GPD GROUP
Cleveland, Ohio

Geotechnical Subsurface Investigation
OTIC 71-20-01 Bridge Deck Rehabilitation
Deck Replacement – TR 17 Bridge
over Mainline at MP 32.2
Fulton County, Ohio

June 2021

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June 28, 2021

TTL Project No. 1982501

Mr. Tom Washko, P.E.
GPD GROUP
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Geotechnical Subsurface Investigation
OTIC 71-20-01 Bridge Deck Rehabilitation
Deck Replacement - TR 17 Bridge over Mainline at MP 32.2
Fulton County, Ohio

Dear Mr. Washko:

Following is the report of the geotechnical subsurface investigation performed by TTL Associates, Inc. (TTL) at the site of the referenced project. This investigation was performed in general accordance with TTL Proposal No. 1982501-rev1, dated August 5, 2020, and authorized via a Subconsultant Agreement for Professional Services dated October 26, 2020. TTL previously submitted a report, dated December 15, 2020, which included results for the desktop study and preliminary evaluations for this project (TTL Project No. 1982501).

This final geotechnical subsurface investigation report addresses the bridge at mile post (MP) 32.2 and contains the results of our study, as well as provides our construction recommendations addressing slope stability concerns associated with new fill planned to be utilized to raise grades at the bridge approaches. Foundation support evaluation and pile design were not included in the scope of work for this bridge location because the new expanded wingwalls/parapet will cantilever from the existing structure and no new piles will be added. Reports addressing the bridges at MP 27.3, MP 37.1, and MP 46.4 will be provided separately.

Soil samples collected during this investigation will be stored at our laboratory for 90 days from the date of this report. The samples will be discarded after this time unless you request that they be saved or delivered to you.

Should you have any questions regarding this report or require additional information, please contact our office.

Sincerely,

TTL Associates, Inc.

STATE OF OHIO
CHRISTOPHER P IOTT
E-69734
REGISTERED PROFESSIONAL ENGINEER

Imad El Hajjar, E.I.
Geotechnical Project Manager

Christopher P. Iott, P.E.
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GEOTECHNICAL SUBSURFACE INVESTIGATION
OTIC 71-20-01 BRIDGE DECK REHABILITATION
DECK REPLACEMENT - TR 17 BRIDGE
OVER MAINLINE AT MP 32.2
FULTON COUNTY, OHIO

FOR

GPD GROUP INC
5595 TRANSPORTATION BOULEVARD, SUITE 100
CLEVELAND, OHIO 44125

SUBMITTED

JUNE 28, 2021
TTL PROJECT NO. 1982501

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1.0 INTRODUCTION

This geotechnical subsurface investigation report has been prepared as part of the OTIC 71-20-01 Bridge Deck Rehabilitation project, specifically for the deck replacement of Township Road 17 (TR 17/CR 17) Bridge over mainline mile post 32.2 (MP 32.2) in Fulton County, Ohio. The general project area is shown on the attached Site Location Map (Plate 1.0).

This final report addresses the bridge at mile post (MP) 32.2, contains the results of our study, as well as provides our construction recommendations addressing slope stability concerns associated with new fill planned to be utilized to raise grades at the bridge approaches. Per the request of GPD, foundation support evaluation and pile design were not included in the scope of work for this bridge location because the new expanded wingwalls/parapet will cantilever from the existing structure and no new piles will be added. Reports addressing the bridges at MP 27.3, MP 37.1, and MP 46.4 will be provided separately.

This investigation was performed in general accordance with TTL Proposal No. 1982501-rev1, dated August 5, 2020, and authorized via a Subconsultant Agreement for Professional Services dated October 26, 2020. TTL previously submitted a report, dated December 15, 2020, which included results for the desktop study and preliminary evaluations for this project (TTL Project No. 1982501).

The purpose of this investigation was to evaluate the subsurface conditions relative to the design and construction of replacement pavements, as well as evaluation of embankment conditions associated with new engineered fill that will be used to raise approach grades at the bridge location. To accomplish this, TTL performed two soil test borings, field and laboratory soil testing, and a geotechnical engineering evaluation of the test results.

This report includes:

- A description of the pavement, subsurface soil, and groundwater conditions encountered in the borings;
- Design recommendations for pavements;
- Recommendations for benching to facilitate sidehill sliver fill placement; and
- Recommendations concerning soil and groundwater related construction procedures such as site preparation, earthwork, benching, pavement construction, and related field testing.

The scope of this study did not include an environmental assessment of the subsurface materials at this site.

2.0 PROJECT DESCIPTION

We understand that it is proposed to raise the profile at the TR-17 overpass bridge on the James W. Shocknessy Ohio Turnpike (Interstate Route 90 [IR-90]) in Fulton County Ohio. This bridge currently has roughly 14.5 feet of vertical clearance with grades along the bridge on the order of Elev. 791 feet. Based on information provided by GPD, and as shown in Figure 1 below, we understand that it is proposed to raise the bridge roughly 1½ to 2 feet such that the final grades along the bridge are on the order of Elev. 792.5 feet. To accommodate the vertical change in grade, sidehill sliver fill placement on the existing embankment will be required. Benching of the existing embankment will be required to facilitate the new sidehill fill. The proposed embankment will measure approximately 28 feet in maximum height, having a roughly 2H:1V slope.

We understand that the new bridge deck will be supported on the same wing wall and that a structural analysis has been performed to confirm that the existing wing wall and associated foundation subsystem are capable of supporting the new raised and/or widened structure.

As stated in our desktop study prepared for this project, dated December 15, 2021, the following should be noted:

- The pavements appeared in generally good condition.
- Evidence of slope instability were not visible.
- Signs of erosion were visible.
- An apparent water swale was observed at the toe of some of the existing slopes, the swale was observed to be dry.

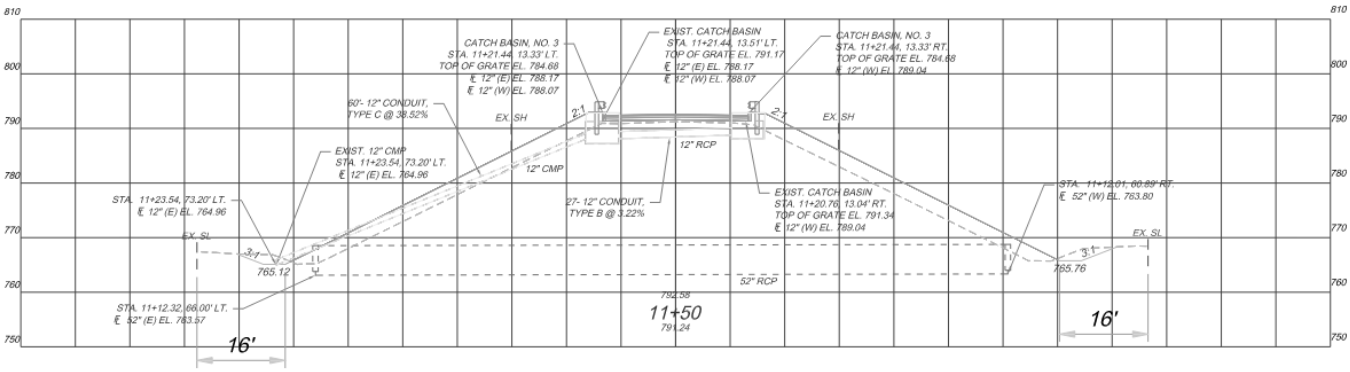


Figure 1: Proposed Raised Approach Embankment Cross-Section

3.0 INVESTIGATIVE PROCEDURE

3.1 Field Sampling and Testing

Two test borings, designated as Borings B-1 and B-2, were drilled by TTL on March 22, 2021. The test borings were performed at the top of the embankment through the Township Road 17 roadway pavement in the southbound lane north of the bridge and the northbound lane south of the bridge. The boring locations were established in the field by TTL based on the provided information from GPD GROUP, by pacing and taping methods. Ground surface elevations at the boring locations were approximated from Google Earth. The approximate locations of the test borings are shown on the attached Test Boring Location Plan (Plate 2.0).

The test borings were performed in general accordance with geotechnical investigative procedures outlined in ASTM Standard D 6151. The test borings performed during this investigation were drilled with a truck-mounted rotary drilling rig utilizing 3¼-inch inside diameter hollow-stem augers. Borings were terminated at the target depth of 80 feet below existing grade (approximate Elev. 711 feet).

During auger advancement, soil samples were collected at 2½-foot intervals to a depth of 10 feet and at 5-foot intervals thereafter to boring termination. Split-spoon (SS) samples were obtained by the Standard Penetration Test (SPT) Method (ASTM D 1586), which consists of driving a 2-inch outside diameter split-spoon sampler into the soil with a 140-pound weight falling freely through a distance of 30 inches. The sum of the number of blows required to advance the sampler the second and third 6-inch increments is termed the Standard Penetration Resistance, or N_m-value, and is typically reported in blows per foot (bpf). The N_m-values were corrected to an equivalent rod energy ratio of 60 percent, N_{60}. The hammer/rod energy ratio for the CME 75 Truck 844 used for this investigation was 66 percent, and was last calibrated on March 15, 2021. The N_{60}-values are presented on the attached Logs of Test Borings and Summary of Soil Test Data sheet. The split-spoon samples were sealed in jars and transported to our laboratory for further classification and testing.

Soil conditions encountered in the test borings are presented in the Logs of Test Borings, along with information related to sample data, SPT results, water conditions observed in the borings, and laboratory test data. It should be noted that these logs have been prepared on the basis of laboratory classification and testing as well as field logs of the encountered soils.

Experience indicates that the actual subsoil conditions at a site could vary from those generalized on the basis of test borings made at specific locations. Therefore, it is essential that

a geotechnical engineer be retained to provide soil engineering services during the site preparation, excavation, and construction phases of the proposed project. This is to observe compliance with the design concepts, specifications, and recommendations, and to allow design changes in the event subsurface conditions differ from those anticipated prior to the start of construction.

3.2 Laboratory Testing

All of the recovered samples of the subsoils were visually or manually classified in accordance with the Ohio Department of Transportation (ODOT) system of soil classification . All samples were also tested in our laboratory for moisture content (ASTM D 2216). Dry density determinations and unconfined compressive strength tests by the constant rate of strain method (ASTM D 2166) were performed for selected intact cohesive samples. Unconfined compressive strength estimates were performed for the remaining intact cohesive samples using a calibrated hand penetrometer. Atterberg limits tests (ASTM D 4318) and particle size analyses (ASTM D 422) were performed on four selected samples from each boring. The results of these tests are presented on the Logs of Test Borings, Summary of Soil Test Data sheet, Atterberg Limits Results sheet, and Grain Size Distribution sheets attached to this report.

4.0 GENERAL SITE AND SUBSURFACE CONDITIONS

4.1 General Surface Conditions

The surface materials encountered in Borings B-1 and B-2 consisted of asphalt approximately 6 inches and 9 inches in thickness, respectively. Aggregate base was encountered underlying the asphalt in each boring on the order of 3 inches and 2 inches in thickness, respectively.

4.2 Site Geology

As stated in the desktop study, published geologic maps from the ODNR indicate that the project site is located within the glaciated portion of Ohio. Quaternary soil deposits consist of Lacustrine Sands (LS), deposited in glacial lakes as shallow-water deltas or nearshore bars and sheets; includes many small areas of dunes.

Based upon the available ODNR references, the surface soils above the bedrock are part of the Oak Openings Beach Ridge Aquifer which more than 100 feet thick and yields 25 to 100 gallons of groundwater per minute.

Bedrock at the site consist of Lower Mississippian and Upper Devonian aged Shale of the undivided Sunbury and Bedford Shale formations. Top of rock elevation was reported between Elevs. 580 and 600 feet, which is anticipated around 190 to 210 feet below existing grades (along the bridge/top of embankment).

