depths ranging from 8.8 m to 45.7 m (EL. 182.1 to EL. 150.2) below the existing ground surface. The thickness of this layer ranged from 36.5 m to 36.7 m in boreholes C-3, CN-7 and RW-1, where the layer was fully penetrated. This layer was not fully penetrated in boreholes C-2, CN-8 to CN-10, T-3 and T-4. Natural gas was encountered near the bedrock surface in boreholes CN-7 and RW-1 at approximate elevations ranging from EL. 149.2 to EL. 150.3. In borehole C-3, natural gas was encountered at EL. 171.7. In the previous GEOCRETS report, the presence of natural gas was reported in all boreholes when contact was made with bedrock.

The SPT N values in this layer ranged from as low as 1 blow to over 100 blows for 30 cm penetration, indicating very soft to hard consistency.

Within this depth, a total of 24 in-situ vane shear tests were carried out. In general, the uncorrected vane shear strengths (C_u) measured between 33 kPa and 116 kPa (EL. 186.1 to EL. 162.9), with a sensitivity ratio value between 1 and 3, indicating firm to very stiff consistency. However, six (6) in-situ vane shear tests exceeded 120 kPa, which occurred in Boreholes C-3 (EL. 182.1), CN-7 (EL. 186.1 and EL. 179.7), CN-10 (EL. 179.1 And EL. 177.6), and RW-1 (EL. 176.4) indicating very stiff consistency compared to the very soft to hard consistency based on SPT 'N' values.

The moisture content of samples tested from this layer range from 2.3% to 41.7%, with an average value of 20.9%. The results of the sieve and hydrometer analysis tests performed on 25 representative samples from this layer are provided on Figures GS-5A/B/C. The test results



indicate that this deposit consists of 0% to 5% gravel, 8% to 27% sand, 39% to 64% silt, and 28% to 50% clay sized particles. Atterberg limits tests were performed on 26 representative samples, including the same samples selected for sieve analysis, and the results are provided on Figure PC-5A/B/C. The test results indicate liquid limit values of 26 to 41, plastic limit values of 13 to 21, and the corresponding plasticity index values of 10 to 24. Based on the test results, this layer may be classified as Clayey Silt (CL) / Silty Clay (CI) in the MTO classification system.

The results of the sieve and hydrometer analysis tests performed on two (2) representative samples from the clayey sand seams are provided on Figures GS-6. Atterberg limits tests performed the same samples, and the results are provided on Figure PC-6.

One-dimensional consolidation testing was conducted on one (1) Shelby tube sample obtained from Borehole CN-7, and the test results are summarized in Table 2B and are provided in Appendix A. As part of the one-dimensional consolidation and particle size analysis of soils (LS-702), specific gravity and unit weight tests were performed on the selected samples. Specific gravity and unit weight tests were conducted on two (2) additional Shelby tube samples selected from Boreholes C-3, and CN-7. The specific gravity of the all-tested samples ranged from 2.709 to 2.788, with an average value of 2.747. The unit weights of the all-tested samples ranged from 18.1 kN/m³ to 20.4 kN/m³, with an average value of 19.0 kN/m³.

Table 2B: Summary of One-Dimensional Consolidation Test

LOCATION	BOREHOLE ID	GROUND SURFACE ELEVATION (m)	SAMPLE DEPTH (m)	ESTIMATED σ'_{vo} (kPa)	ESTIMATED σ'_p (kPa)	C_c	C_{cr}
South Abutment	CN-7	195.9	15.2 – 15.8	216	491	0.30	0.07

σ'_{vo} – Effective Overburden Pressure; σ'_p – Preconsolidation Pressure; C_c – Compression Index;
 C_{cr} – Recompression Index

The virgin consolidation curves including σ'_{vo} , σ'_p , C_c and C_{cr} are presented in Appendix B, Figure No. CT-2.



7.2.2.3 Shale Bedrock

Borehole RW-1 was terminated on probable bedrock at 45.7 m (EL. 150.3).

Bedrock was encountered in Boreholes C-3 and CN-7, below the existing ground surface at elevations of EL. 150.3 and EL. 150.2, respectively. The presence of bedrock was confirmed by obtaining 3.3 m and 3.0 m of rock cores from Boreholes C-3 and CN-7, respectively. The boreholes were advanced using an HQ sized core barrels. The rock core recovery ranged from 74% to 100% and the Rock Quality Designation (RQD) of the rock cores ranged from 75% to 100%, with the exception of Run 1 in borehole C-3 which had an RQD of 0%. Based on the RQD value, the quality of the bedrock at this site may be described as fair to excellent with the exception of Run 1 in Borehole C-3, which may be described as very poor.

Unconfined compressive strength (UCS) of four (4) rock core samples tested from Boreholes CN-7 and C-3 ranged from 60.8 MPa to 84.1 MPa. Based on the unconfined compression test values, the bedrock may be classified as Type R4 (strong) with respect to strength. The bedrock was identified as unweathered shale bedrock. For a complete description of the bedrock, refer to the Rock Core Photographs and the Rock Core Description logs provided in Appendix B.

7.3 Groundwater Conditions

Groundwater was encountered upon completion of drilling in Boreholes RW-1, RW-2, C-2, CN-5 and CN-7 at depths of 9.1 m (EL. 186.9), 15.2 m (EL. 180.2), 6.1 m (EL. 182.7), 7.1 m (EL. 188.4) and 8.2 m (EL. 187.7) respectively, below the existing ground surface. The groundwater level was not encountered or could not be established during drilling or upon completion of drilling in Boreholes CN-2, CN-3, CN-4, CN-8, CN-9, CN-10, C-3 and T-1 to T-4. Monitoring wells, consisting of 50 mm diameter PVC pipe, were installed in Boreholes CN-3, CN-5, CN-7, CN-9, T-1, and T-4. The groundwater levels recorded in monitoring wells ranged from EL. 179.3 to EL. 188.9. The recorded groundwater levels are shown on the Record of Borehole sheets provided in Appendix B, and summarized in Table 3. Groundwater levels may fluctuate due to the influence of precipitation and seasonal changes.



Table 3: Summary of Groundwater Level in Monitoring Wells

BOREHOLE NO.	GROUND SURFACE EL. (m)	GROUNDWATER LEVEL UPON COMPLETION OF DRILLING		GROUNDWATER LEVEL MEASURED IN MONITORING WELLS									
		DEPTH (m)	EL. (m)	DEPTH (m)	EL. (m)	DEPTH (m)	EL. (m)	DEPTH (m)	EL. (m)	DEPTH (m)	EL. (m)	DEPTH (m)	EL. (m)
				JULY 22, 2020		JULY 29, 2020		AUGUST 10, 2020		AUGUST 17/27, 2020		SEPTEMBER 11/12, 2020	
CN-9	195.2	15.9	179.3	18.7	176.5	NM	NM	NM	NM	17.7	177.5	15.9	179.3
CN-7	195.9	8.0	187.9	8.0	187.9	NM	NM	7.9	188.0	8.9	187.0	MWD	MWD
CN-5	195.4	7.3	188.1	NM	NM	7.3	188.1	7.1	188.3	6.7	188.7	MWD	MWD
CN-3	194.7	14.7	180.0	*	*	*	*	17.0	177.7	17.5	177.2	14.7	180.0
				AUGUST 5, 2020		AUGUST 7, 2020		AUGUST 27, 2020		SEPTEMBER 11, 2020		SEPTEMBER 12, 2020	
T-1	187.0	9.8	177.2	Dry to bottom of screen	-	NM	NM	NM	NM	NM	NM	6.1	180.9
T-4	190.9	9.7	181.2	*	*	Dry to bottom of screen	-	6.8	184.1	2.0	188.9	NM	NM

Note: MWD – Monitoring well decommissioned prior to the date; NM – Not measured; * - Monitoring well not installed.



7.4 Chemical Analysis

A total of 14 representative soil samples were sent to SGS Canada Inc.'s (SGS) laboratory located in Toronto, Ontario, which is accredited by Canadian Analytical Laboratory Association (CALA). The corrosivity test results provided by SGS are presented in Appendix C. A summary of the test results is presented in the Table 4.



Table 4: Summary of Soil Chemical Analysis Results

BH NO.	SAMPLE	DEPTH (m)	CORROSIVITY INDEX	CONDUCTIVITY ($\mu\text{S}/\text{cm}$)	SULPHATE ($\mu\text{g}/\text{g}$)	CHLORIDE ($\mu\text{g}/\text{g}$)	pH	RESISTIVITY (Ohm-cm)
RW-1	10	7.6 - 8.2	1	174	49	3.6	8.50	5740
RW-1	16	16.8 - 17.4	8	387	190	10	8.50	2580
RW-2	21	30.5 - 31.1	6	438	320	19	8.40	2280
RW-2	27	42.7 - 43.3	12	628	430	34	8.40	1590
CN-5	12	12.2 - 12.8	8	245	230	6.2	8.68	4080
CN-5	21	33.5 - 34.1	12	624	540	28	8.21	1600
CN-7	19	22.9 - 23.5	8	308	340	12	8.54	3250
CN-7	25	39.6 - 40.2	8	387	480	30	8.54	2580
C-2	5	4.57 - 5.18	4	130	240	13	8.35	7700
C-2	7	6.10 - 6.71	4	274	230	9.1	8.2	3650
C-3	6	3.66 - 4.27	6	527	3.1	37	7.75	1900
C-3	8	7.62 - 8.23	8	169	220	7.6	9.05	5910
C-3	12	13.72 - 14.33	6	404	310	12	8.37	2480
C-3	20	32.00 - 32.61	4	159	420	32	8.41	6290



8. CLOSURE

Mr. M. Mohamed carried out the field investigations under the supervision of Mr. Nazibur Rahman, P.Eng. This Report was prepared by Ms. Natasha Leong-Sem, EIT and reviewed by Mr. Nazibur Rahman, P.Eng. Mr. Robert Ng, PhD, P.Eng., MTO Designated Principal Contact conducted an independent review of the report.

Yours very truly,

Peto MacCallum Ltd.

A handwritten signature in blue ink, appearing to read "Natasha Leong-Sem".

Natasha Leong-Sem, EIT
Geotechnical Services



Nazibur Rahman, P.Eng.
Senior Engineer, Geotechnical Services



Robert Ng, MBA, PhD, P.Eng.
MTO Designated Principal Contact

NLS/NR/RN: nls-nr-nk



APPENDIX A

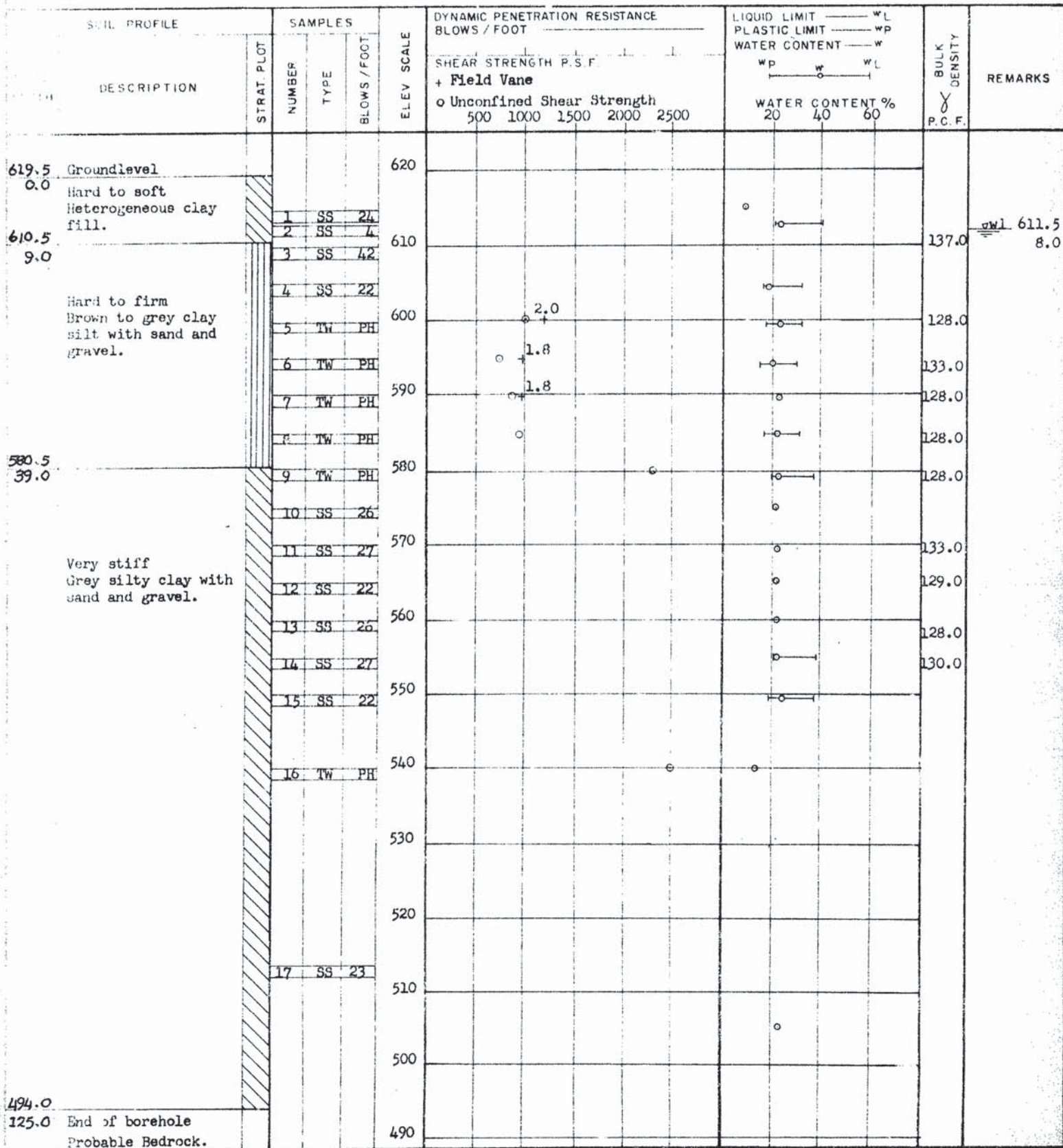
Previous Borehole Logs and Drawings (GEOCRE5 40J16-013)

MINISTRY OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

03-F-12 LOCATION 276+14 53' Lt. ORIGINATED BY T.F.W.
 53-63 BORING DATE Jan. 29, 1963. COMPILED BY T.F.W.
 Geodetic BOREHOLE TYPE 5" Ø Auger. CHECKED BY H.S.



DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 63-F-12

LOCATION 275452 G

ORIGINATED BY T.F.W.

W P 53-63

BORING DATE Feb. 1, 1963.

COMPILED BY T.F.W.

DATUM Geodetic

BOREHOLE TYPE 5" Ø Auger

CHECKED BY _____ H.S.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W	BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER TYPE	BLOWS / FOOT	SHEAR STRENGTH P.S.F. + Field Vane ○ Unconfined Shear Strength 1000 2000 3000 4000 5000	WATER CONTENT % WP ——— W ——— WL 20 40 60	P.C.F.
614.0	Groundlevel						
0.0							
	Hard to firm Brown to grey clayey silt with sand and gravel.		1 SS 18	610			137.0
			2 TW PH				133.0
			3 SS 42				133.0
			4 PH 25				133.0
			5 SS 25				133.0
			6 TW PH	600	1.6		128.0
			7 TW PH		2.2		123.0
			8 TW PH	590			125.0
			9 TW PH				125.0
			10 SS P	580			125.0
			11 TW PH				125.0
575.0			12 TW PH				130.0
39.0			13 TW PH	570			130.0
	Very stiff to firm, grey, silty clay with sand and gravel.		14 TW PH				129.0
			15 TW PH	560			126.0
			16 TW PH	550			
			17 TW PH	540			129.0
			18 TW PH	530			122.0
			19 TW PH	520			125.0
			20 TW PH	510			123.0
495.0			21 SS 30 for 1"	500			
119.0	Shale Bedrock.						
490.0	End of borehole.						
124.0							

FOUNDATION SECTION

[illegible]

HIGHWAYS - ONTARIO
RESEARCH DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

-12 LOCATION 276/55 33' Rt. ORIGINATED BY T.F.W.
 -03 BORING DATE Feb. 6, 1963. COMPILED BY T.F.W.
 Geologic BOREHOLE TYPE 5" Ø Auger. CHECKED BY H.S.

PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — *L PLASTIC LIMIT — *P WATER CONTENT — * *P — * — *L WATER CONTENT % 20 40 60			BULK DENSITY P.C.F.	REMARKS
		NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. + Field Vane o Unconfined Shear strength 500 1000 1500 2000 2500									
Groundlevel heterogeneous fill. clayey silt with sand and boulders.					620										
		1	SS	10											
		2	SS	8											
		3	SS	20	610										
		4	SS	38											
		5	SS	10	600				1.8						
		6	TW	PH	590			1.7						130.0	
		7	TW	PH				1.7						129.0	
Hard to firm. brown to grey clayey silt with sand and gravel.		8	TW	PH	580								130.0		
					570										
					560										
					550										
					540										
					530										
					520										
					510										
End of borehole. Probable Bedrock.				500											

w1 612.0
 8.0

DEPARTMENT OF HIGHWAYS - ONTARIO
 MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 63-F-12 LOCATION 277/65 38.0' Lt. ORIGINATED BY T.F.W.
 W.P. 53-63 BORING DATE Feb. 8, 1963. COMPILED BY T.F.W.
 DATUM Geodetic BOREHOLE TYPE 5" Ø Auger CHECKED BY H.S.

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W			BULK DENSITY P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. + Field Vane o Unconfined Shear Strength 500 1000 1500 2000 2500					WP	W	WL		
615.0	Groundlevel					620										
0.0			1	SS	14	610										134.0
			2	SS	31											142
			3	SS	37											137
	Hard to firm Brown to grey clayey silt with sand and gravel.		4	TW	PH	600				2						131
			5	TW	PH			1.8								132
			6	TW	PH	590			1.8							125
			7	TW	PH				1.8							128
			8	TW	PH	580				1.5						128
			9	TW	PH											130
							570									
							560									
							550									
						540										
						530										
						520										
						510										
494.5						500										
120.5	End of borehole Probable Bedrock															

 ∇wl 599'
 16.0

MINISTRY OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

03-F-12 LOCATION 278+12 50.0' Lt. ORIGINATED BY T.F.W.
03-63 BORING DATE Feb. 11, 1963. COMPILED BY T.F.W.
Geodetic BOREHOLE TYPE 5" Ø Auger CHECKED BY H.S.

SOIL PROFILE		SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT ——— WL	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W	BULK DENSITY P.C.F.	REMARKS
DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. + Field Vane o Unconfined Shear Strength	WATER CONTENT % 20 40 60				
19.0 Groundlevel					620						
0.0 Hard to firm Brown to grey clayey silt with sand and gravel.		1	SS	27	610					137	
		2	SS	36						137.0	
		3	TW	PH	600	2.0 +				132.0	
		4	TW	PH		2.0 +				127.0	
		5	SS	9	590	2.1 +					
		6	SS	21		1.8 +				132.0	
34.5											
30.5 End of borehole.					580						

390210 E
4755500 N 403164



LEGEND

- Bore Hole
- Cone Penetration Test
- Bore & Fine Penetration Test
- Water Level Station

NO.	ELEVATION	STATION	OFFSET
1	619.5	276+14	53'LT
2	614.0	275+52	6'
3	614.0	275+52	48'RT
4	620.0	276+55	35'RT
5	619.5	276+55	29'LT
6	615.0	277+65	38'RT
7	615.0	278+00	49'PT
8	615.0	278+12	50'LT

NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

DATE	BY	DESCRIPTION

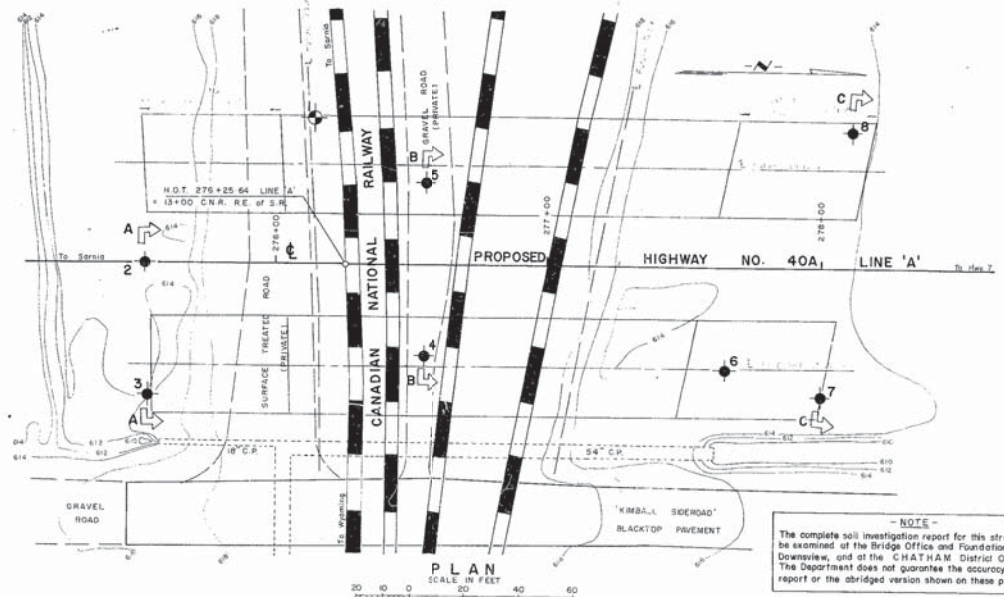
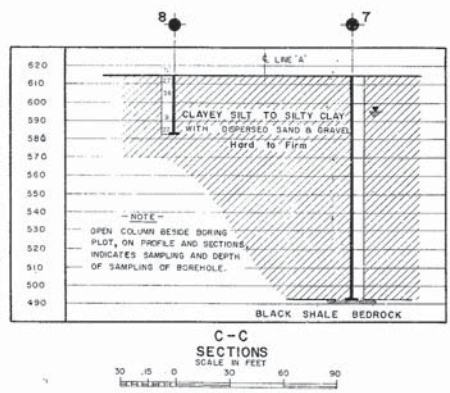
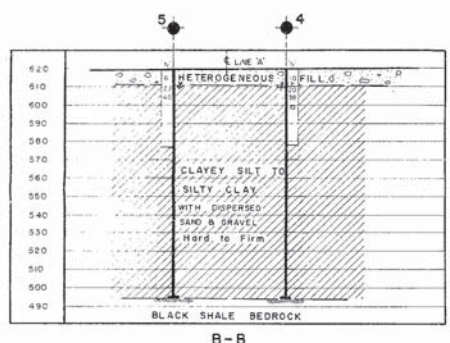
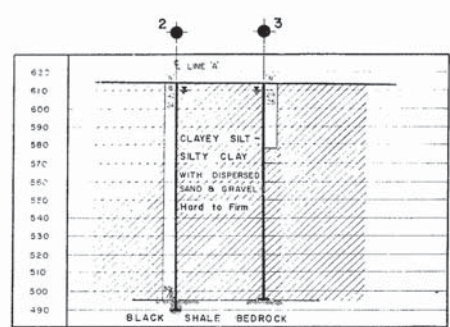
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION - FOUNDATION SECTION

CANADIAN NATIONAL RAILWAY

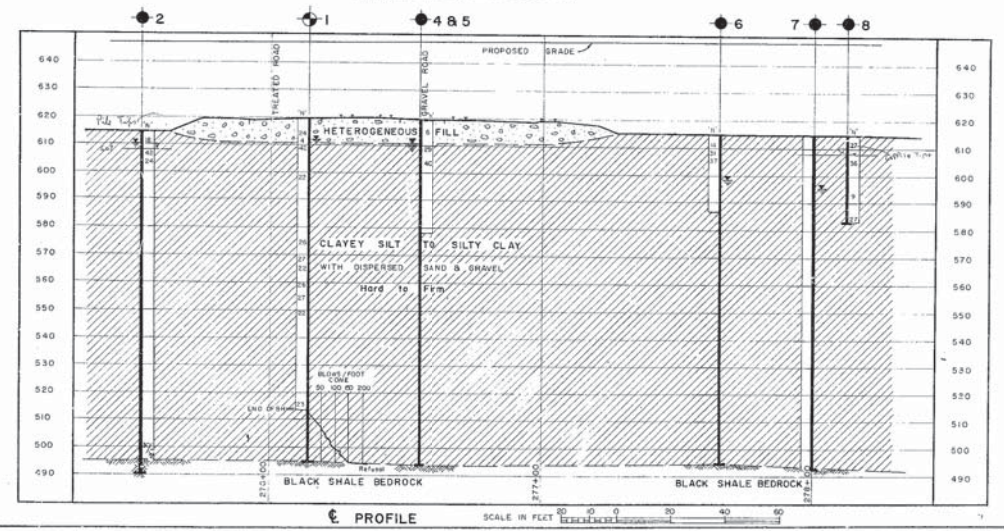
KING'S HIGHWAY NO. 40A LINE 'A' REVISION DIST NO. 1
CO. LAMBTON
TWP. SARINIA LOT 15 & 16 CON. IV

BORE HOLE LOCATIONS & SOIL STRATA

DESIGNED BY: CHECKED BY: DATE: FEB. 8, 1963
DRAWN BY: C.C. CHEN
BRIDGE DRAWING NO. 63-F-12A
APPROVED BY: [Signature] CONT NO.



NOTE
The complete soil investigation report for this structure may be examined at the Bridge Office and Foundation Office, Owen Sound, and at the CHATHAM District Office. The Department does not guarantee the accuracy of this report or the abridged version shown on these plans.



SOME DEFECTS IN NEGATIVE DUE
TO CONDITION OF ORIGINAL DOCUMENTS



APPENDIX B

Borehole Location Plan & Profile – Drawings DWGs E-1 and E-2

Explanations of Terms Used in Report

Record of Borehole Sheets:

C-2, C-3, CN-2 to CN-5, CN-7 to CN-10, RW-1, RW-2, and T-1 to T-4

Results of Grain Size Distribution Analyses:

Figures GS-1, GS-2, GS-3A to 3C, GS-4, GS-5A to 5C and GS-6

Results of Atterberg Limit Tests (Plasticity Charts):

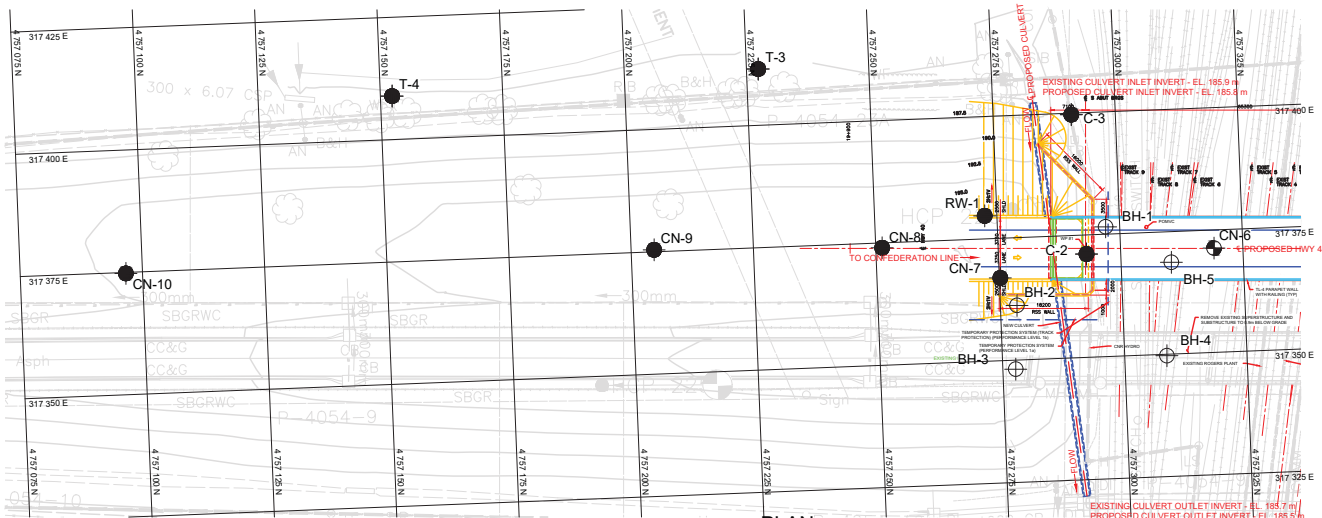
Figures PC-1, PC-2, PC-3A to 3C, PC-4, PC-5A to 5C and PC-6

Results of One-Dimensional Consolidation Tests - Figure Nos. CT-1 to CT-3

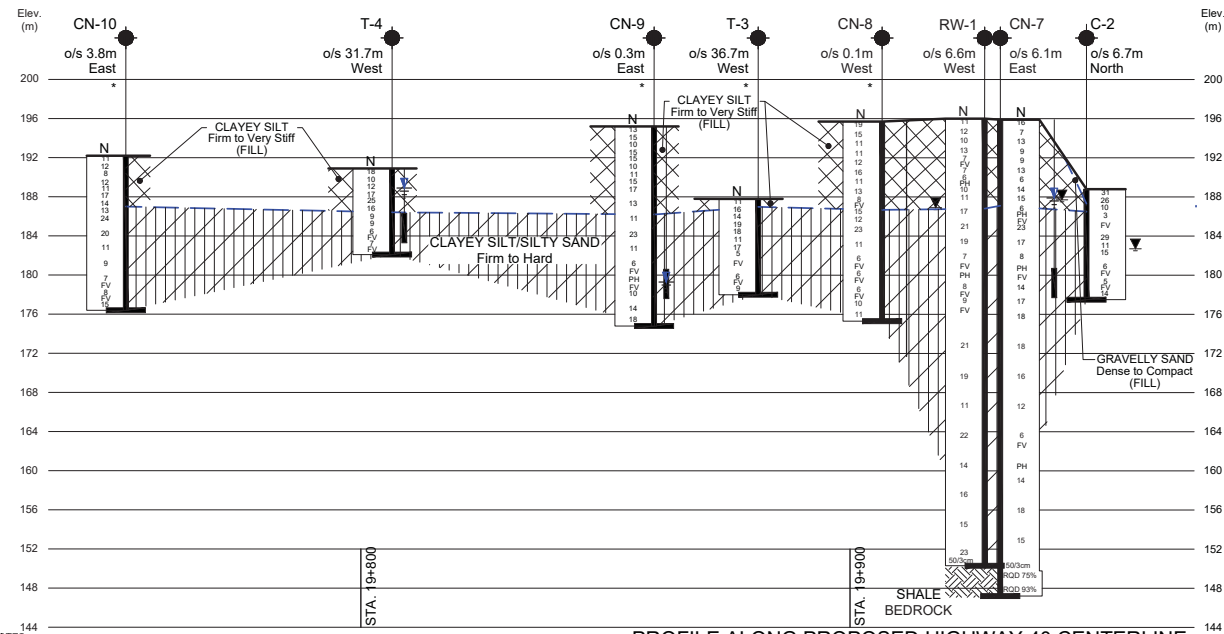
Results of Unconfined Compressive Strength Tests on Rock

Rock Core Description Logs

Rock Core Photographs



PLAN
SCALE
10 0 10 20m



PROFILE ALONG PROPOSED HIGHWAY 40 CENTERLINE

SCALE
HORIZONTAL: 10 0 10 20m
VERTICAL: 5 0 5 10m

NOTES:

- DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.
- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF THE REPORT AND RECORD OF BOREHOLE SHEETS.

CONT No.
GWP No. 3064-11-00
WP No. 3064-11-02

NEW EMBANKMENT ON HIGHWAY 40
AT CNR OVERHEAD
BOREHOLE LOCATION PLAN & PROFILE



SHEET

Peto MacCallum Ltd.
CONSULTING ENGINEERS



KEY MAP
125m 0 250m 500m

LEGEND

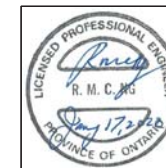
- Borehole Location (Current Investigation - Sept. 2020)
- Canceled Borehole Location (Current Investigation - Sept. 2020)
- Previous Borehole Location (GEOCRE 40J16-058)
- Blows/0.3m (Std. Pen. Test, 475 Jblow)
- Monitoring Well
- Water Level Upon Completion of Drilling
- Water Level in Monitoring Well (August 2020)
- Water Level Not Encountered During Investigation

BH No.	ELEVATION	NORTHINGS	EASTINGS
BOREHOLE LOCATIONS (CURRENT INVESTIGATION - SEPT. 2020)			
CN-7	195.9	4 757 275.2	317 383.1
CN-8	195.7	4 757 251.3	317 376.0
CN-9	195.2	4 757 204.7	317 374.6
CN-10	192.2	4 757 096.6	317 375.2
T-3	187.8	4 757 227.4	317 338.5
T-4	190.9	4 757 152.5	317 341.2
RW-1	196.0	4 757 272.5	317 370.3
C-2	188.8	4 757 293.0	317 378.9
C-3	188.5	4 757 291.0	317 350.3
PREVIOUS BOREHOLES (GEOCRE 40J16-058)			
BH-1	178.6	4 757 297.1	317 373.5
BH-2	178.5	4 757 278.4	317 388.8
BH-3	178.1	4 757 277.6	317 401.9
BH-4	178.1	4 757 308.6	317 400.3
BH-5	177.9	4 757 310.3	317 381.3

NOTE

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

DATE	BY	DESCRIPTION
Geocres No. 40J16-91		
HWY No. 40		Dist West Region
SUBM'D NL	CHECKED NR	DATE JAN 17, 2022
DRWN NL	CHECKED	APPROVED RN
		DATE 14X-0290/B2
		DWG E-1



REF WSP Drawing: GWP S3813001-330-001GA.dwg, Dated Dec., 2021



LEGEND

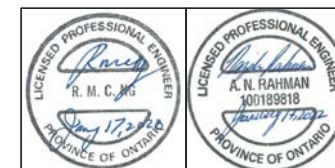
- Borehole Location (Current Investigation - Sept. 2020)
- ⊕ Previous Borehole Location (GECRES 40J16-058)
- N Blows/0.3m (Std. Pen. Test, 475 J/blow)
- Monitoring Well
- Water Level Upon Completion of Drilling
- Water Level in Monitoring Well (August 2020)
- * Water Level Not Encountered During Investigation

BH No.	ELEVATION	NORTHINGS	EASTINGS
BOREHOLE LOCATIONS (CURRENT INVESTIGATION - SEPT. 2020)			
CN-2	192.0	4 757 526.4	317 390.6
CN-3	194.7	4 757 439.1	317 381.7
CN-4	195.5	4 757 383.4	317 380.4
CN-5	195.4	4 757 360.6	317 387.2
T-1	187.0	4 757 487.3	317 361.9
T-2	186.6	4 757 397.2	317 351.0
RW-2	195.4	4 757 366.4	317 373.8
PREVIOUS BOREHOLES (GECRES 40J16-058)			
BH-5	177.9	4 757 310.3	317 381.3
BH-6	172.1	4 757 340.7	317 403.7
BH-7	178.2	4 757 351.7	317 406.5
BH-8	178.6	4 757 356.2	317 378.4

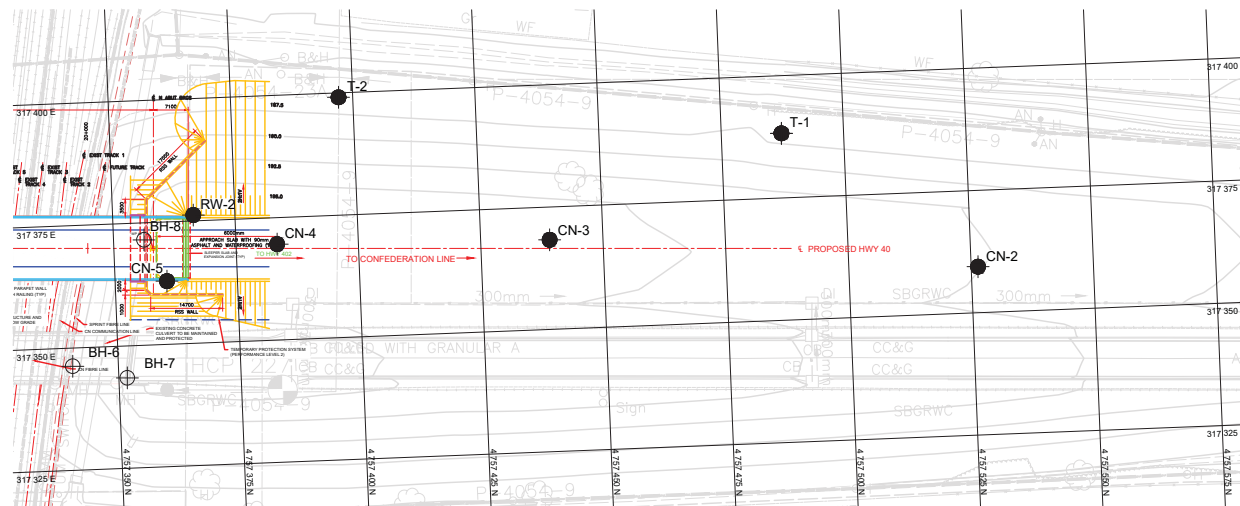
NOTE

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

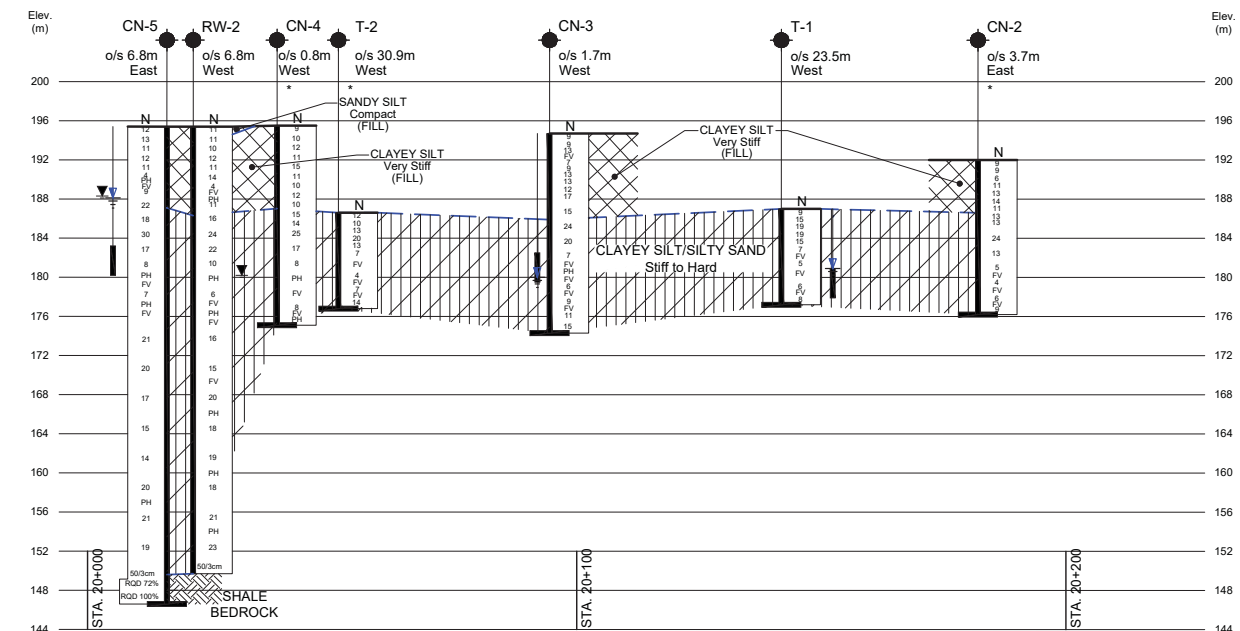
DATE	BY	DESCRIPTION
2022	RY	
Geocres No. 40J16-91		
HWY No. 40	CHECKED NR	DATE JAN 17, 2022
SUBM'D NL	CHECKED	APPROVED RN
DRAWN NL	CHECKED	APPROVED RN



REF WSP Drawing: GWP S3813001-330-001GA.dwg, Dated Dec., 2021



PLAN SCALE
10 0 10 20m



NOTES:

- DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.
- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF THE REPORT AND RECORD OF BOREHOLE SHEETS.

SCALE
HORIZONTAL: 10 0 10 20m
VERTICAL: 5 0 5 10m

EXPLANATION OF TERMS USED IN REPORT

SPT N VALUE: THE STANDARD PENETRATOIN TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT-BARREL SAMPLER TO PENETRATE 0.3 m, AFTER AN INITIAL PENETRATIO OF 150 mm, INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5 kg, FALLING FREELY A DISTANCE OF 0.76 m FOR PENETRATIONS. A SPT N VALUE IS INDICATED AS THE NUMBER OF BLOWS REQUIRED TO DRIVE THE SPLIT-BARREL SAMPLER A DISTANCE OF 300 MM. AN AVERAGE SPT N VALUE IS DENOTED as \bar{N} .

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION, CONSISTENCY OR COMPACTNESS.

COMPOSITION: SECONDARY SOIL COMPONENTS ARE DESCRIBED ON THE BASIS OF PERCENTAGE BY MASS OF THE WHOLE SAMPLE AS FOLLOWS:

PERCENTAGE BY MASS	0 - 10	10 - 20	20 -35	>35	>35 and main fraction
	'trace'	'some'	Adjective (silty, sandy, clayey etc.)	'and'	Noun (gravel, sand, silt, clay)

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

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

N (BLOWS/0.3 m PENETRATION)	0 - 4	4 - 10	10 -30	30 - 50	>50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

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

TOTAL CORE RECOVERY (REC): CORE RECOVERED AS A PERCENTAGE OF TOTAL CORE RUN LENGTH.

ROCK QUALITY DESIGNATION (RQD): TOTAL LENGTH OF SOUND ROCK RECEIVED IN PIECES 10 cm OR LARGER AS A PERCENTAGE OF TOTAL CORE RUN LENGTH. CLASSIFICATION OF ROCK WITH RESPECT TO RQD VALUE AS FOLLOWS:

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

UNIAXIAL COMPRESSIVE STRENGTH (UCS): MAXIMUM AXIAL COMPRESSIVE STRESS THAT A ROCK CORE SPECIMEN CAN WITHSTAND BEFORE FAILING.

POINT LOAD STRENGTH INDEX: AN INDEX TEST TO DETERMINE POINT LOAD STRENGTH INDEX OF ROCK.

CLASSIFICATION OF ROCK WITH RESPECT TO STRENGTH IS AS FOLLOWS:

GRADE*	R0	R1	R2	R3	R4	R5	R6
UCS (MPa)	0.25 - 1	1 - 5	5 - 25	25 - 50	50 - 100	100 - 250	>250
POINT LOAD INDEX (MPa)	**	**	**	1 - 2	2 - 4	4 - 10	>10
TERM	EXTREMELY WEAK	VERY WEAK	WEAK	MEDIUM STRONG	STRONG	VERY STRONG	EXTREMELY STRONG

* - GRADE ACCORDING TO THE INTERNATIONAL SOCIETY OF ROCK MECHANICS (ISRM), 1981.

** - ROCKS WITH UNIAXIAL COMPRESSIVE STRENGTH BELOW 25 MPa ARE LIKELY TO YIELD HIGHLY AMBIGUOUS RESULTS UNDER POINT LOAD TESTING.

DISCONTINUITY SPACING: DISTANCE BETWEEN A PAIR OF DISCONTINUITIES MEASURED ALONG A LINE OF SPECIFIED LOCATION AND ORIENTATION. CLASSIFICATION OF ROCK WITH RESPECT TO DISCONTINUITY SPACING IS AS FOLLOWS (ISRM, 1981):

SPACING WIDTH (m)	<0.02	0.02 - 0.06	0.06 - 0.20	0.20 - 0.6	0.6 - 2.0	2.0 - 6.0	>6.0
SPACING CLASSIFICATION	EXTREMELY CLOSE	VERY CLOSE	CLOSE	MODERATELY CLOSE	WIDE	VERY WIDE	EXTREMELY WIDE

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS – SPLIT SPOON
WS – WASH SAMPLE
AS – AUGER SAMPLE
FV – FIELD VANE
CS – CHUNK SAMPLE
TW – THINWALL SHELBY TUBE SAMPLE
PH – TW ADVANCED HYDRULICALLY
PM – TW ADVANCED MANUALLY

TP – THINWALL PISTON SAMPLE
OS – OSTERBERG SAMPLE
RC – ROCK CORE
BS – BLOCK SAMPLE
FS – FOIL SAMPLE

STRESS AND STRAIN

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

MECHANICAL PROPERTIES OF SOIL

C_c	COMPRESSION INDEX
C_{cr}	RECOMPRESSION INDEX
C_s	SWELL INDEX
c_v	COEFFICIENT OF CONSOLIDATION – VERTICAL (cm ² /s)
c_h	COEFFICIENT OF CONSOLIDATION – HORIZONTAL (cm ² /s)
C_α	COEFFICIENT OF SECONDARY CONSOLIDATION
m_v	COEFFICIENT OF VOLUME CHANGE (kPa ⁻¹)
σ'_p	PRECONSOLIDATION PRESSURE (kPa)
σ'_{vo}	EFFECTIVE OVERBURDEN PRESSURE (kPa)
H	DRAINAGE PATH (m)
U	DEGREE OF CONSOLIDATION
T_v	TIME FACTOR; VERTICAL DRAINAGE
T_h	TIME FACTOR; HORIZONTAL DRAINAGE
S_{at}, c_u	UNDRAINED SHEAR STRENGTH (kPa)
S_R	RESIDUAL SHEAR STRENGTH (kPa)
S_r	REMOULDED SHEAR STRENGTH (kPa)
σ_c	UNIAXIAL COMPRESSIVE STRENGTH (kPa)
c'	EFFECTIVE COHESION INTERCEPT (kPa)
c	APPARENT COHESION INTERCEPT (kPa)
Φ'	EFFECTIVE ANGLE OF INTERNAL FRICTION (Degrees)
S_t	SENSITIVITY (= c_u'/S_c)
I_p	POINT LOAD STRENGTH INDEX

PHYSICAL PROPERTIES

W _p – PLASTIC LIMIT (%)	W _L – LIQUID LIMIT (%)	W – MOISTURE CONTENT (%)
W _s – SHRINKAGE LIMIT (%)	I _p – PLASTICITY INDEX (%)	γ_w – UNIT WEIGHT OF WATER (kg/m ³)
γ – UNIT WEIGHT OF SOIL (kg/m ³)	γ_{sat} – UNIT WEIGHT OF SATURATED SOIL (kg/m ³)	γ_d – UNIT WEIGHT OF DRY SOIL (kg/m ³)
ρ_w – DENSITY OF WATER (kN/m ³)	ρ – DENSITY OF SOIL (kN/m ³)	ρ_{sat} – DENSITY OF SATURATED SOIL (kN/m ³)
ρ_d – DENSITY OF DRY SOIL (kN/m ³)	S_r – DEGREE OF SATURATION (%)	D_r, SG – RELATIVE DENSITY (FORMERLY SPECIFIC GRAVITY)
C_u – UNIFORMITY COEFFICIENT	C_c – CURVATURE COEFFICIENT	

RECORD OF BOREHOLE No C-2

1 OF 1

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 293.0 N; 317 378.9 E ORIGINATED BY M.M.
DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
DATUM Geodetic DATE 2020.09.10 LATITUDE 42.955329 LONGITUDE -82.345831 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							W _p	W	W _L
188.8	Ground Surface						20	40	60	80	100						
0.0	Gravelly SAND, trace silt		1	SS	31												
	Dense to compact, Brown, Moist		2	SS	26												
	CLAYEY SILT		3	SS	10												
	Stiff, Brown, Moist (FILL)																
186.5	SILTY CLAY TO CLAYEY SILT, sandy to some sand, trace gravel		4	SS	3												
2.3	Firm to very stiff, Brown, Moist																
				VANE	FV												
			5	SS	29												
			6	SS	11												
			7	SS	15												
			8	SS	6												
				VANE	FV												
			9	SS	5												
				VANE	FV												
			10	SS	14												
177.5	End of borehole																
11.3																	
	<div>Groundwater level measured upon completion of drilling</div> <div>NOTE: No cave-in was noted inside the borehole upon extraction of hollow stem augers.</div>																

Groundwater level measured
upon completion of drilling
NOTE: No cave-in was noted inside the
borehole upon extraction of
hollow stem augers.

>>: Greater than

+³, X³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No C-3

1 OF 3

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 291.0 N; 317 350.3 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE CFHS Augers + Mud Rotary at 3.7 m + HQ Rock Coring COMPILED BY N.L.
 DATUM Geodetic DATE 2020.09.03 - 2020.09.10 LATITUDE 42.955311 LONGITUDE -82.346182 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
188.5	Ground Surface													
0.0	SAND AND GRAVEL, trace silt		1	SS	29		188							
	Compact, Brown, Dry													
	CLAYEY SILT, some sand, trace gravel		2	SS	9									
	Soft to stiff, Brown, Moist (FILL)													
187.0	SILTY CLAY/CLAYEY SILT, some sand/		3	SS	3		187							
1.5	sandy, trace gravel													
	Stiff to hard, Brown, Moist			VANE	FV		186							
			4	SS	6									
							185							
			5	TW	PH									
							184							
			6	SS	35									
							183							
			7	SS	7									
							182							
				VANE	FV									
							181							
			8	SS	1									
							180							
				VANE	FV									
			9	TW	PH		179							
							178							
			10	SS	16									
							177							
			11	SS	16		176							
							175							
			12	SS	12		174							
173.5														

Continued Next Page

>>: Greater than

+³, X³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No C-3

2 OF 3

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 291.0 N; 317 350.3 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE CFHS Augers + Mud Rotary at 3.7 m + HQ Rock Coring COMPILED BY N.L.
 DATUM Geodetic DATE 2020.09.03 - 2020.09.10 LATITUDE 42.955311 LONGITUDE -82.346182 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						W _P W W _L WATER CONTENT (%)			GR	SA	SI	CL
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
173.5								20	40	60	80	100								
15.0	CLAYEY SILT/SILTY CLAY, trace/some sand, trace gravel																			
	Stiff to very stiff, Grey, Moist		13	SS	22		173							4	1	12	45	42		
							172													
			14	SS	27		171							○						
							170							□	○					
			15	SS	28		169													
							168							○						
							167													
							166													
			17	SS	4		165							○						
				VANE	FV		164							+ ¹						
							163													
			18	SS	11		162							□	□		3	8	46	43
							161													
							160													
			19	SS	17		159							○						
158.5																				

Continued Next Page

>>: Greater than

+³, X³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

METRIC

ONTARIO MTO 20TF016.GPJ ONTARIO MTO.GDT 21-9-21

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-2

1 OF 2

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 526.4 N; 317 390.6 E ORIGINATED BY M.M.
DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
DATUM Geodetic DATE 2020.08.05 LATITUDE 42.957429 LONGITUDE -82.345683 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
192.0	Ground Surface													
0.0	CLAYEY SILT, some sand, trace gravel Stiff, Brown to Grey, Moist (FILL)		1	SS	9									
			2	SS	9		191							
			3	SS	6		190							
			4	SS	11									
			5	SS	13		189							
			6	SS	14		188							
			7	SS	11		187							
186.6	CLAYEY SILT/SILTY CLAY, some sand, trace gravel Very stiff to stiff, Grey, Moist		8	SS	13		186							1 20 43 36
5.4			9	SS	13		185							
			10	SS	24		184							
			11	SS	13		183							1 16 44 39
			12	SS	5		181							
			VANE	FV			180							
			13	SS	4		179							
			VANE	FV			178							3 14 44 39
177.0			VANE	FV										

Continued Next Page

>>: Greater than

+³, X³: Numbers refer to
Sensitivity


○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-2

2 OF 2

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 526.4 N; 317 390.6 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.08.05 LATITUDE 42.957429 LONGITUDE -82.345683 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
177.0								20	40	60	80	100		
15.0	CLAYEY SILT, some sand, trace gravel													
	Stiff, Grey, Moist		15	SS	9									
176.2														
15.8	End of borehole													
NOTES:														
1. Groundwater level was not encountered during or upon completion of drilling.														
2. No cave-in was noted upon extraction of hollow stem augers.														

RECORD OF BOREHOLE No CN-3

1 OF 2

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 439.1 N; 317 381.7 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.08.04 - 2020.08.05 LATITUDE 42.956643 LONGITUDE -82.345794 CHECKED BY N.R.

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							
194.7	Ground Surface							20 40 60 80 100							
0.0	CLAYEY SILT/SILTY CLAY, some sand, trace gravel		1	SS	9		194					○			
	Stiff to very stiff, Brown to grey, Moist (FILL)		2	SS	9		193					○			
			3	SS	13		192					○			
			VANE	FV			191					○			
			4	SS	7		190					○			
			5	SS	9		189					○			
			6	SS	13		188					○			
			7	SS	13		187					○			
			8	SS	12		186					○			
			9	SS	17		185					○			
			10	SS	15		184					○			
185.9	CLAYEY SILT/SILTY CLAY, some sand, trace gravel		11	SS	24		183					○			
8.8	Very stiff to stiff, Grey, Moist		12	SS	20		182					○			
			13	SS	7		181					○			
			VANE	FV			180					○			
			14	TW	PH							○			
			VANE	FV								○			
179.7												○			

Continued Next Page

>>: Greater than

+³, X³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-3

2 OF 2

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 439.1 N; 317 381.7 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.08.04 - 2020.08.05 LATITUDE 42.956643 LONGITUDE -82.345794 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)												
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)																
179.7	CLAYEY SILT/SILTY CLAY, some to trace sand, trace gravel Stiff, Grey, Moist														GR SA SI CL												
15.0			15	SS	6																						
								VANE	FV																		
			16	SS	9																						
								VANE	FV																		
			17	SS	11																						
			18	SS	15																						
174.3	End of borehole													2 9 49 40													
20.4	<div><div></div><div>Groundwater level measured in monitoring well</div></div> <div>NOTES: 1. Groundwater level was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers. 3. The shear vane test conducted at depth 2.1 m (EL. 192.6) below the existing ground surface, was carried out in a second borehole drilled adjacent to Borehole CN-3. 4. Gas reading on Aug. 17 2020: LEL = 0%. 5. Gas reading on Aug. 27 2020: LEL = 6%. 1 minute to dissipate. Monitoring well decommissioned.</div> <div>Monitoring Well Readings:<table><tr><th>Date</th><th>Depth (m)</th><th>Elev.</th></tr><tr><td>Aug.10/20</td><td>17.0</td><td>177.7</td></tr><tr><td>Aug.17/20</td><td>17.5</td><td>177.2</td></tr><tr><td>Sep.12/20</td><td>14.7</td><td>180.0</td></tr></table></div> <div>Monitoring Well Legend:<div><div></div>Concrete</div><div><div></div>Bentonite seal</div><div><div></div>Filter sand</div><div><div></div>Screen</div></div>															Date	Depth (m)	Elev.	Aug.10/20	17.0	177.7	Aug.17/20	17.5	177.2	Sep.12/20	14.7	180.0
Date	Depth (m)	Elev.																									
Aug.10/20	17.0	177.7																									
Aug.17/20	17.5	177.2																									
Sep.12/20	14.7	180.0																									

ONTARIO MTO 20TF016.GPJ ONTARIO MTO.GDT 21-9-21

>>: Greater than

+³, X³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-4

1 OF 2

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 383.4 N; 317 380.4 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.08.04 LATITUDE 42.956142 LONGITUDE -82.345811 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
195.5	Ground Surface							20	40	60	80	100								
0.0	CLAYEY SILT/SILTY CLAY, some sand, trace gravel		1	SS	9		195							○						
	Stiff to very stiff, Grey, Moist (FILL)		2	SS	10									○						
			3	SS	12		194							○						
			4	SS	11		193							○						
			5	SS	15		192							○						
			6	SS	11		191							○						
			7	SS	10									○						
			8	SS	12		190							○						
			9	SS	10		189							○						
							188							○						
			10	SS	15									○						
187.2	CLAYEY SILT, some sand, trace gravel						187													
8.3	Very stiff to stiff, Grey, Moist		11	SS	14		186							○						
			12	SS	25		185							○						
							184													
			13	SS	17		183							○						
			14	SS	8		182							○						
							181							○						
180.5																				

Continued Next Page

>>: Greater than

+³, ×³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-4

2 OF 2

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 383.4 N; 317 380.4 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.08.04 LATITUDE 42.956142 LONGITUDE -82.345811 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
180.5														
15.0	CLAYEY SILT, some sand, trace gravel Stiff, Grey, Moist		15	TW	PH		180						16.8	3 14 44 39 SG = 2,740
							179							
				VANE	FV		178							
			16	SS	8		177							1 13 47 39
				VANE	FV		176							
			17	TW	PH									
175.1	End of borehole													
20.4	NOTES: 1. Groundwater level was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers. 3. The shear vane test conducted at depth 14.6 m (EL. 180.9) below the existing ground surface, was carried out in a second borehole drilled adjacent to Borehole CN-4.													

