SUBGRADE EXPLORATION

Proposed Median Improvements

WOO/LUC-280-06.20/00.00, PID 108584

Wood Co. SLM 6.20 to 6.63 & Lucas Co. SLM 0.00 to 1.69

Northwood and Oregon, Ohio

Submitted to Tetra Tech

Date ***July 2023***

Prepared by

TTL associates inc
Environmental, Geotechnical Engineering & Testing

OHIO DEPARTMENT OF TRANSPORTATION

Proposed Median Improvements

WOO/LUC-280-06.20/00.00
PID 108584

Northwood & Oregon, Ohio

Subgrade Exploration

Tetra Tech
Toledo, Ohio

July 11, 2023

TTL Project No. 2171101

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July 11, 2023

TTL Project No. 2171101

Mr. David T. Charville, PE
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Final Report
Subgrade Exploration
WOO/LUC-280-06.20/00.00, PID 108584
Proposed Median Improvements
Northwood and Oregon, Ohio

Dear Mr. Charville:

Following is the report of our Subgrade Exploration performed by TTL Associates, Inc. (TTL) for the referenced project. This study was performed in accordance with TTL Proposal No. 2171101, dated November 23, 2021 and was authorized by Tetra Tech via a subconsultant service agreement, dated January 14, 2022 referencing Tetra Tech Project No. 200-12914-22001.

Preliminary data including draft logs and GB-1 spreadsheet were sent on August 3 and 26, 2022. This report contains the results of our study, our engineering interpretation of the results with respect to the project characteristics, our recommendations for design and construction of pavements as well as potential modifications to subgrade soils and low-mast foundation design soil parameters. Subgrade evaluations were performed in accordance with ODOT GB-1 "Plan Subgrades." In accordance with ODOT protocol, this report is being submitted as "Draft" pending questions and comments by Tetra Tech and ODOT. However, the report is considered complete and comprehensive with respect to the requested scope of work.

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

Sincerely,

TTL Associates, Inc.

Luke G. Holmes, EIT
Geotechnical Professional II

Curtis E. Roupe, P.E.
Vice President

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FINAL REPORT
SUBGRADE EXPLORATION
WOO/LUC-280-06.20/00.00, PID 108584
PROPOSED MEDIAN IMPROVEMENTS
NORTHWOOD AND OREGON, OHIO

FOR

TETRA TECH
420 MADISON AVENUE, SUITE 1001
TOLEDO, OHIO 43604

SUBMITTED

JULY 11, 2023
TTL PROJECT NO. 2171101

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EXECUTIVE SUMMARY

This subgrade exploration report has been prepared for the repairing and resurfacing Interstate Route 280 in Wood County from SLM 6.20 to 6.63 and in Lucas County from SLM 0.00 to 1.69. Total project length is approximately 2.12 miles in Northwood and Oregon, Ohio. This exploration included 30 test borings for the evaluation of existing pavement sections and subgrade conditions in areas of proposed roadway construction as well as low-mast foundation design soil parameters. Subgrade evaluations were performed in accordance with ODOT GB-1 "Plan Subgrades" (February 11, 2022). A summary of the conclusions and recommendations of this study are as follows:

1. The borings were performed in the existing pavement shoulders between the north and southbound lanes as well as in the inner drive lanes of Interstate 280. The borings performed in the drive lane pavements encountered surface materials consisting of asphalt underlain by concrete, further underlain by an aggregate base. However, one of the drive lane borings, Boring B-005, did not encounter concrete between the asphalt and aggregate base. The borings performed in the shoulder pavements encountered surface materials consisting of asphalt underlain by an aggregate base.

2. Granular existing **fill** materials were only encountered in Boring B-005 underlying the pavement cross section to a depth of 2 feet below existing grade. The granular fill materials consisted of fine sand (A-3) with little amounts of concrete fragments. Cohesive existing **fill** materials were encountered underlying the pavement cross section to depths generally ranging from 3 to 4 feet in Borings B-001, B-003, B-004, B-005, B-015, B-017, and B-021. However, some borings had fill as deep as 8½ feet. Additionally, based on the historic plans for the construction of Interstate 280, any other areas also contain fill to raise grades. With the exception of traces of crushed stone, slag, and/or brick fragments encountered within the borings listed above, fill materials were indistinguishable from the native cohesive soils. As such, the General Soil Conditions include these cohesive fill materials and the soils suspected to be fill based on historic plans within the descriptions of the different encountered strata.

3. Based on the results of our field and laboratory tests, the subsoils encountered underlying the surface materials can generally be characterized as three strata of predominantly cohesive soils of varying strength characteristics. The approximate depths to which each strata extend are summarized in the Table 4.2. The cohesive soils generally consisted of sandy silt (A-4a), silt (A-4b, only encountered at depths of 3 of more below subgrade), silt and clay (A-6a), silty clay (A-6b), and clay (A-7-6). **Stratum I** consisted of predominantly stiff, very stiff, and hard consistency cohesive soils. **Stratum II** consisted of predominantly medium consistency cohesive soils. **Stratum III** consisted of predominantly soft consistency cohesive soils.

4. Based on the limited data available, such as the soil characteristics and the moisture conditions encountered in the borings, it is our opinion that the "normal" groundwater level may generally be encountered at depths ranging from 5 to 13 feet below existing pavement grades. In general, at the deeper end of the range at the southern portion of the project and at the shallower end of

the range at the northern portion of the project. It should be noted that "perched" water may be encountered in the aggregate pavement base materials, or granular fill materials that are underlain by relatively impermeable cohesive soils. If construction does not occur during a particularly wet period, adequate control of groundwater seepage into excavations extending only a few feet below the "normal" groundwater level should be achievable by minor dewatering systems, such as pumping from prepared sumps.

5. As indicated in Table 4.2, several areas along the project alignment, particularly to the north, encounter predominantly Stratum II medium stiff or Stratum III soft soils. Therefore, if drilled shaft foundations are to be utilized, it is anticipated that a special design will be required for the drilled shaft foundations in these areas. In using a shallow spread foundation with the indicated foundations dimensions described in Section 1.2, the existing soils are sufficient to support the low mast lighting.

6. Based on the GB-1 "Subgrade Analysis" worksheet, 20 of the 30 borings contained subgrade soils within the upper profile which indicated subgrade modification is likely to be required. Based on the GB-1 analysis results, subgrade modification may consider global chemical stabilization using cement to a depth of 14 inches, or over-excavation and replacement with new granular engineered fill.

7. ODOT GB-1 "Subgrade Analysis" worksheet resulted in a CBR value of 6 percent for the project site. It should be noted that the CBR determination by the GB-1 spreadsheet is based on an average Group Index of all the evaluated samples. Group indices for the tested samples generally varied from 8 to 16, which would correlate with a CBR value of 4 to 6 percent. The lower Group Indices associated with the A-4a and A-6a cohesive soils that were prominent in the borings performed and would correlate with a CBR value of 6 percent. The higher Group Indices associated with the A-6b and A-7-6 cohesive soils would correlate with CBR values of 5 to 4 percent. However, these where not the predominant soil types and generally were encountered at depths below 3 feet. As such, based on the average design value calculations from GB-1, it does not appear to be unconservative to use the GB-1 design CBR value of 6 percent.

This executive summary highlights our evaluations and recommendations and should only be utilized in conjunction with the accompanying report, including the detailed findings, analysis and recommendations, and qualifications presented herein.

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1.0 INTRODUCTION

This subgrade exploration report has been prepared for the repairing and resurfacing Interstate Route 280 in Wood County from SLM 6.20 to 6.63 and in Lucas County from SLM 0.00 to 1.69. Total project length is approximately 2.12 miles in Northwood and Oregon, Ohio as shown on the Site Location Map (Plate 1.0).

This study was performed in accordance with TTL Proposal No. 2171101, dated November 23, 2021 and was authorized by Tetra Tech via a subconsultant service agreement, dated January 14, 2022 referencing Tetra Tech Project No. 200-12914-22001.

1.1 Purpose and Scope of Exploration

The purpose of this exploration was to evaluate the subsurface conditions and laboratory data relative to the design and construction of pavements and low-mast foundation design soil parameters for the referenced project. To accomplish this, TTL performed 30 test borings, laboratory soil testing, a geotechnical engineering evaluation of the test results, and review of available geologic and soils data for the project area.

This report summarizes our understanding of the proposed construction, describes the investigative and testing procedures utilized to evaluate the subsurface conditions at the site, and presents our findings from the field and laboratory testing. This report also presents our evaluations and conclusions in accordance with ODOT GB-1 "Plan Subgrades" (July 17, 2021) and provides our design and construction recommendations for pavements.

This report includes:

- A description of the existing surface materials, subsurface soils, and groundwater conditions encountered in the borings.
- Design recommendations for pavements and low-mast foundation design soil parameters.
- Recommendations concerning soil and groundwater-related construction procedures such as subgrade preparation in accordance with ODOT GB-1 criteria, earthwork, pavement construction, and related field testing.

Appendix B includes pertinent ODOT Geotechnical Engineering Design Checklists that apply to the scope of this report. This exploration did not include an environmental assessment of the surface or subsurface materials at the site.

1.2 Proposed Construction

The project comprises of repairing and resurfacing Interstate Route 280 in Wood County from SLM 6.20 to 6.63 and in Lucas County from SLM 0.00 to 1.69. Total project length is approximately 2.12 miles. As part of this project, it is planned to replace the existing centerline wall and drainage, as well as to update lighting and poles with low-mast LED lights mounted on the median wall, and conventional LED lights installed along the Wheeling Street ramps. The light poles were indicated to be supported on shallow spread foundations, 7-foot wide, 12-foot long, and bearing at a depth of 1.9 feet below existing grade.

Table 2.1 Foundation Loading for Low-Mast LED Lights

Calculated Reactions	Maximum q (psf)	Minimum q (psf)	Average q (psf)
Extreme Event I	658	116	361
Service I	698	156	401

We have assumed that final roadway grades will approximate existing roadway grades and consist of asphalt pavements. Existing pavement cross-sections encountered in the borings performed for this exploration were on the order of 12 to 26 inches in thickness. For subgrade evaluations, we have assumed that the new pavement cross-section will be on the order of 21 inches in thickness (1¾ feet, average thickness of existing pavement).

2.0 GEOLOGY AND OBSERVATIONS OF THE PROJECT

2.1 General Geology and Hydrogeology

Published geologic maps from the Ohio Department of Natural Resources (ODNR) indicate that the project site is located in the Maumee Lake Plains Region of the Huron-Erie Lake Plains Section. Within the Maumee Lake Plains, the upper profile geology includes predominantly Pleistocene-age lacustrine silt, clay, and wave-planed clayey till over Silurian- and Devonian-age carbonite rock and shale.

The lacustrine soils consist of predominantly sands and sandy silts, and may exhibit alternating thin layers of interbedded silts and clays known as varves. Varved soils are characteristic of lacustrine deposits, and the thin layering is typically attributed to seasonal or other cyclic variations of sedimentation in the lake waters.

The glacial till, also referred to as moraine, was deposited by the advance and retreat of glacial ice. Due to the weight of the ice mass, the till deposits are moderately to highly over-consolidated, that is, the existing soil deposits have experienced a previous vertical stress significantly higher than the present effective vertical stress due to the remaining overlying soil strata in the profile. The till may contain cobbles and/or boulders in the till soil matrix. Additionally, seams of granular soils may be encountered within glacial tills. These granular seams may or may not be water bearing.

On the "Geologic Map of Ohio," the project site is mapped as bedrock consisting of Silurian-age Tymochtee and Greenfield dolomite and shale. Bedrock across the site is mapped at Elevs. 520± at the northern portion on the site and 560± to the southern extent, corresponding to depths varying from approximately 75 feet below existing grades at the north to 55 feet at the southern portion.

The USDA Natural Resource Conservation Service (NRCS) Web Soil Survey indicates that soils in the project area are predominantly mapped as loamy Udorthents (Uo *in Lucas County* and UcE *in Wood County*). Udorthents refer to unban land where surface subsoils have fill materials at the surface as part of previous development.

2.2 Site Reconnaissance

TTL performed a site reconnaissance on March 1, 2022. The portion of Interstate 280 (I-280) that was part of this investigation runs through predominantly sub-urban residential areas as well as business. An exception to that is the rural/agricultural area just north of Brown Road.

The inner shoulders of I-280 were generally in fair condition with occasional transverse cracking and a few areas of longitudinal cracking. The transverse cracking generally extended into the drive lanes of I-280, often extending to the outer shoulder. The longitudinal cracking was observed predominantly at the dividing line between drive lane and shoulder, however, some areas also had longitudinal cracks within the shoulder pavement. At the time of the reconnaissance, cracking in the drive lanes and the shoulders was generally not sealed. However, more recent images from google earth taken during the summer of 2022 indicate that the cracks in the drive lanes have been sealed. The shoulder lanes appear to remain unsealed.

A concrete barricade, generally approximately 4 feet in height, was observed to run the length of the project area, dividing the north and southbound lanes. However, some areas were as low as approximately 3 feet. The concrete had frequent vertical cracks and occasional areas evident of repairs. Drainage inlets where observed underling/incorporated into the concrete barricades throughout the project area. The spacing between these inlets was highly variable. The conventional lighting along I-280 was bolted to the top of the barricade. The concrete of the barricade underlying the lighting mast appeared to be separate from the main barricade.

Grades along the southern portion of the site where generally flat or sloping very slightly upward from south to north. Ranging from Elevation of 616± feet to 618± feet in the areas of Borings B-001-0-21 through B-009-0-21. Elevations north of Boring B-009-0-21 generally sloped downward dropping in Elevation from 618± to 591±.

Review of the Ohio Department of Natural Resources (ODNR) Map of Mines indicates that no recorded mines are near the project site.

3.0 EXPLORATION

3.1 Historic Borings

Review of ODOT Transportation Information Mapping System (TIMS) for the project area indicated numerous historic projects had been performed along or near Interstate 280 (I-280) near the limits of this current exploration. These projects, included LUC/WOO-20&25 (1957), WOO-280-5.74 (1984), LUC-Wheeling St PID 23995 (2006), and LUC-280-1.64 PID 19649 (1999). With the exception of LUC/WOO-20&25 (1957), the borings for all of the remaining projects were generally not along the center line of I-280. Borings for these projects were generally offset 85 feet or further from the centerline of I-280. As such, the boring data were not used in the GB-1 evaluations and design recommendations.

The project designated as LUC/WOO-20&25 (1957) was performed along the center line of I-280 as part of the original design and construction of I-280. However, the historic subsurface exploration within the projects limits of the current exploration consisted of only hand auger borings that did not include Standard Penetration Tests. As such, the boring data were also not utilized for GB-1 evaluations for this project and are not shown on the test boring location plans.

The soils encountered in the historic borings at the currently planned subgrade elevation consisted of predominantly the same soils as were encounters during this investigation as described in Section 4.2.

We have assumed that the information provided in the historic borings was accurate and correct, at the time of those respective explorations, but cannot guarantee as such. Additionally, subgrade soil conditions may have changed or may have been modified due to construction performed following completion of the historic subsurface explorations.

3.2 Project Exploration Program

This exploration included 30 test borings which were extended through existing inner shoulder and drive lane pavements. The test borings were designated as Borings B-001-0-21 through B-030-0-21. Borings B-002-0-21, B-005-0-21, B-012-0-21, and B-029-0-21 were performed in the inner most drive lane. The remaining borings were performed in the inner shoulder. Borings with an odd number (B-001, B-003, etc.) were performed along the northbound side of Interstate 280. While, borings with an even number (B-002, B-004, etc.) were performed along the southbound side. The borings were performed by TTL during the period from May 15 to

18, 2022. These cores and borings are fully designated as in accordance with ODOT protocol, however the "-0-21" portion of the nomenclature is generally omitted for ease of identification in the discussions within this report. The borings were located in the field by TTL spaced approximately 400 feet apart. The approximate locations of the borings are shown on the Test Boring Location Plans (Plates 2.1 through 2.3).

Stationing and offsets at the boring locations were provided by Tetra Tech. Latitude, Longitude, and ground surface elevations were surveyed by TTL via a handheld GPS. The accuracy from the handheld GPS device was generally found to be approximately 2 to 6 inches horizontal, and approximately 4 to 12 inches vertical. These data are presented on the logs of test borings as well as in Table 3.2 below.

Table 3.2 General Boring Location Information							
Boring Number	**County**	**Location***	**Alignment and Station (feet)**	**Offset (feet)**	**Ground Surface Elevation (feet)**	**Latitude (Degrees)**	**Longitude (Degrees)**
B-001-0-21	Wood	NB Shoulder	327+67	5' RT	616.0	41.612167	-83.476956
B-002-0-21		SB Drive Lane	331+66	14' LT	617.0	41.613264	-83.477001
B-003-0-21		NB Shoulder	335+61	5' RT	616.4	41.614347	-83.476965
B-004-0-21		SB Shoulder	339+66	6' LT	616.2	41.615459	-83.477009
B-005-0-21		NB Drive Lane	343+14	14' RT	616.1	41.616417	-83.476971
B-006-0-21		SB Shoulder	347+22	6' LT	616.5	41.617532	-83.477017
B-007-0-21	Lucas	NB Shoulder	0+90	5' RT	617.6	41.618638	-83.476979
B-008-0-21		SB Shoulder	4+86	6' LT	618.5	41.619726	-83.477023
B-009-0-21		NB Shoulder	8+86	5' RT	618.3	41.620824	-83.476985
B-010-0-21		SB Shoulder	12+85	6' LT	617.8	41.621919	-83.47703
B-011-0-21		NB Shoulder	16+87	6' RT	616.9	41.623021	-83.476992
B-012-0-21		SB Drive Lane	20+85	14' LT	616.2	41.624115	-83.477041
B-013-0-21		NB Shoulder	24+85	6' RT	615.5	41.625212	-83.476999
B-014-0-21		SB Shoulder	28+87	7' LT	614.4	41.626312	-83.477106
B-015-0-21		NB Shoulder	32+57	5' RT	614.3	41.627308	-83.477363
B-016-0-21		SB Shoulder	36+57	7' LT	613.0	41.628288	-83.478004
B-017-0-21		NB Shoulder	40+56	5' RT	611.8	41.629188	-83.478833
B-018-0-21		SB Shoulder	44+50	7' LT	609.5	41.629884	-83.479937
B-019-0-21		NB Shoulder	48+67	6' RT	608.4	41.630479	-83.481231
B-020-0-21		SB Shoulder	52+57	7' LT	606.4	41.630891	-83.482548
B-021-0-21		NB Shoulder	56+54	7' RT	604.6	41.631377	-83.483854
B-022-0-21		SB Shoulder	60+52	6' LT	602.8	41.631796	-83.485194
B-023-0-21		NB Shoulder	63+13	7' RT	601.7	41.632141	-83.486034
B-024-0-21		SB Shoulder	66+90	6' LT	599.9	41.632661	-83.48723
B-025-0-21		NB Shoulder	70+95	6' RT	597.8	41.633396	-83.488339
B-026-0-21		SB Shoulder	74+96	7' LT	595.7	41.634189	-83.489355
B-027-0-21		NB Shoulder	78+93	5' RT	594.5	41.635107	-83.490141
B-028-0-21		SB Shoulder	82+98	7' LT	592.0	41.636023	-83.490970
B-029-0-21		NB Drive Lane	86+07	14' RT	591.0	41.636759	-83.491539
B-030-0-21		SB Shoulder	89+42	7' LT	591.9	41.637516	-83.492232

* - Location refers to the inner drive lanes and shoulders
NB = Northbound / SB = Southbound
TBD = To be determined

In accordance with the ODOT Specifications for Geotechnical Explorations (SGE), the upper portion of the borings were performed as ODOT Type A borings to a depth of at least 6 feet below top of subgrade, and were extended to a depth of 15 feet below top of existing grade to evaluate lighting foundation 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, especially at previously developed sites such as this site. Therefore, it is essential that a geotechnical engineer be retained to provide soil engineering services during the site preparation and pavement 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.

3.3 Boring Methods

The test borings performed during this exploration were drilled with a truck-mounted drilling rig. The borings were extended utilizing 3¼-inch hollow-stem augers. After coring or extending the augers though the pavement materials, samples were generally obtained continuously using 18-inch split-spoon (SS) sample drives for six feet, and at a 2½-foot spacing thereafter. All borings were terminated at the planed depth of 15 feet below existing grade. The samples were sealed in jars and transported to our laboratory for further classification and testing.

Pavement cores were obtained from the inner drive lane of Interstate 280 in Borings B-002, B-005, B-012, and B-029 using a nominal 4-inch diameter core barrel.

Split-spoon soil samples were obtained by the Standard Penetration Test Method (ASTM D 1586). The Standard Penetration Test (SPT) 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 sampler was driven in three successive 6-inch increments, with the number of blows per increment being recorded. The number of blows per increment was recorded at each depth interval, and these data are presented under the "SPT" column on the Logs of Test Borings attached to this report. 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 truck-mounted CME 75 drill rig was 66 percent, and was last calibrated on March 15, 2021. The N_{60}-values are presented on the attached Logs of Test Borings.

Shelby tube samples, designated ST on the Log of Test Boring, were obtained from Borings B-005-0-21 (4 to 6 feet), B-013-0-21 (11½ to 13½ feet), B-016-0-21 (6½ to 8½ feet), B-022-0-21 (3½ to 5½ feet), B-027-0-21 (8 to 10 feet), and B-028-0-21 (3½ to 5½ feet). The Shelby tube samples were obtained by hydraulically advancing a 3-inch diameter, thin-walled sampler approximately 24 inches beyond the hollow-stem auger into undisturbed soil, in accordance with ASTM D 1587. The Shelby tubes were then extracted from the subsoils, and the ends were capped and sealed. The samples were transported to our laboratory where they were extruded, classified, and tested.

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. In conjunction with published data and typical correlations, the N_{60}-values can be evaluated as a measure of soil compactness/consistency as well as shear strength.

Field and laboratory data were incorporated into gINT™ software for presentation purposes. 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.

3.4 Laboratory Testing Program

All samples were visually classified in accordance with the ODOT Soil Classification System. All recovered samples of the subsoils were also tested in our laboratory for moisture content (ASTM D 2216). Unconfined compressive strength estimates were obtained for the intact cohesive samples using a calibrated hand penetrometer. Shelby tube samples had dry density determinations and unconfined compressive strength tests by the constant rate of strain method (ASTM D 2166) performed in addition to unconfined compressive strength estimates calibrated hand penetrometer. These test results are presented on the Logs of Test Borings, Summary of Soil Test Data, and the Undisturbed Sample Unconfined Compressive Strength Test Results.

Laboratory testing was performed in accordance with GB-1 “Plan Subgrades” criteria, including mechanical soil classification consisting of an Atterberg limits test (ASTM D 4318) and a particle size analysis (ASTM D 6913 and D 7928) for at least two samples from each boring within 6 feet of the proposed subgrade. These test results are presented on the Logs of Test Borings, Grain Size Distribution sheets, and Summary of Soil Test Data.

Sulfate content determinations (ODOT Supplement 1122) were performed on one sample from each boring, generally within 3 feet of the proposed subgrade. These test results are presented on the Logs of Test Borings and Summary of Soil Test Data.

4.0 FINDINGS

4.1 General Site Conditions

At the time of this exploration the portion of Interstate 280 (I-280) that was part of this investigation runs through predominantly sub-urban residential areas as well as business. An exception to that is the rural/agricultural area just north of Brown Road. Grades along the southern portion of the site where generally flat or sloping very slightly upward from south to north. Grades along the northern portion of the site sloped downward to the north from Elev. 618± to 591±.

The borings were performed in the existing pavement shoulders between the north and southbound lanes as well as in the inner drive lanes of Interstate 280. The borings performed in the drive lane pavements encountered surface materials consisting of asphalt with a thickness on the order of 6 to 7 inches, underlain by concrete with a thickness generally ranging from 8 to 10 inches, further underlain by an aggregate base with a thickness on the order of 7 to 8 inches. However, one of the drive lane borings, Boring B-005, did not encounter concrete between the asphalt and aggregate base. The borings performed in the shoulder pavements encountered surface materials consisting of asphalt with a thickness generally ranging from 10 to 16 inches, underlain by an aggregate base with a thickness that ranged from 6 to 10 inches. The only exception to the asphalt thickness range was in Boring B-007, where asphalt was only 6 inches in thickness. A summary of the encountered pavement sections is summarized in the following table.

Table 4.1. Summary of Encountered Pavement Section					
Boring Number	**County**	**Location***	**Asphalt Thickness (inches)**	**Concrete Thickness (inches)**	**Base Thickness (inches)**
B-001	Wood	NB Shoulder	10	-	8
B-002		SB Drive Lane (*pavement core*)	7	8	8
B-003		NB Shoulder	13	-	7
B-004		SB Shoulder	15	-	10
B-005		NB Drive Lane (*pavement core*)	6	-	7
B-006		SB Shoulder	15	-	9
B-007	Lucas	NB Shoulder	6	-	6
B-008		SB Shoulder	14	-	9
B-009		NB Shoulder	11	-	9
B-010		SB Shoulder	16	-	10
B-011		NB Shoulder	11	-	8
B-012		SB Drive Lane (*pavement core*)	6½	10	7½
B-013		NB Shoulder	12	-	7
B-014		SB Shoulder	14	-	9
B-015		NB Shoulder	14	-	10
B-016		SB Shoulder	16	-	9
B-017		NB Shoulder	15	-	9
B-018		SB Shoulder	15	-	8
B-019		NB Shoulder	15	-	9
B-020		SB Shoulder	16	-	9
B-021		NB Shoulder	14	-	7
B-022		SB Shoulder	15	-	9
B-023		NB Shoulder	15	-	9
B-024		SB Shoulder	15	-	10
B-025		NB Shoulder	15	-	9
B-026		SB Shoulder	14	-	10
B-027		NB Shoulder	16	-	8
B-028		SB Shoulder	15	-	9
B-029		NB Drive Lane (*pavement core*)	6	9½	7½
B-030		SB Shoulder	14	-	10

* - Location refers to the inner drive lanes and shoulders
NB = Northbound / SB = Southbound
"-" = Not encountered

Granular existing **fill** materials were only encountered in Boring B-005 underlying the pavement cross section to a depth of 2 feet below existing grade (Elev. 614±). The granular fill materials consisted of fine sand (A-3) with little amounts of concrete fragments. An SPT N-value of 14 and a moisture content of 10 percent were determined for the recovered sample.

Cohesive existing **fill** materials were encountered underlying the pavement cross section to depths generally ranging from 3 to 4 feet in Borings B-001, B-003, B-004, B-005, B-015, B-017, and B-021. However, some borings had fill as deep as 8½ feet. Additionally, based on the historic plans for the construction of Interstate 280, other areas also contained fill to raise grades. With the exception of traces of crushed stone, slag, and/or brick fragments encountered within the borings listed above, fill materials were indistinguishable from the native cohesive soils. As such, Section 4.2 below, General Soil Conditions, includes these cohesive fill materials and the soils suspected to be fill based on historic plans within the descriptions of the different encountered strata.

4.2 General Soil Conditions

Based on the results of our field and laboratory tests, the subsoils encountered underlying the surface materials can generally be characterized as three strata of predominantly cohesive soils of varying strength characteristics. The approximate depths to which each strata extend are summarized in the table below. The cohesive soils generally consisted of sandy silt (A-4a), silt (A-4b, *only encountered at depths of 3 of more below subgrade*), silt and clay (A-6a), silty clay (A-6b), and clay (A-7-6).

Table 4.2. Summary of Encountered Soil Strata			
Boring Number	Stratum Consistency and Depths[1,2,3], Feet[4] (Elevation)		
	Stratum I Stiff, Very Stiff, or Hard	**Stratum II** Medium Stiff	**Stratum III** **Soft**
B-001	1.5 to 8 (615± to 608±)	8 to 15 (608± to 601±)	-
B-002	2 to 8.5 (615± to 609±)	8.5 to 15 (609± to 602±)	-
B-003	1.75 to 15 (615± to 602±)	-	-
B-004	2 to 8.5 (614± to 608±)	8.5 to 15 (608± to 601±)	-
B-005	1 to 15 (615± to 601±)	-	-
B-006	2 to 15 (615± to 602±)	-	-
B-007	1 to 15 (617± to 603±)	-	-
B-008	2 to 15 (617± to 604±)	-	-
B-009	1.75 to 11 (617± to 607±)	-	11 to 15 (607± to 603±)
B-010	2.25 to 15 (616± to 603±)	-	-
B-011	1.5 to 11 (615± to 606±)	11 to 15 (606± to 602±)	-
B-012	2 to 15 (614± to 601±)	-	-
B-013	1.5 to 11.5 (614± to 604±)	11.5 to 15 (604± to 601±)	-
B-014	2 to 13.5 (612± to 601±)	13.5 to 15 (601± to 599±)	-
B-015	2 to 15 (612± to 599±)	-	-
B-016	2 to 8.5 (611± to 605±)	8.5 to 15 (605± to 598±)	-
B-017	2 to 15 (610± to 597±)	-	-
B-018	2 to 5 (608± to 605±)	5 to 15 (605± to 595±)	-
B-019	2 to 3.5 (606± to 605±)	3.5 to 13.5 (605± to 595±)	13.5 to 15 (595± to 593±)
B-020	2 to 6.5 (604± to 600±)	6.5 to 15 (600± to 591±)	-
B-021	1.75 to 4 (603± to 601±)	4 to 15 (601± to 590±)	-
B-022	2 to 3.5 (601± to 599±)	3.5 to 15 (599± to 588±)	-
B-023	-	2 to 3.5 (600± to 598±)	3.5 to 15 (598± to 587±)
B-024	2 to 4 (598± to 596±)	-	4 to 15 (596± to 585±)
B-025	2 to 5 (596± to 593±)	5 to 15 (593± to 583±)	-
B-026	2 to 3.5 (594± to 592±)	6.5 to 15 (589± to 581±)	**Zone** 3.5 to 6.5 (592± to 589±)
B-027	2 to 3.5 (593± to 591±)	7 to 15 (588± to 580±)	**Zone** 3.5 to 7 (591± to 588±)
B-028	2 to 3.5 (590± to 589±)	-	3.5 to 15 (589± to 577±)
B-029	2 to 15 (589± to 576±)	-	-
B-030	2 to 15 (590± to 577±)	-	-

"-" = Not encountered/not the predominant soil constancy in a particular boring

[1]Note – Stratum/zone/soil consistency is based almost exclusively based on hand penetrometer results per the instruction of ODOT District 2

[2]Note – Thin zones of firmer consistency soils may have been encountered within softer layers (*e.g. a layer of medium stiff soils from 5 to 15 feet may contain a zone of very stiff soils from 8½ to 11 feet but is omitted in this table)*

[3]Note – In contrast to Note 2, softer soil layers are not omitted from the table if a stiffer soil layer is the predominate consistency within a boring

[4]Note – Ranges are approximated to the nearest ¼ foot. Pavement cross-sectional thickness makes up the missing upper portion of the range *(generally 0 to 2 feet)*

Stratum I consisted of predominantly stiff, very stiff, and hard consistency cohesive soils. Unconfined compressive strengths generally ranged from 2,000 pounds per square foot (psf) to greater than 9,000 psf (maximum reading obtainable using a hand penetrometer). SPT N-values generally ranged from 8 to 17 blows per foot (bpf). Moisture contents generally varied from 13 to 27 percent.

Stratum II consisted of predominantly medium consistency cohesive soils. Unconfined compressive strengths generally ranged from 1,000 to 2,000 psf. SPT N-values generally ranged from 6 to 10 bpf. Moisture contents generally varied from 15 to 26 percent.

Stratum III consisted of predominantly **soft** consistency cohesive soils. Unconfined compressive strengths generally ranged from 500 to 1,000 psf. SPT N-values generally ranged from 2 to 8 bpf. Moisture contents generally varied from 13 to 27 percent.

Additional descriptions of the stratigraphy encountered in the borings are presented on the Logs of Test Borings.

4.3 Groundwater Conditions

Groundwater was initially encountered during drilling operations only in Borings B-017 and B-023 at depths of 5 feet and 8 feet (Elev. 607 and 594), respectively. Groundwater was not observed upon completion of drilling in any of the borings. It should be noted that the boreholes were drilled and backfilled within the same day, and stabilized water levels may not have occurred over this limited time period.

Based on the limited data available, such as the soil characteristics and the groundwater conditions encountered in the borings, it is our opinion that the “normal” groundwater level may be encountered at depths ranging from 5 to 13 feet below existing pavement grades. In general, at the deeper end of the range at the southern portion of the project and at the shallower end of the range at the northern portion of the project. This exploration did not include research of possible hydrological influences at the project site. It should be noted that groundwater elevations can fluctuate with seasonal and climatic influences. In particular, “perched” water may be encountered in granular fill material, or crushed stone pavement base materials that are underlain by relatively impermeable native cohesive soils. Therefore, groundwater conditions may vary at different times of the year from those encountered during our exploration.

4.4 Remedial Measures

As indicated in Table 4.2, several areas along the project alignment, particularly to the north, encounter predominantly Stratum II medium stiff or Stratum III soft soils. Therefore, if drilled shafts are to be utilized, it is anticipated that a special design will be required for the drilled shaft foundations in these areas. In using a shallow spread foundation with the indicated foundations dimensions described in Section 1.2, the existing soils are sufficient to support the low mast lighting.

Based on the GB-1 "Subgrade Analysis" worksheet (V14.6, 02/11/2022), 20 of the 30 borings contained subgrade soils within the upper profile which indicated subgrade modification is likely to be required. Based on the GB-1 analysis results, subgrade modification may consider global chemical stabilization using cement to a depth of 14 inches, or over-excavation and replacement with new granular engineered fill. This new pavement project includes approximately 2.12 miles of paving, over the 1-mile threshold that is often when global chemical stabilization becomes cost effective. Therefore, we anticipate global chemical stabilization will be the more economical subgrade stabilization method for this project.

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

5.0 ANALYSES AND RECOMMENDATIONS

The following analysis and recommendations are based on our understanding of the proposed construction and on the data obtained during our field exploration. If the project alignment or subgrade depth should change significantly, a review of these recommendations should be made by TTL.

5.1 Shallow Spread Foundations

It was indicated that the conventional LED lights are to be supported on shallow spread foundations, 7-foot wide, 12-foot long, and bearing at a depth of 1.9 feet below existing grade. Additionally, it was indicated that the bearing pressure is anticipated to be an average of approximately 0.4 kips per square foot (ksf) at the base of the footing, with an isolated maximum pressure of 0.7 ksf.

It should be noted that the minimum required depth for penetration from frost protection in the project area is 3 feet. Final grades are anticipated to approximate existing grades. As such, low-mast LED light foundations bearing 1.9 feet below final grades would not be fully embedded for frost protection. If this is a requirement, deeper embedment for the foundations may be required.