4.3 General Soil Conditions

Based on the results of our field and laboratory tests, the subsoils encountered underlying the pavement materials can generally be characterized by several strata, including a stratum of granular fill embankment materials underlain by three strata of predominantly native cohesive soils of varying strengths and moisture contents.

Stratum I consisted of granular embankment fill material and was encountered underlying the pavement materials to depths of 22 feet below existing grades and 24 feet in Borings B-1 and B-2, respectively (approximate Elevs. 769 and 767, respectively). The granular fill consisted of fine sand (A-3) as well as coarse and fine sand (A-3a). SPT N_{60}-values varied from 19 to 47 blows per foot (bpf), indicative of medium dense to dense compactness. Moisture contents ranged from 7 to 18 percent.

Stratum II consisted of predominantly stiff to very stiff native cohesive soils encountered underlying Stratum I (Granular Embankment Fill) to depths of 42 feet and 43½ feet in Borings B-1 and B-2, respectively (Elevs. 749± and 748±, respectively). The Stratum II soil consisted of sandy silt (A-4a), silt (A-4b), silt and clay (A-6a), as well as silty clay (A-6b). SPT N_{60}-values ranged from 11 to 25 bpf. Unconfined compressive strengths ranged from 2,490 pounds per square foot (psf) to greater than 9,000 psf (highest obtainable reading using a calibrated hand penetrometer). One unconfined compressive strength determined by the constant rate of strain methods was 10,780 psf. The upper extent of these strengths may have been affected by stresses induced by the embankment construction. Moisture contents ranged from 15 to 24 percent.

A zone of native granular soils was encountered within Stratum II underlying the Stratum I embankment fill materials in Boring B-2 to a depth of 28 feet (Elev. 763±). The granular zone consisted of fine sand (A-3). An SPT N_{60}-value of 63 bpf and a moisture content of 7 percent were determined for the sample recovered from this zone. The SPT N_{60}-value is indicative of very dense compactness.

Stratum III consisted of predominantly **soft** to medium stiff cohesive soils encountered in Boring B-1 underlying Stratum II to a depth of 72 feet (Elev. 719±). The Stratum III soils consisted of silt and clay (A-6a) as well as silty clay (A-6b). SPT N_{60}-values were on the order of 3 to 4 bpf. Unconfined compressive strengths determined by the constant rate of strain method were approximately 1,140 psf and 1,320 psf. Unconfined compressive strengths determined by a calibrated hand penetrometer ranged from 2,000 to 3,000 psf. Moisture contents generally ranged from 22 to 29 percent. However, one recovered sample was determined to have a moisture content of 42 percent (SS-15).

Stratum IV consisted of predominantly medium stiff to stiff cohesive soils encountered underlying Stratum III in Boring B-1 and Stratum II in Boring B-2 to termination at a depth of 80 feet (Elev. 711±). The Stratum III soils consisted of silt and clay (A-6a) as well as silty clay (A-6b). SPT N_{60}-values ranged from 6 to 10 bpf. Unconfined compressive strengths generally ranged from 1,670 to 4,000 psf. Moisture contents were on the order of 20 to 23 percent.

Additional descriptions of the soil stratigraphy encountered in the borings are presented on the Logs of Test Borings attached to the report.

4.4 Groundwater Conditions

Groundwater was neither observed during drilling nor upon completion of drilling operations in any of the borings. It should be noted that each of the borings was drilled and backfilled within the same day. As such, stabilized water levels may not have occurred over this limited time period. Instrumentation was not installed to observe long-term groundwater levels.

Based on the limited data available, such as the soil characteristics and moisture conditions encountered in the borings, as well as site conditions, it is our opinion that the "normal" groundwater level will generally be encountered at a depth of approximately 33 feet or deeper below roadway embankment approach grades, corresponding to approximate Elev. 758 or deeper. However, groundwater elevations can fluctuate with seasonal and climatic influences. In particular, "perched" water may be encountered in fill materials underlain by relatively impermeable cohesive soils. Therefore, the groundwater conditions may vary at different times of the year from those encountered during this investigation.

5.0 DESIGN RECOMMENDATIONS

The following conclusions and recommendations are based on our understanding of the proposed construction and the data obtained during our field investigation. If the project information or location as outlined is incorrect or should change significantly, a review of these recommendations should be made by TTL. These recommendations are subject to satisfactory completion of the recommended site and subgrade preparation and fill placement operations described in Section 6.0, "Construction Recommendations."

5.1 New Embankment Fill

Fill will be placed on the existing embankment in order to accommodate the vertical increase in grades planed for the bridge replacement at the overpass of I-90. In order to achieve this, the new embankment fill will be placed at the top and along the sides of the existing embankment, to achieve roughly 28 feet in maximum height and maintaining a roughly 2H:1V slope for the sides. As stated previously, no signs of slope stability and / or pavement distress were noted during our site reconnaissance. However, to accommodate the vertical change in grade for the higher bridge decks, sidehill sliver fill placement would be required on the existing embankment. Benching will be required as part of the new sidehill fill operation.

It should be noted that an apparent water swale was observed at the toe of some of the existing slopes. Consideration should be given to stormwater drainage improvements as part of the new embankment construction.

We understand that a retaining wall at the top of the existing embankment may be considered to support the new fills which are required to accommodate the change in grades along the bridge. This option is not recommended because the embankment and new fill would need to be evaluated for global stability with respect to slopes supporting a structure. Since no structures are currently supported by the embankment (the bridge is supported on deep foundations), the minimum required Factor of Safety is 1.3 (FS =1.3) for slope stability. If a structure were supported by the embankment, a minimum Factor of Safety of 1.5 (FS = 1.5) would be required. Based on the 2H:1V side slopes, and the associated additional wall surcharge loads, it may be difficult to achieve a factor of safety for global stability of 1.5.

As discussed later in Section 5.1.2, a suitable long-term factor of safety of 1.3 was not achievable for the 2H:1V embankment slope based on ODOT prescribed design parameters

for new granular engineered fill. Therefore, new engineered fill should consist of ODOT A-7-6 or better cohesive soils.

5.1.1 Special Benching and Sidehill Embankment Fills

Where fill will be placed along slopes of 4H:1V or flatter, this new fill should be placed in horizontal lifts in accordance with ODOT Construction and Materials Specifications (CMS) Item 203.05, which describes "standard specification" benching. This would only apply to portions of the project at the crest of the embankment, along the TR 17 alignment, as well as beyond the toes of the existing embankment slopes, perpendicular to the TR 17 road alignment.

For the existing side slopes (which are on the order of 2H:1V), fill placement would fall under the specifications of ODOT Geotechnical Bulletin GB-2, "Special Benching and Sidehill Embankment Fills," dated January 17, 2020. Specifically, in accordance with Figure 1 in Section BC (General Case: Special Benched Embankment Construction), the following would apply:

- Minimum 8 feet wide benches;
- Bench drains are not be required.

The contractor should plan to excavate the lower bench having the above noted dimensions at the toe of the proposed slope and extending 1 foot below the proposed swale. The first bench is keyed into the exiting Stratum II, stiff to very stiff soils to achieve the minimum required Factors of Safety against sliding and in order to maintain the minimum 8-foot clearance at the top of each bench. A conceptual figure, showing the proposed dimension and relative location of the prescribed benches, is provided in Appendix E.

The soils in the project area where the excavation for benches will be performed consist of predominantly existing granular embankment fill material. For these soils, a 1.5H:1V backslope should be planned. Based on the conditions encountered in the borings and on the slope stability analysis for the temporary conditions during construction conditions, a 1.5H:1V backslope should be generally achievable for short-term excavations. Based on the different grades on the 4 sides of the bridge abutments, the height of the upper bench should be adjusted such that it intercepts the existing crest of slope.

In general, and as shown on the stability analysis outputs presented in Appendix E, four (4) benches are prescribed for the existing slope. The backslope associated with this bench will

intercept existing crest of slope approximately 18 feet inside the edge of pavement. As such, if it is planned to keep one lane open during construction, special measures for maintenance of traffic (MOT) may be required. The upper bench is expected to intercept the backslope of the benches associated withe the fill operations on the opposite face of the embankment. If the proposed earthwork operations are expected to occur concurrently on both sides of the embankment, all traffic across the bridge will be temporarily halted.

5.1.2 Global Stability

We performed global slope stability analyses using the 2-D Limit Equilibrium Slope Stability Program Slide 6.0 by Rocscience to evaluate the proposed higher 2H:1V embankment slope throughout the site, and to ensure permanent embankment slope designs having factors of safety greater than 1.3 for static conditions. The slope stability analysis of the existing slope was performed for the most critical section within slope construction area of the site. Schematic cross sections of the existing slopes were provided by GPD.

We performed this analysis simulating a 28 feet high embankment having 2H:1V slope. We also analyzed a short term scenario for the temporary condition during construction with the benches completed prior to placement of new engineered fill. Using this program, a myriad of potential failure surfaces can be generated theoretically, from which the factor of safety can be determined as to whether sufficient resisting soil strength can be mobilized to counteract the driving forces (weight of soil, seepage, and surcharge loads) that would cause the slope to move downward. The factor of safety is the ratio of the resisting forces to the driving forces.

Global instability typically is manifested by pronounced movements of a large arc or wedge of soil that result in bulging at the toe of the slope as well as observable displacement of soil at or near the crest of the slope. This crest displacement may be exhibited by a near-vertical tension crack at the back edge of the displaced soil mass, or may be significant enough to exhibit a downward movement of soil that creates a “scarp” such that a sharp drop occurs in an otherwise level ground surface. Global instability of the embankment at this site could create a significant impact due to the potential for such movement to encompass a portion of the roadway.

We analyzed one typical embankment section located along the center of the proposed new embankment. The short term conditions where simulated using total stress soil parameters (TSSP) and the long term conditions using effective stress soil parameters (ESSP). Based on

the site topography and our field observations, the groundwater table was modeled along the ground surface of the adjacent agricultural fields, as a conservative condition.

Shear strength parameters for the new embankment fill were determined using ODOT GB-2 as a general guideline, assuming the embankment fill would consist of ODOT A-7-6 or better cohesive soils. Remaining soil strengths were evaluated based on unconfined compressive strength test results, hand penetrometer readings as well as SPT N-values, moisture content, unit weight (density), and soil plasticity data of the encountered soils. Correlations with published data from ODOT GB-7 "Drilled Shaft Landslide Stabilization Design" Table 1 "Typical Unit Weight Relationships for Various Soils" and Table 2 "Typical Strength Values for Various Soils" were also utilized to estimate soil properties. In general, low to average long-term effective stress internal angle of friction (ϕ'), along with a conservative lower-end residual cohesion (c') was used in our analyses for the native cohesive soils.

It should be noted that the properties of the soil strata vary somewhat with layer and depth. The layers and assigned soil properties used in the analyses are detailed in the attached slope stability outputs that illustrate the proposed benching, potential critical failure surfaces associated with the global stability of the embankment, as well as slope geometry and potential critical failure surfaces associated with the slope. The results of our global stability analyses are summarized in the following table.

Summary of Slope Stability Calculations

Model	Method	Factor of Safety
1	Total Stress Soil Parameters (TSSP) *8 foot-wide Benches*	1.32
2	Effective Stress Soil Parameters (ESSP) *8 foot-wide Benches, **Cohesive** New Engineered Fill*	1.31
3	Effective Stress Soil Parameters (ESSP) *8 foot-wide Benches, **Granular** New Engineered Fill*	1.25
4	Total Stress Soil Parameters (TSSP) *Temporary Conditions during Construction*	1.37

As stated above and shown on the attached slope stability outputs, the prescribed 8 feet-wide benches with 1.5H:1V backslopes, as well as the new higher embankments with 2H:1V final slopes, and A-7-6 or better cohesive engineered fill materials will provide suitable factor of

safety of greater than 1.3 during construction, immediately after construction, and long-term following construction. Since the embankment is not supporting structures (the bridge structure is supported on a deep foundation system), a higher factor of safety of 1.5 is not required to be met. As indicated above, a suitable long-term factor of safety of 1.3 was not achievable for the 2H:1V embankment slope based on ODOT prescribed design parameters for new granular engineered fill. Therefore, new engineered fill should consist of ODOT A-7-6 or better cohesive soils.