>>: Greater than

+³, X³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-5

1 OF 4

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 360.6 N; 317 387.2 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers + HQ Rock Coring COMPILED BY N.L.
 DATUM Geodetic DATE 2020.07.27 LATITUDE 42.955937 LONGITUDE -82.345729 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
195.4	Ground Surface													
0.0	CLAYEY SILT, some sand, trace gravel Stiff to very stiff, Brown, Moist (FILL)		1	SS	12		195						○	
			2	SS	13		194						○	
			3	SS	11		193						○	
			4	SS	12		192						○	
			5	SS	11		191						○	
			6	SS	4		190						○	
			7	TW	PH		189						○	
				VANE	FV		188						○	
			8	SS	9		187						○	
							186						○	
			9	SS	22		185						○	
187.1	CLAYEY SILT/SILTY CLAY, some sand, trace gravel Very stiff to stiff, Brown, Moist		10	SS	18		184						○	
8.3			11	SS	30		183						○	
			12	SS	17		182						○	
			13	SS	8		181						○	
180.4														

Continued Next Page

>>: Greater than

+³, ×³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-5

2 OF 4

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 360.6 N; 317 387.2 E ORIGINATED BY M.M.
DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers + HQ Rock Coring COMPILED BY N.L.
DATUM Geodetic DATE 2020.07.27 LATITUDE 42.955937 LONGITUDE -82.345729 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
180.4														
15.0	CLAYEY SILT/SILTY CLAY, some to trace sand, trace gravel Stiff to very stiff, Brown, Moist		14	TW	PH		180						20.3	2 14 45 39 SG = 2.755 e _s = 0.649 P _c = 430 kPa C _c = 0.334 C _{cr} = 0.052
				VANE	FV		179							
			15	SS	7		178							3 14 45 38
							177							
			16	TW	PH		176							
				VANE	FV		175							
							174							
			17	SS	21		173							
							172							
							171							0 9 47 44
			18	TW	20		170							
							169							
							168							
			19	SS	17		167							
							166							

Continued Next Page

>>: Greater than

+³, X³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-5

3 OF 4

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 360.6 N; 317 387.2 E ORIGINATED BY M.M.
DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers + HQ Rock Coring COMPILED BY N.L.
DATUM Geodetic DATE 2020.07.27 LATITUDE 42.955937 LONGITUDE -82.345729 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
165.4														
30.0	CLAYEY SILT/SILTY CLAY, trace to some sand, trace gravel Very stiff, Brown, Moist						165							
			20	SS	15		164							
							163							
							162							
			21	SS	14		161							
							160							
							159							
			22	SS	20		158							
							157							
			23	TW	PH		156							
							155							
			24	SS	21		154							
							153							
			25	SS	19		152							
							151							
150.4														

Continued Next Page

>>: Greater than

+³, X³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-5

4 OF 4

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 360.6 N; 317 387.2 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers + HQ Rock Coring COMPILED BY N.L.
 DATUM Geodetic DATE 2020.07.27 LATITUDE 42.955937 LONGITUDE -82.345729 CHECKED BY N.R.

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																					
150.4								20	40	60	80	100																	
45.0	CLAYEY SILT, some sand, trace gravel						150																						
	Hard, Brown, Moist																												
149.6			26	SS	50/3cm																								
45.8	SHALE BEDROCK																												
	Unweathered		RUN 1	RC HQ	RQD 72%		149										REC = 74% UCS = 71.7 MPa												
							148																						
			RUN 2	RC HQ	RQD 100%		147										REC = 100% UCS = 84.0 MPa												
146.6	End of borehole																												
48.8	<div>▼ Groundwater level measured upon completion of drilling</div> <div>▼ Groundwater level measured in monitoring well</div> <div>NOTES: 1. No cave-in was noted upon extraction of hollow stem augers. 2. Gas pocket encountered from EL. 148.6 to EL. 149.6. LEL = 100%. 45 minutes taken to dissipate before rock coring. 3. Gas reading on Aug. 17 2020: LEL = 0%. 4. Gas reading on Aug. 27 2020: LEL = 0%. Monitoring well decommissioned.</div> <div>Monitoring Well Readings: <table><tr><th>Date</th><th>Depth (m)</th><th>Elev.</th></tr><tr><td>Jul. 29/20</td><td>7.3</td><td>188.1</td></tr><tr><td>Aug.10/20</td><td>7.1</td><td>188.3</td></tr><tr><td>Aug.17/20</td><td>6.7</td><td>188.7</td></tr></table></div> <div>Monitoring Well Legend: <div> Concrete</div><div> Bentonite seal</div><div> Filter sand</div><div> Screen</div></div>																	Date	Depth (m)	Elev.	Jul. 29/20	7.3	188.1	Aug.10/20	7.1	188.3	Aug.17/20	6.7	188.7
Date	Depth (m)	Elev.																											
Jul. 29/20	7.3	188.1																											
Aug.10/20	7.1	188.3																											
Aug.17/20	6.7	188.7																											

ONTARIO MTO 20TF016.GPJ ONTARIO MTO.GDT 21-9-21

>>: Greater than

+³, X³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-7

1 OF 4

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 275.2 N; 317 383.1 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers + HQ Rock Coring COMPILED BY N.L.
 DATUM Geodetic DATE 2020.07.20 - 2020.07.21 LATITUDE 42.955168 LONGITUDE -82.34578 CHECKED BY N.R.

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						
195.9	Ground Surface							20 40 60 80 100						
0.0	CLAYEY SILT, some sand/sandy, trace/some gravel		1	NR	16			○ UNCONFINED + FIELD VANE						
	Stiff to very stiff, Brown, Moist (FILL)		2	SS	7		195			>>	○			
			3	SS	13		194				○			
			4	SS	9		193				○			
			5	SS	9		192				—○—			6 34 29 31
			6	SS	13		191				○			
			7	SS	6		190					○		
			8	SS	14		189					○		
			9	SS	15		188					○		
			10	SS	6		187					—○—		
186.9	CLAYEY SILT/SILTY CLAY, sandy, trace gravel		11	TW	PH		186			>>			18.1	16 35 30 19 SG = 2.709
9.0	Very stiff to stiff, Grey, Moist			VANE	FV		185					○		
			12	SS	23		184							
			13	SS	17		183					○		
			14	SS	8		182					○		
180.9							181							

Continued Next Page

>>: Greater than

+³, ×³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-7

2 OF 4

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 275.2 N; 317 383.1 E ORIGINATED BY M.M.
DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers + HQ Rock Coring COMPILED BY N.L.
DATUM Geodetic DATE 2020.07.20 - 2020.07.21 LATITUDE 42.955168 LONGITUDE -82.34578 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	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		20 40 60 80 100	20 40 60 80 100					
180.9													
15.0	CLAYEY SILT/SILTY CLAY, some to trace sand, trace gravel Very stiff to stiff, Grey, Moist		15	TW	PH							20.4	4 14 46 36 SG = 2.744 e _p = 0.624 P _c = 491 kPa C _c = 0.301 C _{cr} = 0.065
				VANE	FV								
			16	SS	14								3 9 48 40
			17	SS	17								
			18	SS	18								
			19	SS	18								
			20	SS	16								2 8 44 46
			21	SS	12								
165.9													

Continued Next Page

>>: Greater than

+³, ×³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-7

3 OF 4

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 275.2 N; 317 383.1 E ORIGINATED BY M.M.
DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers + HQ Rock Coring COMPILED BY N.L.
DATUM Geodetic DATE 2020.07.20 - 2020.07.21 LATITUDE 42.955168 LONGITUDE -82.34578 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			
								○ UNCONFINED		+ FIELD VANE										
								● QUICK TRIAXIAL		× LAB VANE										
165.9							20	40	60	80	100	20	40	60						
30.0	CLAYEY SILT/SILTY CLAY, trace sand, trace gravel																			
	Stiff to very stiff, Grey, Moist																			
										</										

Continued Next Page

>>: Greater than

+³, ×³: Numbers refer to
Sensitivity









○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-7

4 OF 4

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 275.2 N; 317 383.1 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers + HQ Rock Coring COMPILED BY N.L.
 DATUM Geodetic DATE 2020.07.20 - 2020.07.21 LATITUDE 42.955168 LONGITUDE -82.34578 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL													
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								WATER CONTENT (%)												
150.9								20	40	60	80	100																
45.0	SILTY CLAY, trace sand, trace gravel																											
	Hard, Grey, Moist		27	SS	50/3cm																							
150.2																												
45.7	SHALE BEDROCK																											
	Unweathered		Run 1	RC HQ	RQD 75%		150										REC = 78% UCS = 84.1 MPa											
							149																					
			Run 2	RC HQ	RQD 93%		148										REC = 93% UCS = 60.8 MPa											
147.2																												
48.7	End of borehole																											
	<div> Groundwater level measured upon completion of drilling</div> <div> Groundwater level measured in monitoring well</div> <div>NOTES: 1. No cave-in was noted upon extraction of hollow stem augers. 2. The shear vane tests conducted at depths 0.8 m (EL. 195.1) and 4.6 m (EL. 191.3) below the existing ground surface, were carried out in a second borehole drilled adjacent to Borehole CN-7. 3. Gas pocket encountered from EL. 149.2 to EL. 150.2. LEL = 100%. 45 minutes taken to dissipate before rock coring. 4. Gas reading on Aug. 17 2020: LEL = 5% to LEL = 0% in 30 seconds. 5. Gas reading on Aug. 27 2020: LEL = 1% to LEL = 0% in 15 seconds. Monitoring well decommissioned.</div> <div><div>Monitoring Well Readings:</div><table><tr><th>Date</th><th>Depth (m)</th><th>Elev.</th></tr><tr><td>Jul. 22/20</td><td>8.0</td><td>187.9</td></tr><tr><td>Aug. 10/20</td><td>7.9</td><td>188.0</td></tr><tr><td>Aug. 17/20</td><td>8.9</td><td>187.0</td></tr></table><div>Monitoring Well Legend:</div><div><div> Concrete</div><div> Bentonite seal</div><div> Filter sand</div><div> Screen</div></div></div>	Date	Depth (m)	Elev.	Jul. 22/20	8.0	187.9	Aug. 10/20	7.9	188.0	Aug. 17/20	8.9	187.0															
Date	Depth (m)	Elev.																										
Jul. 22/20	8.0	187.9																										
Aug. 10/20	7.9	188.0																										
Aug. 17/20	8.9	187.0																										

ONTARIO MTO 20TF016.GPJ ONTARIO MTO.GDT 21-9-21

>>: Greater than

+ 3, X 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-8

1 OF 2

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 251.3 N; 317 376.0 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.08.06 LATITUDE 42.954533 LONGITUDE -82.345886 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)					
								○ UNCONFINED	+ FIELD VANE														
								● QUICK TRIAXIAL	× LAB VANE														
195.7	Ground Surface							20	40	60	80	100											
0.0	CLAYEY SILT/SILTY CLAY, sandy, trace gravel		1	SS	19		195							○									
	Stiff to very stiff, Grey, Moist (FILL)		2	SS	15		194							○									
			3	SS	11		193							○									
			4	SS	11		192							○									
			5	SS	12		191							○									
			6	SS	16		190							○									
			7	SS	11		189							○									
			8	SS	13		188							○									
			9	SS	8		187							○									
				VANE	FV		186							○									
			10	SS	15		185							○									
							184																
							183																
							182																
							181																
186.7	CLAYEY SILT/SILTY CLAY, some sand, trace gravel		11	SS	12		180							○									
9.0	Stiff to very stiff, Grey, Moist		12	SS	23		179							○									
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>>: Greater than

+³, ×³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-8

2 OF 2

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 251.3 N; 317 376.0 E ORIGINATED BY M.M.
DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
DATUM Geodetic DATE 2020.08.06 LATITUDE 42.954533 LONGITUDE -82.345886 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			W _p	W	W _L		WATER CONTENT (%)				GR	SA	SI	CL														
180.7	CLAYEY SILT/SILTY CLAY, some sand, trace gravel Stiff to very stiff, Grey, Moist (<i>Cont'd</i>)						20	40	60	80	100	20	40	60																						
			15	SS	6																															
				VANE	FV																															
			16	SS	6																															
				VANE	FV																															
			17	SS	10																															

>>: Greater than

+³, X³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-9

1 OF 2

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 204.7 N; 317 374.6 E ORIGINATED BY M.M.
DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
DATUM Geodetic DATE 2020.08.07 LATITUDE 42.954953 LONGITUDE -82.345869 CHECKED BY N.R.

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			20 40 60 80 100	20 40 60 80 100					
195.2	Ground Surface													
0.0	CLAYEY SILT/SILTY CLAY, some sand, trace gravel		1	SS	13		195			○				
	Very stiff, Brown to grey, Moist (FILL)		2	SS	15		194			○				2 21 46 31
			3	SS	10		193			○				
			4	SS	15		192			○				2 17 44 37
			5	SS	15		191			○				
			6	SS	10		190			○				
			7	SS	11		189			○				1 20 43 36
			8	SS	15		188			○				
			9	SS	17		187			○				
			10	SS	13		186			○				1 20 42 37
186.2	CLAYEY SILT/SILTY CLAY, some sand, trace gravel		11	SS	11		185			○				
9.0	Very stiff to stiff, Grey, Moist		12	SS	23		184			○				
			13	SS	11		183			○				
			14	SS	6		182			○				
			VANE	FV			181			○				1 17 43 39
180.2														

Continued Next Page

>>: Greater than

+³, ×³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-9

2 OF 2

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 204.7 N; 317 374.6 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.08.07 LATITUDE 42.954953 LONGITUDE -82.345869 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																										
								○ UNCONFINED	+ FIELD VANE																									
180.2							● QUICK TRIAXIAL	× LAB VANE		WATER CONTENT (%)																								
15.0	CLAYEY SILT/SILTY CLAY, some to trace sand, trace gravel Very stiff, Grey, Moist		15	TW	PH																													
				VANE	FV				+ ²																									
			16	SS	10																													
			17	SS	14																													
			18	SS	18																													
174.8	End of borehole																																	
20.4	<div>▼ Groundwater level measured in monitoring well</div> <div>NOTES: 1. Groundwater level was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers. 3. Gas reading on Aug. 17 2020: LEL = 3% to LEL = 0% in 20 seconds. 4. Gas reading on Aug. 27 2020: LEL = 4% to LEL = 0% in 30 s. Monitoring well decommissioned. Monitoring Well Readings: <table><tr><th>Date</th><th>Depth (m)</th><th>Elev.</th></tr><tr><td>Aug. 10/20</td><td>18.7</td><td>176.5</td></tr><tr><td>Aug. 27/20</td><td>17.7</td><td>177.5</td></tr><tr><td>Sep. 11/20</td><td>15.9</td><td>179.3</td></tr></table> Monitoring Well Legend: <table><tr><td></td><td>Concrete</td></tr><tr><td></td><td>Bentonite seal</td></tr><tr><td></td><td>Filter sand</td></tr><tr><td></td><td>Screen</td></tr></table></div>	Date	Depth (m)	Elev.	Aug. 10/20	18.7	176.5	Aug. 27/20	17.7	177.5	Sep. 11/20	15.9	179.3		Concrete		Bentonite seal		Filter sand		Screen													
Date	Depth (m)	Elev.																																
Aug. 10/20	18.7	176.5																																
Aug. 27/20	17.7	177.5																																
Sep. 11/20	15.9	179.3																																
	Concrete																																	
	Bentonite seal																																	
	Filter sand																																	
	Screen																																	

ONTARIO MTO 20TF016.GPJ ONTARIO MTO.GDT 21-9-21

>>: Greater than

+³, X³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-10

1 OF 2

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 096.6 N; 317 375.2 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.08.07 LATITUDE 42.95356 LONGITUDE -82.345882 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
192.2	Ground Surface													
0.0	CLAYEY SILT, some sand, trace gravel Stiff to very stiff, Brown to grey, Moist (FILL)		1	SS	11		192							
			2	SS	12		191							
			3	SS	8		190							3 19 43 35
			4	SS	12		189							
			5	SS	11		188							
			6	SS	17		187							
			7	SS	14		186							
187.0	CLAYEY SILT, some sand, trace gravel Stiff to very stiff, Grey, Moist		8	SS	13		185							0 19 45 36
5.2			9	SS	24		184							
			10	SS	20		183							
			11	SS	11		182							
			12	SS	9		181							1 16 44 39
			13	SS	7		180							
			VANE	FV			179							
			14	SS	8		178							
			VANE	FV										
177.2														

Continued Next Page

>>: Greater than

+³, X³: Numbers refer to
Sensitivity


○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CN-10

2 OF 2

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 096.6 N; 317 375.2 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.08.07 LATITUDE 42.95356 LONGITUDE -82.345882 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
177.2 15.0	CLAYEY SILT, some sand, trace gravel Very stiff, Grey, Moist		15	SS	15		177								
176.4 15.8	End of borehole														
NOTES: 1. Groundwater level was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers. 3. The shear vane tests conducted at depth 1.5 m (EL. 190.7) below the existing ground surface, was carried out in a second borehole drilled adjacent to Borehole CN-10.															

>>: Greater than

+³, X³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No RW-1

1 OF 4

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 272.5 N; 317 370.3 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.07.24 LATITUDE 42.955144 LONGITUDE -82.345938 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE								
196.0	Ground Surface							20	40	60	80	100							
0.0	CLAYEY SILT, trace/some sand, trace gravel		1	SS	11		195						○						
	Stiff to very stiff, Brown, Moist (FILL)		2	SS	12								○						
			3	SS	10		194						○						
			4	SS	13								○						
			5	SS	7		193						○						
			6	VANE SS	FV 7		192						○						
			7	SS	6		191						○						
			8	TW	PH								○						
			9	SS	10		190						○						
			10	SS	11		189						○						
							188						○						
							187						○						
186.8	CLAYEY SILT/SILTY CLAY, some sand, trace gravel		11	SS	17		186						○						
9.2	Very stiff to stiff, Grey, Moist		12	SS	21		185						○						
			13	SS	19		184						○						
			14	SS	7		183						○						
			VANE	FV			182						○						
181.0													○						

Continued Next Page

>>: Greater than

+³, ×³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No RW-1

2 OF 4

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 272.5 N; 317 370.3 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.07.24 LATITUDE 42.955144 LONGITUDE -82.345938 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p W W _L			GR	SA	SI	CL	
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)							
181.0								20	40	60	80	100								
15.0	CLAYEY SILT/SILTY CLAY, some sand, trace gravel																			
	Stiff to very stiff, Grey, Moist		15	TW	PH		180							○						
			16	SS	8		179							○						
				VANE	FV						+ ¹									
							178													
			17	SS	9									⊕	⊕					
							177													
				VANE	FV									>>						
							176													
							175													
							174													
			18	SS	21		173							○						
							172													
							171													
			19	SS	19		170							○						
							169													
							168													
			20	SS	11		167							○						
166.0																				

Continued Next Page

>>: Greater than

+³, X³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

METRIC

SOIL PROFILE	SAMPLES	...	DYNAMIC CONE PENETRATION			
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

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No RW-1

4 OF 4

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 272.5 N; 317 370.3 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.07.24 LATITUDE 42.955144 LONGITUDE -82.345938 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
151.0								20	40	60	80	100					
45.0	CLAYEY SILT, some sand, trace gravel																
	Hard, Grey, Moist																
150.3			26	SS	50/3cm												
45.7	End of borehole Auger refusal on probable bedrock																
	 Groundwater level measured upon completion of drilling																
	NOTES: 1. No cave-in was noted upon extraction of hollow stem augers. 2. Gas pocket encountered from EL. 149.3 to EL. 150.3. LEL = 100%. 3. The shear vane tests conducted at depths 3.1 m (EL. 192.9), 4.0 m (EL. 192.0), and 4.6 m (EL. 191.4) below the existing ground surface, were carried out in a second borehole drilled adjacent to Borehole RW-1.																

>>: Greater than

+³, X³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

METRIC

[illegible]

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No RW-2

2 OF 4

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 366.5 N; 317 373.8 E ORIGINATED BY M.M.
DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
DATUM Geodetic DATE 2020.07.22 - 2020.07.23 LATITUDE 42.95599 LONGITUDE -82.345893 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)	
								○ UNCONFINED	+ FIELD VANE							
								● QUICK TRIAXIAL	× LAB VANE							
180.4							20	40	60	80	100					
15.0	CLAYEY SILT/SILTY CLAY, some to trace sand, trace gravel Stiff to very stiff, Brown, Moist		14	TW	PH											
			15	SS	6											
				VANE	FV											
			16	TW	PH											
				VANE	FV											
			17	SS	16											
			18	SS	15											
				VANE	FV											
			19	SS	20											
			20	TW	PH											
165.4																

Continued Next Page

>>: Greater than

+³, ×³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No RW-2

3 OF 4

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 366.5 N; 317 373.8 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.07.22 - 2020.07.23 LATITUDE 42.95599 LONGITUDE -82.345893 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
165.4														
30.0	CLAYEY SILT/SILTY CLAY, trace sand, trace gravel Very stiff, Grey, Moist		21	SS	18		165							
							164							
							163							
							162							
			22	SS	19		161							
							160							
			23	TW	PH		159							
							158							
			24	SS	18		157							
							156							
			25	SS	21		155							
							154							
			26	TW	PH		153							
							152							
			27	SS	23		151							
150.4														

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>>: Greater than

+³, X³: Numbers refer to Sensitivity




○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No RW-2

4 OF 4

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 366.5 N; 317 373.8 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.07.22 - 2020.07.23 LATITUDE 42.95599 LONGITUDE -82.345893 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
150.4 45.0	SILTY CLAY, trace sand, trace gravel Hard, Grey, Moist						150								
149.7 45.7	End of borehole Auger refusal on probable bedrock		28	SS	50/3cm										
	<div> Groundwater level measured upon completion of drilling</div> <div>NOTES: 1. No cave-in was noted upon extraction of hollow stem augers. 2. Gas pocket encountered from EL. 148.7 to EL. 149.7. LEL = 100%. 45 minutes taken to dissipate before rock coring.</div>														

>>: Greater than

+³, X³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No T-1

1 OF 1

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 487.3 N; 317 361.9 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.08.05 LATITUDE 42.957078 LONGITUDE -82.346036 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								WATER CONTENT (%)
187.0	Ground Surface							20 40 60 80 100		20 40 60						
0.0	_____ organics															
	CLAYEY SILT/SILTY CLAY, some sand, trace gravel Stiff to very stiff, Brown to grey, Moist		1	SS	9											
			2	SS	15											
			3	SS	19											
			4	SS	19											
			5	SS	15											
			6	SS	7											
			VANE	FV												
			7	SS	5											
			VANE	FV												
			8	SS	6											
			VANE	FV												
177.2	End of borehole		9	SS	8											
9.8	<div><div></div>Groundwater level measured in monitoring well</div> <div>NOTES: 1. Groundwater level was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers.</div> <div>Monitoring Well Readings: Date Depth Elev. (m) Aug. 05/20 DRY — Aug. 27/20 6.1 180.9 Sep. 12/20 6.1 180.9</div> <div>Monitoring Well Legend: <div><div></div>Concrete</div><div><div></div>Bentonite seal</div><div><div></div>Filter sand</div><div><div></div>Screen</div></div>															

>>: Greater than

+³, X³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No T-2

1 OF 1

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 397.2 N; 317 351.0 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.08.10 LATITUDE 42.956266 LONGITUDE -82.346172 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							W _P W W _L					
186.6	Ground Surface						20	40	60	80	100	20	40	60	GR	SA	SI	CL		
0.0	_____ organics																			
	CLAYEY SILT/SILTY CLAY, some sand, trace gravel		1	SS	12								○							
	Stiff to very stiff, Brown to grey, Moist		2	SS	10								○							
			3	SS	13								○				3	20	41	36
			4	SS	20								○							
			5	SS	13								○							
			6	SS	7								○							
				VANE	FV															
	_____ sandy		7	SS	4								○				3	29	42	26
				VANE	FV															
			8	SS	7								○							
				VANE	FV															
			9	SS	14								○				1	7	50	42
176.8	End of borehole																			
9.8																				
	NOTES: 1. Groundwater level was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers.																			

NOTES:

- Groundwater level was not encountered during or upon completion of drilling.
- No cave-in was noted upon extraction of hollow stem augers.

>>: Greater than

+³, X³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No T-3

1 OF 1

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 227.4 N; 317 338.5 E ORIGINATED BY M.M.
 DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
 DATUM Geodetic DATE 2020.08.10 LATITUDE 42.954738 LONGITUDE -82.346328 CHECKED BY N.R.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)	
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
187.8	Ground Surface							20	40	60	80	100		20	40	60		GR SA SI CL
0.0	CLAYEY SILT/SILTY CLAY, some sand, trace gravel Stiff, Brown to grey, Moist (FILL)		1	SS	11									○				
187.0	CLAYEY SILT/SILTY CLAY, some sand, trace gravel Very stiff to stiff, Brown to grey, Moist		2	SS	16									○				
0.8			3	SS	14									○				
			4	SS	19									○				
			5	SS	18									○				
			6	SS	11									○				
			7	SS	17									○				
			8	SS	5									○				
			VANE	FV										○				
														○				
			9	SS	6									○				
			VANE	FV										○				
														○				
			10	SS	9									○				
178.0	End of borehole																	
9.8																		
	NOTES: 1. Groundwater level was not encountered during or upon completion of drilling. 2. No cave-in was noted upon extraction of hollow stem augers.																	

NOTES:

- Groundwater level was not encountered during or upon completion of drilling.
- No cave-in was noted upon extraction of hollow stem augers.

>>: Greater than

+³, X³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No T-4

1 OF 1

METRIC

G.W.P. 3064-11-00-06 LOCATION Coords: 4 757 152.5 N; 317 341.2 E ORIGINATED BY M.M.
DIST West Region HWY 40 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.L.
DATUM Geodetic DATE 2020.08.07 LATITUDE 42.954064 LONGITUDE -82.346298 CHECKED BY N.R.

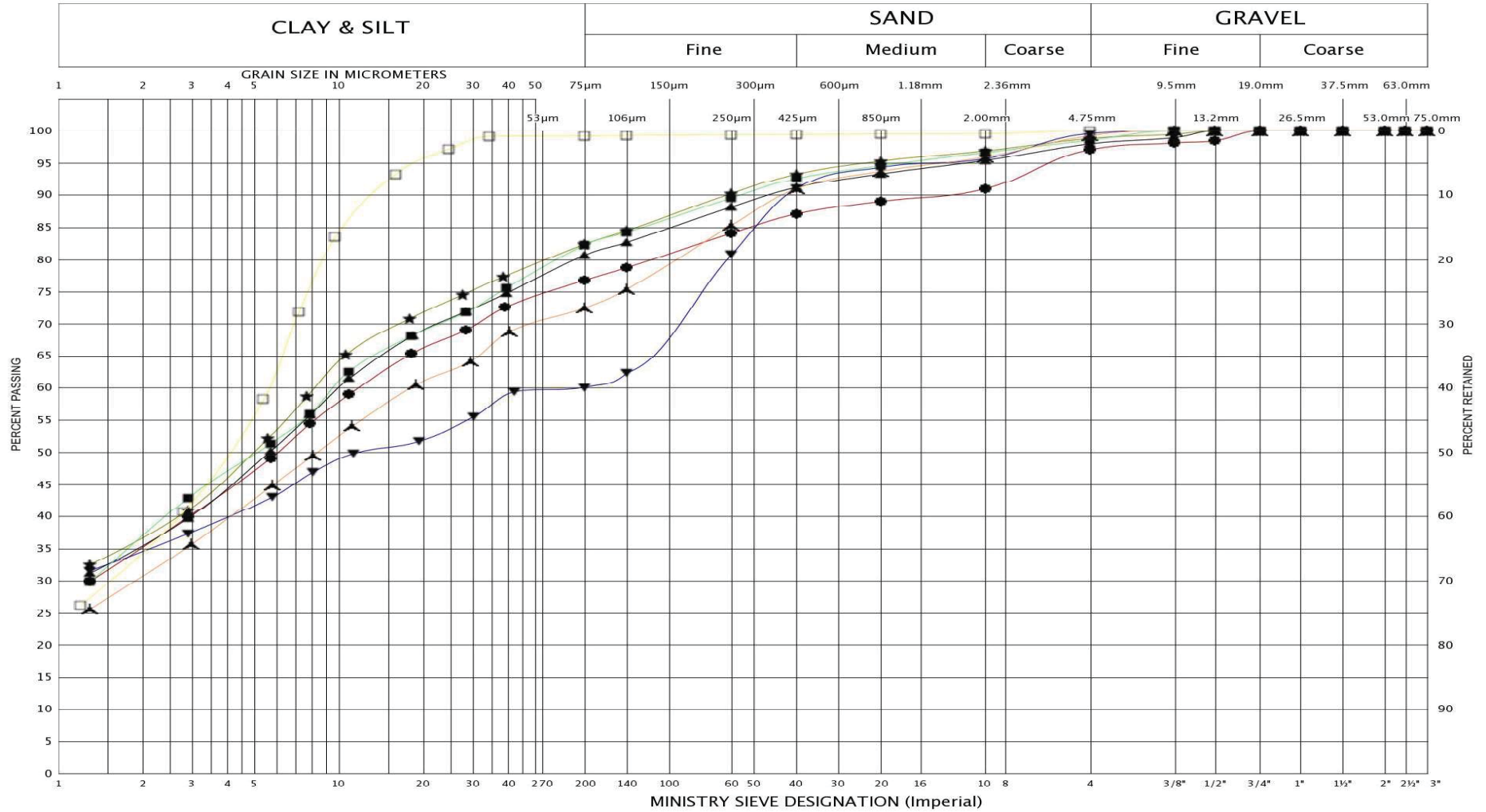
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
190.9	Ground Surface							20	40	60	80	100					
0.0	_____organics		1	SS	18												
	CLAYEY SILT/SILTY CLAY, some sand, trace gravel																
	Stiff to very stiff, Brown to grey, Moist (FILL)		2	SS	10												0 20 44 36
			3	SS	12												
			4	SS	17												
			5	SS	25												
			6	SS	16												
186.4	CLAYEY SILT/SILTY CLAY, some sand, trace gravel		7	SS	9												3 21 45 31
4.5	Stiff to very stiff, Grey, Moist		8	SS	9												
			9	SS	6												
			VANE	FV													
			10	SS	7												1 14 46 39
			VANE	FV													
182.1	End of borehole																
8.8																	
	Groundwater level measured in monitoring well																
	NOTES:																
	1. Groundwater level was not encountered during or upon completion of drilling.																
	2. No cave-in was noted upon extraction of hollow stem augers.																
	<u>Monitoring Well Readings:</u>																
	Date Depth Elev.																
	(m)																
	Aug. 07/20 DRY —																
	Aug. 27/20 6.8 184.1																
	Sep. 11/20 2.0 188.9																
	<u>Monitoring Well Legend:</u>																
	Concrete																
	Bentonite seal																
	Filter sand																
	Screen																

>>: Greater than

+³, X³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	CN-3	CN-3	CN-4	CN-4	CN-5	RW-2	RW-2
	SAMPLE	4	7	7	10	4	4	8
	SYMBOL	●	▲	★	▼	■	▲	□



GRAIN SIZE DISTRIBUTION

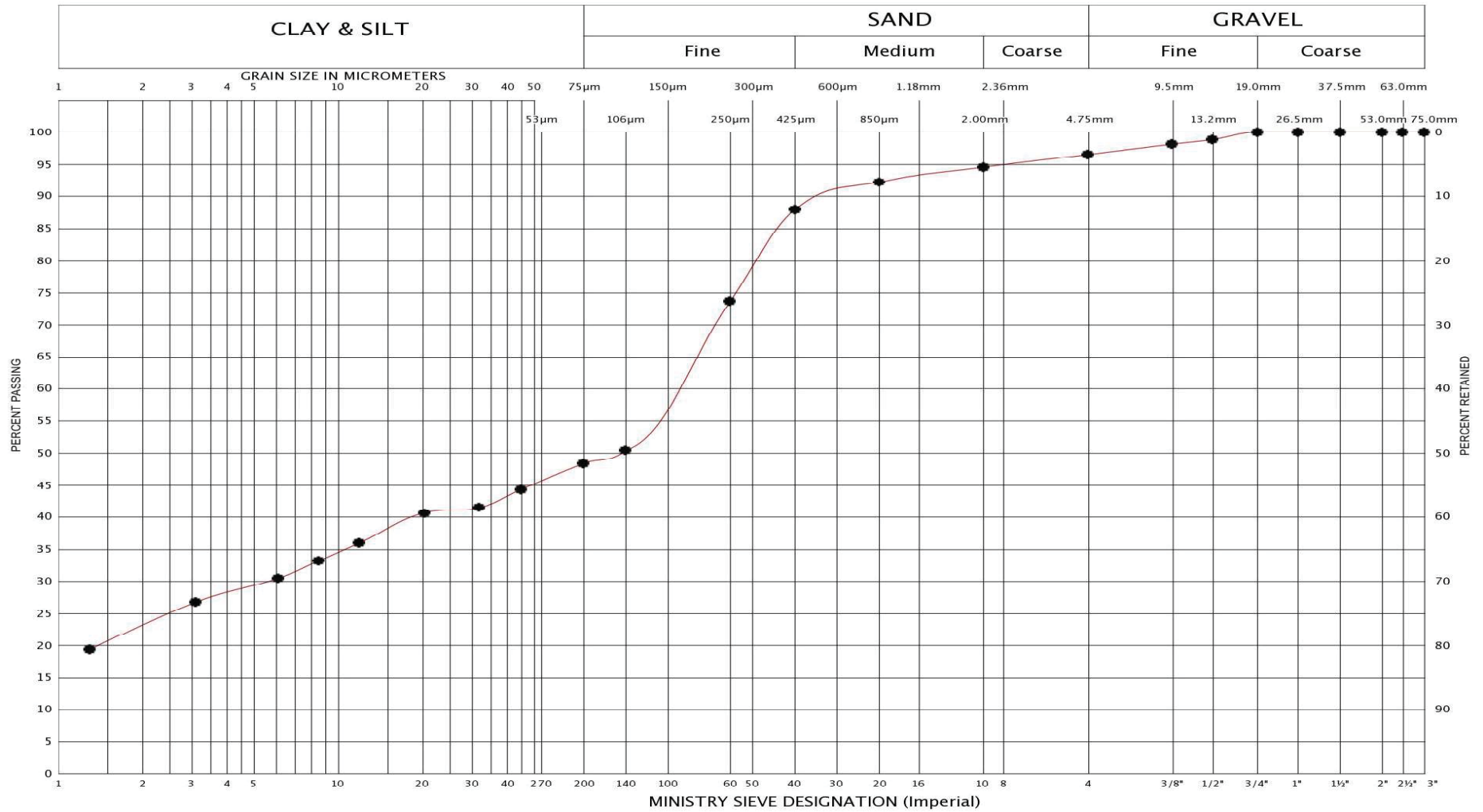
CLAYEY SILT/SILTY CLAY, Trace Sand to Sandy, Trace Gravel (FILL)

FIG No.: GS-1

HWY : 40

GWP 3064-11-00

UNIFIED SOIL CLASSIFICATION SYSTEM



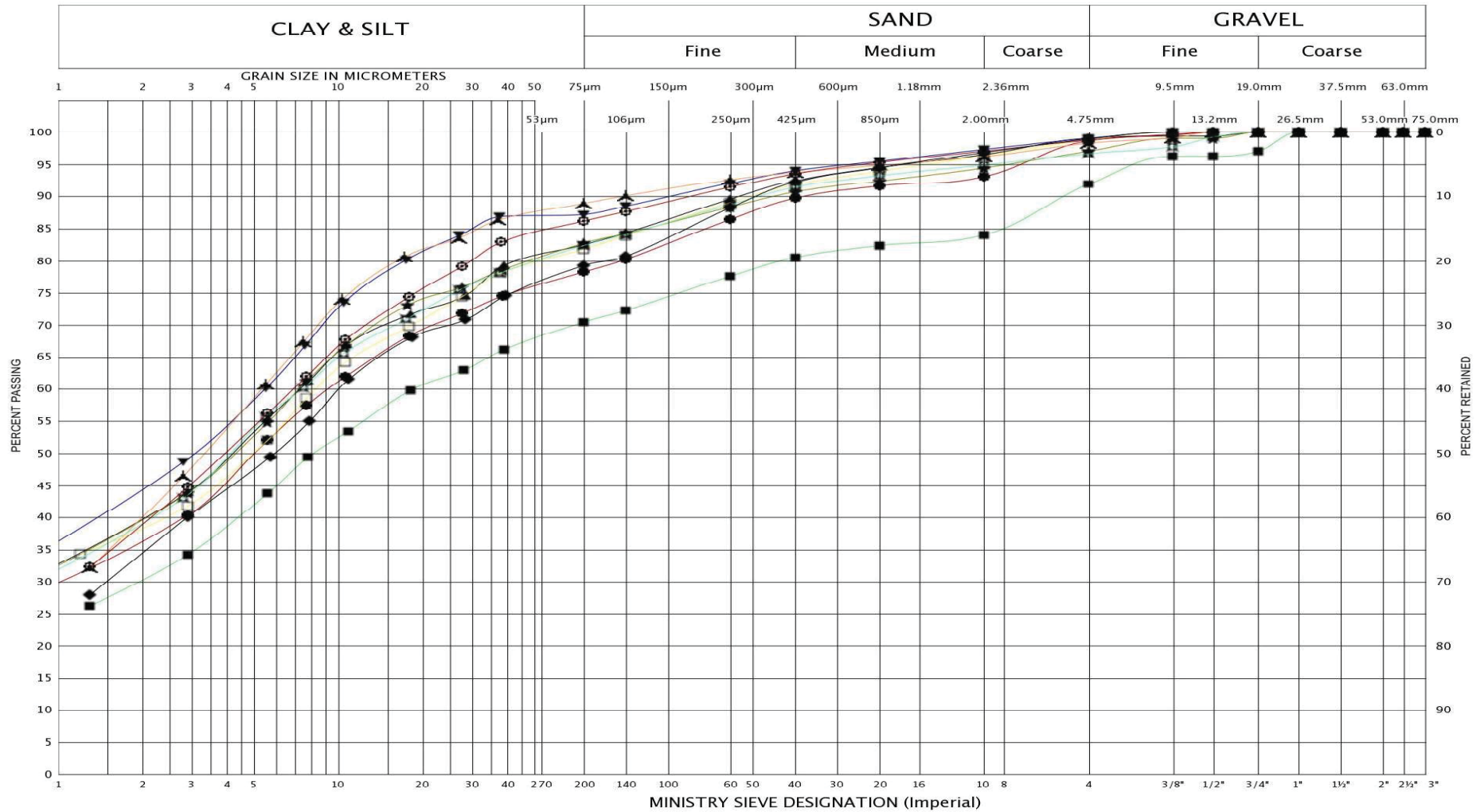
LEGEND	BH	CN-5
	SAMPLE	9
	SYMBOL	•



GRAIN SIZE DISTRIBUTION
CLAYEY SAND, With Silt, Trace Gravel (FILL)

FIG No.:	GS-2
HWY :	40
GWP	3064-11-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	CN-2	CN-2	CN-2	CN-2	CN-3	CN-3	CN-4	CN-4	CN-4	CN-5
	SAMPLE	8	11	14	15	11	18	13	15	16	11
	SYMBOL	●	▲	★	▼	■	▲	□	■	⊗	◆



GRAIN SIZE DISTRIBUTION

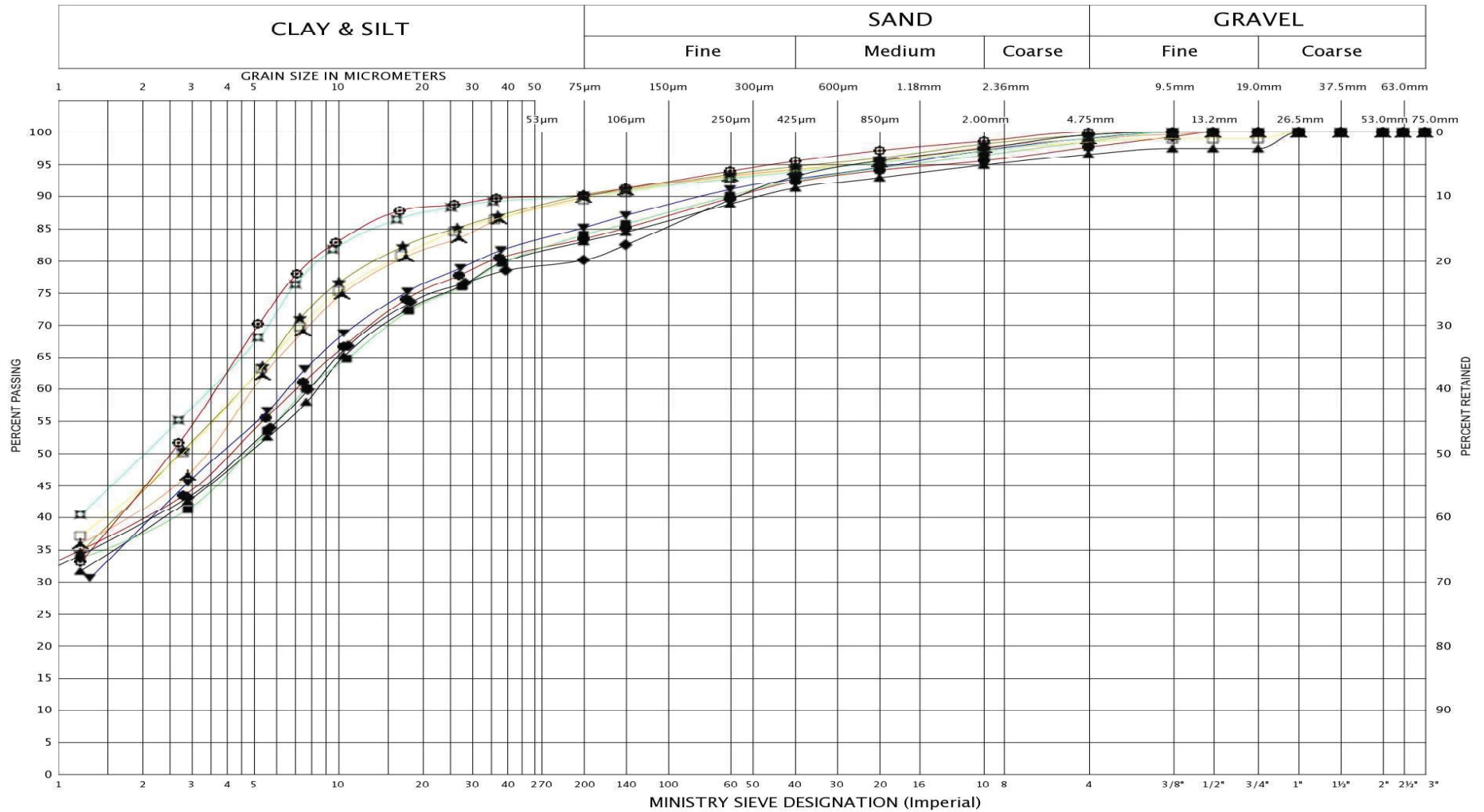
CLAYEY SILT/ SILTY CLAY, Trace Sand to With Sand,
Trace Gravel

FIG No.: GS-3A

HWY : 40

GWP 3064-11-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	CN-5	CN-5	CN-5	CN-5	RW-2	RW-2	RW-2	RW-2	RW2	T-1
	SAMPLE	14	15	18	24	15	17	19	24	26	4
	SYMBOL	●	▲	★	▼	■	▲	□	■	⊗	◆



GRAIN SIZE DISTRIBUTION

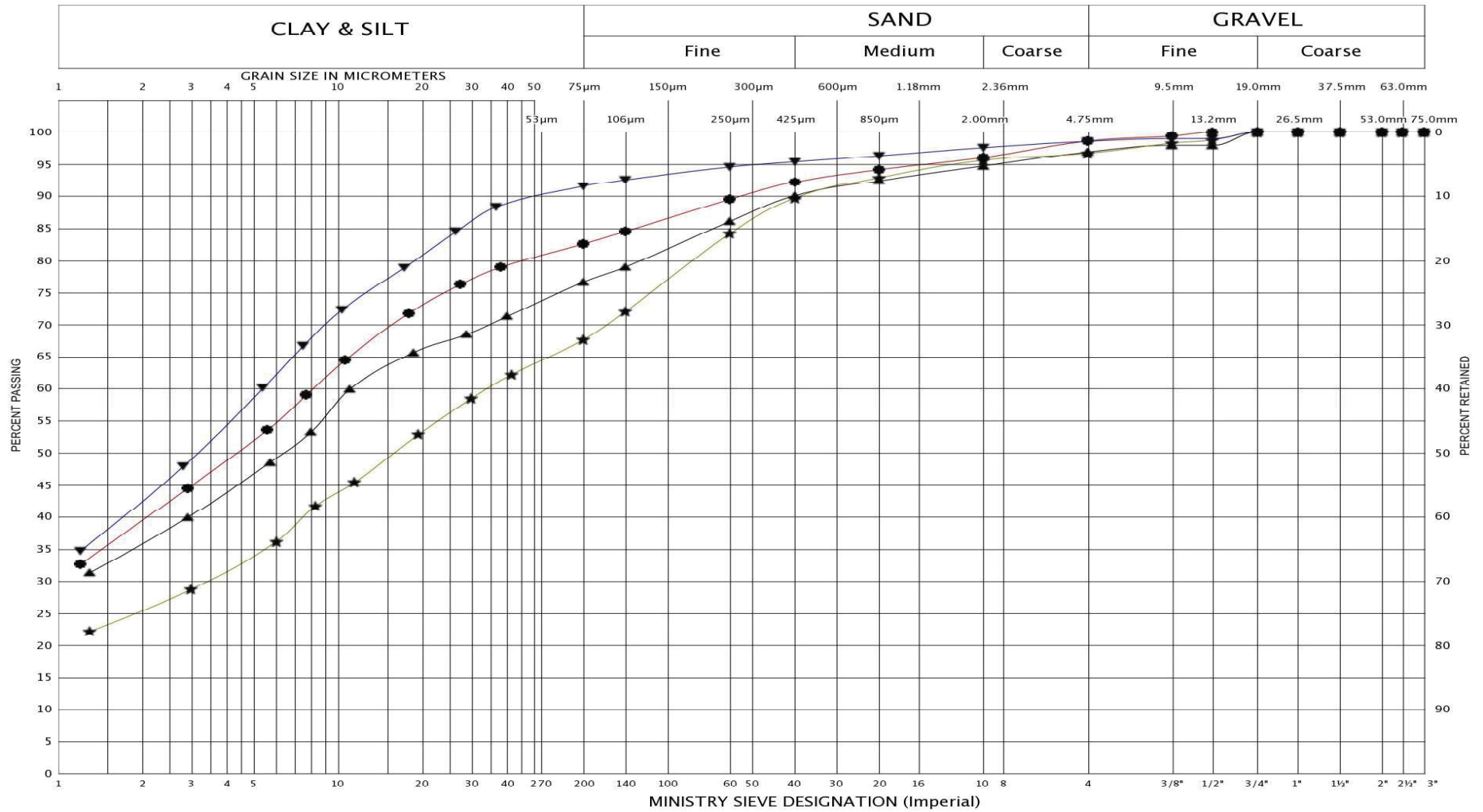
CLAYEY SILT/ SILTY CLAY, Trace Sand to With Sand,
Trace Gravel

FIG No.: GS-3B

HWY : 40

GWP 3064-11-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	T-1	T-2	T-2	T-2
	SAMPLE	7	3	7	9
	SYMBOL	●	▲	★	▼



GRAIN SIZE DISTRIBUTION

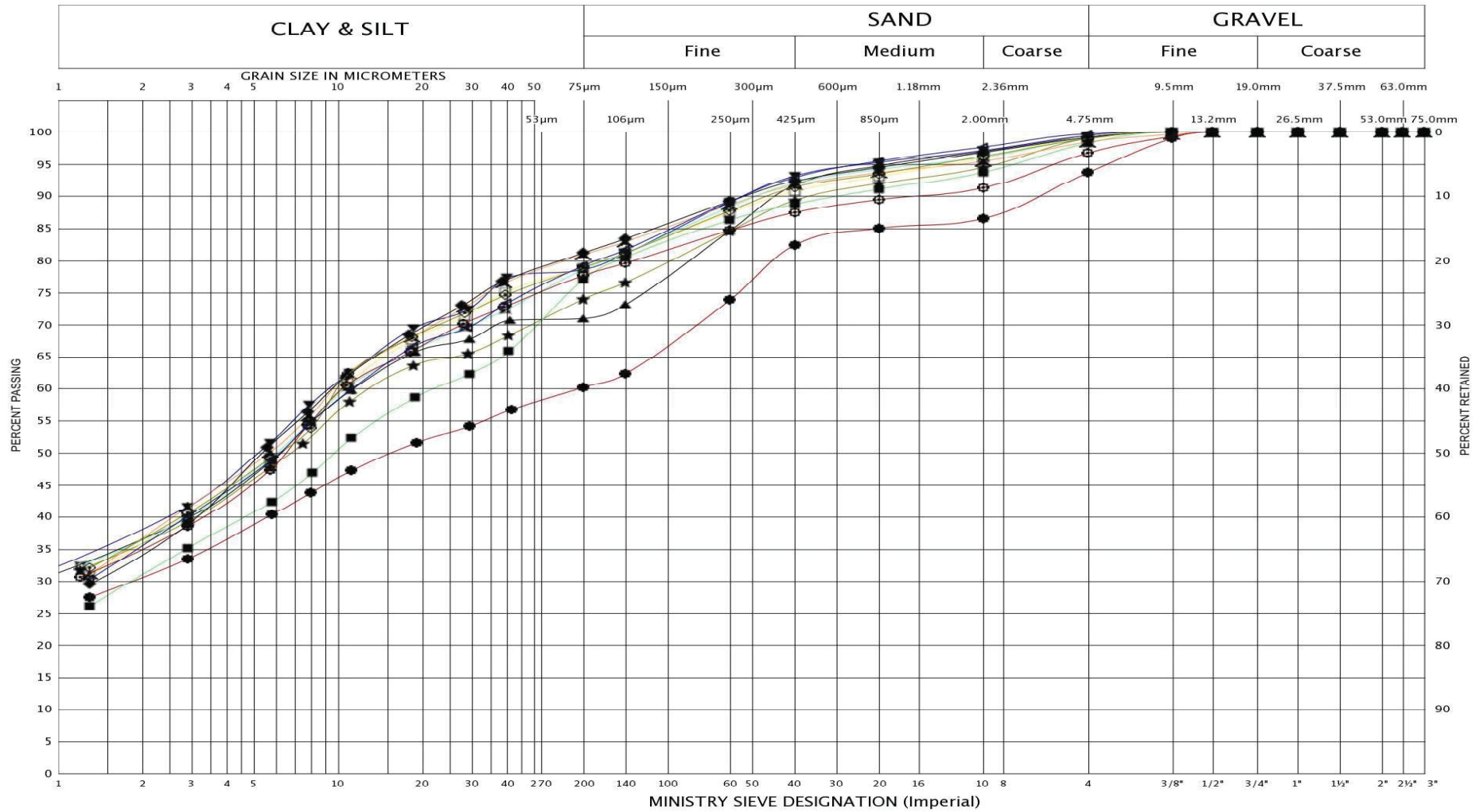
CLAYEY SILT/ SILTY CLAY, Trace Sand to With Sand,
Trace Gravel

FIG No.: GS-3C

HWY : 40

GWP 3064-11-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	CN-7	CN-8	CN-8	CN-8	CN-9	CN-9	CN-9	CN-9	CN-10	RW-1	RW-1	T-4
	SAMPLE	5	4	6	9	2	5	7	10	3	5	9	2
	SYMBOL	●	▲	★	▼	■	▲	□	■	⊗	◆	⊗	◀



GRAIN SIZE DISTRIBUTION

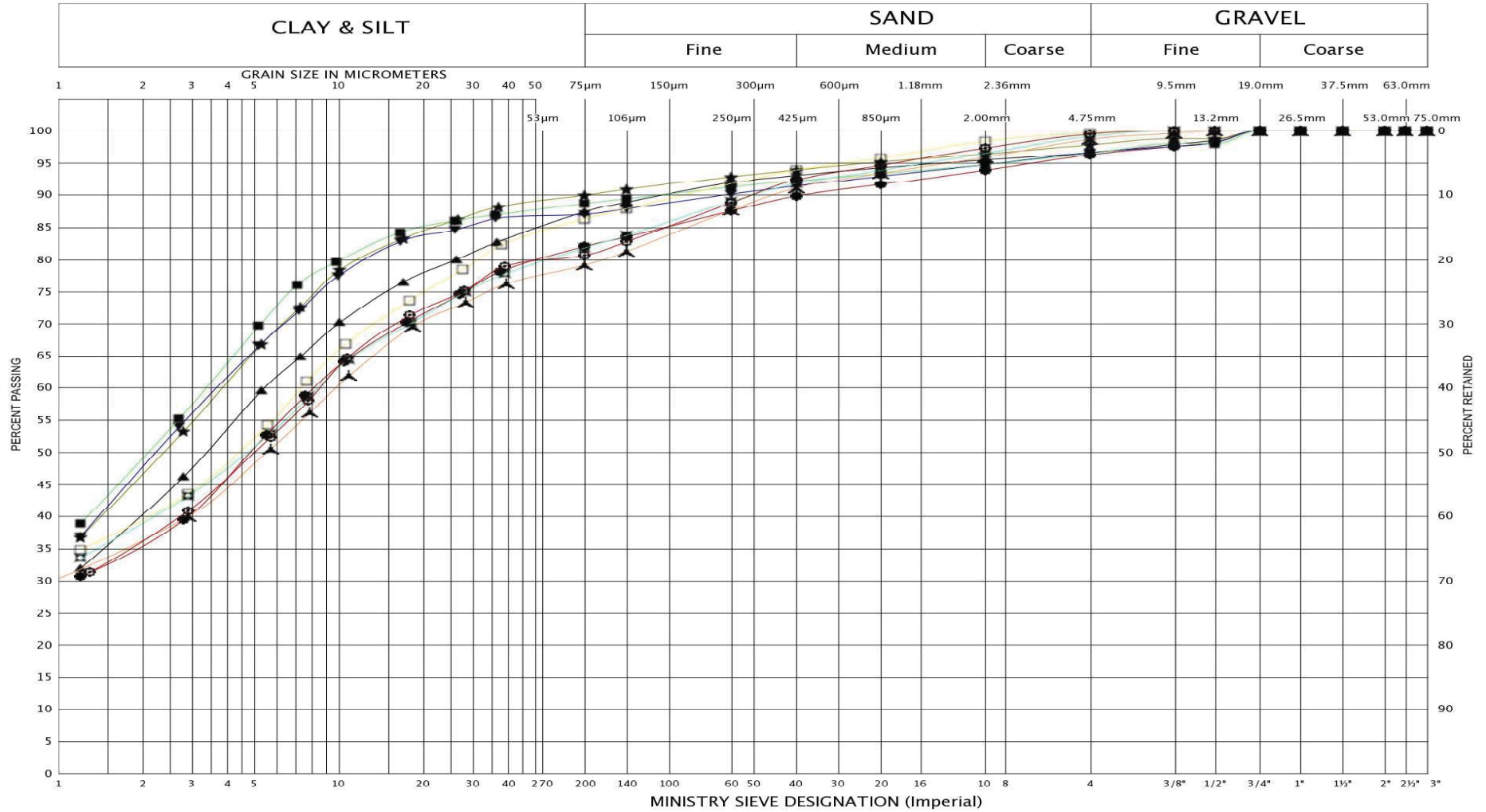
CLAYEY SILT/ SILTY CLAY, Some Sand to Sandy, Trace Gravel (FILL)

FIG No.: GS-4

HWY : 40

GWP 3064-11-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	CN-7	CN-7	CN-7	CN-7	CN-7	CN-8	CN-8	CN-9	CN-10
	SAMPLE	15	16	20	24	26	12	16	14	8
	SYMBOL	●	▲	★	▼	■	▲	□	■	⊗