Based on the conditions encountered in the borings, the soils at the anticipated light-support foundation bearing elevation are expected to consist of Stratum I stiff to hard native cohesive soils or Stratum II medium stiff native cohesive soils. However, in Borings B-023, B-024, and B-026 through B-028, Stratum III **soft** cohesive soils or zones of **soft** cohesive soils were encountered at a depth of approximately 1½ feet below the bottom of the proposed footing. The marginal conditions encountered in these borings compared to the other project borings were utilized for our evaluations to consider whether the soil conditions were suitable for the proposed foundations.

We understand that the spread foundation will be designed using LRFD specifications. At the service limit state, a nominal (unfactored) bearing resistance (q_n) of 1 kips per square foot (ksf) was determined for the borings were the footer would be in close proximity above the Stratum III soft native cohesive soils. At the service limit state, the resistance factor (ϕ_b) is 1.0. Therefore, the factored bearing resistance (q_r) is 1 ksf. From a conventional allowable stress design comparison, this is roughly akin to using an allowable bearing pressure.

At the strength limit state, we recommend a nominal bearing resistance (q_n) of 3 ksf for the light-support foundation bearing on Stratum I or II soils, but in close proximity above the Stratum III soft native cohesive soils. At the strength limit state, the resistance factor (ϕ_b) is 0.5. Therefore, the factored bearing resistance (q_r) is 1.5 ksf. From a conventional allowable stress design comparison, this is roughly akin to calculating an ultimate bearing capacity and applying a factor of safety.

Settlement of a light-support foundation was calculated by conventional consolidation theory utilizing recompression indices for the over-consolidated cohesive soils, based on empirical relations using moisture content. Based on a bearing pressure of 1 ksf, using the service limit state bearing resistance indicated above, total settlement was calculated to be on the order of ½ to ¾ inches, which is expected to be within the tolerable magnitude of settlement. Based on the provided average bearing pressure of 0.4 ksf, total settlement was calculated to be on the order of ¼ to ½ inches, which (again) is expected to be within the tolerable magnitude of settlement.

The Stratum III soils are suitable for the indicated average bearing pressure of 400 psf. As such, confirmation of suitable bearing of native cohesive soils can be verified with minimum unconfined compressive strength of 700 psf. Field verification can be confirmed with a hand penetrometer reading of 0.5 tsf. If marginal conditions are encountered, an undisturbed sample can be obtained and tested in the laboratory to confirm a minimum unconfined compressive strength of 700 psf or using a UU triaxial test to confirm an undrained shear strength of 350 psf. If final design results in average pressures higher than 1.2 ksf associated with the factored strength limit state resistance associated with the stratum III soils or 1 ksf associated with the factored service limit state evaluations, TTL should be contacted for further evaluation.

Although not anticipated to be prevalent, if unsuitable bearing soils are encountered during light-support foundation installation, over-excavation should extend through these materials to suitable bearing soils. The base of the over-excavation should be widened one foot for every foot of depth extending beyond the edge of the light-support foundation. The over-excavated areas should be backfilled with dense-graded aggregate. The aggregate should be placed and compacted as described in Section 5.8. Alternatively, the over-excavated areas could be backfilled with lean concrete having a minimum compressive strength of 1,500 pounds per square inch (psi) or other flowable controlled-density fill having a minimum compressive strength of 300 psi.

5.2 Low-Mast Foundation Design Soil Parameters

TTL understands that as part of this project, it is planned to update lighting and poles with low-mast LED lights mounted on the median concrete barrier. If drilled shafts are to be utilized for support, the low-mast lighting requires at a minimum a 2-foot diameter by 10 feet deep foundation. However, according to the Traffic Engineering Manual, deeper foundations should be considered in areas of poor soils.

Recommended design soil parameters for use in the evaluation of drilled shaft size and embedment are summarized as follows:

Table 5.1 Low-Mast Foundation Design Soil Parameters

Stratum	**Total Unit Weight (pcf)**	**Average Undrained Shear Strength, S_u (psf)**	**Design Depth**
I – Stiff to Hard Cohesive	135	1,500	*Depths provided in Table 4.2*
II – Medium Stiff Cohesive	130	750	
III – **Soft** Cohesive	125	350	

As indicated in Table 4.2, several areas along the project alignment, particularly to the north, encounter predominantly Stratum II medium stiff or Stratum III soft soils. Therefore, it is anticipated that a special design will be required for the drilled shaft foundations in these areas.

Although it is not anticipated that thinner diameter drilled shafts will be utilized, we do not recommend diameters less than 24 inches for drilled shafts. It should be noted that typical construction practice for small diameter drilled shafts no longer includes inspection at the bottom of the pier for bearing due to time and costs associates with casing and safe entry into the drilled foundation. Therefore, confirmation of bearing capacity should include sufficient acquisition of relatively "undisturbed" samples from the drilling operations to evaluate soil strength.

We recommend a minimum 28-day compressive strength for the concrete (f'_c) of 4,000 pounds per square inch (psi). Drilled shafts should be constructed in accordance with ODOT Construction and Material Specifications (CMS) Item 524.

It should be noted that actual capacity of drilled shafts is dependent on proper installation methods, and the allowable capacity is based on the assumption that a reasonable standard of care and quality control will be exercised during drilled shaft installation.

Due to the encountered Strata II and III soft to medium stiff cohesive soils, temporary steel casing may be required in these portions of the subsurface profile in order to support the shaft walls. The “normal” groundwater level is anticipated at depths ranging from of 5 to 13 feet below existing grade. If sand seams or sandier zones are encountered below the groundwater table, casing will also aid in sealing out water seepage prior to concrete placement. During concrete placement, as the steel casing is withdrawn, sufficient concrete should be maintained above the bottom of the casing to counteract any hydrostatic head and prevent collapse or “necking” of the shaft. Care must be taken during concreting and removal of any temporary casing to prevent the possibility of soil intrusions. The contractor should submit procedures for shaft installation prior to the start of work.

Drilled shafts should be clean and free of all loose material prior to the placement of concrete. A TTL representative should verify that drilled shaft foundations are bearing on competent materials and that the installation procedures meet specifications.

5.3 GB-1 “Plan Subgrades” Evaluation

An evaluation of the subgrade soils was completed in general accordance with ODOT Geotechnical Bulletin GB-1 “Plan Subgrades” (January 15, 2021). As part of this evaluation, the ODOT “Subgrade Analysis” worksheet (V14.6, 02/11/2022) was completed for the project and is attached to this report.

Existing pavement cross-sections encountered in the borings performed for this exploration were on the order of 12 to 26 inches in thickness. For subgrade evaluations, we have assumed that the new pavement cross-section will be on the order of 21 inches in thickness (1¾ feet, average thickness of existing pavement), and that final pavement grades will approximate existing pavement grades.

Based on GB-1, soils classified as ODOT A-4b, A-2-5, A-5, A-7-5, A-8a, A-8b, or rock have been designated as being problematic with respect to pavement subgrade support. None of these soil types were encountered at planned or within 3 feet of the planned subgrade elevations in the borings performed for this exploration. The subgrade materials encountered in the borings located within the project area included predominantly cohesive soils consisting of

ODOT A-4a, A-6a, A-6b, and A-7-6 soils. Zones of ODOT A-4b soils determined by visual classification were also encountered in Borings B-003, B-011, B-019, and B-025. However, these zones were all encountered at depths greater than 3 feet below the planned subgrade elevations.

Based on GB-1 criteria, subgrade soils with moisture contents greater than 3 percent above optimum likely indicate the presence of unstable subgrade that may require some form of subgrade modification. Moisture contents for approximately 60 percent of the tested subgrade soil samples were greater than 3 percent above the optimum as determined using GB-1 criteria. It should be noted that approximately 80 percent of the evaluated samples with moisture contents greater than 3 percent above optimum had moisture contents equal to or greater than 5 percent above optimum. Thus, where moisture contents were wet of optimum, they were significantly wet of optimum. Scarification and aeration methods may not be feasible to achieve satisfactory proof rolling and stabilization of the cohesive subgrades.

The type and thickness of subgrade modification is determined by GB-1 criteria based on the average, low SPT N_{60}-value (N_{60L}) of the subgrade soils in a particular portion of the project area, hand penetrometer values, soil type, and moisture content. Based on these criteria, 20 of the 30 borings contained subgrade soils within the upper profile which indicated subgrade modification is likely to be required. Based on the GB-1 analysis results, subgrade modification may consider global chemical stabilization using cement, or over-excavation and replacement with new granular engineered fill. The GB-1 prescribed type and depth of global chemical stabilization for each intersection is summarized in the following table.

Table 5.3.A GB-1 Recommended Type and Depth of Global Chemical Stabilization

Location	Chemical Type	Stabilization Depth (Inches)
I-280 Median	Cement	14

As required by GB-1, sulfate content tests (ODOT Supplement 1122) were performed on a sample within the upper 3 feet of anticipated subgrade elevation from each boring. The sulfate content test results are summarized in the following table.

Table 5.3.B. Sulfate Content

Boring Number	Sulfate Content (ppm)	Boring Number	Sulfate Content (ppm)
B-001	260	B-016	240
B-002	300	B-017	240

B-003	200	B-018	210
B-004	230	B-019	210
B-005	180	B-020	220
B-006	190	B-021	220
B-007	210	B-022	270
B-008	210	B-023	260
B-009	210	B-024	230
B-010	210	B-025	240
B-011	200	B-026	220
B-012	220	B-027	230
B-013	220	B-028	230
B-014	210	B-029	240
B-015	250	B-030	250

GB-1 indicates that chemical stabilization cannot be utilized when sulfate contents for the majority of the samples exceed 3,000 parts per million (ppm), or individual soil samples exhibit sulfate contents of greater than 5,000 ppm. All tested samples had a sulfate content on the order of 300 ppm or less. Based on GB-1 criteria, sulfate content would not be restrictive to considering global chemical stabilization.

Stabilization may also be performed using excavate and replace methods. A summary of the depths of undercut indicated by GB-1 analyses is presented in the following table.

Table 5.3.C GB-1 Recommended Depth of Undercut and Replacement with Granular Engineered Fill				
Boring Number	**County**	**GB-1 Recommended Depth of Undercut and Replacement with Granular Engineered Fill (inches)**	**Recommended Subgrade Modification Extents**	**Approximate Project Segment Length (feet)**
B-001	Wood	12	Sta. 327+64 to Sta. 333+63	600
B-002				
B-003		No treatment indicated by GB-1	Sta. 333+63 to Sta. 337+63	400
B-004		12	Sta. 337+63 to Sta. 341+41	375
B-005		24	Sta. 341+41 to Sta. 345+18	380
B-006		12	Sta. 345+18 to Sta. 349+06	390
B-007	Lucas	No treatment indicated by GB-1	Wood Sta. 349+06 to Sta. 350+00 Lucas Sta. 0+00 to Sta. 2+88	380
B-008		12	Sta. 2+88 to Sta. 6+87	395
B-009		No treatment indicated by GB-1	Sta. 6+87 to Sta. 10+86	400
B-010		12	Sta. 10+86 to Sta. 14+86	400
B-011		No treatment indicated by GB-1	Sta. 14+86 to Sta. 18+87	1,970
B-012				
B-013				
B-014				
B-015				
B-016		12	Sta. 34+57 to Sta. 38+57	1,995
B-017				
B-018				
B-019				
B-020				
B-021		24	Sta. 54+56 to Sta. 58+53	400
B-022		42	Sta. 58+53 to Sta. 61+82	650
B-023				
B-024		12	Sta. 65+1 to Sta. 68+93	390
B-025		42	Sta. 68+93 to Sta. 72+96	1,205
B-026				
B-027				
B-028		15	Sta. 80+95 to Sta. 84+53	355
B-029		No treatment indicated by GB-1	Sta. 84+53 to Sta. 89+48	495
B-030				

It should be noted that, in the above table, transitions were based on the station approximately half way between borings indicating areas of recommended treatment and borings indicating no treatment or varying undercut depth was required by GB-1 analyses.

Where undercut and replacement is utilized, all fill should consist of ODOT Item 304 Aggregate Base or Item 703.16C, Granular Material Type B or Type C. It is recommended that geotextile fabric (referenced in ODOT Item 204, and specified as ODOT Item 712.09, Type D) be utilized on the subgrade at the bottom of the undercut zone. If particularly unstable subgrades are encountered during construction, or undercuts exceed approximately 18 inches, a geogrid could be used to reduce the total undercut and replacement of the unsuitable soils by 6 inches.

It should be noted that GB-1 analyses are used as a pre-construction tool to plan subgrade modification alternatives. **Actual subgrade modification will depend on field observations of proof-rolling conditions at the time of construction.** Changes in soil moisture content could create more or less favorable subgrade conditions that may result in adjustments to subgrade modification or soil stabilization requirements at the time of construction.

5.4 Flexible (Asphalt) Pavement Design

Based on the GB-1 analysis, a design CBR of 6 percent was determined for the project. It should be noted that the CBR determination by the GB-1 spreadsheet is based on an average Group Index of all the evaluated samples of the project. Additionally, it was indicated that consideration was being given to cement stabilization and that ODOT requested a modified design CBR for the cement stabilized soils. Based on Section 203.4.1 of the Pavement Design Manual (PDM), the subgrade resilient modulus (proportional to the CBR) may be increased by 36 percent when using global chemical stabilization. The design CBR values determined by the GB-1 analysis performed and a modified design CBR per the increase described in the PDM are summarized in the following table.

Table 5.4 GB-1 CBR Results by Intersection

Stabilization	Design CBR (Percent)
Undercut and replacement with granular engineered fill per Table 5.1.C.	6 *(GB-1 Calculated)*
Global cement stabilization to a depth of 14 inches.	8 *(PDM Modified)*

ODOT GB-1 “Subgrade Analysis” worksheet resulted in a CBR value of 6 percent was determined for the project site. It should be noted that the CBR determination by the GB-1 spreadsheet is based on an average Group Index of all the evaluated samples. Group indices for the tested samples generally varied from 8 to 16, which would correlate with a CBR value of 4 to 6 percent. The lower Group Indices associated with the A-4a and A-6a cohesive soils that were prominent in the borings performed and would correlate with a CBR value of 6 percent. The higher Group Indices associated with the A-6b and A-7-6 cohesive soils would correlate with CBR values of 5 to 4 percent. However, these where not the predominant soil types and generally were encountered at depths below 3 feet. As such, based on the average design value calculations from GB-1, it does not appear to be unconservative to use the GB-1 design CBR value of 6 percent.

It should also be noted that the design CBR values are based on subgrades compacted to at least 100 percent of the maximum dry density as determined by ASTM D 698 (Standard Proctor) or verified as stable through proof-rolling in accordance with Section 5.3 of this report.

All pavement design and paving operations should conform to 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 pavements need repairs or overlays over time as a result of progressive yielding under repeated loading for a prolonged period.

It is recommended that proof rolling, placement of aggregate base, and placement of asphalt be performed within as short a time period as possible. Exposure of the aggregate base to rain, snow, or freezing conditions may lead to deterioration of the subgrade and/or base materials due to excessive moisture conditions and to difficulties in achieving the required compaction.

5.5 Site and Subgrade Preparation

Site and subgrade preparation activities should conform to ODOT Construction and Materials Specifications (CMS) Item 204 specifications. Site preparation activities should include the removal of vegetation, topsoil, root mats, pavements, and other deleterious non-soil materials from all proposed roadway areas. The actual amount of required stripping should be determined in the field by a geotechnical engineer or qualified representative.

Upon completion of the clearing and undercutting activities, all areas that are to receive fill, or that have been excavated to proposed final subgrade elevation, should be inspected by a geotechnical engineer. Pavement subgrades should be proof rolled in accordance with ODOT CMS 204.06.

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 recompaction. As stated previously, based on the conditions encountered during our exploration, where subgrade soil moisture contents were wet of optimum, they were significantly wet of optimum. The encountered granular subgrade soils should be generally conducive for subgrade modification consisting of scarification, aeration, and in-place re-compaction, provided weather conditions and construction schedule will allow for these activities. However, scarification and aeration methods may not be feasible to achieve satisfactory proof rolling and stabilization of the cohesive subgrades.

The GB-1 analysis indicates options for “planned” subgrade modification consisting of global chemical stabilization using cement to a depth of 14 inches), or over-excavation of unsuitable subgrade soils and replacement with new granular engineered fill. This new pavement project includes relatively small areas of new pavement at various widespread intersections. Therefore, we anticipate over-excavation and replacement will be the more economical subgrade stabilization method for this project.

5.6 Groundwater Control

Encountered groundwater conditions were previously discussed in Section 4.3. Based on the limited data available, such as the soil characteristics and the moisture conditions encountered in the borings, it is our opinion that the “normal” groundwater level may generally be encountered at depths ranging from 5 to 13 feet below existing pavement grades. In general, at the deeper end of the range at the southern portion of the project and at the shallower end of the range at the northern portion of the project. It should be noted that “perched” water may be encountered in the aggregate pavement base materials, or granular fill materials that are underlain by relatively impermeable cohesive soils.

If construction does not occur during a particularly wet period, adequate control of groundwater seepage into excavations extending only a few feet below the “normal” groundwater level should be achievable by minor dewatering systems, such as pumping from prepared sumps. Even at depths slightly below the “normal” groundwater level, control of groundwater using sumps should be feasible due to the predominantly cohesive nature of the encountered soils and their associated low permeability, but will require due diligence by the contractor to maintain a stable subgrade condition at the bottom of the excavation.

Recommendations for groundwater control in drilled shafts are provided in Section 5.2.

5.7 Excavations and Slopes

The sides of temporary excavations for construction should be adequately sloped to provide stable sides and safe working conditions. Otherwise, the excavation must be properly braced against lateral movements. In any case, applicable Occupational Safety and Health Administration (OSHA) safety standards must be followed.

Based on the test borings, the soils likely to be encountered in shallow excavations may include:

- OSHA Type A soils (cohesive soils with unconfined compressive strengths of 3,000 pounds per square foot (psf) or greater),
- OSHA Type B soils (cohesive soils with unconfined compressive strengths greater than 1,000 psf but less than or equal to 3,000 psf), and
- OSHA Type C soils (existing fill materials and cohesive soils with unconfined compressive strengths less than 1,000 psf).

Temporary excavations in Type A, B, and C soils should be constructed no steeper than ¾ horizontal to 1 vertical (¾H:1V), 1H:1V, and 1½H:1V, respectively. For situations where a higher strength soil overlies a lower strength soil, and the excavation extends into the lower strength soil, the slope of the entire excavation is governed by that required for the lower strength soil. In all cases, flatter slopes may be required if lower strength soils or adverse seepage conditions are encountered during construction.

For permanent excavations and slopes, we recommend that grades generally be no steeper than 3H:1V. It should be noted that ODOT routinely uses 2H:1V slopes for roadway embankments. While these steeper slopes may be used, it is our experience that the embankment faces on these slopes are more prone to erosion and sloughing.

5.8 Fill

Material for engineered fill or backfill required to achieve design grades should meet ODOT Item 203 “Embankment Fill” placement and compaction requirements. In general, suitable fills may consist of any non-organic soils having a maximum dry density as determined by the Standard Proctor (ASTM D 698) of 90 pounds per cubic foot (pcf) or greater. Additionally, fill utilized to achieve design grades should consist of granular materials similar to, or better than, the on-site soils. Otherwise, a reduced CBR value may be required for pavement design.

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. Depending on seasonal conditions, the on-site soils may be wet of optimum and may require scarification and aeration to achieve satisfactory compaction. However, if the construction schedule does not allow for scarification and aeration activities, it may be more practical or economical to utilize imported granular fill.

Fill should be placed in uniform layers not more than 8 inches thick (loose measure) and adequately keyed into stripped and scarified soils. All fill placed within pavement areas should be compacted to a dry density consistent with the requirements of ODOT Item 203, based on the maximum dry density as determined by ASTM D 698.

The on-site soils consist of predominantly cohesive soils. For the cohesive soils, a sheepsfoot roller should provide the most effective soil compaction. For granular fill, or dense-graded aggregate pavement base materials, 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.

6.0 QUALIFICATION OF RECOMMENDATIONS

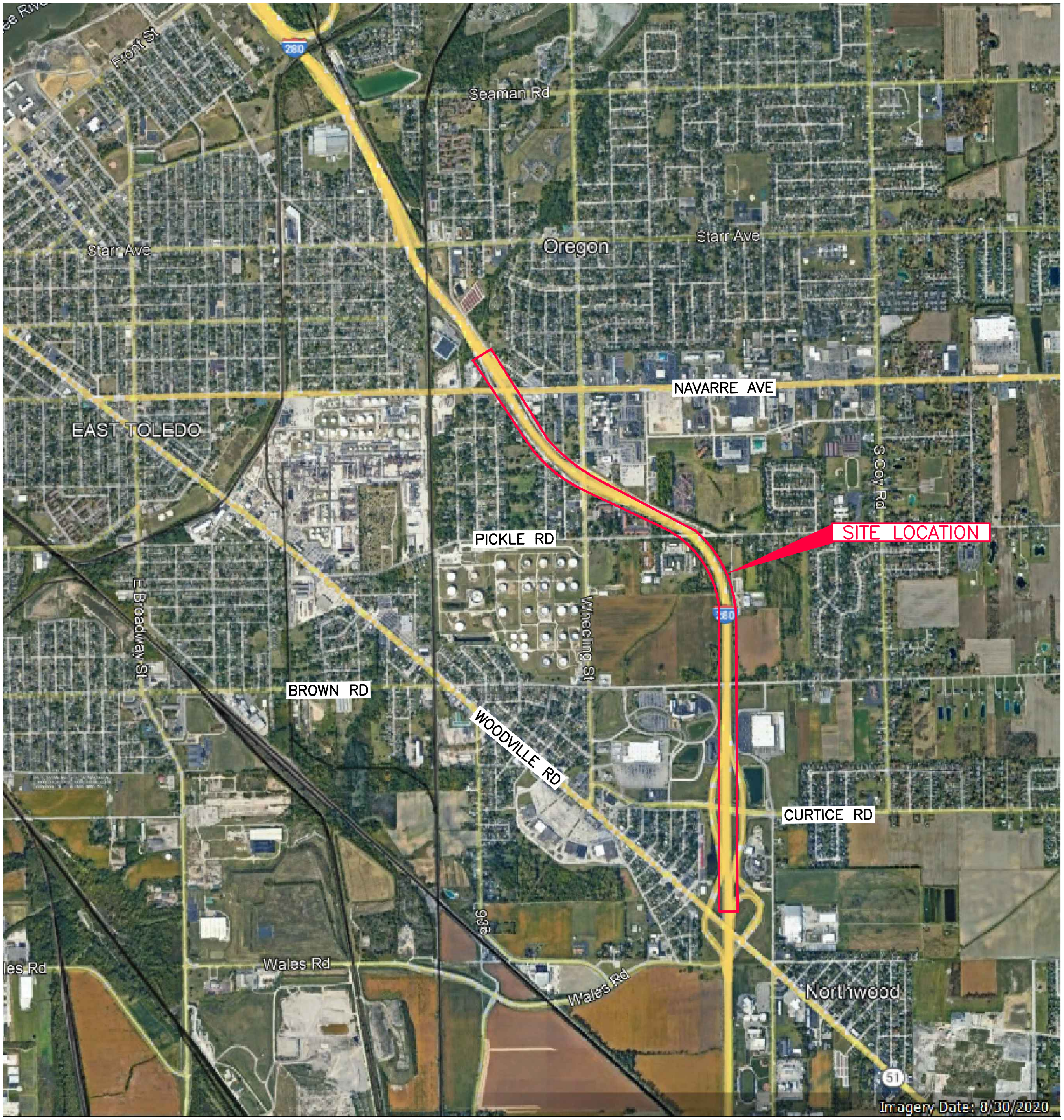
Our evaluation of the pavement design and construction conditions has been based on the data obtained during our field exploration, as well as the criteria in ODOT Geotechnical Bulletin GB-1 “Plan Subgrades” (January 15, 2021). The general subsurface conditions were based on interpretation of the subsurface data at specific boring locations. Regardless of the thoroughness of a subsurface exploration, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions at the time of construction are not as anticipated by the designers, or that the construction process has altered the soil conditions. This is especially true for previously developed sites. Therefore, experienced geotechnical engineers should observe earthwork and pavement 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 design recommendations in this report have been developed on the basis of the previously described project characteristics and subsurface conditions. If project criteria or locations change, TTL should be permitted to determine whether the recommendations must be modified. The findings of such a review will be presented in a supplemental report.

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, our findings derived, and our recommendations prepared 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



LEGEND

APPROXIMATE SITE LOCATION

N

APPROXIMATE SCALE – FEET

0 2,800 5,600

PLATE 1.0
SITE LOCATION MAP

WOO/LUC–280–06.20/00.00, PID 108584
I–280, WOOD CO. SLM 6.20–6.63 AND LUCAS CO. SLM 0.00–1.69
NORTHWOOD AND OREGON, OHIO

PREPARED FOR
TETRA TECH
TOLEDO, OHIO

DRAWN	TRR/9–12–22	CHECKED	LGH/9–16–22
REVISED	TRR/7–11–23	APPROVED	LGH/7–11–23
JOB NO.	2171101		
DRAWING NUMBER	**2171101–01G**		

TTL associates inc
Environmental, Geotechnical Engineering & Testing

GOOGLE EARTH IMAGE DATED AUGUST 30, 2020.

LEGEND

B-001-0-21 ⊕ APPROXIMATE TEST BORING LOCATION

A———A' MATCHLINE

APPROXIMATE SCALE – FEET

0 300 600

PLATE 2.1
TEST BORING LOCATION PLAN

WOO/LUC-280-06.20/0.00, PID 108584
I-280, WOOD CO. SLM 06.20-6.63 AND LUCAS CO. SLM 0.00-1.69
NORTHWOOD AND OREGON, OHIO

PREPARED FOR
TETRA TECH
TOLEDO, OHIO

DRAWN TRR/9-13-22	CHECKED LGH/9-16-22
REVISED	APPROVED
JOB NO. 2171101	
DRAWING NUMBER **2171101-02.1G**	TTL associates inc — Environmental, Geotechnical Engineering & Testing

LEGEND

B-011-0-21 APPROXIMATE TEST BORING LOCATION

A———A' MATCHLINE

APPROXIMATE SCALE – FEET

0 300 600

PLATE 2.2
TEST BORING LOCATION PLAN

WOO/LUC-280-06.20/00.00, PID 108584
I-280, WOOD CO. SLM 6.20-6.63 AND LUCAS CO. SLM 0.00-1.69
NORTHWOOD AND OREGON, OHIO

PREPARED FOR
TETRA TECH
TOLEDO, OHIO

DRAWN	TRR/9-13-22	CHECKED	LGH/9-16-22
REVISED		APPROVED	
JOB NO.	2171101		
DRAWING NUMBER	**2171101-02.2G**		

TTL associates inc
Environmental, Geotechnical Engineering & Testing

LEGEND

B-021-0-21 ⊕ APPROXIMATE TEST BORING LOCATION

B———————B' MATCHLINE

APPROXIMATE SCALE – FEET

0 300 600

GOOGLE EARTH IMAGE DATED AUGUST 30, 2020.

PLATE 2.3

TEST BORING LOCATION PLAN

WOO/LUC-280-06.20/00.00, PID 108584

I-280, WOOD CO. SLM 6.20-6.63 AND LUCAS CO. SLM 0.00-1.69

NORTHWOOD AND OREGON, OHIO

PREPARED FOR

TETRA TECH

TOLEDO, OHIO

DRAWN TRR/9-13-22	CHECKED
REVISED	APPROVED
JOB NO. 2171101	TTL associates inc — Environmental, Geotechnical Engineering & Testing
DRAWING NUMBER **2171101-02.3G**	

FIGURES

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 327+67, 5 RT	EXPLORATION ID B-001-0-21
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: WOO I-280 CL	PAGE 1 OF 1
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 616.0 (NAVD88) EOB: 15.0 ft.	
START: 5/15/22 END: 5/15/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.612167000, -83.476956000	

MATERIAL DESCRIPTION AND NOTES	ELEV. 616.0	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 - 10 INCHES	615.2																	
AGGREGATE BASE - 8 INCHES	614.5	1																
HARD, DARK BROWN, **SANDY SILT**, LITTLE CLAY, TRACE CRUSHED STONE, TRACE ORGANICS, DAMP FILL	614.0	2	6 6 3	10	67	SS-1	4.50	-	-	-	-	-	-	-	-	13	A-4a (V)	
STIFF, BROWN/GRAY, **SILTY CLAY**, LITTLE SAND, TRACE BRICK FRAGMENTS, TRACE ORGANICS, MOIST FILL							-	-	-	-	-	-	-	-	-	-	A-6b (V)	
	611.5	3–4	3 3 3	7	83	SS-2	1.50	5	2	13	22	58	33	15	18	20	A-6b (11)	
STIFF TO VERY STIFF, BROWN/GRAY, **CLAY**, SOME SILT, LITTLE SAND, TRACE ORGANICS, MOIST		5	3 3 5	9	67	SS-3	1.25	0	1	13	26	60	41	20	21	26	A-7-6 (13)	
@7': BROWN	608.0	6–7	3 3 4	8	89	SS-4	2.50	-	-	-	-	-	-	-	-	26	A-7-6 (V)	
MEDIUM STIFF, GRAY, **CLAY**, SOME SILT, LITTLE SAND, TRACE GRAVEL, DAMP		8–9	2 4 4	9	78	SS-5	0.75	-	-	-	-	-	-	-	-	18	A-7-6 (V)	
	602.5	10–13																
STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, MOIST	601.0	14	4 4 6	11	67	SS-6	1.50	-	-	-	-	-	-	-	-	21	A-6b (V)	
		EOB 15																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/16/23 12:25 - S:\PROJECTS\2171101.GPJ

PROJECT: WOO/LUC-280-06.20/00.00 TYPE: ROADWAY PID: 108584 BR ID: N/A START: 5/18/22 END: 5/18/22	DRILLING FIRM / OPERATOR: TTL / JW SAMPLING FIRM / LOGGER: TTL / KKC DRILLING METHOD: 3.25" HSA SAMPLING METHOD: SPT	DRILL RIG: CME 75 TRUCK 844 HAMMER: CME AUTOMATIC CALIBRATION DATE: 3/15/21 ENERGY RATIO (%): 66	STATION / OFFSET: 331+66, 14 LT ALIGNMENT: WOO I-280 CL ELEVATION: 617.0 (NAVD88) EOB: 15.0 ft. COORD: 41.613264000, -83.477001000

EXPLORATION ID: B-002-0-21

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 617.0
ASPHALT - 7 INCHES	616.4
CONCRETE - 8 INCHES	615.7
AGGREGATE BASE - 8 INCHES	615.1
VERY STIFF, BROWN, **SILT AND CLAY**, LITTLE SAND, DAMP	613.0
VERY STIFF, BROWN, **SILTY CLAY**, TRACE SAND, MOIST	611.0
STIFF, GRAY, **SILT AND CLAY**, SOME SAND, MOIST	610.5
STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST	608.5
MEDIUM STIFF, BROWN, **SILTY CLAY**, "AND" SAND, LITTLE GRAVEL, DAMP @11': GRAY/BROWN, LITTLE SAND, TRACE GRAVEL, MOIST	604.0
VERY STIFF, BROWN, **SILTY CLAY**, TRACE SAND, MOIST	602.0

EOB — 15

SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)
4 4 4	9	89	SS-1	3.25	0	2	9	24	65	34	19	15	17	A-6a (10)
3 3 4	8	94	SS-2	-	-	-	-	-	-	-	-	-	-	A-6a (V)
				3.50	0	1	6	51	42	34	18	16	21	A-6b (10)
4 4 5	10	72	SS-3	-	-	-	-	-	-	-	-	-	-	A-6b (V)
				-	0	1	31	22	46	26	15	11	19	A-6a (7)
2 3 3	7	94	SS-4	1.50	-	-	-	-	-	-	-	-	26	A-6b (V)
3 4 4	9	89	SS-5	0.50	-	-	-	-	-	-	-	-	15	A-6b (V)
3 2 3	6	100	SS-6	0.50	-	-	-	-	-	-	-	-	26	A-6b (V)
4 5 10	16	94	SS-7	3.50	-	-	-	-	-	-	-	-	25	A-6b (V)

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 335+61, 5 RT
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: WOO I-280 CL
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 616.4 (NAVD88) EOB: 15.0 ft.
START: 5/15/22 END: 5/15/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.614347000, -83.476965000

EXPLORATION ID B-003-0-21

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 616.4	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 - 13 INCHES	615.3	0 - 1.1																
AGGREGATE BASE - 7 INCHES	614.7	1.1 - 1.7																
HARD, GRAY/BROWN, **SILT AND CLAY**, SOME SAND, TRACE CRUSHED STONE, TRACE SLAG, TRACE ORGANICS, DAMP FILL	613.2	1.7 - 3.2	6 5 7	13	72	SS-1	4.50	0	3	20	26	51	29	17	12	16	A-6a (9)	
HARD, GRAY, **SILT AND CLAY**, TRACE SAND, MOIST		3.2 - 6.2	4 5 7	13	78	SS-2	4.25	0	2	6	24	68	32	18	14	20	A-6a (10)	
@4.7': VERY STIFF	610.2		5 7 9	18	67	SS-3	2.50	-	-	-	-	-	-	-	-	22	A-6a (V)	
VERY STIFF, BROWN/GRAY, **SILT**, SOME CLAY, LITTLE SAND, WET	608.4	6.2 - 8.0	4 4 3	8	89	SS-4	3.00	-	-	-	-	-	-	-	-	22	A-4b (V)	
STIFF, BROWN, **SILT**, SOME CLAY, TRACE SAND, WET	605.4	8.0 - 11.0	4 3 6	10	78	SS-5	1.50	-	-	-	-	-	-	-	-	28	A-4b (V)	
STIFF, BROWN, **SILTY CLAY**, TRACE SAND, MOIST		11.0 - 15.0																
@13': GRAY	601.4	EOB 15	2 2 3	6	94	SS-6	1.00	-	-	-	-	-	-	-	-	28	A-6b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/16/23 12:26 - S:\PROJECTS\2171101.GPJ

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 339+66, 6 LT	EXPLORATION ID B-004-0-21
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: WOO I-280 CL	
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 616.2 (NAVD88) EOB: 15.0 ft.	PAGE 1 OF 1
START: 5/18/22 END: 5/18/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.615459000, -83.477009000	