5.2 Subgrades

5.2.1 Pavement Subgrade

The subgrade along the pavement area is anticipated to consist of newly placed engineered fill material (ODOT item 203) used to raise the height of the existing embankment. These soils are considered adequate to support the proposed pavement. If loose or soft soils that have been affected by traffic or weather following placement are encountered during the subgrade proofroll, we recommend over-excavating this material and backfilling with ODOT Construction and Materials Specifications (CMS) Item 203 material.

5.2.2 Modified Subgrade

If soils wet of optimum are encountered, lowering the moisture content by scarification and aeration (discing and exposure to sun and wind) may be required. Very moist to wet soils will "pump" under the operation of heavy equipment, resulting in deep rutting and perhaps rendering the operation of grading and paving equipment difficult or impossible. The granular subgrade soils should be generally conducive for drying using scarification and aeration.

If the schedule does not allow for scarification and aeration, other methods of subgrade modification may be required in areas of high moisture content. Modification may be achieved by undercutting and replacement with granular subbase (possibly in combination with a geotextile separation layer or geogrid reinforcement), mixing stone into the subgrade, or treating the subgrade with cement. The method of subgrade modification should be determined at the time of construction (See Section 6.1, "Construction Recommendations - Site and Subgrade Preparation").

5.3 Flexible (Asphalt) Pavement Design

Cohesive soils consisting of ODOT A-7-6 or better materials were prescribed to be placed as part of the benching and embankment widening activities associated with this project, to provide suitable factor of safety for global stability of the newly constructed 2H:1V slopes. As such, cohesive materials are anticipated at new roadway subgrade elevations. Depending on the types of cohesive soils utilized for fill, various design CBR values should be utilized for design. The soil types and associated design CBR values are summarized in the following table.

Recommended Design CBR Values	
ODOT Soil Type	**Design CBR Value (percent)**
A-4a	6
A-6a	5
A-6b	4
A-7-6	3

It should be noted that we are not privy to the design traffic loads or intended design life. The subgrade support recommendations indicated herein should be reviewed by the site engineer in conjunction with the design traffic criteria to determine the required pavement sections.

All paving operations should conform to the Ohio Turnpike Commission and the Ohio Department of Transportation (ODOT) specifications. The pavement and subgrade preparation procedures outlined in this report should result in a reasonably workable and satisfactory pavement. It should be recognized, however, that all flexible pavements need repairs or overlays from time to time as a result of progressive yielding under repeated traffic loads for a prolonged period of time, as well as exposure to freeze-thaw conditions.

5.4 Groundwater Control and Pavement Drainage

As stated previously, groundwater was generally not observed during drilling operations or upon completion of drilling of the test boring. Based on the soil characteristics and groundwater conditions encountered in the borings, it is our opinion that the “normal” long-term groundwater table will be generally encountered will be generally encountered at depths of approximately 33 feet or deeper below approach embankment grades, corresponding to approximate Elev. 758 or deeper. However, groundwater elevations can fluctuate with seasonal and climatic influences. In particular, “perched” water may be encountered in fill materials

underlain by relatively impermeable cohesive soils. Therefore, the groundwater conditions may vary at different times of the year from those encountered during this investigation.

Due to the presence of an apparent swale along the toe of some slopes and in order re-to construct the embankment, cofferdam installation or a pump conveyance system, may be required to dewater the areas of proposed construction. The contractor is responsible to design the dewatering measures.

Construction planning should include potential remedial measures to be implemented where excessive groundwater seepage or unstable subgrades are encountered in the proposed excavations. Dewatering methods may include multiple sumps or a system of well points. The type of dewatering system utilized will depend on construction practices, soil conditions encountered in the bench excavations, seasonal conditions, and the depth of excavation. Additionally, the contractor will need to exercise diligence to control seepage and runoff to maintain a stable subgrade. Installation of utilities early in the site development may also alleviate unstable subgrade conditions.

Based on the poorly-drained nature of the clayey soils associated with the cohesive fill material that will be used at subgrade elevations, it is anticipated that surface water infiltration may collect in the aggregate base course. Without adequate drainage, water will remain in the base for extended periods of time, creating localized wet, soft pockets. The presence of these pockets will increase the likelihood that pavement distress (cracking, potholes, etc.) will develop. Drainage features may include grading the subgrade surface to slope downward to the outside edge of pavements and/or providing longitudinal edge drains connected to storm sewers or other outlets.

6.0 CONSTRUCTION RECOMMENDATIONS

6.1 Site and Subgrade Preparation

Site and subgrade preparation activities should conform to ODOT Construction and Materials Specifications (CMS) Item 204 specifications. Prior to proceeding with construction operations, all pavements, vegetation, topsoil, root systems, debris, and other deleterious non-soil materials should be stripped from the proposed construction area. Suitable topsoil may be stockpiled for later use in landscaped areas. The actual amount of required stripping should be determined in the field by a geotechnical engineer or qualified representative. The pavement thickness presented in the borings are not intended as a basis for project quantity estimates or bid purposes.

It should be noted that the topsoil thickness may vary across the site. Dark soils having the appearance of topsoil, but exhibiting only root "hairs" or trace organics less than approximately three percent, may not require stripping for the full depth of the darkly colored zone, provided the subgrade can be satisfactorily proof rolled as described below. Conversely, the site may contain areas where additional excavation will be required beyond the darkly colored zone due to organics in order to provide a stable subgrade for construction.

In addition, and as stated previously, the contractor should plan to excavate the first bench at the toe of the proposed slope extending inside the swale. The first bench should be excavated at least one foot into the exiting native soils and its subgrade should consist of stiff to very stiff native cohesive soils consistent with the soil encountered in the test borings.

Upon completion of the stripping and clearing, the areas intended to support new fill, and pavements should be carefully inspected by a geotechnical engineer. Pavement subgrades should be proof rolled in general accordance with ODOT CMS 204.06. At the time of inspection, the engineer may require proof rolling of the cohesive subgrades utilizing a 20- to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. The vehicle should make a sufficient number of passes, in two perpendicular directions, covering the proposed development area, to locate any soft, weak, or excessively wet soils that may be present at the time of construction.

The purpose of proof rolling the clayey subgrades is to locate any weak, soft, or excessively wet soils that may be present at the time of construction. Any unsuitable materials observed

during the inspection and proof-rolling operations should be undercut and replaced with compacted fill or stabilized in place utilizing conventional remedial measures such as discing, aeration, and re-compaction. Once the site has been proof rolled, inspected, and stabilized, the proof-rolled or inspected subgrades should not be exposed to wet conditions. It should be recognized that during periods of wet weather, the clayey soils that will be exposed at design subgrades will tend to pond water for short periods of time, with the potential to deteriorate the prepared subgrade. Additionally, we recommend that the fill areas be constantly sloped for positive gravity drainage to avoid ponded water on fills, and that fill areas be sealed at the end of each day by smooth-drum rolling when there is a threat of precipitation.

The results of the proof-rolling and inspection operations will be partially dependent on construction operations, the moisture content of the soil, and the weather conditions prevalent at the time. If pumping or rutting is encountered and difficulty is experienced in the operation of construction equipment, TTL should be notified to determine which method of subgrade modification may be best suited for the conditions encountered. At that time, we may recommend that a small test area be used to determine the necessary depth of undercutting and stone replacement to achieve a stable subgrade condition.

6.2 Fill

Material for engineered fill or backfill required to achieve design grades should meet ODOT Item 203 “Embankment Fill” placement and compaction requirements. New embankment fill shall be placed in accordance with ODOT Item 203 and shall consist of natural soils classified as A-4a, A-6a, A-6b, or A-7-6 with a maximum dry density of 90 pcf or greater as determined by ODOT Supplement 1015. In general, the majority of the existing embankment soils on site would meet the above-noted requirements, provided that the soils are moisture conditioned and/or blended as required to meet ODOT Item 203 compaction requirements. On-site soils may be used as engineered fill materials provided that they are free of organic matter, debris, excessive moisture, and rock or stone fragments larger than 3 inches in diameter, and consist of the above-referenced cohesive soils. Depending on seasonal conditions, the on-site soils may be wet of optimum and may require scarification and aeration to achieve satisfactory compaction.

Fill placement shall be performed as symmetrical as possible across the entire site to prevent lateral stresses from developing on the existing bridge abutments and their foundation components. Compaction of the new fill placement around existing structures shall be

accomplished through the use of portable compaction equipment (hand operated tampers or other equipment approved by the engineer).

The on-site soils consist of granular existing embankment fill and native cohesive soils. For the cohesive soils, a sheepsfoot roller should provide the most effective soil compaction. For re-compaction of existing granular embankment soils, a vibratory smooth-drum roller would be required to provide effective compaction.

Scarified subgrade soils and all fill material should be within 3 percent of the optimum moisture content to facilitate compaction. Furthermore, fill material should not be frozen or placed on a frozen base. It is recommended that all earthwork and site preparation activities be conducted under adequate specifications and properly monitored in the field by a qualified geotechnical testing firm.

7.0 QUALIFICATIONS OF RECOMMENDATIONS

Our evaluation of construction conditions for embankment fill placement and pavement construction has been based on our understanding of the site and project information and the data obtained during our field investigation. The general subsurface conditions were based on interpretation of the subsurface data at specific boring locations. Regardless of the thoroughness of a subsurface investigation, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. Therefore, experienced geotechnical engineers should observe earthwork and foundation construction to confirm that the conditions anticipated in design are noted. Otherwise, TTL assumes no responsibility for construction compliance with the design concepts, specifications, or recommendations.