GRAIN SIZE DISTRIBUTION

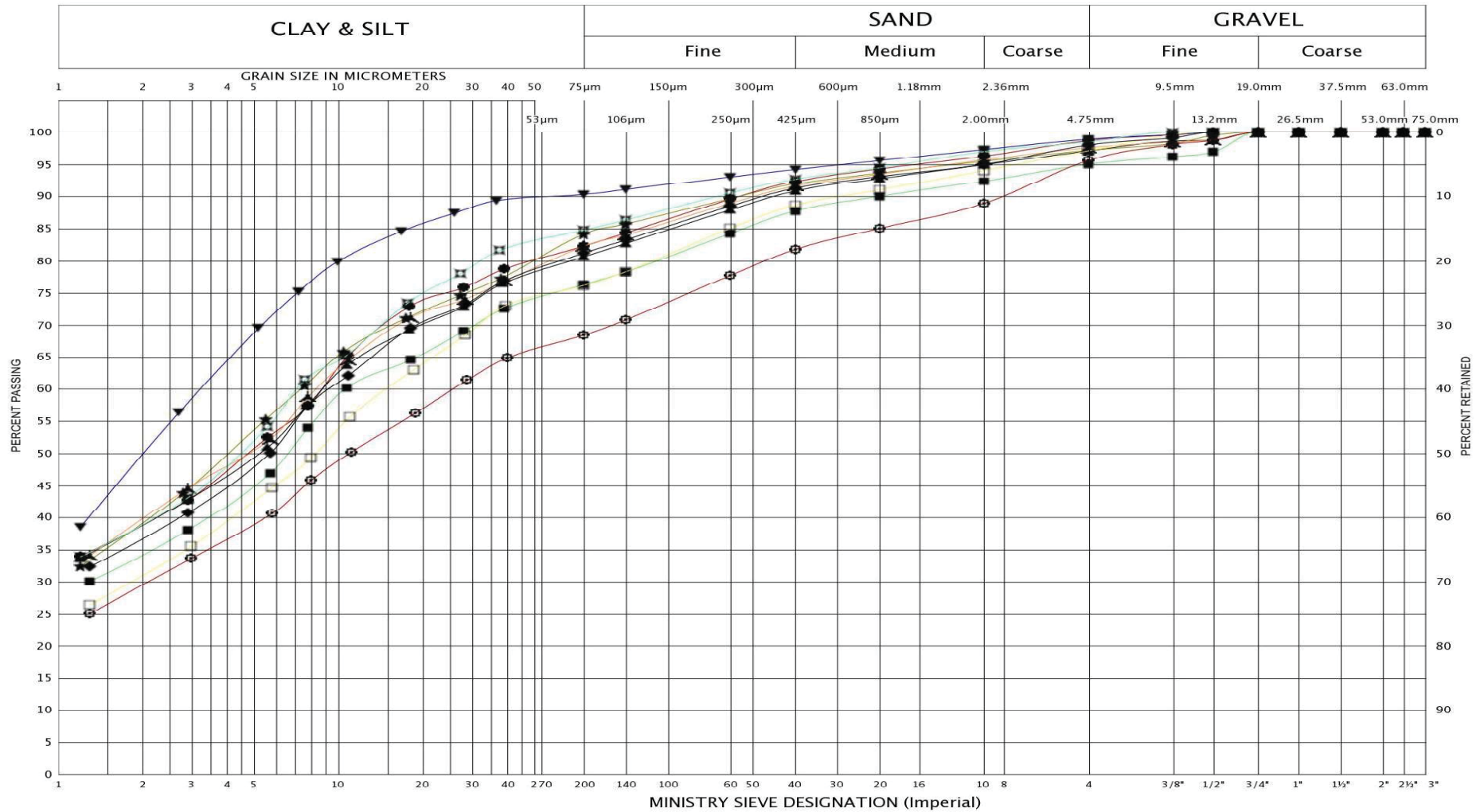
CLAYEY SILT/ SILTY CLAY, Some Sand to With Sand,
Trace Gravel

FIG No.: GS-5A

HWY : 40

GWP 3064-11-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	CN-10	RW-1	RW-1	RW-1	T-3	T-3	T-4	T-4	C-2	C-2
	SAMPLE	12	14	17	21	5	7	6	10	4	6
	SYMBOL	●	▲	★	▼	■	▲	□	■	⊗	◆



GRAIN SIZE DISTRIBUTION

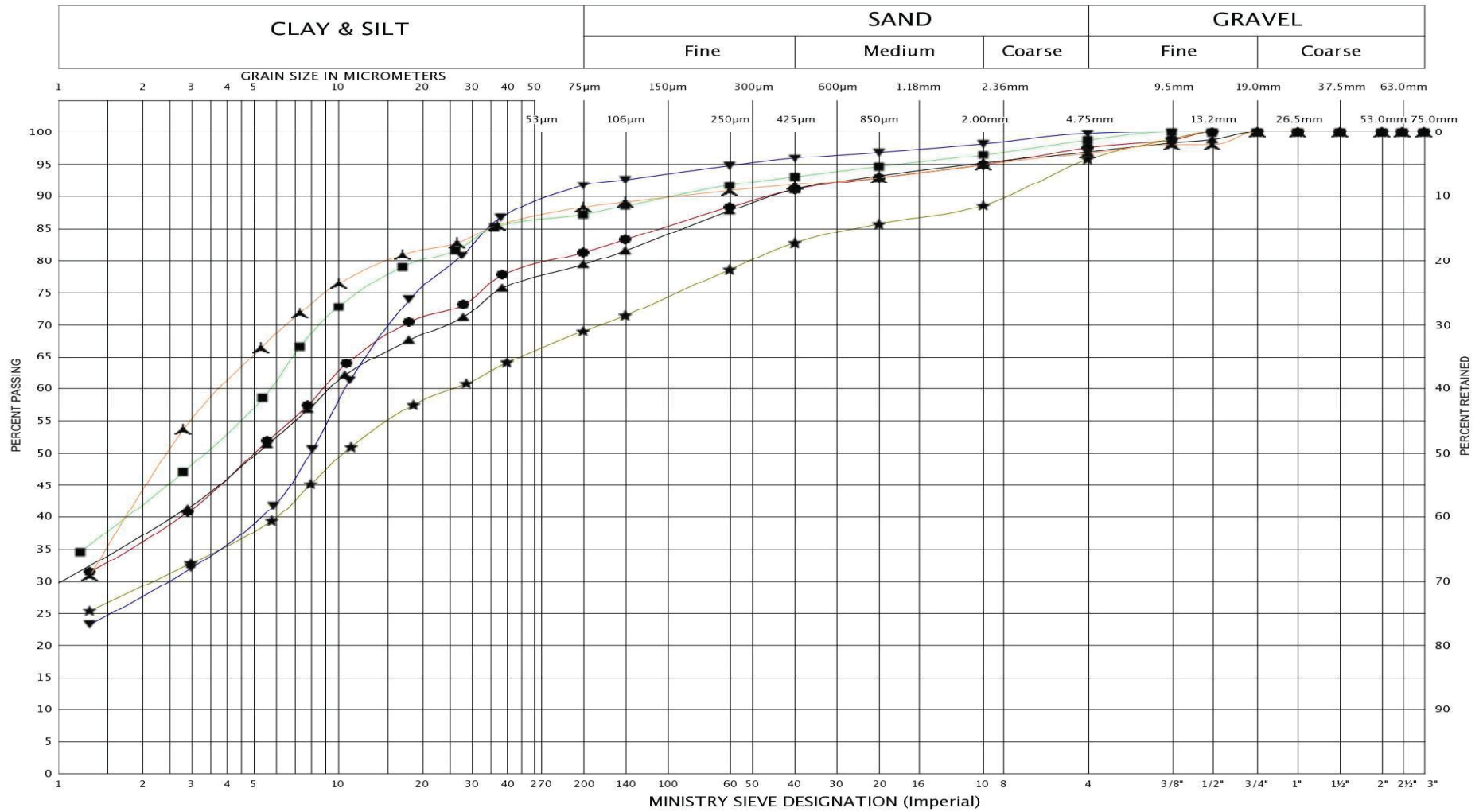
CLAYEY SILT/ SILTY CLAY, Some Sand to With Sand,
Trace Gravel

FIG No.: GS-5B

HWY : 40

GWP 3064-11-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	C-2	C-3	C-3	C-3	C-3	C-3
	SAMPLE	8	5	6	10	13	18
	SYMBOL	●	▲	★	▼	■	▲



GRAIN SIZE DISTRIBUTION

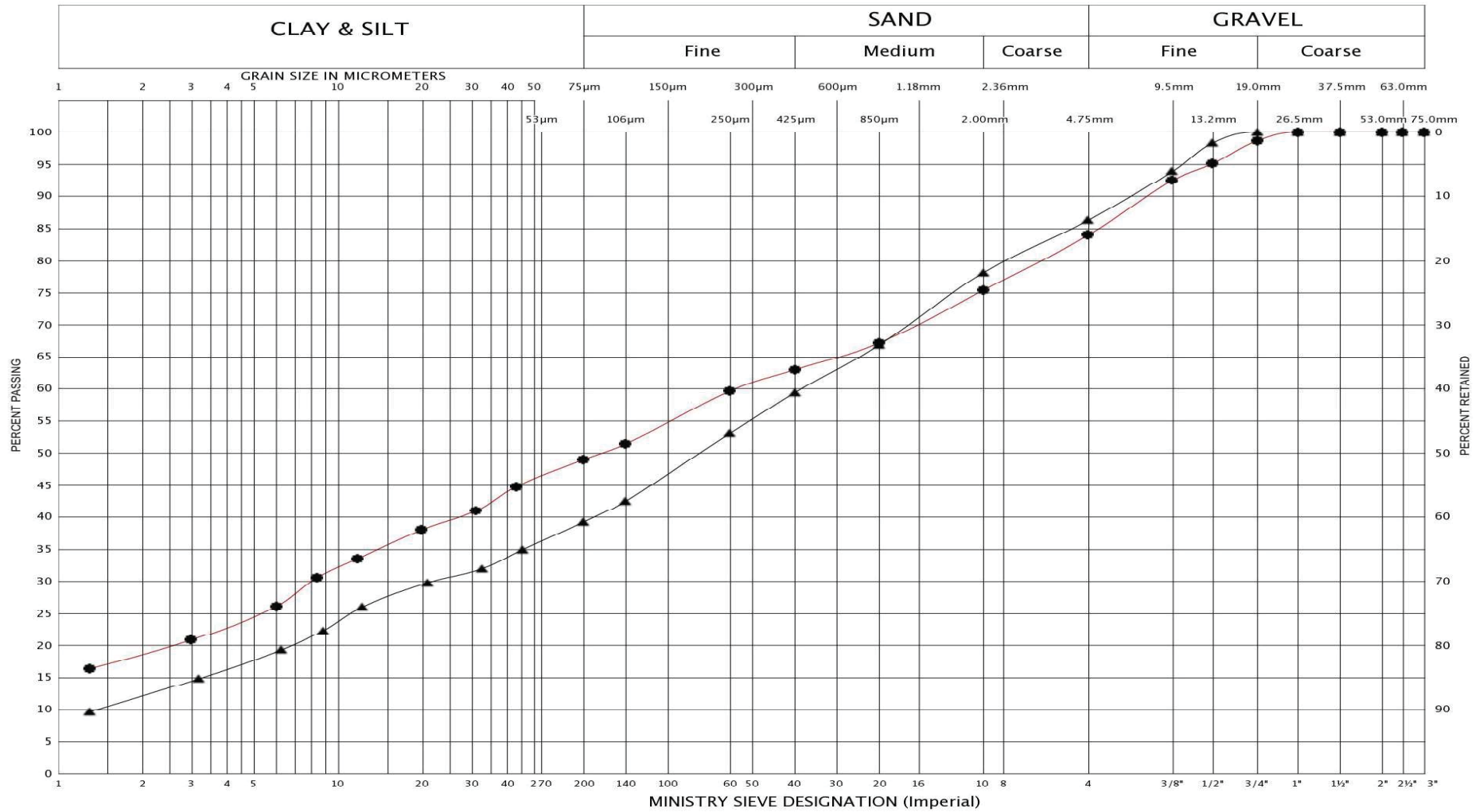
CLAYEY SILT/ SILTY CLAY, Some Sand to With Sand,
Trace Gravel

FIG No.: GS-5C

HWY : 40

GWP 3064-11-00

UNIFIED SOIL CLASSIFICATION SYSTEM

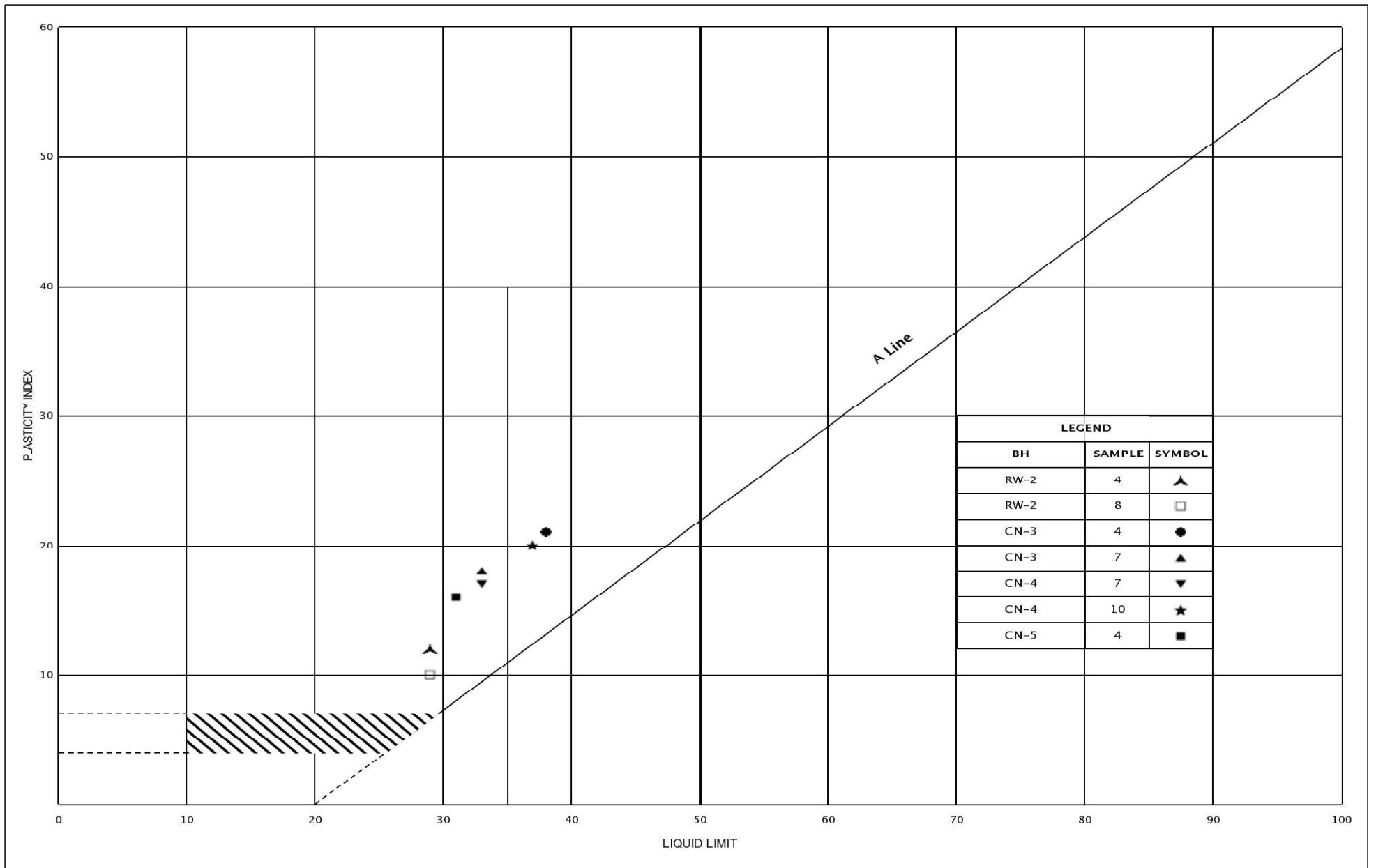


LEGEND	BH	CN-7	RW-1
	SAMPLE	11	25
	SYMBOL	●	▲



GRAIN SIZE DISTRIBUTION
CLAYEY SAND, With Silt, Some Gravel

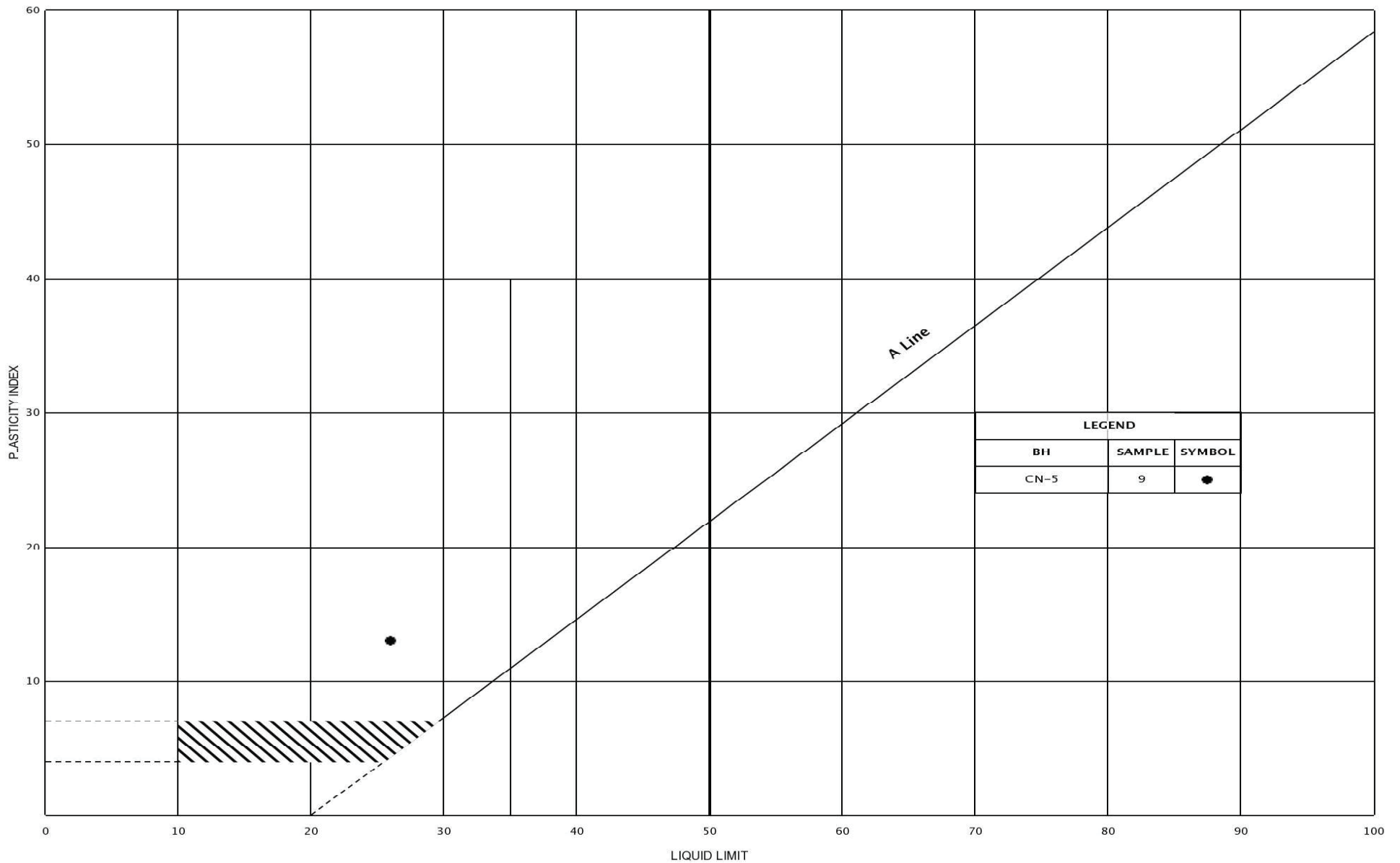
FIG No.:	GS-6
HWY :	40
GWP	3064-11-00



PLASTICITY CHART

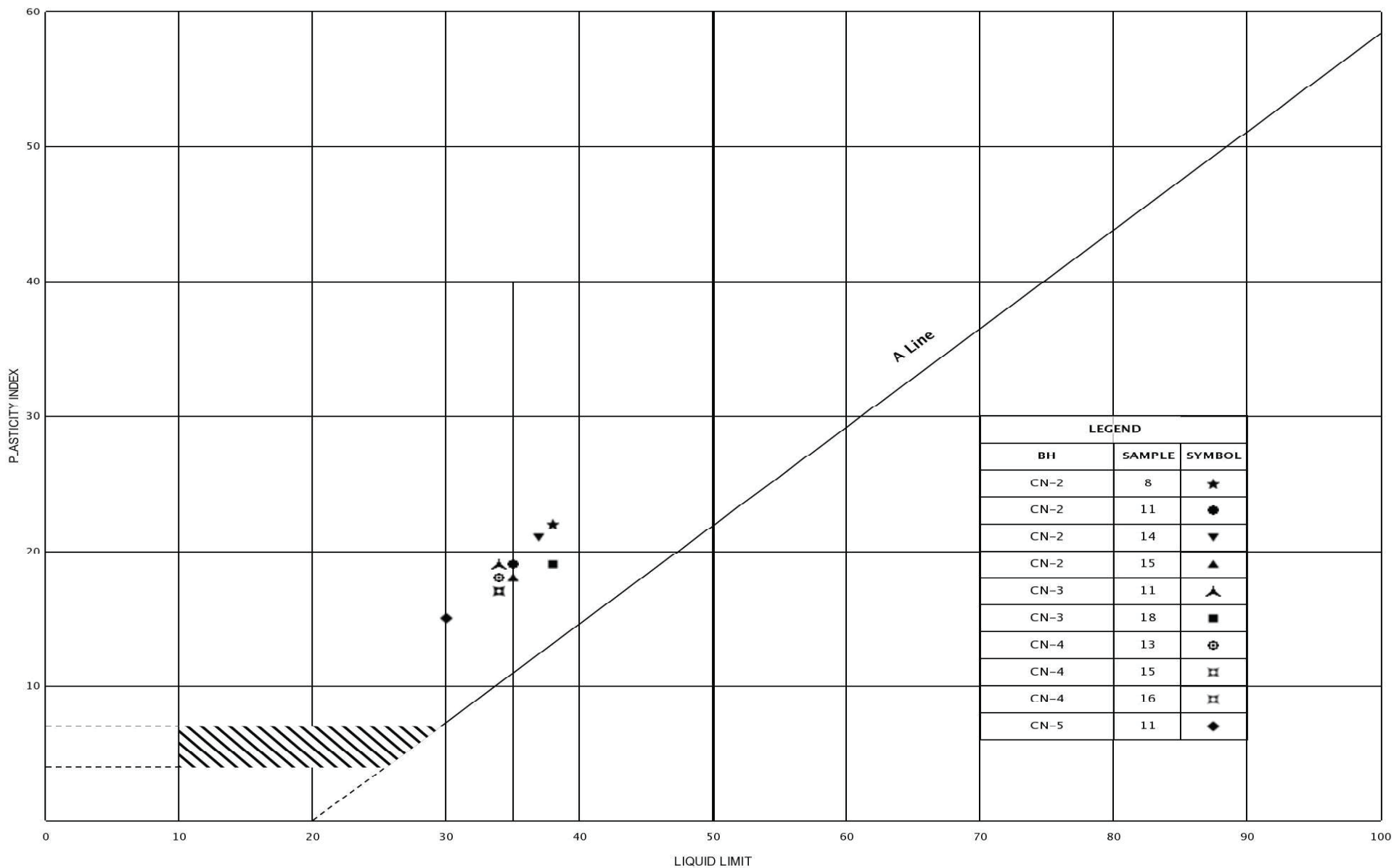
CLAYEY SILT/SILTY CLAY, Trace Sand to Sandy, Trace Gravel (FILL)

FIG No.:	PC-1
HWY.:	40
GWP	3064-11-00



PLASTICITY CHART
CLAYEY SAND, With Silt, Trace Gravel (FILL)

FIG No.: PC-2
HWY.: 40
GWP 3064-11-00



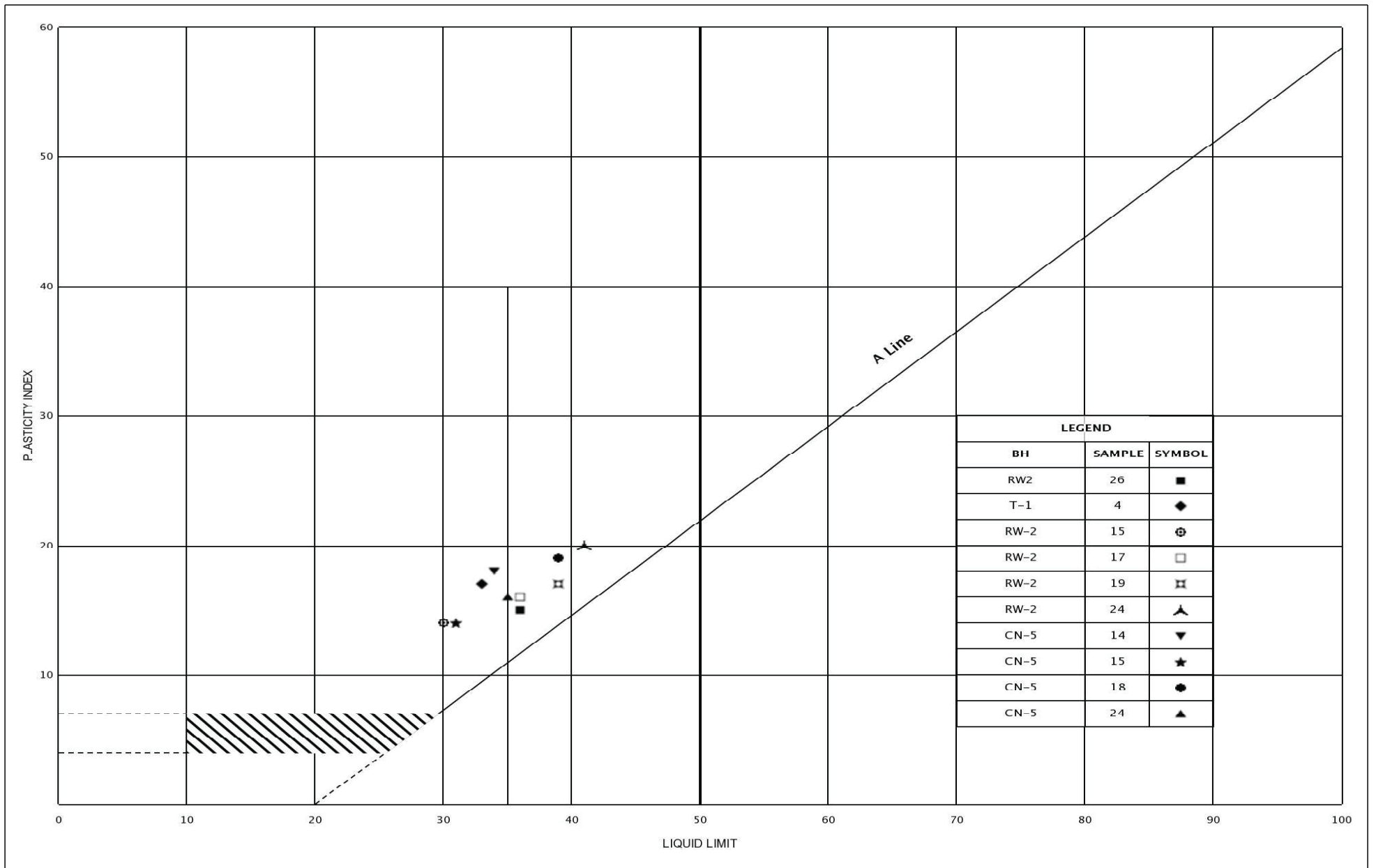
PLASTICITY CHART

CLAYEY SILT/ SILTY CLAY, Trace Sand to With Sand,
Trace Gravel

FIG No.: PC-3A

HWY.: 40

GWP 3064-11-00



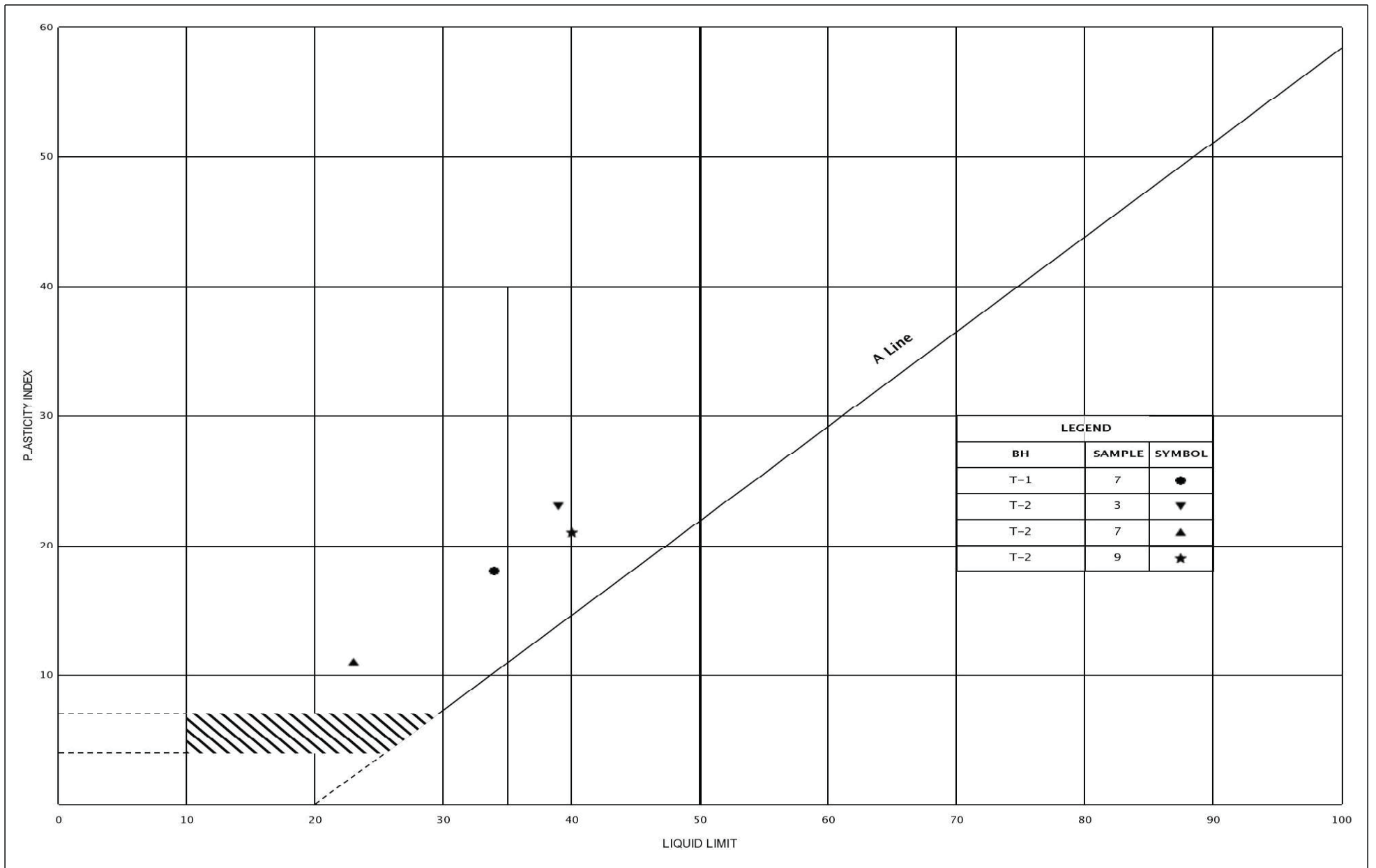
PLASTICITY CHART

CLAYEY SILT/ SILTY CLAY, Trace Sand to With Sand,
Trace Gravel

FIG No.: PC-3B

HWY.: 40

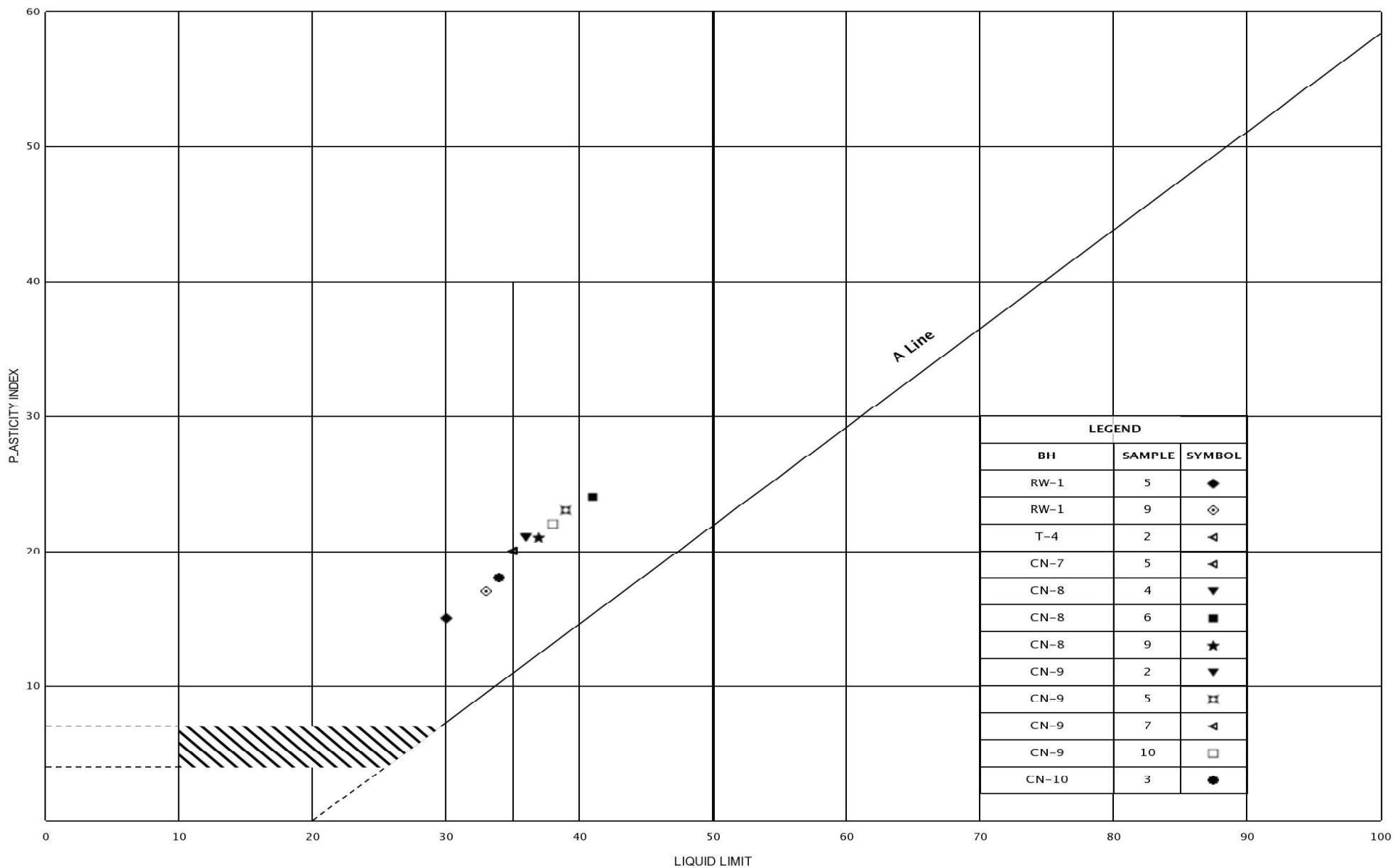
GWP 3064-11-00



PLASTICITY CHART

CLAYEY SILT/ SILTY CLAY, Trace Sand to With Sand, Trace Gravel

FIG No.:	PC-3C
HWY.:	40
GWP	3064-11-00



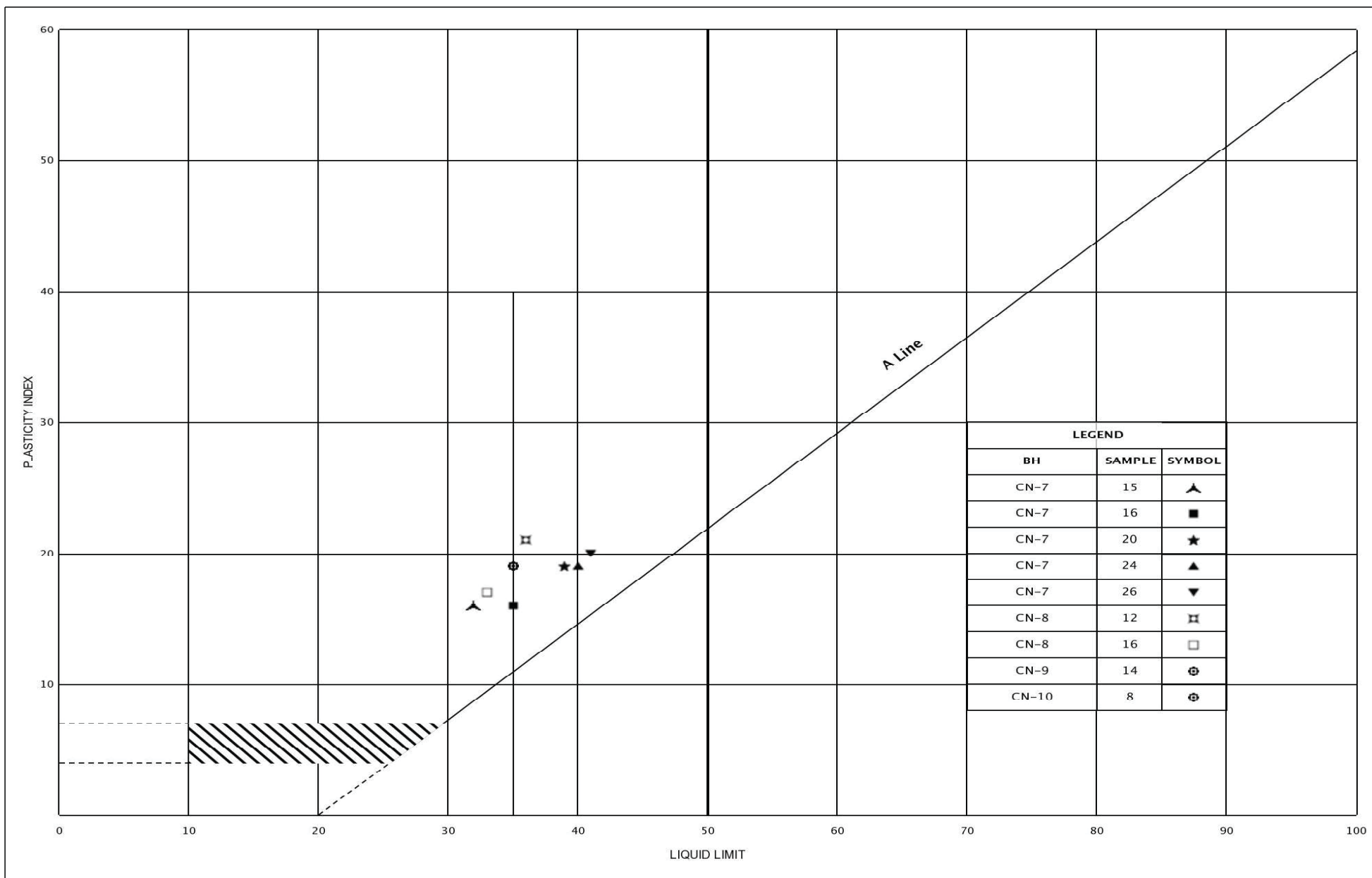
PLASTICITY CHART

CLAYEY SILT/ SILTY CLAY, Some Sand to Sandy, Trace Gravel (FILL)

FIG No.: PC-4

HWY.: 40

GWP 3064-11-00



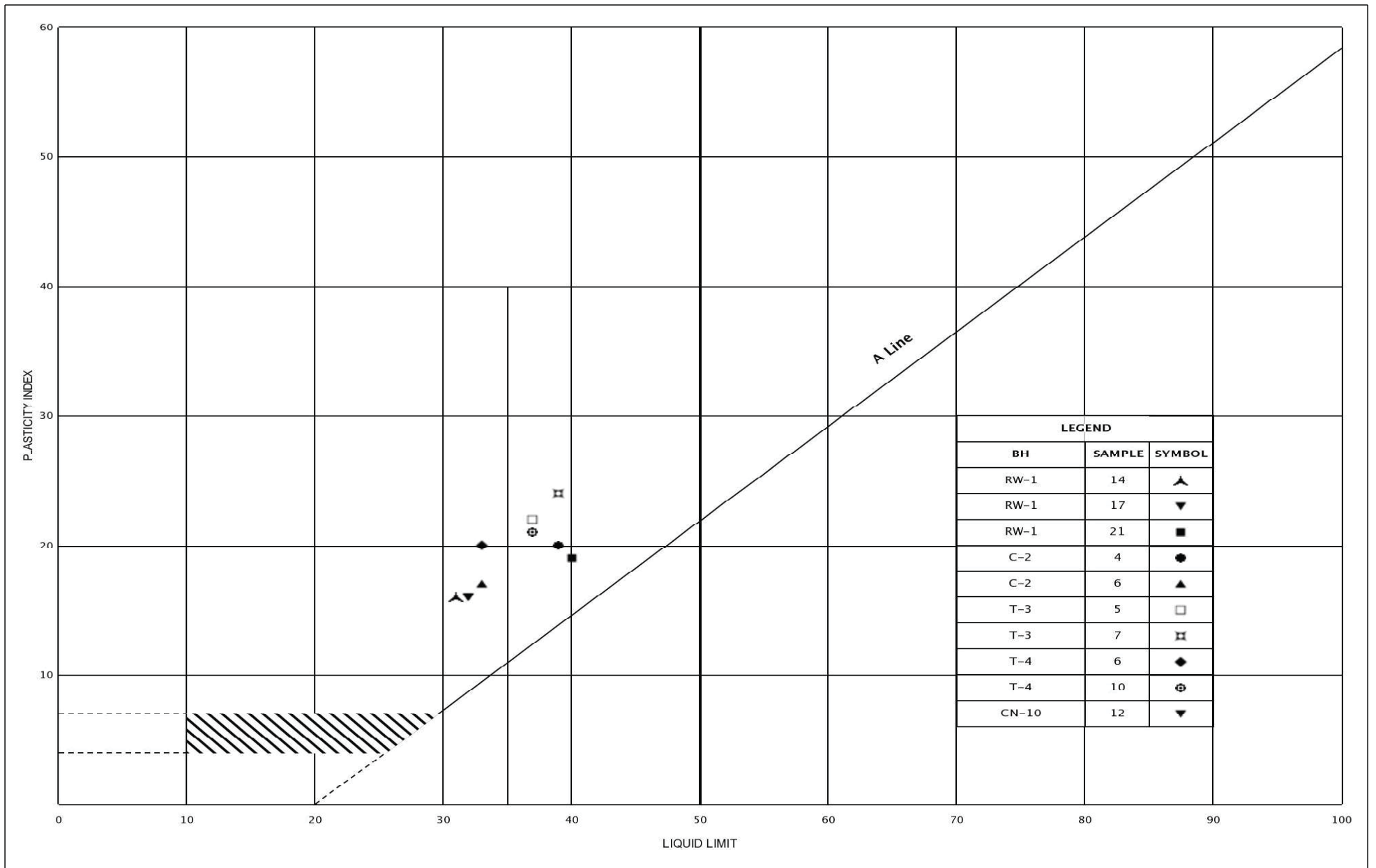
PLASTICITY CHART

CLAYEY SILT/ SILTY CLAY, Some Sand to With Sand,
Trace Gravel

FIG No.: PC-5A

HWY.: 40

GWP 3064-11-00



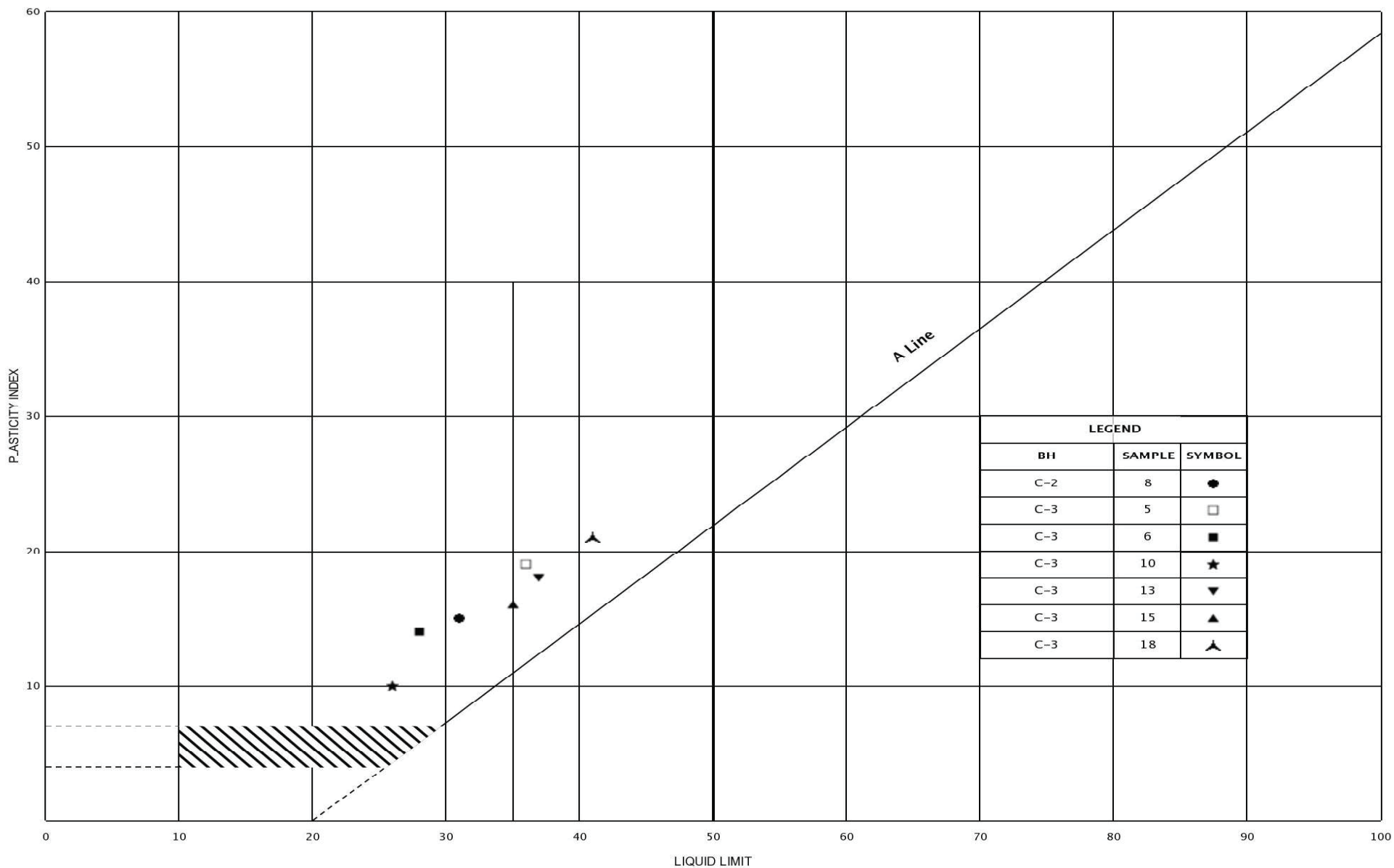
PLASTICITY CHART

CLAYEY SILT/ SILTY CLAY, Some Sand to With Sand,
Trace Gravel

FIG No.: PC-5B

HWY.: 40

GWP 3064-11-00



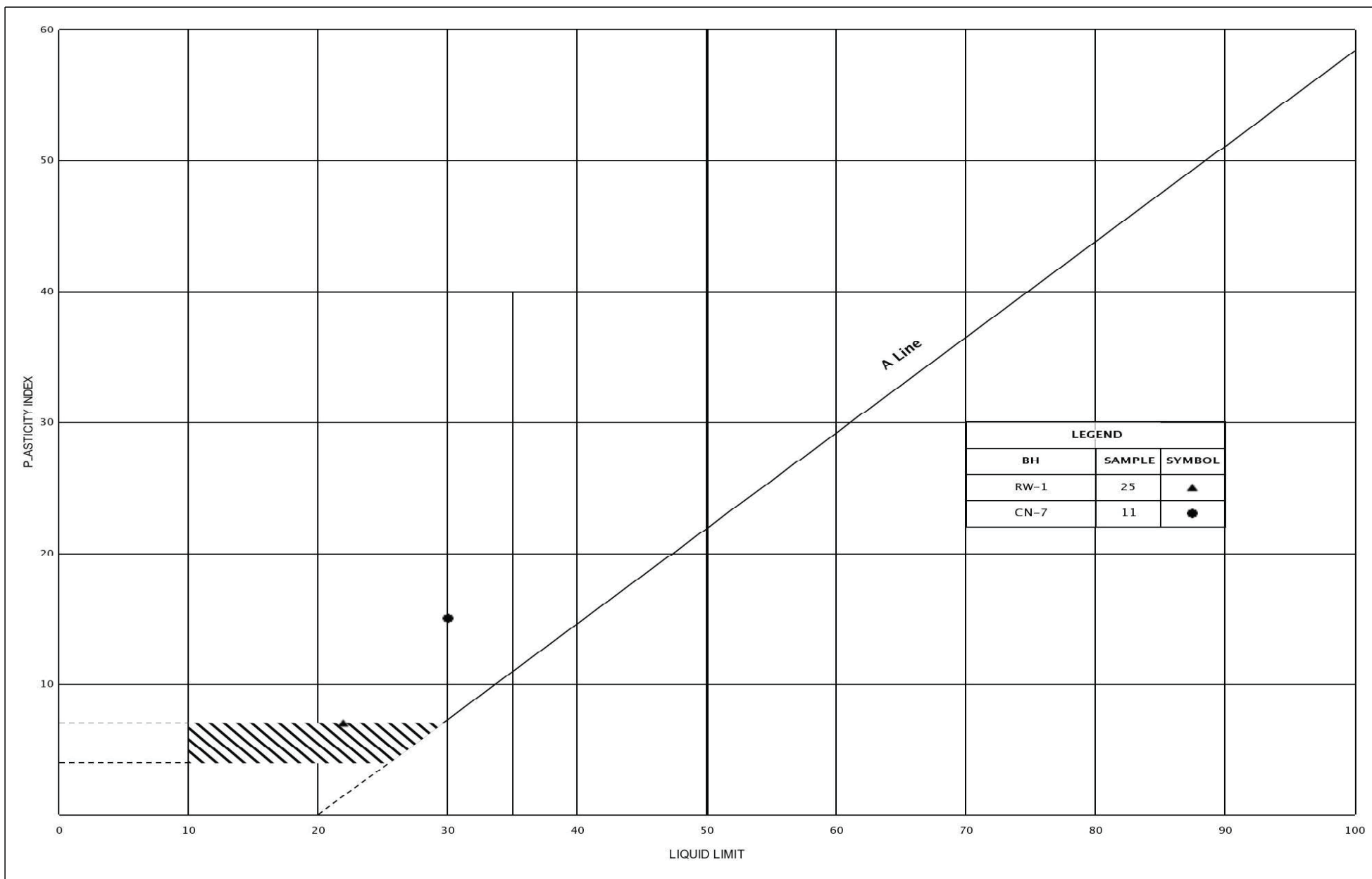
PLASTICITY CHART

CLAYEY SILT/ SILTY CLAY, Some Sand to With Sand,
Trace Gravel

FIG No.: PC-5C

HWY.: 40

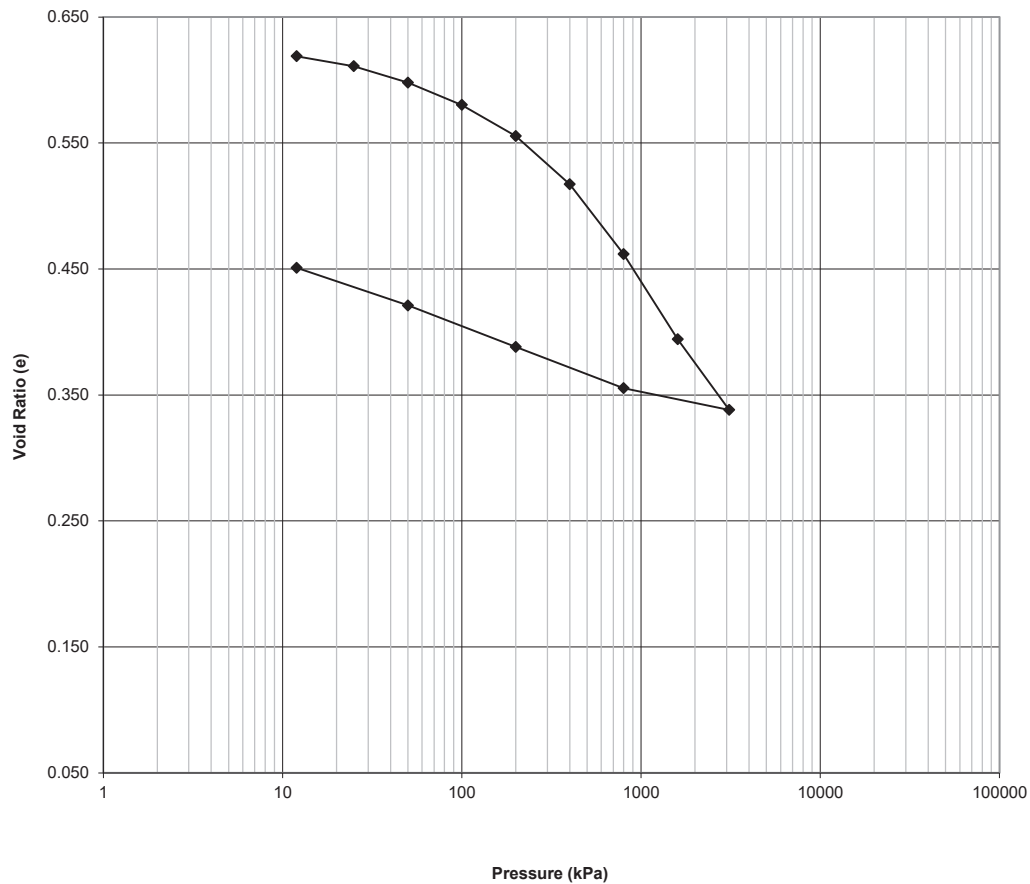
GWP 3064-11-00



Consolidation Test Results
(ASTM D2435)
Highway 40/CNR Overhead (WP 3064-11-02)

Borehole CN-5, Sample 14, Depth 15.2 - 15.8 m

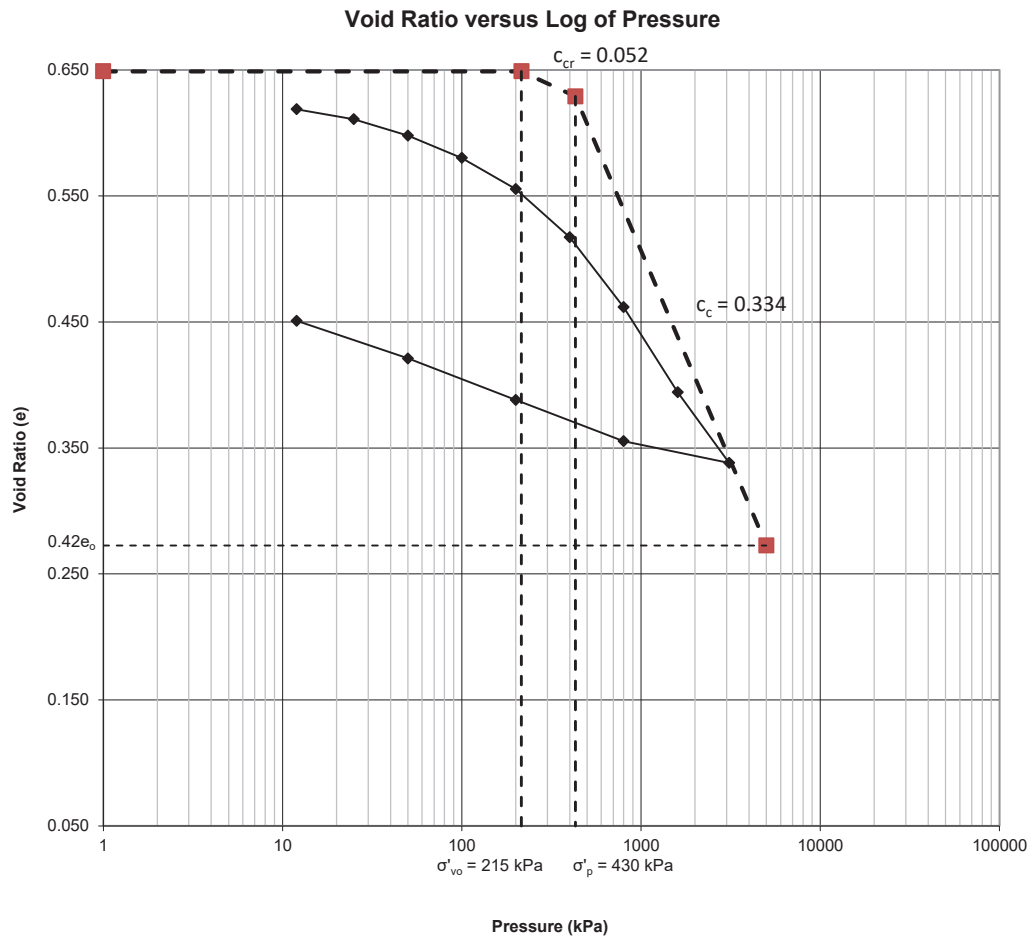
Void Ratio versus Log of Pressure



SOIL TYPE: Silty Clay			
e_0	= 0.649	W_L	= 34
W_0	= 23.8 %	W_P	= 16
γ	= 20.3 kN/m ³	PI	= 18
FIGURE No: CT-1			
Highway 40/CNR Overhead (WP 3064-11-02)			
PML Ref: 20TF017			