MATERIAL DESCRIPTION AND NOTES	ELEV. 616.2	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 - 15 INCHES	614.9	0 – 1.3																
AGGREGATE BASE - 10 INCHES	614.1	1.3 – 2.1																
HARD, WHITE/BROWN, **SILT AND CLAY**, LITTLE SAND, MOIST FILL	612.2	2.1 – 4.0	4 5 5	11	83	SS-1	4.50	0	3	13	29	55	29	14	15	16	A-6a (10)	
							-	-	-	-	-	-	-	-	-	-	A-6a (V)	
VERY STIFF, GRAY, **SILTY CLAY**, TRACE SAND, MOIST	611.1	4.0 – 5.1	2 3 4	8	100	SS-2	3.75	0	2	7	23	68	33	17	16	20	A-6b (10)	
VERY STIFF, GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, TRACE ORGANICS, MOIST	609.6	5.1 – 6.6	5 5 4	10	72	SS-3	2.50	1	1	31	24	43	28	13	15	18	A-6a (8)	
VERY STIFF, GRAY/BROWN, **SILTY CLAY**, TRACE SAND, MOIST @7': WET, BROWN, LITTLE SAND, TRACE GRAVEL	607.7	6.6 – 8.5	3 3 2	6	94	SS-4	3.00	-	-	-	-	-	-	-	-	26	A-6b (V)	
MEDIUM STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, WET (FREE WATER NOTED)	605.2	8.5 – 11.0	2 2 3	6	100	SS-5	0.75	-	-	-	-	-	-	-	-	35	A-6b (V)	
MEDIUM STIFF TO STIFF, GRAY/BROWN, **SILT**, SOME CLAY, TRACE SAND, MOIST		11.0 – 15.0	3 2 4	7	94	SS-6	1.25	-	-	-	-	-	-	-	-	28	A-4b (V)	
@13.5': BROWN	601.2	EOB 15	3 3 3	7	100	SS-7	2.50	-	-	-	-	-	-	-	-	25	A-4b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

PROJECT: WOO/LUC-280-06.20/00.00 TYPE: ROADWAY PID: 108584 BR ID: N/A START: 5/15/22 END: 5/15/22	DRILLING FIRM / OPERATOR: TTL / JW SAMPLING FIRM / LOGGER: TTL / KKC DRILLING METHOD: 3.25" HSA SAMPLING METHOD: SPT	DRILL RIG: CME 75 TRUCK 844 HAMMER: CME AUTOMATIC CALIBRATION DATE: 3/15/21 ENERGY RATIO (%): 66	STATION / OFFSET: 343+15, 14 RT ALIGNMENT: WOO I-280 CL ELEVATION: 616.1 (NAVD88) EOB: 15.0 ft. COORD: 41.616417000, -83.476971000

EXPLORATION ID: B-005-0-21

MATERIAL DESCRIPTION AND NOTES	ELEV. 616.1	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	615.6																	
AGGREGATE BASE - 7 INCHES	615.0																	
MEDIUM DENSE, GRAY/BROWN, **FINE SAND**, LITTLE CONCRETE FRAGMENTS, TRACE SILT, MOIST FILL	614.1	1	8 8 5	14	100	SS-1	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
VERY STIFF, BROWN/GRAY, **SILTY CLAY**, TRACE SAND, MOIST		2					-	-	-	-	-	-	-	-	-	-	A-6b (V)	
		3	2 2 2	4	89	SS-2	2.00	0	2	6	24	68	36	18	18	25	A-6b (11)	
@4': SOME SAND, Qu = 24.8 PSI = 3,570 PSF		4–5			71	ST-3	2.50	0	0	21	23	56	34	17	17	21	A-6b (11)	
	610.1	6																
STIFF, BROWN/GRAY, **SILTY CLAY**, TRACE SAND, MOIST		7	2 3 4	8	94	SS-4	1.00	-	-	-	-	-	-	-	-	27	A-6b (V)	
	607.6	8																
VERY STIFF, BROWN, **SILT**, LITTLE CLAY, TRACE SAND, WET		9	3 5 5	11	78	SS-5	3.25	-	-	-	-	-	-	-	-	26	A-4b (V)	
	602.6	10–13																
STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP	601.1	14	3 2 5	8	83	SS-6	1.50	-	-	-	-	-	-	-	-	16	A-6b (V)	
		EOB 15																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

PROJECT: WOO/LUC-280-06.20/00.00 TYPE: ROADWAY PID: 108584 BR ID: N/A START: 5/18/22 END: 5/18/22	DRILLING FIRM / OPERATOR: TTL / JW SAMPLING FIRM / LOGGER: TTL / KKC DRILLING METHOD: 3.25" HSA SAMPLING METHOD: SPT	DRILL RIG: CME 75 TRUCK 844 HAMMER: CME AUTOMATIC CALIBRATION DATE: 3/15/21 ENERGY RATIO (%): 66	STATION / OFFSET: 347+22, 6 LT ALIGNMENT: WOO I-280 CL ELEVATION: 616.5 (NAVD88) EOB: 15.0 ft. COORD: 41.617532000, -83.477017000	EXPLORATION ID B-006-0-21 PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 616.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT - 15 INCHES	615.2	0 – 1.3																
AGGREGATE BASE - 9 INCHES	614.5	1.3 – 2.0																
HARD, DARK GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MOIST		2.0 – 3.5	5 5 5	11	67	SS-1	4.50	1	3	21	22	53	28	15	13	15	A-6a (9)	
@3.5': BROWN		3.5 – 5.5			100	ST-2	4.50	7	3	26	22	42	26	15	11	13	A-6a (6)	
@5.5': VERY STIFF, WET	609.5	5.5 – 7.0	3 4 7	12	78	SS-3	2.50	-	-	-	-	-	-	-	-	26	A-6a (V)	
HARD, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, MOIST	608.0	7.0 – 8.5	5 7 7	15	72	SS-4	4.50	-	-	-	-	-	-	-	-	17	A-4a (V)	
VERY STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST	606.5	8.5 – 10.0	8 5 7	13	67	SS-5	3.75	-	-	-	-	-	-	-	-	21	A-6b (V)	
HARD, BROWN/GRAY, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, DAMP		11.0 – 12.5	8 8 8	18	67	SS-6	4.50	-	-	-	-	-	-	-	-	13	A-4a (V)	
@13.5'; STIFF, GRAY, **SANDY SILT**, SOME CLAY, MOIST	601.5	13.5 – 15.0 (EOB)	3 4 5	10	89	SS-7	1.00	-	-	-	-	-	-	-	-	21	A-4a (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/16/23 12:26 - S:\PROJECTS\2171101.GPJ

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 0+90, 5 RT	EXPLORATION ID B-007-0-21
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: LUC I-280 CL	
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 617.6 (NAVD88) EOB: 15.0 ft.	PAGE 1 OF 1
START: 5/15/22 END: 5/15/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.618638000, -83.476979000	

MATERIAL DESCRIPTION AND NOTES	ELEV. 617.6	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	617.1																	
AGGREGATE BASE - 6 INCHES	616.6	1																
HARD, BROWN/GRAY, **SILT AND CLAY**, LITTLE SAND, DAMP		2	6 8 8	18	72	SS-1	4.50	0	1	11	29	59	31	17	14	15	A-6a (10)	
@2.5': DAMP TO MOIST		3	9 9 7	18	78	SS-2	4.50	0	1	18	22	59	26	14	12	14	A-6a (9)	
@4': GRAY, TRACE GRAVEL, MOIST	612.6	4	9 9 12	23	67	SS-3	4.50	-	-	-	-	-	-	-	-	19	A-6a (V)	
STIFF TO VERY STIFF, BROWN, **SILTY CLAY**, TRACE SAND, MOIST		5					-	-	-	-	-	-	-	-	-	-	A-6b (V)	
		6	5 5 4	10	67	SS-4	2.00	-	-	-	-	-	-	-	-	27	A-6b (V)	
		7																
		8																
		9	3 5 4	10	78	SS-5	1.25	-	-	-	-	-	-	-	-	27	A-6b (V)	
		10																
		11																
		12																
	604.1	13																
STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST	602.6	14	3 3 3	7	83	SS-6	1.25	-	-	-	-	-	-	-	-	26	A-6b (V)	
		EOB 15																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/16/23 12:26 - S:\PROJECTS\2171101.GPJ

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 4+86, 6 LT
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: LUC I-280 CL
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 618.5 (NAVD88) EOB: 15.0 ft.
START: 5/18/22 END: 5/18/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.619726000, -83.477023000

EXPLORATION ID B-008-0-21

MATERIAL DESCRIPTION AND NOTES	ELEV. 618.5
ASPHALT - 14 INCHES	617.3
AGGREGATE BASE - 9 INCHES	616.6
HARD, BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP @3.5': DARK BROWN, TRACE SAND @5': BROWN/GRAY, MOIST @6.5': VERY STIFF, BROWN	610.0
STIFF TO VERY STIFF, BROWN, **SILTY CLAY**, TRACE SAND, MOIST @12': GRAY	603.5

EOB at 15 ft.

DEPTHS (ft)	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)
2.0–3.5	4 5 5	11	78	SS-1	4.50	1	2	9	20	68	28	16	12	14	A-6a (9)
3.5–5.0	4 4 5	10	67	SS-2	4.50	0	0	7	30	63	29	16	13	15	A-6a (9)
5.0–6.5	7 7 4	12	78	SS-3	4.25	-	-	-	-	-	-	-	-	16	A-6a (V)
6.5–8.0	4 4 6	11	67	SS-4	3.00	-	-	-	-	-	-	-	-	16	A-6a (V)
8.5–10.0	4 4 3	8	72	SS-5	2.50	-	-	-	-	-	-	-	-	24	A-6b (V)
11.0–12.5	3 4 4	9	78	SS-6	2.75	-	-	-	-	-	-	-	-	23	A-6b (V)
13.5–15.0	4 3 5	9	78	SS-7	1.00	-	-	-	-	-	-	-	-	27	A-6b (V)

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

PROJECT: WOO/LUC-280-06.20/00.00 TYPE: ROADWAY PID: 108584 BR ID: N/A START: 5/15/22 END: 5/15/22	DRILLING FIRM / OPERATOR: TTL / JW SAMPLING FIRM / LOGGER: TTL / KKC DRILLING METHOD: 3.25" HSA SAMPLING METHOD: SPT	DRILL RIG: CME 75 TRUCK 844 HAMMER: CME AUTOMATIC CALIBRATION DATE: 3/15/21 ENERGY RATIO (%): 66	STATION / OFFSET: 8+87, 5 RT ALIGNMENT: LUC I-280 CL ELEVATION: 618.3 (NAVD88) EOB: 15.0 ft. COORD: 41.620824000, -83.476985000

EXPLORATION ID B-009-0-21

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 618.3	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 - 11 INCHES	617.4																	
AGGREGATE BASE - 9 INCHES	616.6																	
VERY STIFF TO HARD, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP		1.5–3.0	9 10 7	19	72	SS-1	4.50	1	1	27	41	30	25	17	8	15	A-4a (7)	
@3': BROWN/GRAY		3.0–4.5	5 7 6	14	78	SS-2	4.50	-	-	-	-	-	-	-	-	14	A-4a (V)	
		4.5–6.0	5 7 10	19	67	SS-3	2.50	0	1	36	41	22	24	16	8	15	A-4a (6)	
@6': LITTLE CLAY, MOIST		6.0–7.5	5 6 10	18	67	SS-4	4.50	-	-	-	-	-	-	-	-	20	A-4a (V)	
	607.3	8.5–10.0	4 4 5	10	83	SS-5	2.75	-	-	-	-	-	-	-	-	21	A-4a (V)	
SOFT, BROWN, **SILT**, LITTLE CLAY, TRACE SAND, MOIST																		
@13.5': WET	603.3	13.5–15.0 EOB	5 4 3	8	89	SS-6	0.25	-	-	-	-	-	-	-	-	22	A-4b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 12+86, 6 LT	EXPLORATION ID B-010-0-21
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: LUC I-280 CL	
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 617.8 (NAVD88) EOB: 15.0 ft.	PAGE 1 OF 1
START: 5/18/22 END: 5/18/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.621919000, -83.477030000	

MATERIAL DESCRIPTION AND NOTES	ELEV. 617.8	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)
ASPHALT - 16 INCHES	616.5	0–1.3															
AGGREGATE BASE - 10 INCHES	615.6	1.3–2.2															
HARD, GRAY/BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MOIST	613.8	2.2–4.0	5 4 4	9	72	SS-1	4.50	1	1	24	21	53	25	14	11	13	A-6a (8)
			6 6 7	14	67	SS-2	-	-	-	-	-	-	-	-	-	-	A-6a (V)
HARD, DARK BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, MOIST		4.0–7.0					4.50	-	-	-	-	-	-	-	-	13	A-4a (V)
@6': GRAY, TRACE CLAY, TRACE ORGANICS	610.8		5 9 12	23	56	SS-3	-	0	0	45	47	8	25	17	8	15	A-4a (4)
			5 5 4	10	72	SS-4	-	-	-	-	-	-	-	-	-	-	A-4a (V)
VERY STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, MOIST	609.3	7.0–8.5					2.75	-	-	-	-	-	-	-	-	18	A-6b (V)
@8.5': TRACE SAND			3 3 3	7	89	SS-5	2.50	-	-	-	-	-	-	-	-	24	A-6b (V)
@11': BROWN			2 3 4	8	100	SS-6	2.50	-	-	-	-	-	-	-	-	27	A-6b (V)
@13.5': LITTLE SAND, TRACE GRAVEL	602.8	EOB 15	3 3 3	7	94	SS-7	2.50	-	-	-	-	-	-	-	-	28	A-6b (V)

GRADATION (%): GR, CS, FS, SI, CL; ATTERBERG: LL, PL, PI; BACK FILL

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/16/23 12:26 - S:\PROJECTS\2171101.GPJ

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 16+87, 6 RT	EXPLORATION ID B-011-0-21
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: LUC I-280 CL	
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 616.9 (NAVD88) EOB: 15.0 ft.	PAGE
START: 5/16/22 END: 5/16/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.623021000, -83.476992000	1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 616.9	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 - 11 INCHES	616.0																	
AGGREGATE BASE - 8 INCHES	615.3																	
HARD, BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST	613.9		4 3 5	9	78	SS-1	4.50	6	5	9	28	52	26	15	11	15	A-6a (8)	
HARD, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MOIST	612.4		5 6 7	14	72	SS-2	4.50	1	0	22	21	56	27	15	12	15	A-6a (9)	
HARD, GRAY/BROWN, **SILT**, LITTLE CLAY, TRACE SAND, MOIST	610.9		9 9 11	22	83	SS-3	4.50	-	-	-	-	-	-	-	-	16	A-4b (V)	
STIFF, BROWN/GRAY, **SILTY CLAY**, TRACE SAND, MOIST			5 4 3	8	89	SS-4	1.50	-	-	-	-	-	-	-	-	23	A-6b (V)	
@8.5': GRAY/BROWN	605.9		3 3 3	7	94	SS-5	1.75	-	-	-	-	-	-	-	-	31	A-6b (V)	
MEDIUM STIFF, BROWN, **SILTY CLAY**, TRACE SAND, MOIST			3 4 4	9	100	SS-6	0.75	-	-	-	-	-	-	-	-	26	A-6b (V)	
@13.5': BROWN/GRAY, SOME SAND	601.9	EOB 15	2 2 5	8	100	SS-7	0.75	-	-	-	-	-	-	-	-	26	A-6b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

PROJECT: WOO/LUC-280-06.20/00.00 TYPE: ROADWAY PID: 108584 BR ID: N/A START: 5/18/22 END: 5/18/22	DRILLING FIRM / OPERATOR: TTL / JW SAMPLING FIRM / LOGGER: TTL / KKC DRILLING METHOD: 3.25" HSA SAMPLING METHOD: SPT	DRILL RIG: CME 75 TRUCK 844 HAMMER: CME AUTOMATIC CALIBRATION DATE: 3/15/21 ENERGY RATIO (%): 66	STATION / OFFSET: 20+86, 14 LT ALIGNMENT: LUC I-280 CL ELEVATION: 616.2 (NAVD88) EOB: 15.0 ft. COORD: 41.624115000, -83.477041000

EXPLORATION ID B-012-0-21

MATERIAL DESCRIPTION AND NOTES	ELEV. 616.2	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 - 6.5 INCHES	615.7																	
CONCRETE - 10 INCHES	614.8	1																
AGGREGATE BASE - 7.5 INCHES	614.2	2																
HARD, DARK BROWN, **SANDY SILT**, LITTLE CLAY, TRACE ORGANICS, DAMP		3	10 9 11	22	72	SS-1	4.50	0	1	38	45	16	23	16	7	14	A-4a (5)	
@3.5': DARK BROWN, SOME CLAY		4	11 13 13	29	67	SS-2	-	0	2	26	45	27	26	16	10	15	A-4a (7)	
@5': BROWN, SOME GRAVEL, LITTLE CLAY	609.7	5–6	15 10 7	19	78	SS-3	4.50	-	-	-	-	-	-	-	-	13	A-4a (V)	
STIFF, BROWN, **SILTY CLAY**, SOME SAND, MOIST		7–8	3 4 3	8	100	SS-4	1.00	-	-	-	-	-	-	-	-	28	A-6b (V)	
@8.5': TRACE SAND	606.2	9–10	3 2 3	6	94	SS-5	1.75	-	-	-	-	-	-	-	-	28	A-6b (V)	
@10': SOME SAND	603.2	11–12	4 5 4	10	89	SS-6	1.75	-	-	-	-	-	-	-	-	26	A-6b (V)	
STIFF, BROWN/GRAY, **SILT**, SOME CLAY, LITTLE GRAVEL, TRACE SAND, MOIST	601.2	13–14, EOB 15	2 3 4	8	100	SS-7	1.25	-	-	-	-	-	-	-	-	17	A-4b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 24+86, 6 RT
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: LUC I-280 CL
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 615.5 (NAVD88) EOB: 15.0 ft.
START: 5/16/22 END: 5/16/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.625212000, -83.476999000

EXPLORATION ID B-013-0-21

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 615.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT - 12 INCHES	614.5																	
AGGREGATE BASE - 7 INCHES	613.9																	
HARD, GRAY, **CLAY**, SOME SILT, TRACE SAND, DRY	612.5		7 5 7	13	78	SS-1	4.50	0	1	4	27	68	42	21	21	13	A-7-6 (13)	
HARD, DARK GRAY, **SANDY SILT**, LITTLE CLAY, MOIST			7 7 9	18	72	SS-2	4.50	0	2	41	44	13	23	14	9	15	A-4a (4)	
@4.5' VERY STIFF, BROWN/GRAY, TRACE CLAY			10 11 11	24	67	SS-3	3.50	0	0	44	48	8	24	15	9	15	A-4a (4)	
	608.5		3 2 3	6	89	SS-4	-	-	-	-	-	-	-	-	-	-	A-4a (V)	
STIFF, BROWN, **SILT AND CLAY**, TRACE SAND, WET							1.25	-	-	-	-	-	-	-	-	28	A-6a (V)	
			3 4 3	8	83	SS-5	1.25	-	-	-	-	-	-	-	-	26	A-6a (V)	
@10': GRAY, LITTLE SAND, TRACE GRAVEL	604.0																	
MEDIUM STIFF, GRAY, **SILT AND CLAY**, TRACE SAND, MOIST Qu = 12.6 PSI = 1,815 PSF					96	ST-6	1.25	0	2	7	23	68	29	18	11	26	A-6a (8)	
@13.5': WET	600.5	EOB 15	2 2 3	6	100	SS-7	0.50	-	-	-	-	-	-	-	-	23	A-4a (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

PROJECT: WOO/LUC-280-06.20/00.00 TYPE: ROADWAY PID: 108584 BR ID: N/A START: 5/17/22 END: 5/17/22	DRILLING FIRM / OPERATOR: TTL / JW SAMPLING FIRM / LOGGER: TTL / KKC DRILLING METHOD: 3.25" HSA SAMPLING METHOD: SPT	DRILL RIG: CME 75 TRUCK 844 HAMMER: CME AUTOMATIC CALIBRATION DATE: 3/15/21 ENERGY RATIO (%): 66	STATION / OFFSET: 28+88, 7 LT ALIGNMENT: LUC I-280 CL ELEVATION: 614.4 (NAVD88) EOB: 15.0 ft. COORD: 41.626312000, -83.477106000

EXPLORATION ID B-014-0-21

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 614.4	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 - 14 INCHES	613.2	0 - 1.2																
AGGREGATE BASE - 9 INCHES	612.5	1.2 - 1.9																
HARD, DARK BROWN, **SANDY SILT**, LITTLE CLAY, DAMP		2 - 3.5	5 6 8	15	67	SS-1	4.50	0	1	33	47	19	24	15	9	14	A-4a (6)	
@3.5': BROWN/GRAY, TRACE CLAY	609.4	3.5 - 5	11 9 9	20	56	SS-2	4.50	0	0	53	41	6	24	16	8	15	A-4a (2)	
VERY STIFF TO HARD, BROWN, **SILTY CLAY**, LITTLE SAND, MOIST		5 - 6.5	12 12 9	23	67	SS-3	4.50	-	-	-	-	-	-	-	-	20	A-6b (V)	
@6.5': TRACE SAND		6.5 - 8	4 5 6	12	83	SS-4	2.00	-	-	-	-	-	-	-	-	26	A-6b (V)	
	604.4	8.5 - 10	6 5 5	11	83	SS-5	2.00	-	-	-	-	-	-	-	-	25	A-6b (V)	
STIFF, BROWN/GRAY, **SILTY CLAY**, SOME SAND, MOIST	600.9	11 - 12.5	5 6 5	12	89	SS-6	1.50	-	-	-	-	-	-	-	-	27	A-6b (V)	
MEDIUM STIFF, GRAY, **SILTY CLAY**, TRACE SAND, MOIST	599.4	13.5 - 15 (EOB)	3 2 4	7	100	SS-7	0.75	-	-	-	-	-	-	-	-	20	A-6b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/16/23 12:26 - S:\PROJECTS\2171101.GPJ

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 32+58, 5 RT	EXPLORATION ID B-015-0-21
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: LUC I-280 CL	
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 614.3 (NAVD88) EOB: 15.0 ft.	PAGE 1 OF 1
START: 5/16/22 END: 5/16/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.627308000, -83.477363000	

MATERIAL DESCRIPTION AND NOTES	ELEV. 614.3	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)
ASPHALT - 14 INCHES	613.1	0 – 1.2															
AGGREGATE BASE - 10 INCHES	612.3	1.2 – 2.0															
HARD, DARK GRAY, **SILT AND CLAY**, SOME SAND, TRACE CRUSHED STONE, TRACE WOOD, MOIST FILL	610.8	2.0 – 3.5	5 6 6	13	67	SS-1	4.50	4	6	19	37	34	27	14	13	15	A-6a (8)
HARD, GRAY, **SILT AND CLAY**, AND SAND, MOIST	609.3	3.5 – 5.0	3 3 5	9	83	SS-2	4.25	0	3	42	28	27	28	17	11	18	A-6a (4)
STIFF, BROWN/GRAY, **SANDY SILT**, SOME CLAY, MOIST	607.8	5.0 – 6.5	5 7 8	16	72	SS-3	1.50	-	-	-	-	-	-	-	-	20	A-4a (V)
STIFF TO VERY STIFF, BROWN, **SILTY CLAY**, TRACE SAND, MOIST		6.5 – 8.0	4 4 3	8	67	SS-4	2.75	-	-	-	-	-	-	-	-	28	A-6b (V)
@8.5': LITTLE SAND, TRACE GRAVEL		8.5 – 10.0	3 3 4	8	83	SS-5	1.00	-	-	-	-	-	-	-	-	31	A-6b (V)
@11': SOME SAND, LITTLE GRAVEL		11.0 – 12.5	4 7 9	18	67	SS-6	3.75	-	-	-	-	-	-	-	-	20	A-6b (V)
@13': GRAY, LITTLE SAND, TRACE GRAVEL	599.3	13.5 – 15.0 EOB	2 3 3	7	89	SS-7	1.00	-	-	-	-	-	-	-	-	25	A-6b (V)

BACK FILL

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/16/23 12:27 - S:\PROJECTS\2171101.GPJ

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 36+57, 7 LT	EXPLORATION ID B-016-0-21
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: LUC I-280 CL	
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 613.0 (NAVD88) EOB: 15.0 ft.	PAGE 1 OF 1
START: 5/17/22 END: 5/17/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.628288000, -83.478004000	

MATERIAL DESCRIPTION AND NOTES	ELEV. 613.0	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 - 16 INCHES	611.7	0–1.3																
AGGREGATE BASE - 9 INCHES	610.9	1.3–2.1																
STIFF, GRAY/BROWN, **SANDY SILT**, TRACE CLAY, DAMP	609.5	2.1–3.5	6 7 7	15	67	SS-1	-	0	1	48	47	4	NP	NP	NP	13	A-4a (3)	
VERY STIFF, BROWN, **SILTY CLAY**, TRACE SAND, MOIST	607.0	3.5–6.0	5 5 6	12	72	SS-2	3.75	-	-	-	-	-	-	-	-	23	A-6b (V)	
			5 6 6	13	72	SS-3	3.00	0	1	8	23	68	37	19	18	25	A-6b (11)	
STIFF TO VERY STIFF, BROWN, **SILT AND CLAY**, TRACE SAND, MOIST @6': TRACE SAND @6.5': Qu = 17.8 PSI = 2,565 PSF	604.5	6.0–8.5					-	-	-	-	-	-	-	-	-	-	A-6a (V)	
					92	ST-4	2.00	0	1	6	25	68	34	20	14	26	A-6a (10)	
MEDIUM STIFF, BROWN, **SILT**, SOME CLAY, TRACE SAND, WET	602.0	8.5–11.0	3 3 4	8	10	SS-5	0.75	-	-	-	-	-	-	-	-	27	A-4b (V)	
MEDIUM STIFF, GRAY, **SILTY CLAY**, TRACE SAND, MOIST	599.5	11.0–13.5	3 4 5	10	94	SS-6	0.50	-	-	-	-	-	-	-	-	29	A-6b (V)	
MEDIUM STIFF, GRAY, **SILT**, SOME CLAY, LITLTE SAND, TRACE GRAVEL, MOIST	598.0	13.5–15.0 EOB	3 4 5	10	89	SS-7	0.75	-	-	-	-	-	-	-	-	17	A-4b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/16/23 12:27 - S:\PROJECTS\2171101.GPJ

PROJECT: WOO/LUC-280-06.20/00.00 TYPE: ROADWAY PID: 108584 BR ID: N/A START: 5/16/22 END: 5/16/22	DRILLING FIRM / OPERATOR: TTL / JW SAMPLING FIRM / LOGGER: TTL / KKC DRILLING METHOD: 3.25" HSA SAMPLING METHOD: SPT	DRILL RIG: CME 75 TRUCK 844 HAMMER: CME AUTOMATIC CALIBRATION DATE: 3/15/21 ENERGY RATIO (%): 66	STATION / OFFSET: 40+56, 5 RT ALIGNMENT: LUC I-280 CL ELEVATION: 611.8 (NAVD88) EOB: 15.0 ft. COORD: 41.629188000, -83.478833000	EXPLORATION ID B-017-0-21 PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 611.8	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT - 15 INCHES	610.5																	
AGGREGATE BASE - 9 INCHES	609.8																	
VERY STIFF, BROWN/GRAY, **SANDY SILT**, WITH CLAY, TRACE GRAVEL, DAMP FILL	608.3		5 6 6	13	72	SS-1	2.50	1	4	12	42	41	25	17	8	16	A-4a (8)	
STIFF, BLACK, **SILTY CLAY**, SOME SAND, TRACE SLAG, MOIST FILL		W	7 4 3	8	67	SS-2	1.50	5	8	18	28	41	40	22	18	27	A-6b (10)	
	605.8		4 5 5	11	78	SS-3	-	-	-	-	-	-	-	-	-	-	A-6b (V)	
VERY STIFF, GRAY, **SILTY CLAY**, TRACE SAND, MOIST	605.3						2.75	-	-	-	-	-	-	-	-	21	A-6b (V)	
STIFF, BROWN, **SILTY CLAY**, TRACE SAND, MOIST	603.8		3 2 2	4	94	SS-4	1.50	-	-	-	-	-	-	-	-	27	A-6b (V)	
VERY STIFF TO HARD, BROWN, **SILTY CLAY**, TRACE SAND, MOIST			2 3 3	7	100	SS-5	2.25	-	-	-	-	-	-	-	-	27	A-6b (V)	
	598.3		3 6 6	13	72	SS-6	4.50	1	3	7	22	67	39	20	19	25	A-6b (12)	
VERY STIFF, GRAY, **SILT**, SOME CLAY, TRACE SAND, TRACE GRAVEL, MOIST	596.8	EOB 15	2 3 4	8	100	SS-7	2.50	-	-	-	-	-	-	-	-	19	A-4b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/16/23 12:27 - S:\PROJECTS\2171101.GPJ

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 44+51, 7 LT
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: LUC I-280 CL
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 609.5 (NAVD88) EOB: 15.0 ft.
START: 5/17/22 END: 5/17/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.629884000, -83.479937000

EXPLORATION ID B-018-0-21

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 609.5	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 - 15 INCHES	608.2																	
AGGREGATE BASE - 8 INCHES	607.6																	
HARD, BROWN/GRAY, **SILT AND CLAY**, SOME SAND, MOIST			7 5 5	11	78	SS-1	4.50	0	2	27	25	46	27	16	11	14	A-6a (8)	
							-	-	-	-	-	-	-	-	-	-	A-6a (V)	
@4': VERY STIFF, BROWN, TRACE SAND, TRACE GRAVEL	604.5		5 5 5	11	72	SS-2	3.50	1	2	5	24	68	33	19	14	21	A-6a (10)	
MEDIUM STIFF TO STIFF, BROWN, **SILT AND CLAY**, TRACE SAND, TRACE GRAVEL, MOIST			6 6 7	14	83	SS-3	1.00	0	2	6	24	68	31	18	13	26	A-6a (9)	
							-	-	-	-	-	-	-	-	-	-	A-6a (V)	
@6.7': GRAY, LITTLE SAND			3 4 5	10	94	SS-4	1.00	-	-	-	-	-	-	-	-	26	A-6a (V)	
			4 4 6	11	89	SS-5	1.00	-	-	-	-	-	-	-	-	16	A-6a (V)	
	596.0		5 6 8	15	78	SS-6	0.75	-	-	-	-	-	-	-	-	17	A-6a (V)	
MEDIUM STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP	594.5	EOB 15	3 2 4	7	100	SS-7	0.75	-	-	-	-	-	-	-	-	17	A-6b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/16/23 12:27 - S:\PROJECTS\2171101.GPJ

PROJECT: WOO/LUC-280-06.20/00.00 TYPE: ROADWAY PID: 108584 BR ID: N/A START: 5/16/22 END: 5/16/22	DRILLING FIRM / OPERATOR: TTL / JW SAMPLING FIRM / LOGGER: TTL / KKC DRILLING METHOD: 3.25" HSA SAMPLING METHOD: SPT	DRILL RIG: CME 75 TRUCK 844 HAMMER: CME AUTOMATIC CALIBRATION DATE: 3/15/21 ENERGY RATIO (%): 66	STATION / OFFSET: 48+67, 6 RT ALIGNMENT: LUC I-280 CL ELEVATION: 608.4 (NAVD88) EOB: 15.0 ft. COORD: 41.630479000, -83.481231000	EXPLORATION ID B-019-0-21 PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 608.4	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 - 15 INCHES	607.1																	
AGGREGATE BASE - 9 INCHES	606.4																	
VERY STIFF, BROWN, **SILT AND CLAY**, TRACE SAND, TRACE GRAVEL, MOIST	604.9		3 3 4	8	89	SS-1	2.75	4	1	5	24	66	32	18	14	21	A-6a (10)	
MEDIUM STIFF, BROWN, **SILT AND CLAY**, TRACE SAND, TRACE GRAVEL, MOIST	603.4		4 3 3	7	94	SS-2	0.75	0	2	5	25	68	30	19	11	26	A-6a (8)	
VERY STIFF, BROWN, **SILT**, SOME CLAY, TRACE SAND, WET	601.4		5 5 5	11	89	SS-3	2.25	-	-	-	-	-	-	-	-	24	A-4b (V)	
			3 3 3	7	89	SS-4	-	-	-	-	-	-	-	-	-	-	A-4b (V)	
MEDIUM STIFF, BROWN/GRAY, **SILTY CLAY**, TRACE SAND, MOIST	599.9						0.75	-	-	-	-	-	-	-	-	26	A-6b (V)	
STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP	594.9		2 3 3	7	100	SS-5	1.25	-	-	-	-	-	-	-	-	17	A-6b (V)	
			4 5 5	11	89	SS-6	1.00	-	-	-	-	-	-	-	-	16	A-6b (V)	
SOFT, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST	593.4	EOB 15	2 1 2	3	100	SS-7	0.50	-	-	-	-	-	-	-	-	18	A-6b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 52+57, 7 LT	EXPLORATION ID B-020-0-21
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: LUC I-280 CL	
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 606.4 (NAVD88) EOB: 15.0 ft.	PAGE 1 OF 1
START: 5/17/22 END: 5/17/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.630891000, -83.482548000	

MATERIAL DESCRIPTION AND NOTES	ELEV. 606.4	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 - 16 INCHES	605.1																	
AGGREGATE BASE - 9 INCHES	604.3																	
HARD, BROWN, **SANDY SILT**, WITH CLAY, MOIST	602.9	2–3	3 4 4	9	89	SS-1	4.25	0	2	6	40	52	27	17	10	19	A-4a (8)	
STIFF, BROWN, **SILT AND CLAY**, TRACE SAND, MOIST		3.5–5	3 2 3	6	100	SS-2	1.50	0	2	5	25	68	29	15	14	24	A-6a (10)	
@5.5': GRAY, LITTLE SAND, TRACE GRAVEL	599.9	5–6.5	4 4 5	10	89	SS-3	1.75	2	7	11	28	52	26	15	11	17	A-6a (8)	
MEDIUM STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST		6.5–8	3 3 4	8	94	SS-4	0.50	-	-	-	-	-	-	-	-	23	A-6b (V)	
	595.4	8.5–10	3 4 3	8	89	SS-5	0.50	3	5	6	20	66	30	14	16	20	A-6b (10)	
STIFF, GRAY, **SILT**, SOME CLAY, LITTLE SAND, TRACE GRAVEL, MOIST	592.9	11–12.5	4 4 4	9	100	SS-6	1.00	-	-	-	-	-	-	-	-	17	A-4b (V)	
MEDIUM STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP	591.4	13.5–15 EOB	1 3 3	7	100	SS-7	0.75	-	-	-	-	-	-	-	-	17	A-6b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