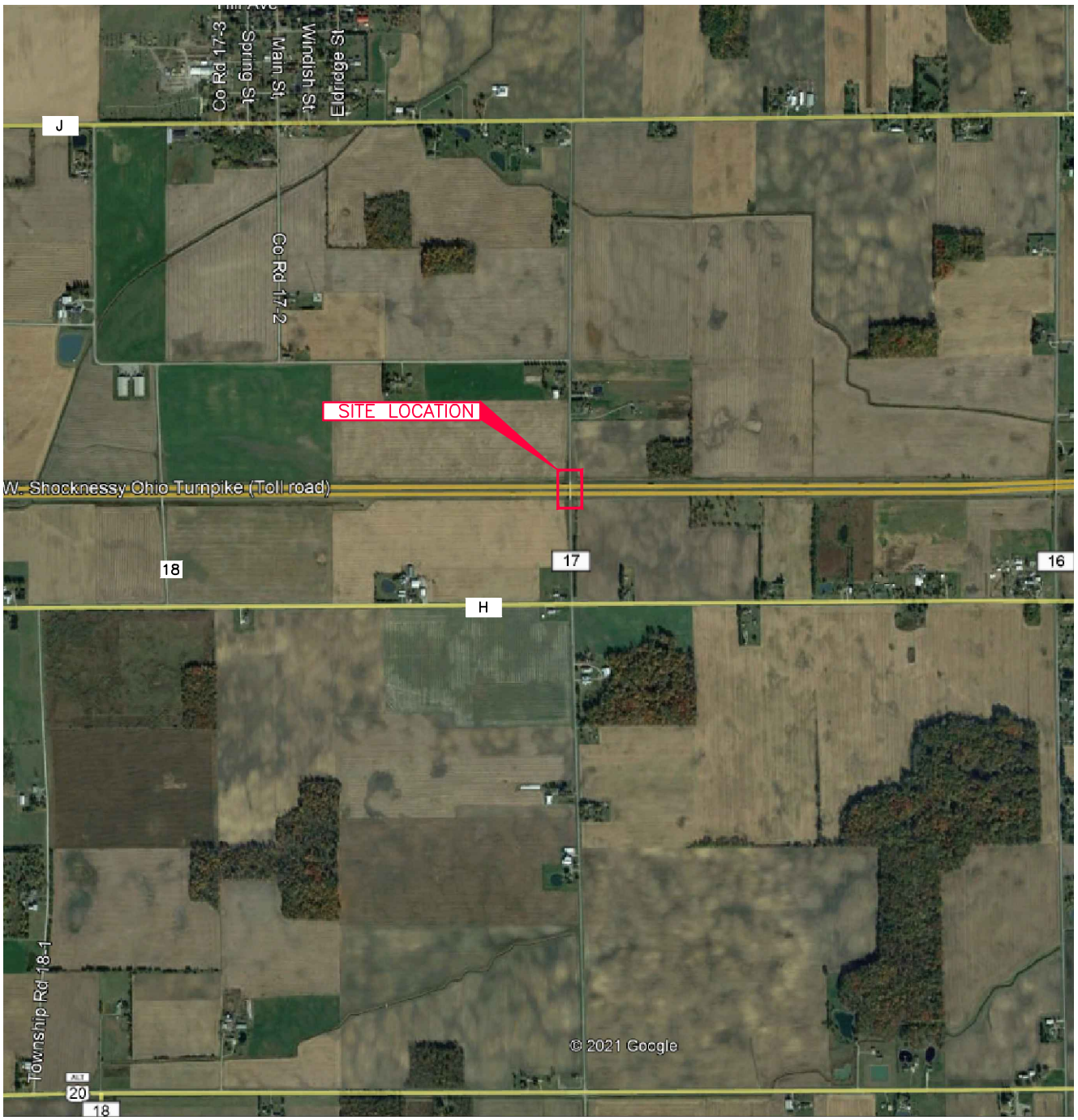
The evaluations and recommendations presented in this report have been formulated on the basis of reported or assumed data relating to the location and finished grades for the proposed structure. Any significant change in this data in the final design plans should be brought to our attention for review and evaluation with respect to the prevailing subsoil conditions.

The nature and extent of variations between the borings may not become evident until the course of construction. If such variations are encountered, it will be necessary to reevaluate the recommendations of this report after on-site observations of the conditions.

Our professional services have been performed and our findings have been derived in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied. TTL is not responsible for the conclusions, opinions, or recommendations of others based on this data.

Plates

Plate 1.0	**Site Location Map**
Plate 2.0	**Test Boring Location Plan**



LEGEND

APPROXIMATE SITE LOCATION

N

APPROXIMATE SCALE – FEET

0 1,700 3,400

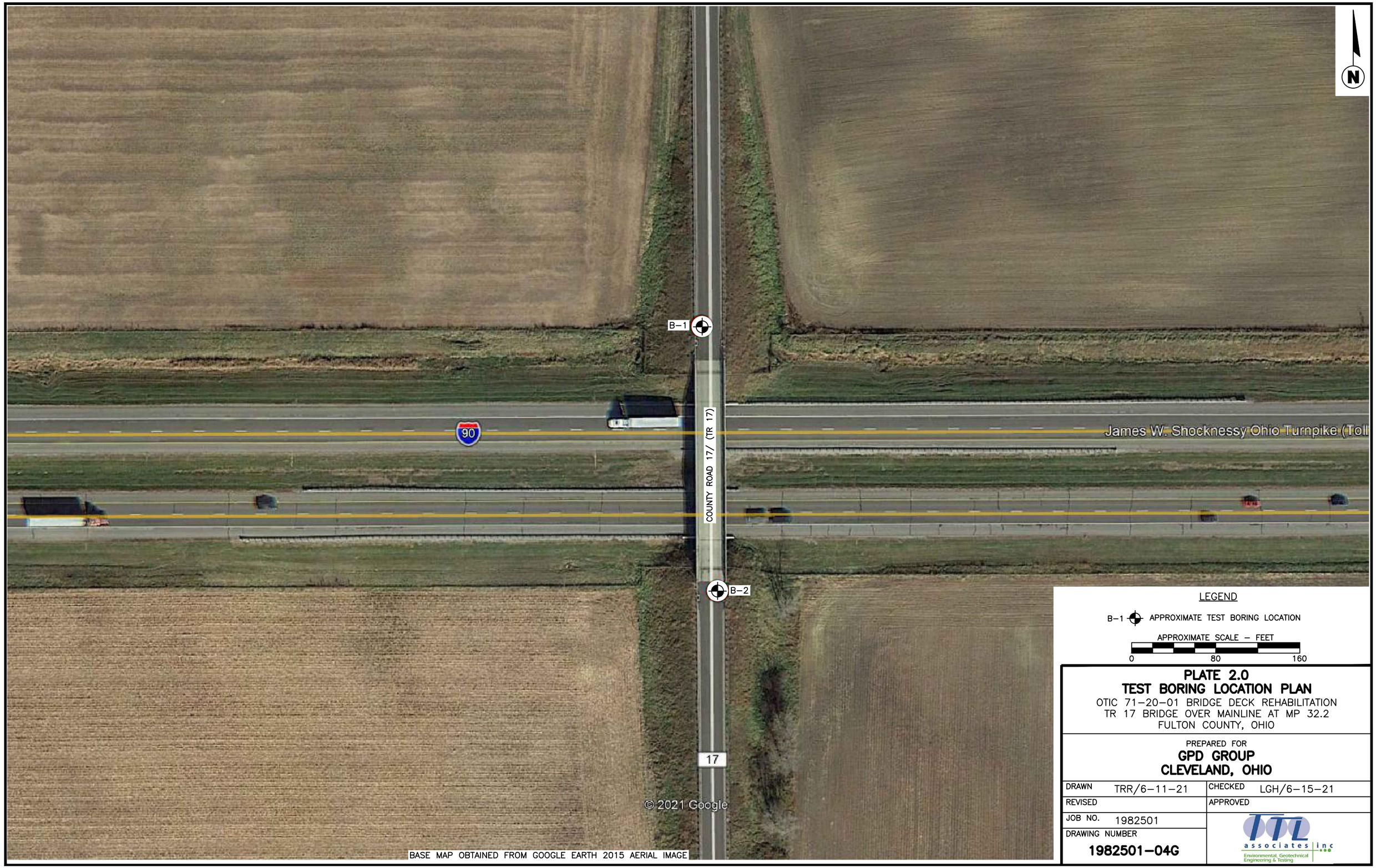
PLATE 1.0
SITE LOCATION MAP

OTIC 71–20–01 BRIDGE DECK REHABILITATION
TR 17 BRIDGE OVER MAINLINE AT MP 32.2
FULTON COUNTY, OHIO

PREPARED FOR
GPD GROUP
CLEVELAND, OHIO

DRAWN	TRR/6–11–21	CHECKED	LGH/6–15–21
REVISED		APPROVED	
JOB NO.	1982501		
DRAWING NUMBER	**1982501–03G**		

TTL associates inc
Environmental, Geotechnical Engineering & Testing



BASE MAP OBTAINED FROM GOOGLE EARTH 2015 AERIAL IMAGE

PLATE 2.0
TEST BORING LOCATION PLAN
OTIC 71-20-01 BRIDGE DECK REHABILITATION
TR 17 BRIDGE OVER MAINLINE AT MP 32.2
FULTON COUNTY, OHIO

PREPARED FOR
GPD GROUP
CLEVELAND, OHIO

DRAWN TRR/6-11-21	CHECKED LGH/6-15-21
REVISED	APPROVED
JOB NO. 1982501	
DRAWING NUMBER **1982501-04G**	

ITL associates inc
Environmental, Geotechnical Engineering & Testing

APPENDIX A

Log of Test Borings

PROJECT: BRIDGE DECK REHAB	DRILLING FIRM / OPERATOR: TTL / TB	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET:
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: TR 17
PID: N/A SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 791.0 (NAVD88) EOB: 80.0 ft.
START: 3/22/21 END: 3/22/21	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: Not Recorded

EXPLORATION ID TR17 B-1

MATERIAL DESCRIPTION AND NOTES	ELEV. 791.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT - 6 INCHES	790.5																	
AGGREGATE BASE - 3 INCHES	790.2																	
DENSE, BROWN, **FINE SAND**, TRACE SILT, DAMP FILL	787.5	1 2 3	15 15 17	35	89	SS-1	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE CLAY, DAMP FILL	785.0	4 5	8 11 18	32	100	SS-2	-	0	1	79	18	2	NP	NP	NP	9	A-3a (0)	
DENSE, BROWN, **FINE SAND**, TRACE SILT, DAMP FILL		6 7 8	12 16 20	40	100	SS-3	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
@8.5': moist	778.0	9 10 11 12 13	10 12 16	31	100	SS-4	-	-	-	-	-	-	-	-	-	12	A-3 (V)	
MEDIUM DENSE, BROWN, **FINE SAND**, TRACE SILT, MOIST FILL	773.0	14 15 16 17 18	6 8 12	22	100	SS-5	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
DENSE, BROWN/GRAY, **COARSE AND FINE SAND**, LITTLE SILT, MOIST FILL	769.0	19 20 21 22 23	7 13 16	32	78	SS-6	-	-	-	-	-	-	-	-	-	14	A-3a (V)	
VERY STIFF, BROWN/GRAY, **SANDY SILT**, LITTLE CLAY, DAMP	762.5	24 25 26 27 28	15 10 7	19	100	SS-7	2.75	-	-	-	-	-	-	-	-	15	A-4a (V)	
STIFF, GRAY/BROWN, **SANDY SILT**, WITH CLAY, MOIST Qu = 2493 PSF		29	2 4 6	11	100	SS-8	1.75	0	1	4	45	50	29	22	7	24	A-4a (8)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 6/28/21 18:36 - S:\PROJECTS\1982501.GPJ

PID: N/A	SFN: N/A	PROJECT: BRIDGE DECK REHAB	STATION / OFFSET:	START: 3/22/21	END: 3/22/21	PG 2 OF 3	TR17 B-1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
STIFF, GRAY/BROWN, **SANDY SILT**, WITH CLAY, MOIST *(continued)*	761.0	31, 32, 33																
VERY STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP	758.0	34, 35, 36, 37, 38	4 6 10	18	100	SS-9	4.50	-	-	-	-	-	-	-	-	17	A-6b (V)	
@38.5': Qu = 6585 PSF, moist		39, 40, 41, 42, 43	4 6 10	18	100	SS-10	4.25	-	-	-	-	-	-	-	-	23	A-6b (V)	
SOFT TO MEDIUM STIFF, GRAY, **SILTY CLAY**, TRACE SAND, MOIST	749.0	44, 45, 46, 47, 48	0 2 2	4	100	SS-11	1.50	-	-	-	-	-	-	-	-	29	A-6b (V)	
		49, 50, 51, 52, 53	1 1 2	3	100	SS-12	1.00	-	-	-	-	-	-	-	-	28	A-6b (V)	
SOFT TO MEDIUM STIFF, GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST Qu = 1142 PSF	738.0	54, 55, 56, 57, 58	1 2 2	4	100	SS-13	1.00	6	4	7	20	63	33	20	13	23	A-6a (9)	
		59, 60, 61	1 2 2	4	100	SS-14	1.25	-	-	-	-	-	-	-	-	26	A-6a (V)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 6/28/21 18:36 - S:\PROJECTS\1982501.GPJ