Consolidation Test Results
(ASTM D2435)
Highway 40/CNR Overhead (WP 3064-11-02)

Borehole CN-5, Sample 14, Depth 15.2 - 15.8 m

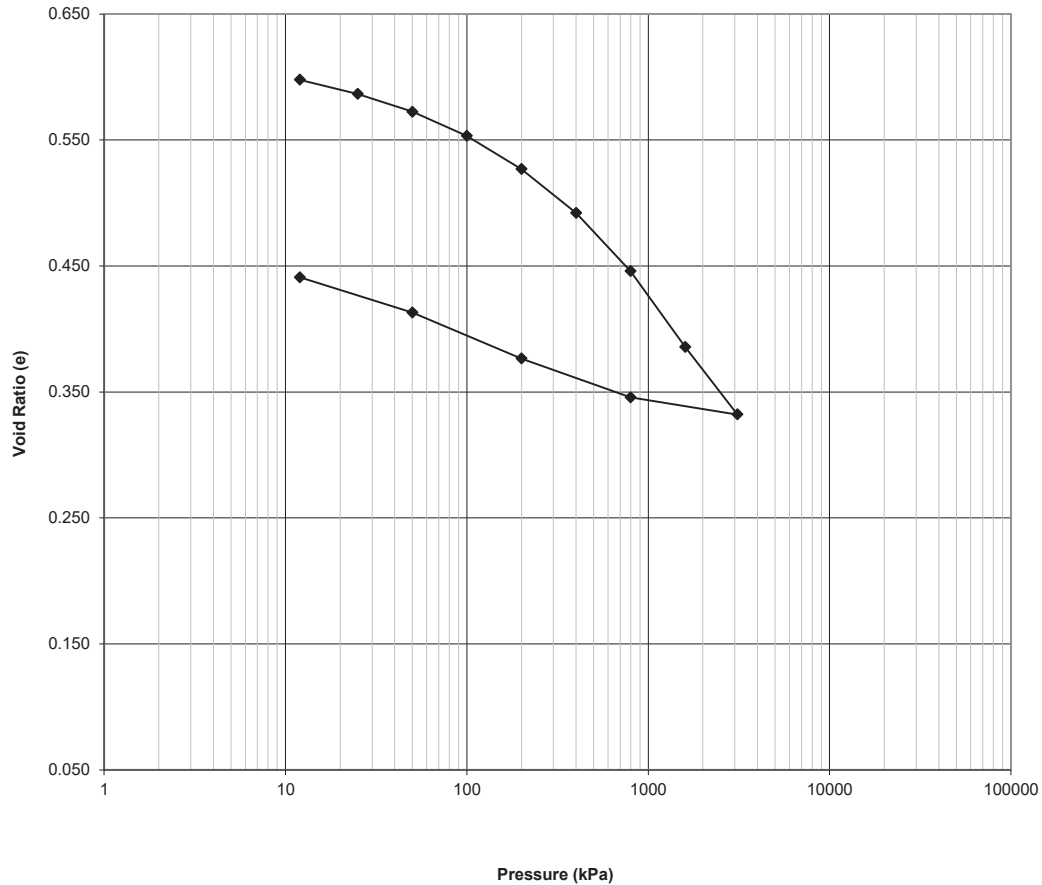


SOIL TYPE: Silty Clay			
e_0	= 0.649	W_L	= 34
W_0	= 23.8 %	W_P	= 16
γ	= 20.3 kN/m ³	PI	= 18
FIGURE No: CT-1			
Highway 40/CNR Overhead (WP 3064-11-02)			
PML Ref: 20TF017			

Consolidation Test Results
(ASTM D2435)
Highway 40/CNR Overhead (WP3064-11-02)

Borehole CN-7, Sample 15, Depth 15.2 - 15.8 m

Void Ratio versus Log of Pressure

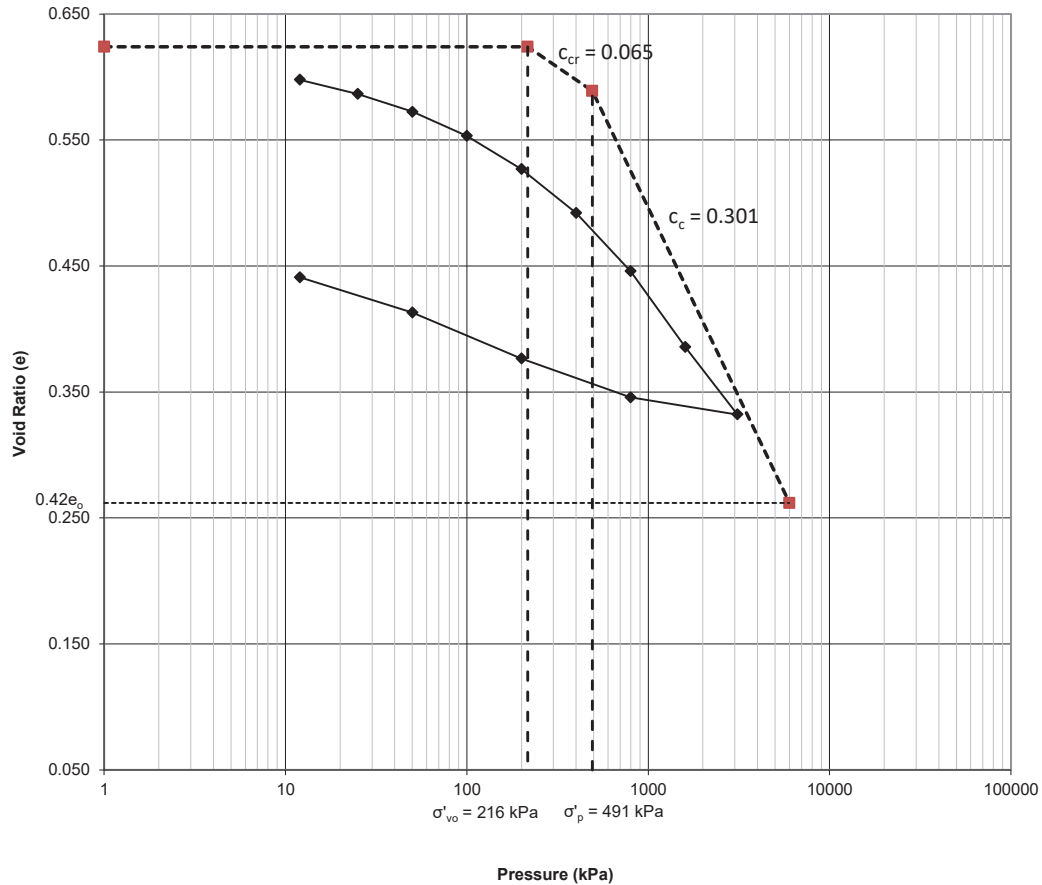


SOIL TYPE: Silty Clay			
e_0	= 0.624	W_L	= 32
W_0	= 23.1 %	W_P	= 16
γ	= 20.4 kN/m ³	PI	= 16
FIGURE No: CT-2			
Highway 40/CNR Overhead (WP3064-11-02)			
PML Ref: 20TF017			

Consolidation Test Results
(ASTM D2435)
Highway 40/CNR Overhead (WP3064-11-02)

Borehole CN-7, Sample 15, Depth 15.2 - 15.8 m

Void Ratio versus Log of Pressure

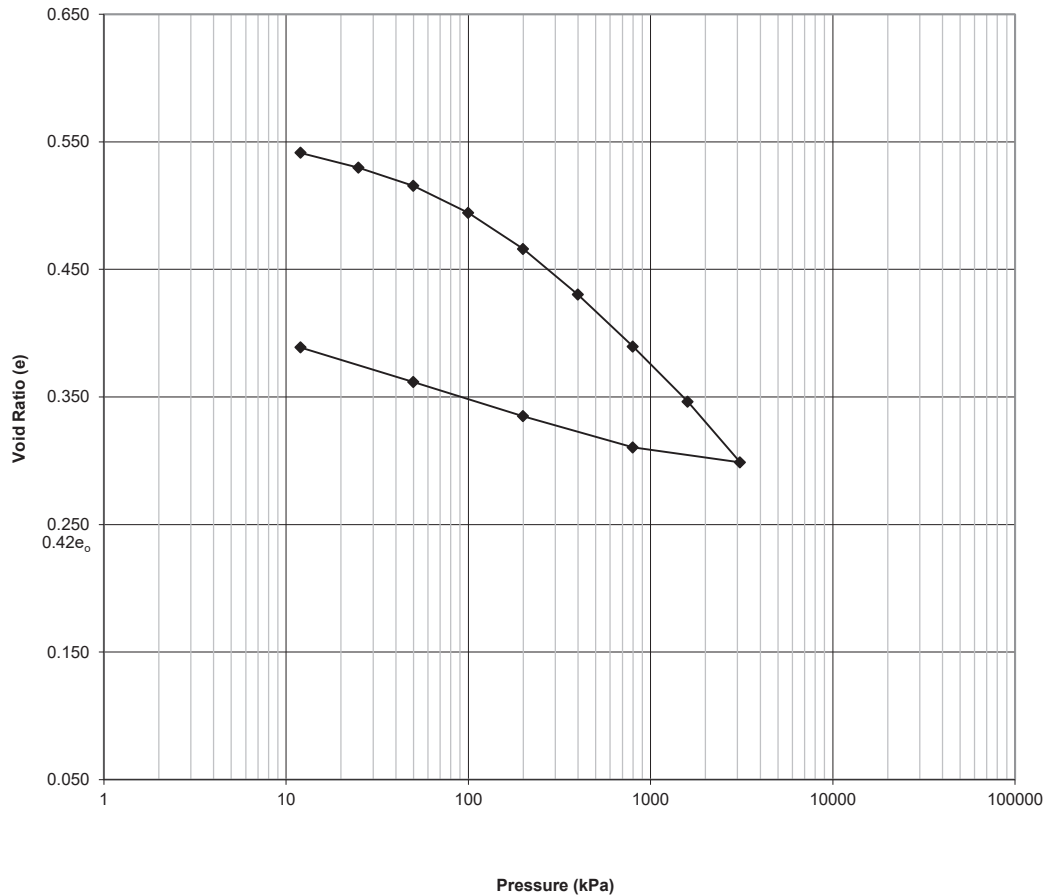


SOIL TYPE: Silty Clay			
e_0	= 0.624	W_L	= 32
W_0	= 23.1 %	W_P	= 16
γ	= 20.4 kN/m ³	PI	= 16
		FIGURE No: CT-2	
		Highway 40/CNR Overhead (WP3064-11-02)	
		PML Ref: 20TF017	

Consolidation Test Results
(ASTM D2435)
Highway 40/CNR Overhead (WP 3064-11-02)

Borehole RW2, Sample 16, Depth 18.3 - 18.9 m

Void Ratio versus Log of Pressure

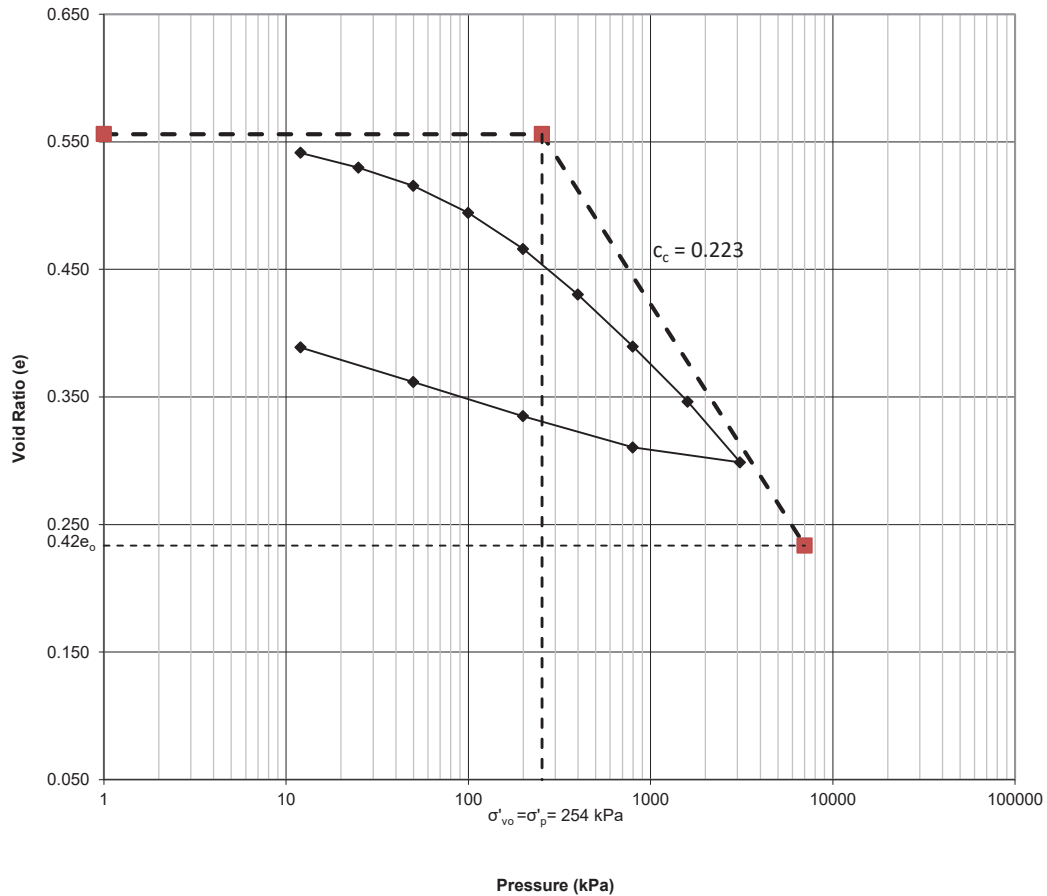


SOIL TYPE: Silty Clay			
e_0	=	0.556	W_L = -
W_0	=	21.9 %	W_P = -
γ	=	20.7 kN/m ³	PI = -
FIGURE No: CT-3			
Highway 40/CNR Overhead (WP 3064-11-02)			
PML Ref: 20TF017			

Consolidation Test Results
(ASTM D2435)
Highway 40/CNR Overhead (WP 3064-11-02)

Borehole RW2, Sample 16, Depth 18.3 - 18.9 m

Void Ratio versus Log of Pressure



SOIL TYPE: Silty Clay			
e_0	=	0.556	W_L = -
W_0	=	21.9 %	W_P = -
γ	=	20.7 kN/m ³	PI = -
			FIGURE No: CT-3
			Highway 40/CNR Overhead (WP 3064-11-02)
			PML Ref: 20TF017

Peto MacCallum Ltd.

CONSULTING ENGINEERS

UNIAXIAL COMPRESSIVE STRENGTH OF ROCK CORE

ASTM D7012

CLIENT WSP
PROJECT HWY 40/CNR OVERPASS
SAMPLE IDENTIFICATION CN-5 RUN1 46.55 m - 46.81 m

PML REF 20TF017
LAB NO. 2008570A
DATE SAMPLED 2020/12/17
DATE TESTED
TESTED BY

CORE DIMENSIONS		COMPRESSIVE STRENGTH	
SPECIMEN DIAMETER (mm.)	62.705	TEST TIME (min) (spec. 2 to 15)	19:12
SPECIMEN LENGTH (mm.)	131.648	MAXIMUM LOAD APPLIED (kN)	221.50
	131.953		
	131.597	COMPRESSIVE STRENGTH (MPa)	71.7
AVE.	131.724	TYPE OF FAILURE	2
CROSS SECTIONAL AREA (sq mm)	3088	LENGTH TO DIAMETER RATIO (spec 2-2.5)	2.1

MOISTURE CONTENT

UNIT WEIGHT

WEIGHT OF WET SAMPLE + TARE (g)	1080.31	WEIGHT OF DRY SAMPLE IN AIR (g)	957.17
WEIGHT OF DRY SAMPLE + TARE (g)	1065.50	VOLUME OF SAMPLE (cu m)	0.000407
WEIGHT OF WATER (g)	14.81	UNIT WEIGHT (kg/cu m)	2353
WEIGHT OF TARE (g)	128.09		
WEIGHT OF DRY SAMPLE (g)	937.41		
MOISTURE CONTENT (%)	1.6		
REMARKS			



REVIEWED BY

J.Noor

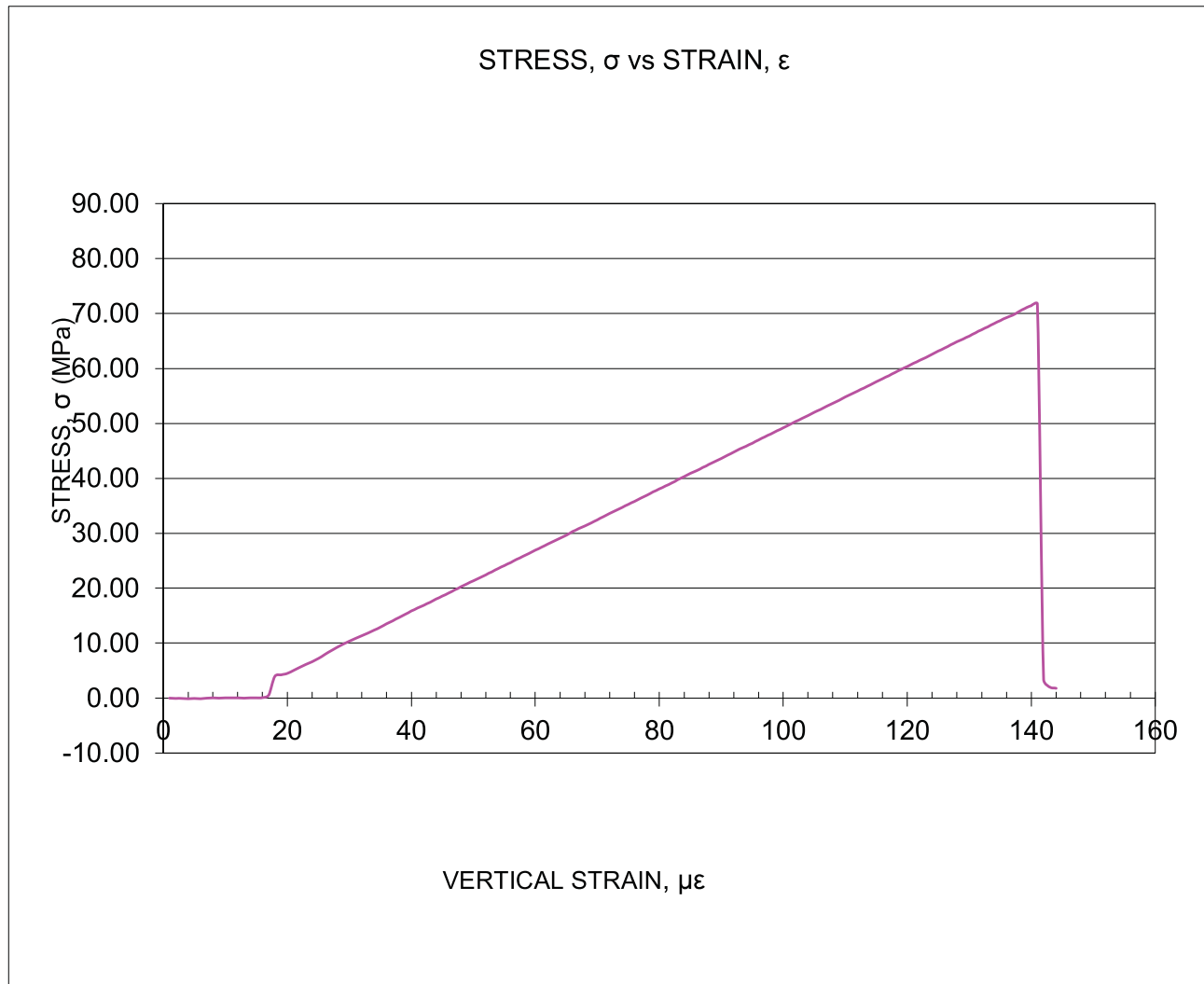
DATE

2021/01/08

ELASTIC MODULI OF ROCK CORE IN UNIAXIAL COMPRESSION

ASTM D7012

CLIENT	WSP	PML REF	20TF017
PROJECT	HWY 40/CNR OVERPASS	LAB NO.	2008570A
SAMPLE IDENTIFICATION	CN-5 RUN1 46.55 m - 46.81 m	DATE SAMPLED	2020/12/17
YOUNG'S MODULUS, E_{tan} (at 50% σ)	GPa	DATE TESTED	
YOUNG'S MODULUS, E_{sec} (at 50% σ)	GPa	TESTED BY	
YOUNG'S MODULUS, $E_{ave.}$ (at 50% σ)	GPa	POISSON'S RATIO	



REVIEWED BY

J.Noor

DATE 2021/01/08

Peto MacCallum Ltd.

CONSULTING ENGINEERS

UNIAXIAL COMPRESSIVE STRENGTH OF ROCK CORE

ASTM D7012

CLIENT WSP
PROJECT HWY 40/CNR OVERPASS
SAMPLE IDENTIFICATION CN-5 RUN2 48.36 m - 48.58 m

PML REF 2005221A
LAB NO. 20TF017
DATE SAMPLED 2020/08/18
DATE TESTED 8/31/2020
TESTED BY A.Saidajan

CORE DIMENSIONS		COMPRESSIVE STRENGTH	
SPECIMEN DIAMETER (mm.)	62.669	TEST TIME (min) (spec. 2 to 15)	9:36
SPECIMEN LENGTH (mm.)	153.492	MAXIMUM LOAD APPLIED (kN)	259.20
	152.730		
	152.806	COMPRESSIVE STRENGTH (MPa)	84.0
AVE.	153.010	TYPE OF FAILURE	2
CROSS SECTIONAL AREA (sq mm)	3085	LENGTH TO DIAMETER RATIO (spec 2-2.5)	2.44

MOISTURE CONTENT

UNIT WEIGHT

WEIGHT OF WET SAMPLE + TARE (g)	1252.52	WEIGHT OF DRY SAMPLE IN AIR (g)	1103.79
WEIGHT OF DRY SAMPLE + TARE (g)	1229.23	VOLUME OF SAMPLE (cu m)	0.000472
WEIGHT OF WATER (g)	23.29	UNIT WEIGHT (kg/cu m)	2339
WEIGHT OF TARE (g)	187.01		
WEIGHT OF DRY SAMPLE (g)	1042.22		
MOISTURE CONTENT (%)	2.2		
REMARKS			



REVIEWED BY

J.Noor

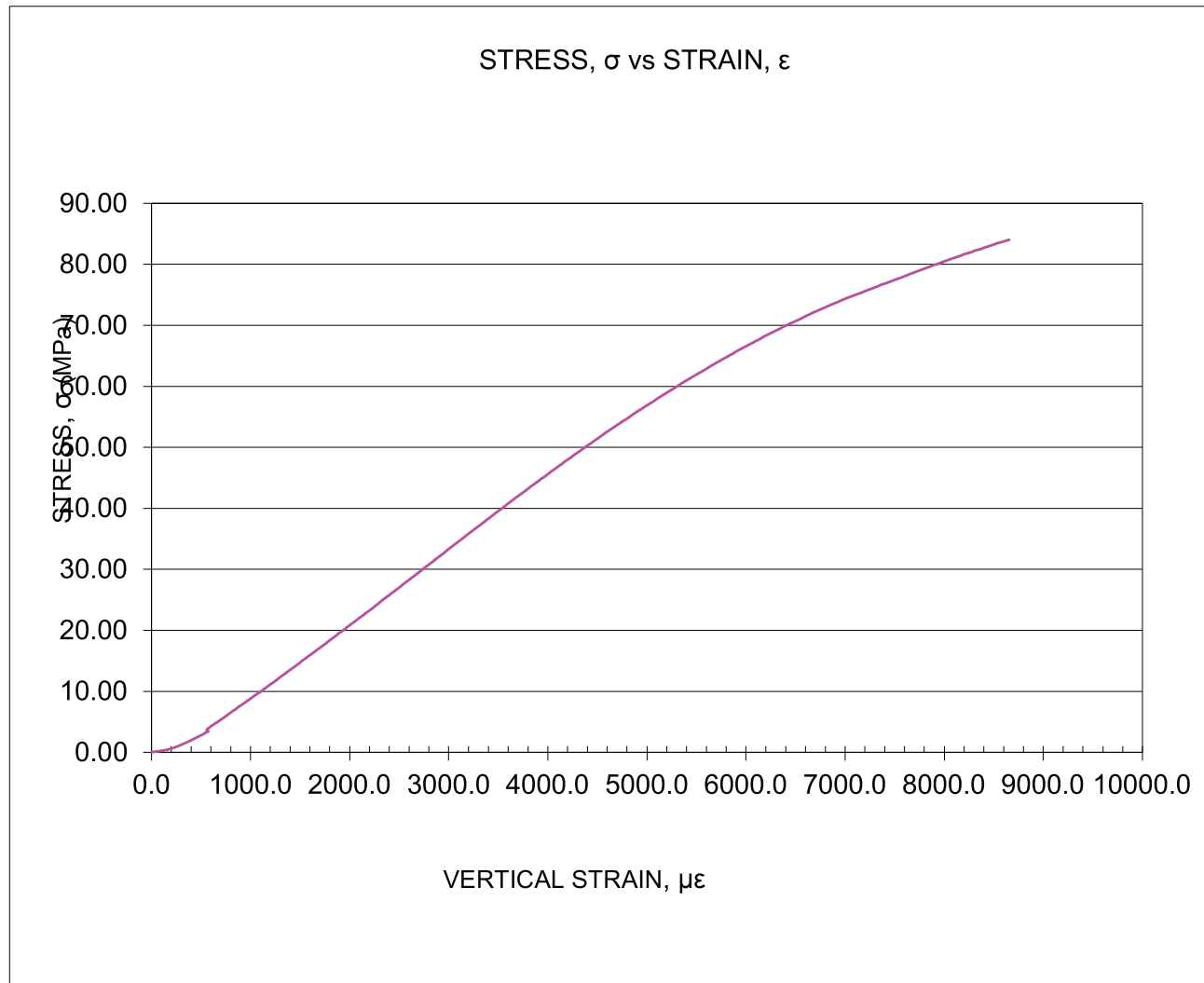
DATE

2020/09/03

ELASTIC MODULI OF ROCK CORE IN UNIAXIAL COMPRESSION

ASTM D7012

CLIENT	WSP	PML REF	2005221A
PROJECT	HWY 40/CNR OVERPASS	LAB NO.	20TF017
SAMPLE IDENTIFICATION	CN-5 RUN2 48.36 m - 48.58 m	DATE SAMPLED	2020/08/18
YOUNG'S MODULUS, E_{tan} (at 50% σ)	12.92 GPa	DATE TESTED	8/31/2020
YOUNG'S MODULUS, E_{sec} (at 50% σ)	11.35 GPa	TESTED BY	A.Saidajan
YOUNG'S MODULUS, $E_{ave.}$ (at 50% σ)	12.13 GPa	POISSON'S RATIO	0.192



REVIEWED BY

J.Noor

DATE 2020/09/03

Peto MacCallum Ltd.

CONSULTING ENGINEERS

UNIAXIAL COMPRESSIVE STRENGTH OF ROCK CORE

ASTM D7012

CLIENT WSP
PROJECT HWY 40/CNR OVERPASS
SAMPLE IDENTIFICATION C-3 RUN2 38.86 m - 39.13 m

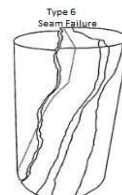
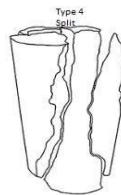
PML REF 20TF017
LAB NO. 2008570D
DATE SAMPLED 2020/12/17
DATE TESTED 1/5/2021
TESTED BY Azar Saidajar

CORE DIMENSIONS		COMPRESSIVE STRENGTH	
SPECIMEN DIAMETER (mm.)	30.544	TEST TIME (min) (spec. 2 to 15)	4:00
SPECIMEN LENGTH (mm.)	121.971	MAXIMUM LOAD APPLIED (kN)	229.00
	121.641		
	121.869	COMPRESSIVE STRENGTH (MPa)	78.1
AVE.	121.818	TYPE OF FAILURE	1
CROSS SECTIONAL AREA (sq mm)	2931	LENGTH TO DIAMETER RATIO (spec 2-2.5)	1.99

MOISTURE CONTENT

UNIT WEIGHT

WEIGHT OF WET SAMPLE + TARE (g)	943.73	WEIGHT OF DRY SAMPLE IN AIR (g)	838.30
WEIGHT OF DRY SAMPLE + TARE (g)	934.57	VOLUME OF SAMPLE (cu m)	0.000357
WEIGHT OF WATER (g)	9.16	UNIT WEIGHT (kg/cu m)	2348
WEIGHT OF TARE (g)	105.96		
WEIGHT OF DRY SAMPLE (g)	828.61		
MOISTURE CONTENT (%)	1.1		
REMARKS			



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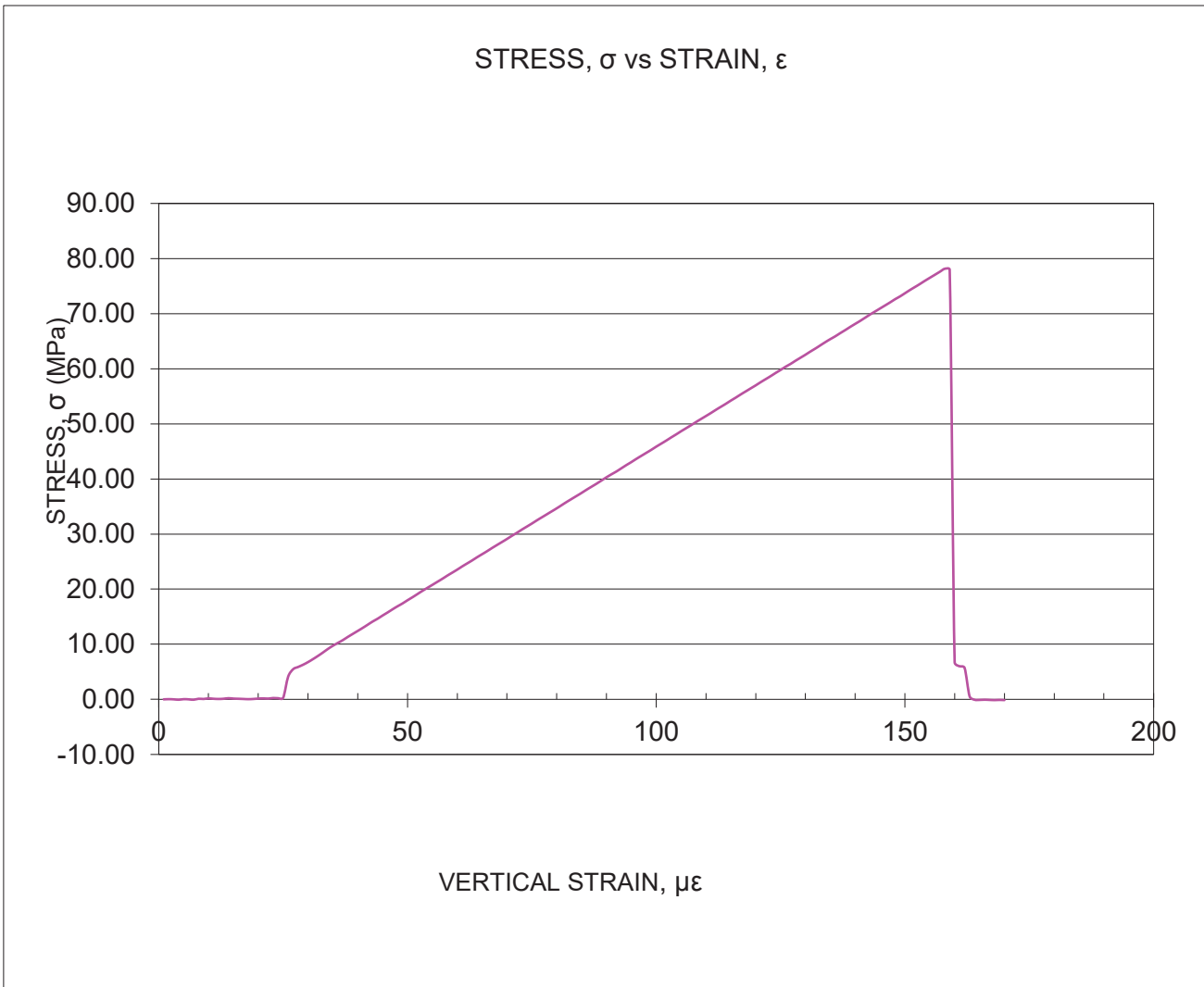
J.Noor

DATE

2021/01/08

ELASTIC MODULI OF ROCK CORE IN UNIAXIAL COMPRESSION
ASTM D7012

CLIENT	WSP	PML REF	20TF017
PROJECT	HWY 401/CNR OVERPASS	LAB NO.	2008570D
SAMPLE IDENTIFICATION	C-3 RUN2 38.86 m- 39.13 m	DATE SAMPLED	2020/12/17
YOUNG'S MODULUS, E_{tan} (at 50% σ)	GPa	DATE TESTED	1/5/2021
YOUNG'S MODULUS, E_{sec} (at 50% σ)	GPa	TESTED BY	Azar Saidajan
YOUNG'S MODULUS, $E_{ave.}$ (at 50% σ)	GPa	POISSON'S RATIO	



REVIEWED BY

J.Noor

DATE 2021/01/08

Peto MacCallum Ltd.

CONSULTING ENGINEERS

UNIAXIAL COMPRESSIVE STRENGTH OF ROCK CORE

ASTM D7012

CLIENT WSP
PROJECT HWY 401/CNR OVERPASS
SAMPLE IDENTIFICATION C-3 RUN3 40.4 m - 40.59 m

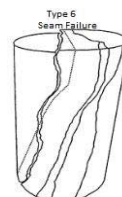
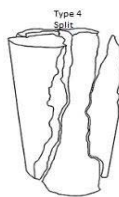
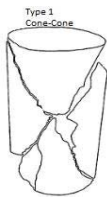
PML REF 20TF017
LAB NO. 2008570C
DATE SAMPLED 2020/12/17
DATE TESTED 1/5/2021
TESTED BY Azar Saidajar

CORE DIMENSIONS		COMPRESSIVE STRENGTH	
SPECIMEN DIAMETER (mm.)	30.298	TEST TIME (min) (spec. 2 to 15)	1:36
SPECIMEN LENGTH (mm.)	122.809	MAXIMUM LOAD APPLIED (kN)	213.80
	122.377		
	122.301	COMPRESSIVE STRENGTH (MPa)	74.1
AVE.	122.504	TYPE OF FAILURE	2
CROSS SECTIONAL AREA (sq mm)	2884	LENGTH TO DIAMETER RATIO (spec 2-2.5)	2.02

MOISTURE CONTENT

UNIT WEIGHT

WEIGHT OF WET SAMPLE + TARE (g)	943.94	WEIGHT OF DRY SAMPLE IN AIR (g)	853.68
WEIGHT OF DRY SAMPLE + TARE (g)	932.26	VOLUME OF SAMPLE (cu m)	0.000353
WEIGHT OF WATER (g)	11.68	UNIT WEIGHT (kg/cu m)	2416
WEIGHT OF TARE (g)	128.08		
WEIGHT OF DRY SAMPLE (g)	804.18		
MOISTURE CONTENT (%)	1.5		
REMARKS			



REVIEWED BY

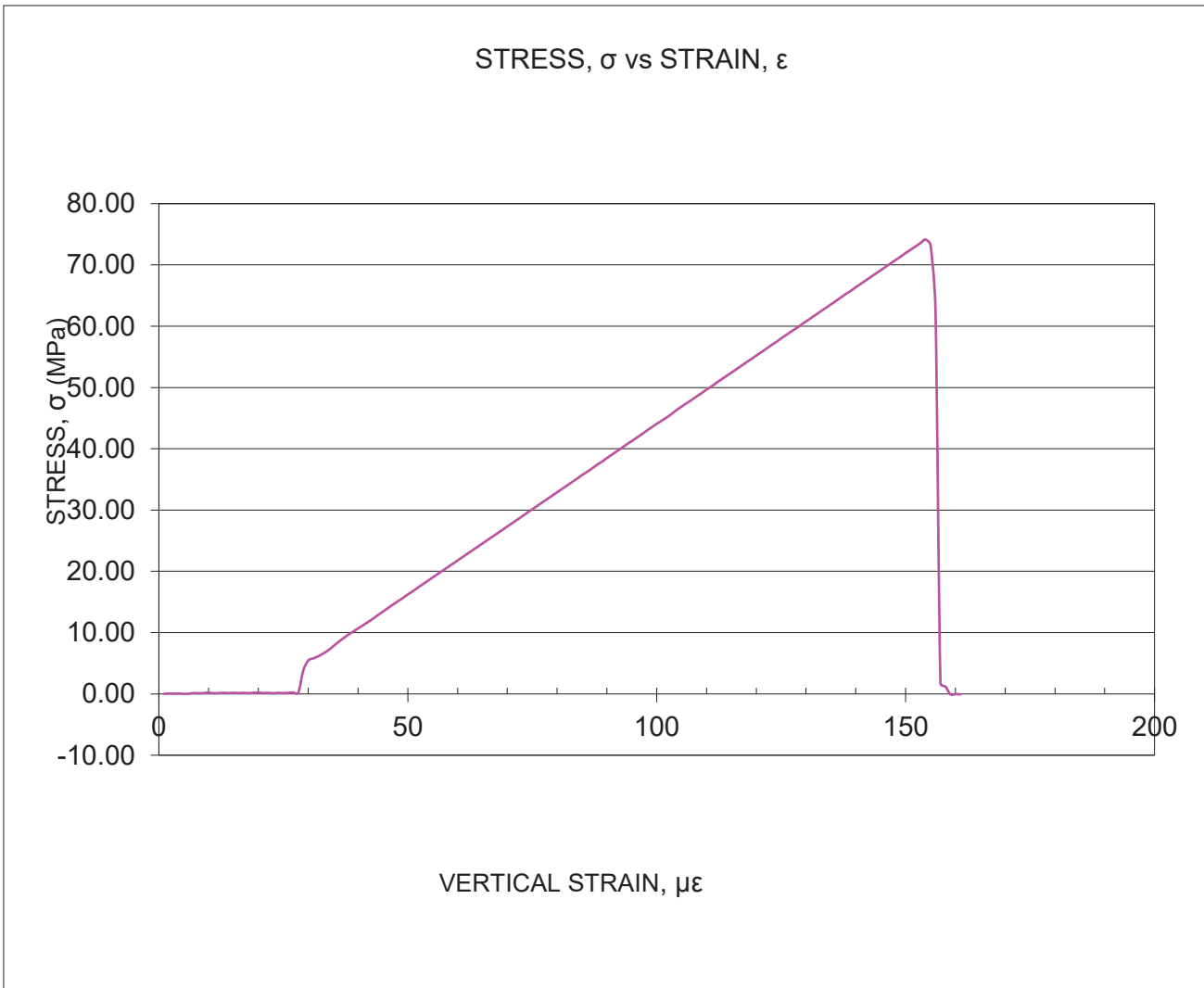
J.Noor

DATE

2021/01/08

ELASTIC MODULI OF ROCK CORE IN UNIAXIAL COMPRESSION
ASTM D7012

CLIENT	WSP	PML REF	20TF017
PROJECT	HWY 401/CNR OVERPASS	LAB NO.	2008570C
SAMPLE IDENTIFICATION	C-3 RUN3 40.4 m - 40.59 m	DATE SAMPLED	2020/12/17
YOUNG'S MODULUS, E_{tan} (at 50% σ)	GPa	DATE TESTED	1/5/2021
YOUNG'S MODULUS, E_{sec} (at 50% σ)	GPa	TESTED BY	Azar Saidajan
YOUNG'S MODULUS, $E_{ave.}$ (at 50% σ)	GPa	POISSON'S RATIO	



REVIEWED BY

J.Noor

DATE 2021/01/08

Peto MacCallum Ltd.

CONSULTING ENGINEERS

UNIAXIAL COMPRESSIVE STRENGTH OF ROCK CORE

ASTM D7012

CLIENT WSP
PROJECT HWY40/CNR
SAMPLE IDENTIFICATION CN-7 RUN1 46.65 m - 46.81 m

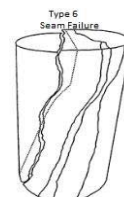
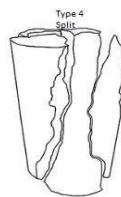
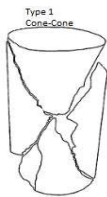
PML REF 2005221B
LAB NO. 20TF017
DATE SAMPLED 2020/08/18
DATE TESTED 8/31/2020
TESTED BY A.Saidajan

CORE DIMENSIONS		COMPRESSIVE STRENGTH	
SPECIMEN DIAMETER (mm.)	31.559	TEST TIME (min) (spec. 2 to 15)	9:36
SPECIMEN LENGTH (mm.)	150.089	MAXIMUM LOAD APPLIED (kN)	263.30
	149.962		
	149.936	COMPRESSIVE STRENGTH (MPa)	84.1
AVE.	149.987	TYPE OF FAILURE	1
CROSS SECTIONAL AREA (sq mm)	3129	LENGTH TO DIAMETER RATIO (spec 2-2.5)	2.38

MOISTURE CONTENT

UNIT WEIGHT

WEIGHT OF WET SAMPLE + TARE (g)	1270.59	WEIGHT OF DRY SAMPLE IN AIR (g)	1110.00
WEIGHT OF DRY SAMPLE + TARE (g)	1254.09	VOLUME OF SAMPLE (cu m)	0.000469
WEIGHT OF WATER (g)	16.50	UNIT WEIGHT (kg/cu m)	2365
WEIGHT OF TARE (g)	173.58		
WEIGHT OF DRY SAMPLE (g)	1080.51		
MOISTURE CONTENT (%)	1.5		
REMARKS		173.58	



REVIEWED BY

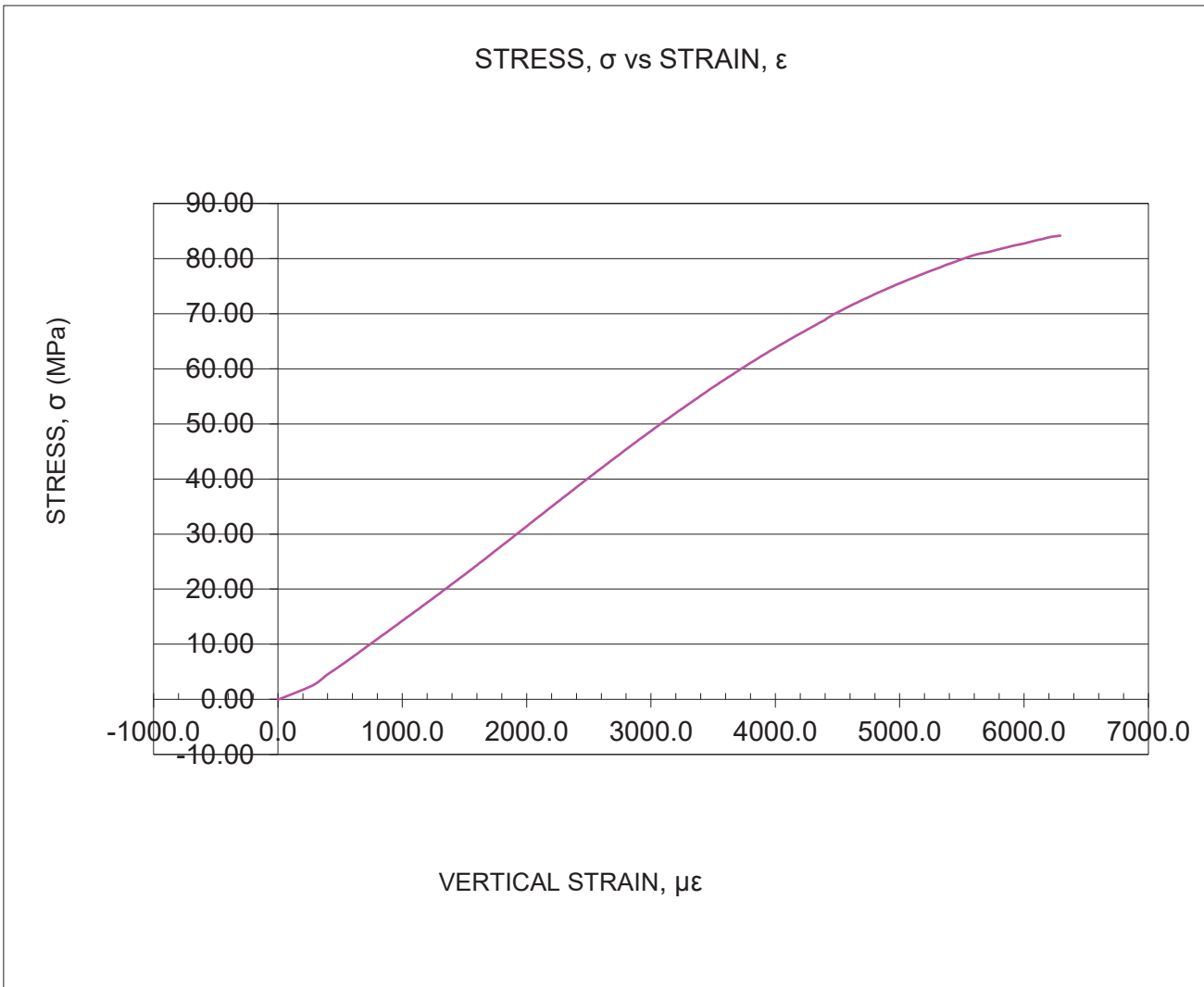
J.Noor

DATE

2020/09/03

ELASTIC MODULI OF ROCK CORE IN UNIAXIAL COMPRESSION
ASTM D7012

CLIENT	WSP	PML REF	2005221B
PROJECT	HWY40/CNR	LAB NO.	20TF017
SAMPLE IDENTIFICATION	CN-7 RUN1 46.65 m-46.81 m	DATE SAMPLED	2020/08/18
YOUNG'S MODULUS, E_{tan} (at 50% σ)	17.33 GPa	DATE TESTED	8/31/2020
YOUNG'S MODULUS, E_{sec} (at 50% σ)	16.13 GPa	TESTED BY	A.Saidajan
YOUNG'S MODULUS, $E_{ave.}$ (at 50% σ)	16.73 GPa	POISSON'S RATIO	0.453



REVIEWED BY

J.Noor

DATE 2020/09/03

Peto MacCallum Ltd.

CONSULTING ENGINEERS

UNIAXIAL COMPRESSIVE STRENGTH OF ROCK CORE

ASTM D7012

CLIENT WSP
PROJECT HWY 401/CNR OVERPASS
SAMPLE IDENTIFICATION CN-7 RUN2 48.13 m - 48.31 m

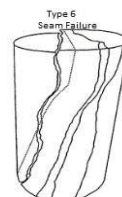
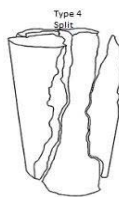
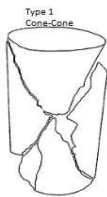
PML REF 20TF017
LAB NO. 2008570B
DATE SAMPLED 2020/12/17
DATE TESTED 12/23/2020
TESTED BY Azar Saidajar

CORE DIMENSIONS		COMPRESSIVE STRENGTH	
SPECIMEN DIAMETER (mm.)	63.010	TEST TIME (min) (spec. 2 to 15)	16:00
SPECIMEN LENGTH (mm.)	133.096	MAXIMUM LOAD APPLIED (kN)	189.60
	133.045		
	133.147	COMPRESSIVE STRENGTH (MPa)	60.8
AVE.	133.096	TYPE OF FAILURE	1
CROSS SECTIONAL AREA (sq mm)	3118	LENGTH TO DIAMETER RATIO (spec 2-2.5)	2.11

MOISTURE CONTENT

UNIT WEIGHT

WEIGHT OF WET SAMPLE + TARE (g)	1074.14	WEIGHT OF DRY SAMPLE IN AIR (g)	960.58
WEIGHT OF DRY SAMPLE + TARE (g)	1069.00	VOLUME OF SAMPLE (cu m)	0.000415
WEIGHT OF WATER (g)	5.14	UNIT WEIGHT (kg/cu m)	2315
WEIGHT OF TARE (g)	112.65		
WEIGHT OF DRY SAMPLE (g)	956.35		
MOISTURE CONTENT (%)	0.5		
REMARKS			



REVIEWED BY

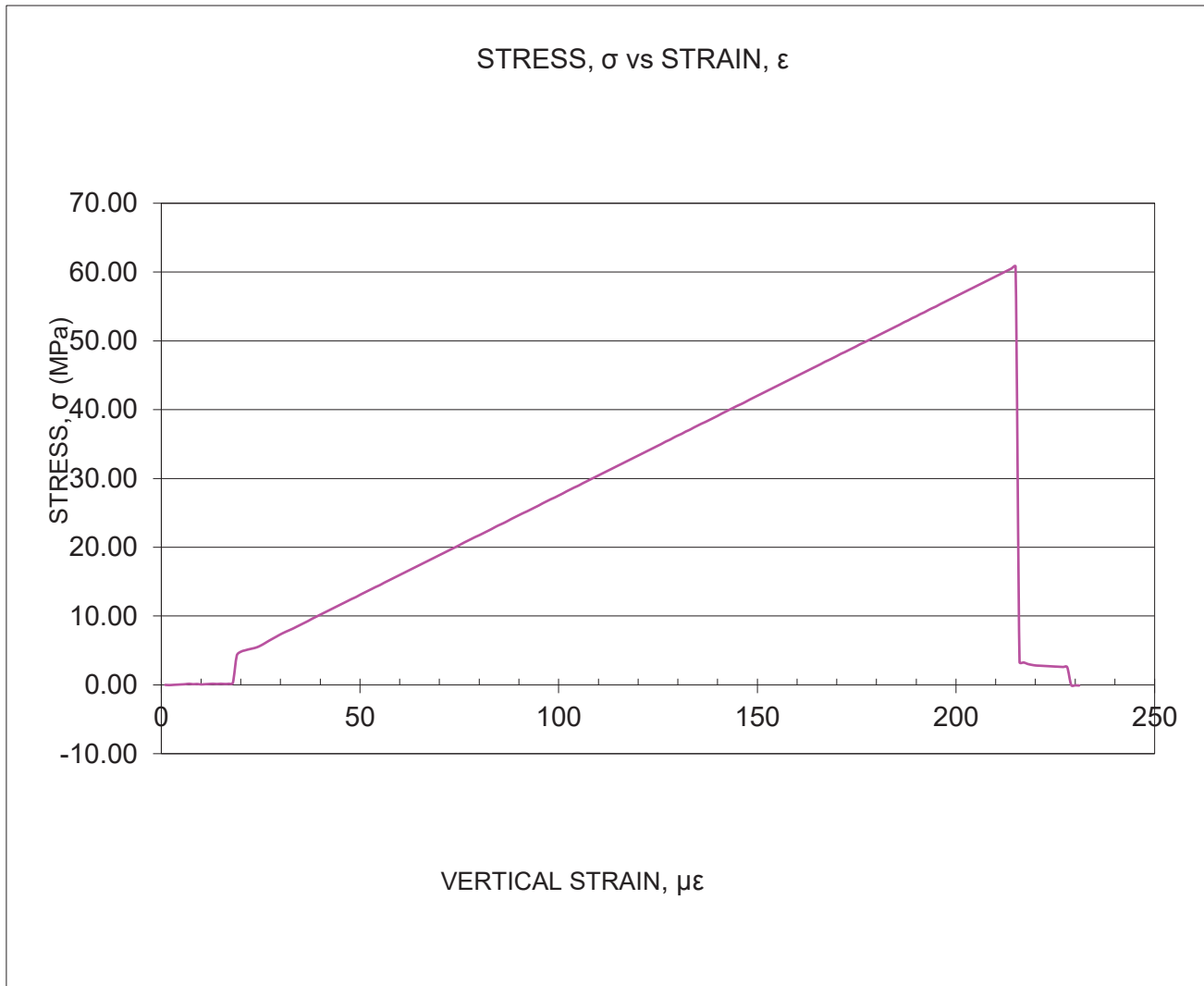
J.Noor

DATE

2021/01/08

ELASTIC MODULI OF ROCK CORE IN UNIAXIAL COMPRESSION
ASTM D7012

CLIENT	WSP	PML REF	20TF017
PROJECT	HWY 401/CNR OVERPASS	LAB NO.	2008570B
SAMPLE IDENTIFICATION	CN-7 RUN2 48.13 m-48.31 m	DATE SAMPLED	2020/12/17
YOUNG'S MODULUS, E_{tan} (at 50% σ)	GPa	DATE TESTED	12/23/2020
YOUNG'S MODULUS, E_{sec} (at 50% σ)	GPa	TESTED BY	Azar Saidajan
YOUNG'S MODULUS, $E_{ave.}$ (at 50% σ)	GPa	POISSON'S RATIO	



REVIEWED BY

J.Noor

DATE 2021/01/08

STRENGTH

VH = Very High = >200 MPa
H = High = 50-200 MPa
M = Medium = 15-50 MPa
L = Low = 4-15 MPa
VL = Very Low = 1-4 MPa

WEATHERING

U = Unweathered = No signs
S = Slightly = Oxidized
M = Moderately = Discoloured
H = Highly = Friable
C = Completely = Soil-Like

DISCONTINUITY TYPE

B = Bedding Joint
J = Cross Joint
F = Fault
S = Shear Plane
BR = Broken Rock

ORIENTATION

F = Flat = 0-20°
D = Dipping = 20-50°
V = Vertical >50°

SPACING

VW = Very Wide = >3 m
W = Wide = 1-3 m
M = Moderate = 0.3-1 m
C = Close = 5-30 cm
VC = Very Close = <5 cm

ROUGHNESS

RU = Rough Undulating
RP = Rough Planar
SU = Smooth Undulating
SP = Smooth Planar
LU = Slickensided Undulating
LP = Slickensided Planar

FILLING

T = Tight, Hard
O = Oxidized
SA = Slightly Altered, Clay Free
S = Sandy, Clay Free
Si = Sandy, Silty, Minor Clay
NC = Non-softening Clay
SC = Swelling, Soft Clay

CORE LOG IDENTIFICATION

BOREHOLE #: CN-5
PML REF.: 20TF017
PROJECT: Highway 40/CNR 2019-3076 Overhead
LOCATION: Highway 40 CNR Sarnia, Ontario
DATE: August 7, 2020
LOGGED BY: H. Racher, P.Geo.

Provincial Highways: A Guide to the
Description of Rock for Engineering
Purposes
MI-47

RUN #	DEPTH TO (m)	CORE RECOVERY (%)	RQD (%)	DEPTH TO (m)	GENERAL DESCRIPTION	STRENGTH	WEATHERING	DISCONTINUITIES							OCCASIONAL FEATURES	DRILLING OBSERVATIONS
								# OF SETS	TYPE	ORIENTATION	SPACING	ROUGHNESS	APERTURE	FILLING		
1	45.72	74% (1.12 m)	72% (1.09 m)	47.24	KETTLE POINT FORMATION Unweathered, fissile, thinly laminated, black, soft SHALE .	L	U	2	J	F	C	SP	-	-	Occasional presence of sulphide lenses.	
2	47.24	100% (1.52 m)	100% (1.52 m)	48.76	KETTLE POINT FORMATION Unweathered, fissile, thinly laminated, black, soft SHALE .	L	U	-	-	-	-	-	-	-	Occasional presence of sulphide lenses/nodules; sample taken at 48.36-48.58 m.	

STRENGTH

VH = Very High = >200 MPa
H = High = 50-200 MPa
M = Medium = 15-50 MPa
L = Low = 4-15 MPa
VL = Very Low = 1-4 MPa

WEATHERING

U = Unweathered = No signs
S = Slightly = Oxidized
M = Moderately = Discoloured
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DISCONTINUITY TYPE

B = Bedding Joint
J = Cross Joint
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D = Dipping = 20-50°
V = Vertical >50°

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W = Wide = 1-3 m
M = Moderate = 0.3-1 m
C = Close = 5-30 cm
VC = Very Close = <5 cm

ROUGHNESS

RU = Rough Undulating
RP = Rough Planar
SU = Smooth Undulating
SP = Smooth Planar
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FILLING

T = Tight, Hard
O = Oxidized
SA = Slightly Altered, Clay Free
S = Sandy, Clay Free
Si = Sandy, Silty, Minor Clay
NC = Non-softening Clay
SC = Swelling, Soft Clay

CORE LOG IDENTIFICATION

BOREHOLE #: CN-7
PML REF.: 20TF017
PROJECT: Highway 40/CNR 2019-3076 Overhead
LOCATION: Highway 40 CNR Sarnia, Ontario
DATE: August 7, 2020
LOGGED BY: H. Rancher, P.Geo.