PROJECT: WOO/LUC-280-06.20/00.00 TYPE: ROADWAY PID: 108584 BR ID: N/A START: 5/16/22 END: 5/16/22	DRILLING FIRM / OPERATOR: TTL / JW SAMPLING FIRM / LOGGER: TTL / KKC DRILLING METHOD: 3.25" HSA SAMPLING METHOD: SPT	DRILL RIG: CME 75 TRUCK 844 HAMMER: CME AUTOMATIC CALIBRATION DATE: 3/15/21 ENERGY RATIO (%): 66	STATION / OFFSET: 56+55, 7 RT ALIGNMENT: LUC I-280 CL ELEVATION: 604.6 (NAVD88) EOB: 15.0 ft. COORD: 41.631377000, -83.483854000

EXPLORATION ID B-021-0-21

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 604.6	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 - 14 INCHES	603.4																	
AGGREGATE BASE - 7 INCHES	602.8																	
STIFF, GRAY/BROWN, **SILTY CLAY**, TRACE SAND, TRACE SLAG, MOIST FILL	600.6	2-3.5	4 4 4	9	89	SS-1	2.00	7	4	5	21	63	30	13	17	18	A-6b (11)	
MEDIUM STIFF, BROWN/GRAY, **SILT AND CLAY**, TRACE SAND, TRACE GRAVEL, MOIST		3.5-5	3 4 4	9	100	SS-2	0.75	1	1	5	25	68	32	17	15	24	A-6a (10)	
	598.1	5-6.5	4 4 5	10	78	SS-3	0.75	1	2	5	24	68	32	18	14	26	A-6a (10)	
MEDIUM STIFF, GRAY, **SILTY CLAY**, SOME SAND, TRACE GRAVEL, MOIST		6.5-8	4 3 3	7	89	SS-4	0.50	-	-	-	-	-	-	-	-	17	A-6b (V)	
		8.5-10	3 3 4	8	89	SS-5	0.75	-	-	-	-	-	-	-	-	18	A-6b (V)	
		11-12.5	3 4 3	8	94	SS-6	0.50	-	-	-	-	-	-	-	-	18	A-6b (V)	
@13.5': LITTLE SAND	589.6	13.5-15	2 2 3	6	100	SS-7	0.50	-	-	-	-	-	-	-	-	17	A-6b (V)	

EOB 15

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/16/23 12:27 - S:\PROJECTS\2171101.GPJ

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 60+52, 6 LT	EXPLORATION ID B-022-0-21
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: LUC I-280 CL	
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 602.8 (NAVD88) EOB: 15.0 ft.	PAGE 1 OF 1
START: 5/17/22 END: 5/17/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.631796000, -83.485194000	

MATERIAL DESCRIPTION AND NOTES	ELEV. 602.8	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 - 15 INCHES	601.5	0–1.3																
AGGREGATE BASE - 9 INCHES	600.8	1.3–2.0																
STIFF, BROWN/GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST	599.3	2–3.5	5 4 2	7	83	SS-1	1.25	9	5	10	19	57	24	13	11	15	A-6a (8)	
MEDIUM STIFF, BROWN/GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST Qu = 8.0 PSI = 1,155 PSF		3.5–5.5			100	ST-2	0.66	6	7	7	20	60	27	16	11	18	A-6a (8)	
@6': SOME SAND, LITTLE GRAVEL		5.5–7	2 4 3	8	100	SS-3	0.50	11	11	11	20	47	26	15	11	18	A-6a (7)	
	594.8	7–8.5	1 2 2	4	94	SS-4	0.50	-	-	-	-	-	-	-	-	18	A-6a (V)	
MEDIUM STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST							-	-	-	-	-	-	-	-	-	-	A-6b (V)	
		8.5–10	2 3 3	7	100	SS-5	0.50	-	-	-	-	-	-	-	-	18	A-6b (V)	
		11–12.5	3 3 5	9	83	SS-6	-	-	-	-	-	-	-	-	-	19	A-6b (V)	
	587.8	13.5–15	2 4 5	10	94	SS-7	0.50	-	-	-	-	-	-	-	-	18	A-6b (V)	
		EOB 15																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 63+13, 7 RT	EXPLORATION ID B-023-0-21
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: LUC I-280 CL	
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 601.7 (NAVD88) EOB: 15.0 ft.	PAGE 1 OF 1
START: 5/16/22 END: 5/16/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.632141000, -83.486034000	

MATERIAL DESCRIPTION AND NOTES	ELEV. 601.7	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 - 15 INCHES	600.4	0–1.3																
AGGREGATE BASE - 9 INCHES	599.7	1.3–2.0																
MEDIUM STIFF TO STIFF, GRAY/BROWN, **SILT AND CLAY**, LITTLE SAND, LITTLE CRUSHED STONE, TRACE SLAG, MOIST FILL	598.2	2.0–3.5	5 9 8	19	67	SS-1	1.00	17	9	9	18	47	28	15	13	15	A-6a (7)	
SOFT, GRAY/BROWN, **SILTY CLAY**, LITTLE SAND, TRACE CRUSHED STONE, MOIST FILL		3.5–5.0	5 3 2	6	78	SS-2	0.25	8	5	11	24	52	32	16	16	25	A-6b (10)	
@5': GRAY		5.0–6.5	2 2 2	4	100	SS-3	0.25	-	-	-	-	-	-	-	-	27	A-6b (V)	
@6.5': LITTLE CRUSHED STONE	593.2	6.5–8.0 (W at 8.0)	2 2 1	3	100	SS-4	-	-	-	-	-	-	-	-	-	21	A-6b (V)	
SOFT, BROWN/GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST		8.5–10.0	2 2 3	6	94	SS-5	0.25	-	-	-	-	-	-	-	-	19	A-6b (V)	
@11': GRAY		11.0–12.5	4 3 4	8	89	SS-6	0.25	-	-	-	-	-	-	-	-	19	A-6b (V)	
	586.7	13.5–15.0 EOB	2 3 2	6	100	SS-7	0.25	-	-	-	-	-	-	-	-	19	A-6b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/16/23 12:28 - S:\PROJECTS\2171101.GPJ

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 66+91, 6 LT	EXPLORATION ID B-024-0-21
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: LUC I-280 CL	
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 599.9 (NAVD88) EOB: 15.0 ft.	PAGE 1 OF 1
START: 5/17/22 END: 5/17/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.632661000, -83.487230000	

MATERIAL DESCRIPTION AND NOTES	ELEV. 599.9	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)
ASPHALT - 15 INCHES	598.6	0–1.3															
AGGREGATE BASE - 10 INCHES	597.8	1.3–2.1															
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MOIST		2.0–3.5	4 2 3	6	89	SS-1	3.75	5	8	15	26	46	29	15	14	15	A-6a (9)
	595.9						-	-	-	-	-	-	-	-	-	-	A-6a (V)
SOFT, BROWN/GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST		3.5–5.0	4 4 3	8	83	SS-2	0.25	-	-	-	-	-	-	-	-	28	A-6b (V)
@5': GRAY, TRACE SAND		5.0–6.5	3 4 4	9	89	SS-3	0.25	0	1	3	28	68	34	17	17	31	A-6b (11)
@6.5': SOME SAND		6.5–8.0	4 2 3	6	94	SS-4	0.25	-	-	-	-	-	-	-	-	19	A-6b (V)
		8.5–10.0	2 3 2	6	89	SS-5	0.25	-	-	-	-	-	-	-	-	19	A-6b (V)
@11': LITTLE SAND		11.0–12.5	3 4 4	9	83	SS-6	0.25	-	-	-	-	-	-	-	-	19	A-6b (V)
@13.5': SOFT TO MEDIUM STIFF	584.9	13.5–15.0 EOB	2 3 3	7	94	SS-7	0.50	-	-	-	-	-	-	-	-	19	A-6b (V)

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 70+96, 6 RT	EXPLORATION ID B-025-0-21
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: LUC I-280 CL	
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 597.8 (NAVD88) EOB: 15.0 ft.	PAGE 1 OF 1
START: 5/16/22 END: 5/16/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.633396000, -83.488339000	

MATERIAL DESCRIPTION AND NOTES	ELEV. 597.8	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 - 15 INCHES	596.5																	
AGGREGATE BASE - 9 INCHES	595.8																	
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MOIST	594.3		3 4 4	9	89	SS-1	3.50	6	10	18	26	40	28	15	13	17	A-6a (7)	
HARD, BROWN/GRAY, **SILT AND CLAY**, TRACE SAND, MOIST	592.8		5 5 5	11	72	SS-2	4.25	0	2	5	25	68	31	19	12	22	A-6a (9)	
MEDIUM STIFF, GRAY, **SILT**, SOME CLAY, TRACE SAND, WET	591.3		4 4 3	8	83	SS-3	0.50	-	-	-	-	-	-	-	-	29	A-4b (V)	
MEDIUM STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP	589.3		2 3 3	7	100	SS-4	0.50	-	-	-	-	-	-	-	-	17	A-6b (V)	
VERY STIFF, GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST	586.8		3 4 3	8	94	SS-5	3.00	3	4	7	26	60	28	16	12	18	A-6a (9)	
MEDIUM STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST	584.3		3 3 4	8	89	SS-6	0.50	-	-	-	-	-	-	-	-	18	A-6b (V)	
@13.5': DAMP		EOB 15	2 2 2	4	100	SS-7	0.50	-	-	-	-	-	-	-	-	16	A-6b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

PROJECT: WOO/LUC-280-06.20/00.00 TYPE: ROADWAY PID: 108584 BR ID: N/A START: 5/17/22 END: 5/17/22	DRILLING FIRM / OPERATOR: TTL / JW SAMPLING FIRM / LOGGER: TTL / KKC DRILLING METHOD: 3.25" HSA SAMPLING METHOD: SPT	DRILL RIG: CME 75 TRUCK 844 HAMMER: CME AUTOMATIC CALIBRATION DATE: 3/15/21 ENERGY RATIO (%): 66	STATION / OFFSET: 74+97, 7 LT ALIGNMENT: LUC I-280 CL ELEVATION: 595.7 (NAVD88) EOB: 15.0 ft. COORD: 41.634189000, -83.489355000	EXPLORATION ID B-026-0-21 PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 595.7	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 - 14 INCHES	594.5																	
AGGREGATE BASE - 10 INCHES	593.7																	
HARD, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP	592.2		4 4 5	10	83	SS-1	4.50	6	9	12	20	53	27	15	12	12	A-6a (8)	
SOFT, GRAY, **SANDY SILT**, WITH CLAY, TRACE GRAVEL, MOIST			3 2 3	6	100	SS-2	0.25	3	9	14	35	39	25	15	10	16	A-4a (8)	
	589.2		3 3 3	7	94	SS-3	0.25	-	-	-	-	-	-	-	-	17	A-4a (V)	
MEDIUM STIFF, GRAY, **SANDY SILT**, WITH CLAY, TRACE GRAVEL, MOIST			2 3 3	7	100	SS-4	0.50	-	-	-	-	-	-	-	-	18	A-4a (V)	
	584.7		4 4 4	9	94	SS-5	0.50	-	-	-	-	-	-	-	-	17	A-4a (V)	
MEDIUM STIFF, GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MOIST	582.2		4 5 4	10	78	SS-6	0.50	4	10	18	24	44	26	12	14	18	A-6a (8)	
STIFF, GRAY, **SILTY CLAY**, LITTLE GRAVEL, LITTLE SAND, DAMP	580.7	EOB 15	2 4 3	8	89	SS-7	1.50	-	-	-	-	-	-	-	-	17	A-6b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/16/23 12:28 - S:\PROJECTS\2171101.GPJ

PROJECT: WOO/LUC-280-06.20/00.00 TYPE: ROADWAY PID: 108584 BR ID: N/A START: 5/16/22 END: 5/16/22	DRILLING FIRM / OPERATOR: TTL / JW SAMPLING FIRM / LOGGER: TTL / KKC DRILLING METHOD: 3.25" HSA SAMPLING METHOD: SPT	DRILL RIG: CME 75 TRUCK 844 HAMMER: CME AUTOMATIC CALIBRATION DATE: 3/15/21 ENERGY RATIO (%): 66	STATION / OFFSET: 78+94, 5 RT ALIGNMENT: LUC I-280 CL ELEVATION: 594.5 (NAVD88) EOB: 15.0 ft. COORD: 41.635107000, -83.490141000	EXPLORATION ID B-027-0-21 PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 594.5	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 - 16 INCHES	593.2	0–1.3																
AGGREGATE BASE - 8 INCHES	592.5	1.3–2																
HARD, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MOIST	591.0	2–3.5	7 6 8	15	67	SS-1	4.50	3	9	18	23	47	27	15	12	15	A-6a (8)	
SOFT, BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST		3.5–5	4 3 3	7	89	SS-2	0.25	4	8	11	20	57	27	14	13	19	A-6a (9)	
		5–6.5	3 2 3	6	100	SS-3	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
@6': LITTLE GRAVEL	587.5						0.25	-	-	-	-	-	-	-	-	18	A-6a (V)	
MEDIUM STIFF, BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST @7': TRACE GRAVEL		6.5–8	2 3 3	7	100	SS-4	0.50	-	-	-	-	-	-	-	-	18	A-6a (V)	
@8': LITTLE GRAVEL, Qu = 10.2 PSI = 1,470 PSF		8–10			100	ST-5	0.75	10	6	7	20	57	27	14	13	15	A-6a (9)	
		11–12.5	1 2 4	7	94	SS-6	0.50	-	-	-	-	-	-	-	-	18	A-6a (V)	
	579.5	13.5–15 EOB	2 3 3	7	94	SS-7	0.50	-	-	-	-	-	-	-	-	17	A-6a (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 82+98, 7 LT	EXPLORATION ID B-028-0-21
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: LUC I-280 CL	
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 592.0 (NAVD88) EOB: 15.0 ft.	PAGE
START: 5/17/22 END: 5/17/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.636023000, -83.490970000	1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 592.0	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 - 15 INCHES	590.7	0 - 1.3																
AGGREGATE BASE - 9 INCHES	590.0	1.3 - 2.0																
VERY STIFF, GRAY/BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP	588.5	2.0 - 3.5	3 2 4	7	83	SS-1	4.50	9	6	10	19	56	26	15	11	13	A-6a (8)	
SOFT TO MEDIUM STIFF, GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST Qu = 6.6 PSI = 950 PSF		3.5 - 5.5			100	SS-2	0.75	14	7	9	19	51	28	15	13	18	A-6a (8)	
	585.0	5.5 - 7.0	1 2 3	6	94	SS-3	0.50	-	-	-	-	-	-	-	-	17	A-6a (V)	
SOFT, GRAY, **SILTY CLAY**, SOME SAND, TRACE GRAVEL, MOIST		7.0 - 8.5	1 1 1	2	94	SS-4	0.50	-	-	-	-	-	-	-	-	18	A-6b (V)	
		8.5 - 10.0	1 2 2	4	100	SS-5	0.50	-	-	-	-	-	-	-	-	18	A-6b (V)	
	581.0	10.0 - 11.0																
MEDIUM STIFF TO STIFF, GRAY, **SILTY CLAY**, SOME SAND, TRACE GRAVEL, MOIST		11.0 - 12.5	4 4 4	9	94	SS-6	0.50	-	-	-	-	-	-	-	-	18	A-6b (V)	
		12.5 - 13.5																
	577.0	13.5 - 15.0 EOB	2 3 4	8	100	SS-7	1.00	-	-	-	-	-	-	-	-	17	A-6b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/16/23 12:28 - S:\PROJECTS\2171101.GPJ

PROJECT: WOO/LUC-280-06.20/00.00 TYPE: ROADWAY PID: 108584 BR ID: N/A START: 5/17/22 END: 5/17/22	DRILLING FIRM / OPERATOR: TTL / JW SAMPLING FIRM / LOGGER: TTL / KKC DRILLING METHOD: 3.25" HSA SAMPLING METHOD: SPT	DRILL RIG: CME 75 TRUCK 844 HAMMER: CME AUTOMATIC CALIBRATION DATE: 3/15/21 ENERGY RATIO (%): 66	STATION / OFFSET: 86+07, 14 RT ALIGNMENT: LUC I-280 CL ELEVATION: 591.0 (NAVD88) EOB: 15.0 ft. COORD: 41.636759000, -83.491539000	EXPLORATION ID B-029-0-21 PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 591.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT - 6 INCHES	590.5																	
CONCRETE - 9.5 INCHES	589.7	1																
AGGREGATE BASE - 7.5 INCHES	589.1																	
HARD, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, MOIST	587.0	2-3	5 6 6	13	72	SS-1	4.50	6	9	17	46	22	19	12	7	12	A-4a (7)	
VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP		4	7 4 3	8	78	SS-2	3.00	-	-	-	-	-	-	-	-	14	A-4a (V)	
	585.0	5	3 4 5	10	72	SS-3	-	-	-	-	-	-	-	-	-	-	A-4a (V)	
STIFF, GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST	584.0	6					1.25	4	6	7	20	63	27	15	12	17	A-6a (9)	
STIFF, GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, MOIST	582.5	7-8	3 2 4	7	89	SS-4	2.00	-	-	-	-	-	-	-	-	14	A-4a (V)	
STIFF, GRAY, **SILTY CLAY**, SOME SAND, TRACE GRAVEL, DAMP		9-10	3 4 4	9	100	SS-5	1.50	-	-	-	-	-	-	-	-	17	A-6b (V)	
@11': LITTLE SAND, LITTLE GRAVEL		11-12	5 6 5	12	94	SS-6	1.25	-	-	-	-	-	-	-	-	16	A-6b (V)	
@13.5': SOME SAND, TRACE GRAVEL, MOIST	576.0	13-15 EOB	2 3 3	7	100	SS-7	1.50	-	-	-	-	-	-	-	-	18	A-6b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

PROJECT: WOO/LUC-280-06.20/00.00	DRILLING FIRM / OPERATOR: TTL / JW	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET: 89+42, 7 LT
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT: LUC I-280 CL
PID: 108584 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 591.9 (NAVD88) EOB: 15.0 ft.
START: 5/17/22 END: 5/17/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: 41.637516000, -83.492232000

EXPLORATION ID B-030-0-21

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 591.9	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT - 14 INCHES	590.7	0-1.2																
AGGREGATE BASE - 10 INCHES	589.9	1.2-2.0																
HARD, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP	588.4	2-3.5	5 5 7	13	67	SS-1	4.50	6	8	21	25	40	31	17	14	14	A-6a (8)	
VERY STIFF, BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST		3.5-5	3 2 4	7	94	SS-2	2.50	2	9	10	21	58	31	16	15	19	A-6a (10)	
@5': STIFF, LITTLE GRAVEL		5-6.5	3 4 4	9	83	SS-3	1.75	-	-	-	-	-	-	-	-	17	A-6a (V)	
@6.5': GRAY/BROWN, TRACE GRAVEL	583.4	6.5-8	3 2 4	7	100	SS-4	1.50	-	-	-	-	-	-	-	-	16	A-6a (V)	
STIFF TO VERY STIFF, GRAY, **SILTY CLAY**, SOME SAND, TRACE GRAVEL, MOIST		8.5-10	4 3 3	7	89	SS-5	2.00	8	6	14	23	49	35	16	19	16	A-6b (11)	
@10': DAMP		11-12.5	5 5 6	12	78	SS-6	1.50	-	-	-	-	-	-	-	-	16	A-6b (V)	
	576.9	13.5-15 (EOB 15)	2 4 5	10	94	SS-7	2.25	-	-	-	-	-	-	-	-	16	A-6b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH AUGER CUTTINGS; PLACED 0.25 BAG QUICKCRETE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/16/23 12:28 - S:\PROJECTS\2171101.GPJ

LITHOLOGIC SYMBOLS (Unified Soil Classification System)

A-3: Ohio DOT: A-3, 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

A-7-6: Ohio DOT: A-7-6, clay

PAVEMENT OR BASE: Ohio DOT: Pavement or Aggregate base

SAMPLER SYMBOLS

Thin Walled Undisturbed Sample

WELL CONSTRUCTION SYMBOLS

Soil Cuttings Backfill mixed with Bentonite Pellets or Chips

Asphalt or Concrete Pavement Patch

Notes:

1. Exploratory test borings were drilled during the period from May 15 to 18, 2022., utilizing 3¼-inch hollow-stem augers. Pavement cores were performed during this period in Borings B-002, B-005, B-012, and B-029 using a nominal 4-inch diameter core barrel.

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

3. Stationing and offsets at the boring locations were provided by Tetra Tech. Latitude, Longitude, and ground surface elevations were surveyed by TTL via a handheld GPS. The accuracy from the handheld GPS device was generally found to be approximately 2 to 6 inches horizontal, and approximately 4 to 12 inches vertical.

4. Material Description and Notes:
   Qu = Unconfined Compressive Strength Test by ASTM D 2166

SUMMARY OF SOIL TEST DATA
WOO/LUC-280-06.20/00.00, PID 108584

EXPLORATION ID., STATION & OFFSET	FROM - TO	SAMPLE ID	N60	% REC	tsf HP	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-001-0-21	1.5 - 2.0	SS-1A	10	67	4.50	-	-	-	-	-	-	-	-	13	A-4a (VISUAL)	260
STA. 327+67, 5' RT	2.0 - 3.0	SS-1B	-	-	-	-	-	-	-	-	-	-	-	-	A-6b (VISUAL)	-
LATITUDE = 41.612167	3.0 - 4.5	SS-2	7	83	1.50	5	2	13	22	58	33	15	18	20	A-6b (11)	-
LONGITUDE = -83.476956	4.5 - 6.0	SS-3	9	67	1.25	0	1	13	26	60	41	20	21	26	A-7-6 (13)	-
	6.0 - 7.5	SS-4	8	89	2.50	-	-	-	-	-	-	-	-	26	A-7-6 (VISUAL)	-
	8.5 - 10.0	SS-5	9	78	0.75	-	-	-	-	-	-	-	-	18	A-7-6 (VISUAL)	-
	13.5 - 15.0	SS-6	11	67	1.50	-	-	-	-	-	-	-	-	21	A-6b (VISUAL)	-
B-002-0-21	2.0 - 3.5	SS-1	9	89	3.25	0	2	9	24	65	34	19	15	17	A-6a (10)	-
STA. 331+66, 14' LT	3.5 - 4.0	SS-2A	8	94	-	-	-	-	-	-	-	-	-	-	A-6a (VISUAL)	-
LATITUDE = 41.613264	4.0 - 5.0	SS-2B	-	-	3.50	0	1	6	51	42	34	18	16	21	A-6b (10)	300
LONGITUDE = -83.477001	5.0 - 6.0	SS-3A	10	72	-	-	-	-	-	-	-	-	-	-	A-6b (VISUAL)	-
	6.0 - 6.5	SS-3B	-	-	-	0	1	31	22	46	26	15	11	19	A-6a (7)	-
	6.5 - 8.0	SS-4	7	94	1.50	-	-	-	-	-	-	-	-	26	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	9	89	0.50	-	-	-	-	-	-	-	-	15	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	6	100	0.50	-	-	-	-	-	-	-	-	26	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	17	94	3.50	-	-	-	-	-	-	-	-	25	A-6b (VISUAL)	-
B-003-0-21	1.5 - 3.0	SS-1	13	72	4.50	0	3	20	26	51	29	17	12	16	A-6a (9)	200
STA. 335+61, 5' RT	3.0 - 4.5	SS-2	13	78	4.25	0	2	6	24	68	32	18	14	20	A-6a (10)	-
LATITUDE = 41.614347	4.5 - 6.0	SS-3	18	67	2.50	-	-	-	-	-	-	-	-	22	A-6a (VISUAL)	-
LONGITUDE = -83.476965	6.0 - 7.5	SS-4	8	89	3.00	-	-	-	-	-	-	-	-	22	A-4b (VISUAL)	-
	8.5 - 10.0	SS-5	10	78	1.50	-	-	-	-	-	-	-	-	28	A-4b (VISUAL)	-
	13.5 - 15.0	SS-6	6	94	1.00	-	-	-	-	-	-	-	-	28	A-6b (VISUAL)	-
B-004-0-21	2.0 - 3.5	SS-1	11	83	4.50	0	3	13	29	55	29	14	15	16	A-6a (10)	230
STA. 339+66, 6' LT	3.5 - 4.0	SS-2A	8	100	-	-	-	-	-	-	-	-	-	-	A-6a (VISUAL)	-
LATITUDE = 41.615459	4.0 - 5.0	SS-2B	-	-	3.75	0	2	7	23	68	33	17	16	20	A-6b (10)	-
LONGITUDE = -83.477009	5.0 - 6.5	SS-3	10	72	2.50	1	1	31	24	43	28	13	15	18	A-6a (8)	-
	6.5 - 8.0	SS-4	6	94	3.00	-	-	-	-	-	-	-	-	26	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	6	100	0.75	-	-	-	-	-	-	-	-	35	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	7	94	1.25	-	-	-	-	-	-	-	-	28	A-4b (VISUAL)	-
	13.5 - 15.0	SS-7	7	100	2.50	-	-	-	-	-	-	-	-	25	A-4b (VISUAL)	-

EXPLORATION ID., STATION & OFFSET	FROM - TO	SAMPLE ID	N60	% REC	tsf HP	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-005-0-21	1.0 - 2.0	SS-1A	14	100	-	-	-	-	-	-	-	-	-	10	A-3 (VISUAL)	180
STA. 343+14, 14' RT	2.0 - 2.5	SS-1B	-	-	-	-	-	-	-	-	-	-	-	-	A-6b (VISUAL)	-
LATITUDE = 41.616417	2.5 - 4.0	SS-2	4	89	2.00	0	2	6	24	68	36	18	18	25	A-6b (11)	-
LONGITUDE = -83.476971	4.0 - 6.0	ST-3	ST	71	2.50	0	0	21	23	56	34	17	17	21	A-6b (11)	-
	6.0 - 7.5	SS-4	8	94	1.00	-	-	-	-	-	-	-	-	27	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	11	78	3.25	-	-	-	-	-	-	-	-	26	A-4b (VISUAL)	-
	13.5 - 15.0	SS-6	8	83	1.50	-	-	-	-	-	-	-	-	16	A-6b (VISUAL)	-
B-006-0-21	2.0 - 3.5	SS-1	11	67	4.50	1	3	21	22	53	28	15	13	15	A-6a (9)	190
STA. 347+22, 6' LT	3.5 - 5.5	ST-2	ST	100	4.50	7	3	26	22	42	26	15	11	13	A-6a (6)	-
LATITUDE = 41.617532	5.5 - 7.0	SS-3	12	78	2.50	-	-	-	-	-	-	-	-	26	A-6a (VISUAL)	-
LONGITUDE = -83.477017	7.0 - 8.5	SS-4	15	72	4.50	-	-	-	-	-	-	-	-	17	A-4a (VISUAL)	-
	8.5 - 10.0	SS-5	13	67	3.75	-	-	-	-	-	-	-	-	21	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	18	67	4.50	-	-	-	-	-	-	-	-	13	A-4a (VISUAL)	-
	13.5 - 15.0	SS-7	10	89	1.00	-	-	-	-	-	-	-	-	21	A-4a (VISUAL)	-
B-007-0-21	1.0 - 2.5	SS-1	18	72	4.50	0	1	11	29	59	31	17	14	15	A-6a (10)	210
STA. 0+90, 5' RT	2.5 - 4.0	SS-2	18	78	4.50	0	1	18	22	59	26	14	12	14	A-6a (9)	-
LATITUDE = 41.618638	4.0 - 5.0	SS-3A	23	67	4.50	-	-	-	-	-	-	-	-	19	A-6a (VISUAL)	-
LONGITUDE = -83.476979	5.0 - 5.5	SS-3B	-	-	-	-	-	-	-	-	-	-	-	-	A-6b (VISUAL)	-
	5.5 - 7.0	SS-4	10	67	2.00	-	-	-	-	-	-	-	-	27	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	10	78	1.25	-	-	-	-	-	-	-	-	27	A-6b (VISUAL)	-
	13.5 - 15.0	SS-6	7	83	1.25	-	-	-	-	-	-	-	-	26	A-6b (VISUAL)	-
B-008-0-21	2.0 - 3.5	SS-1	11	78	4.50	1	2	9	20	68	28	16	12	14	A-6a (9)	-
STA. 4+86, 6' LT	3.5 - 5.0	SS-2	10	67	4.50	0	0	7	30	63	29	16	13	15	A-6a (9)	210
LATITUDE = 41.619726	5.0 - 6.5	SS-3	12	78	4.25	-	-	-	-	-	-	-	-	16	A-6a (VISUAL)	-
LONGITUDE = -83.477023	6.5 - 8.0	SS-4	11	67	3.00	-	-	-	-	-	-	-	-	16	A-6a (VISUAL)	-
	8.5 - 10.0	SS-5	8	72	2.50	-	-	-	-	-	-	-	-	24	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	9	78	2.75	-	-	-	-	-	-	-	-	23	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	9	78	1.00	-	-	-	-	-	-	-	-	27	A-6b (VISUAL)	-

EXPLORATION ID., STATION & OFFSET	FROM - TO	SAMPLE ID	N60	% REC	tsf HP	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-009-0-21	1.5 - 3.0	SS-1	19	72	4.50	1	1	27	41	30	25	17	8	15	A-4a (7)	210
STA. 8+86, 5' RT	3.0 - 4.5	SS-2	14	78	4.50	-	-	-	-	-	-	-	-	14	A-4a (VISUAL)	-
LATITUDE = 41.620824	4.5 - 6.0	SS-3	19	67	2.50	0	1	36	41	22	24	16	8	15	A-4a (6)	-
LONGITUDE = -83.476985	6.0 - 7.5	SS-4	18	67	4.50	-	-	-	-	-	-	-	-	20	A-4a (VISUAL)	-
	8.5 - 10.0	SS-5	10	83	2.75	-	-	-	-	-	-	-	-	21	A-4a (VISUAL)	-
	13.5 - 15.0	SS-6	8	89	0.25	-	-	-	-	-	-	-	-	22	A-4b (VISUAL)	-
B-010-0-21	2.0 - 3.5	SS-1	9	72	4.50	1	1	24	21	53	25	14	11	13	A-6a (8)	-
STA. 12+85, 6' LT	3.5 - 4.0	SS-2A	14	67	-	-	-	-	-	-	-	-	-	-	A-6a (VISUAL)	-
LATITUDE = 41.621919	4.0 - 5.0	SS-2B	-	-	4.50	-	-	-	-	-	-	-	-	13	A-4a (VISUAL)	210
LONGITUDE = -83.477030	5.0 - 6.5	SS-3	23	56	-	0	0	45	47	8	25	17	8	15	A-4a (4)	-
	6.5 - 7.0	SS-4A	10	72	-	-	-	-	-	-	-	-	-	-	A-4a (VISUAL)	-
	7.0 - 8.0	SS-4B	-	-	2.75	-	-	-	-	-	-	-	-	18	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	7	89	2.50	-	-	-	-	-	-	-	-	24	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	8	100	2.50	-	-	-	-	-	-	-	-	27	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	7	94	2.50	-	-	-	-	-	-	-	-	28	A-6b (VISUAL)	-
B-011-0-21	1.5 - 3.0	SS-1	9	78	4.50	6	5	9	28	52	26	15	11	15	A-6a (8)	200
STA. 16+87, 6' RT	3.0 - 4.5	SS-2	14	72	4.50	1	0	22	21	56	27	15	12	15	A-6a (9)	-
LATITUDE = 41.623021	4.5 - 6.0	SS-3	22	83	4.50	-	-	-	-	-	-	-	-	16	A-4b (VISUAL)	-
LONGITUDE = -83.476992	6.0 - 7.5	SS-4	8	89	1.50	-	-	-	-	-	-	-	-	23	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	7	94	1.75	-	-	-	-	-	-	-	-	31	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	9	100	0.75	-	-	-	-	-	-	-	-	26	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	8	100	0.75	-	-	-	-	-	-	-	-	26	A-6b (VISUAL)	-
B-012-0-21	2.0 - 3.5	SS-1	22	72	4.50	0	1	38	45	16	23	16	7	14	A-4a (5)	-
STA. 20+85, 14' LT	3.5 - 5.0	SS-2	29	67	-	0	2	26	45	27	26	16	10	15	A-4a (7)	220
LATITUDE = 41.624115	5.0 - 6.5	SS-3	19	78	4.50	-	-	-	-	-	-	-	-	13	A-4a (VISUAL)	-
LONGITUDE = -83.477041	6.5 - 8.0	SS-4	8	100	1.00	-	-	-	-	-	-	-	-	28	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	6	94	1.75	-	-	-	-	-	-	-	-	28	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	10	89	1.75	-	-	-	-	-	-	-	-	26	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	8	100	1.25	-	-	-	-	-	-	-	-	17	A-4b (VISUAL)	-