PID: N/A	SFN: N/A	PROJECT: BRIDGE DECK REHAB	STATION / OFFSET:	START: 3/22/21	END: 3/22/21	PG 3 OF 3	TR17 B-1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
SOFT TO MEDIUM STIFF, GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST *(continued)*	728.9																	
@63.5': wet		63																
		64	2 2 2	4	100	SS-15	1.25	-	-	-	-	-	-	-	-	42	A-6a (V)	
		65																
		66																
		67																
		68																
@68.5': Qu = 1321 PSF, moist		69	2 2 2	4	100	SS-16	1.25	-	-	-	-	-	-	-	-	22	A-6a (V)	
		70																
		71																
	719.0	72																
MEDIUM STIFF TO STIFF, GRAY, **SILT AND CLAY**, TRACE SAND, TRACE GRAVEL, MOIST		73																
		74	1 2 3	6	100	SS-17	1.50	-	-	-	-	-	-	-	-	22	A-6a (V)	
		75																
		76																
		77																
		78																
		79	3 3 4	8	100	SS-18	1.25	2	3	6	23	66	32	19	13	23	A-6a (9)	
	711.0	EOB 80																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; AUGER CUTTINGS MIXED WITH 4 BAGS BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 6/28/21 18:36 - S:\PROJECTS\1982501.GPJ

PROJECT: BRIDGE DECK REHAB	DRILLING FIRM / OPERATOR: TTL / TB	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET:
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: TR 17
PID: N/A SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 791.0 (NAVD88) EOB: 80.0 ft.
START: 3/22/21 END: 3/22/21	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: Not Recorded

EXPLORATION ID TR17 B-2

MATERIAL DESCRIPTION AND NOTES	ELEV. 791.0	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT - 9 INCHES	790.2																
AGGREGATE BASE - 2 INCHES	790.1																
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE CLAY, MOIST FILL		8 9 8	19	89	SS-1	-	0	1	81	16	2	NP	NP	NP	11	A-3a (0)	
@3.5': Dense		5 12 18	33	89	SS-2	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
		11 13 17	33	100	SS-3	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
	782.5																
DENSE, GRAY/BROWN, **FINE SAND**, TRACE SILT, MOIST FILL		10 15 20	39	100	SS-4	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
@13.5': BROWN		12 14 17	34	100	SS-5	-	-	-	-	-	-	-	-	-	14	A-3 (V)	
	774.0																
DENSE, BROWN/GRAY, **COARSE AND FINE SAND**, SOME SILT, TRACE CLAY, MOIST FILL		8 15 28	47	100	SS-6	-	0	1	71	24	4	NP	NP	NP	18	A-3a (0)	
	767.0																
VERY DENSE, BROWN/GRAY, **FINE SAND**, SOME GRAVEL, TRACE SILT, DAMP		10 20 37	63	100	SS-7	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
	763.0																
VERY STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP Qu = 10780 PSF		7 10 13	25	100	SS-8	4.50	-	-	-	-	-	-	-	-	17	A-6b (V)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 6/28/21 18:36 - S:\PROJECTS\1982501.GPJ

PID: N/A	SFN: N/A	PROJECT: BRIDGE DECK REHAB	STATION / OFFSET:	START: 3/22/21	END: 3/22/21	PG 2 OF 3	TR17 B-2

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
VERY STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP *(continued)*	761.0	31, 32, 33																
VERY STIFF, GRAY, **SILT**, SOME CLAY, TRACE SAND, DAMP	758.0	34, 35, 36, 37, 38	4 7 8	17	100	SS-9	2.75	-	-	-	-	-	-	-	-	16	A-4b (V)	
STIFF TO VERY STIFF, GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP Qu = 5711 PSF	754.0	39, 40, 41, 42, 43	4 6 8	15	100	SS-10	3.50	1	4	9	21	65	34	19	15	18	A-6a (10)	
MEDIUM STIFF TO STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST	747.5	44, 45, 46, 47, 48	1 3 4	8	100	SS-11	3.00	-	-	-	-	-	-	-	-	20	A-6b (V)	
		49, 50, 51, 52, 53	2 2 3	6	100	SS-12	1.25	-	-	-	-	-	-	-	-	23	A-6b (V)	
@53.5': Qu = 2257 PSF		54, 55, 56, 57, 58	2 3 4	8	100	SS-13	1.75	-	-	-	-	-	-	-	-	21	A-6b (V)	
		59, 60, 61	2 3 4	8	100	SS-14	1.50	-	-	-	-	-	-	-	-	22	A-6b (V)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 6/28/21 18:36 - S:\PROJECTS\1982501.GPJ

PID: N/A	SFN: N/A	PROJECT: BRIDGE DECK REHAB	STATION / OFFSET:	START: 3/22/21	END: 3/22/21	PG 3 OF 3	TR17 B-2

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
MEDIUM STIFF TO STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST *(continued)*	728.9	63																
		64	3 3 4	8	100	SS-15	1.50	-	-	-	-	-	-	-	-	22	A-6b (V)	
		65																
		66																
		67																
	723.0	68																
STIFF, GRAY, **SILT AND CLAY**, TRACE SAND, TRACE GRAVEL, MOIST Qu = 1665 PSF		69	2 3 6	10	100	SS-16	1.75	2	3	6	23	66	32	19	13	22	A-6a (9)	
		70																
		71																
		72																
	717.5	73																
MEDIUM STIFF TO STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST		74	1 2 4	7	100	SS-17	1.50	-	-	-	-	-	-	-	-	23	A-6b (V)	
		75																
		76																
		77																
		78																
		79	3 3 6	10	100	SS-18	2.00	-	-	-	-	-	-	-	-	21	A-6b (V)	
	711.0	EOB 80																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; AUGER CUTTINGS MIXED WITH 4 BAGS BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 6/28/21 18:36 - S:\PROJECTS\1982501.GPJ

APPENDIX B

Legend Key

LEGEND KEY

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)

- A-3: Ohio DOT: A-3, fine sand
- A-3A: Ohio DOT: A-3a, coarse and fine sand
- A-4A: Ohio DOT: A-4a, sandy silt
- A-4B: Ohio DOT: A-4b, silt
- A-6A: Ohio DOT: A-6a, silt and clay
- A-6B: Ohio DOT: A-6b, silty clay
- PAVEMENT OR BASE: Ohio DOT: Pavement or Aggregate base

SAMPLER SYMBOLS

Notes:

1. Exploratory borings were drilled by TTL on March 22, 2021, using 3¼-inch diameter hollow-stem augers.

2. These logs are subject to the limitations, conclusions, and recommendations in the report and should not be interpreted separate from the report.

3. The test borings were located in the field by TTL Associates, Inc. in accordance with information provided by GPD Group.

APPENDIX C

Summary of Soil Test Data

TTL Associates, Inc.
1915 N 12th Street
Toledo, Ohio 43624
Telephone: 419-324-2222
Fax: 419-241-1808

SUMMARY OF LABORATORY RESULTS

CLIENT _____ **PROJECT NAME** _____

PROJECT NUMBER N/A **PROJECT LOCATION** N/A

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
TR17 B-1	1.0							6.8			
TR17 B-1	3.5	NP	NP	NP	2	20	SM	9.0			
TR17 B-1	6.0							7.6			
TR17 B-1	8.5							11.8			
TR17 B-1	13.5							10.4			
TR17 B-1	18.5							14.4			
TR17 B-1	23.5							14.5			
TR17 B-1	28.5	29	22	7	4.75	95	CL-ML	23.6	103.3	103	0.613
TR17 B-1	33.5							17.4			
TR17 B-1	38.5							22.5	100.3	91	0.662
TR17 B-1	43.5							29.0			
TR17 B-1	48.5							28.3			
TR17 B-1	53.5	33	20	13	19	83	CL	22.5	107.4	109	0.552
TR17 B-1	58.5							26.2			
TR17 B-1	63.5							41.8			
TR17 B-1	68.5							22.3	106.0	104	0.572
TR17 B-1	73.5							21.9			
TR17 B-1	78.5	32	19	13	9.5	89	CL	22.6			
TR17 B-2	1.0	NP	NP	NP	2	18	SM	10.6			
TR17 B-2	3.5							11.6			
TR17 B-2	6.0							9.8			
TR17 B-2	8.5							11.2			
TR17 B-2	13.5							14.3			
TR17 B-2	18.5	NP	NP	NP	4.75	28	SM	18.1			
TR17 B-2	23.5							6.9			
TR17 B-2	28.5							17.3	111.5	93	0.496
TR17 B-2	33.5							15.9			
TR17 B-2	38.5	34	19	15	9.5	86	CL	18.1	110.4	95	0.510
TR17 B-2	43.5							19.6			
TR17 B-2	48.5							22.8			
TR17 B-2	53.5							20.5	109.0	103	0.529
TR17 B-2	58.5							22.3			
TR17 B-2	63.5							21.9			
TR17 B-2	68.5	32	19	13	9.5	89	CL	21.5	108.3	107	0.539
TR17 B-2	73.5							23.1			
TR17 B-2	78.5							21.1			

APPENDIX D

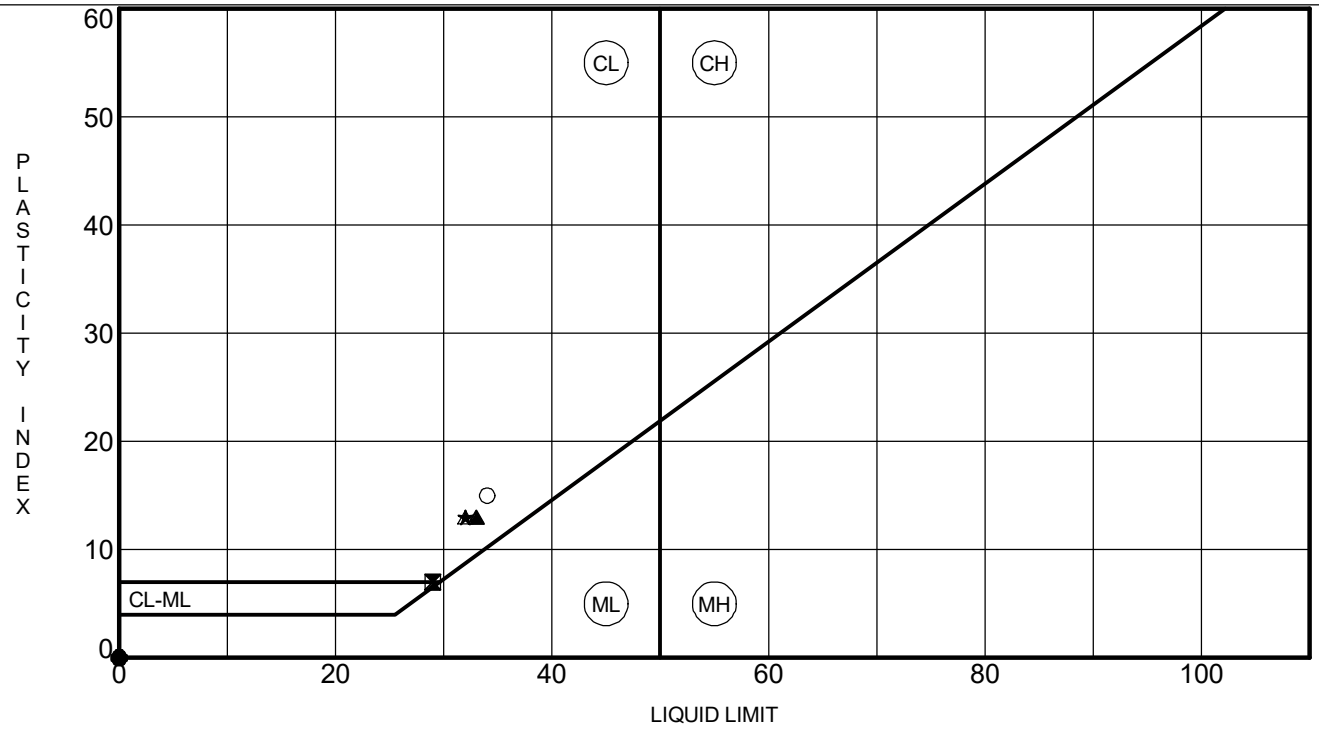
Laboratory Test Results

TTL Associates, Inc.
1915 N 12th Street
Toledo, Ohio 43624
Telephone: 419-324-2222
Fax: 419-241-1808