Provincial Highways: A Guide to the
Description of Rock for Engineering
Purposes
MI-47

RUN #	DEPTH TO (m)	CORE RECOVERY (%)	RQD (%)	DEPTH TO (m)	GENERAL DESCRIPTION	STRENGTH	WEATHERING	DISCONTINUITIES							OCCASIONAL FEATURES	DRILLING OBSERVATIONS
								# OF SETS	TYPE	ORIENTATION	SPACING	ROUGHNESS	APERTURE	FILLING		
1	45.72	78% (1.19 m)	75% (1.14 m)	47.24	KETTLE POINT FORMATION Unweathered, fissile, thinly laminated, black, soft SHALE .	L	U	1	J	F	-	SP	-	-	Broken rock at 45.72-45.74 m; sample taken at 46.65-46.81 m.	
2	47.24	93% (1.42 m)	93% (1.42 m)	48.76	KETTLE POINT FORMATION Unweathered, fissile, thinly laminated, black, soft SHALE .	L	U	2	J	F	M	SP	-	-	Occasional presence of sulphide stringers/nodules; white quartz vein <15.0 mm thick.	

STRENGTH

VH = Very High = >200 MPa

H = High = 50-200 MPa

M = Medium = 15-50 MPa

L = Low = 4-15 MPa

VL = Very Low = 1-4 MPa

WEATHERING

U = Unweathered = No signs

S = Slightly = Oxidized

M = Moderately = Discoloured

H = Highly = Friable

C = Completely = Soil-Like

DISCONTINUITY TYPE

B = Bedding Joint

J = Cross Joint

F = Fault

S = Shear Plane

BR = Broken Rock

ORIENTATION

F = Flat = 0-20°

D = Dipping = 20-50°

V = Vertical >50°

SPACING

VW = Very Wide = >3 m

W = Wide = 1-3 m

M = Moderate = 0.3-1 m

C = Close = 5-30 cm

VC = Very Close = <5 cm

ROUGHNESS

RU = Rough Undulating

RP = Rough Planar

SU = Smooth Undulating

SP = Smooth Planar

LU = Slickensided Undulating

LP = Slickensided Planar

FILLING

T = Tight, Hard

O = Oxidized

SA = Slightly Altered, Clay Free

S = Sandy, Clay Free

Si = Sandy, Silty, Minor Clay

NC = Non-softening Clay

SC = Swelling, Soft Clay

CORE LOG IDENTIFICATION

BOREHOLE #: C-3

PML REF.: 20TF017

PROJECT: Highway 40/CNR 2019-

3076 Overhead

LOCATION: Highway 40 CNR
Sarnia, Ontario

DATE: October 2, 2020

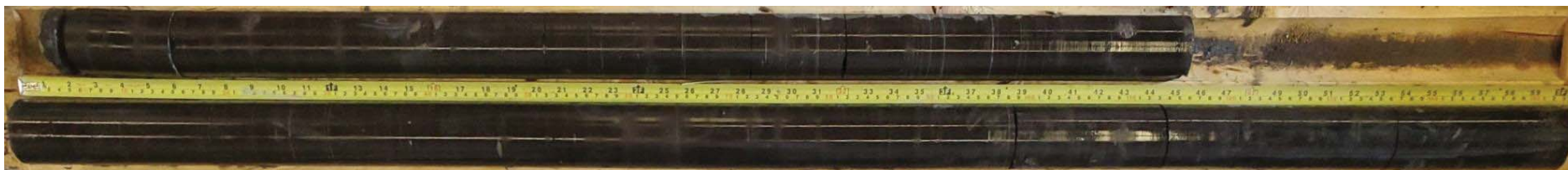
LOGGED BY: H. Racher, P.Geo.

Provincial Highways: A Guide to the
Description of Rock for Engineering
Purposes
MI-47

RUN #	DEPTH TO (m)	CORE RECOVERY (%)	ROD (%)	DEPTH TO (m)	GENERAL DESCRIPTION	STRENGTH	WEATHERING	DISCONTINUITIES							OCCASIONAL FEATURES	DRILLING OBSERVATIONS
								# OF SETS	TYPE	ORIENTATION	SPACING	ROUGHNESS	APERTURE	FILLING		
1	38.25	74% (0.13 m)	0% (0.00 m)	38.41	KETTLE POINT FORMATION Unweathered, fissile, thinly laminated, black, soft SHALE .	L	U	1	BR	-	-	-	-	-	Entire run broken rock.	
2	38.41	+100% (1.65 m)	100% (1.55 m)	39.93	KETTLE POINT FORMATION Unweathered, fissile, thinly laminated, black, soft SHALE .	L	U	1	J	F	-	SP	-	-	Occasional presence of sulphide lenses/nodules; broken rock at 39.45-39.51 m; sample taken at 38.86-39.13 m.	
								1	BR	-	-	-	-	-		
3	39.93	+100% (1.63 m)	100% (1.63 m)	41.45	KETTLE POINT FORMATION Unweathered, fissile, thinly laminated, black, soft SHALE .	L	U	1	J	F	-	SP	-	-	Occasional presence of sulphide lenses/nodules; calcite vein <3.0 mm wide; vertical fracture at 41.40-41.56 m.	
								1	J	V	-	SP	-	-		

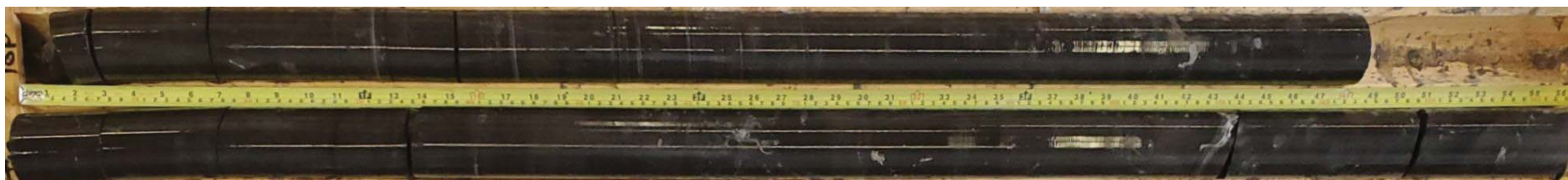
ROCK CORE PHOTOGRAPHS

Borehole CN-5



Borehole CN5 – RUN1 and RUN2– 45.72 m -48.76 m

Borehole CN-7



Borehole CN7 – RUN1 and RUN2– 45.72 m -48.76 m

Borehole C-3



Borehole C-3 – RUN1 and RUN2– 38.25 -39.93 m

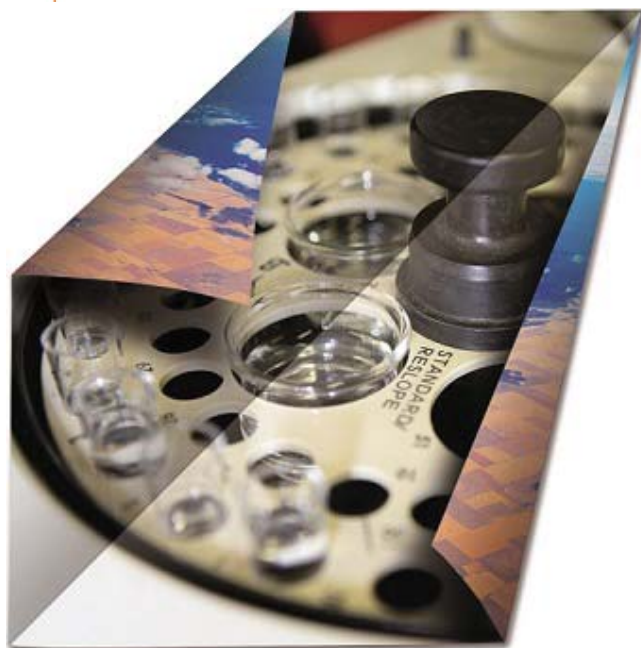


Borehole C-3 – RUN3 – 39.93-41.45 m



APPENDIX C

Results of Chemical Tests Provided by SGS Canada Inc



FINAL REPORT

CA14944-AUG20 R1

20TF017

Prepared for

Peto MacCallum Ltd

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Peto MacCallum Ltd	Project Specialist	Brad Moore Hon. B.Sc
Address	165 Cartwright Ave Toronto, ON M6A 1V5, Canada	Laboratory	SGS Canada Inc.
Contact	Nazibur Rahman	Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	416-785-5110	Telephone	705-652-2143
Facsimile	416-785-5120	Facsimile	705-652-6365
Email	nrahman@petomacallum.com	Email	brad.moore@sgs.com
Project	20TF017	SGS Reference	CA14944-AUG20
Order Number		Received	08/31/2020
Samples	Soil (8)	Approved	09/03/2020
		Report Number	CA14944-AUG20 R1
		Date Reported	09/03/2020

COMMENTS
<p>Temperature of Sample upon Receipt: 9 degrees C</p> <p>Cooling Agent Present: YES</p> <p>Custody Seal Present: YES</p> <p>Chain of Custody Number: 013261</p> <p>Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.</p>


SIGNATORIES
<p>Brad Moore Hon. B.Sc</p> 

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Legend.....	7
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FINAL REPORT

CA14944-AUG20 R1

Client: Peto MacCallum Ltd

Project: 20TF017

Project Manager: Nazibur Rahman

Samplers: Omar Noor

PACKAGE: - Corrosivity Index (SOIL)

Sample Number	5	6	7	8	9	10	11	12
Sample Name	CN-7 Sample 19 75'-77'	CN-7 Sample 25 130'-132'	CN-5 Sample 12 40'-42'	CN-5 Sample 21 110'-112'	RW-1 Sample 10 25'-27'	RW-1 Sample 16 55'-57'	RW-2 Sample 21 100'-102'	RW-2 Sample 27 140'-140'
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020

Parameter	Units	RL		Result	Result	Result	Result	Result	Result	Result	
Corrosivity Index											
Corrosivity Index	none	1		8	8	8	12	1	8	6	12
Soil Redox Potential	mV	-		164	218	241	157	239	84	148	218
Sulphide	%	0.04		0.44	0.40	0.13	0.43	< 0.04	0.15	0.46	0.43
pH	pH Units	0.05		8.54	8.54	8.68	8.21	8.50	8.50	8.40	8.30
Resistivity (calculated)	ohms.cm	-9999		3250	2580	4080	1600	5740	2580	2280	1590

PACKAGE: - General Chemistry (SOIL)

Sample Number	5	6	7	8	9	10	11	12
Sample Name	CN-7 Sample 19 75'-77'	CN-7 Sample 25 130'-132'	CN-5 Sample 12 40'-42'	CN-5 Sample 21 110'-112'	RW-1 Sample 10 25'-27'	RW-1 Sample 16 55'-57'	RW-2 Sample 21 100'-102'	RW-2 Sample 27 140'-140'
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020

Parameter	Units	RL		Result	Result	Result	Result	Result	Result	Result	
General Chemistry											
Conductivity	uS/cm	2		308	387	245	624	174	387	438	628

PACKAGE: - Metals and Inorganics (SOIL)

Sample Number	5	6	7	8	9	10	11	12
Sample Name	CN-7 Sample 19 75'-77'	CN-7 Sample 25 130'-132'	CN-5 Sample 12 40'-42'	CN-5 Sample 21 110'-112'	RW-1 Sample 10 25'-27'	RW-1 Sample 16 55'-57'	RW-2 Sample 21 100'-102'	RW-2 Sample 27 140'-140'
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020

Parameter	Units	RL		Result	Result	Result	Result	Result	Result	Result	
Metals and Inorganics											
Moisture Content	%	0.1		18.5	19.8	15.6	21.9	13.3	18.0	19.6	19.2



FINAL REPORT

CA14944-AUG20 R1

Client: Peto MacCallum Ltd

Project: 20TF017

Project Manager: Nazibur Rahman

Samplers: Omar Noor

PACKAGE: - Metals and Inorganics (SOIL)

Sample Number	5	6	7	8	9	10	11	12
Sample Name	CN-7 Sample 19 75'-77'	CN-7 Sample 25 130'-132'	CN-5 Sample 12 40'-42'	CN-5 Sample 21 110'-112'	RW-1 Sample 10 25'-27'	RW-1 Sample 16 55'-57'	RW-2 Sample 21 100'-102'	RW-2 Sample 27 140'-140'
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020

Parameter	Units	RL	Result	Result	Result	Result	Result	Result	Result
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Metals and Inorganics (continued)

Sulphate	µg/g	0.4		340	480	230	540	49	190	320	430
----------	------	-----	--	-----	-----	-----	-----	----	-----	-----	-----

PACKAGE: - Other (ORP) (SOIL)

Sample Number	5	6	7	8	9	10	11	12
Sample Name	CN-7 Sample 19 75'-77'	CN-7 Sample 25 130'-132'	CN-5 Sample 12 40'-42'	CN-5 Sample 21 110'-112'	RW-1 Sample 10 25'-27'	RW-1 Sample 16 55'-57'	RW-2 Sample 21 100'-102'	RW-2 Sample 27 140'-140'
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020	31/08/2020

Parameter	Units	RL	Result	Result	Result	Result	Result	Result	Result
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Other (ORP)

Chloride	µg/g	0.4		12	30	6.2	28	3.6	10	19	34
----------	------	-----	--	----	----	-----	----	-----	----	----	----



FINAL REPORT

CA14944-AUG20 R1

QC SUMMARY

Anions by IC
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0019-SEP20	µg/g	0.4	<0.4	0	20	94	80	120	107	75	125
Sulphate	DIO0019-SEP20	µg/g	0.4	<0.4	0	20	96	80	120	94	75	125

Carbon/Sulphur
Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	ECS0004-SEP20	%	0.04	< 0.04	1	20	104	80	120			

Conductivity
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0012-SEP20	uS/cm	2	< 2	2	20	100	90	110	NA		



FINAL REPORT

CA14944-AUG20 R1

QC SUMMARY

pH
Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0012-SEP20	pH Units	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

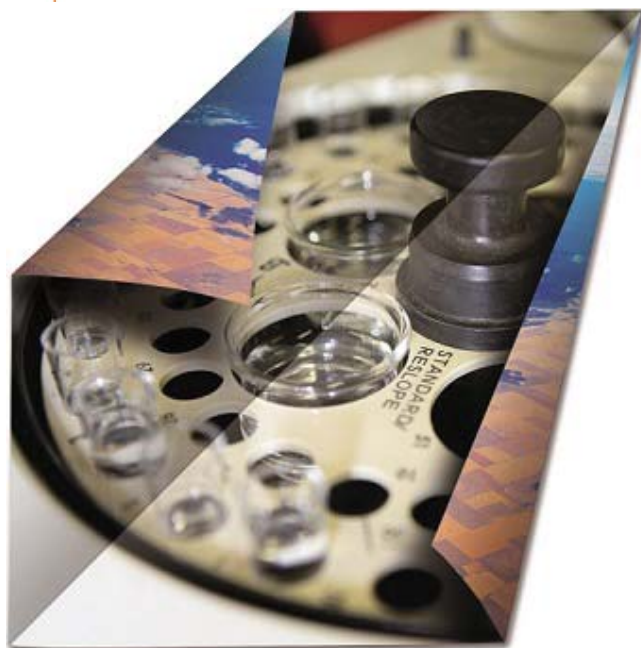
Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --



FINAL REPORT

CA14840-OCT20 R1

20TF017

Prepared for

Peto MacCallum Ltd

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Peto MacCallum Ltd	Project Specialist	Jill Campbell, B.Sc.,GISAS
Address	165 Cartwright Ave Toronto, ON M6A 1V5, Canada	Laboratory	SGS Canada Inc.
Contact	Nazibur Rahman	Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	416-785-5110	Telephone	2165
Facsimile	416-785-5120	Facsimile	705-652-6365
Email	nrahman@petomacallum.com	Email	jill.campbell@sgs.com
Project	20TF017	SGS Reference	CA14840-OCT20
Order Number		Received	10/21/2020
Samples	Soil (8)	Approved	10/27/2020
		Report Number	CA14840-OCT20 R1
		Date Reported	10/27/2020

COMMENTS
<p>Temperature of Sample upon Receipt: 7 degrees C</p> <p>Cooling Agent Present:Yes</p> <p>Custody Seal Present:Yes</p> <p>Chain of Custody Number:004117</p> <p>Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.</p>


SIGNATORIES
<p>Jill Campbell, B.Sc.,GISAS</p> 

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FINAL REPORT

CA14840-OCT20 R1

Client: Peto MacCallum Ltd

Project: 20TF017

Project Manager: Nazibur Rahman

Samplers: Omar Noor

PACKAGE: - Corrosivity Index (SOIL)

Sample Number	5	6	7	8	9	10	11	12
Sample Name	C-3 Sample 8, 25'-27"	C-3 Sample 12, 45'-47"	C-3 Sample 20, 105'-107"	C-3 Sample 5, 12'-14'	C-2 Sample 5, 15'-17'	C-2 Sample 7, 20'-22'	C-1 Sample 5, 12.5'-14.5'	C-1 Sample 8, 25'-27"
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	16/10/2020	16/10/2020	16/10/2020	20/10/2020	20/10/2020	21/10/2020	21/10/2020	21/10/2020

Parameter	Units	RL	Result	Result	Result	Result	Result	Result	Result
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Corrosivity Index

Corrosivity Index	none	1		8	6	4	6	4	4	10	8
Soil Redox Potential	mV	-		149	169	151	142	161	163	152	128
Sulphide (Na2CO3)	%	0.04		0.13	0.41	0.41	< 0.04	0.10	0.13	0.10	0.12
pH	pH Units	0.05		9.05	8.37	8.41	7.75	8.35	8.20	8.55	8.51
Resistivity (calculated)	ohms.cm	-9999		5910	2480	6290	1900	7700	3650	2410	4220

PACKAGE: - General Chemistry (SOIL)

Sample Number	5	6	7	8	9	10	11	12
Sample Name	C-3 Sample 8, 25'-27"	C-3 Sample 12, 45'-47"	C-3 Sample 20, 105'-107"	C-3 Sample 5, 12'-14'	C-2 Sample 5, 15'-17'	C-2 Sample 7, 20'-22'	C-1 Sample 5, 12.5'-14.5'	C-1 Sample 8, 25'-27"
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	16/10/2020	16/10/2020	16/10/2020	20/10/2020	20/10/2020	21/10/2020	21/10/2020	21/10/2020

Parameter	Units	RL	Result	Result	Result	Result	Result	Result	Result
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General Chemistry

Conductivity	uS/cm	2		169	404	159	527	130	274	415	237
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PACKAGE: - Metals and Inorganics (SOIL)

Sample Number	5	6	7	8	9	10	11	12
Sample Name	C-3 Sample 8, 25'-27"	C-3 Sample 12, 45'-47"	C-3 Sample 20, 105'-107"	C-3 Sample 5, 12'-14'	C-2 Sample 5, 15'-17'	C-2 Sample 7, 20'-22'	C-1 Sample 5, 12.5'-14.5'	C-1 Sample 8, 25'-27"
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	16/10/2020	16/10/2020	16/10/2020	20/10/2020	20/10/2020	21/10/2020	21/10/2020	21/10/2020

Parameter	Units	RL	Result	Result	Result	Result	Result	Result	Result
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Metals and Inorganics

Moisture Content	%	0.1		18.7	18.2	22.3	18.8	14.8	17.3	14.2	18.5
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FINAL REPORT

CA14840-OCT20 R1

Client: Peto MacCallum Ltd

Project: 20TF017

Project Manager: Nazibur Rahman

Samplers: Omar Noor

PACKAGE: - Metals and Inorganics (SOIL)

Sample Number	5	6	7	8	9	10	11	12
Sample Name	C-3 Sample 8, 25'-27"	C-3 Sample 12, 45'-47"	C-3 Sample 20, 105'-107"	C-3 Sample 5, 12'-14'	C-2 Sample 5, 15'-17'	C-2 Sample 7, 20'-22'	C-1 Sample 5, 12.5'-14.5'	C-1 Sample 8, 25'-27"
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	16/10/2020	16/10/2020	16/10/2020	20/10/2020	20/10/2020	21/10/2020	21/10/2020	21/10/2020

Parameter	Units	RL	Result	Result	Result	Result	Result	Result	Result	Result
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Metals and Inorganics (continued)

Sulphate	µg/g	0.4		220	310	420	3.1	240	230	190	200
----------	------	-----	--	-----	-----	-----	-----	-----	-----	-----	-----

PACKAGE: - Other (ORP) (SOIL)

Sample Number	5	6	7	8	9	10	11	12
Sample Name	C-3 Sample 8, 25'-27"	C-3 Sample 12, 45'-47"	C-3 Sample 20, 105'-107"	C-3 Sample 5, 12'-14'	C-2 Sample 5, 15'-17'	C-2 Sample 7, 20'-22'	C-1 Sample 5, 12.5'-14.5'	C-1 Sample 8, 25'-27"
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	16/10/2020	16/10/2020	16/10/2020	20/10/2020	20/10/2020	21/10/2020	21/10/2020	21/10/2020

Parameter	Units	RL	Result	Result	Result	Result	Result	Result	Result	Result
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Other (ORP)

Chloride	µg/g	0.4		7.6	12	32	37	13	9.1	91	9.4
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QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0467-OCT20	µg/g	0.4	<0.4	12	20	94	80	120	98	75	125
Sulphate	DIO0467-OCT20	µg/g	0.4	<0.4	7	20	94	80	120	110	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0029-OCT20	%	0.04	< 0.04	18	20	109	80	120			

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0421-OCT20	uS/cm	2	< 2	0	20	100	90	110	NA		



FINAL REPORT

CA14840-OCT20 R1

QC SUMMARY

pH
Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0421-OCT20	pH Units	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --



PART B - FOUNDATION DESIGN REPORT

for

NEW EMBANKMENT ON HIGHWAY 40 AT CNR OVERHEAD

SITE 14X-0290/B2

G.W.P. 3064-11-00

W.P. 3064-11-02

GEOGRAPHICAL TOWNSHIP OF SARNIA

LAMBTON COUNTY, ONTARIO

LATITUDE AND LONGITUDE: 42.955937, -82.345729

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May 4, 2022



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ATTACHMENTS

Appendix D – Slope Stability Analyses Results

Appendix E – List of Standard Specifications, NSSP and Operations Constraint Relevant to Report

Peto MacCallum Ltd.

C O N S U L T I N G E N G I N E E R S

PART B - FOUNDATION DESIGN REPORT

for

New Embankments on Highway 40 at CNR Overhead

Site No. 14X-0290/B2

G.W.P. 3064-11-00

Geographical Township of Sarnia, Lambton County, Ontario

9. INTRODUCTION

This foundation investigation and design report including the interpretations and recommendations are intended for the use of WSP on behalf of the MTO, for this project, and shall not be used or relied upon for any other purposes or by any other parties. Where comments related to construction are made in this report, they are provided only to highlight those aspects that could affect the design of the project. Contractors must make their own interpretation of the factual information provided in Part A of the report for construction purposes, as it may affect equipment selection, proposed construction methods and scheduling.

10. PROJECT DESCRIPTION

10.1 General

This report provides detail design level foundation design recommendations for the north and south embankments associated with the proposed Highway 40 Canadian National Railway (CNR) Overhead structure, located in the Town of Sarnia, Ontario. The recommendations are based on interpretation of the geotechnical data presented in the factual report (Part A).

The existing Highway 40 north and south embankments for the proposed overhead structure were placed more than 40 years ago during the construction of the existing Highway 40 CNR overhead structure. Overall the grades of the existing embankments will be raised by placing new fill to the proposed grades for the new Highway 40 alignment. Prior to placement of fill, and construction of the proposed overpass structure and Retained Soil System (RSS) walls at the south abutment, the existing south culvert at Station 19+942.5 will be replaced. It is anticipated that excavation of the existing south embankment fill approximately up to 9.0 m from Station 19+950 to Station 19+925 will be required for construction of the abutment and RSS wall and the replacement of the south culvert. At the north embankment, the existing embankment fill will be excavated approximately up to 9.0 m from Station 19+998 to Station 20+032 prior to construction of the abutment and RSS wall. The excavated material will be replaced with new fill. The proposed total length of the south and north RSS walls is approximately 53.2 and 51.2 m, respectively.



10.2 Existing Embankments for New Overhead Structure

The existing north and south embankments were initially constructed without a mid-slope berm. No major settlement or instability was observed during the current investigation period. The slope of the existing embankments is approximately 2H:1V. Based on the cross section drawings provided by WSP via email dated May 4, 2021, the south embankment will be raised approximately 2.8 m to 6.4 m from Station 19+730 to Station 19+941.18, and the north embankment will be raised approximately 3.0 m to 4.3 m from Station 20+020.28 to Station 20+350 above the existing embankment grades to the proposed grades. At both north and south abutment locations, Retained Soil System (RSS) walls will be constructed. Discussions and recommendations pertaining to the RSS walls are presented in Foundation Investigation and Design Report for New CNR Overhead on Highway 40, prepared by PML.

10.3 Proposed Scope of Work

Slope stability and settlement analyses of the north and south embankments associated with placement of new fill are carried out for this project. The slope stability analyses were conducted to assess the stability of the new embankments placed on existing embankments, and the magnitude of total settlements induced by the new fill are assessed. It is anticipated that the new embankments will be constructed with Granular A. The granular material should be in accordance with OPSS.PROV 1010, amended by SSP 110S06. Based on WSP email dated April 21, 2021, and follow up discussions, Table 5 summarizes the scenarios were considered for the slope stability analyses.



Table 5: Summary of Slope Stability Scenarios

LOCATION	SCENARIO 1	SCENARIO 2	SCENARIO 3
South Approach, Station 19+725 to Station 19+941.18	No Berm, Slope at 1.75H:1V	With 1.0 m berm located approximately 6.0 m down from the crest of slope. Berm slope 1.65H: 1V	Rip-Rap Placement (nominal thickness considered 1.0 m to 1.3 m)
North Approach, Station 20+020.28 to Station 20+150	-	With 2.0 m berm located approximately 5.0 m down from the crest of slope. Berm slope 2.0H:1V	-
North Approach, Station 20+175 to Station 20+350	No Berm, Slope at 1.5H:1V	-	Rip-Rap Placement (nominal thickness considered 1.4 m to 1.5 m)

Based on discussion with WSP on December 8, 2021, it is anticipated that the existing side slopes will be benched in accordance with OPSD 208.010, the footprint will generally be maintained with steeper side slopes.

11. PROPOSED EMBANKMENTS

Based on the Preliminary General Arrangement (GA) drawing, provided by WSP via email dated May 12, 2021, the proposed length of the single span structure is 65.3 m and the width is 13.1 m. The proposed abutments are to be supported on integral abutments. The design grade of the approaches at the north and south abutments will be approximately EL. ±198.6 and EL. ±198.8, respectively.

The existing north and south embankments were initially constructed without a mid-slope berm. It is understood that the scenario of a steepened slope without a mid-height bench is being considered for the south approach embankment to limit the width of the embankments within the MTO right-of-way.

The grades of the existing south embankment will be raised approximately 2.8 m to 6.4 m from Station 19+730 to Station 19+941.18, and the north embankment will be raised approximately



3.0 m to 4.3 m from Station 20+020.28 to Station 20+350. Overall the grades of the existing embankments will be raised for the new Highway 40 alignment, and widened to the west to accommodate the required slopes of the embankments for their stability. A part of the existing north embankment, approximately from Station 19+998 to Station 20+013, will be removed permanently during the construction of the new overhead structure.

11.1 Factors Governing the Analyses

The factors governing the design and construction of the fill embankments are as follows:

- Geometry of the proposed embankments.
- Type of embankment fill material.
- Thickness and engineering properties of foundation soils.
- Groundwater conditions.
- Slope stability of embankments.
- The magnitude of settlements during construction and maximum permissible post construction settlements.
- MTO Guidelines for post construction settlement of embankments.

Slope stability analyses of embankments and estimate of settlements were carried out based on the soil profiles and the soil parameters for design obtained from the current investigation. The results of the analyses presented in this report include different sections of the north and south embankments.

11.2 Subsurface Conditions

The current investigation was carried out approximately from Station 19+750 to Station 19+950 and from Station 20+015 to Station 20+185. In general, the subsoil conditions consist of 2.3 m to 9.2 m of fill along the north and south embankment alignments, which is underlain by a stiff to very stiff, locally firm, silty clay/clayey silt deposit. The silty clay/clayey silt deposit is mantling over the shale bedrock.

Groundwater was encountered upon completion of drilling in Boreholes RW-1, RW-2, C-2, CN-5 and CN-7 at depths ranging from 6.1 m to 15.2 m (EL. 180.2 to EL. 188.4) below the existing ground



surface. The groundwater level was not encountered or could not be established during drilling or upon completion of drilling in Boreholes CN-2, CN-3, CN-4, CN-8, CN-9, CN-10, C-3 and T-1 to T-4. Monitoring wells, consisting of 50 mm diameter PVC pipe, were installed in Boreholes CN-3, CN-5, CN-7, CN-9, T-1, and T-4. The groundwater levels recorded in monitoring wells ranged from EL. 179.3 to EL. 188.9. Groundwater levels may fluctuate due to the influence of precipitation and seasonal changes.

11.3 Slope Stability Analysis

The slope stability analyses were conducted to assess the stability of the new embankments placed on existing embankments. In accordance with OPSD 202.010, a minimum of 2.0 m wide mid-height berm is to be provided where the height of the embankment equals or exceeds 8.0 m. Benching of earth slopes during construction/embankment widening is required in accordance with OPSD 208.010.

A total of three (3) scenarios, as indicated in Table 5, were analysed, and the results are provided in the following sections for evaluation of slope stability.

The slope stability analyses were carried out utilizing the commercially available software Slide (Version 6.0) developed by Rocscience Inc., employing the Morgenstern-Price method of slices for the limit equilibrium analysis. Following the MTO Foundation Engineering Services Version 2 and resistance factors for typical understanding, the report recommends and targets a minimum factor of safety (FOS) of 1.4 to be adopted for the present design and assessments.

Beyond the investigation stations as stated in Section 11.2, the subsurface conditions were assumed consistent as encountered in the drilled boreholes.

The geotechnical parameters used in the analyses are presented in Table 6.



Table 6: Reference Geotechnical Parameters for Stability and Settlement Analyses

SOIL STRATA	BULK UNIT WEIGHT, γ_b (kN/m ³)	UNDRAINED SHEAR STRENGTH, s_u (kPa)	EFFECTIVE ANGLE OF INTERNAL FRICTION, ϕ' (degree)
Pavement	22	0	35
Granular A	22.5	0	35
Clayey Silt Fill (Existing Embankment)	18	75	0
Clayey Silt	20	48 to 100	0
Rip-Rap	24.5	0	45

1) Scenario 1 – No Berm

The results of the stability analyses are presented in Table 7A. The FOS values ranged from 1.2 to 1.4. Refer to Figure Nos. 1 to 12 Appendix D for the results of the stability analyses conducted.

Table 7A: Results of Stability Analyses

LOCATION	STATION	MAXIMUM NEW EMBANKMENT FILL HEIGHT OVER EXISTING EMBANKMENT ¹ (m)	SIDE SLOPE GEOMETRY OF NEW EMBANKMENT (Approximate)	FOS FOR SLOPE STABILITY	FIGURE NO.
South Approach	19+941.18	-*	1.75H:1V	1.4	1
	19+930	3.0		1.5	2
	19+920	2.8		1.3	3
	19+870	3.0		1.3	4
	19+820	3.0		1.3	5
	19+770	3.0		1.3	6
	19+730	3.2		1.3	7
North Approach	20+180	3.2	1.5H:1V	1.2	8
	20+230	3.6		1.3	9
	20+280	4.0		1.2	10



Table 7A: Results of Stability Analyses

LOCATION	STATION	MAXIMUM NEW EMBANKMENT FILL HEIGHT OVER EXISTING EMBANKMENT ¹ (m)	SIDE SLOPE GEOMETRY OF NEW EMBANKMENT (Approximate)	FOS FOR SLOPE STABILITY	FIGURE NO.
	20+330	4.3		1.2	11
North Approach	20+350	3.7	1.5H:1V	1.2	12

Note 1: Slope stability analysis was carried out on the cross sections provided by WSP.

* - the full height of the existing fill is anticipated to be removed to the bottom of the existing culvert bedding level, and replaced with Granular A material following replacement the existing culvert to the embankment full height.

From Station 19+920 to Station 19+770 and Station 20+180 to 20+280, the existing embankment fill configuration was modified to evaluate if the calculated FOS would increase and if it would attain the target value of 1.4. The existing embankment slope was initially flattened by cutting back from top of slope by 2.0 m to 3.0 m. The results of the stability analyses are presented in Table 7B. However, the results indicated that the analysed FOS did not show improvements. Refer to Figure Nos. 13 to 20 in Appendix D for the results of the stability analyses conducted.

Table 7B: Results of Stability Analyses

LOCATION	STATION	MAXIMUM NEW EMBANKMENT FILL HEIGHT OVER EXISTING EMBANKMENT ¹ (m)	SIDE SLOPE GEOMETRY OF NEW EMBANKMENT (Approximate)	FOS FOR SLOPE STABILITY	FIGURE NO.
South Approach	19+920	2.8	1.75H:1V	1.3	13
	19+870	3.0		1.3	14
	19+820	3.0		1.3	15
	19+770	3.0		1.3	16
	19+730	3.2		1.3	17
North Approach	20+180	3.2	1.5H:1V	1.2	18
	20+230	3.6		1.3	19
	20+280	4.0		1.2	20

Note 1: Slope stability analysis was carried out on the cross sections provided by WSP.



2) Scenario 2 - Slope with 1.0 m to 2.0 m Wide Berm

The results of the stability analyses are presented in Table 8A. For the north and south approaches, and the calculated FOS values ranged from 1.2 to 1.7. Refer to Figures 21 to 30 in Appendix D for the results of the stability analyses conducted.

Table 8A: Results of Stability Analyses

LOCATION	STATION	MAXIMUM NEW EMBANKMENT FILL HEIGHT OVER EXISTING EMBANKMENT ¹ (m)	SIDE SLOPE GEOMETRY OF NEW EMBANKMENT (Approximate)	FOS FOR SLOPE STABILITY	FIGURE NO.
South Approach	19+941.18	-*	Berm Slope 1.65H:1V	1.3 to 1.5	21
	19+930	3.0		1.3 to 1.7	22
	19+920	2.8		1.2 to 1.3	23
	19+870	3.0		1.2 to 1.3	24
	19+820	3.0		1.3 to 1.4	25
North Approach	20+150	3.1	Berm Slope 2.0H:1V	1.5 to 1.7	26
	20+130	3.2		1.6 to 1.7	27
	20+070	3.1		1.6 to 1.7	28
	20+030	3.0		1.5 to 1.7	29
	20+020.38	3.6		1.4 to 1.7	30

Note 1: Slope stability analysis was carried out on the cross sections provided by WSP.

* - the full height of the existing fill is anticipated to be removed to the bottom of the existing culvert bedding level, and replaced with Granular A material following replacement the existing culvert to the embankment full height.

From Station 19+930 to Station 19+820, modifications were made to evaluate if the analysed FOS would increase and reach the target value of 1.4. Modifications included cutting back of existing slope by 2.0 to 3.0 m and flattening the existing embankment slopes, and/or modifying the mid-height bench location. However, the analysed FOS values did not show improvement from Station 19+930 to Station 19+820. Table 8B summarizes the results. Refer to Figure Nos. 31 to 34 in Appendix D for the results of the stability analyses conducted.



Table 8B: Results of Stability Analyses

LOCATION	STATION	MAXIMUM NEW EMBANKMENT FILL HEIGHT OVER EXISTING EMBANKMENT ¹ (m)	SIDE SLOPE GEOMETRY OF NEW EMBANKMENT (Approximate)	FOS FOR SLOPE STABILITY	FIGURE NO.
South Approach	19+930	3.0	Berm Slope 1.65H:1V	1.3 to 1.5	31
	19+920	2.8		1.2 to 1.3	32
	19+870	3.0		1.2 to 1.3	33
	19+820	3.0		1.2 to 1.4	34

Note 1: Slope stability analysis was carried out on the cross sections provided by WSP.

3) Scenario 3 - Rip-Rap Placement

Placing of rip-rap (R-10), or equivalent slope protection material, placed along the length of slope face was also considered, and to evaluate if the FOS would increase to satisfy the target value of 1.4 from Station 19+941.18 to Station 19+820, and from Station 20+180 to Station 20+350. The rip-rap shall be in accordance with OPSS.PROV 1004. The thickness of the rip-rap considered ranged from 1.0 m to 1.4 m (measured perpendicular from the slope surface), and the layer was intended to add stability against a sliding failure, and also serve to enhance surface erosion protection. The thickness of the rip-rap applied to the analysis at each station is the minimum required to achieve the FOS of 1.4. The results are presented in Table 9. Refer to Figures 35 to 46 in Appendix D for the results of the stability analyses conducted.

Table 9: Results of Stability Analyses

LOCATION	STATION	MAXIMUM NEW EMBANKMENT FILL HEIGHT OVER EXISTING EMBANKMENT ¹ (m)	SIDE SLOPE GEOMETRY OF NEW EMBANKMENT	FOS FOR SLOPE STABILITY	NOMINAL RIP-RAP THICKNESS (m)	FIGURE NO.
South Approach	19+941.18	-*	1.75H:1V	1.5	1.3	35
	19+930	3.0		1.6	1.3	36
	19+920	2.8		1.5	1.0	37
	19+870	3.0		1.4	1.0	38
	19+820	3.0		1.4	1.0	39



Table 9: Results of Stability Analyses

LOCATION	STATION	MAXIMUM NEW EMBANKMENT FILL HEIGHT OVER EXISTING EMBANKMENT ¹ (m)	SIDE SLOPE GEOMETRY OF NEW EMBANKMENT	FOS FOR SLOPE STABILITY	NOMINAL RIP-RAP THICKNESS (m)	FIGURE NO.
	19+770	3.0		1.5	1.0	40
	19+730	3.2		1.6	1.0	41
North Approach	20+180	3.2	1.5H:1V	1.5	1.4	42
	20+230	3.6		1.4	1.4	43
	20+280	4.0		1.5	1.4	44
	20+330	4.3		1.5	1.4	45
	20+350	3.7		1.5	1.4	46

Note 1: Slope stability analysis was carried out on the cross sections provided by WSP.

* - the full height of the existing fill is anticipated to be removed to the bottom of the existing culvert bedding level, and replaced with Granular A material following replacement the existing culvert to the embankment full height.

11.3.1 Slope Stability Analyses Summary

The above slope analysis results show that for north embankment, the slope configuration from Station 20+150 to Station 20+020.38 (Figures 26 to 30), using a mid-slope berm will meet the minimum FOS of 1.4. The slope configurations, from Station 19+941.18 to Station 19+730 (Figures 35 to 41) for the south embankment, and from Station 20+180 to 20+350 (Figures 42 to 46) for the north embankment, with a 1.0 to 1.4 m thick layer of rip-rap protection will meet the minimum FOS of 1.4. For steepened 1.75H:1.0V side slopes, only the south approach from Station 19+941.18 to Station 19+930 meet the minimum FOS of 1.4. The proposed slope configurations and the assessed FOS suggested that it is feasible to construct the embankment within the MTO ROW.

11.4 Settlement Considerations

The estimates of the magnitude of total settlements induced by the new fill are based only on the primary consolidation of the subgrade under the embankments. The secondary compression (also



known as creep) of subgrade soil consisting of the low plastic clayey silt (CL) at this site is not expected to exceed about 10 mm over a long period of time and is not included in the estimation of total settlement.

Based on the cross sections provided by WSP, the maximum height of the proposed south and north embankments in the area of new embankment placed on the existing embankment from Station 19+730 to 19+941.18 and from Station 20+020.38 to Station 20+350 is anticipated up to 6.4 m above the grade of existing surface, and is expected to impose a maximum load of about 144 kPa, assuming a compacted density of the fill about 22.5 kN/m³.

It is anticipated that excavation of the existing south embankment fill up to 9.0 m from Station 19+950 to Station 19+925 will be required for construction purposes. At the north embankment, the existing embankment fill will be excavated up to 9.0 m from Station 19+998 to Station 20+032 for construction purposes. A part of the existing north embankment, approximately from Station 19+998 to Station 20+013, will be removed permanently during the construction of the new overhead structure.

It is anticipated that the new embankment fill will be placed and compacted to 100% of Standard Proctor Maximum Dry Density (SPMDD). Hence, no settlement of the new fill is anticipated after placement. Compaction shall be carried out in accordance with OPSS.PROV 501, amended by SSP 105S22. The majority of the predicted settlement of the existing embankment fill above the water table is anticipated to occur within a relatively short period of time during and following placement of new embankment fill.

For the south culvert replacement, it is anticipated that the replacement box culvert will be constructed at Station 19+941.4, 1.1 m south of the existing culvert location (Station 19+942.5). The length of the proposed south culvert is anticipated to be 79.2 m long at a skew of 82 degrees from the centerline of the new Highway 40 alignment. The inlet and outlet invert elevations will be approximately EL. 185.8 and EL.185.5, respectively. It is anticipated that the south culvert will be constructed by the cut and cover method. Negligible additional pressure is anticipated from the replacement culvert following removal of existing subsoil at Station 19+942.5.



For immediate settlement of the existing embankment fill shown in Table 10, the settlement magnitude was estimated assuming a modulus value of 18 MPa and a Poisson ratio of 0.4¹.

A total of three (3) consolidation tests were conducted on undisturbed samples obtained from the cohesive subgrade. Based on the laboratory results, samples tested from Boreholes CN-5 and CN-7 are considered overconsolidated (OCR ranging from 2.0 to 2.2). The graphical procedure developed by Schmertmann (1955) was used to estimate the field virgin compression index (c_c) of the clayey silt and resulted in an average c_c value of 0.318, and an average recompression index (C_{cr}) value of 0.059. The sample tested from Borehole RW-2 is considered normally consolidated (OCR=1) based on the consolidation test result. The c_c of the sample is estimated to be 0.223.

Highway 40 is considered to be a Non-Freeway. In accordance with the guidelines provided in the “Embankment Settlement Criteria for Design – dated July 2 2010”, the maximum post-construction settlement of the new embankment is limited to 200 mm for Non-Freeways with a differential settlement rate of 100:1 for Non-Freeways on compressible soils. The maximum post-construction settlement for transition is limited to 25 mm within 20 m from the abutments, 50 mm from 20 m to 50 m from the abutments, 100 mm from 50 m to 75 m from the abutments and 200 mm from more than 75 m from the abutments for non-Freeways. For embankment widening, the post construction settlement limit is 75 mm with a differential settlement rate of 100:1 for non-Freeways. Considering a width of 13.1 m, the maximum differential settlement allowed is 65.5 mm.

Table 10 summarizes the estimated immediate settlement of the existing fill embankment, primary consolidation settlement of the cohesive layers below the existing fill embankment, and the approximate duration it will take to reach acceptable post construction settlement level in accordance with the guideline. The anticipated total settlement is the sum of the calculated immediate and consolidation settlements.

¹ Look, B. G. 2007. *Handbook of Geotechnical Investigation and Design Tables*. Taylor & Francis Group, London, UK. Chapter 11, p. 121-135.



Table 10: Results of Settlement Analyses

LOCATION	STATION	MAXIMUM NEW EMBANKMENT FILL HEIGHT OVER EXISTING EMBANKMENT GROUND SURFACE ¹	ESTIMATED IMMEDIATE SETTLEMENT OF EXISTING FILL EMBANKMENT (mm)	ESTIMATED PRIMARY CONSOLIDATION OF CLAYEY SILT BELOW EXISTING FILL EMBANKMENT (mm)	ANTICIPATED TOTAL SETTLEMENT (mm)	APPROXIMATE DURATION TO REACH ACCEPTABLE POST CONSTRUCTION SETTLEMENT AFTER EMBANKMENT CONSTRUCTION (months)
North Approach	20+230	5.0	10	40	50	1
	20+180	5.2	15	30	45	1
	20+130	3.1	20	20	40	1
	20+070	3.1	20	20	40	1
	20+040	3.3	25	15	40	4
	20+030 ³	3.5	25	15	40	4
	20+020.38 ²	3.5	0	25	25	4
South Approach	19+941.18 ²	6.4	0	50	50	8
	19+930 ³	3.0	35	20	55	4
	19+920	2.8	35	10	45	4
	19+870	3.0	35	10	45	1
	19+820	3.0	35	10	45	1
	19+770	3.0	35	10	45	1
	19+730	3.2	25	15	40	1

Note 1: The fill height is based on cross section drawings provided by WSP.

Note 2: At this station, all existing fill will be excavated, and replaced with granular material.

Note 3: At this station, it is anticipated that approximately 3.0 to 5.0 m of existing fill will be excavated and replaced with granular material.



Based on Table 10, it is estimated that the maximum total settlements will range from 40 mm to 55 mm and is within the acceptable settlement limit. The estimated maximum differential settlements are also expected to be within the acceptable limits.

For the north embankment, it is anticipated that the settlement will be within the acceptable post construction settlement following 4 months after embankment construction to the full height. The pavement could be constructed over the new north embankment after this period. For the south embankment, it is anticipated that the settlement will be within the acceptable post construction settlement following 8 months after embankment construction to full height. The pavement could be constructed over the new south embankment after this period. The differential settlement is anticipated to be within 65.5 mm.

It is recommended to monitor the settlements within the 20 m of north and south approaches prior to pavement construction following construction of the embankments to their full heights. If the rate of settlements have attenuated prior to the predicted dates, then the paving could commence at an earlier date at the approval of the CA.

The pavement design life is 19 years based on WSP email dated July 28, 2021. It is anticipated that the primary consolidation settlements will be largely completed by the pavement design life.

11.5 Erosion Protection of Slope Surface

For both scenarios, based on the results, slope surface sloughing is anticipated for both approaches as shown in the figures (surficial slope failure). Vegetative cover (OPSS.PROV 803) should be provided on the side slopes soon after the embankment construction to mitigate surface sloughing/erosion. If rip-rap or equivalent material is utilized, vegetative cover is not required.



12. CONSTRUCTION CONSIDERATIONS

12.1 Excavation

All work should be carried out in accordance with the Occupational Health and Safety Act (OHSA) (Ontario Regulation 213/91) and with local/MTO regulations.

The soil classification and slope cut geometry for OHSA purposes has been covered in reports associated with the replacement of the south culvert, and the proposed Highway 40 and CNR Overhead. Refer to the "Foundation Investigation and Design Report for New CNR Overhead on Highway 40", and the Foundation Investigation and Design Report for Replacement of South Culvert at CNR Overhead", prepared by PML, for discussions and recommendations. A NSSP is included to advise the Contractor of the potential presence of cobbles and boulders may be present within the ground, and abandoned ground infrastructure, construction debris, concrete, cinder and the like materials may be encountered during the excavation works. An operations constraint with regards to stockpiling of excavated material is included with this report.

12.2 Temporary Roadway Protection

Where temporary protection is required during the embankment fill construction, it should be constructed in accordance with OPSS.PROV 539, amended by SSP 105S09, and shall be designed to meet at least a Performance Level of 2. The Contractor shall be responsible for the selection, detailed design and performance of the roadway protection system. Refer to the "Foundation Investigation and Design Report for New CNR Overhead on Highway 40", and the "Foundation Investigation and Design Report for Replacement of South Culvert at CNR Overhead", prepared by PML, for discussions and recommendations.

12.3 Groundwater Control

Surface water flow or seepage from perched water should be directed away from the excavation areas to mitigate disturbance and weakening of the native clayey silt/silty clay soil.



Conventional sump pumping techniques are considered to be adequate to mitigate any surface runoff and seepage from localized soil fissures at the excavation depth.

For other aspects of groundwater control refer to the “Foundation Investigation and Design Report for New CNR Overhead on Highway 40”, and the “Foundation Investigation and Design Report for Replacement of South Culvert at CNR Overhead”, prepared by PML, for discussions and recommendations.

The Contractor should be responsible for the selection, performance and detailed design of the dewatering system. If and where necessary, the dewatering scheme is required to lower the groundwater level to a minimum of 0.5 m below the lowest level of excavation.

12.4 Foundation Frost Depth

In accordance with OPSD 3090.101, a minimum of 1.1 m earth cover is required to protect against the frost penetration in the area where the site is located.

12.5 Seismic Considerations

The Spectral ($S_a(T)$, where T is in seconds) and Peak Ground Acceleration (PGA) for the project site is 0.086 ($S_a(0.2)$) and 0.050 (2%/50 years), respectively, based on the longitude and latitude coordinates of the proposed structure (National Building Code of Canada, 2015). The soil below the founding level at this site for seismic design purposes is classified as Site Class D in accordance with Table 4.1, CHBDC 2019.



13. CLOSURE

This report was prepared by Mr. Nazibur Rahman, P.Eng., Senior Engineer with the assistance of Ms. Natasha Leong-Sem, EIT. Mr. Robert Ng, P.Eng., MTO Designated Principal Contact, conducted an independent review of the report.

Yours very truly,

Peto MacCallum Ltd.

A handwritten signature in blue ink, appearing to read "Natasha Leong-Sem".