EXPLORATION ID., STATION & OFFSET	FROM - TO	SAMPLE ID	N60	% REC	tsf HP	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-013-0-21	1.5 - 3.0	SS-1	13	78	4.50	0	1	4	27	68	42	21	21	13	A-7-6 (13)	220
STA. 24+85, 6' RT	3.0 - 4.5	SS-2	18	72	4.50	0	2	41	44	13	23	14	9	15	A-4a (4)	-
LATITUDE = 41.625212	4.5 - 6.0	SS-3	24	67	3.50	0	0	44	48	8	24	15	9	15	A-4a (4)	-
LONGITUDE = -83.476999	6.0 - 7.0	SS-4A	6	89	-	-	-	-	-	-	-	-	-	-	A-4a (VISUAL)	-
	7.0 - 7.5	SS-4B	-	-	1.25	-	-	-	-	-	-	-	-	28	A-6a (VISUAL)	-
	8.5 - 10.0	SS-5	8	83	1.25	-	-	-	-	-	-	-	-	26	A-6a (VISUAL)	-
	11.5 - 13.5	ST-6	ST	96	1.25	0	2	7	23	68	29	18	11	26	A-6a (8)	-
	13.5 - 15.0	SS-7	6	100	0.50	-	-	-	-	-	-	-	-	23	A-4a (VISUAL)	-
B-014-0-21	2.0 - 3.5	SS-1	15	67	4.50	0	1	33	47	19	24	15	9	14	A-4a (6)	-
STA. 28+87, 7' LT	3.5 - 5.0	SS-2	20	56	4.50	0	0	53	41	6	24	16	8	15	A-4a (2)	210
LATITUDE = 41.626312	5.0 - 6.5	SS-3	23	67	4.50	-	-	-	-	-	-	-	-	20	A-6b (VISUAL)	-
LONGITUDE = -83.477106	6.5 - 8.0	SS-4	12	83	2.00	-	-	-	-	-	-	-	-	26	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	11	83	2.00	-	-	-	-	-	-	-	-	25	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	12	89	1.50	-	-	-	-	-	-	-	-	27	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	7	100	0.75	-	-	-	-	-	-	-	-	20	A-6b (VISUAL)	-
B-015-0-21	2.0 - 3.5	SS-1	13	67	4.50	4	6	19	37	34	27	14	13	15	A-6a (8)	250
STA. 32+57, 5' RT	3.5 - 5.0	SS-2	9	83	4.25	0	3	42	28	27	28	17	11	18	A-6a (4)	-
LATITUDE = 41.627308	5.0 - 6.5	SS-3	17	72	1.50	-	-	-	-	-	-	-	-	20	A-4a (VISUAL)	-
LONGITUDE = -83.477363	6.5 - 8.0	SS-4	8	67	2.75	-	-	-	-	-	-	-	-	28	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	8	83	1.00	-	-	-	-	-	-	-	-	31	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	18	67	3.75	-	-	-	-	-	-	-	-	20	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	7	89	1.00	-	-	-	-	-	-	-	-	25	A-6b (VISUAL)	-
B-016-0-21	2.0 - 3.5	SS-1	15	67	-	0	1	48	47	4	NP	NP	NP	13	A-4a (3)	-
STA. 36+57, 7' LT	3.5 - 5.0	SS-2	12	72	3.75	-	-	-	-	-	-	-	-	23	A-6b (VISUAL)	240
LATITUDE = 41.628288	5.0 - 6.0	SS-3A	13	72	3.00	0	1	8	23	68	37	19	18	25	A-6b (11)	-
LONGITUDE = -83.478004	6.0 - 6.5	SS-3B	-	-	-	-	-	-	-	-	-	-	-	-	A-6a (VISUAL)	-
	6.5 - 8.5	ST-4	ST	92	2.00	0	1	6	25	68	34	20	14	26	A-6a (10)	-
	8.5 - 10.0	SS-5	8	10	0.75	-	-	-	-	-	-	-	-	27	A-4b (VISUAL)	-
	11.0 - 12.5	SS-6	10	94	0.50	-	-	-	-	-	-	-	-	29	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	10	89	0.75	-	-	-	-	-	-	-	-	17	A-4b (VISUAL)	-

EXPLORATION ID., STATION & OFFSET	FROM - TO	SAMPLE ID	N60	% REC	tsf HP	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-017-0-21	2.0 - 3.5	SS-1	13	72	2.50	1	4	12	42	41	25	17	8	16	A-4a (8)	240
STA. 40+56, 5' RT	3.5 - 5.0	SS-2	8	67	1.50	5	8	18	28	41	40	22	18	27	A-6b (10)	-
LATITUDE = 41.629188	5.0 - 6.0	SS-3A	11	78	-	-	-	-	-	-	-	-	-	-	A-6b (VISUAL)	-
LONGITUDE = -83.478833	6.0 - 6.5	SS-3B	-	-	2.75	-	-	-	-	-	-	-	-	21	A-6b (VISUAL)	-
	6.5 - 8.0	SS-4	4	94	1.50	-	-	-	-	-	-	-	-	27	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	7	100	2.25	-	-	-	-	-	-	-	-	27	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	13	72	4.50	1	3	7	22	67	39	20	19	25	A-6b (12)	-
	13.5 - 15.0	SS-7	8	100	2.50	-	-	-	-	-	-	-	-	19	A-4b (VISUAL)	-
B-018-0-21	2.0 - 3.5	SS-1	11	78	4.50	0	2	27	25	46	27	16	11	14	A-6a (8)	-
STA. 44+50, 7' LT	3.5 - 4.0	SS-2A	11	72	-	-	-	-	-	-	-	-	-	-	A-6a (VISUAL)	-
LATITUDE = 41.629884	4.0 - 5.0	SS-2B	-	-	3.50	1	2	5	24	68	33	19	14	21	A-6a (10)	210
LONGITUDE = -83.479937	5.0 - 6.5	SS-3	14	83	1.00	0	2	6	24	68	31	18	13	26	A-6a (9)	-
	6.5 - 7.0	SS-4A	10	94	-	-	-	-	-	-	-	-	-	-	A-6a (VISUAL)	-
	7.0 - 8.0	SS-4B	-	-	1.00	-	-	-	-	-	-	-	-	26	A-6a (VISUAL)	-
	8.5 - 10.0	SS-5	11	89	1.00	-	-	-	-	-	-	-	-	16	A-6a (VISUAL)	-
	11.0 - 12.5	SS-6	15	78	0.75	-	-	-	-	-	-	-	-	17	A-6a (VISUAL)	-
	13.5 - 15.0	SS-7	7	100	0.75	-	-	-	-	-	-	-	-	17	A-6b (VISUAL)	-
B-019-0-21	2.0 - 3.5	SS-1	8	89	2.75	4	1	5	24	66	32	18	14	21	A-6a (10)	210
STA. 48+67, 6' RT	3.5 - 5.0	SS-2	7	94	0.75	0	2	5	25	68	30	19	11	26	A-6a (8)	-
LATITUDE = 41.630479	5.0 - 6.5	SS-3	11	89	2.25	-	-	-	-	-	-	-	-	24	A-4b (VISUAL)	-
LONGITUDE = -83.481231	6.5 - 7.0	SS-4A	7	89	-	-	-	-	-	-	-	-	-	-	A-4b (VISUAL)	-
	7.0 - 8.0	SS-4B	-	-	0.75	-	-	-	-	-	-	-	-	26	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	7	100	1.25	-	-	-	-	-	-	-	-	17	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	11	89	1.00	-	-	-	-	-	-	-	-	16	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	3	100	0.50	-	-	-	-	-	-	-	-	18	A-6b (VISUAL)	-
B-020-0-21	2.0 - 3.5	SS-1	9	89	4.25	0	2	6	40	52	27	17	10	19	A-4a (8)	-
STA. 52+57, 7' LT	3.5 - 5.0	SS-2	6	100	1.50	0	2	5	25	68	29	15	14	24	A-6a (10)	220
LATITUDE = 41.630891	5.0 - 6.5	SS-3	10	89	1.75	2	7	11	28	52	26	15	11	17	A-6a (8)	-
LONGITUDE = -83.482548	6.5 - 8.0	SS-4	8	94	0.50	-	-	-	-	-	-	-	-	23	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	8	89	0.50	3	5	6	20	66	30	14	16	20	A-6b (10)	-
	11.0 - 12.5	SS-6	9	100	1.00	-	-	-	-	-	-	-	-	17	A-4b (VISUAL)	-
	13.5 - 15.0	SS-7	7	100	0.75	-	-	-	-	-	-	-	-	17	A-6b (VISUAL)	-

EXPLORATION ID., STATION & OFFSET	FROM - TO	SAMPLE ID	N60	% REC	tsf HP	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-021-0-21	2.0 - 3.5	SS-1	9	89	2.00	7	4	5	21	63	30	13	17	18	A-6b (11)	220
STA. 56+54, 7' RT	3.5 - 5.0	SS-2	9	100	0.75	1	1	5	25	68	32	17	15	24	A-6a (10)	-
LATITUDE = 41.631377	5.0 - 6.5	SS-3	10	78	0.75	1	2	5	24	68	32	18	14	26	A-6a (10)	-
LONGITUDE = -83.483854	6.5 - 8.0	SS-4	7	89	0.50	-	-	-	-	-	-	-	-	17	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	8	89	0.75	-	-	-	-	-	-	-	-	18	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	8	94	0.50	-	-	-	-	-	-	-	-	18	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	6	100	0.50	-	-	-	-	-	-	-	-	17	A-6b (VISUAL)	-
B-022-0-21	2.0 - 3.5	SS-1	7	83	1.25	9	5	10	19	57	24	13	11	15	A-6a (8)	270
STA. 60+52, 6' LT	3.5 - 5.5	ST-2	ST	100	0.66	6	7	7	20	60	27	16	11	18	A-6a (8)	-
LATITUDE = 41.631796	5.5 - 7.0	SS-3	8	100	0.50	11	11	11	20	47	26	15	11	18	A-6a (7)	-
LONGITUDE = -83.485194	7.0 - 8.0	SS-4A	4	94	0.50	-	-	-	-	-	-	-	-	18	A-6a (VISUAL)	-
	8.0 - 8.5	SS-4B	-	-	-	-	-	-	-	-	-	-	-	-	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	7	100	0.50	-	-	-	-	-	-	-	-	18	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	9	83	-	-	-	-	-	-	-	-	-	19	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	10	94	0.50	-	-	-	-	-	-	-	-	18	A-6b (VISUAL)	-
B-023-0-21	2.0 - 3.5	SS-1	19	67	1.00	17	9	9	18	47	28	15	13	15	A-6a (7)	-
STA. 63+13, 7' RT	3.5 - 5.0	SS-2	6	78	0.25	8	5	11	24	52	32	16	16	25	A-6b (10)	260
LATITUDE = 41.632141	5.0 - 6.5	SS-3	4	100	0.25	-	-	-	-	-	-	-	-	27	A-6b (VISUAL)	-
LONGITUDE = -83.486034	6.5 - 8.0	SS-4	3	100	-	-	-	-	-	-	-	-	-	21	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	6	94	0.25	-	-	-	-	-	-	-	-	19	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	8	89	0.25	-	-	-	-	-	-	-	-	19	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	6	100	0.25	-	-	-	-	-	-	-	-	19	A-6b (VISUAL)	-
B-024-0-21	2.0 - 3.5	SS-1	6	89	3.75	5	8	15	26	46	29	15	14	15	A-6a (9)	230
STA. 66+90, 6' LT	3.5 - 4.0	SS-2A	8	83	-	-	-	-	-	-	-	-	-	-	A-6a (VISUAL)	-
LATITUDE = 41.632661	4.0 - 5.0	SS-2B	-	-	0.25	-	-	-	-	-	-	-	-	28	A-6b (VISUAL)	-
LONGITUDE = -83.487230	5.0 - 6.5	SS-3	9	89	0.25	0	1	3	28	68	34	17	17	31	A-6b (11)	-
	6.5 - 8.0	SS-4	6	94	0.25	-	-	-	-	-	-	-	-	19	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	6	89	0.25	-	-	-	-	-	-	-	-	19	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	9	83	0.25	-	-	-	-	-	-	-	-	19	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	7	94	0.50	-	-	-	-	-	-	-	-	19	A-6b (VISUAL)	-

EXPLORATION ID., STATION & OFFSET	FROM - TO	SAMPLE ID	N60	% REC	tsf HP	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-025-0-21	2.0 - 3.5	SS-1	9	89	3.50	6	10	18	26	40	28	15	13	17	A-6a (7)	240
STA. 70+95, 6' RT	3.5 - 5.0	SS-2	11	72	4.25	0	2	5	25	68	31	19	12	22	A-6a (9)	-
LATITUDE = 41.633396	5.0 - 6.5	SS-3	8	83	0.50	-	-	-	-	-	-	-	-	29	A-4b (VISUAL)	-
LONGITUDE = -83.488339	6.5 - 8.0	SS-4	7	100	0.50	-	-	-	-	-	-	-	-	17	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	8	94	3.00	3	4	7	26	60	28	16	12	18	A-6a (9)	-
	11.0 - 12.5	SS-6	8	89	0.50	-	-	-	-	-	-	-	-	18	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	4	100	0.50	-	-	-	-	-	-	-	-	16	A-6b (VISUAL)	-
B-026-0-21	2.0 - 3.5	SS-1	10	83	4.50	6	9	12	20	53	27	15	12	12	A-6a (8)	-
STA. 74+96, 7' LT	3.5 - 5.0	SS-2	6	100	0.25	3	9	14	35	39	25	15	10	16	A-4a (8)	220
LATITUDE = 41.634189	5.0 - 6.5	SS-3	7	94	0.25	-	-	-	-	-	-	-	-	17	A-4a (VISUAL)	-
LONGITUDE = -83.489355	6.5 - 8.0	SS-4	7	100	0.50	-	-	-	-	-	-	-	-	18	A-4a (VISUAL)	-
	8.5 - 10.0	SS-5	9	94	0.50	-	-	-	-	-	-	-	-	17	A-4a (VISUAL)	-
	11.0 - 12.5	SS-6	10	78	0.50	4	10	18	24	44	26	12	14	18	A-6a (8)	-
	13.5 - 15.0	SS-7	8	89	1.50	-	-	-	-	-	-	-	-	17	A-6b (VISUAL)	-
B-027-0-21	2.0 - 3.5	SS-1	15	67	4.50	3	9	18	23	47	27	15	12	15	A-6a (8)	230
STA. 78+93, 5' RT	3.5 - 5.0	SS-2	7	89	0.25	4	8	11	20	57	27	14	13	19	A-6a (9)	-
LATITUDE = 41.635107	5.0 - 6.0	SS-3A	6	100	-	-	-	-	-	-	-	-	-	-	A-6a (VISUAL)	-
LONGITUDE = -83.490141	6.0 - 6.5	SS-3B	-	-	0.25	-	-	-	-	-	-	-	-	18	A-6a (VISUAL)	-
	6.5 - 8.0	SS-4	7	100	0.50	-	-	-	-	-	-	-	-	18	A-6a (VISUAL)	-
	8.0 - 10.0	ST-5	ST	100	0.75	10	6	7	20	57	27	14	13	15	A-6a (9)	-
	11.0 - 12.5	SS-6	7	94	0.50	-	-	-	-	-	-	-	-	18	A-6a (VISUAL)	-
	13.5 - 15.0	SS-7	7	94	0.50	-	-	-	-	-	-	-	-	17	A-6a (VISUAL)	-
B-028-0-21	2.0 - 3.5	SS-1	7	83	4.50	9	6	10	19	56	26	15	11	13	A-6a (8)	-
STA. 82+98, 7' LT	3.5 - 5.5	ST-2	-	100	0.75	14	7	9	19	51	28	15	13	18	A-6a (8)	230
LATITUDE = 41.636023	5.5 - 7.0	SS-3	6	94	0.50	-	-	-	-	-	-	-	-	17	A-6a (VISUAL)	-
LONGITUDE = -83.490970	7.0 - 8.5	SS-4	2	94	0.50	-	-	-	-	-	-	-	-	18	A-6b (VISUAL)	-
	8.5 - 10.0	SS-5	4	100	0.50	-	-	-	-	-	-	-	-	18	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	9	94	0.50	-	-	-	-	-	-	-	-	18	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	8	100	1.00	-	-	-	-	-	-	-	-	17	A-6b (VISUAL)	-

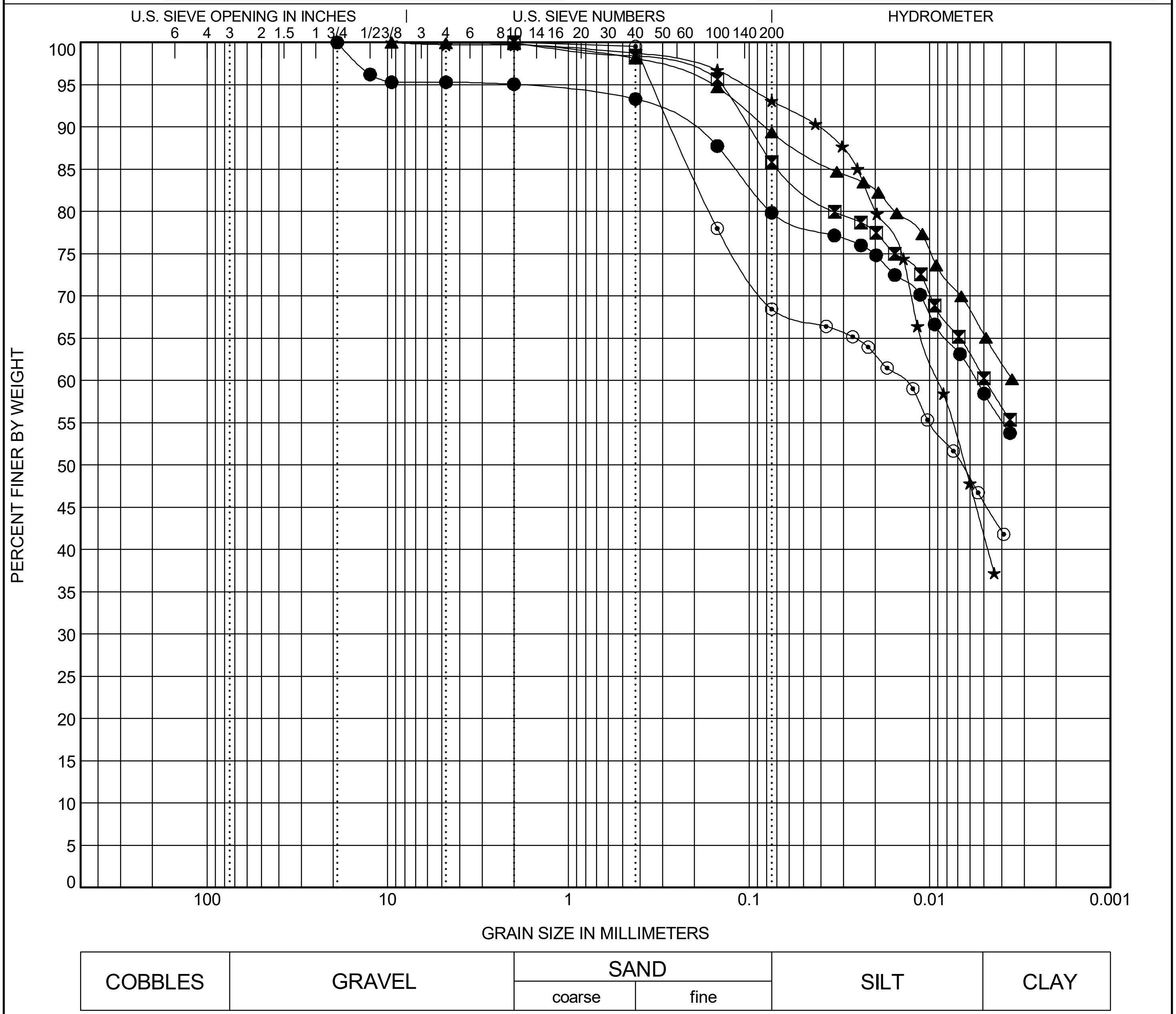
EXPLORATION ID., STATION & OFFSET	FROM - TO	SAMPLE ID	N60	% REC	tsf HP	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-029-0-21	2.0 - 3.5	SS-1	13	72	4.50	6	9	17	46	22	19	12	7	12	A-4a (7)	240
STA. 86+07, 14' RT	3.5 - 5.0	SS-2	8	78	3.00	-	-	-	-	-	-	-	-	14	A-4a (VISUAL)	-
LATITUDE = 41.636759	5.0 - 6.0	SS-3A	10	72	-	-	-	-	-	-	-	-	-	-	A-4a (VISUAL)	-
LONGITUDE = -83.491539	6.0 - 6.5	SS-3B	-	-	1.25	4	6	7	20	63	27	15	12	17	A-6a (9)	-
	6.5 - 8.0	SS-4	7	89	2.00	-	-	-	-	-	-	-	-	14	A-4a (VISUAL)	-
	8.5 - 10.0	SS-5	9	100	1.50	-	-	-	-	-	-	-	-	17	A-6b (VISUAL)	-
	11.0 - 12.5	SS-6	12	94	1.25	-	-	-	-	-	-	-	-	16	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	7	100	1.50	-	-	-	-	-	-	-	-	18	A-6b (VISUAL)	-
B-030-0-21	2.0 - 3.5	SS-1	13	67	4.50	6	8	21	25	40	31	17	14	14	A-6a (8)	250
STA. 89+42, 7' LT	3.5 - 5.0	SS-2	7	94	2.50	2	9	10	21	58	31	16	15	19	A-6a (10)	-
LATITUDE = 41.637516	5.0 - 6.5	SS-3	9	83	1.75	-	-	-	-	-	-	-	-	17	A-6a (VISUAL)	-
LONGITUDE = -83.492232	6.5 - 8.0	SS-4	7	100	1.50	-	-	-	-	-	-	-	-	16	A-6a (VISUAL)	-
	8.5 - 10.0	SS-5	7	89	2.00	8	6	14	23	49	35	16	19	16	A-6b (11)	-
	11.0 - 12.5	SS-6	12	78	1.50	-	-	-	-	-	-	-	-	16	A-6b (VISUAL)	-
	13.5 - 15.0	SS-7	10	94	2.25	-	-	-	-	-	-	-	-	16	A-6b (VISUAL)	-

GRAIN SIZE DISTRIBUTION

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT WOO/LUC-280-06.20/00.00 **PID** 108584

OGE NUMBER N/A **PROJECT TYPE** ROADWAY



Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	B-001-0-21	3.0	A-6b ~ LEAN CLAY with SAND(CL)	33	15	18
⧗	B-001-0-21	4.5	A-7-6 ~ LEAN CLAY(CL)	41	20	21
▲	B-002-0-21	2.0	A-6a ~ LEAN CLAY(CL)	34	19	15
★	B-002-0-21	4.0	A-6b ~ LEAN CLAY(CL)	34	18	16
⊙	B-002-0-21	6.0	A-6a ~ SANDY LEAN CLAY(CL)	26	15	11

Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	B-001-0-21	3.0	0.228				5	2	13	22	58		
⧗	B-001-0-21	4.5	0.1				0	1	13	26	60		
▲	B-002-0-21	2.0	0.081				0	2	9	24	65		
★	B-002-0-21	4.0	0.041	0.006			0	1	6	51	42		
⊙	B-002-0-21	6.0	0.268	0.007			0	1	31	22	46		

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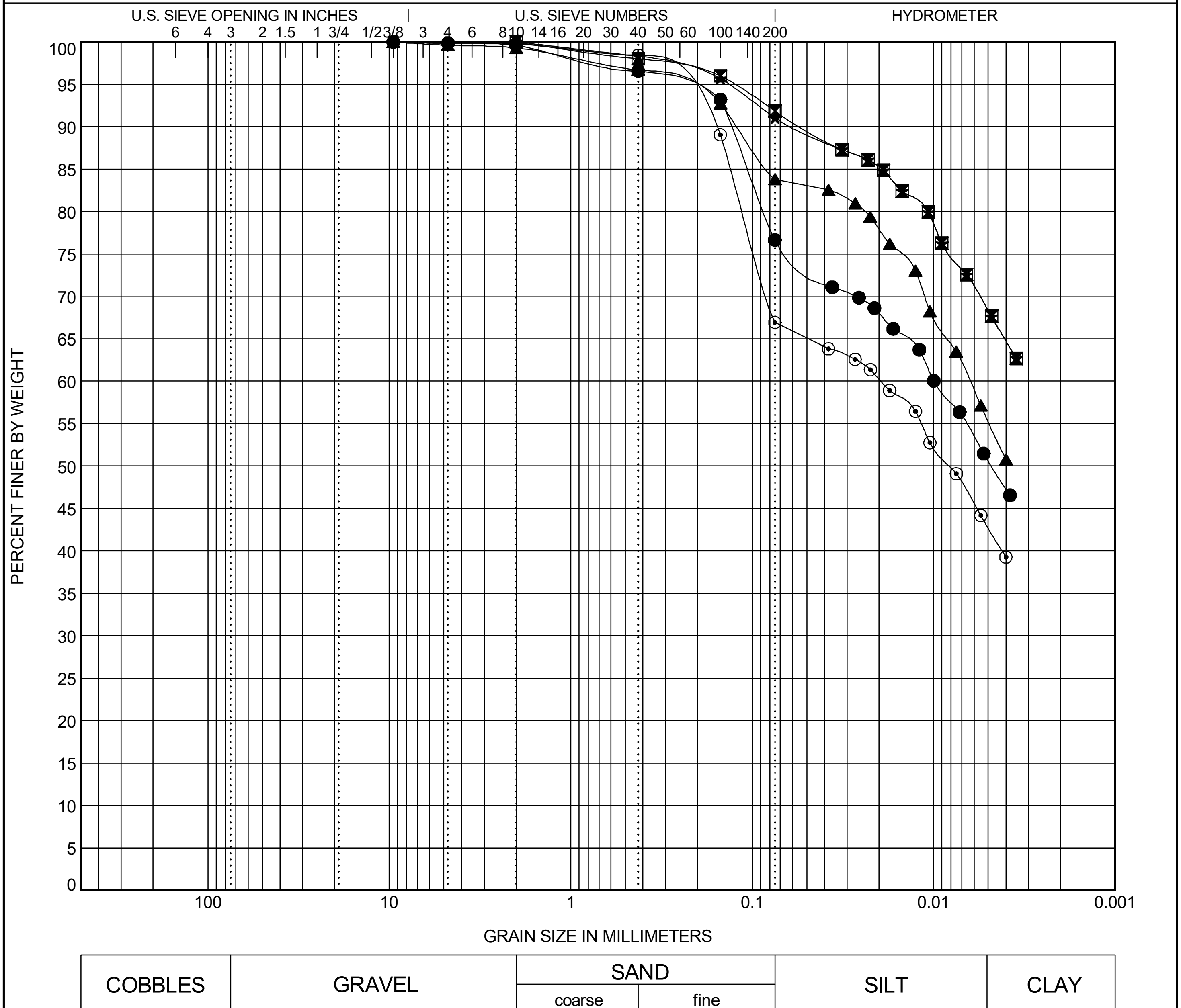
PROJECT WOO/LUC-280-06.20/00.00 **PID** 108584

OGE NUMBER N/A **PROJECT TYPE** ROADWAY



Specimen Identification		ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
● B-003-0-21	1.5	A-6a ~ LEAN CLAY with SAND(CL)	29	17	12
⧗ B-003-0-21	3.0	A-6a ~ LEAN CLAY(CL)	32	18	14
▲ B-004-0-21	2.0	A-6a ~ LEAN CLAY with SAND(CL)	29	14	15
★ B-004-0-21	4.0	A-6b ~ LEAN CLAY(CL)	33	17	16
⊙ B-004-0-21	5.0	A-6a ~ SANDY LEAN CLAY(CL)	28	13	15

Specimen Identification		D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
● B-003-0-21	1.5	0.131	0.005			0	3	20	26	51		
⧗ B-003-0-21	3.0	0.053				0	2	6	24	68		
▲ B-004-0-21	2.0	0.121				0	3	13	29	55		
★ B-004-0-21	4.0	0.059				0	2	7	23	68		
⊙ B-004-0-21	5.0	0.167	0.008			1	1	31	24	43		

GRAIN SIZE DISTRIBUTION

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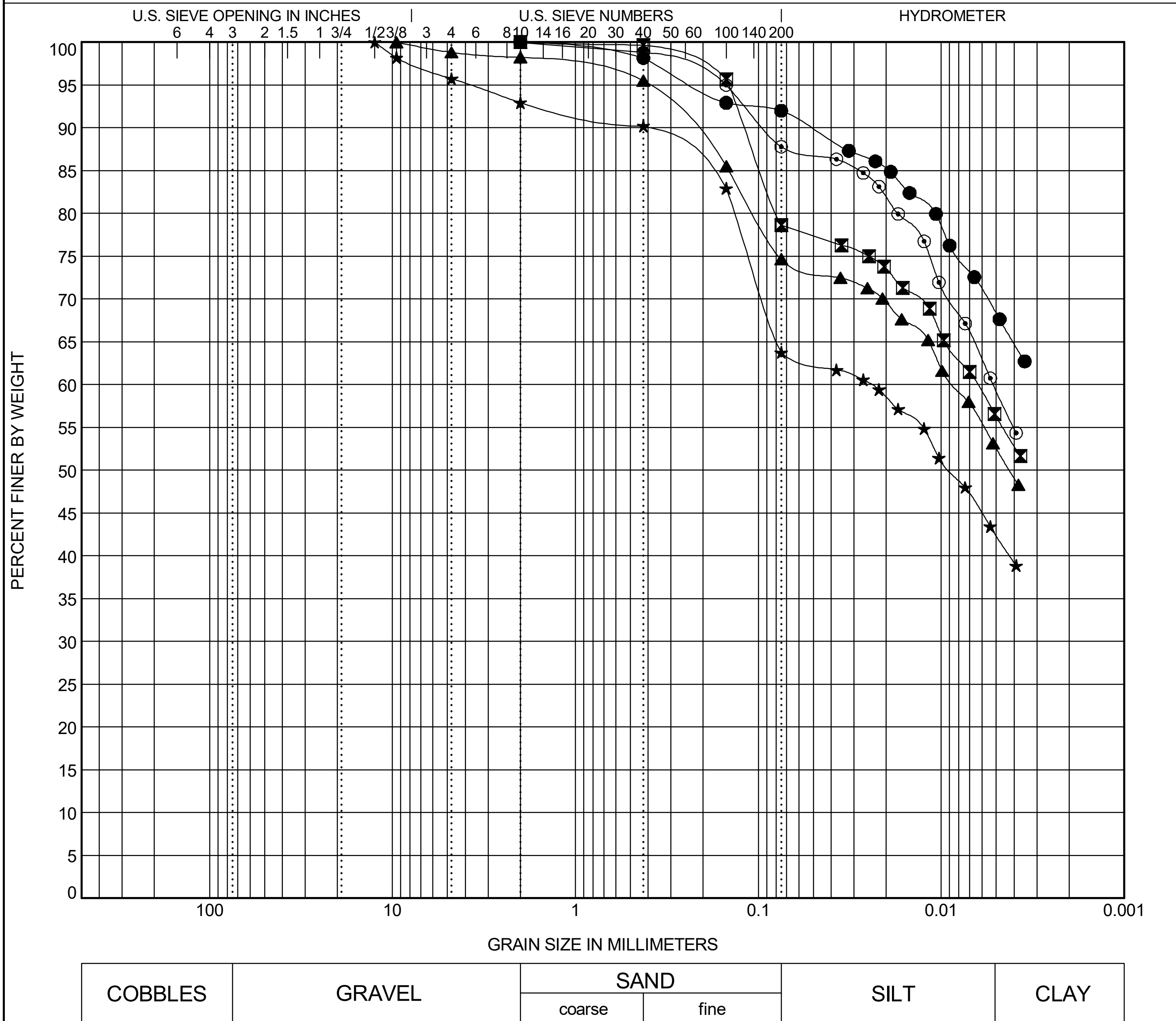
PROJECT WOO/LUC-280-06.20/00.00 **PID** 108584
OGE NUMBER N/A **PROJECT TYPE** ROADWAY



Specimen Identification		ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	**B-005-0-21 2.5**	**A-6b ~ LEAN CLAY(CL)**	**36**	**18**	**18**
⧗	**B-005-0-21 4.0**	**A-6b ~ LEAN CLAY with SAND(CL)**	**34**	**17**	**17**
▲	**B-006-0-21 2.0**	**A-6a ~ LEAN CLAY with SAND(CL)**	**28**	**15**	**13**
★	**B-006-0-21 3.5**	**A-6a ~ SANDY LEAN CLAY(CL)**	**26**	**15**	**11**
⊙	**B-007-0-21 1.0**	**A-6a ~ LEAN CLAY(CL)**	**31**	**17**	**14**

Specimen Identification		D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	**B-005-0-21 2.5**	**0.052**				**0**	**2**	**6**	**24**	**68**		
⧗	**B-005-0-21 4.0**	**0.119**				**0**	**0**	**21**	**23**	**56**		
▲	**B-006-0-21 2.0**	**0.239**	**0.004**			**1**	**3**	**21**	**22**	**53**		
★	**B-006-0-21 3.5**	**0.412**	**0.009**			**7**	**3**	**26**	**22**	**42**		
⊙	**B-007-0-21 1.0**	**0.093**				**0**	**1**	**11**	**29**	**59**		

GRAIN SIZE DISTRIBUTION

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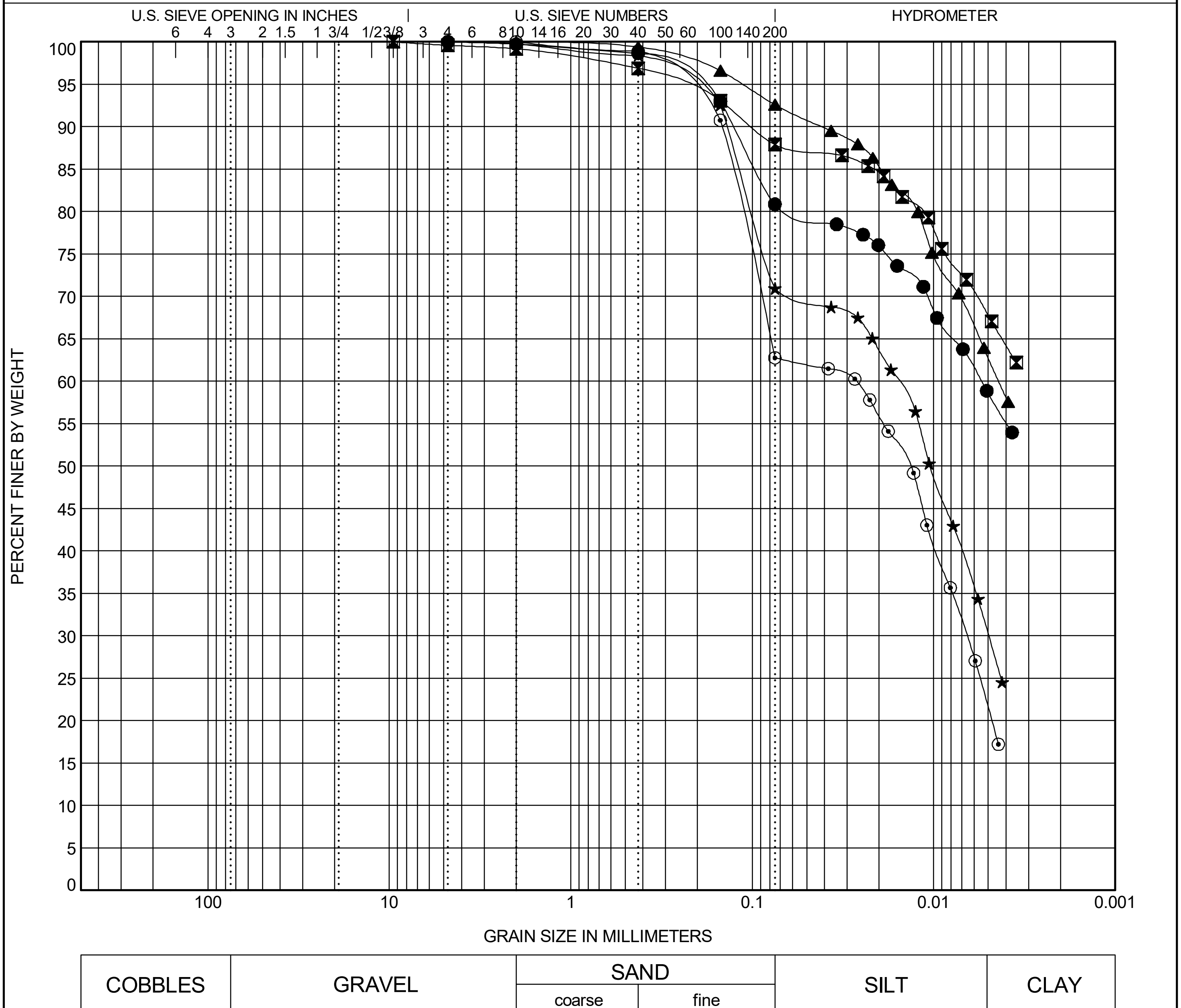
PROJECT WOO/LUC-280-06.20/00.00 **PID** 108584