ATTERBERG LIMITS' RESULTS

CLIENT _____ **PROJECT NAME** _____

PROJECT NUMBER N/A **PROJECT LOCATION** N/A



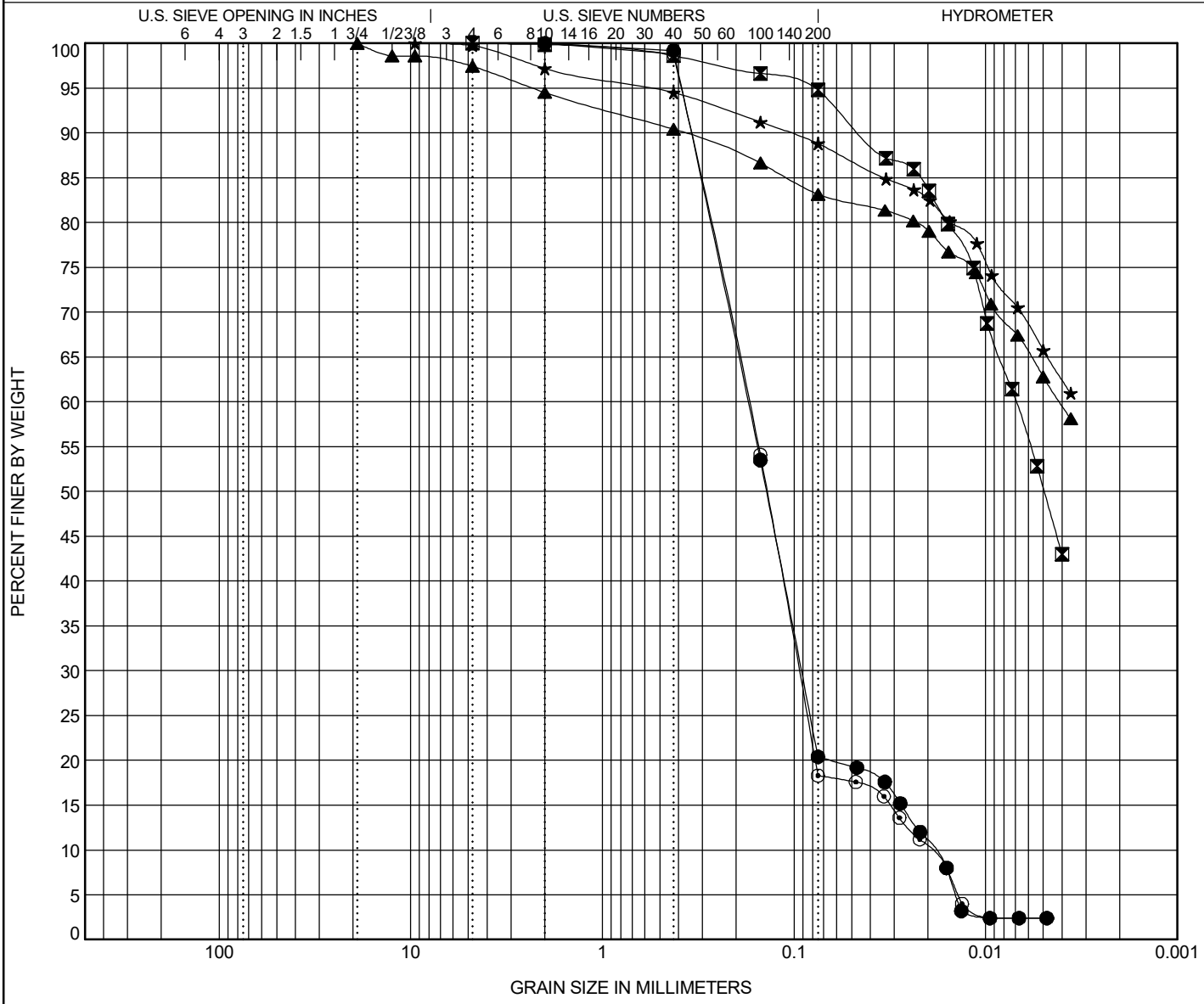
	Specimen Identification		LL	PL	PI	Fines	Classification
●	**TR17 B-1**	**3.5**	**NP**	**NP**	**NP**	**20**	**SILTY SAND (SM)**
⧗	**TR17 B-1**	**28.5**	**29**	**22**	**7**	**95**	**SILTY CLAY (CL-ML)**
▲	**TR17 B-1**	**53.5**	**33**	**20**	**13**	**83**	**LEAN CLAY with SAND (CL)**
★	**TR17 B-1**	**78.5**	**32**	**19**	**13**	**89**	**LEAN CLAY (CL)**
⊙	**TR17 B-2**	**1.0**	**NP**	**NP**	**NP**	**18**	**SILTY SAND (SM)**
✪	**TR17 B-2**	**18.5**	**NP**	**NP**	**NP**	**28**	**SILTY SAND (SM)**
○	**TR17 B-2**	**38.5**	**34**	**19**	**15**	**86**	**LEAN CLAY (CL)**
△	**TR17 B-2**	**68.5**	**32**	**19**	**13**	**89**	**LEAN CLAY (CL)**

TTL Associates, Inc.
1915 N 12th Street
Toledo, Ohio 43624
Telephone: 419-324-2222
Fax: 419-241-1808

GRAIN SIZE DISTRIBUTION

CLIENT _____ **PROJECT NAME** _____

PROJECT NUMBER N/A **PROJECT LOCATION** N/A



COBBLES	GRAVEL		SAND		SILT	CLAY
	coarse	fine	coarse	fine		

	Specimen Identification		OHDOT Classification	LL	PL	PI	Cc	Cu
●	**TR17 B-1**	**3.5**	**A-3a (0)**	**NP**	**NP**	**NP**	**2.6**	**9.3**
⊠	**TR17 B-1**	**28.5**	**A-4a (8)**	**29**	**22**	**7**		
▲	**TR17 B-1**	**53.5**	**A-4a (9)**	**33**	**20**	**13**		
★	**TR17 B-1**	**78.5**	**A-4a (9)**	**32**	**19**	**13**		
⊙	**TR17 B-2**	**1.0**	**A-3a (0)**	**NP**	**NP**	**NP**	**2.6**	**8.8**

	Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TR17 B-1**	**3.5**	**2**	**0.139**	**0.092**	**0.019**	**0.0**	**79.6**	**18.0**	**2.4**
⊠	**TR17 B-1**	**28.5**	**4.75**	**0.005**			**0.1**	**5.1**	**44.5**	**50.3**
▲	**TR17 B-1**	**53.5**	**19**				**5.5**	**11.3**	**20.4**	**62.8**
★	**TR17 B-1**	**78.5**	**9.5**				**2.8**	**8.4**	**23.1**	**65.7**
⊙	**TR17 B-2**	**1.0**	**2**	**0.139**	**0.094**	**0.02**	**0.0**	**81.7**	**15.9**	**2.4**

SILT-CLAY BOUNDARY = 0.005 MILLIMETERS

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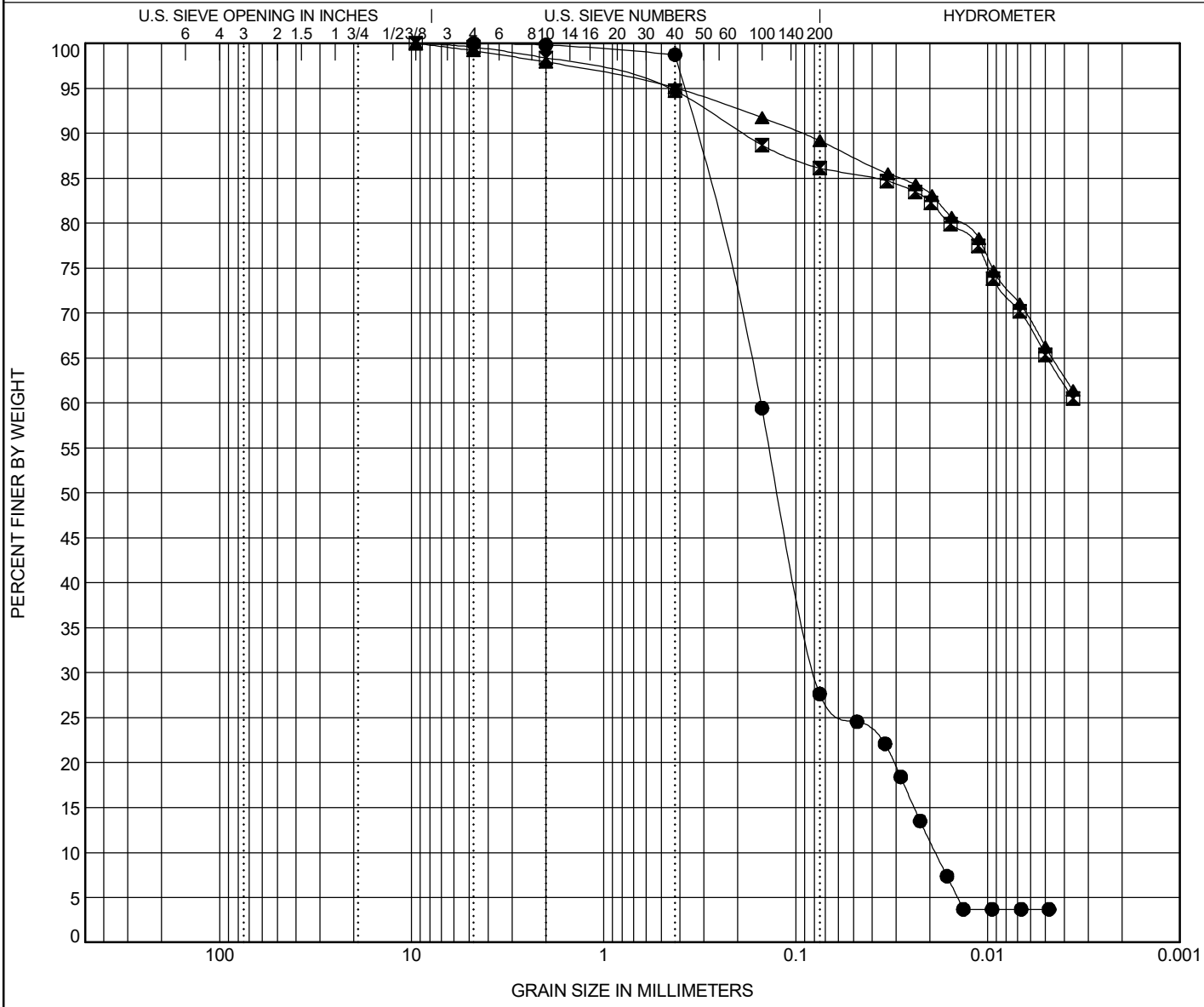
GRAIN SIZE DISTRIBUTION