Natasha Leong-Sem, EIT
Geotechnical Services



Nazibur Rahman, P.Eng.
Senior Engineer, Geotechnical Services



Robert Ng, MBA, PhD, P.Eng.
MTO Designated Principal Contact

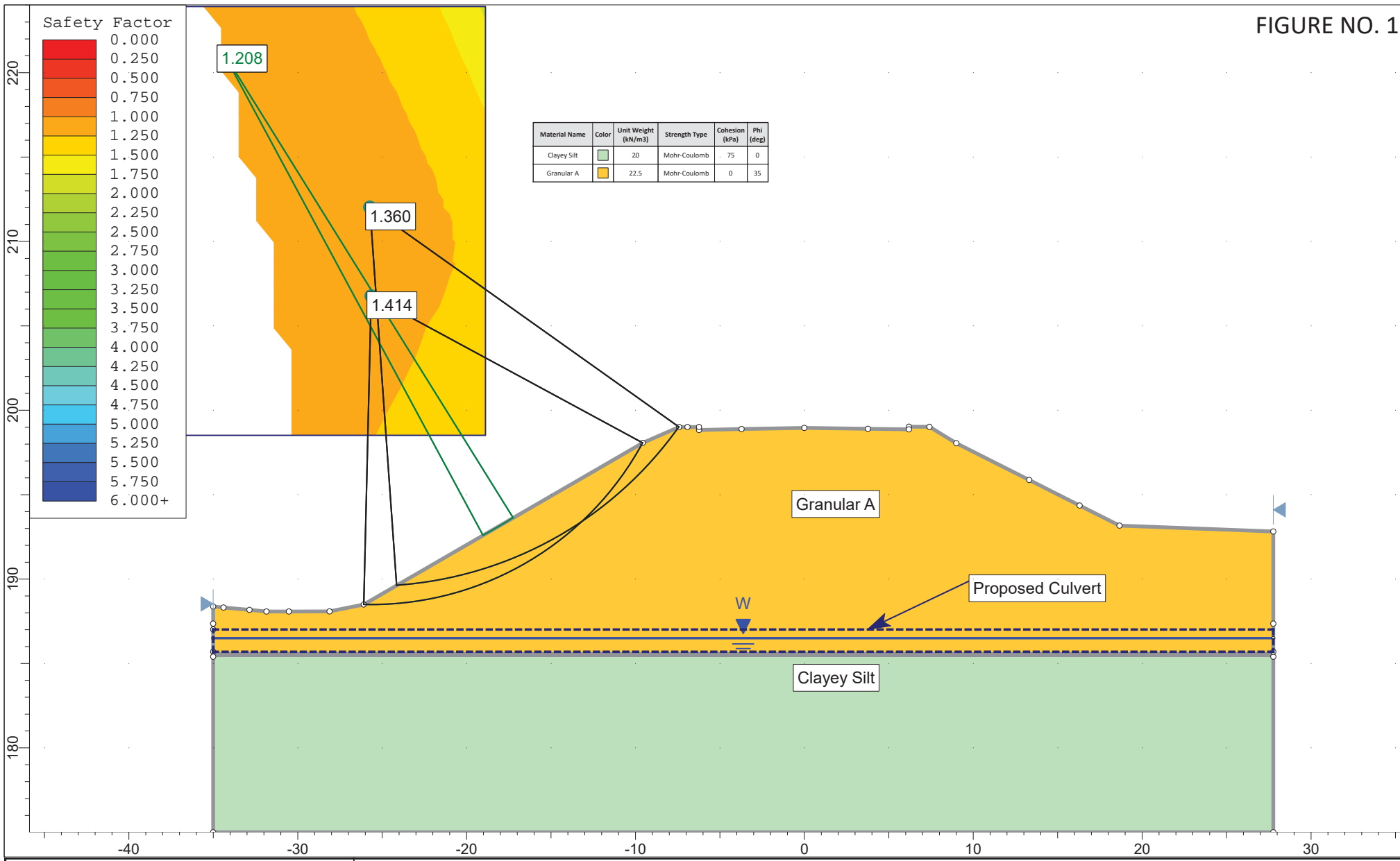
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APPENDIX D

Slope Stability Analyses Results

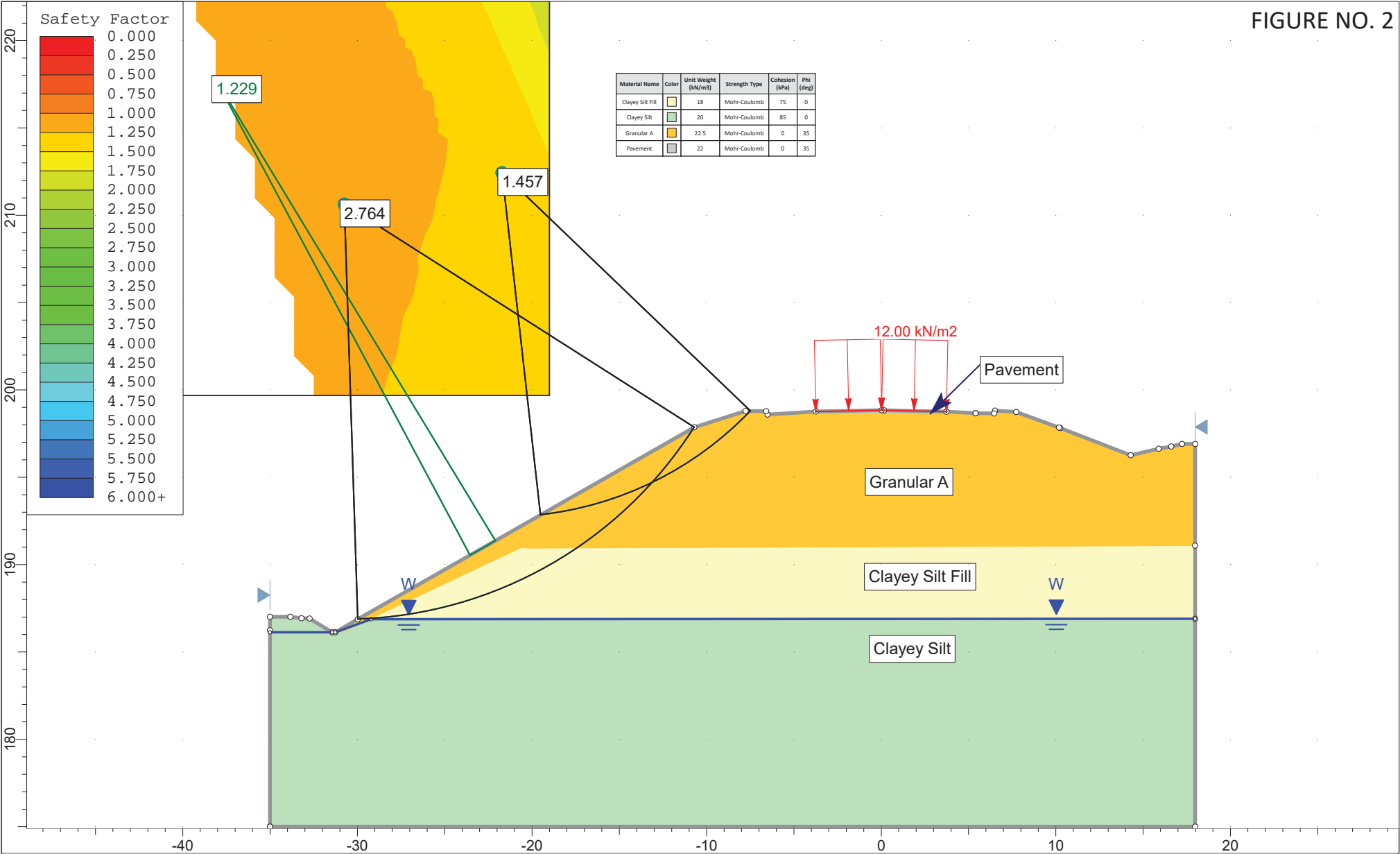
FIGURE NO. 1



SLIDEINTERPRET 6.039

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New Highway 40 and CNR Overhead			
Analysis Description			
Station 19+941.18			
Drawn By	N. Rahman	Scale	1:311
Company		PML	
Date		File Name	19+941.18.slim

FIGURE NO. 2




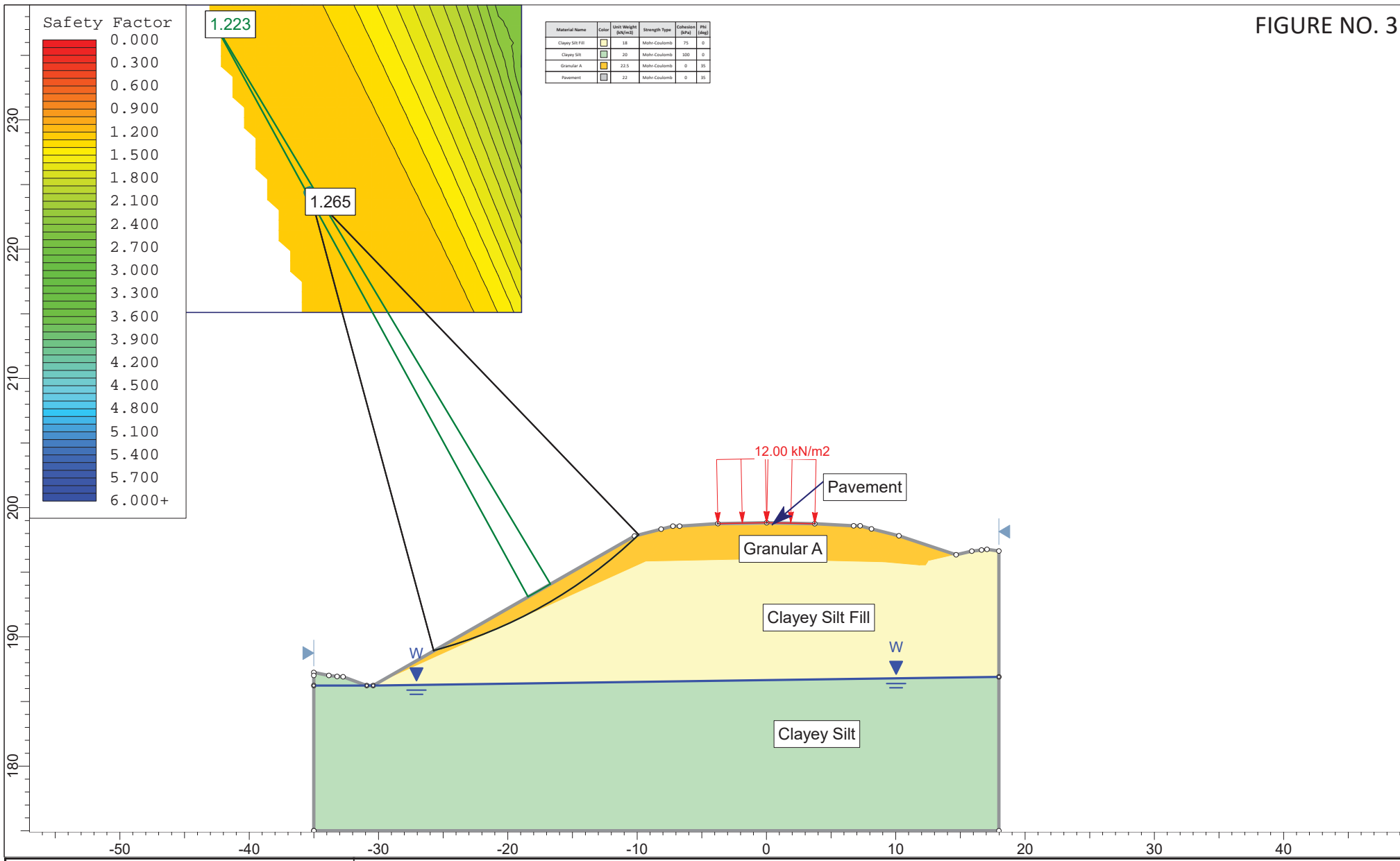
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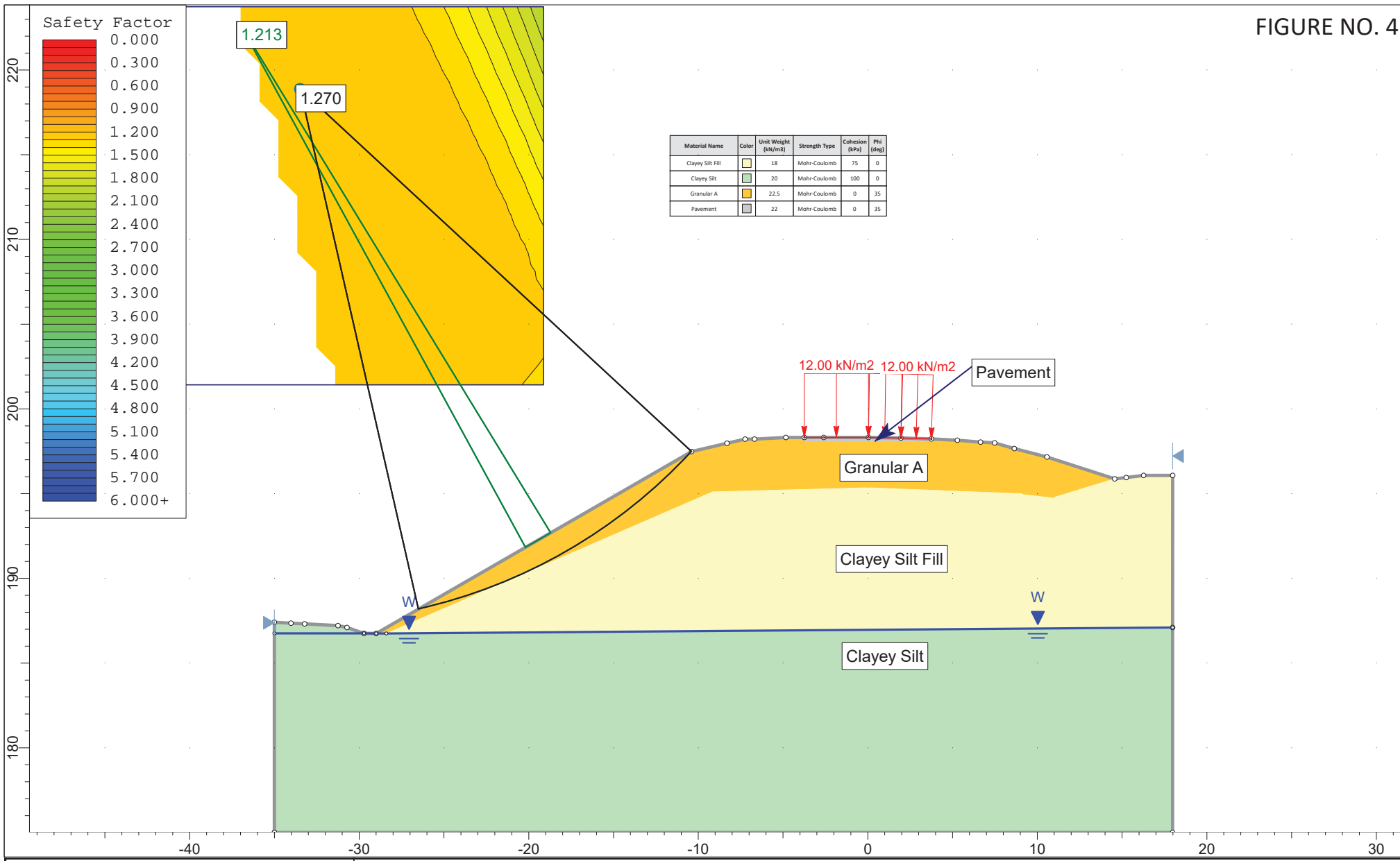
FIGURE NO. 3



SLIDEINTERPRET 6.039

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Analysis Description			
Station 19+920			
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Date		Company	PML
		File Name	19+920.slim

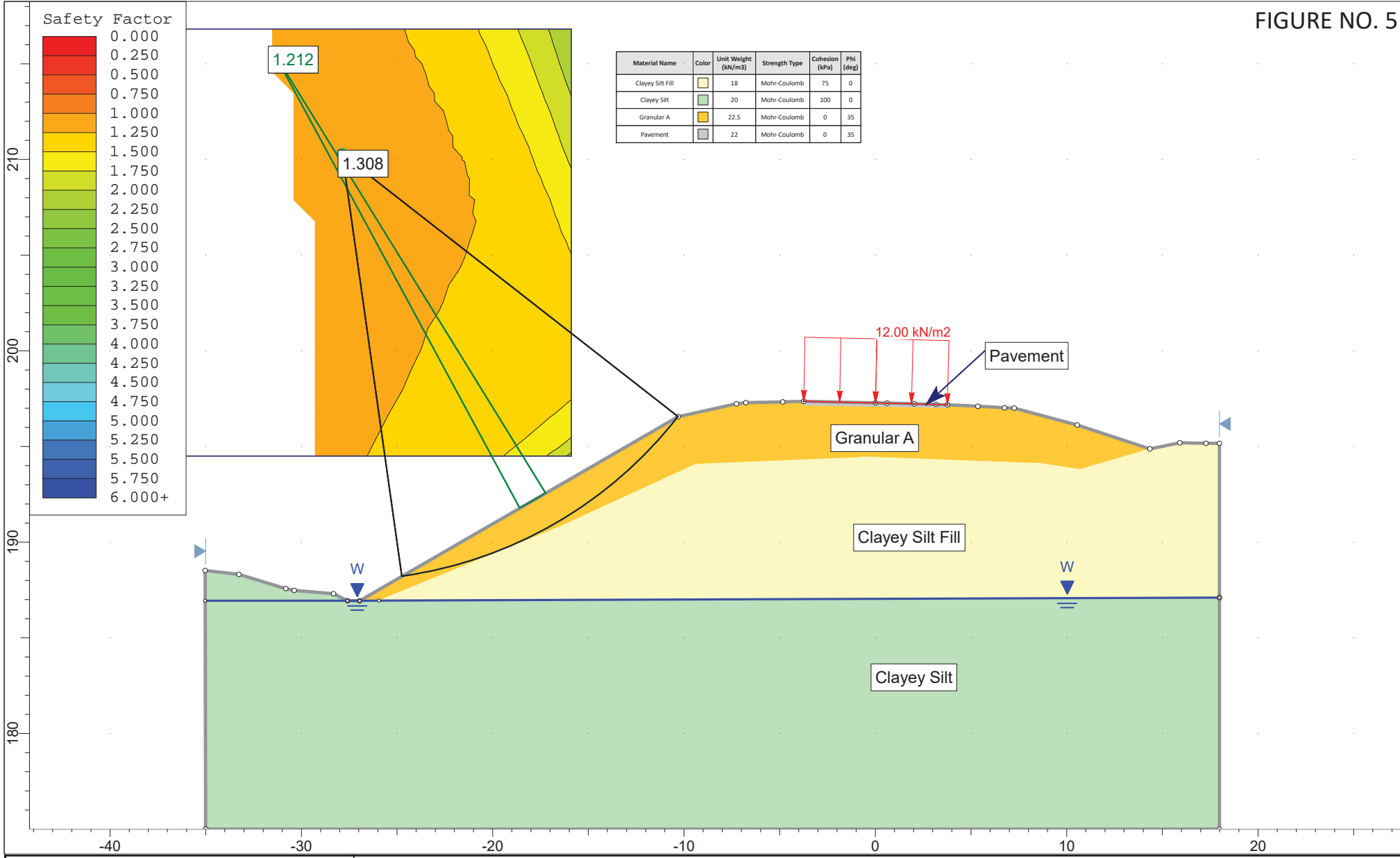
FIGURE NO. 4



SLIDEINTERPRET 6.039

Project			
New Highway 40 and CNR Overhead			
Analysis Description			
Station 19+870			
Drawn By	N. Rahman	Scale	1:309
		Company	PML
Date			
		File Name	19+870.slim

FIGURE NO. 5



roscience

SLIDEINTERPRET 6.039

Project		New Highway 40 and CNR Overhead	
Analysis Description		Station 19+820	
Drawn By	N. Rahman	Scale	1:274
		Company	PML
Date		File Name	19+820.slim

FIGURE NO. 6

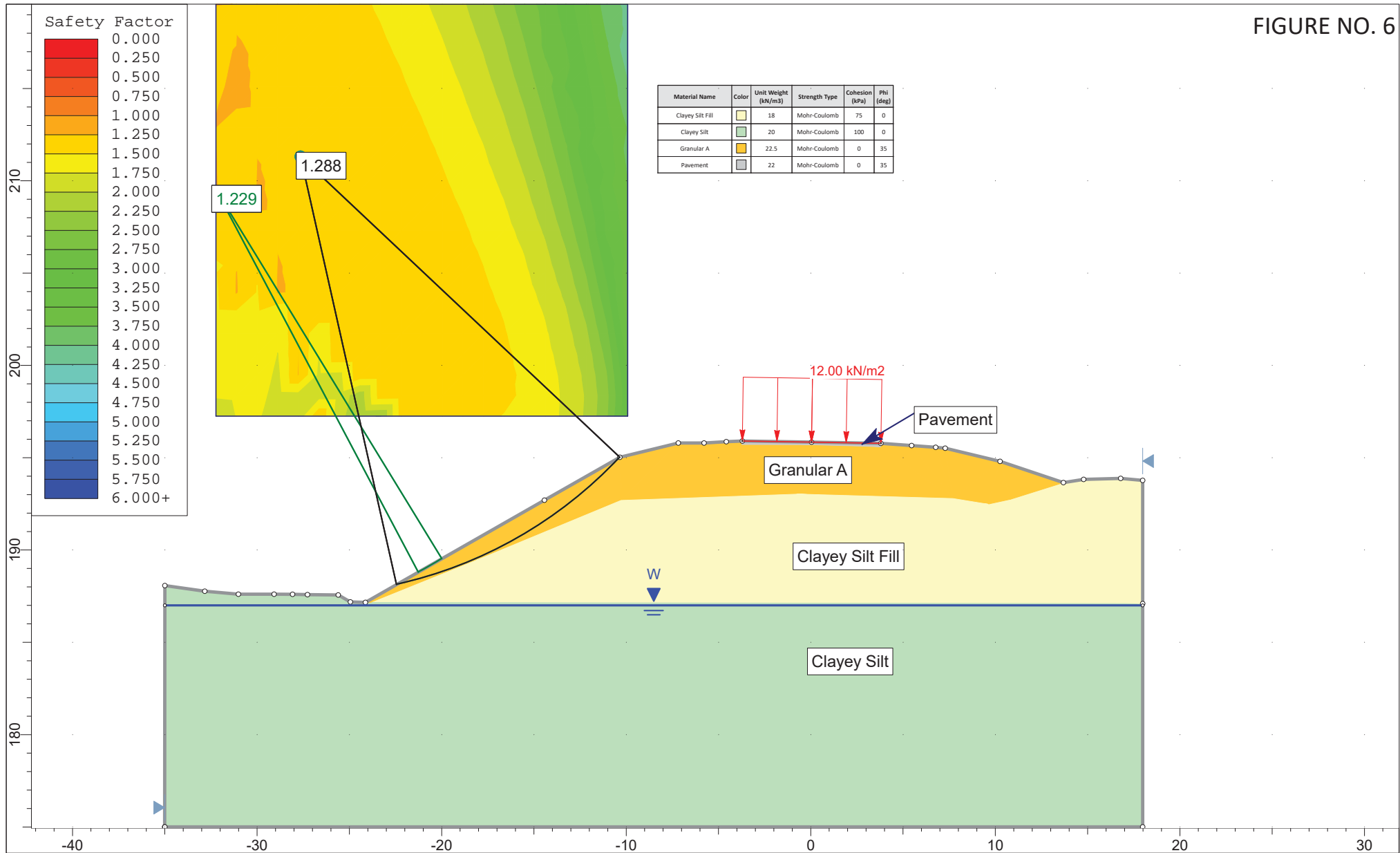
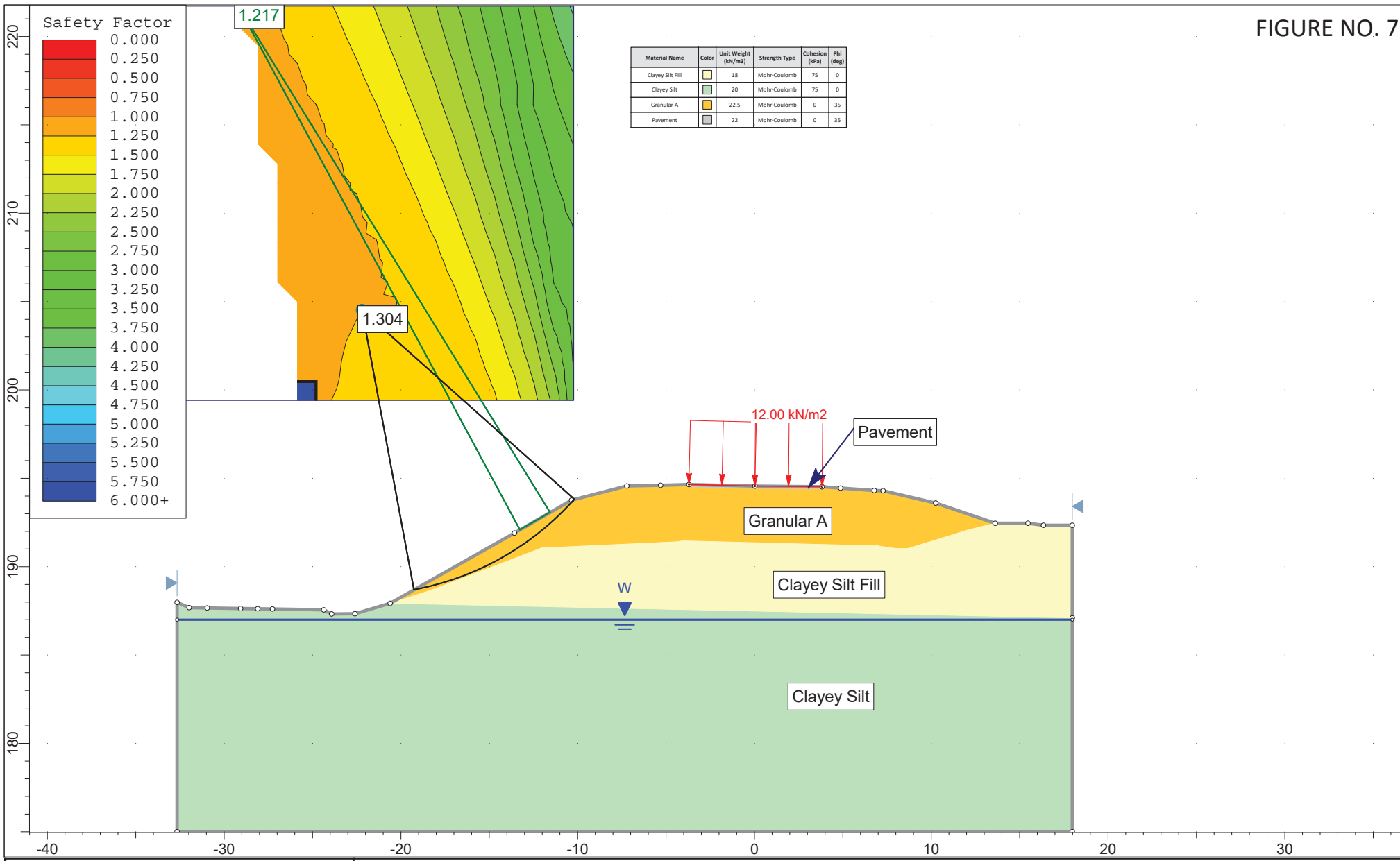


FIGURE NO. 7




	Project			New Highway 40 and CNR Overhead	
	Analysis Description			Station 19+730	
	Drawn By	N. Rahman	Scale	1:297	Company PML
	Date				File Name 19+730.slim

FIGURE NO. 8

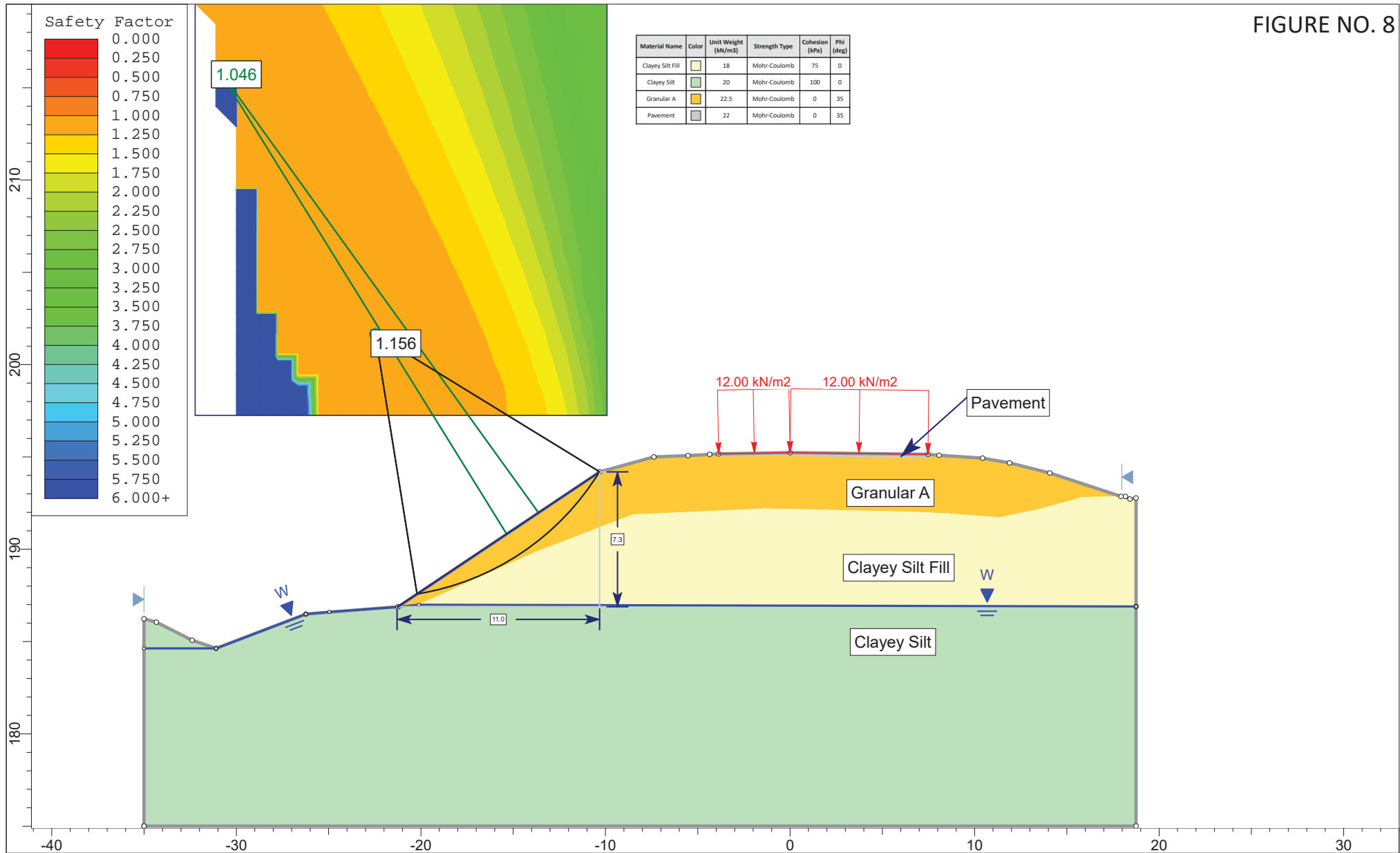
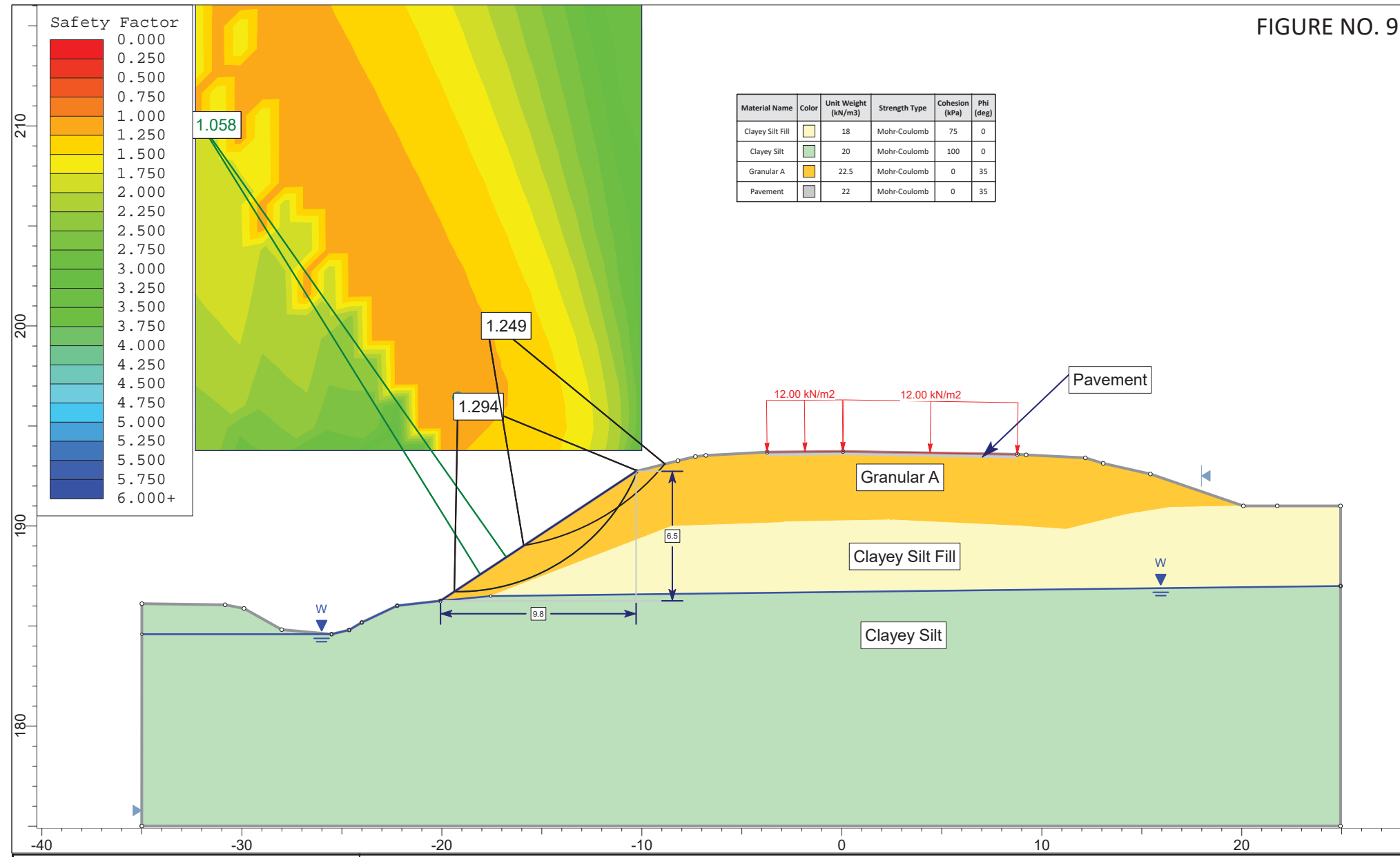


FIGURE NO. 9



SLIDEINTERPRET 6.039

Project			New Highway 40 and CNR Overhead		
Analysis Description			Station 20+230 - 1.5H:1V		
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Date				File Name	20+230 - 1.5H 1V.slim

FIGURE NO. 10

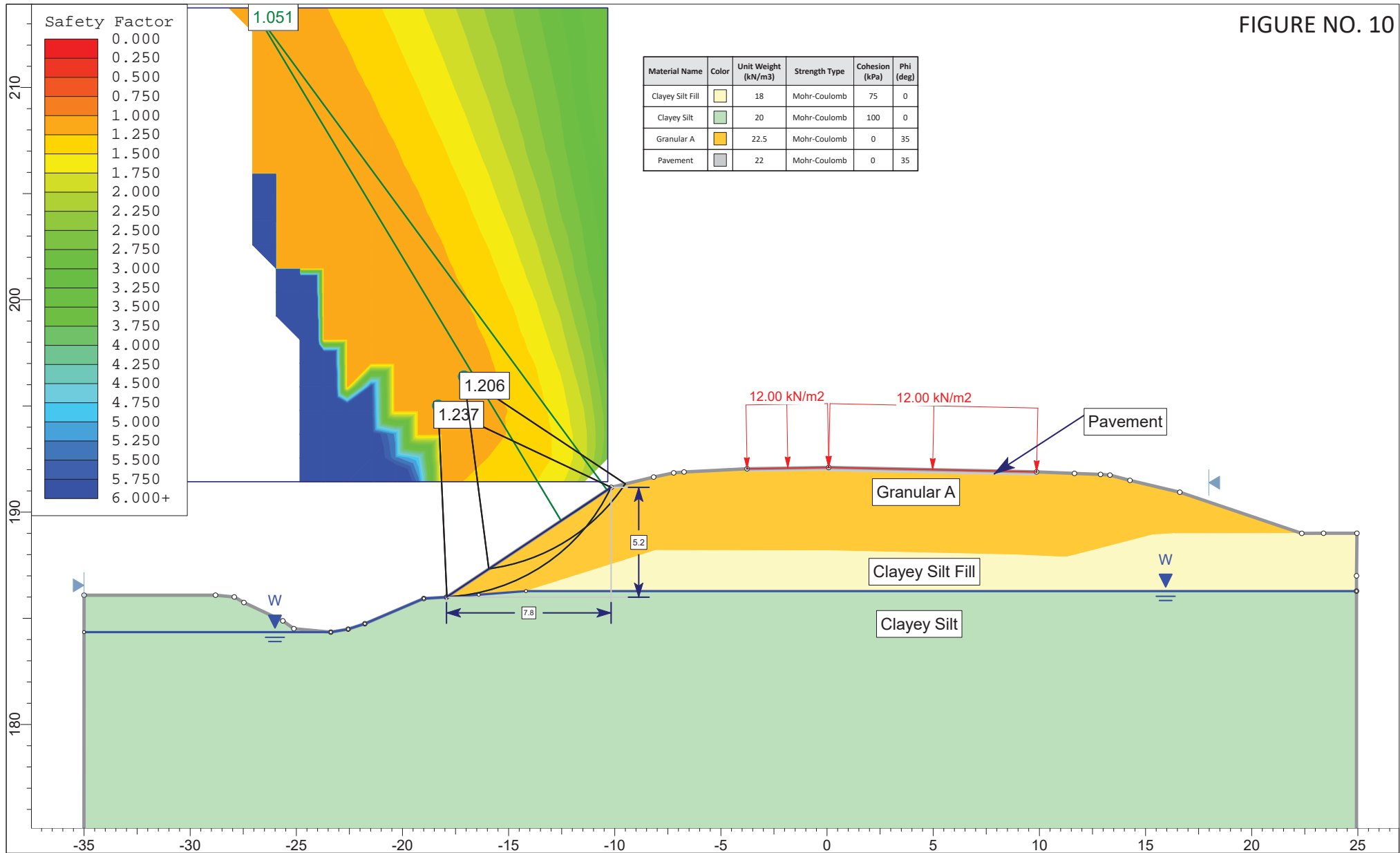


FIGURE NO. 11

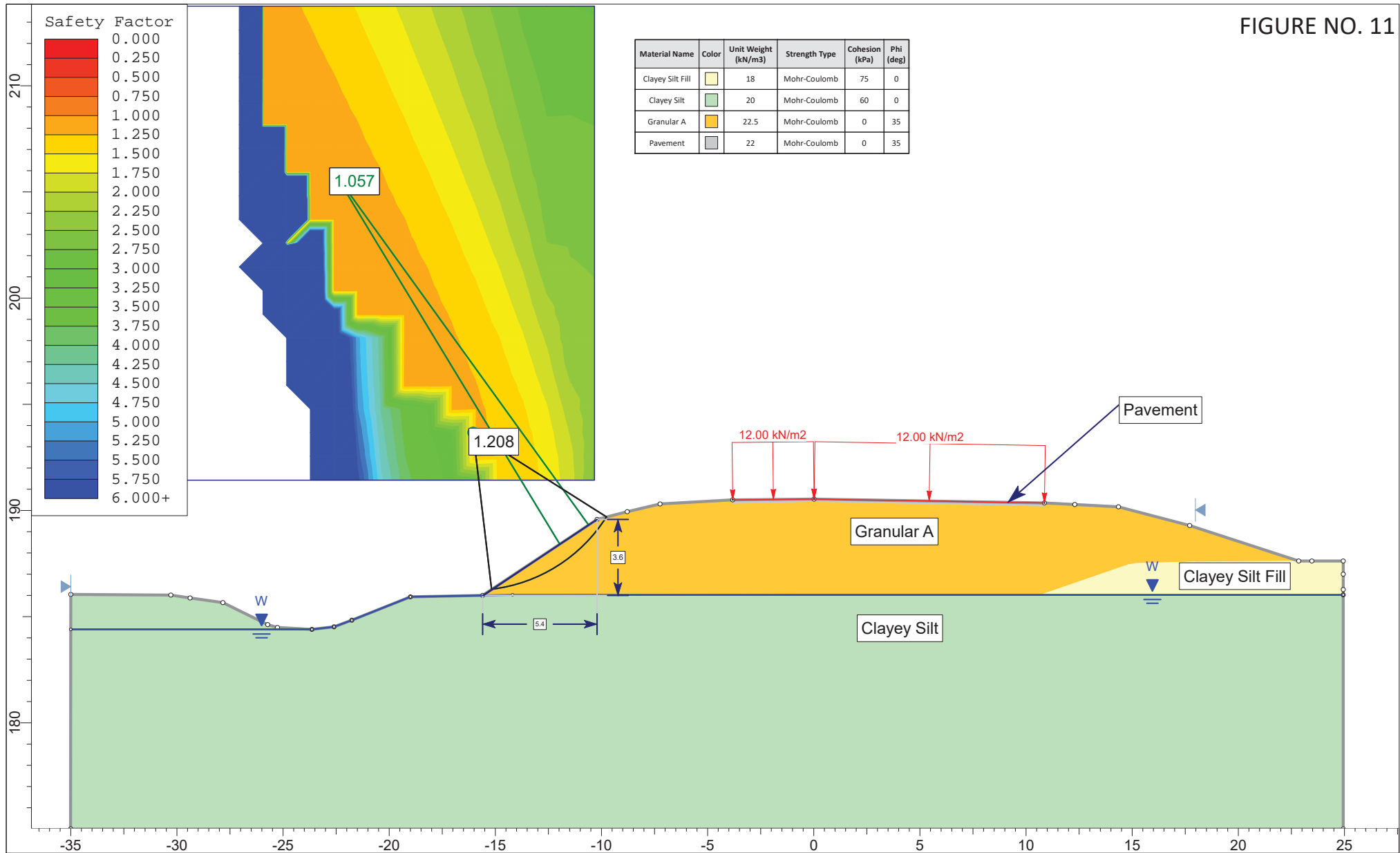


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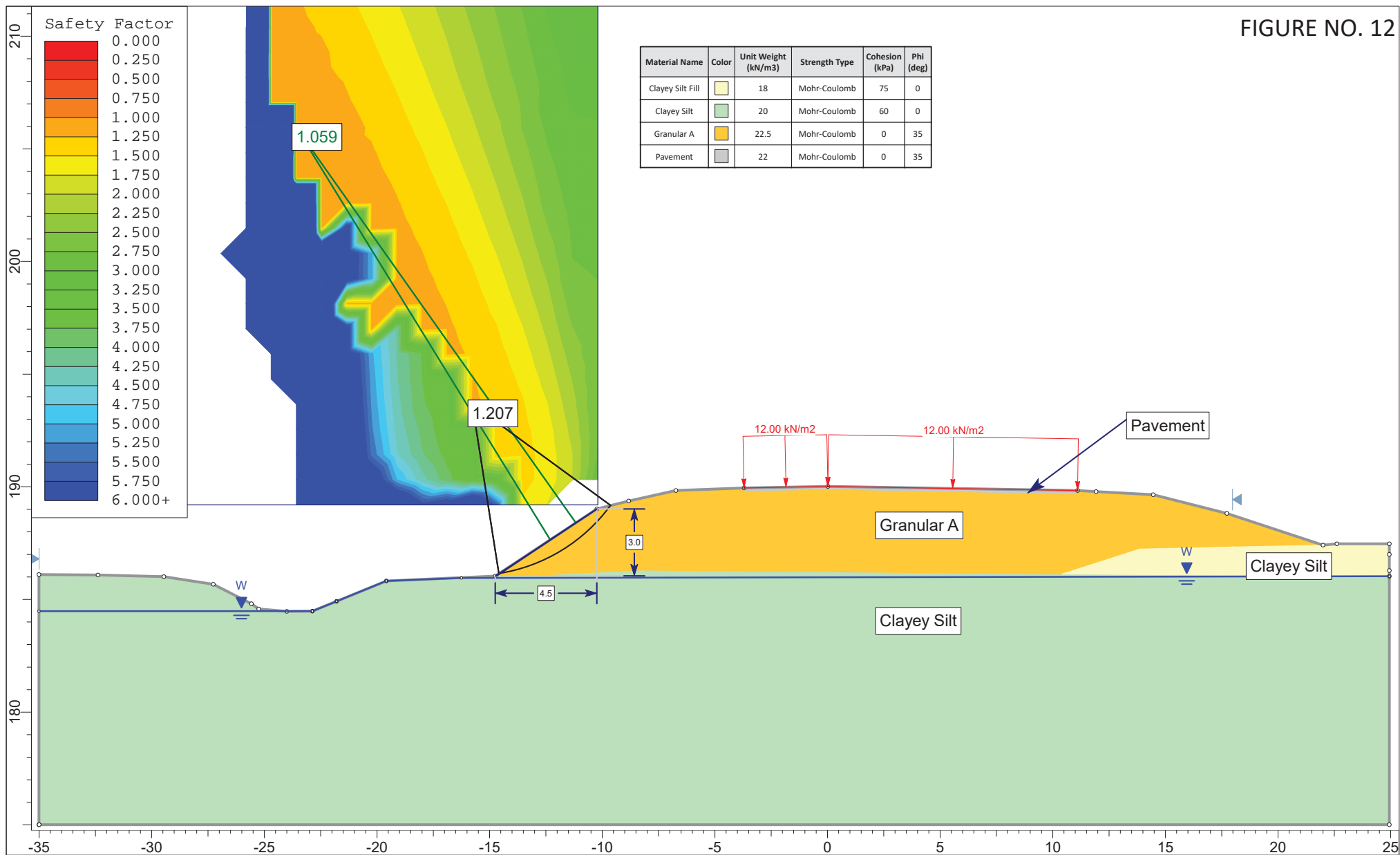


FIGURE NO. 13

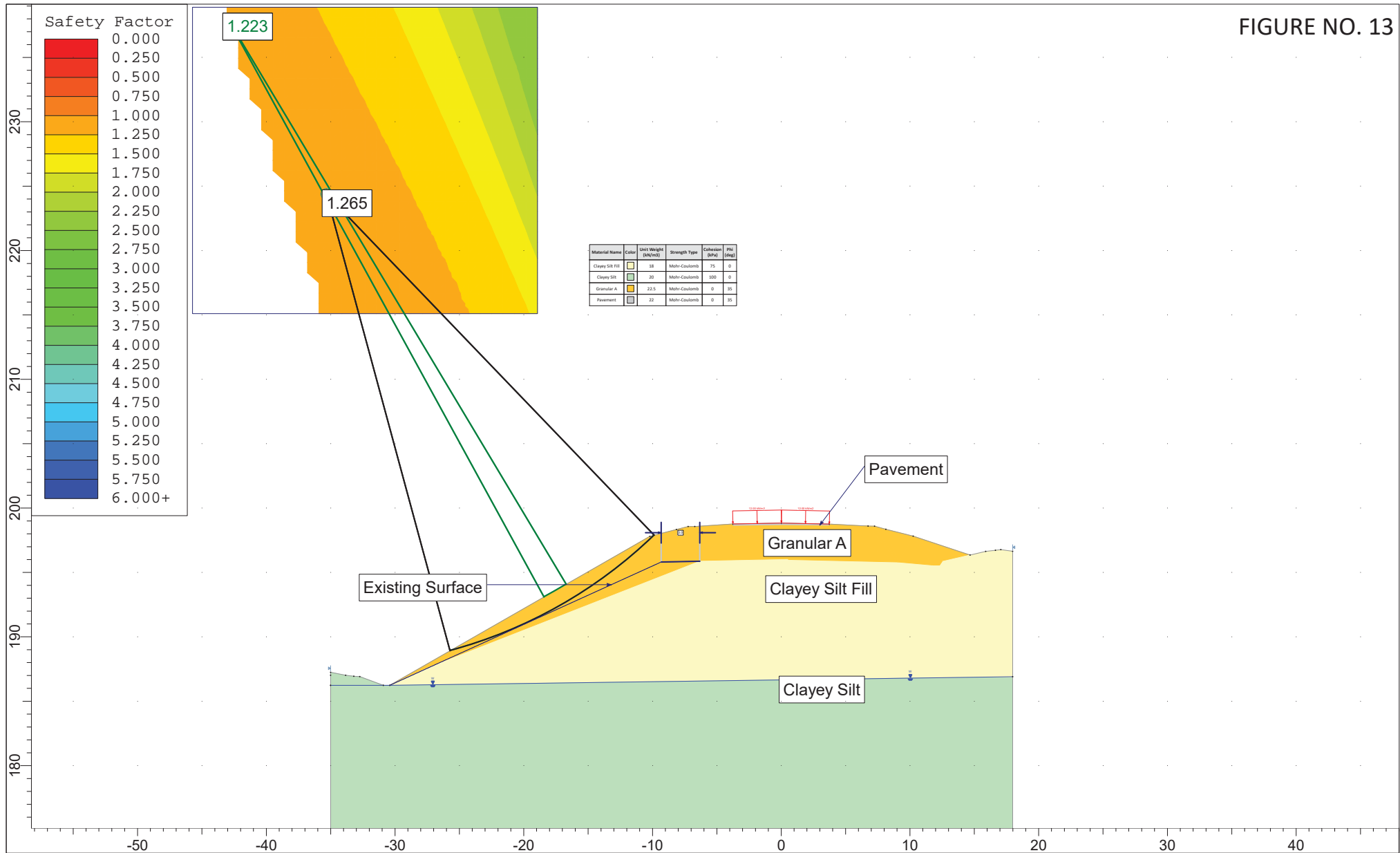


FIGURE NO. 14

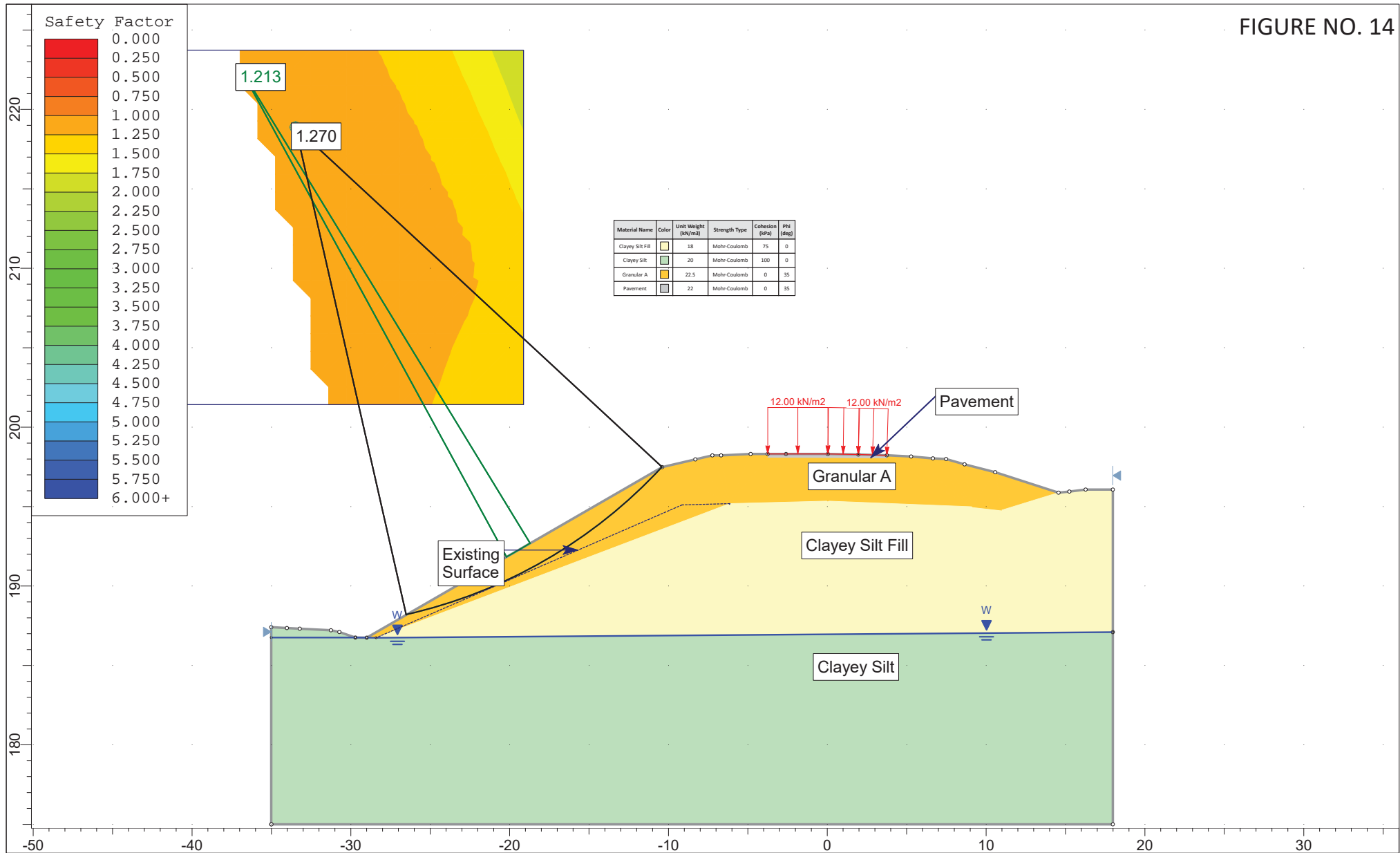


FIGURE NO. 15

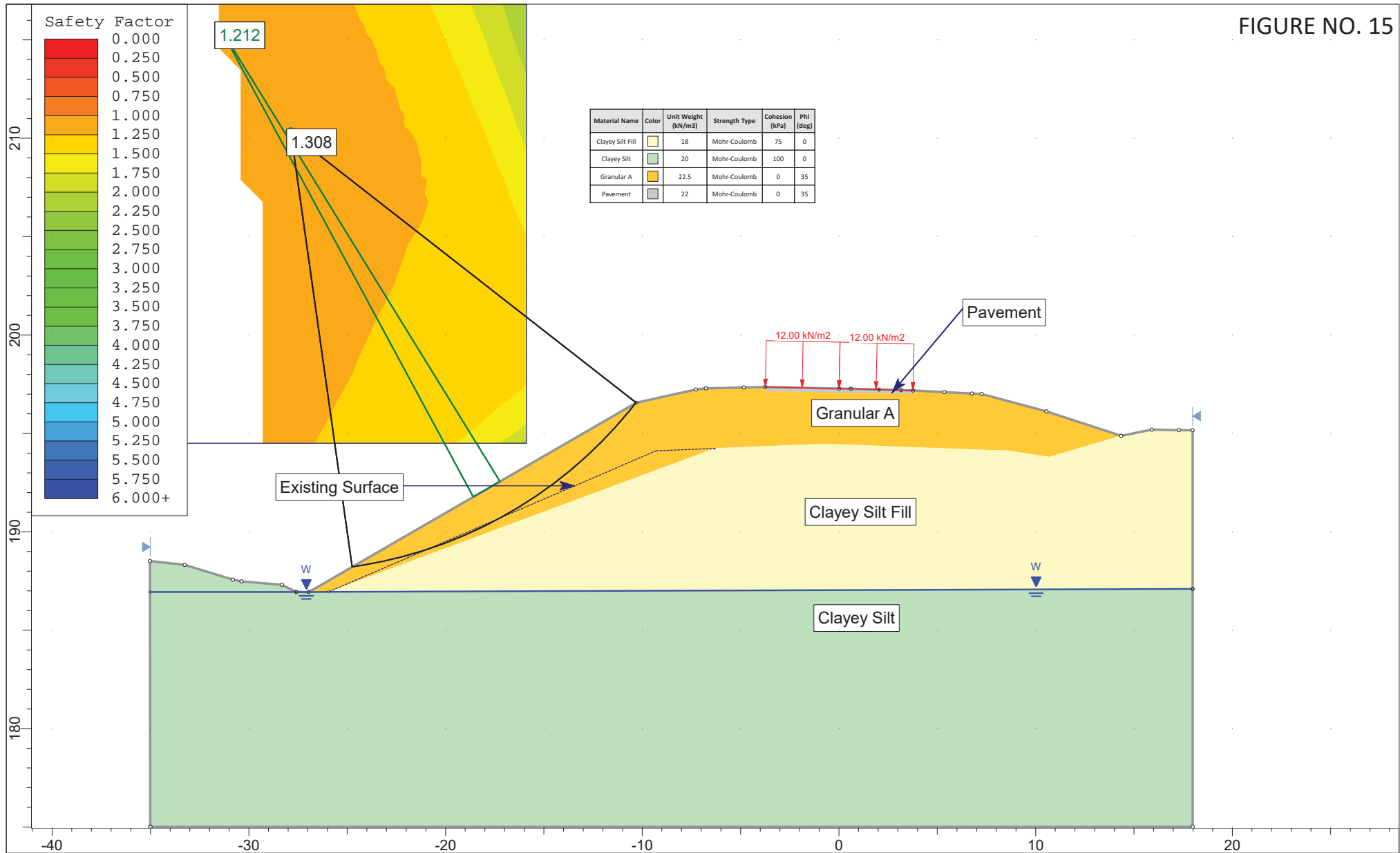


FIGURE NO. 16

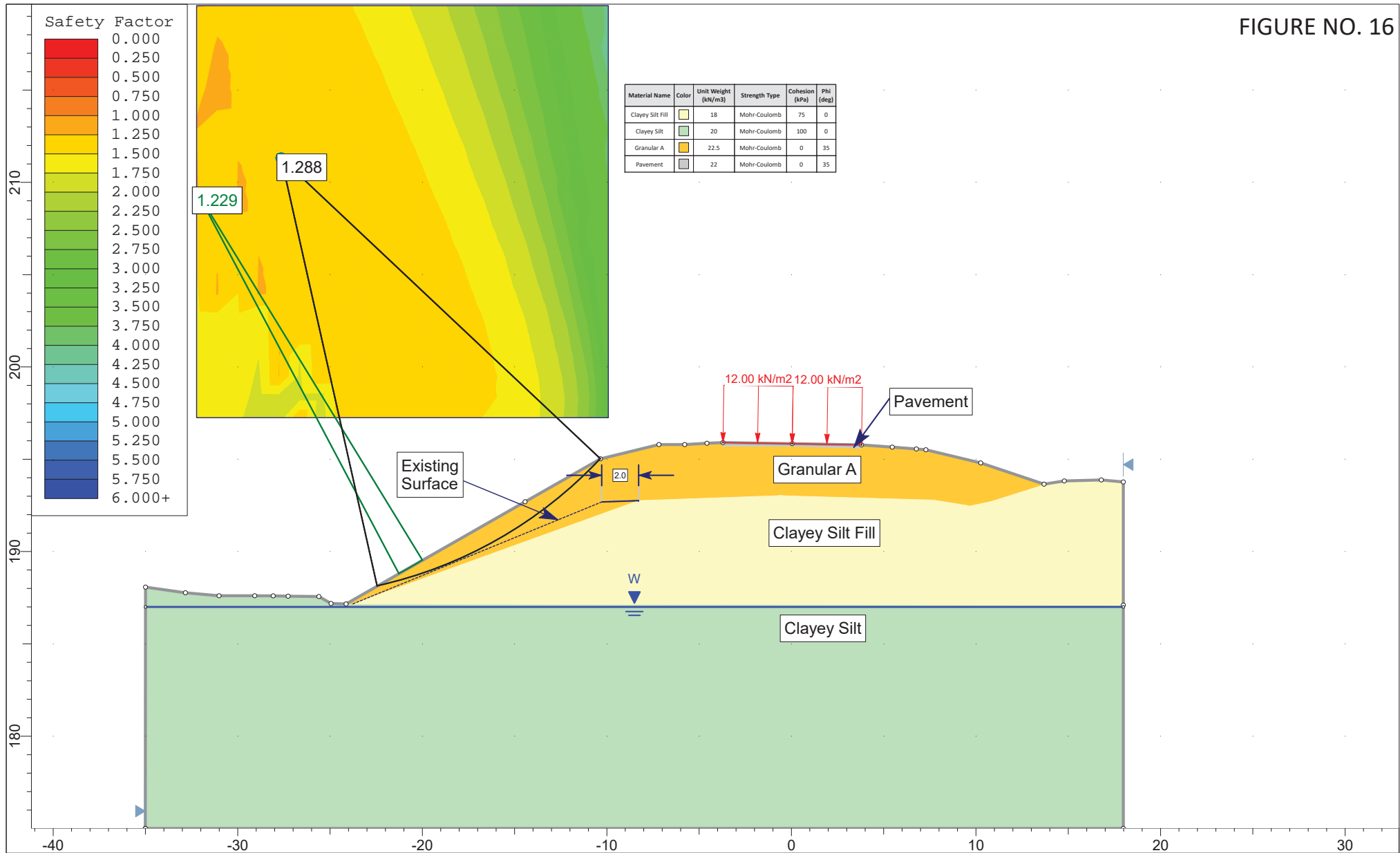


FIGURE NO. 17

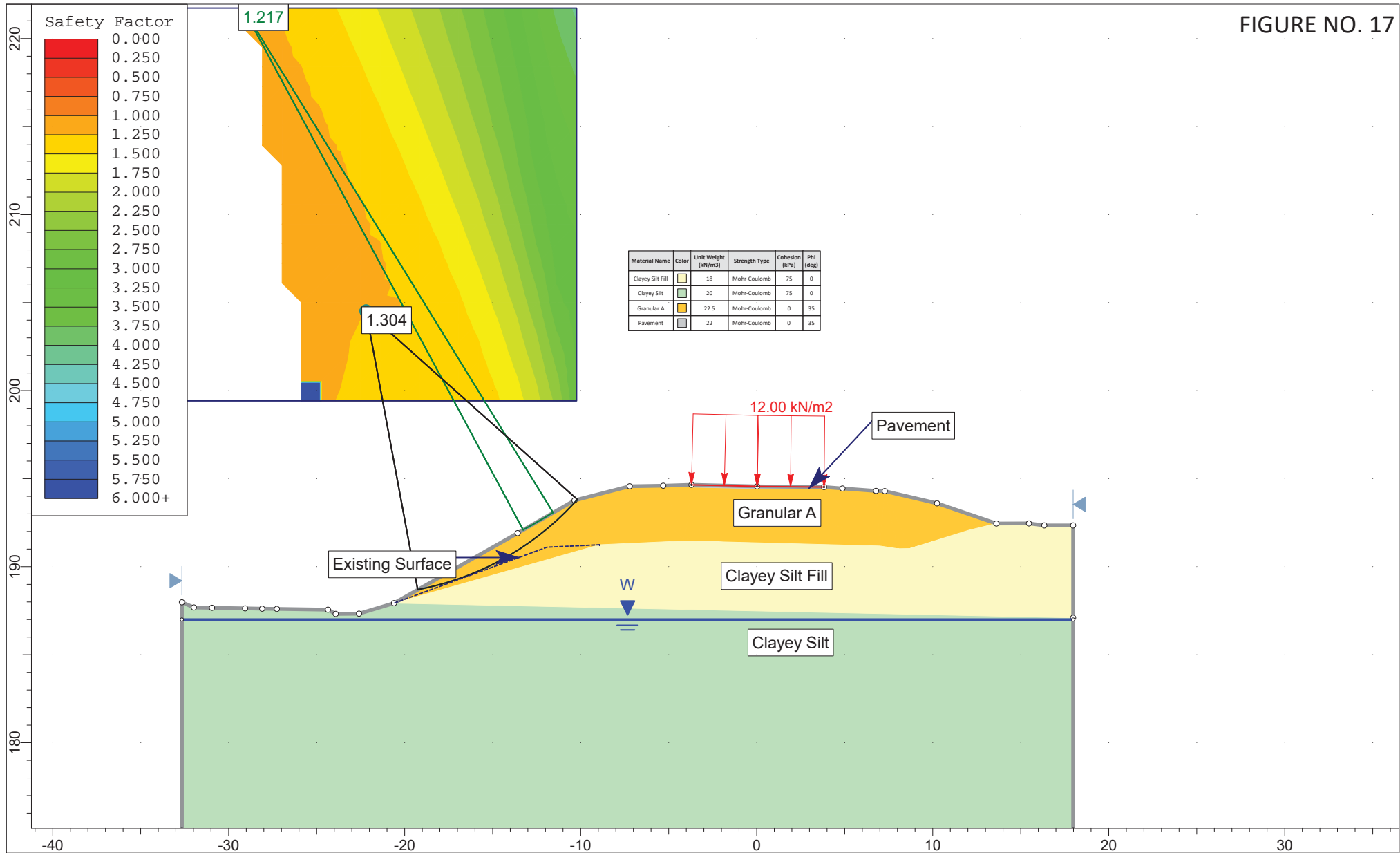
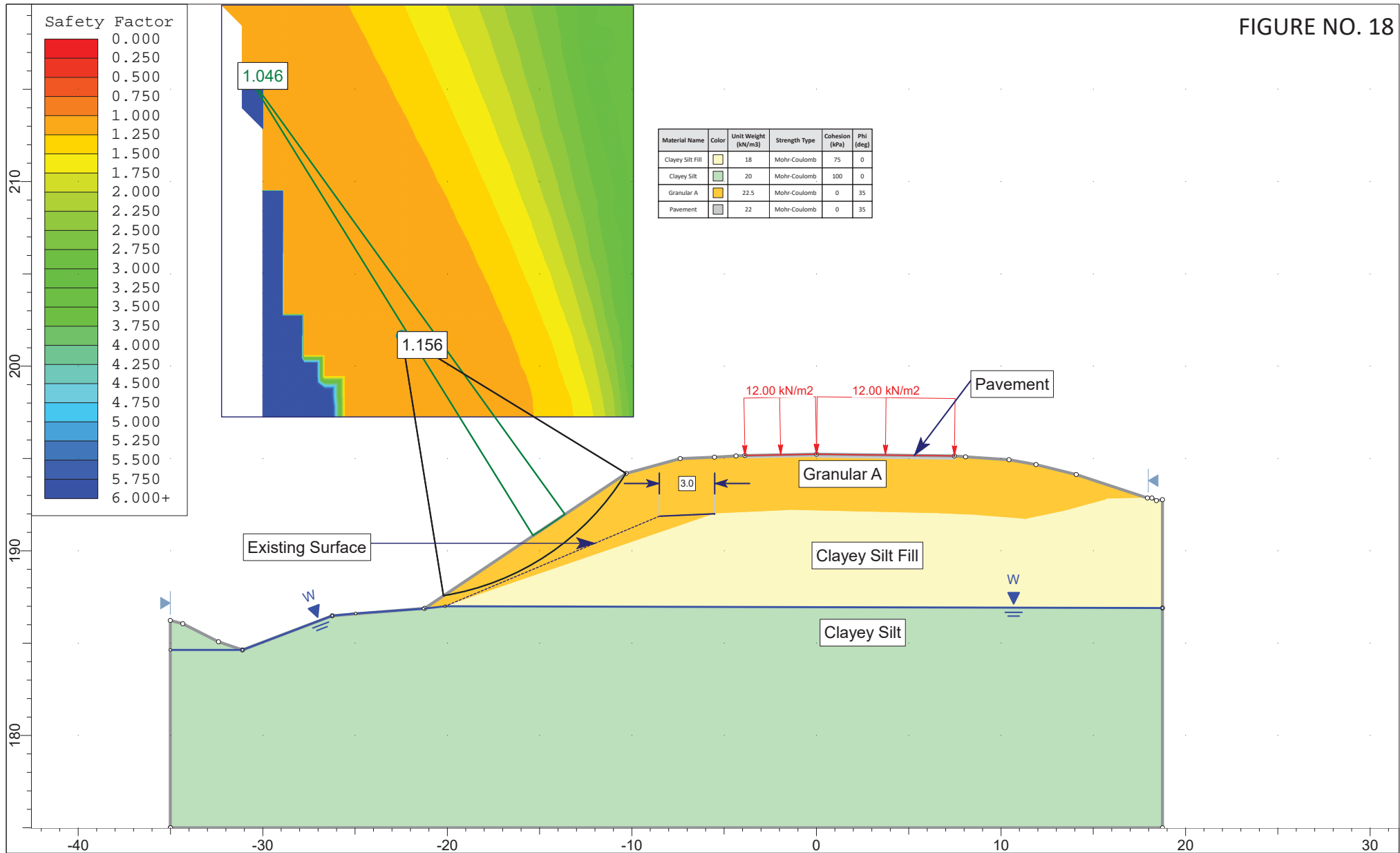