OGE NUMBER N/A **PROJECT TYPE** ROADWAY



Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	**B-007-0-21**	**2.5**	**A-6a ~ LEAN CLAY with SAND(CL)**	**26**	**14**	**12**
⊠	**B-008-0-21**	**2.0**	**A-6a ~ LEAN CLAY(CL)**	**28**	**16**	**12**
▲	**B-008-0-21**	**3.5**	**A-6a ~ LEAN CLAY(CL)**	**29**	**16**	**13**
★	**B-009-0-21**	**1.5**	**A-4a ~ LEAN CLAY with SAND(CL)**	**25**	**17**	**8**
⊙	**B-009-0-21**	**4.5**	**A-4a ~ SANDY LEAN CLAY(CL)**	**24**	**16**	**8**

Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	**B-007-0-21**	**2.5**	**0.126**				**0**	**1**	**18**	**22**	**59**		
⊠	**B-008-0-21**	**2.0**	**0.099**				**1**	**2**	**9**	**20**	**68**		
▲	**B-008-0-21**	**3.5**	**0.041**				**0**	**0**	**7**	**30**	**63**		
★	**B-009-0-21**	**1.5**	**0.138**	**0.01**	**0.005**		**1**	**1**	**27**	**41**	**30**		
⊙	**B-009-0-21**	**4.5**	**0.147**	**0.014**	**0.007**		**0**	**1**	**36**	**41**	**22**		

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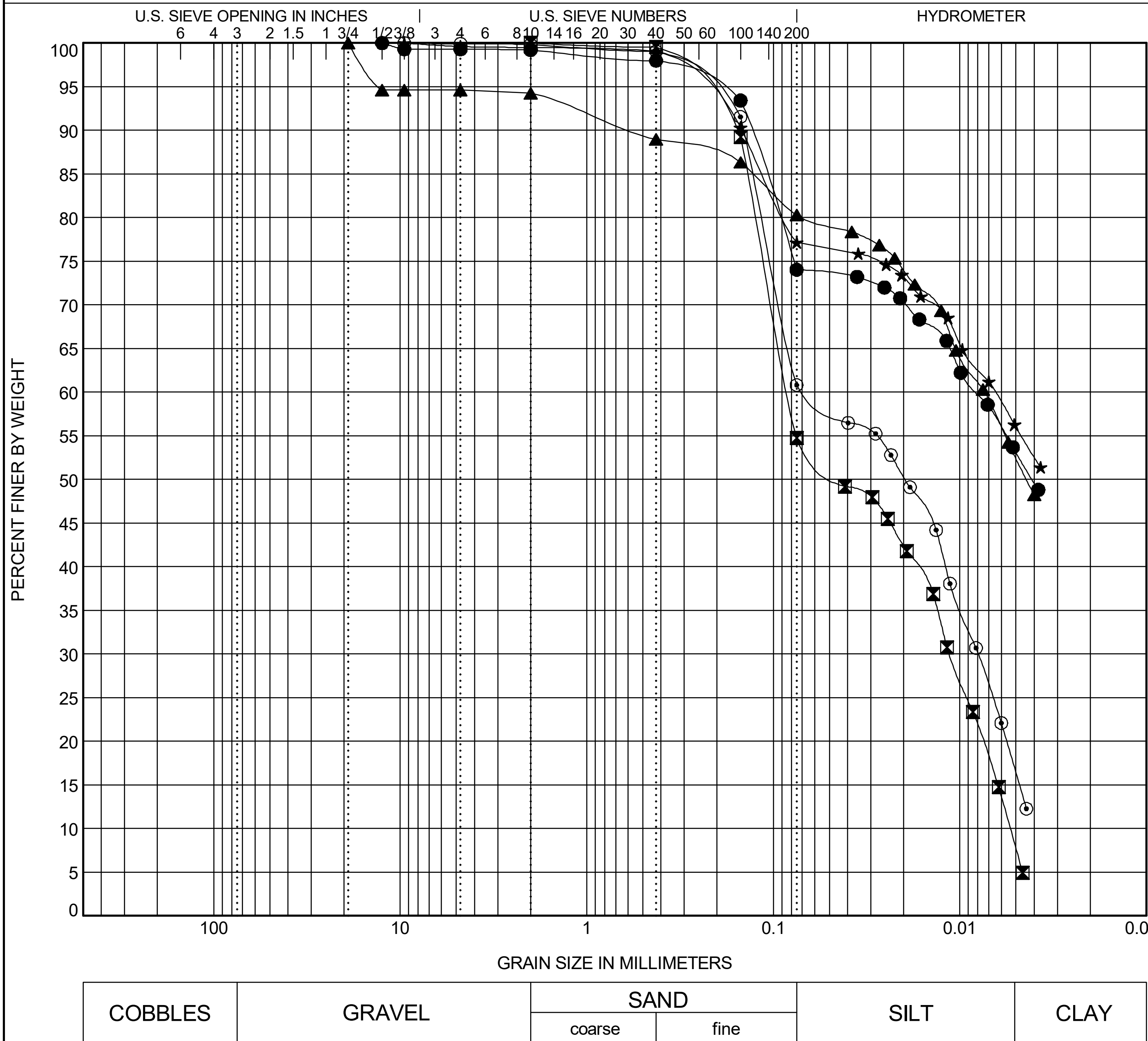
PROJECT WOO/LUC-280-06.20/00.00 **PID** 108584

OGE NUMBER N/A **PROJECT TYPE** ROADWAY



	Specimen Identification		ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	**B-010-0-21**	**2.0**	**A-6a ~ LEAN CLAY with SAND(CL)**	**25**	**14**	**11**
⊠	**B-010-0-21**	**5.0**	**A-4a ~ SANDY LEAN CLAY(CL)**	**25**	**17**	**8**
▲	**B-011-0-21**	**1.5**	**A-6a ~ LEAN CLAY with SAND(CL)**	**26**	**15**	**11**
★	**B-011-0-21**	**3.0**	**A-6a ~ LEAN CLAY with SAND(CL)**	**27**	**15**	**12**
⊙	**B-012-0-21**	**2.0**	**A-4a ~ SANDY SILTY CLAY(CL-ML)**	**23**	**16**	**7**

	Specimen Identification		D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	**B-010-0-21**	**2.0**	**0.133**	**0.004**			**1**	**1**	**24**	**21**	**53**		
⊠	**B-010-0-21**	**5.0**	**0.162**	**0.045**	**0.011**	**0.005**	**0**	**0**	**45**	**47**	**8**	**0.29**	**15.53**
▲	**B-011-0-21**	**1.5**	**0.574**	**0.004**			**6**	**5**	**9**	**28**	**52**		
★	**B-011-0-21**	**3.0**	**0.147**				**1**	**0**	**22**	**21**	**56**		
⊙	**B-012-0-21**	**2.0**	**0.145**	**0.02**	**0.008**		**0**	**1**	**38**	**45**	**16**		

GRAIN SIZE DISTRIBUTION

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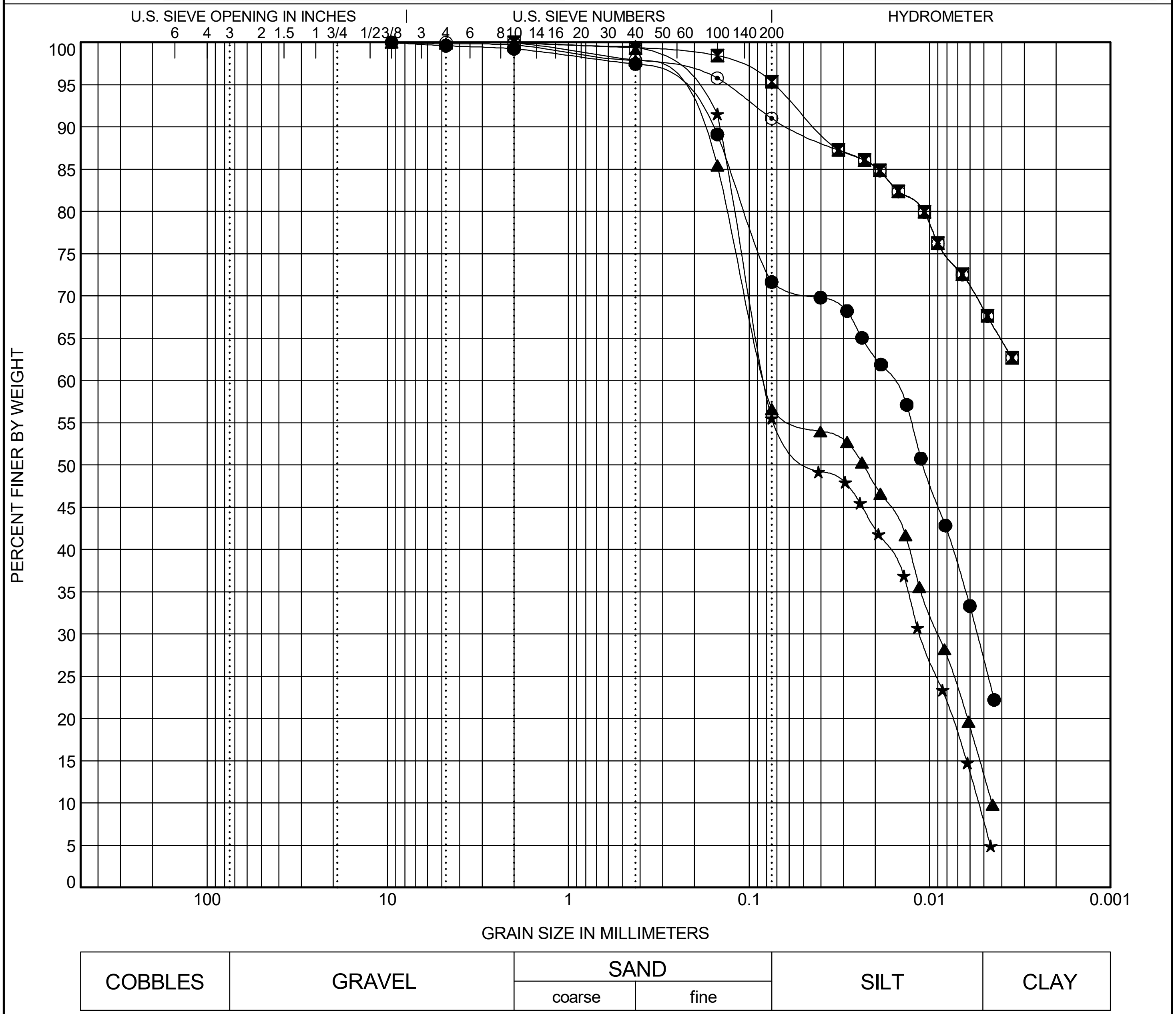
PROJECT WOO/LUC-280-06.20/00.00 **PID** 108584

OGE NUMBER N/A **PROJECT TYPE** ROADWAY



Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	**B-012-0-21**	**3.5**	**A-4a ~ LEAN CLAY with SAND(CL)**	**26**	**16**	**10**
⊠	**B-013-0-21**	**1.5**	**A-7-6 ~ LEAN CLAY(CL)**	**42**	**21**	**21**
▲	**B-013-0-21**	**3.0**	**A-4a ~ SANDY LEAN CLAY(CL)**	**23**	**14**	**9**
★	**B-013-0-21**	**4.5**	**A-4a ~ SANDY LEAN CLAY(CL)**	**24**	**15**	**9**
⊙	**B-013-0-21**	**11.5**	**A-6a ~ LEAN CLAY(CL)**	**29**	**18**	**11**

Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	**B-012-0-21**	**3.5**	**0.167**	**0.011**	**0.005**		**0**	**2**	**26**	**45**	**27**		
⊠	**B-013-0-21**	**1.5**	**0.042**				**0**	**1**	**4**	**27**	**68**		
▲	**B-013-0-21**	**3.0**	**0.219**	**0.023**	**0.009**	**0.005**	**0**	**2**	**41**	**44**	**13**	**0.22**	**17.97**
★	**B-013-0-21**	**4.5**	**0.146**	**0.045**	**0.011**	**0.005**	**0**	**0**	**44**	**48**	**8**	**0.29**	**15.23**
⊙	**B-013-0-21**	**11.5**	**0.059**				**0**	**2**	**7**	**23**	**68**		

GRAIN SIZE DISTRIBUTION

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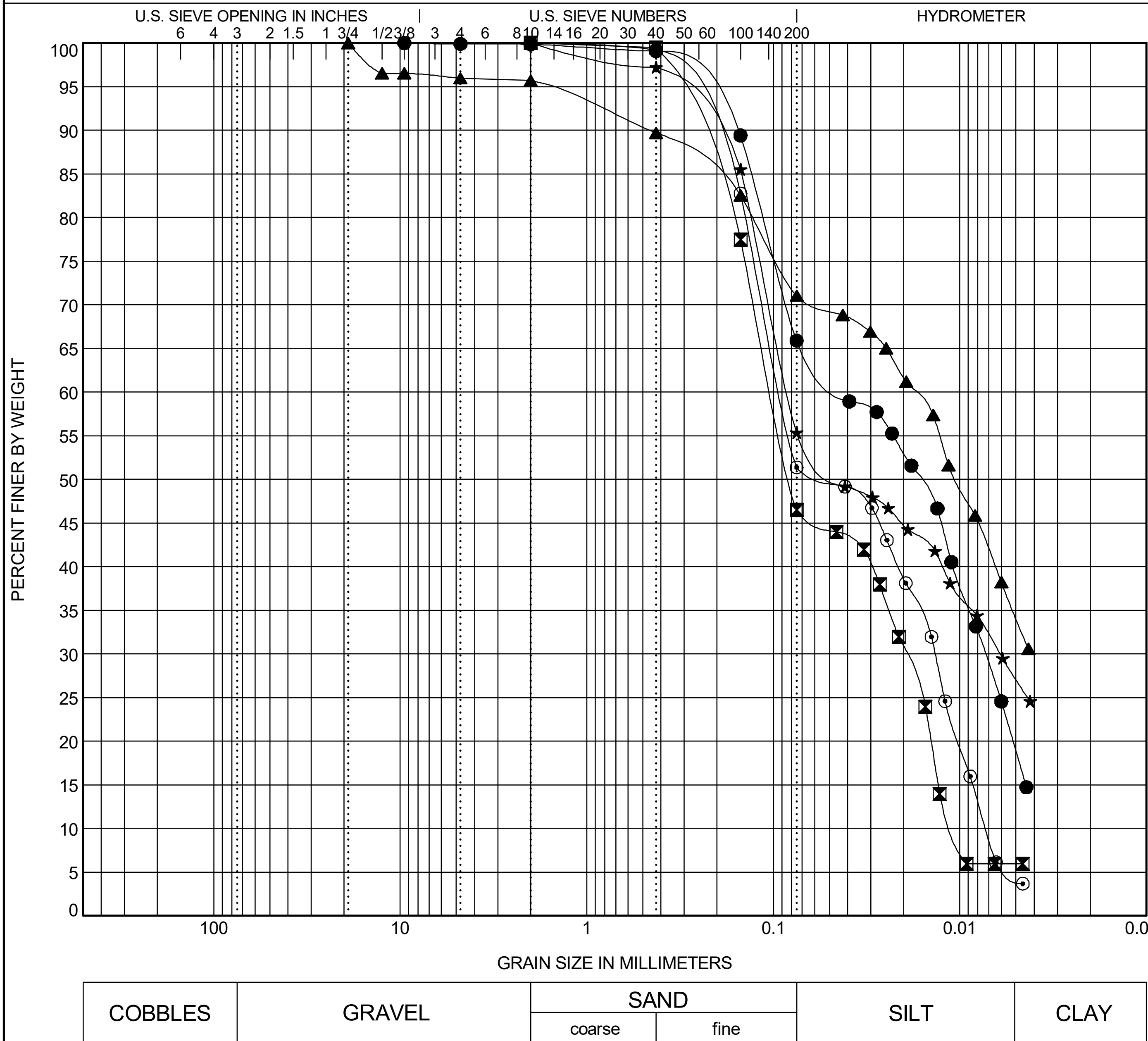
PROJECT WOO/LUC-280-06.20/00.00 **PID** 108584

OGE NUMBER N/A **PROJECT TYPE** ROADWAY



Specimen Identification		ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
● B-014-0-21	2.0	**A-4a ~ SANDY LEAN CLAY(CL)**	24	15	9
⧗ B-014-0-21	3.5	**A-4a ~ CLAYEY SAND(SC)**	24	16	8
▲ B-015-0-21	2.0	**A-6a ~ LEAN CLAY with SAND(CL)**	27	14	13
★ B-015-0-21	3.5	**A-6a ~ SANDY LEAN CLAY(CL)**	28	17	11
⊙ B-016-0-21	2.0	**A-4a ~ SANDY SILT(ML)**	NP	NP	NP

Specimen Identification		D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
● B-014-0-21	2.0	0.16	0.016	0.007		0	1	33	47	19		
⧗ B-014-0-21	3.5	0.271	0.081	0.02	0.011	0	0	53	41	6	0.35	9.34
▲ B-015-0-21	2.0	0.457	0.01			4	6	19	37	34		
★ B-015-0-21	3.5	0.223	0.045	0.006		0	3	42	28	27		
⊙ B-016-0-21	2.0	0.237	0.051	0.014	0.007	0	1	48	47	4	0.28	12.51

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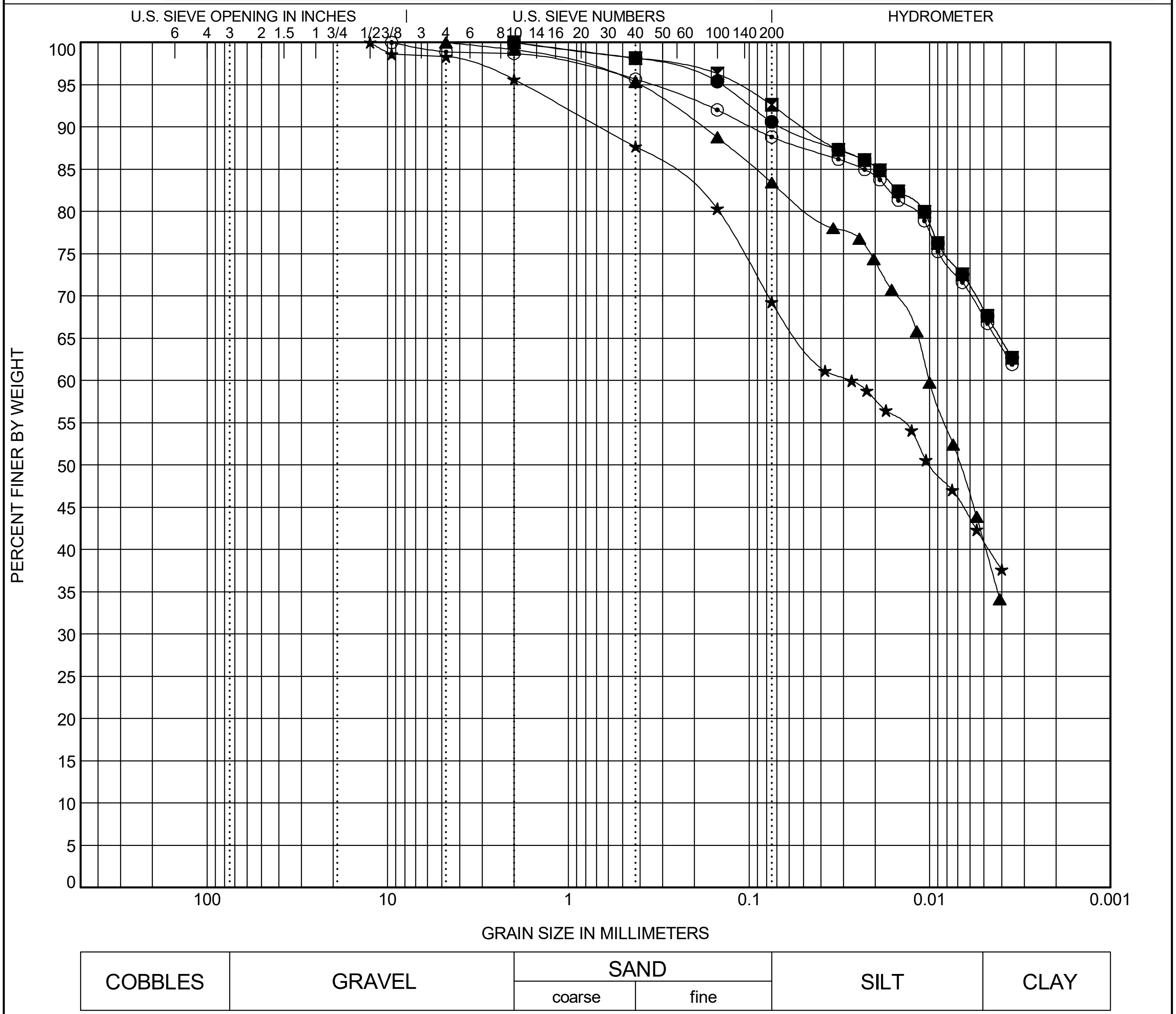

Specimen Identification		ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
● B-016-0-21	5.0	A-6b ~ LEAN CLAY(CL)	37	19	18
⊠ B-016-0-21	6.5	A-6a ~ LEAN CLAY(CL)	34	20	14
▲ B-017-0-21	2.0	A-4a ~ LEAN CLAY with SAND(CL)	25	17	8
★ B-017-0-21	3.5	A-6b ~ SANDY LEAN CLAY(CL)	40	22	18
⊙ B-017-0-21	11.0	A-6b ~ LEAN CLAY(CL)	39	20	19

Specimen Identification		D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
● B-016-0-21	5.0	0.064				0	1	8	23	68		
⊠ B-016-0-21	6.5	0.049				0	1	6	25	68		
▲ B-017-0-21	2.0	0.182	0.007			1	4	12	42	41		
★ B-017-0-21	3.5	0.667	0.01			5	8	18	28	41		
⊙ B-017-0-21	11.0	0.097				1	3	7	22	67		

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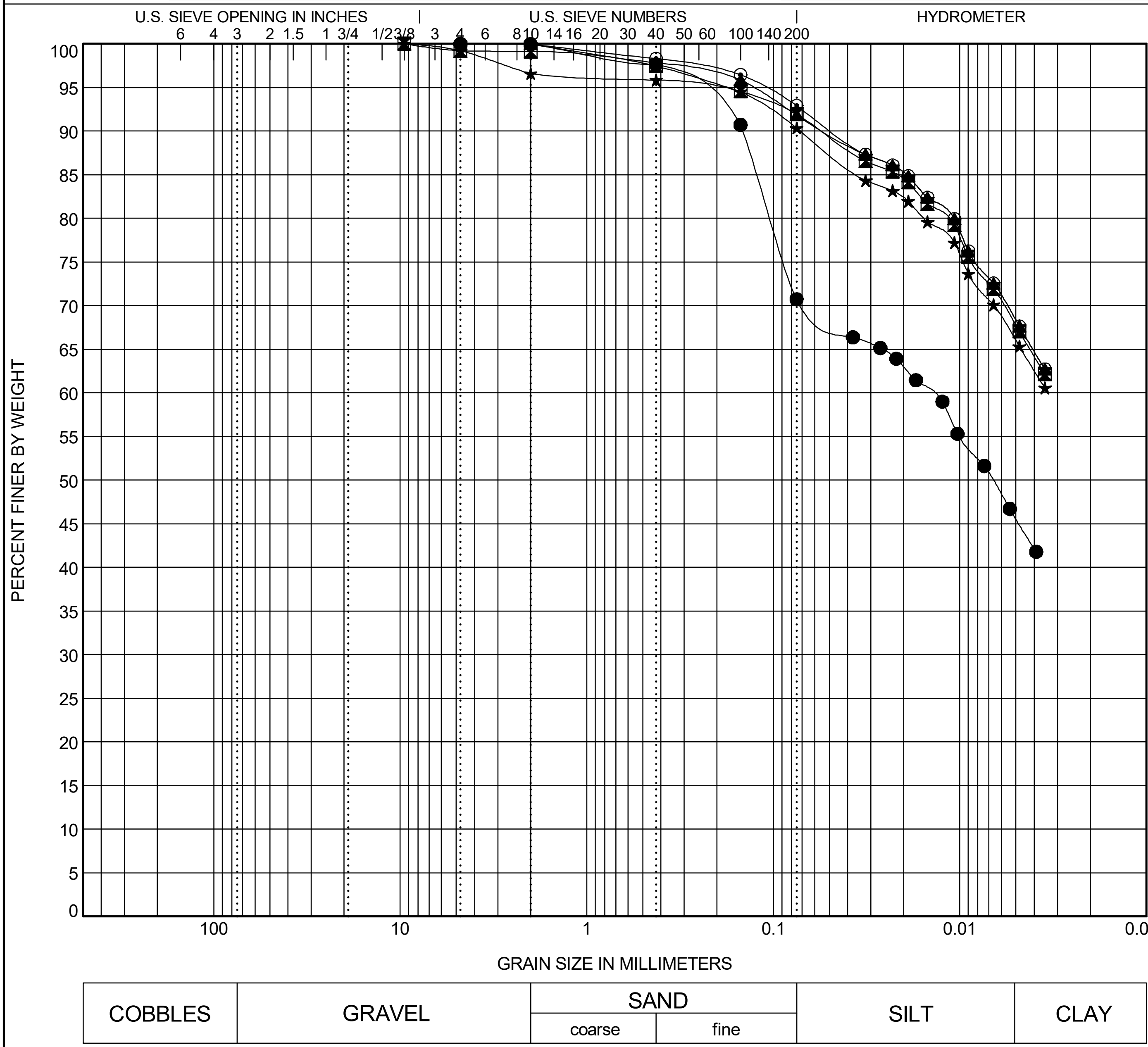

Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	**B-018-0-21**	**2.0**	**A-6a ~ LEAN CLAY with SAND(CL)**	**27**	**16**	**11**
⊠	**B-018-0-21**	**4.0**	**A-6a ~ LEAN CLAY(CL)**	**33**	**19**	**14**
▲	**B-018-0-21**	**5.0**	**A-6a ~ LEAN CLAY(CL)**	**31**	**18**	**13**
★	**B-019-0-21**	**2.0**	**A-6a ~ LEAN CLAY(CL)**	**32**	**18**	**14**
⊙	**B-019-0-21**	**3.5**	**A-6a ~ LEAN CLAY(CL)**	**30**	**19**	**11**

Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	**B-018-0-21**	**2.0**	**0.146**	**0.007**			**0**	**2**	**27**	**25**	**46**		
⊠	**B-018-0-21**	**4.0**	**0.055**				**1**	**2**	**5**	**24**	**68**		
▲	**B-018-0-21**	**5.0**	**0.053**				**0**	**2**	**6**	**24**	**68**		
★	**B-019-0-21**	**2.0**	**0.071**				**4**	**1**	**5**	**24**	**66**		
⊙	**B-019-0-21**	**3.5**	**0.048**				**0**	**2**	**5**	**25**	**68**		

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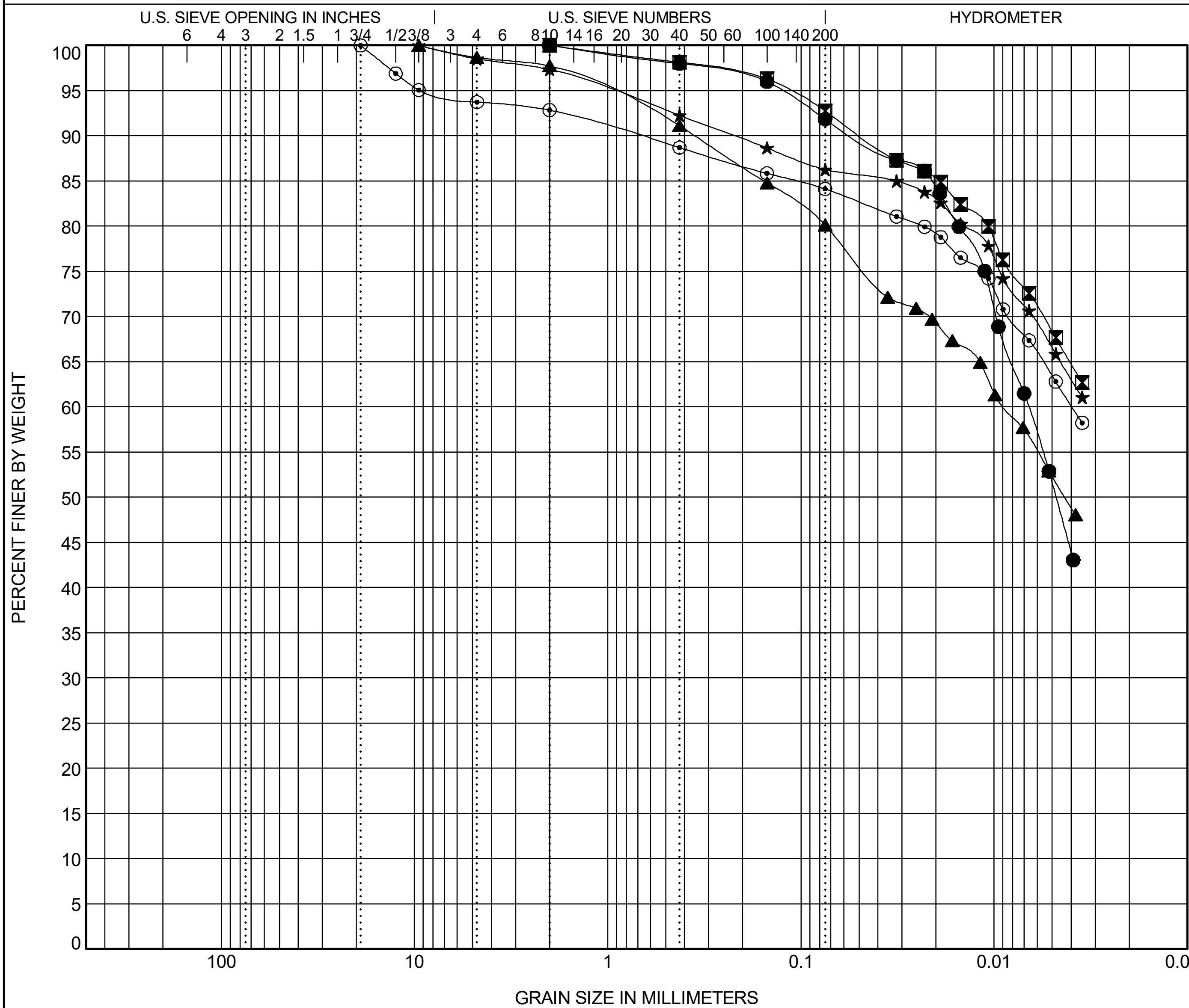

COBBLES	GRAVEL	SAND (coarse)	SAND (fine)	SILT	CLAY

Specimen Identification		ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
● **B-020-0-21**	**2.0**	**A-4a ~ LEAN CLAY(CL)**	**27**	**17**	**10**
⧗ **B-020-0-21**	**3.5**	**A-6a ~ LEAN CLAY(CL)**	**29**	**15**	**14**
▲ **B-020-0-21**	**5.0**	**A-6a ~ LEAN CLAY with SAND(CL)**	**26**	**15**	**11**
★ **B-020-0-21**	**8.5**	**A-6b ~ LEAN CLAY(CL)**	**30**	**14**	**16**
⊙ **B-021-0-21**	**2.0**	**A-6b ~ LEAN CLAY with SAND(CL)**	**30**	**13**	**17**

Specimen Identification		D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
● **B-020-0-21**	**2.0**	**0.053**	**0.005**			**0**	**2**	**6**	**40**	**52**		
⧗ **B-020-0-21**	**3.5**	**0.049**				**0**	**2**	**5**	**25**	**68**		
▲ **B-020-0-21**	**5.0**	**0.353**	**0.004**			**2**	**7**	**11**	**28**	**52**		
★ **B-020-0-21**	**8.5**	**0.221**				**3**	**5**	**6**	**20**	**66**		
⊙ **B-021-0-21**	**2.0**	**0.691**				**7**	**4**	**5**	**21**	**63**		