CLIENT _____ **PROJECT NAME** _____

PROJECT NUMBER N/A **PROJECT LOCATION** N/A



COBBLES	GRAVEL		SAND		SILT	CLAY
	coarse	fine	coarse	fine		

	Specimen Identification		OHDOT Classification	LL	PL	PI	Cc	Cu
●	**TR17 B-2**	**18.5**	**A-3a (0)**	**NP**	**NP**	**NP**	**2.2**	**8.1**
⊠	**TR17 B-2**	**38.5**	**A-4a (10)**	**34**	**19**	**15**		
▲	**TR17 B-2**	**68.5**	**A-4a (9)**	**32**	**19**	**13**		

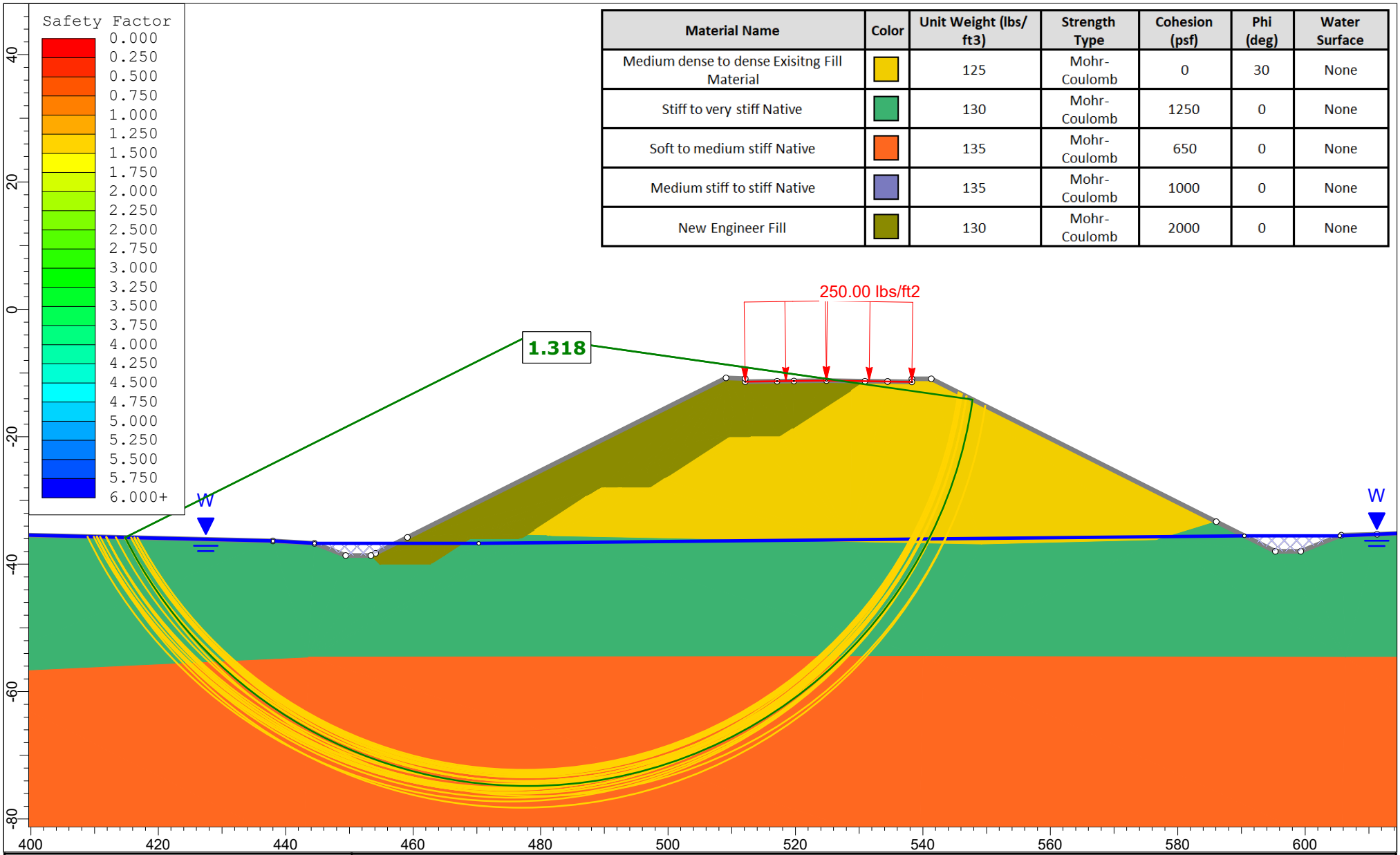
	Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TR17 B-2**	**18.5**	**4.75**	**0.122**	**0.079**	**0.019**	**0.2**	**72.2**	**24.0**	**3.7**
⊠	**TR17 B-2**	**38.5**	**9.5**				**1.6**	**12.3**	**20.8**	**65.4**
▲	**TR17 B-2**	**68.5**	**9.5**				**2.1**	**8.7**	**23.0**	**66.2**

SILT-CLAY BOUNDARY = 0.005 MILLIMETERS

APPENDIX E

Slope Stability Analysis Outputs

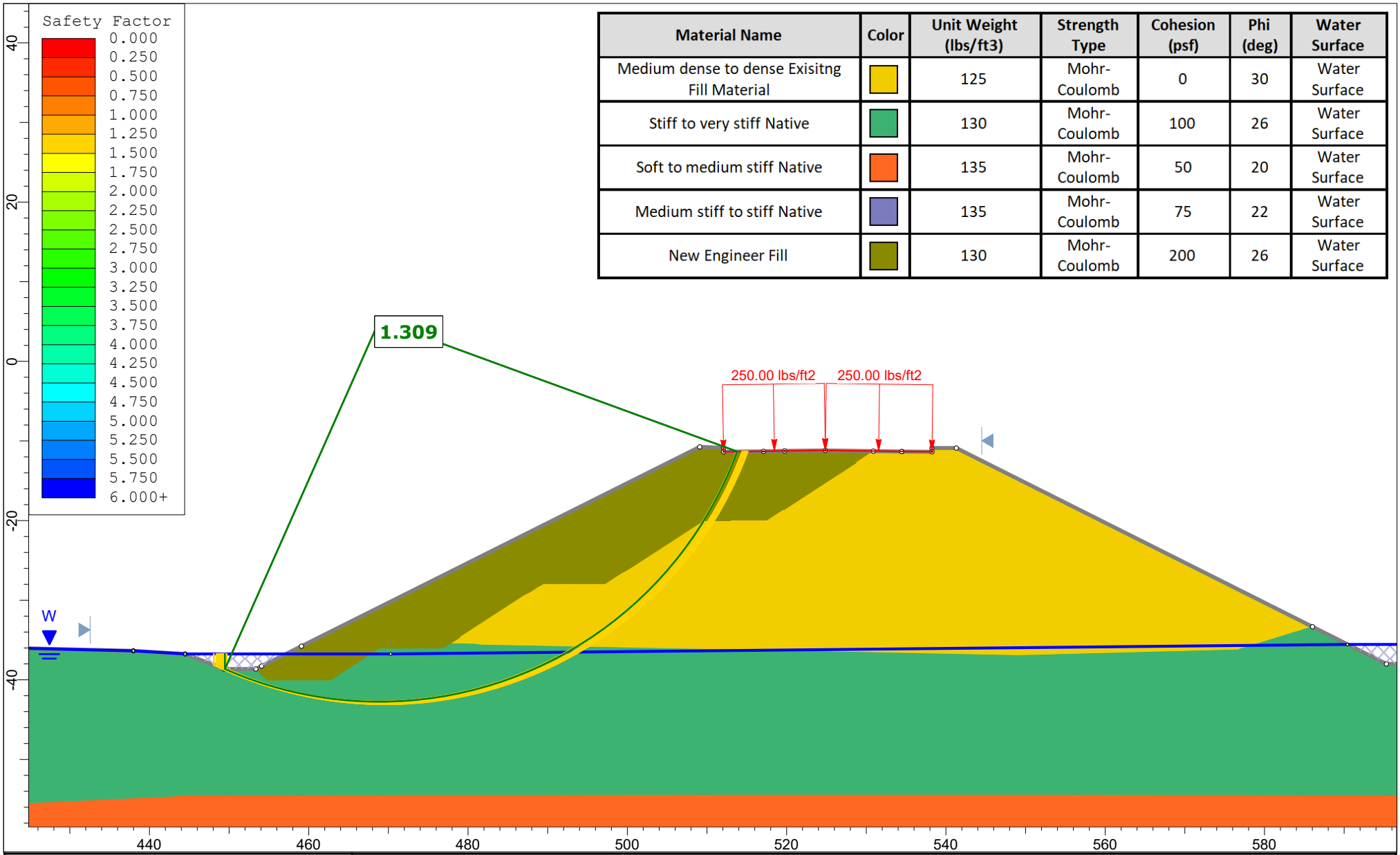
Material Name	Color	Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Medium dense to dense Exisitng Fill Material		125	Mohr-Coulomb	0	30	None
Stiff to very stiff Native		130	Mohr-Coulomb	1250	0	None
Soft to medium stiff Native		135	Mohr-Coulomb	650	0	None
Medium stiff to stiff Native		135	Mohr-Coulomb	1000	0	None
New Engineer Fill		130	Mohr-Coulomb	2000	0	None



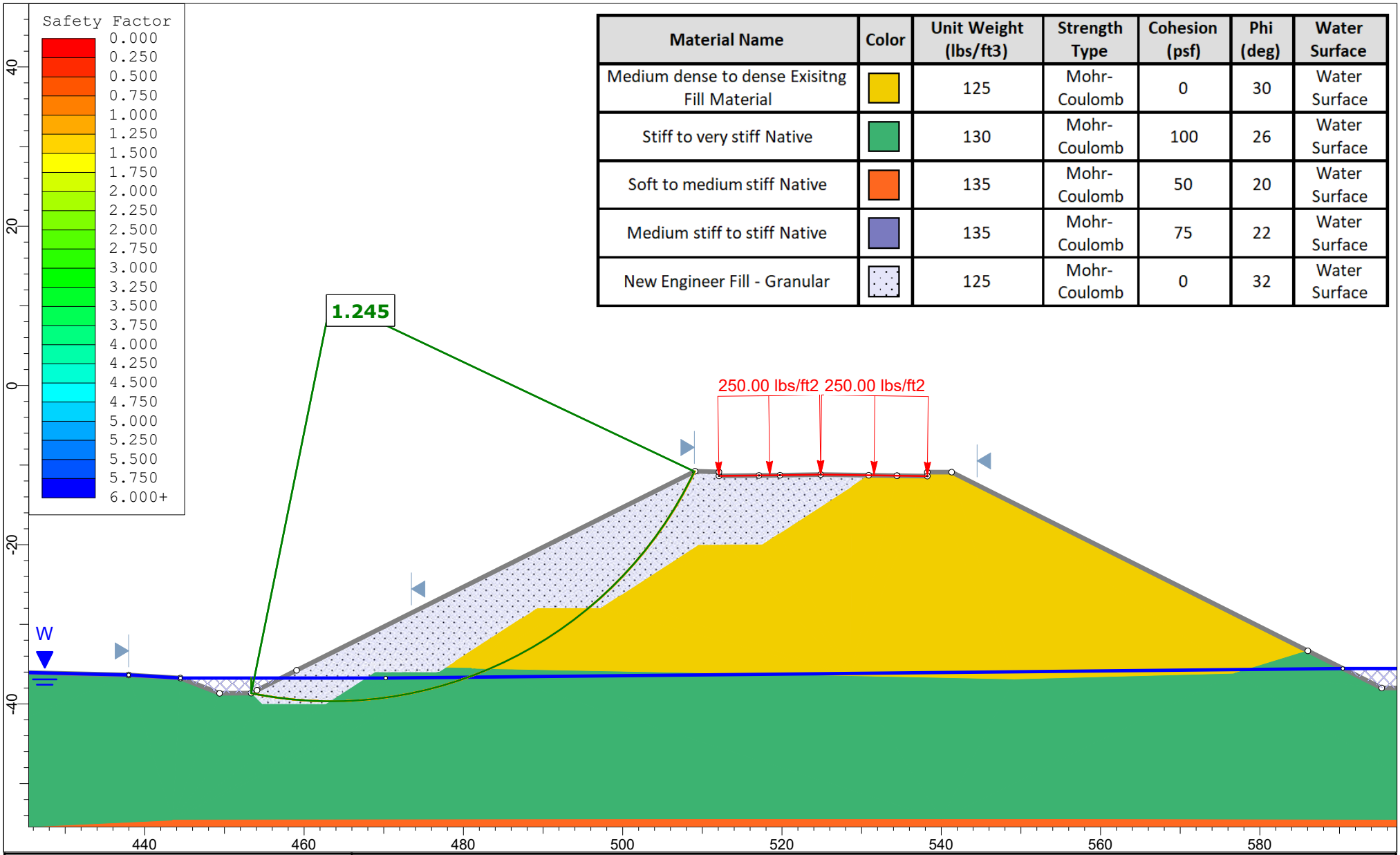
TTL associates inc
Environmental, Geotechnical Engineering & Testing