FIGURE NO. 18



Project			New Highway 40 and CNR Overhead		
Analysis Description			Station 20+180 - Modify Existing Embankment Slope		
Drawn By	N. Rahman	Scale	1:283	Company	PML
Date				File Name	20+180 - 1.5H 1V Modify Existing Slope.slim

FIGURE NO. 19

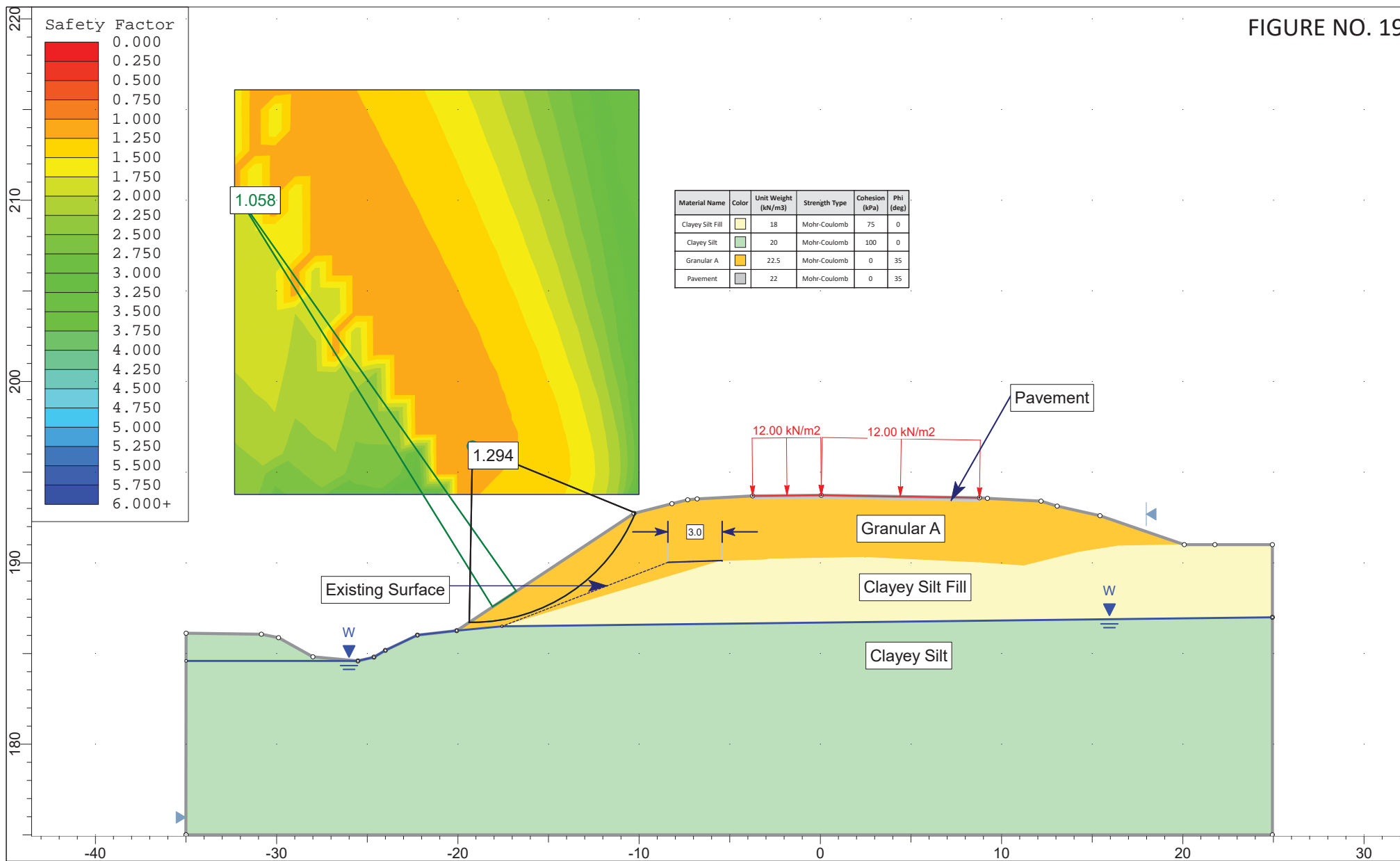


FIGURE NO. 20

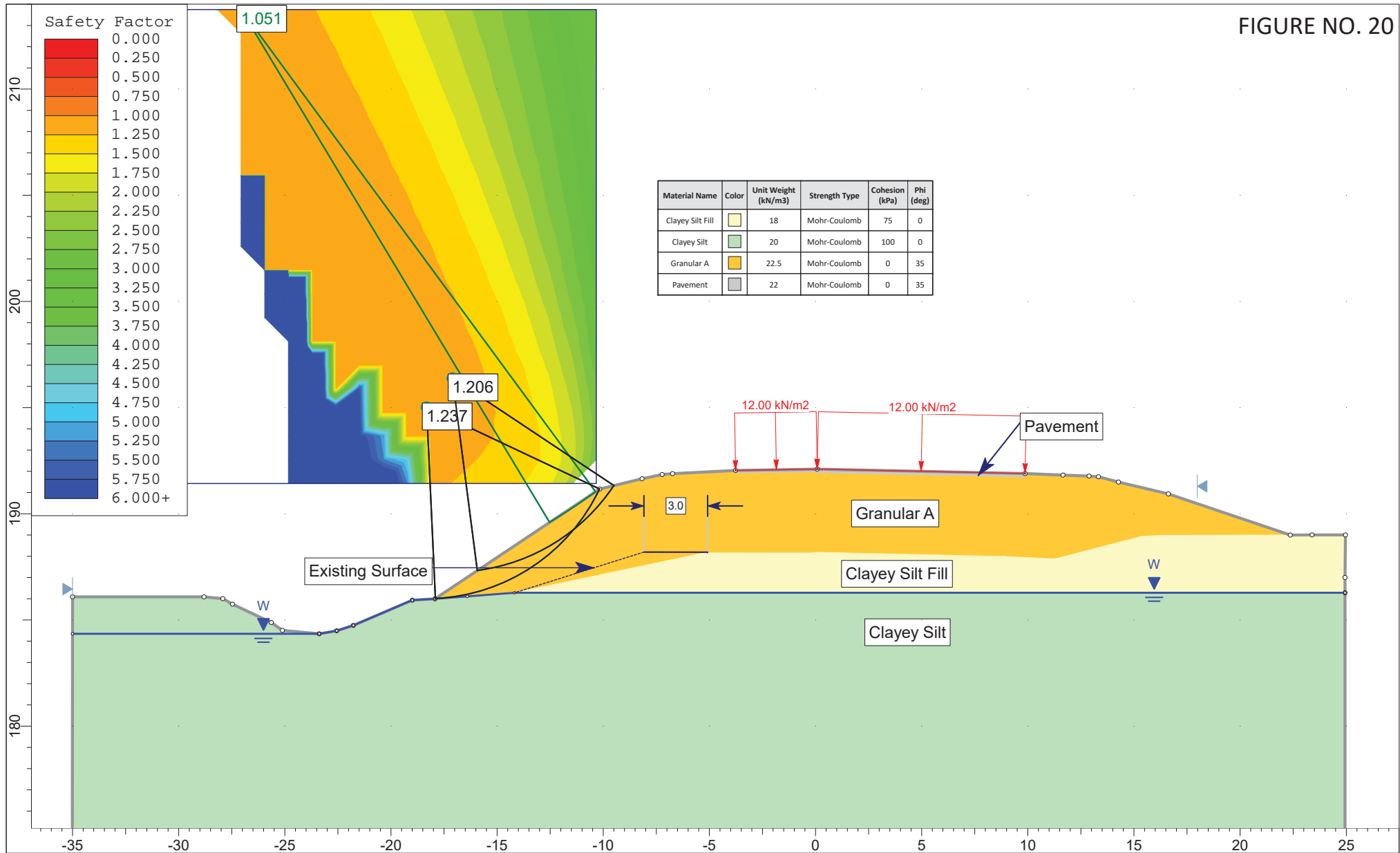
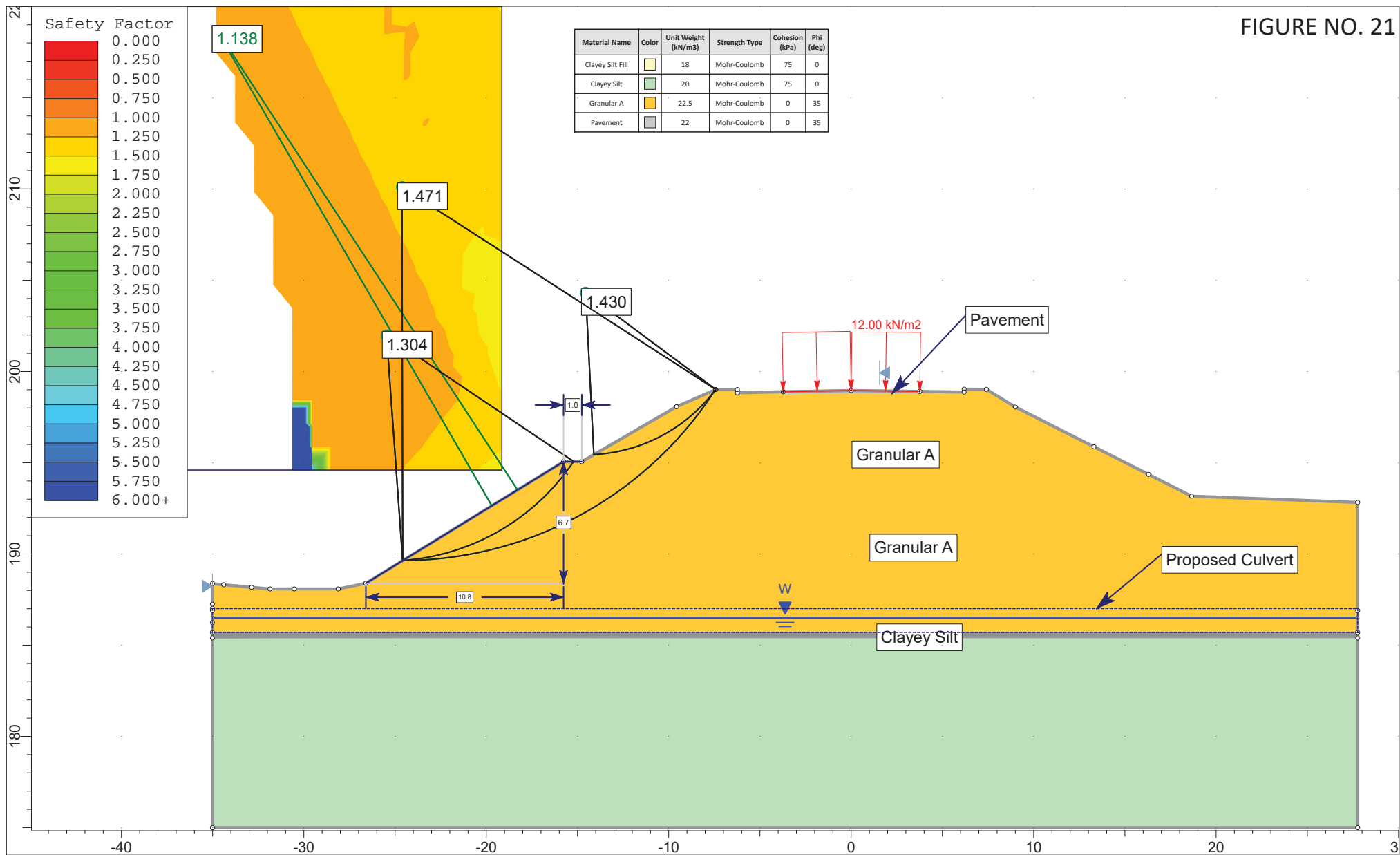
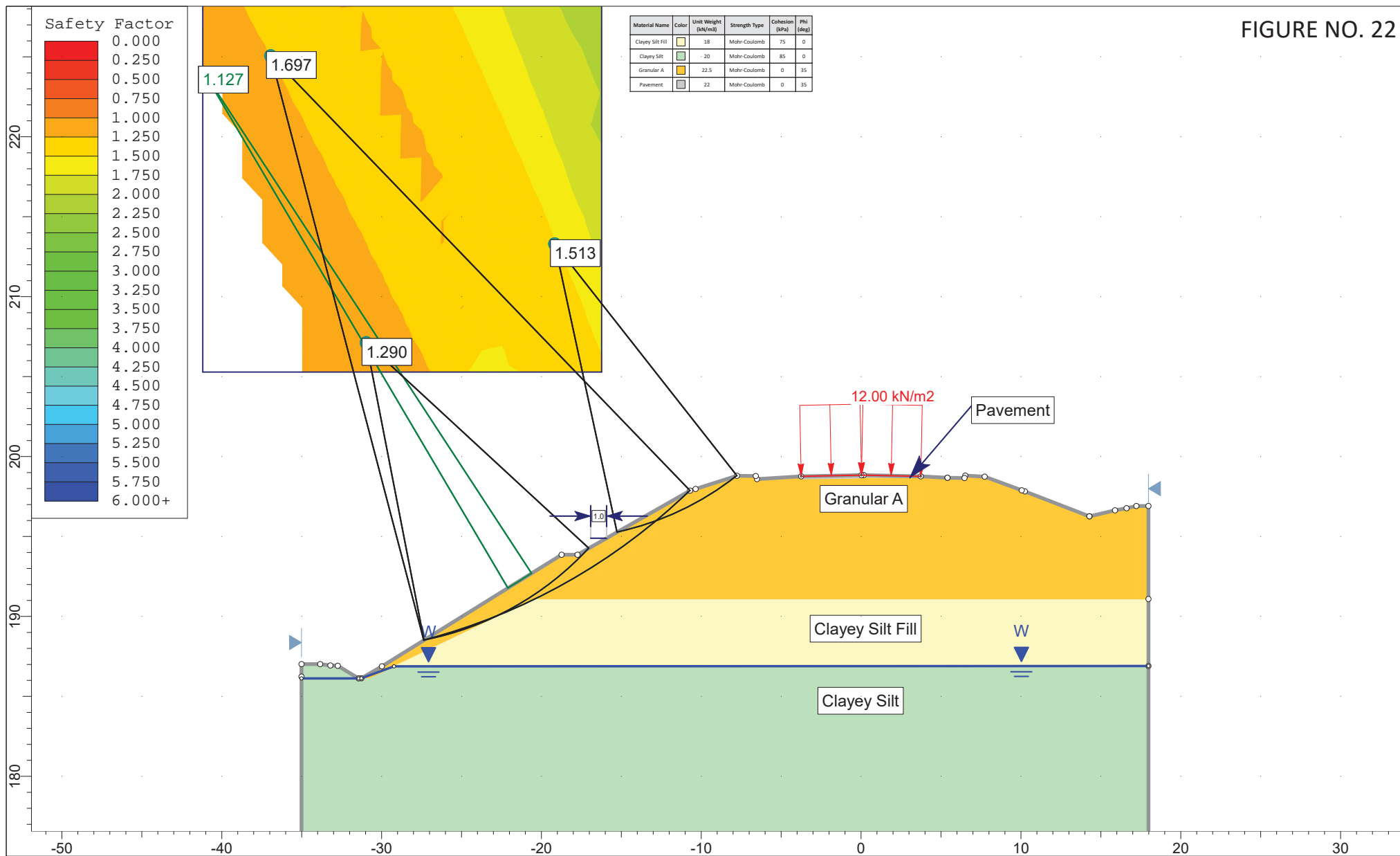


FIGURE NO. 21



Project			New Highway 40 and CNR Overhead			
Analysis Description			Station 19+941.18 - Mid Height Bench			
Drawn By		N. Rahman	Scale	1:286	Company	PML
Date				File Name	19+941.18 -mid height bench.slim	

FIGURE NO. 22



Project			
New Highway 40 and CNR Overhead			
Analysis Description			
Station 19+930 - Mid Height Berm			
Drawn By	N. Rahman	Scale	1:327
Date	3/9/2021, 12:48:01 PM	Company	PML
		File Name	19+930 - Mid height Berm.slim

FIGURE NO. 23

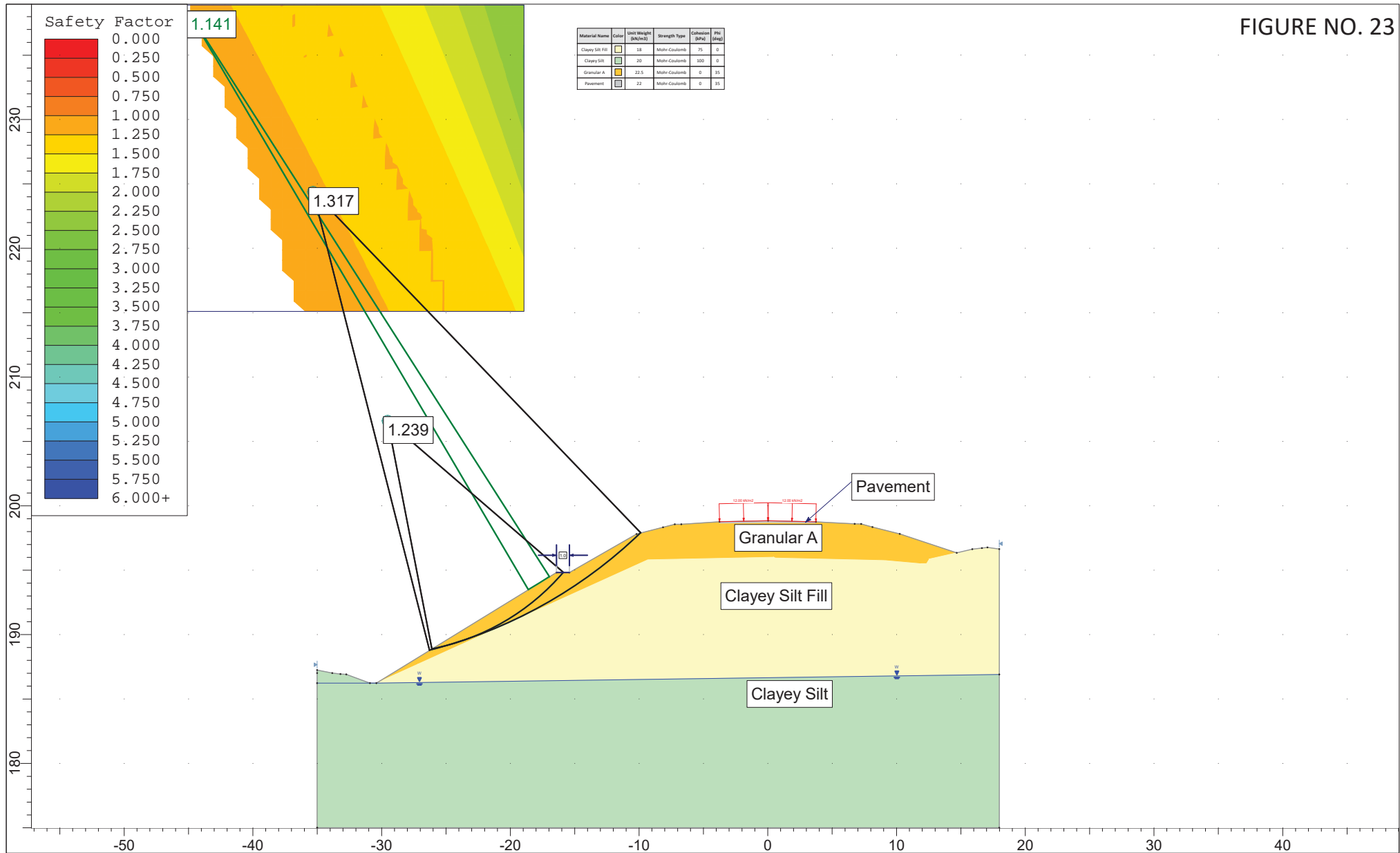
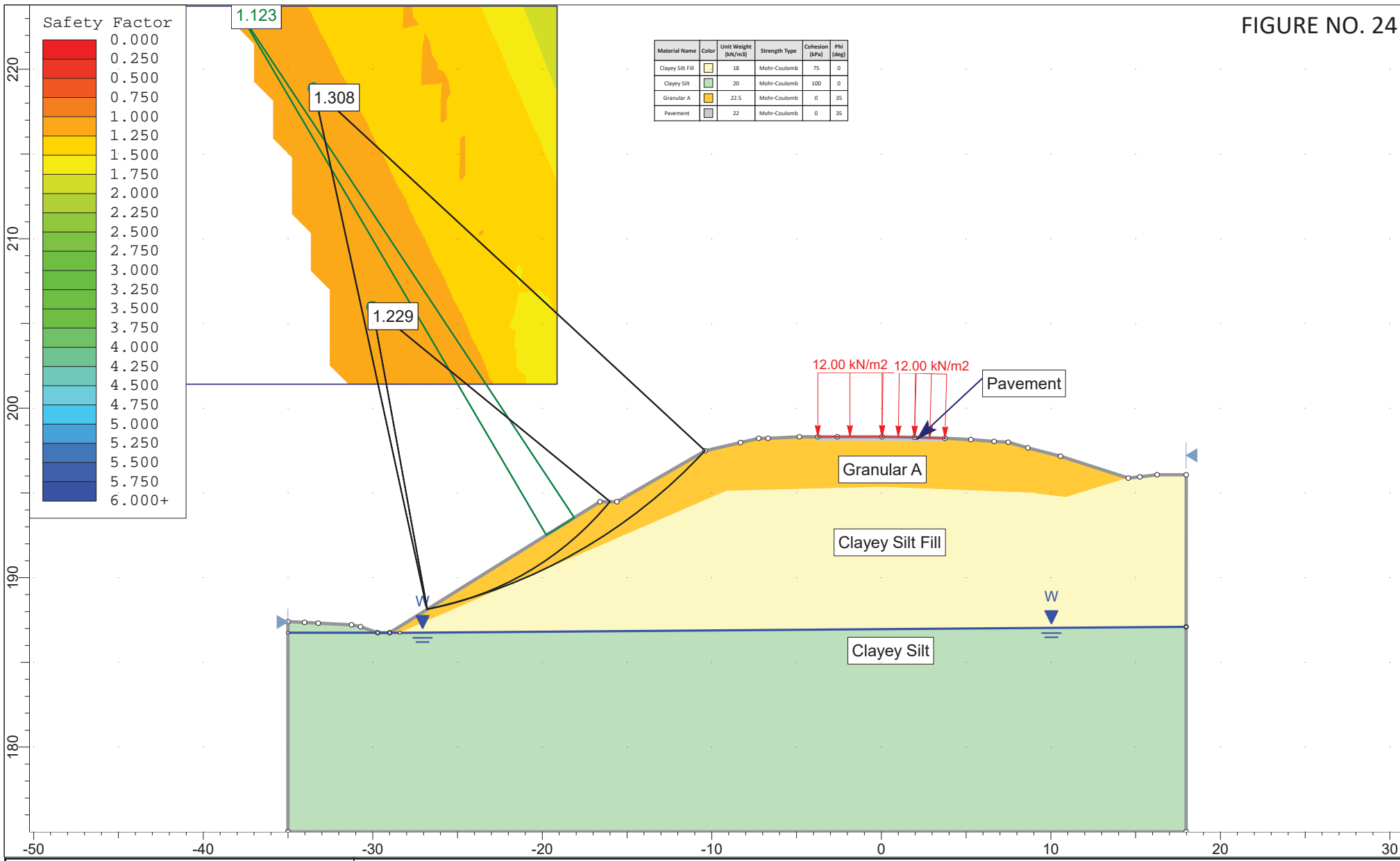


FIGURE NO. 24



SLIDEINTERPRET 6.039

Project			New Highway 40 and CNR Overhead		
Analysis Description			Station 19+870 - Mid Height Berm		
Drawn By		N. Rahman	Scale	1:309	Company
Date					PML
				File Name	19+870 - 1.0 m berm.slim

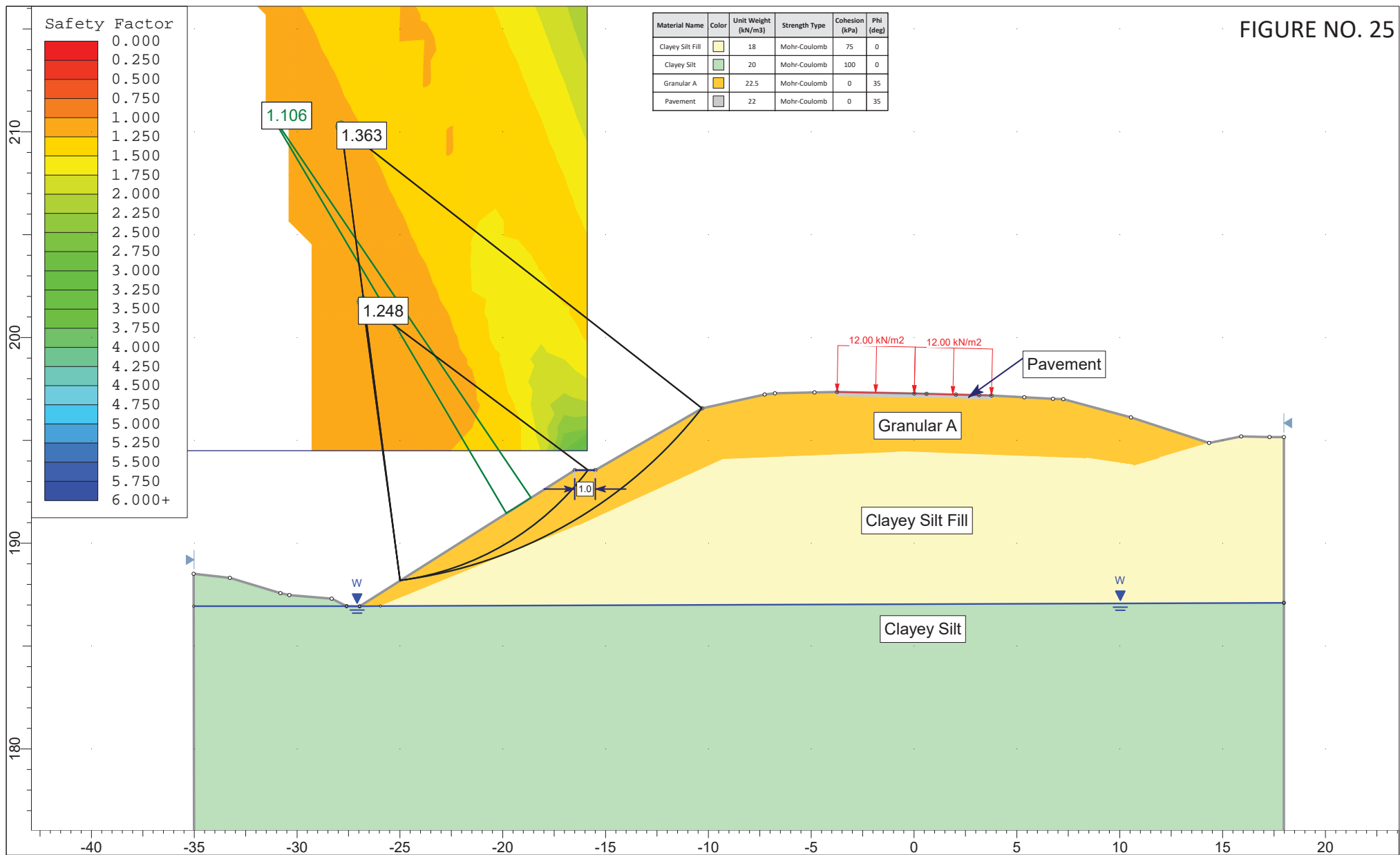
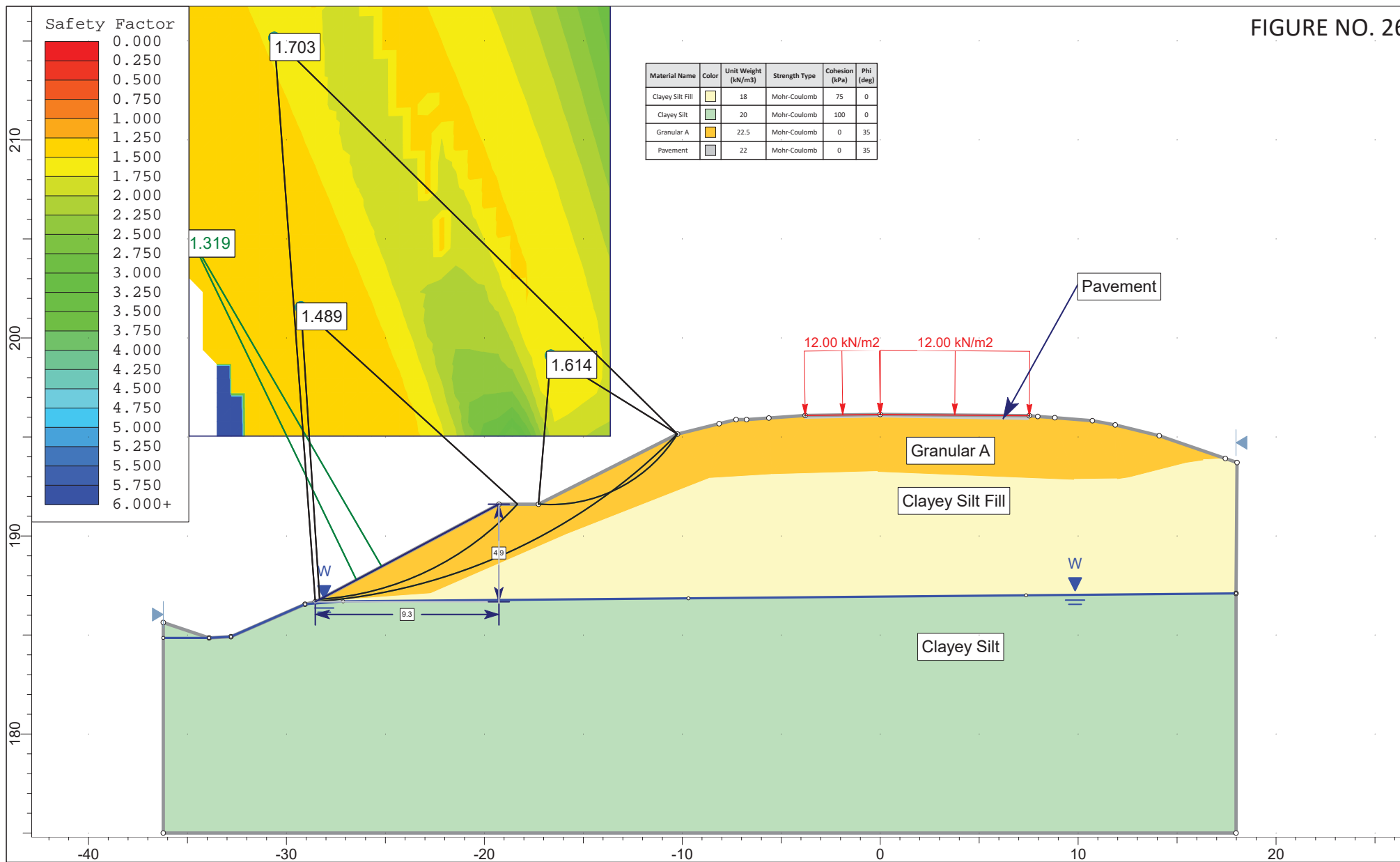


FIGURE NO. 26



Project			
New Highway 40 and CNR Overhead			
Analysis Description			
Station 20+150			
Drawn By	N. Rahman	Scale	1:266
Date		Company	PML
		File Name	20+150.slim

FIGURE NO. 27

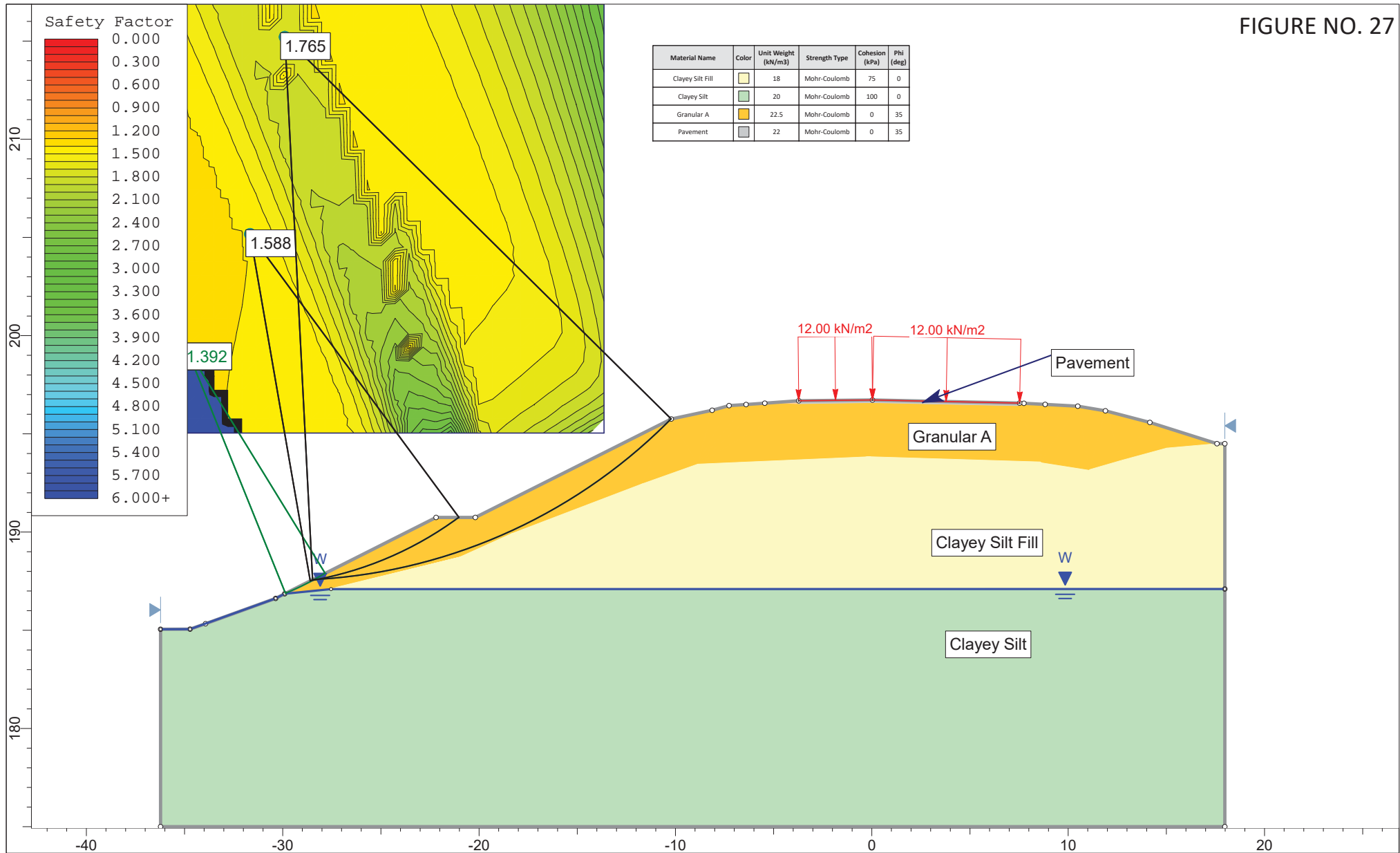


FIGURE NO. 28

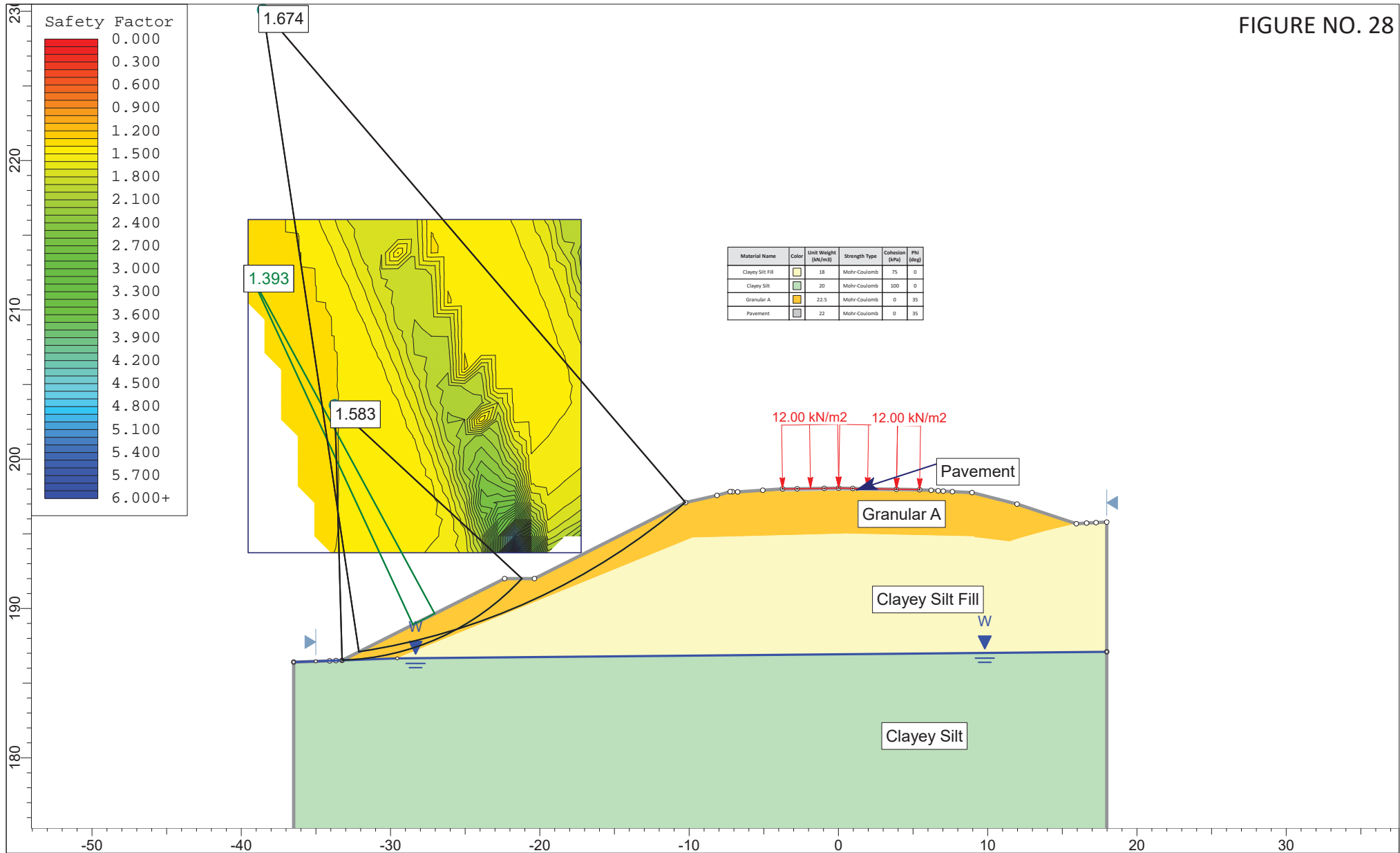
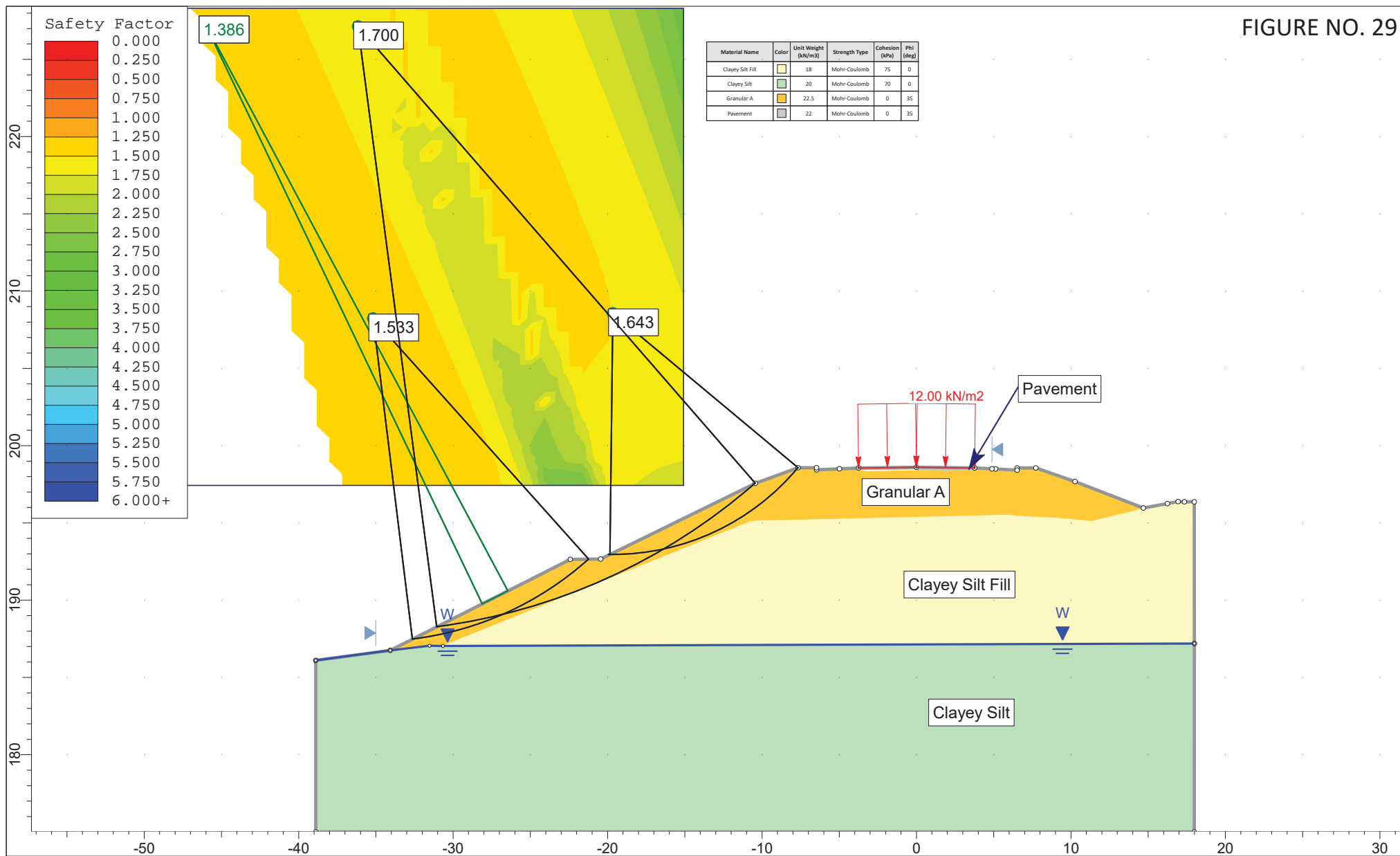


FIGURE NO. 29



Project		New Highway 40 and CNR Overhead	
Analysis Description		Station 20+030	
Drawn By	N. Rahman	Scale	1:339
Date		Company	PML
		File Name	20+030.slim