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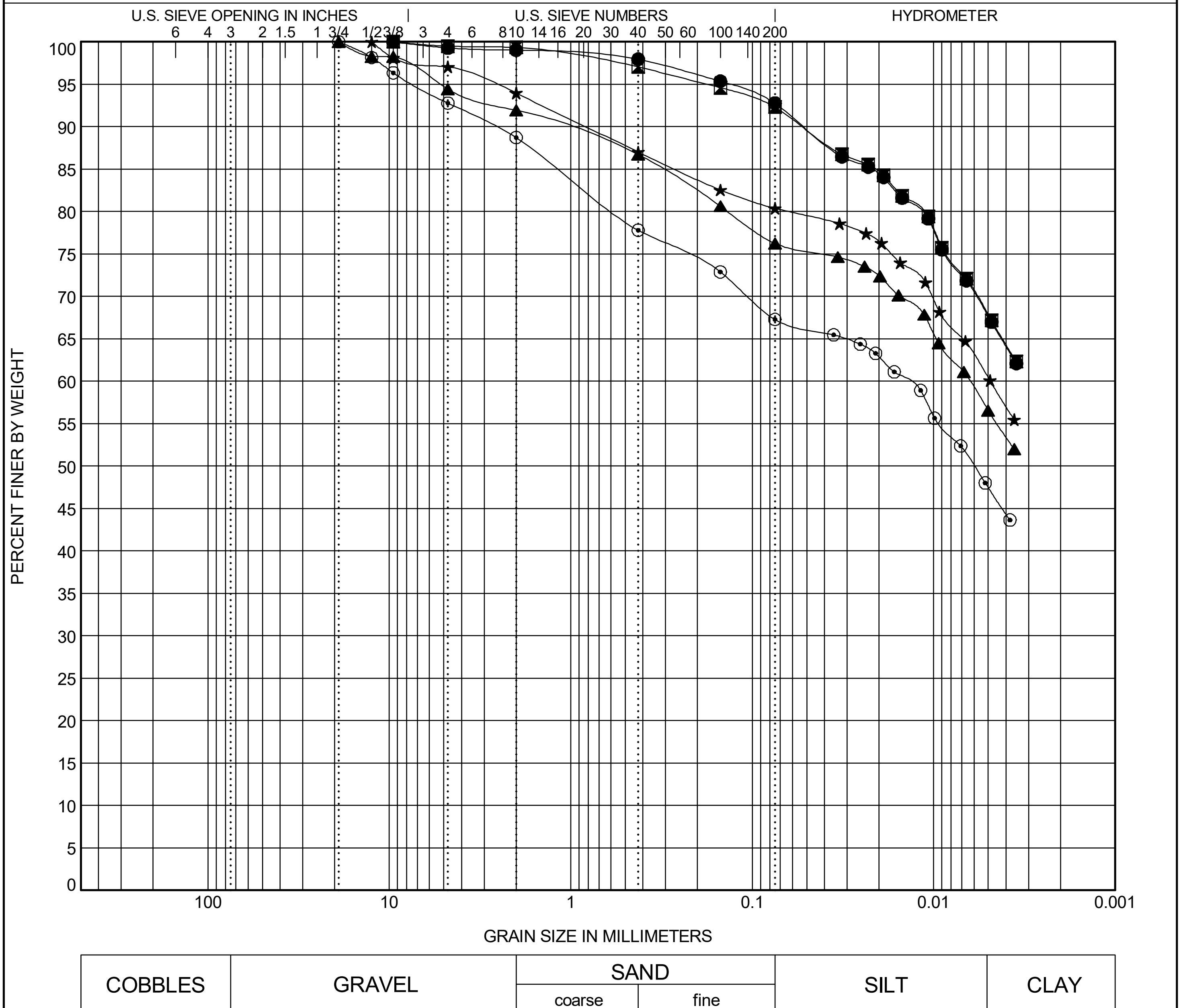

Specimen Identification		ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
● B-021-0-21	3.5	**A-6a ~ LEAN CLAY(CL)**	32	17	15
⊠ B-021-0-21	5.0	**A-6a ~ LEAN CLAY(CL)**	32	18	14
▲ B-022-0-21	2.0	**A-6a ~ LEAN CLAY with SAND(CL)**	24	13	11
★ B-022-0-21	3.5	**A-6a ~ LEAN CLAY with SAND(CL)**	27	16	11
⊙ B-022-0-21	5.5	**A-6a ~ SANDY LEAN CLAY(CL)**	26	15	11

Specimen Identification		D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
● B-021-0-21	3.5	0.052				1	1	5	25	68		
⊠ B-021-0-21	5.0	0.053				1	2	5	24	68		
▲ B-022-0-21	2.0	1.121				9	5	10	19	57		
★ B-022-0-21	3.5	0.824				6	7	7	20	60		
⊙ B-022-0-21	5.5	2.625	0.006			11	11	11	20	47		

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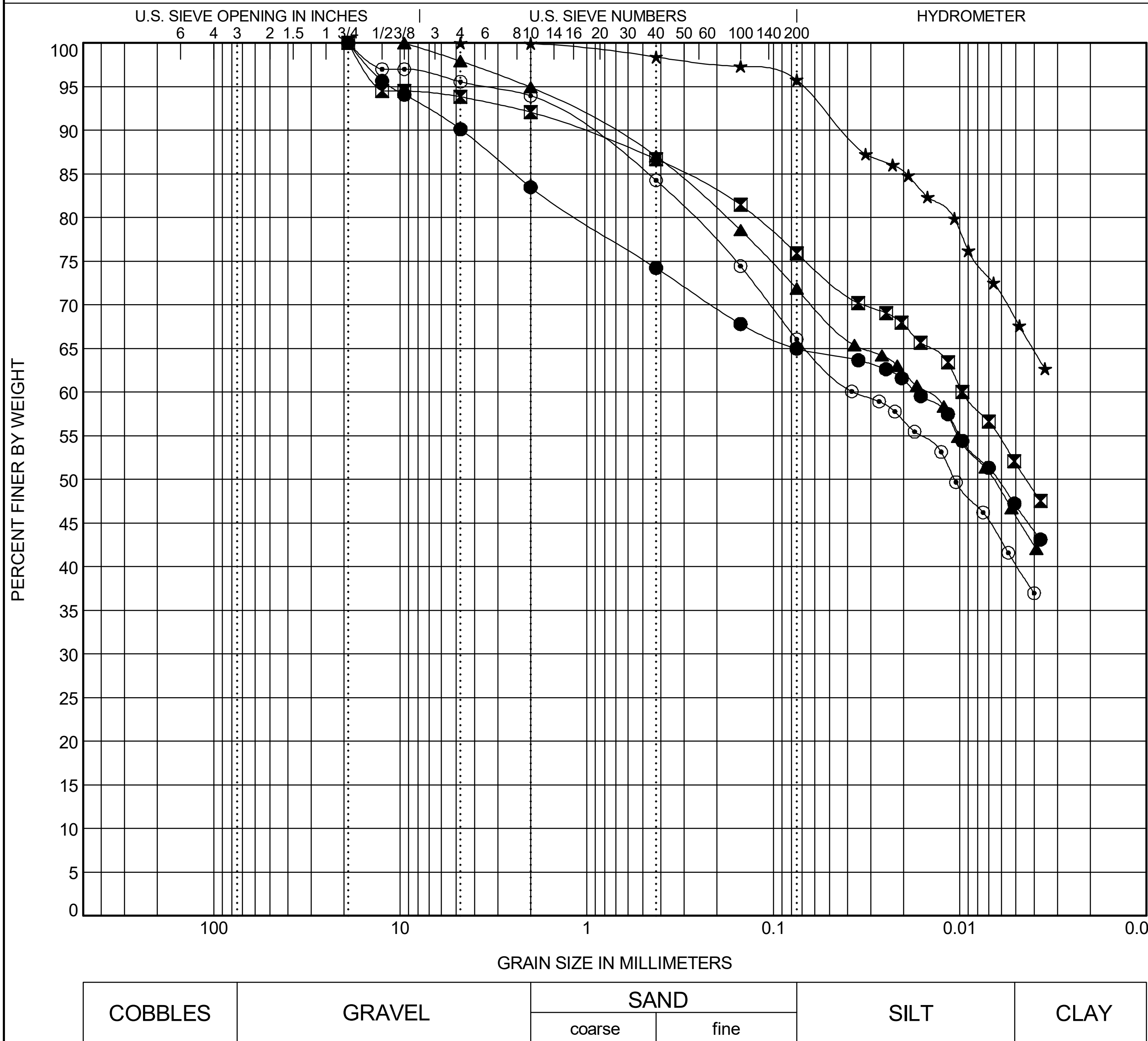

Specimen Identification		ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
● B-023-0-21	2.0	A-6a ~ SANDY LEAN CLAY(CL)	28	15	13
⧗ B-023-0-21	3.5	A-6b ~ LEAN CLAY with SAND(CL)	32	16	16
▲ B-024-0-21	2.0	A-6a ~ LEAN CLAY with SAND(CL)	29	15	14
★ B-024-0-21	5.0	A-6b ~ LEAN CLAY(CL)	34	17	17
⊙ B-025-0-21	2.0	A-6a ~ SANDY LEAN CLAY(CL)	28	15	13

Specimen Identification		D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
● B-023-0-21	2.0	4.67	0.006			17	9	9	18	47		
⧗ B-023-0-21	3.5	1.098	0.004			8	5	11	24	52		
▲ B-024-0-21	2.0	0.759	0.007			5	8	15	26	46		
★ B-024-0-21	5.0	0.042				0	1	3	28	68		
⊙ B-025-0-21	2.0	1.062	0.011			6	10	18	26	40		

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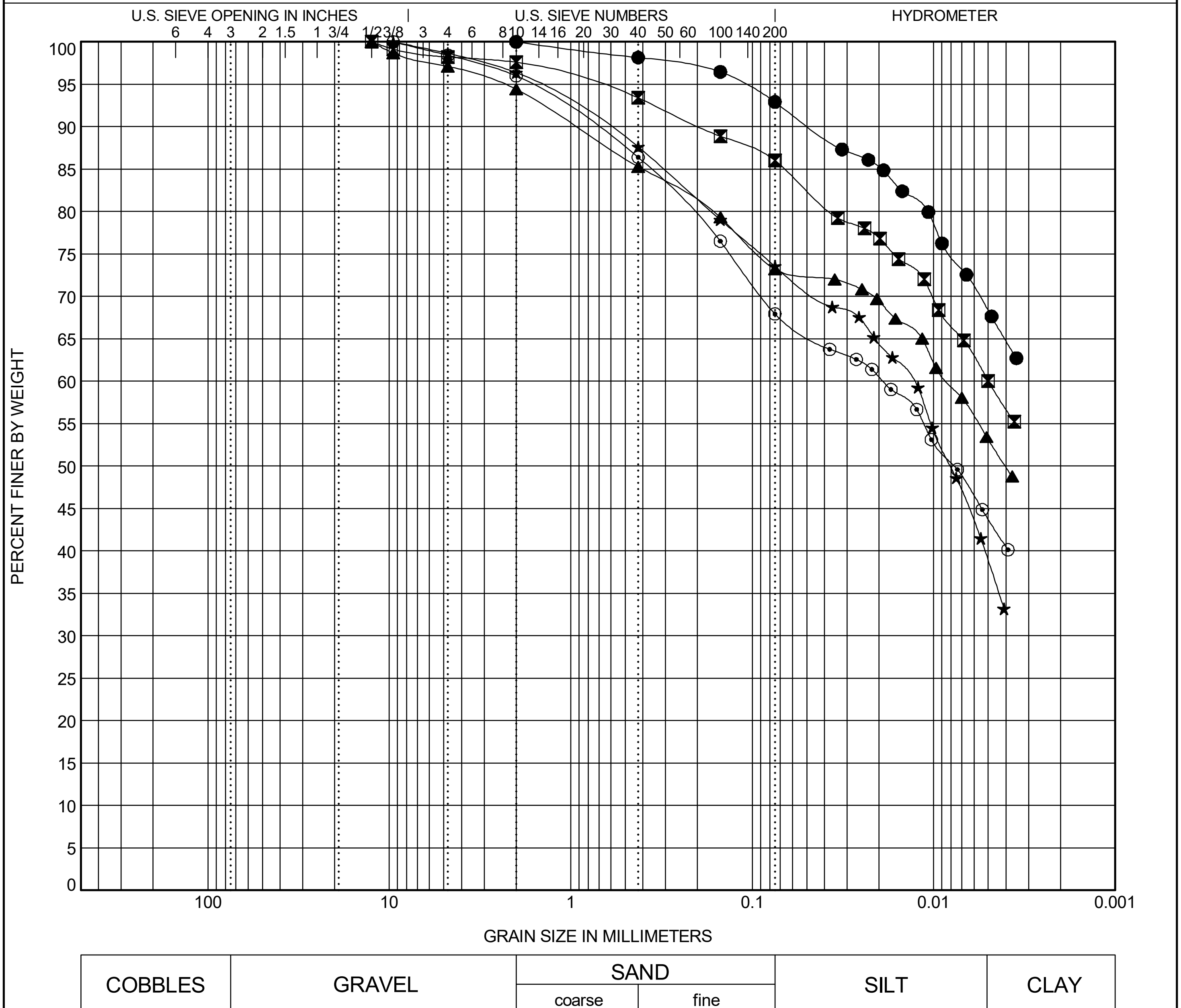
OGE NUMBER N/A **PROJECT TYPE** ROADWAY



Specimen Identification		ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
● B-025-0-21	3.5	A-6a ~ LEAN CLAY(CL)	31	19	12
⊠ B-025-0-21	8.5	A-6a ~ LEAN CLAY(CL)	28	16	12
▲ B-026-0-21	2.0	A-6a ~ LEAN CLAY with SAND(CL)	27	15	12
★ B-026-0-21	3.5	A-4a ~ LEAN CLAY with SAND(CL)	25	15	10
⊙ B-026-0-21	11.0	A-6a ~ SANDY LEAN CLAY(CL)	26	12	14

Specimen Identification		D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
● B-025-0-21	3.5	0.048				0	2	5	25	68		
⊠ B-025-0-21	8.5	0.194				3	4	7	26	60		
▲ B-026-0-21	2.0	0.944	0.004			6	9	12	20	53		
★ B-026-0-21	3.5	0.645	0.008			3	9	14	35	39		
⊙ B-026-0-21	11.0	0.759	0.008			4	10	18	24	44		

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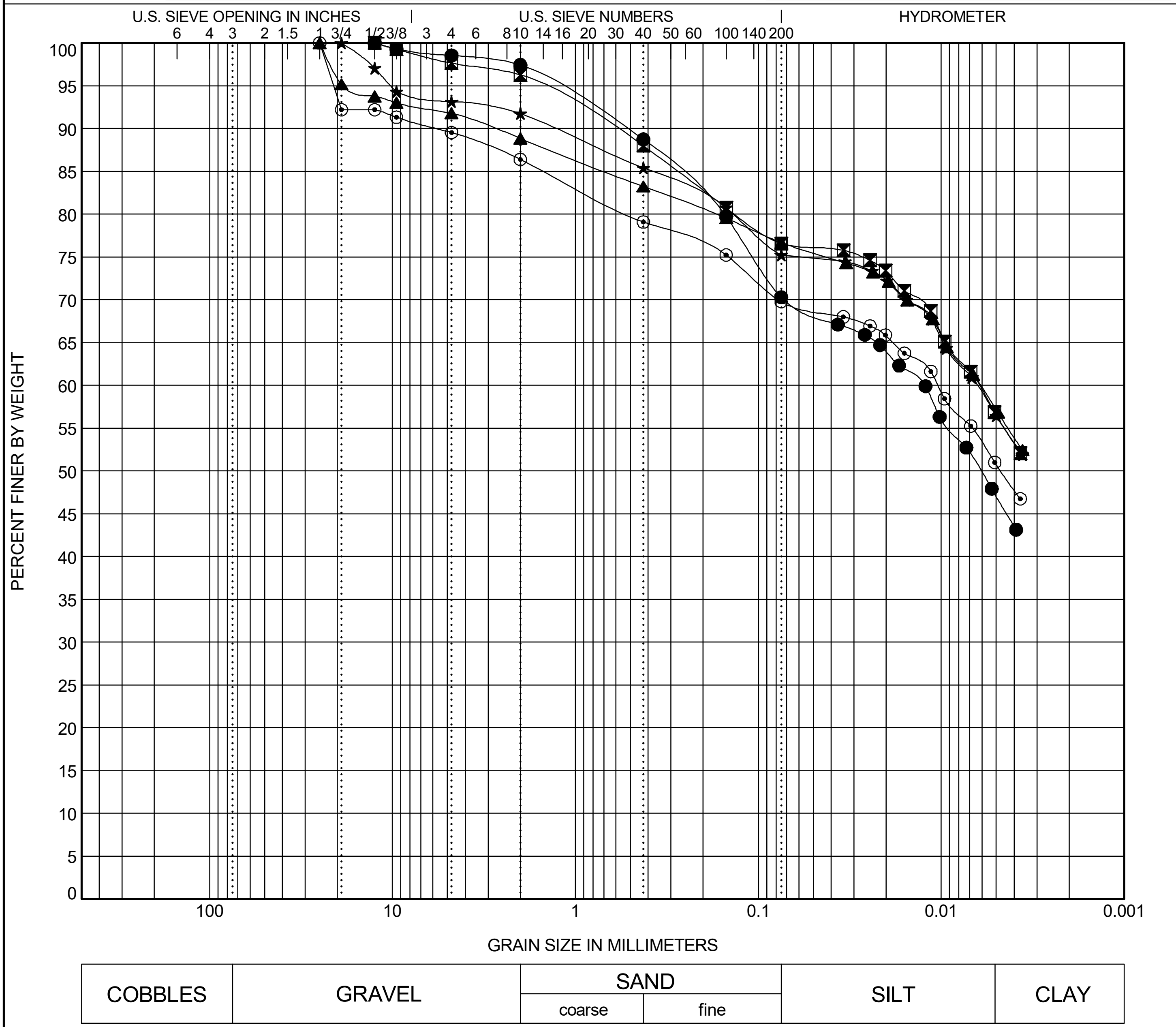

Specimen Identification		ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
● B-027-0-21	2.0	**A-6a ~ LEAN CLAY with SAND(CL)**	27	15	12
⧗ B-027-0-21	3.5	**A-6a ~ LEAN CLAY with SAND(CL)**	27	14	13
▲ B-027-0-21	8.0	**A-6a ~ LEAN CLAY with SAND(CL)**	27	14	13
★ B-028-0-21	2.0	**A-6a ~ LEAN CLAY with SAND(CL)**	26	15	11
⊙ B-028-0-21	3.5	**A-6a ~ SANDY LEAN CLAY(CL)**	28	15	13

Specimen Identification		D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
● B-027-0-21	2.0	0.531	0.006			3	9	18	23	47		
⧗ B-027-0-21	3.5	0.617				4	8	11	20	57		
▲ B-027-0-21	8.0	2.804				10	6	7	20	57		
★ B-028-0-21	2.0	1.298				9	6	10	19	56		
⊙ B-028-0-21	3.5	5.663	0.005			14	7	9	19	51		

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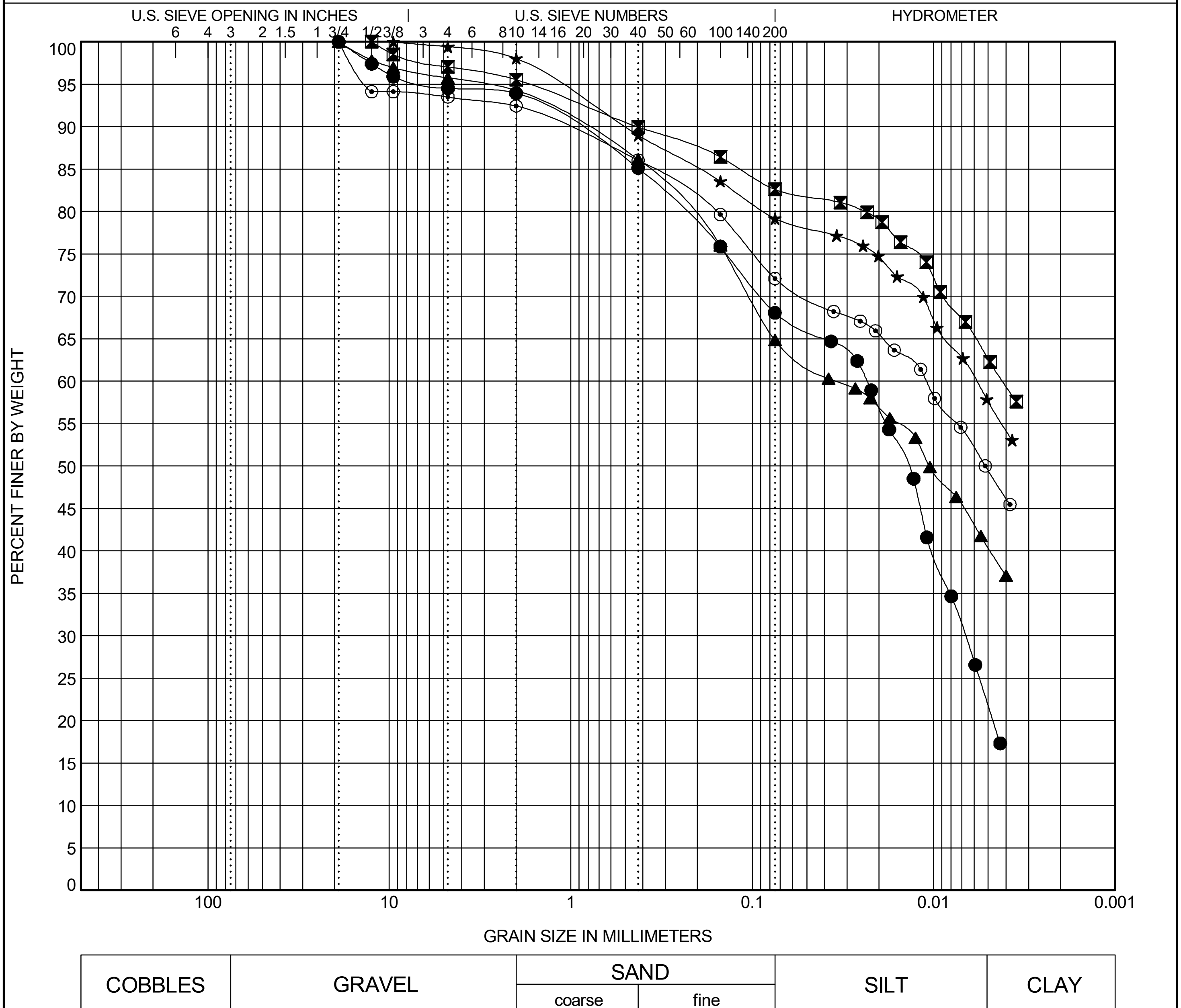
OGE NUMBER N/A **PROJECT TYPE** ROADWAY



Specimen Identification		ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
● B-029-0-21	2.0	**A-4a ~ SANDY SILTY CLAY(CL-ML)**	19	12	7
⧗ B-029-0-21	6.0	**A-6a ~ LEAN CLAY with SAND(CL)**	27	15	12
▲ B-030-0-21	2.0	**A-6a ~ SANDY LEAN CLAY(CL)**	31	17	14
★ B-030-0-21	3.5	**A-6a ~ LEAN CLAY with SAND(CL)**	31	16	15
⊙ B-030-0-21	8.5	**A-6b ~ LEAN CLAY with SAND(CL)**	35	16	19

Specimen Identification		D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
● B-029-0-21	2.0	1	0.014	0.007		6	9	17	46	22		
⧗ B-029-0-21	6.0	0.429				4	6	7	20	63		
▲ B-030-0-21	2.0	0.883	0.011			6	8	21	25	40		
★ B-030-0-21	3.5	0.504				2	9	10	21	58		
⊙ B-030-0-21	8.5	1.105	0.005			8	6	14	23	49		

UNCONFINED COMPRESSION TEST

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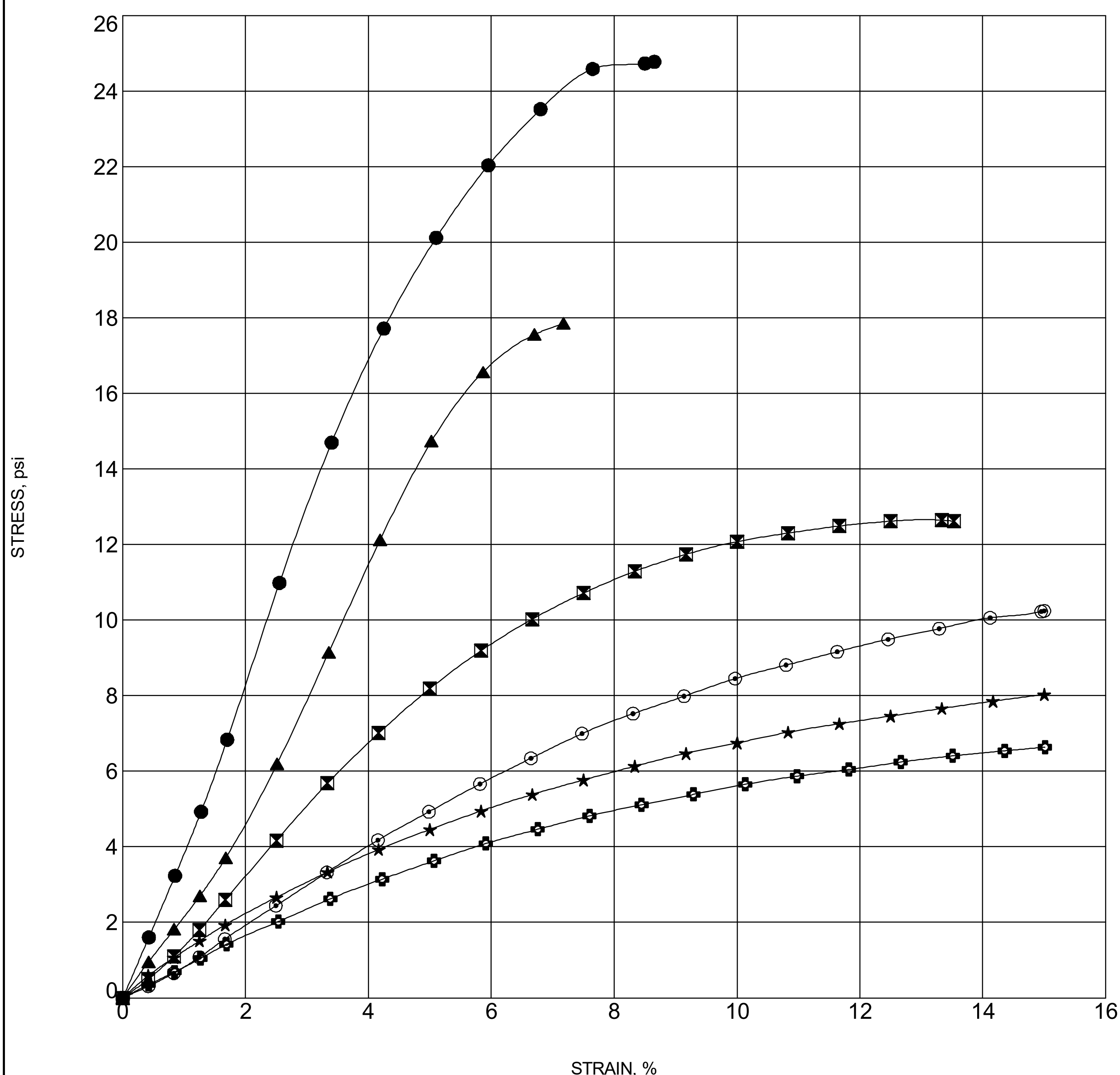


Specimen Identification			Classification	γ_d	MC%
●	B-005-0-21	4.0	A-6a	107	21
⧗	B-013-0-21	11.5	A-6a	101	26
▲	B-016-0-21	6.5	A-6a	100	26
★	B-022-0-21	3.5	A-6a	115	18
⊙	B-027-0-21	8.0	A-6a	117	18
✿	B-028-0-21	3.5	A-6a	116	18

CORE LOG for B-002-0-21

Project: WOO/LUC-280-06.20/00.00, PID 108584

Project Location: Northwood and Oregon, Ohio

TTL Project No. 2171101

Core Date: May 18, 2022

ASPHALT THICKNESS (in)	=	7.0
CONCRETE THICKNESS (in)	=	8.0
BASE THICKNESS (in)	=	8.0
CORE BARREL DIAMETER (in)	=	4.0

VISUAL DESCRIPTION:

Pavement core appeared in good condition.

CORE LOG for B-005-0-21

Project: WOO/LUC-280-06.20/00.00, PID 108584

Project Location: Northwood and Oregon, Ohio

TTL Project No. 2171101

Core Date: May 15, 2022

ASPHALT THICKNESS (in)	=	6.0
CONCRETE THICKNESS (in)	=	-
BASE THICKNESS (in)	=	7.0
CORE BARREL DIAMETER (in)	=	4.0

VISUAL DESCRIPTION:

Pavement core appeared in good condition.

CORE LOG for B-012-0-21

Project: WOO/LUC-280-06.20/00.00, PID 108584

Project Location: Northwood and Oregon, Ohio

TTL Project No. 2171101

Core Date: May 18, 2022

ASPHALT THICKNESS (in)	=	6.5
CONCRETE THICKNESS (in)	=	10.0
BASE THICKNESS (in)	=	7.5
CORE BARREL DIAMETER (in)	=	4.0

VISUAL DESCRIPTION:

Asphalt pavement core appeared in good condition.

Only 5 inches of concrete pavement core recovered.

CORE LOG for B-029-0-21

Project: WOO/LUC-280-06.20/00.00, PID 108584

Project Location: Northwood and Oregon, Ohio

TTL Project No. 2171101

Core Date: May 17, 2022

ASPHALT THICKNESS (in)	=	6.0
CONCRETE THICKNESS (in)	=	9.5
BASE THICKNESS (in)	=	7.5
CORE BARREL DIAMETER (in)	=	4.0

VISUAL DESCRIPTION:

Pavement core appeared in good condition.

Appendix A:
Engineering Calculations
(Including GB-1 Spreadsheets)

GENERAL FOUNDATION INFORMATION:

It is indicated that the median mounted light poles will be supported on foundations. The foundation dimentions were indicated to be 12-foot by 7-foot spread footing bearing at a depth of 1.9 feet.

GENERAL SOIL INFORMATION:

At a depth of 1.9 feet the foundations are generally expected to bear either:

- Stratum I - Stiff, Very Stiff, or Hard Cohesive Soils or
- Stratum II - Medium Stiff Cohesive Soils

However Borings B-023, B-024, B-026 through B-028 encoutered softer soil at a depth of approximately 1.5 feet below the proposed foundations depth, consisting of either:

- Stratum III - **Soft** Cohesive Soils
- Zones of **Soft** Cohesive Soils

in the boring with softer soils underlying the stiffer soils:

Stratum	Sample	Depth	Avg. N_{60}	Avg. Qu	~ c N_{60}	~ c Qu
I & II	SS-1	~1.5 to 3	11	3.5	1.38	3.5
III	SS-2	~3 to 4.5	7	0.25	0.88	0.25
III Boring B-028	ST-2	~3.5 to 5.5	-	0.66	-	0.66
	UNIT	Feet	bpf	tsf	ksf	ksf

USE c_1 =	1.0	ksf for Stratum I and II
USE c_2 =	0.35	ksf for Stratum III

(see attached *Low-Mast Foundation Design Soil Parameters* for further details)

Groundwater

Based on the GDM, Section 1201, groundwater should be assumed at a depth of 3 feet below grade unless more shallow ground water is identified at the site.

"normal" groundwater for site is anticipated at a depths ranging from 5 to 13 feet.

As such a gorundwater depth of 3 feet has been used for caluclations.

STRENTH LIMIT STATE:

AASHTO LRFD Bridge Design Spesifications, Ninth Edition, 2020

$q_R = \varphi_b * q_n$ (AASHTO LRFD 10.6.3.1.1-1)

q_R = factored resistance at strength limit state (ksf)
φ_b = resistance factor (Article 10.5.5.2.2)
q_n = nominal bearing resistance (ksf)

$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma}$ (AASHTO LRFD 10.6.3.1.2a-1)
$N_{cm} = N_c s_c i_c$ (AASHTO LRFD 10.6.3.1.2a-2)
$N_{qm} = N_q s_q d_q i_q$ (AASHTO LRFD 10.6.3.1.2a-3)
$N_{\gamma m} = N_\gamma s_\gamma i_\gamma$ (AASHTO LRFD 10.6.3.1.2a-4)

c = cohesion, undrained shear strength (ksf)
N_c = cohesion term (Table 10.6.3.1.2a-1)
N_q = surcharge term (Table 10.6.3.1.2a-1)
N_γ = unit weight term (Table 10.6.3.1.2a-1)
γ = total (moist) unit weight (kcf)
D_f = footing embedment depth (ft)
B = footing width (ft)
C_{wq} , $C_{w\gamma}$ = groundwater correction factors (Table 10.6.3.1.2a-2)
s_c , s_γ , s_q = shape correction factors (Table 10.6.3.1.2a-3)
d_q = shear resistance thought cohesionless material correction factor (Table 10.6.3.1.2a-4)
i_c , i_γ , i_q = inclination correction factors

10.6.3.1.2d—Considerations for Two-Layer Soil Systems—Critical Depth

Where the soil profile contains a second layer of soil with different properties affecting shear strength within a distance below the footing less than H_{crit}, the bearing resistance of the layered soil profile shall be determined using the provisions for two-layered soil systems herein. The distance H_{crit}, in feet, may be taken as:

$$H_{crit} = \frac{(3B)\ \ln\left(\frac{q_1}{q_2}\right)}{2\left(1+\frac{B}{L}\right)} \qquad (10.6.3.1.2d\text{-}1)$$

where:

q_1 = nominal bearing resistance of footing supported in the upper layer of a two-layer system, assuming the upper layer is infinitely thick (ksf)
q_2 = nominal bearing resistance of a fictitious footing of the same size and shape as the actual footing but supported on surface of the second (lower) layer of a two-layer system (ksf)
B = footing width (ft)
L = footing length (ft)

10.6.3.1.2e—Two-Layered Soil System in Undrained Loading

Where a footing is supported on a two-layered soil system subjected to undrained loading, the nominal bearing resistance may be determined using Eq. 10.6.3.1.2a-1 with the following modifications:

c_1 = undrained shear strength of the top layer of soil as depicted in Figure 10.6.3.1.2e-1 (ksf)
N_{cm} = N_m, a bearing capacity factor as specified below (dim)
N_{qm} = 1.0 (dim)

Where the bearing stratum overlies a stiffer cohesive soil, N_m, may be taken as specified in Figure 10.6.3.1.2e-2.