Project	OTIC 71-20-01 Bridge Deck Rehabilitation - TR 17		
Group		Scenario	TSSP
Drawn By	IJH	Company	TTL Associates, Inc
Date	6/25/21	File Name	TSSP - 8 ft benches + water - Back Slope 1.slim

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Medium dense to dense Exisitng Fill Material		125	Mohr-Coulomb	0	30	Water Surface
Stiff to very stiff Native		130	Mohr-Coulomb	100	26	Water Surface
Soft to medium stiff Native		135	Mohr-Coulomb	50	20	Water Surface
Medium stiff to stiff Native		135	Mohr-Coulomb	75	22	Water Surface
New Engineer Fill		130	Mohr-Coulomb	200	26	Water Surface



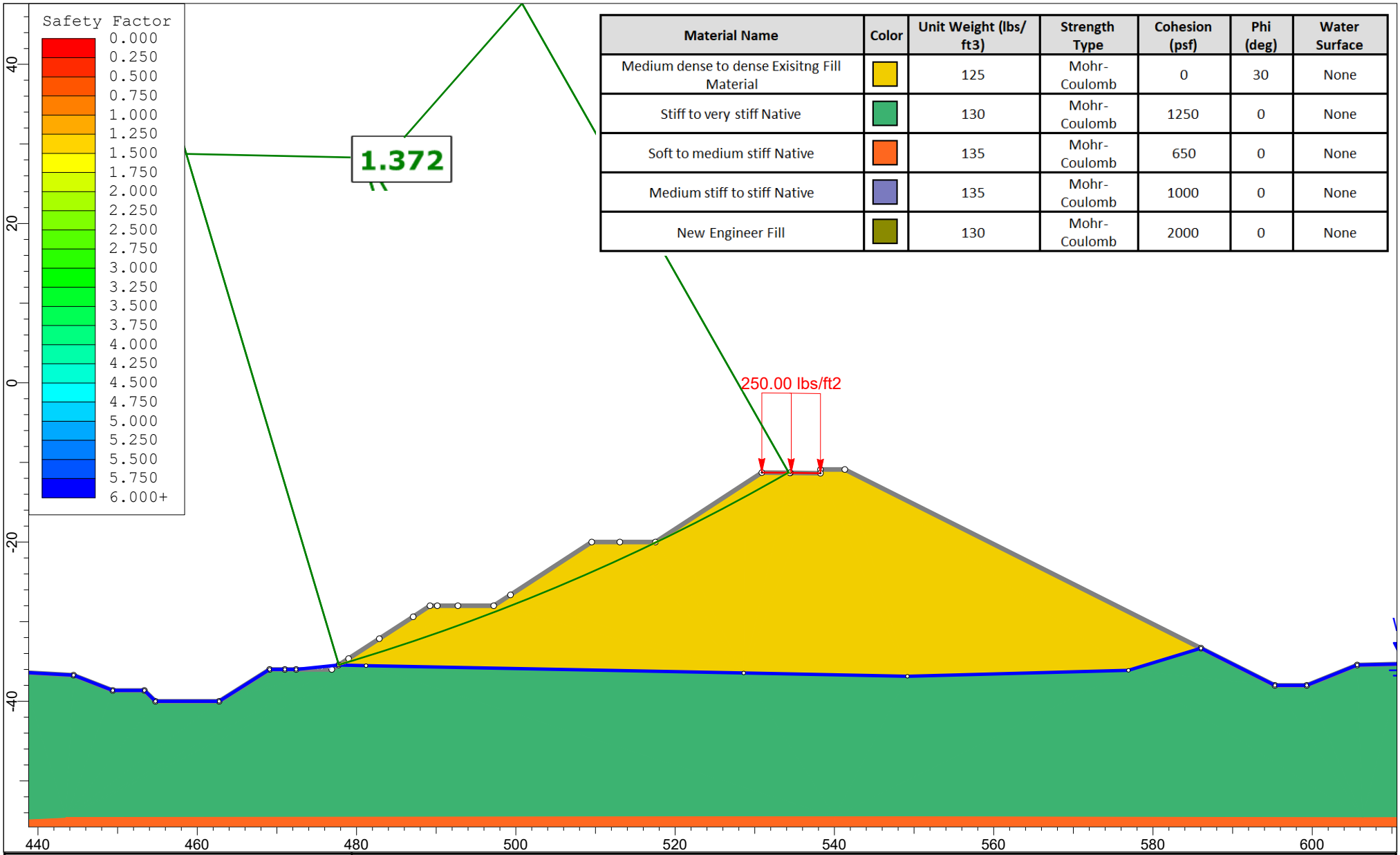
TTL associates inc — Environmental, Geotechnical Engineering & Testing	Project	OTIC 71-20-01 Bridge Deck Rehabilitation - TR 17	
	Group		Scenario: ESSP - Cohesive Fill
	Drawn By: IJH		Company: TTL Associates, Inc
	Date: 6/25/21		File Name: ESSP - 8 ft benches + water - Back Slope 1.5-1.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Medium dense to dense Exisitng Fill Material		125	Mohr-Coulomb	0	30	Water Surface
Stiff to very stiff Native		130	Mohr-Coulomb	100	26	Water Surface
Soft to medium stiff Native		135	Mohr-Coulomb	50	20	Water Surface
Medium stiff to stiff Native		135	Mohr-Coulomb	75	22	Water Surface
New Engineer Fill - Granular		125	Mohr-Coulomb	0	32	Water Surface

TTL associates inc
Environmental, Geotechnical Engineering & Testing

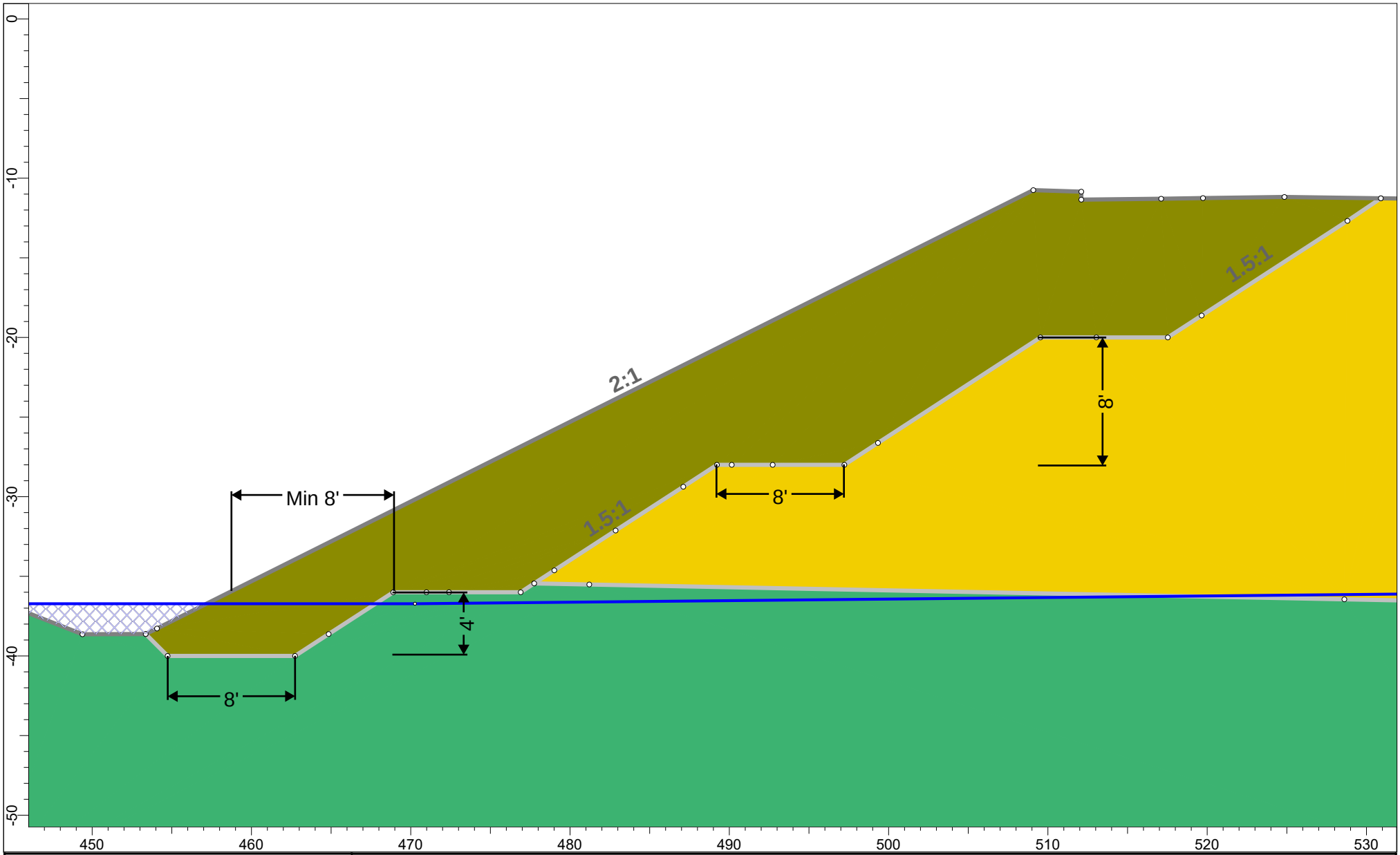
Project	OTIC 71-20-01 Bridge Deck Rehabilitation - TR 17		
Group	ESS	Scenario	ESSP - Granular Fill
Drawn By	IJH	Company	TTL Associates, Inc
Date	6/25/21	File Name	ESSP - 8 ft benches + water - Back Slope 1.5-1.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Medium dense to dense Exisitng Fill Material		125	Mohr-Coulomb	0	30	None
Stiff to very stiff Native		130	Mohr-Coulomb	1250	0	None
Soft to medium stiff Native		135	Mohr-Coulomb	650	0	None
Medium stiff to stiff Native		135	Mohr-Coulomb	1000	0	None
New Engineer Fill		130	Mohr-Coulomb	2000	0	None

TTL associates inc
Environmental, Geotechnical Engineering & Testing

Project	**OTIC 71-20-01 Bridge Deck Rehabilitation - TR 17**		
Group		*Scenario*	TSSP - Temporary Slope
Drawn By	IJH	*Company*	TTL Associates, Inc
Date	6/25/21	*File Name*	TSSP - Temporary Slope - 1.5-1.slim



TTL associates inc Environmental, Geotechnical Engineering & Testing	*Project*	**OTIC 71-20-01 Bridge Deck Rehabilitation - TR 17**	
	Group	*Scenario*	----
	Drawn By	IJH	*Company*	TTL Associates, Inc
	Date	6/25/21	*File Name*	Dimension Sketch