FIGURE NO. 30

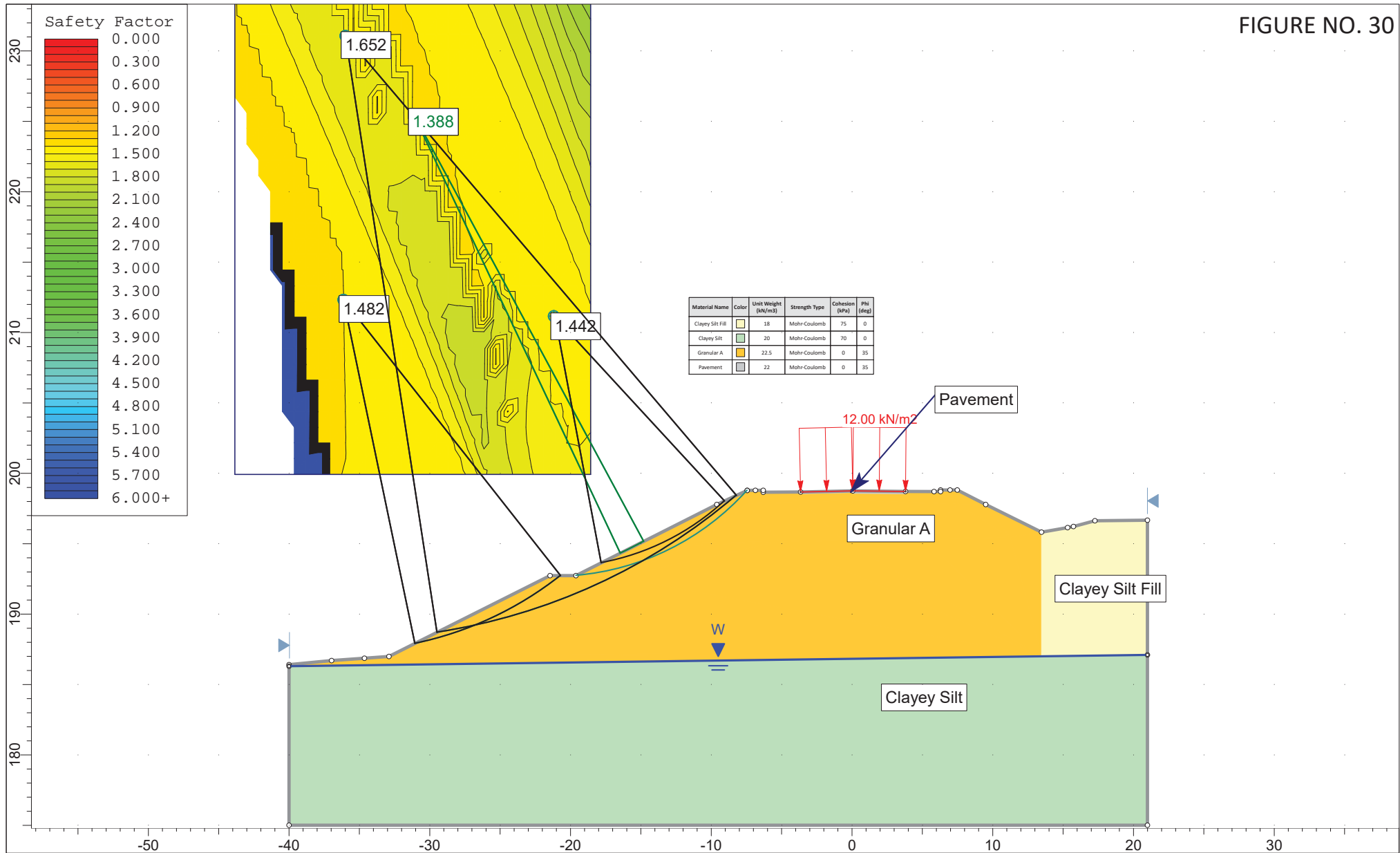


FIGURE NO. 31

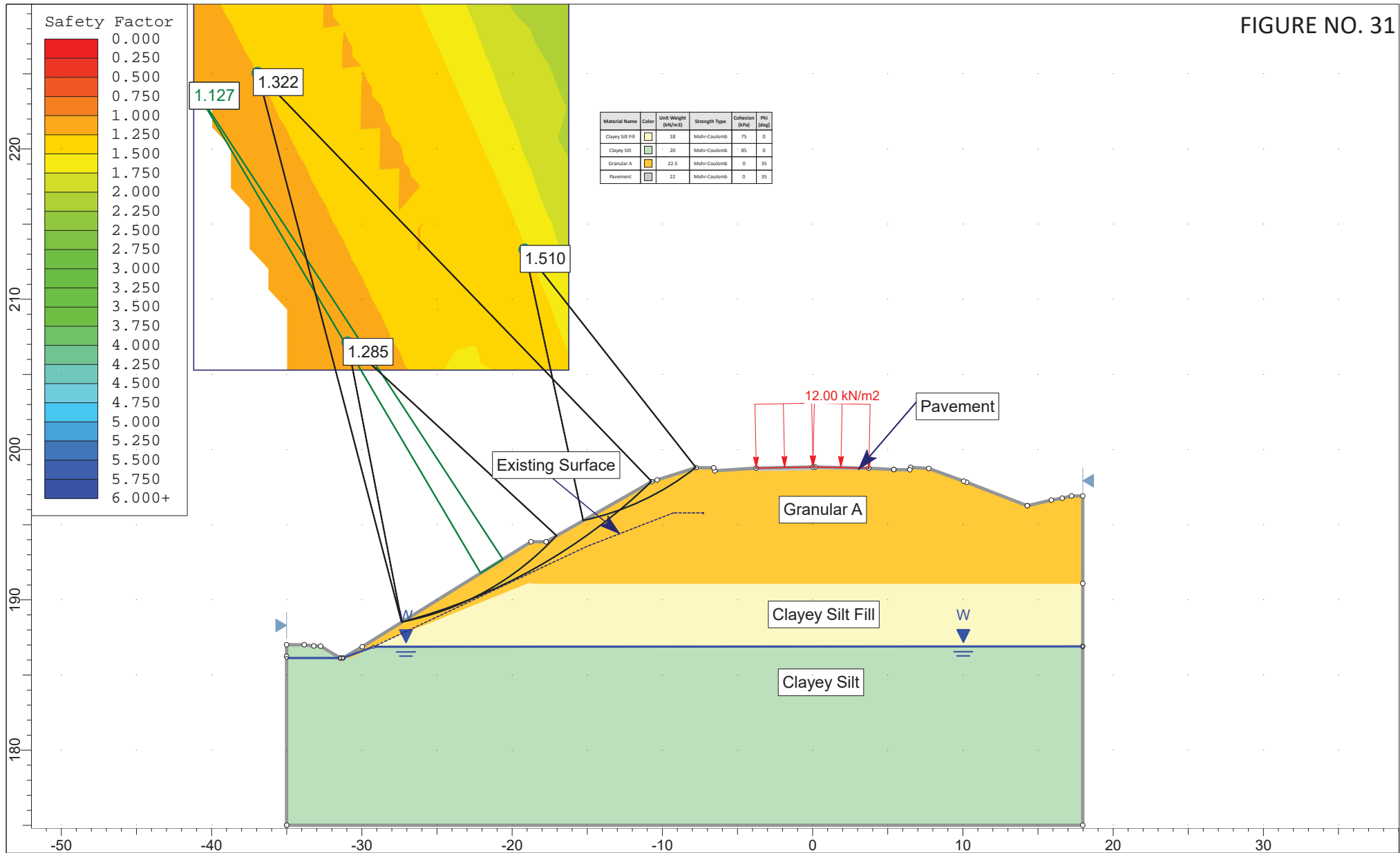


FIGURE NO. 32

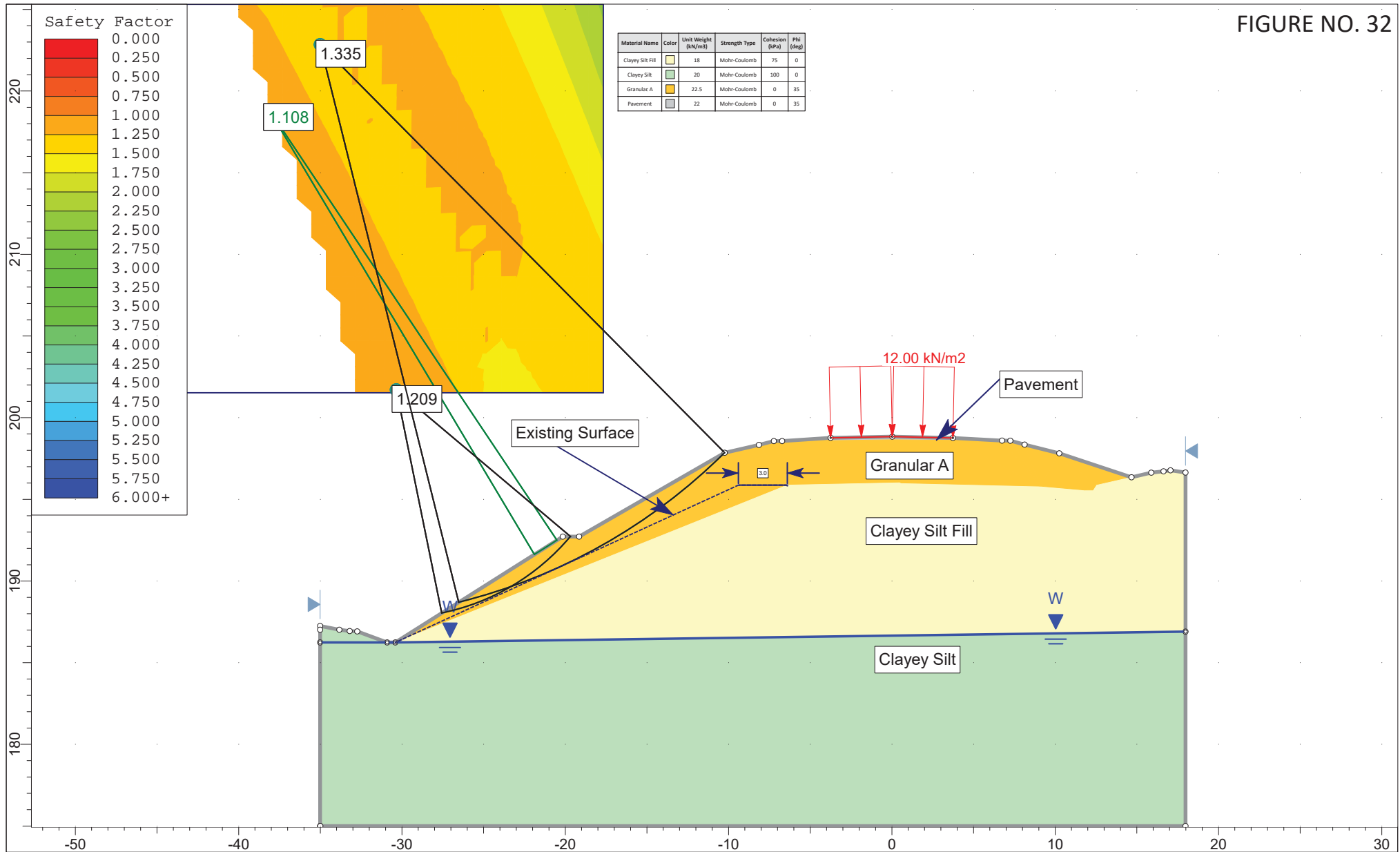


FIGURE NO. 33

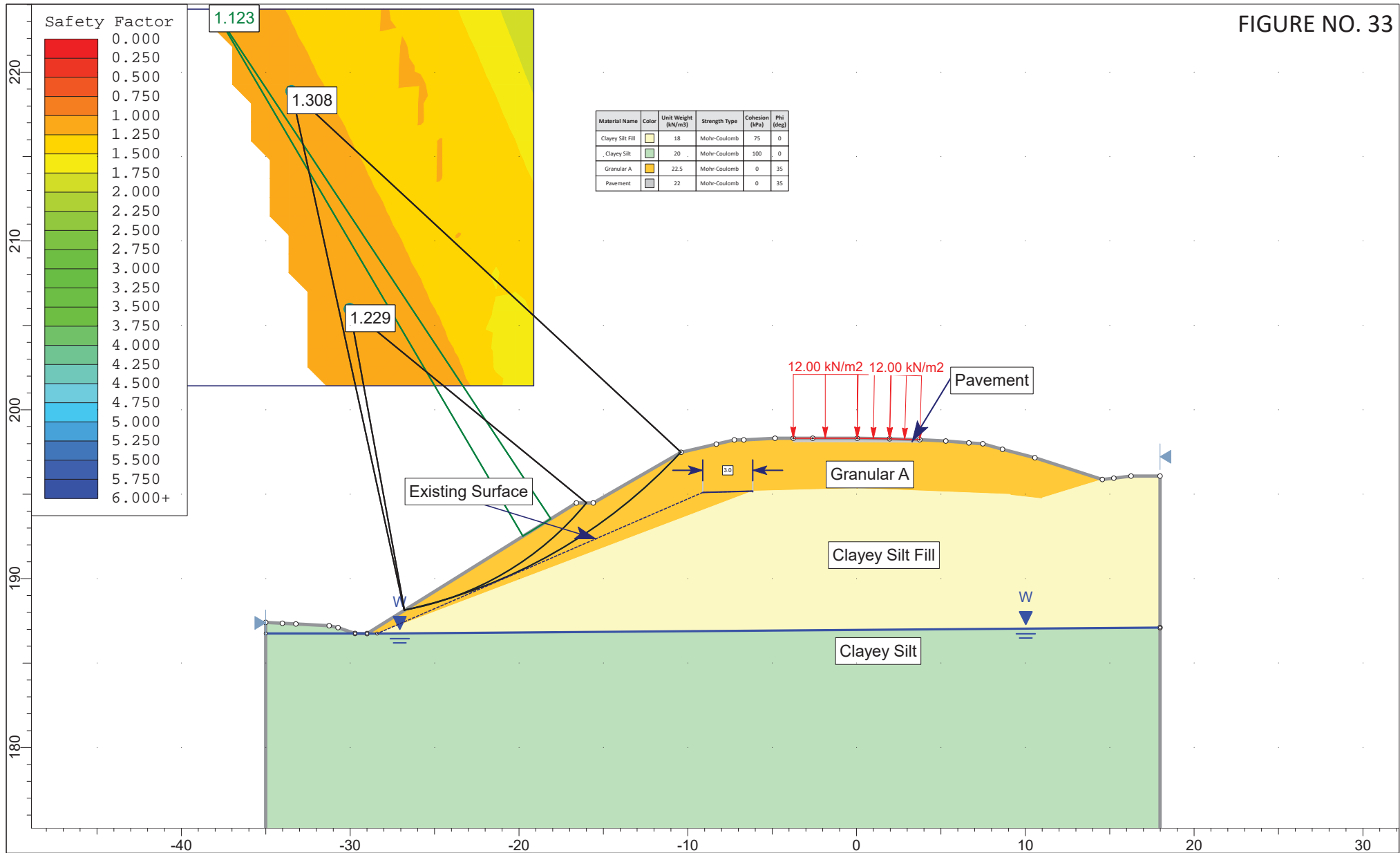


FIGURE NO. 34

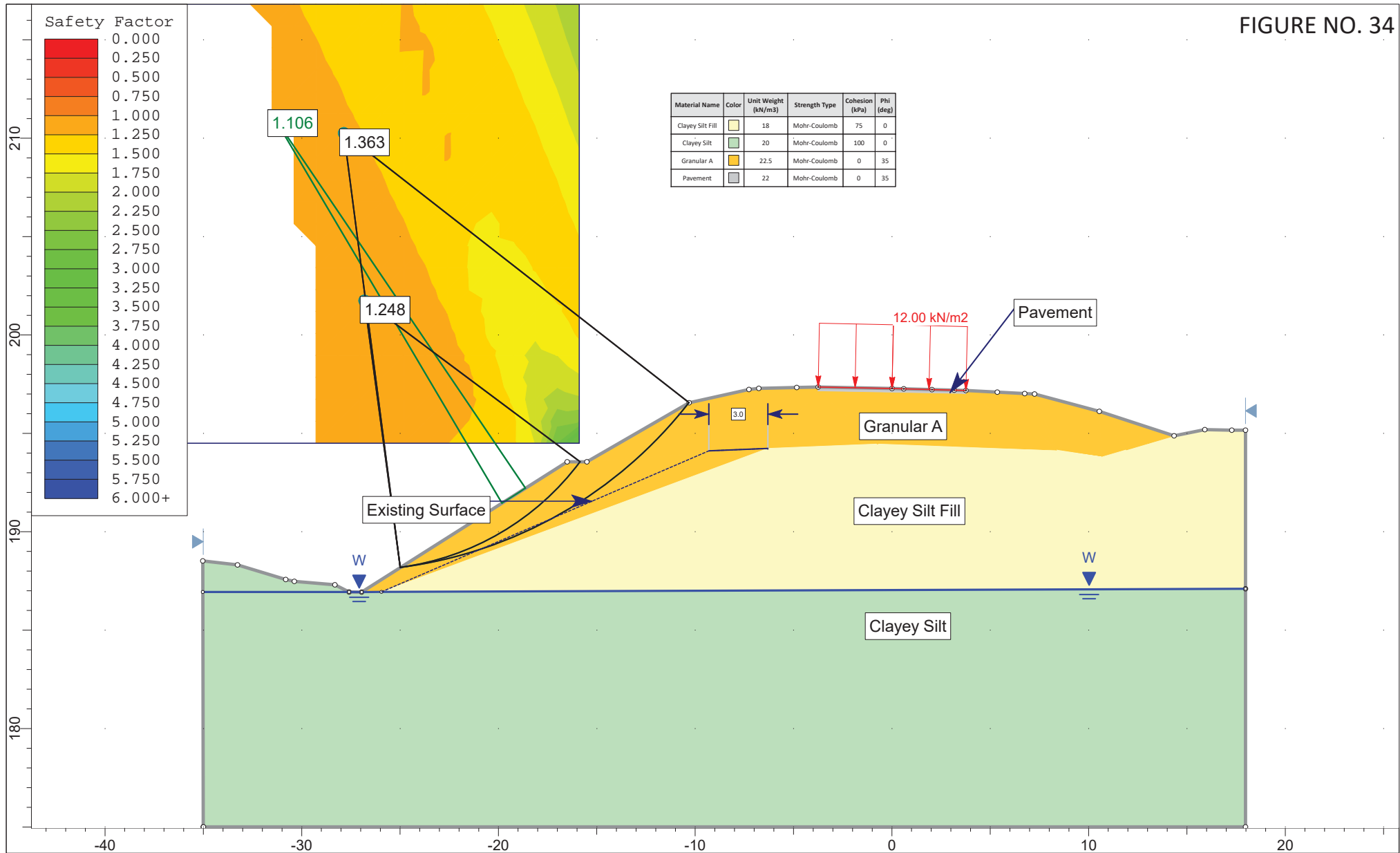


FIGURE NO. 35

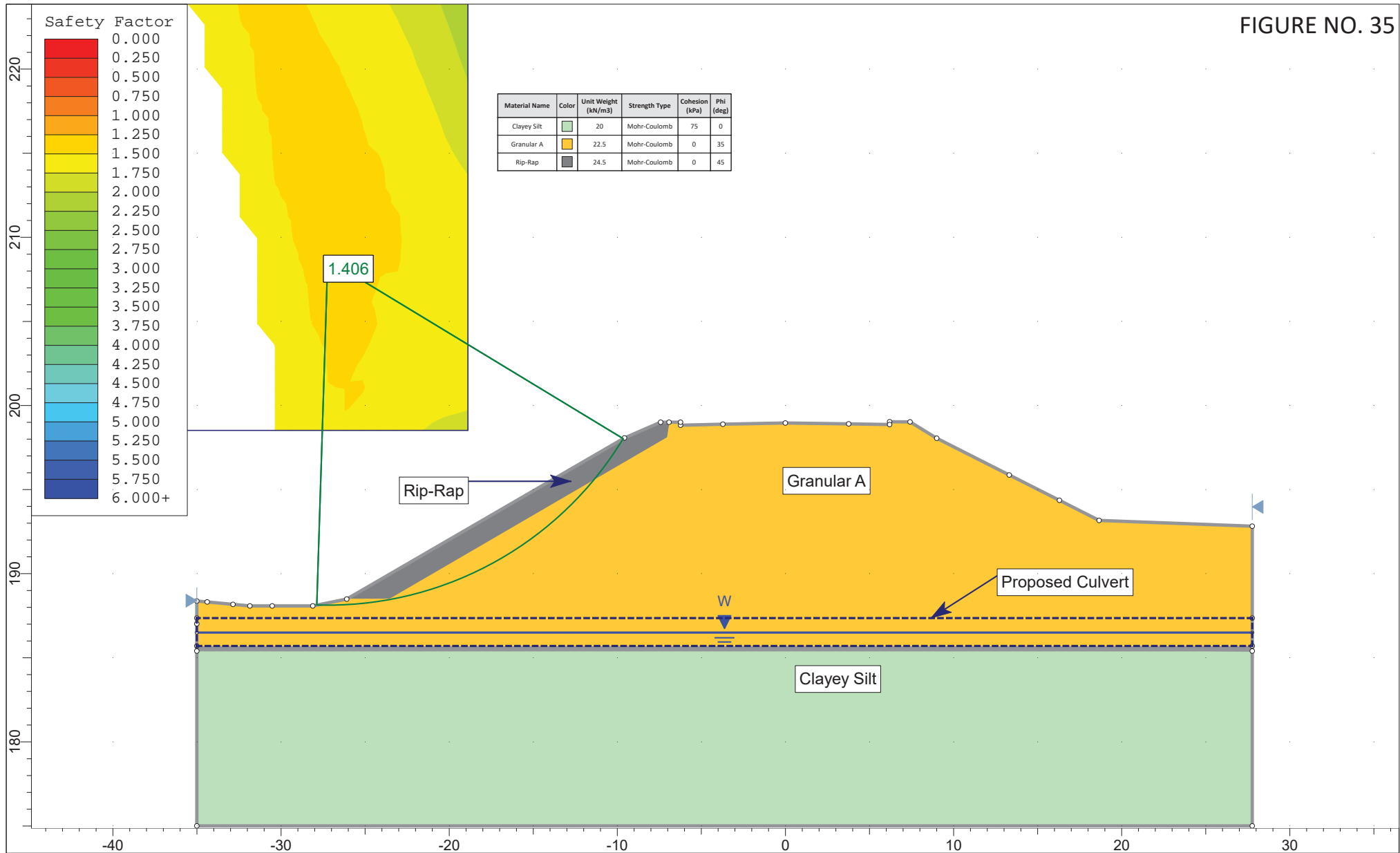


FIGURE NO. 36

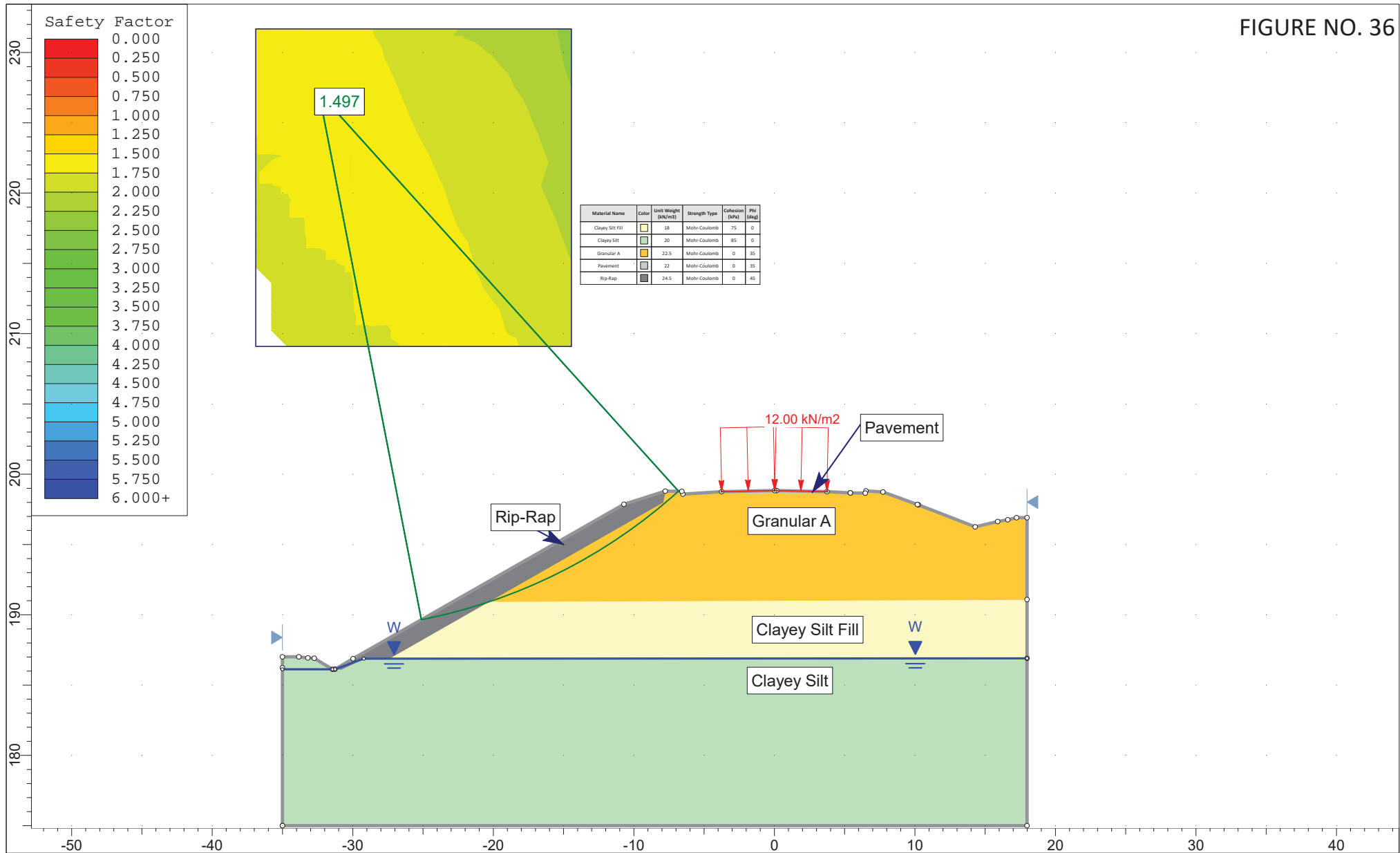


FIGURE NO. 37

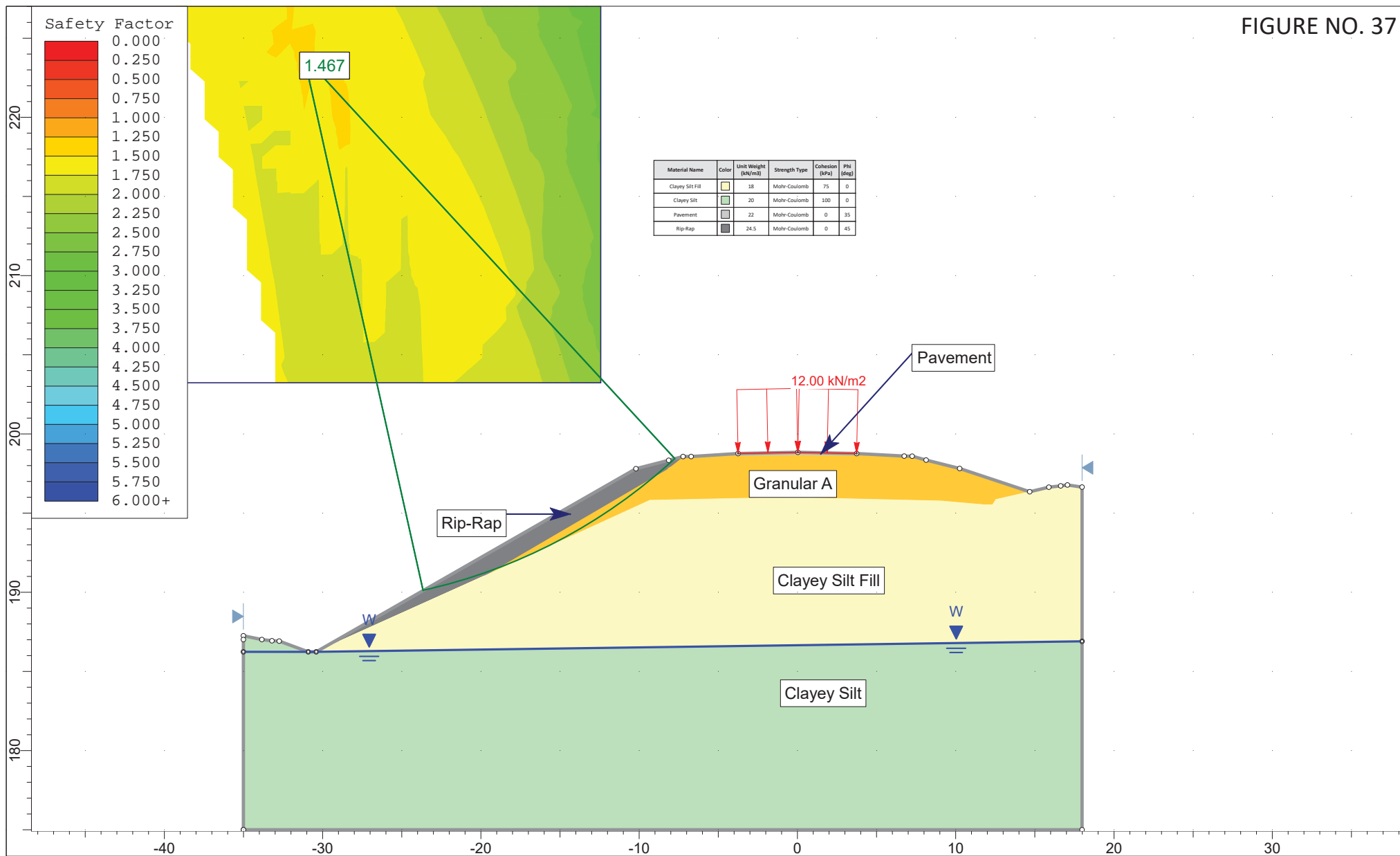


FIGURE NO. 38

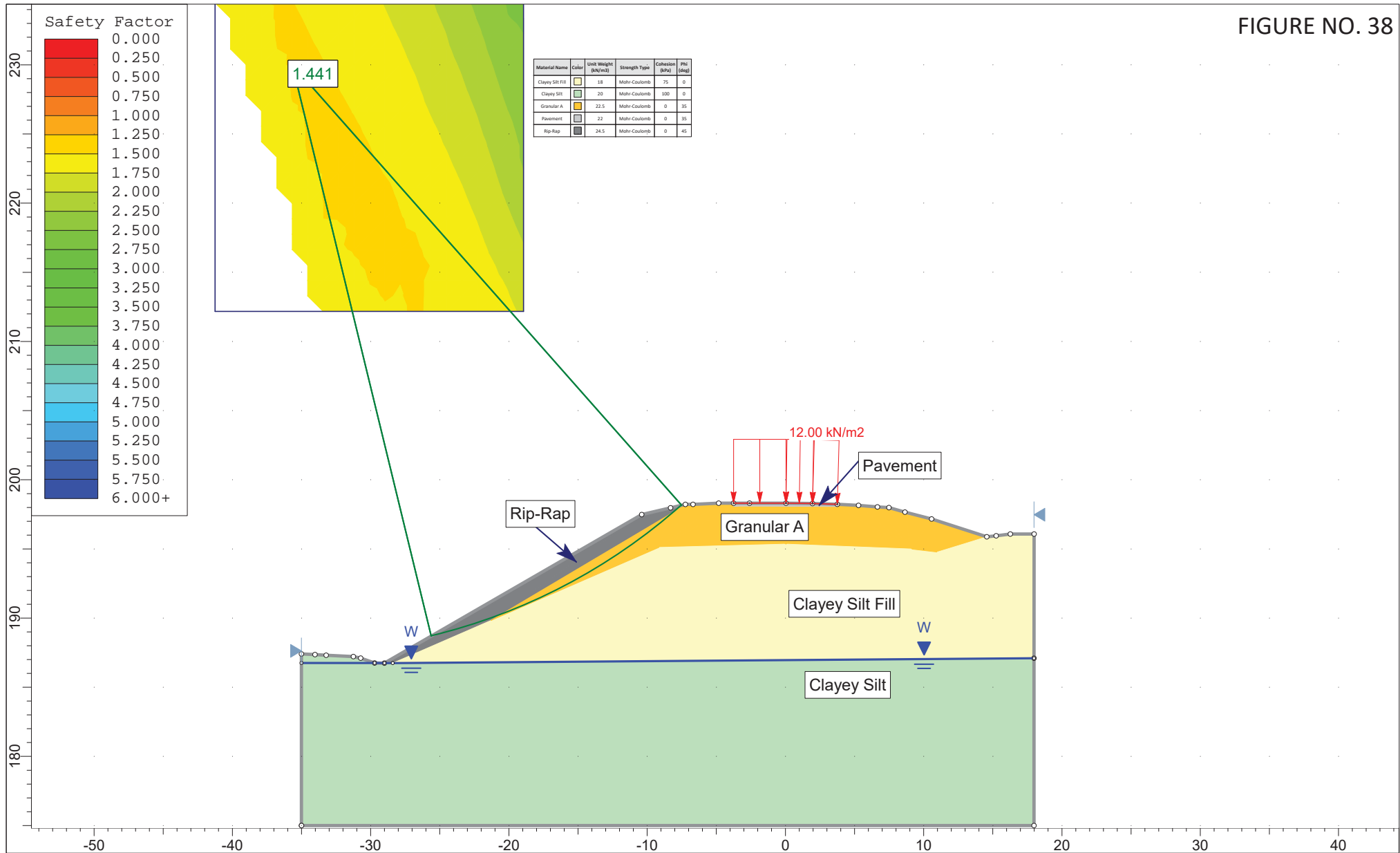


FIGURE NO. 39

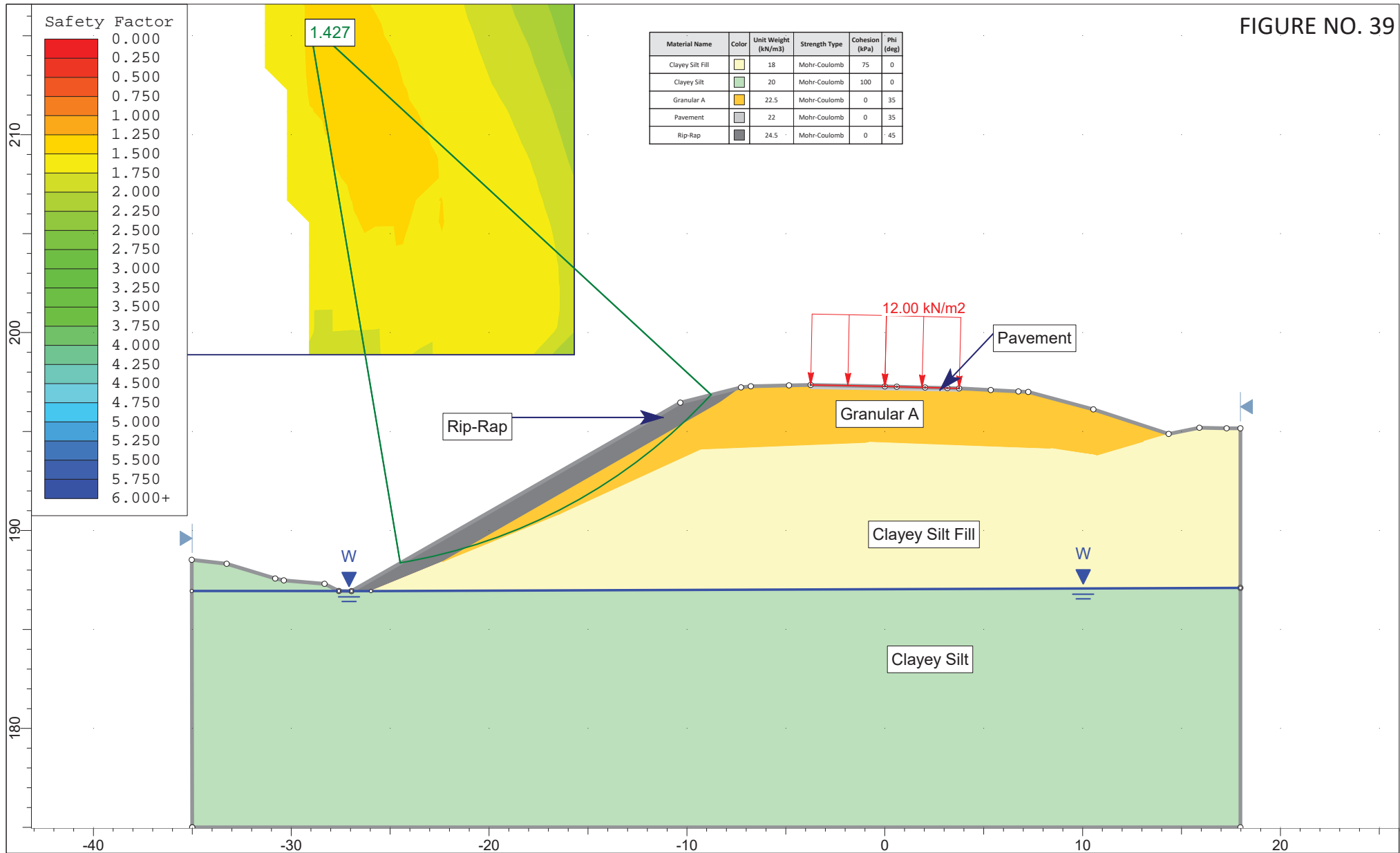


FIGURE NO. 40

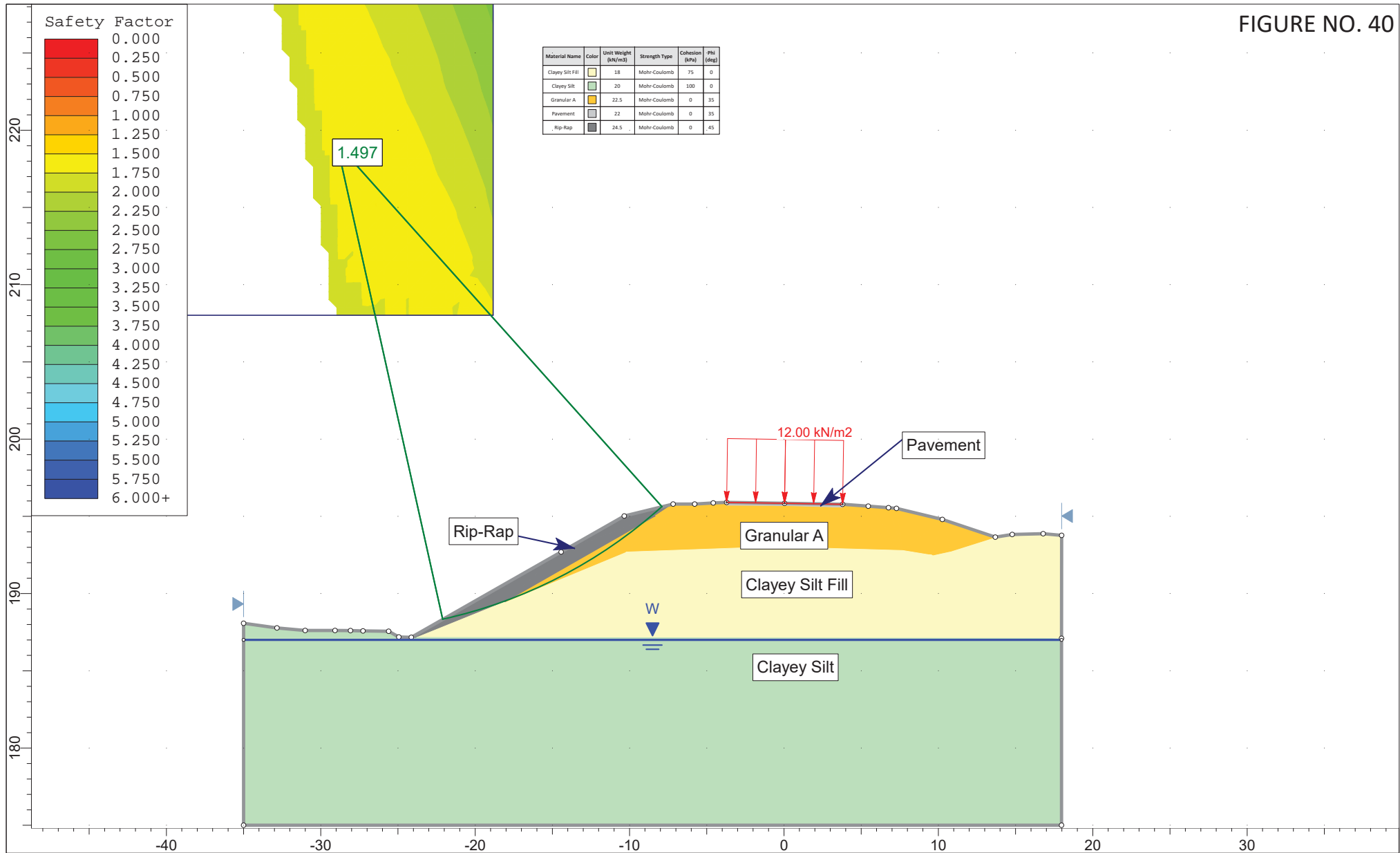


FIGURE NO. 41

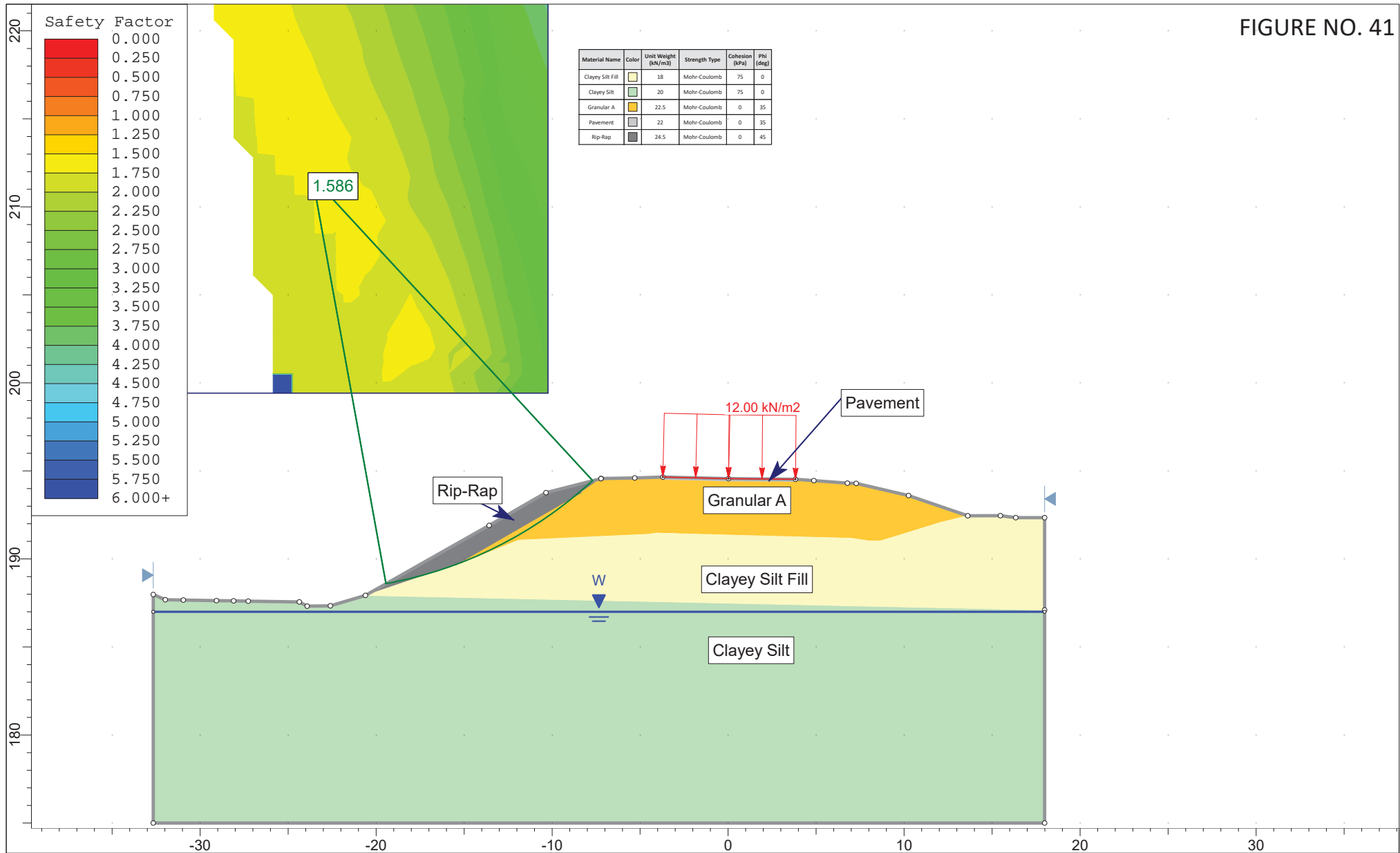


FIGURE NO. 42

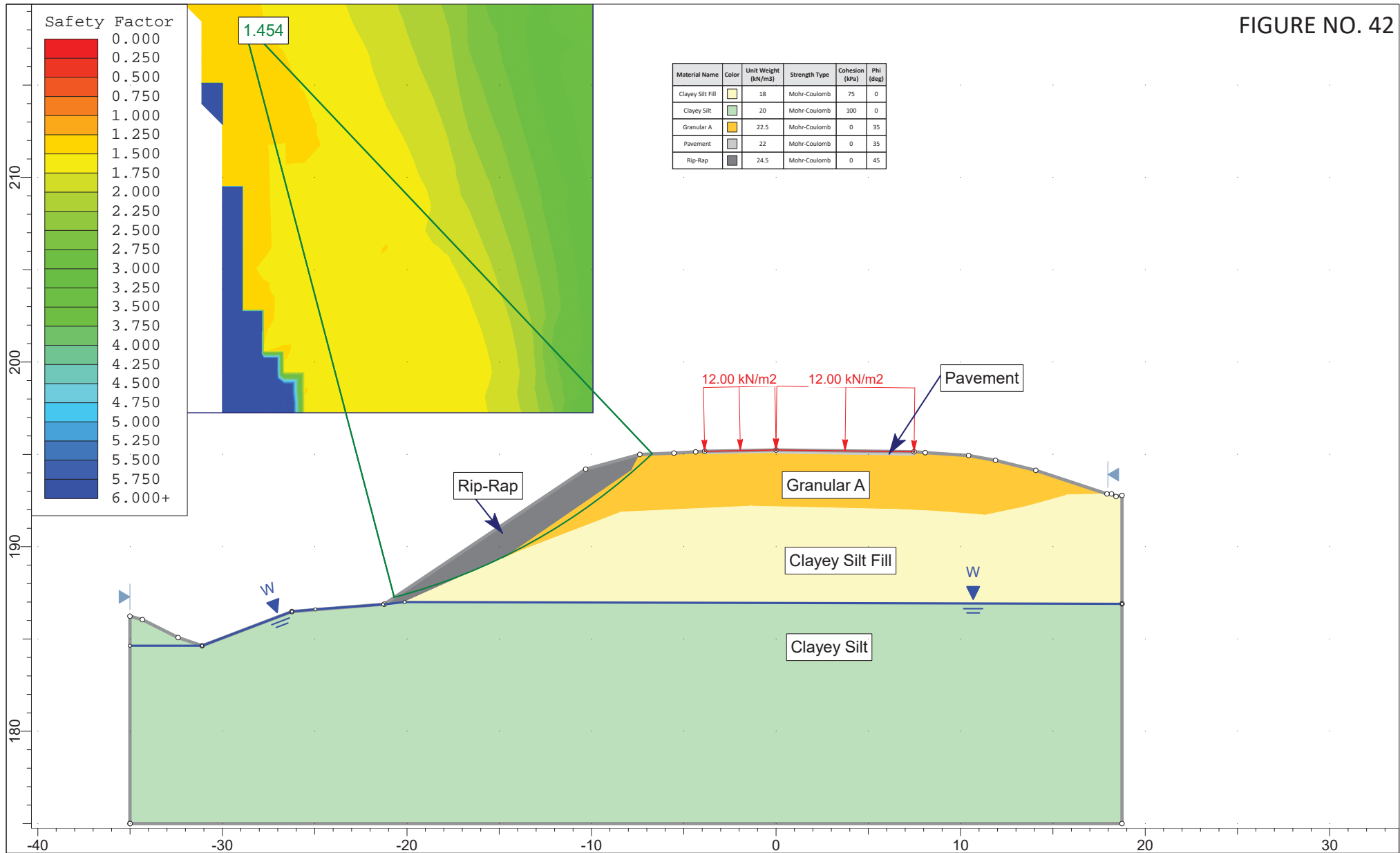


FIGURE NO. 43

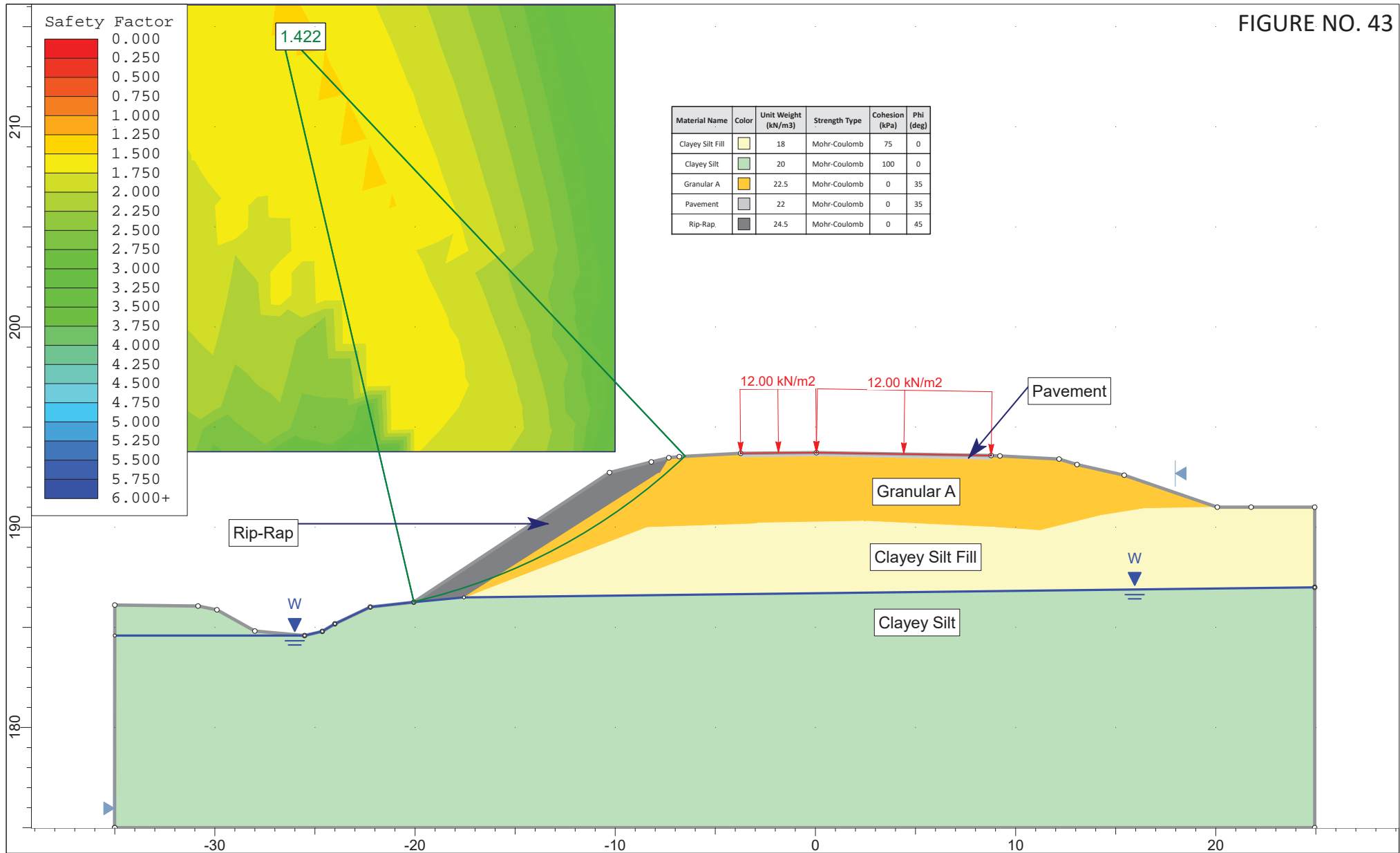


FIGURE NO. 44

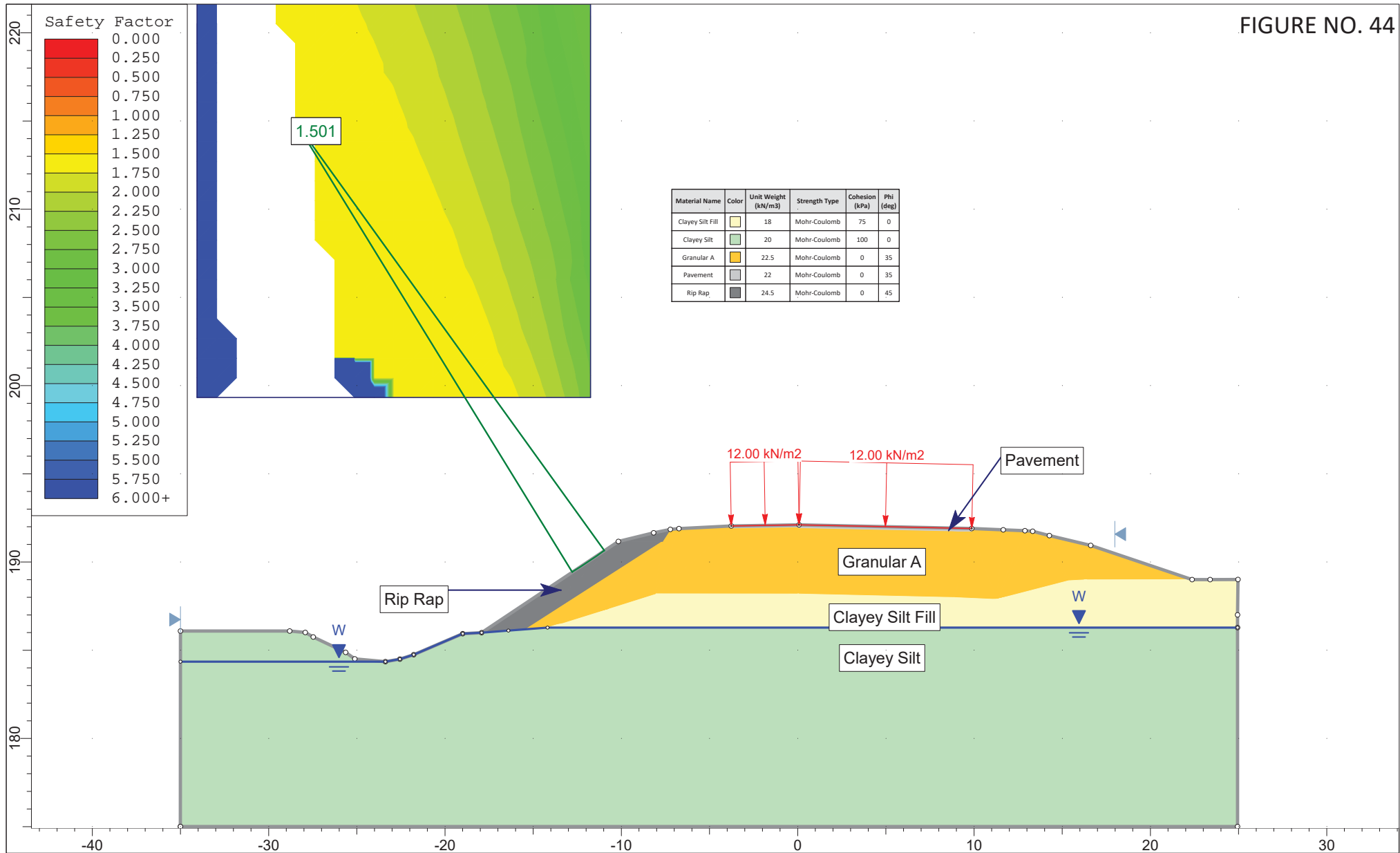


FIGURE NO. 45

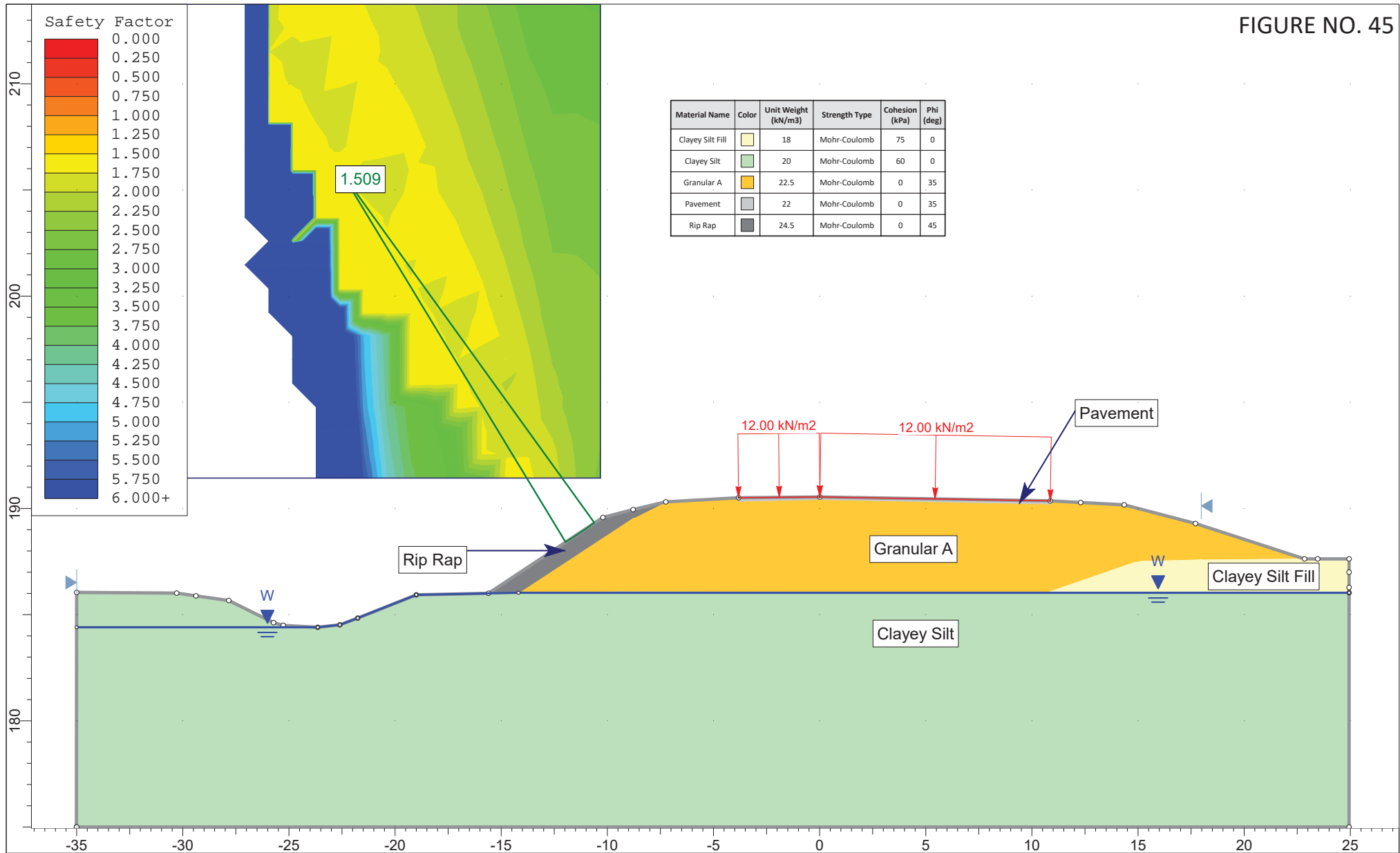
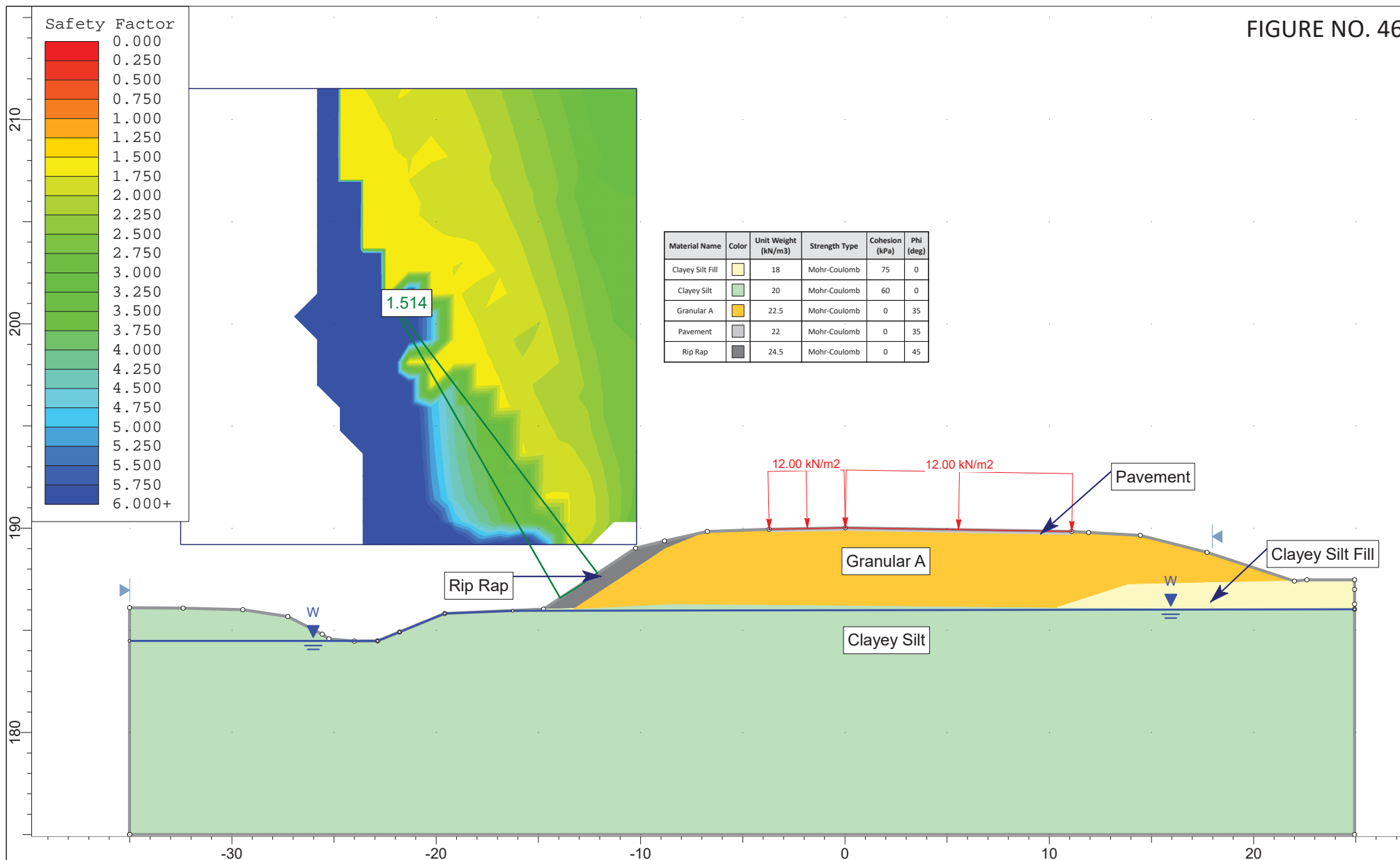


FIGURE NO. 46



Project			New Highway 40 and CNR Overhead		
Analysis Description			Station 20+350 - 1.5H:1V		
Drawn By	N. Rahman	Scale	1:258	Company	PML
Date				File Name	20+350 - 1.5H 1V rip rap.slim



APPENDIX E

List of Standard Specifications, NSSP, and Operations Constraint Relevant to Report



LIST OF STANDARD SPECIFICATIONS RELEVANT TO REPORT

DOCUMENT	TITLE
OPSS.PROV 501	Construction Specification for Compacting
OPSS.PROV 539	Construction Specification for Temporary Protection System
OPSS.PROV 803	Construction Specification for Vegetative Cover
OPSS.PROV 1004	Material Specification for Aggregates – Miscellaneous
OPSS.PROV 1010	Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material
OPSS.PROV 1860	Material Specification for Geotextiles
OPSD 202.010	Slope Flattening using Surplus Excavated Material on Earth or Rock Embankment
OPSD 208.010	Benching of Earth Slopes
OPSD 3090.101	Foundation, Frost Penetration depths for Southern Ontario
SSP 105S09	Amendment to OPSS 539
SSP 105S22	Amendment to OPSS 501
SSP 110S06	Amendment to OPSS 1010



NSSP – Excavation (Addition to OPSS.PROV 902)

The Contractor shall be advised that cobbles and boulders may be present within the ground, and abandon ground infrastructure, construction debris, concrete, cinders, and the like materials may be encountered within the fill, and that the Contractor shall use appropriate equipment and methods for the excavations.

Operations Constraint

Stockpiling of excavated soils and/or construction materials including granular material shall not be permitted anywhere on the top or the sides of the north and south approach embankments, or near the crest of any temporary excavations to minimize the potential for embankment/excavation instability.