Where the bearing stratum overlies a softer cohesive soil, N_m may be taken as:

$$N_m = \left(\frac{1}{\beta_m} + \kappa s_c N_c\right) \le s_c N_c \qquad (10.6.3.1.2e\text{-}1)$$

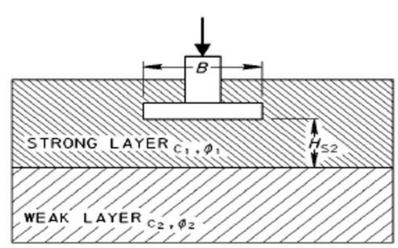
in which:

$$\beta_m = \frac{BL}{2(B+L)H_{s2}} \qquad (10.6.3.1.2e\text{-}2)$$

$$\kappa = \frac{c_2}{c_1} \qquad (10.6.3.1.2e\text{-}3)$$

where:

β_m = punching index (dim)
c_1 = undrained shear strength of upper soil layer (ksf)
c_2 = undrained shear strength of lower soil layer (ksf)
H_{s2} = distance from bottom of footing to top of the second soil layer (ft)
s_c = shape correction factor determined from Table 10.6.3.1.2a-3
N_c = bearing capacity factor determined herein (dim)
N_{qm} = bearing capacity factor determined herein (dim)



(b)

Figure 10.6.3.1.2e-1—Two-Layer Soil Profiles

Critical depth 'H' for Square Foundations (Column):

1) Theoretical case to obtain q_1

Bearing in Statum I cohesive soils at the provided depth of 1.9 feet

Setup	c_1 =	1	ksf	
	ϕ_f =	0	degrees	assumed zero in cohesive soil
	N_c =	5.14	*units*	
	N_q =	1.0	*units*	for soil with a ϕ_f = 0 Degrees
	N_γ =	0.0	*units*	
	γ =	0.125	kcf	(assumed)
	D_f =	1.9	ft	
	B =	7	ft	Width (indicated by prime)
	L =	12	ft	Length (indicated by prime)
	D_w =	3	ft	highest anticipated groundwater depth
	C_{wq} =	1.0	*units*	where Dw < 1.5B + Df; $1.5B + D_f$ = 12.4
	$C_{w\gamma}$ =	0.5	*units*	
	s_c =	1.1	*units*	$s_c = 1 + (B/(5L))$ — $s_c = 1 + (B/(5L))(Nq/Nc)$
	s_γ =	1.0	*units*	for $\phi_f = 0$: $s_\gamma = 1$ — for $\phi_f > 0$: $s_\gamma = 1 - 0.4(B/L)$
	s_q =	1.0	*units*	$s_q = 1$ — $s_q = 1 + ((B/L)\tan(\phi_f))$
	d_q =	1.0	*units*	taken as 1 since cohesive soil; D_f / B = 0.271429
	i_c , i_γ , i_q =	1.0	*units*	Assumed loaded without inclination

calculation

$N_{cm} = N_c s_c i_c$ = 5.14 * 1.117 * 1 = 5.741

$N_{qm} = N_q s_q d_q i_q$ = 1 * 1 * 1 * 1 = 1

$N_{\gamma m} = N_\gamma s_\gamma i_\gamma$ = 0 * 1 * 1 = 0

$q_1 = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma}$

= (1*5.741) + (0.125*1.9*1*1) + (0.5*0.125*7*0*0.5) =

= (5.741) + (0.238) + (0) =

cN_{cm} =	5.741
$\gamma D_f N_{qm} C_{wq}$ =	0.238
$0.5\gamma B N_{\gamma m} C_{w\gamma}$ =	0

q_1 = 5.98 ksf

Critical depth 'H' for Square Foundations (Column):

2) Theoretical case to obtain q_2

Bearing in Statum III cohesive soils at the Stratum Starting depth of 3.5 feet

Setup	$c_2 =$	0.35	ksf	
	$\phi_f =$	0	degrees	assumed zero in cohesive soil
	$N_c =$	5.14	*units*	
	$N_q =$	1.0	*units*	for soil with a $\phi_f =$ 0 Degrees
	$N_\gamma =$	0.0	*units*	
	$\gamma =$	0.125	kcf	(assumed)
	$D_f =$	3.5	ft	at top of Stratum III
	$B =$	7	ft	Width (indicated by prime)
	$L =$	12	ft	Length (indicated by prime)
	$D_w =$	3	ft	highest anticipated groundwater depth
	$C_{wq} =$	1.0	*units*	where Dw < 1.5B + Df; $1.5B + D_f =$ 14
	$C_{w\gamma} =$	0.5	*units*	
	$s_c =$	1.1	*units*	$s_c = 1 + (B/(5L))$; $s_c = 1 + (B/(5L))(Nq/Nc)$
	$s_\gamma =$	1.0	*units*	for $\phi_f = 0$: $s_\gamma = 1$; for $\phi_f > 0$: $s_\gamma = 1 - 0.4(B/L)$
	$s_q =$	1.0	*units*	$s_q = 1$; $s_q = 1 + ((B/L)\tan(\phi_f))$
	$d_q =$	1.0	*units*	taken as 1 since cohesive soil; $D_f / B =$ 0.5
	$i_c , i_\gamma , i_q =$	1.0	*units*	Assumed loaded without inclination

calculation

$N_{cm} = N_c s_c i_c$ = 5.14 * 1.117 * 1 = 5.741

$N_{qm} = N_q s_q d_q i_q$ = 1 * 1 * 1 * 1 = 1

$N_{\gamma m} = N_\gamma s_\gamma i_\gamma$ = 0 * 1 * 1 = 0

$q_2 = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma}$

= (0.35*5.741) + (0.125*3.5*1*1) + (0.5*0.125*7*0*0.5) =

= (2.009) + (0.438) + (0) =

$cN_{cm} =$ 2.009

$\gamma D_f N_{qm} C_{wq} =$ 0.438

$0.5\gamma B N_{\gamma m} C_{w\gamma} =$ 0

$q_2 =$ 2.45 ksf

CPI: Note that factored bearing resistance on Stratum III would be 2.45 ksf x 0.5 = 1.23 ksf, which is greater than average bearing pressure of 0.4 ksf indicated for the structures. Therefore, no expected undercuts for installation of these structures.

Critical depth 'H' for Square Foundations (Column):

3) H_{crit} Calculation

Check to see if 2 layer analasis is Applicable

Setup	q_1 =	5.98	ksf		
	q_2 =	2.45	ksf		
	B =	7	ft	Width	(indicated by prime)
	L =	12	ft	Length	(indicated by prime)
	D_f =	1.9	ft	Bearing Depth below GSE	
	H =	3.5	ft	Depth to Layer 2 below GSE	

calculation $H_{crit} = \underline{X} / \underline{Y}$

$\underline{X} = (3B)*\ln(q_1/q_2)$ | $\underline{X} = (3B)*\ln(q_1/q_2)$ | $\underline{Y} = 2*(1+B/L)$

$\underline{Y} = 2*(1+B/L)$ | $X = (3*7)*\ln(5.98/2.45)$ | $Y = 2*(1+7/12)$

$\underline{X}$ = 18.76 ft | $\underline{Y}$ = 3.17 ft

$H_{s2} = H - D_f$

H_{crit} = 18.76 / 3.17 | H_{s2} = 3.5 - 1.9

H_{crit} = 5.92 ft | H_{s2} = 1.60 ft

$H_{crit} > H_{s2}$ Two Layer Analysis IS Applicable

By: LGH Date: 3/12/2023 Checked: CPI Date: 3/14/2023

2 Layer Square Foundations (Column):

1) Strong Over Weak Clay

Bearing in Statum I or II cohesive soils at a depth of 1.9 feet with Startum III at 3.5 feet

Setup

c_1 =	1	ksf	for Layer 1
c_2 =	0.35	ksf	for Layer 2
ϕ_f =	0	degrees	assumed zero in cohesive soil
N_c =	5.14	*units*	
N_q =	1.0	*units*	for soil with a ϕ_f = 0 Degrees
N_γ =	0.0	*units*	
γ =	0.125	kcf	(assumed)
D_f =	1.9	ft	bearing depth
H_{s2} =	1.60	ft	thickness of layer 1 below footing
B =	7	ft	Width (indicated by prime)
L =	12	ft	Length (indicated by prime)
D_w =	3	ft	highest anticipated groundwater depth
C_{wq} =	1.0	*units*	where Dw < 1.5B + Df; $1.5B + D_f$ = 12.4
$C_{w\gamma}$ =	0.5	*units*	
s_c =	1.12	*units*	$s_c = 1 + (B/(5L))$; $s_c = 1 + (B/(5L))(Nq/Nc)$
s_γ =	1.0	*units*	for $\phi_f = 0$: $s_\gamma = 1$; for $\phi_f > 0$: $s_\gamma = 1 - 0.4(B/L)$
s_q =	1.0	*units*	$s_q = 1$; $s_q = 1 + ((B/L)\tan(\phi_f))$
d_q =	1.0	*units*	taken as 1 since cohesive soil; D_f / B = 0.271429
i_c , i_γ , i_q =	1.0	*units*	Assumed loaded without inclination

calculation

$\beta_m = (B*L) / (2(B+L)H_{s2})$	= (7*12) / (2(7+12)1.6) =	1.382	
$k = c_2 / c_1$	= 0.35 / 1 =	0.350	
$N_m = ((1/\beta_m)+k*N_c*s_c) \leq S_c*N_c$	= ((1/1.38)+0.35*5.14*1.12) ≤ 1.12*5.14 =	2.733	≤ 5.741
$N_{qm} = 1$	=	1	
$N_{\gamma m} = N_\gamma s_\gamma i_\gamma$	= 0 * 1 * 1 =	0	

$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma}$

= (1*2.733) + (0.125*1.9*1*1) + (0.5*0.125*7*0*0.5) =

= (2.733) + (0.238) + (0) =

cN_m = 2.733

$\gamma D_f N_{qm} C_{wq}$ = 0.238

$0.5\gamma B N_{\gamma m} C_{w\gamma}$ = 0

q_n = 2.97 ksf

φ_b = 0.5 based on theoretical method (Munfakh et al., 2001), in clay

$q_R = \varphi_b * q_n$ = 0.5 * 2.971 = 1.49 ksf 1,486 psf

Factored resistance at the strength limit state for the spread foundations bearing in Stratum I or Stratum II cohesive soils unerlain by Stratum III soils is equal to 1.5 ksf

SERVICE LIMIT STATE:

Based on : (Table C10.6.2.6.1-1)

"Presumptive Bearing Resistance for Spread Footing Foundations at the Service Limit State" Table

Stratum III Soft Cohesive Soils
within applicable borings and depths:

Consistency	Soil Type	Bearing Resistance (ksf)	
		Ordinary Range	Recommended Value to use
Soft Cohesive Soils	Lean Clay (CL)	1 to 2	1

φ_b = 1

Factored bearing resistance = 1 ksf

1 ksf OKAY based on settlement <1" (see attached *Settlement Calculation*)

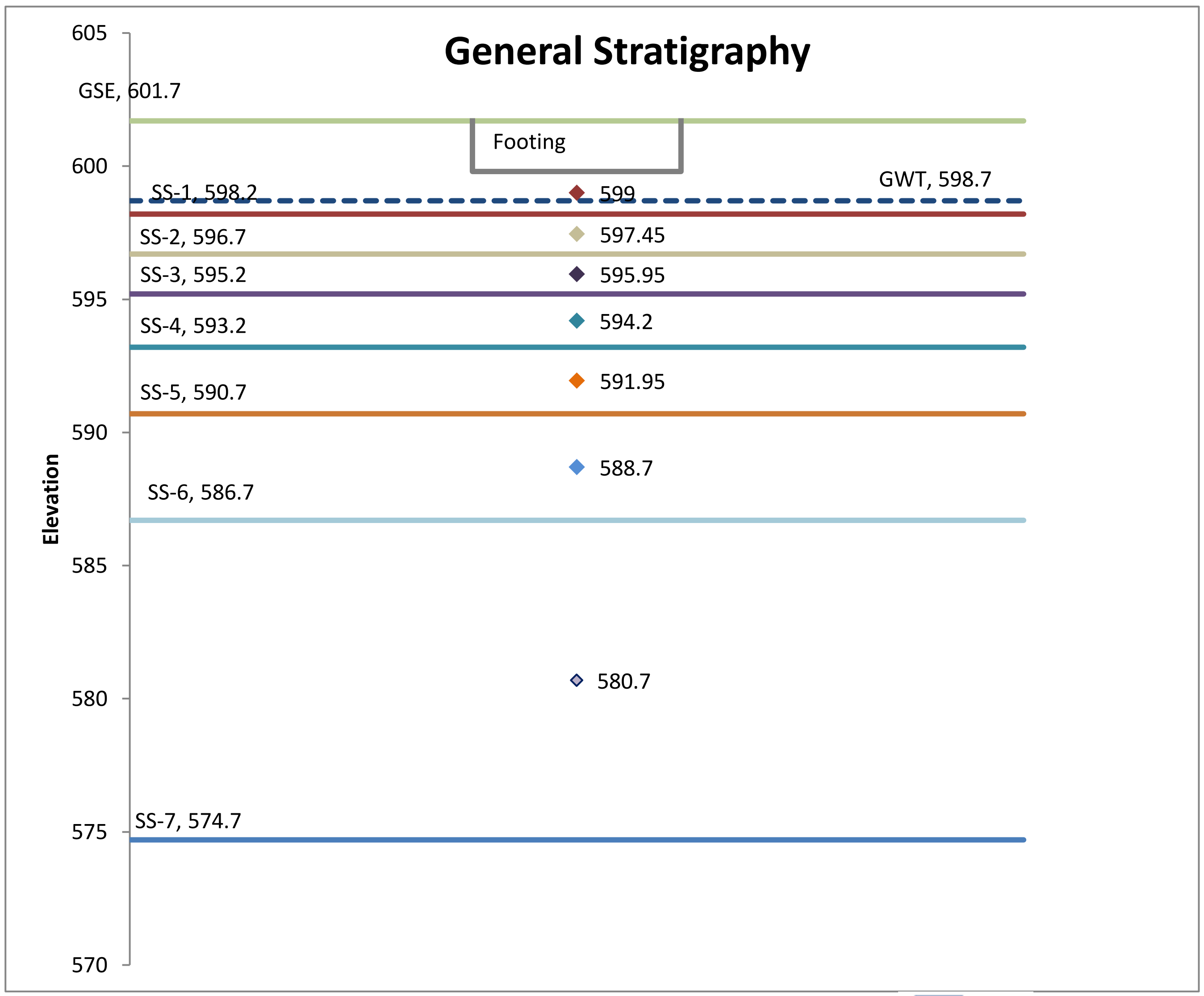
Project Name:	2171101	Boring Number	B-023
Project Number:	WOO LUC 280 06 20 00 00 PID 108584	Analysis Type	Rectangular
Calculated by:	LGH 3/14/2023		

Reviewed: CPI 3/14/2023

Layer	H (feet)	C_r	e_o	sigma v (psf)	z (feet)	b (feet)	(z-Df) / b	I_z*	delta p@	400 psf	(check) sigma v+ΔP	delta H (inches)
SS-1	1.6	0.015	0.56	338	0.8	7	0.1	0.249	398		735	0.06
SS-2	1.5	0.025	0.68	453	2.35	7	0.3	0.227	363		816	0.07
SS-3	1.5	0.027	0.72	547	3.85	7	0.6	0.188	300		847	0.05
SS-4	2	0.021	0.64	657	5.6	7	0.8	0.143	228		885	0.04
SS-5	2.5	0.019	0.60	798	7.85	7	1.1	0.099	159		956	0.03
SS-6	4	0.019	0.60	1001	11.1	7	1.6	0.062	98		1099	0.02
SS-7	12	0.019	0.60	1189	19.1	7	2.7	0.025	40		1229	0.02

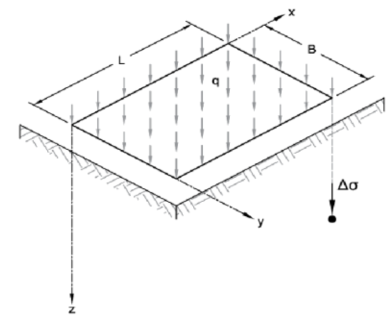
**Note: Influence factors are multiplied by 4 in calculation of delta p*

Total delta H (in.)	0.30
+15%	0.34
-15%	0.25



Project Number:	2171101	Boring Number	B-023		
Project Name:	WOO LUC 280 06 20 00 00 PID 108584	Analysis Type	Rectangular	Reviewed:	CPI 3/14/2023
Calculated by:	LGH 3/14/2023				

G (assumed)	2.7
GSE	601.7
GWT	598.7
Bearing Elev	599.8
D_f	1.9 ft
Footing Width, B	7 ft
Length, L	12 ft
P	400 psf



$\Delta\sigma \ldots\ldots = qI_B$

$I_B \ldots = \frac{1}{4\pi}\left[\frac{2|mn|\sqrt{V}}{V+V_1} \times \frac{V+1}{V} + \tan^{-1}\left(\frac{2|mn|\sqrt{V}}{V-V_1}\right) + \beta\right]$

$V \ldots\ldots = m^2 + n^2 + 1$

$V_1 \ldots\ldots = (mn)^2$

$\beta \left(\text{when } \tan^{-1}\left(\frac{2|mn|\sqrt{V}}{V-V_1}\right) \leq 0\right) \ldots\ldots = \pi$

$\beta \left(\text{when } \tan^{-1}\left(\frac{2|mn|\sqrt{V}}{V-V_1}\right) > 0\right) \ldots\ldots = 0$

$m \ldots\ldots = \frac{B}{z}$

$n \ldots\ldots = \frac{L}{z}$

	Bot. Elev.	Centroid (C) Elev.	H (ft)	z below footing	z below GSE	γ_T (pcf)	γ_d (pcf)	H_{GWT-C}	w at C (%) (or C_rx1000)	e_o	Depth of Influence = $(z-D_f)/B$	m = 0.5*B/z	n = 0.5*L/z	I_z*	σ_v' (psf)	V	V1	$\tan^{-1}\left(\frac{2\lvert mn\rvert\sqrt{V}}{V-V_1}\right)$	Beta
SS-1	598.2	599	1.6	0.8	2.7	125	109	-0.3	15	0.56	0.11	4.4	7.5	0.249	338	76	1077	-0.52	3.14
SS-2	596.7	597.45	1.5	2.35	4.25	125	100	1.25	25	0.68	0.3	1.5	2.6	0.227	453	10	14	-1.37	3.14
SS-3	595.2	595.95	1.5	3.85	5.75	125	98	2.75	27	0.72	0.6	0.9	1.6	0.188	547	4.3	2.0	1.20	0.00
SS-4	593.2	594.2	2	5.6	7.5	125	103	4.5	21	0.64	0.8	0.6	1.1	0.143	657	2.5	0.4	0.80	0.00
SS-5	590.7	591.95	2.5	7.85	9.75	125	105	6.75	19	0.60	1.1	0.4	0.8	0.099	798	1.8	0.12	0.50	0.00
SS-6	586.7	588.7	4	11.1	13	125	105	10	19	0.60	1.6	0.32	0.5	0.062	1001	1.4	0.03	0.29	0.00
SS-7	574.7	580.7	12	19.1	21	125	105	18	19	0.60	2.7	0.18	0.3	0.025	1189	1.1	0.00	0.11	0.00

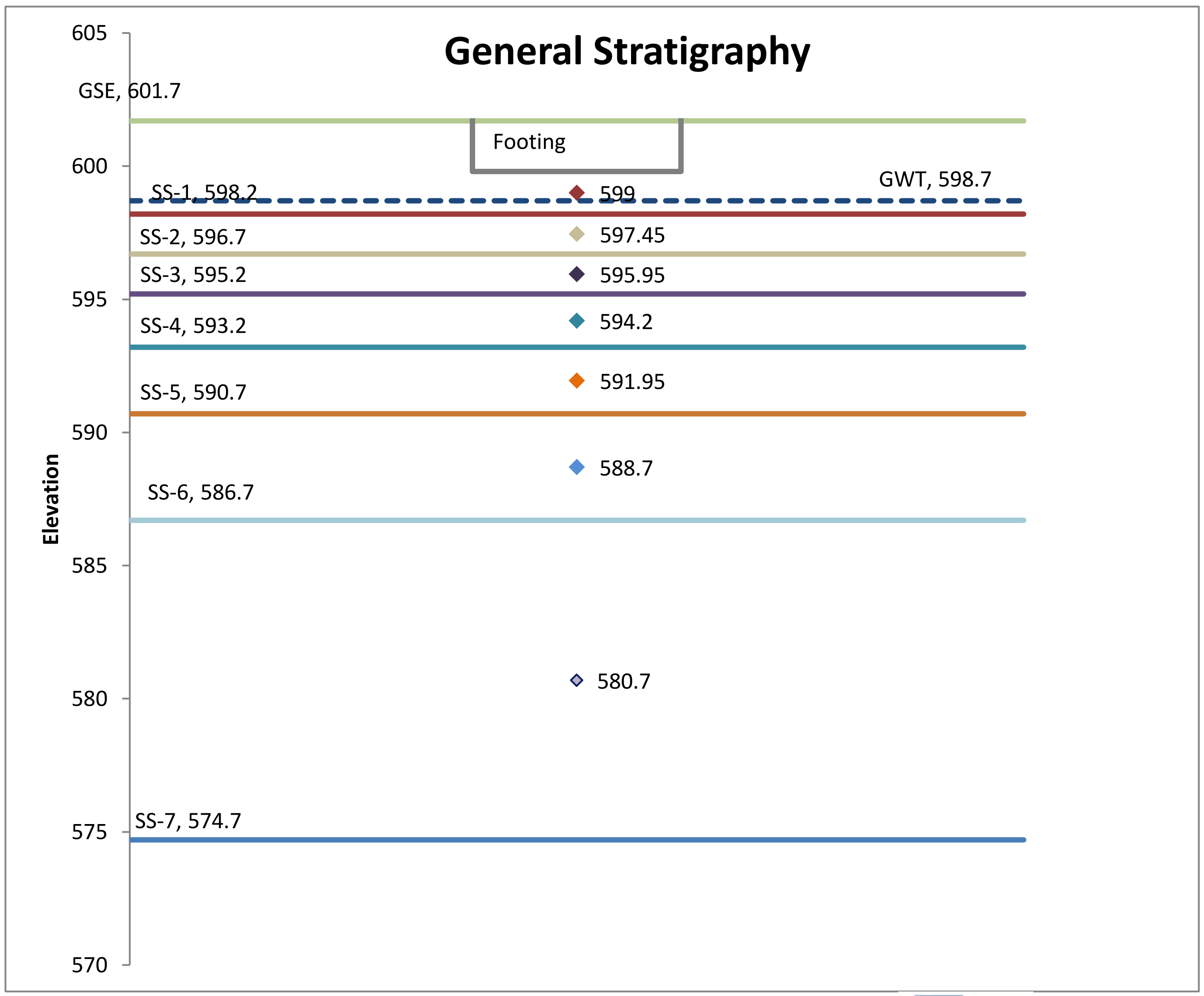
Project Name:	2171101	Boring Number	B-023
Project Number:	WOO LUC 280 06 20 00 00 PID 108584	Analysis Type	Rectangular
Calculated by:	LGH 3/14/2023		

Reviewed: CPI 3/14/2023

Layer	H (feet)	C_r	e_o	sigma v (psf)	z (feet)	b (feet)	(z-Df) / b	I_z*	delta p@	1000 psf	(check) sigma v+ΔP	delta H (inches)
SS-1	1.6	0.015	0.56	338	0.8	7	0.1	0.249	995		1332	0.11
SS-2	1.5	0.025	0.68	453	2.35	7	0.3	0.227	907		1360	0.13
SS-3	1.5	0.027	0.72	547	3.85	7	0.6	0.188	750		1297	0.11
SS-4	2	0.021	0.64	657	5.6	7	0.8	0.143	570		1227	0.08
SS-5	2.5	0.019	0.60	798	7.85	7	1.1	0.099	397		1195	0.06
SS-6	4	0.019	0.60	1001	11.1	7	1.6	0.062	246		1247	0.05
SS-7	12	0.019	0.60	1189	19.1	7	2.7	0.025	99		1288	0.06

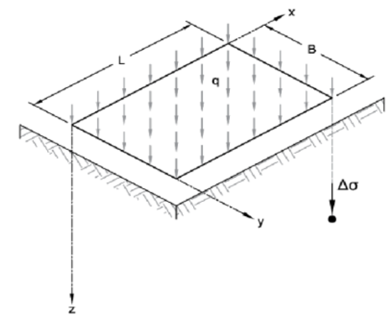
Note: Influence factors are multiplied by 4 in calculation of delta p

Total delta H (in.)	0.60
+15%	0.69
-15%	0.51



Project Number:	2171101	Boring Number	B-023		
Project Name:	WOO LUC 280 06 20 00 00 PID 108584	Analysis Type	Rectangular	Reviewed:	CPI 3/14/2023
Calculated by:	LGH 3/14/2023				

G (assumed)	2.7	
GSE	601.7	
GWT	598.7	
Bearing Elev	599.8	
D_f	1.9	ft
Footing Width, B	7	ft
Length, L	12	ft
P	1000	psf



$$\Delta\sigma \ldots\ldots = qI_B$$

$$I_B \ldots\ldots = \frac{1}{4\pi}\left[\frac{2|mn|\sqrt{V}}{V+V_1}\times\frac{V+1}{V}+\tan^{-1}\left(\frac{2|mn|\sqrt{V}}{V-V_1}\right)+\beta\right]$$

$$V \ldots\ldots = m^2+n^2+1$$

$$V_1 \ldots\ldots = (mn)^2$$

$$\beta\ \left(\text{when } \tan^{-1}\left(\frac{2|mn|\sqrt{V}}{V-V_1}\right)\leq 0\right)\ldots\ldots = \pi$$

$$\beta\ \left(\text{when } \tan^{-1}\left(\frac{2|mn|\sqrt{V}}{V-V_1}\right)> 0\right)\ldots\ldots = 0$$

$$m \ldots\ldots = \frac{B}{z}$$

$$n \ldots\ldots = \frac{L}{z}$$

	Bot. Elev.	Centroid (C) Elev.	H (ft)	z below footing	z below GSE	γ_T (pcf)	γ_d (pcf)	H_{GWT-C}	w at C (%) (or C_rx1000)	e_o	Depth of Influence = $(z-D_f)/B$	m = 0.5*B/z	n = 0.5*L/z	I_z*	σ_v' (psf)	V	V1	$\tan^{-1}\left(\frac{2\lvert mn\rvert\sqrt{V}}{V-V_1}\right)$	Beta
SS-1	598.2	599	1.6	0.8	2.7	125	109	-0.3	15	0.56	0.11	4.4	7.5	0.249	338	76	1077	-0.52	3.14
SS-2	596.7	597.45	1.5	2.35	4.25	125	100	1.25	25	0.68	0.3	1.5	2.6	0.227	453	10	14	-1.37	3.14
SS-3	595.2	595.95	1.5	3.85	5.75	125	98	2.75	27	0.72	0.6	0.9	1.6	0.188	547	4.3	2.0	1.20	0.00
SS-4	593.2	594.2	2	5.6	7.5	125	103	4.5	21	0.64	0.8	0.6	1.1	0.143	657	2.5	0.4	0.80	0.00
SS-5	590.7	591.95	2.5	7.85	9.75	125	105	6.75	19	0.60	1.1	0.4	0.8	0.099	798	1.8	0.12	0.50	0.00
SS-6	586.7	588.7	4	11.1	13	125	105	10	19	0.60	1.6	0.32	0.5	0.062	1001	1.4	0.03	0.29	0.00
SS-7	574.7	580.7	12	19.1	21	125	105	18	19	0.60	2.7	0.18	0.3	0.025	1189	1.1	0.00	0.11	0.00

Project No.	2171101
By	LGH
Date	9/21/2022
Checked	
Date	

Purpose

Calulate average undrained shear strength (Su) and estimate total unit weight of soil by stratum as part of low-mast foundation design soil parameters.

Calculation

Representative/Average Values	Stratum		
	I - Stiff to Hard	II - Medium Stiff	III - Soft
SPT N - value (bpf)	11	7	4
HP (tsf)	1.5	0.75	0.25
Qu - Shelby tube (psf)	3,235	1,480	950
Su (N_{60}) (psf)	1,375	875	500
Su (HP) (psf)	1,500	750	250
Su (ST) (psf)	1,620	740	475
Say/Use - Su (psf)	**1,500**	**750**	**350**
Typical Wet Density (pcf)	135	130	120
Say/Use - Wet Density (pcf)	**135**	**130**	**120**

Qu = (2000/8)(N)
Su = c = Qu/2

Summary

Say/Use	Stratum		
	I - Stiff to Hard	II - Medium Stiff	III - Soft
Su (psf)	1,500	750	350
Wet Density (pcf)	135	130	120

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Bulletin GB1

Instructions: Enter data in the shaded cells only.
(Enter state route number, project description,county, consultant's name, prepared by name, and date prepared. This information will be transferred to all other sheets. The date prepared must be entered in the appropriate cell on this sheet to remove these instructions prior to printing.)

WOO/LUC-280-06.20/00.00
108584

Proposed Median Improvements in Northwood and Oregon, Ohio

TTL Associates, Inc.

Prepared By: Luke G. Holmes, EIT
Date prepared: Wednesday, August 3, 2022

Luke G. Holmes, EIT
1915 North 12th Street
Toledo, OH 43604-5305

(419) 304-6482
lholmes@ttlassoc.com

NO. OF BORINGS: 30

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-001-0-21	WOO I-280 CL	327+67	5	Rt	CME 75 Truck 844 \03	66	616.0	614.3	1.8 C
2	B-002-0-21	WOO I-280 CL	331+66	14	Lt	CME 75 Truck 844 \03	66	617.0	615.3	1.8 C
3	B-003-0-21	WOO I-280 CL	335+61	5	Rt	CME 75 Truck 844 \03	66	616.4	614.7	1.8 C
4	B-004-0-21	WOO I-280 CL	339+66	6	Lt	CME 75 Truck 844 \03	66	616.2	614.5	1.8 C
5	B-005-0-21	WOO I-280 CL	343+15	14	Rt	CME 75 Truck 844 \03	66	616.1	614.4	1.8 C
6	B-006-0-21	WOO I-280 CL	347+22	6	Lt	CME 75 Truck 844 \03	66	616.5	614.8	1.8 C
7	B-007-0-21	LUC I-280 CL	0+90	5	Rt	CME 75 Truck 844 \03	66	617.6	615.9	1.8 C
8	B-008-0-21	LUC I-280 CL	4+86	6	Lt	CME 75 Truck 844 \03	66	618.5	616.8	1.8 C
9	B-009-0-21	LUC I-280 CL	8+87	5	Rt	CME 75 Truck 844 \03	66	618.3	616.6	1.8 C
10	B-010-0-21	LUC I-280 CL	12+86	6	Lt	CME 75 Truck 844 \03	66	617.8	616.1	1.8 C
11	B-011-0-21	LUC I-280 CL	16+87	6	Rt	CME 75 Truck 844 \03	66	616.9	615.2	1.8 C
12	B-012-0-21	LUC I-280 CL	20+86	14	Lt	CME 75 Truck 844 \03	66	616.2	614.5	1.8 C
13	B-013-0-21	LUC I-280 CL	24+86	6	Rt	CME 75 Truck 844 \03	66	615.5	613.8	1.8 C
14	B-014-0-21	LUC I-280 CL	28+88	7	Lt	CME 75 Truck 844 \03	66	614.4	612.7	1.8 C
15	B-015-0-21	LUC I-280 CL	32+58	5	Rt	CME 75 Truck 844 \03	66	614.3	612.6	1.8 C
16	B-016-0-21	LUC I-280 CL	36+57	7	Lt	CME 75 Truck 844 \03	66	613.0	611.3	1.8 C
17	B-017-0-21	LUC I-280 CL	40+56	5	Rt	CME 75 Truck 844 \03	66	611.8	610.1	1.8 C
18	B-018-0-21	LUC I-280 CL	44+51	7	Lt	CME 75 Truck 844 \03	66	609.5	607.8	1.8 C
19	B-019-0-21	LUC I-280 CL	48+67	6	Rt	CME 75 Truck 844 \03	66	608.4	606.7	1.8 C
20	B-020-0-21	LUC I-280 CL	52+57	7	Lt	CME 75 Truck 844 \03	66	606.4	604.7	1.8 C
21	B-021-0-21	LUC I-280 CL	56+55	7	Rt	CME 75 Truck 844 \03	66	604.6	602.9	1.8 C
22	B-022-0-21	LUC I-280 CL	60+52	6	Lt	CME 75 Truck 844 \03	66	602.8	601.1	1.8 C
23	B-023-0-21	LUC I-280 CL	63+13	7	Rt	CME 75 Truck 844 \03	66	601.7	600.0	1.8 C
24	B-024-0-21	LUC I-280 CL	66+91	6	Lt	CME 75 Truck 844 \03	66	599.9	598.2	1.8 C
25	B-025-0-21	LUC I-280 CL	70+96	6	Rt	CME 75 Truck 844 \03	66	597.8	596.1	1.8 C
26	B-026-0-21	LUC I-280 CL	74+97	7	Lt	CME 75 Truck 844 \03	66	595.7	594.0	1.8 C
27	B-027-0-21	LUC I-280 CL	78+94	5	Rt	CME 75 Truck 844 \03	66	594.5	592.8	1.8 C
28	B-028-0-21	LUC I-280 CL	82+98	7	Lt	CME 75 Truck 844 \03	66	592.0	590.3	1.8 C
29	B-029-0-21	LUC I-280 CL	86+07	14	Rt	CME 75 Truck 844 \03	66	591.0	589.3	1.8 C
30	B-030-0-21	LUC I-280 CL	89+42	7	Lt	CME 75 Truck 844 \03	66	591.9	590.2	1.8 C

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	SS-1a	1.5	2.0	-0.3	0.3	13		4.5							13	10	A-4a	8	260		N_{60} & Mc		12"	12"
	001-0	SS-1b	2.0	3.0	0.3	1.3	10		-							13	16	A-6b	16			N_{60}		12"	204 Geotextile
	21	SS-2	3.0	4.5	1.3	2.8	7		1.5	33	15	18	22	58	80	20	16	A-6b	11			HP & Mc			
		SS-3	4.5	7.0	2.8	5.3	9	7	1.25	41	20	21	26	60	86	26	18	A-7-6	13						
2	B	SS-1	2.0	4.0	0.3	2.3	9		3.25	34	19	15	24	65	89	17	14	A-6a	10			N_{60} & Mc		12"	12"
	002-0	SS-2b	4.0	6.0	2.3	4.3	8		3.5	34	18	16	51	42	93	21	16	A-6b	10	300					204 Geotextile
	21	SS-3b	6.0	6.5	4.3	4.8	11		-	26	15	11	22	46	68	19	14	A-6a	7						
		SS-4	6.5	8.5	4.8	6.8	7	7	1.5							26	16	A-6b	16						
3	B	SS-1	1.5	3.2	-0.3	1.5	13		4.5	29	17	12	26	51	77	16	14	A-6a	9	200					0"
	003-0	SS-2	3.2	4.7	1.5	3.0	13		4.25	32	18	14	24	68	92	20	14	A-6a	10			N_{60} & Mc			
	21	SS-3	4.7	6.2	3.0	4.5	18		2.5							22	14	A-6a	10						
		SS-4	6.2	8.0	4.5	6.3	8	8	3							22	10	A-4b	8						
4	B	SS-1	2.0	4.0	0.3	2.3	11		4.5	29	14	15	29	55	84	16	14	A-6a	10	230		N_{60}		12"	12"
	004-0	SS-2b	4.0	5.1	2.3	3.4	8		3.75	33	17	16	23	68	91	20	16	A-6b	10			N_{60} & Mc			204 Geotextile
	21	SS-3	5.1	6.6	3.4	4.9	10		2.5	28	13	15	24	43	67	18	14	A-6a	8						
		SS-4	6.6	8.5	4.9	6.8	6	6	3							26	16	A-6b	16						
5	B	SS-1	1.1	2.0	-0.7	0.3	18		-							10	8	A-3	0	180					24"
	005-0	SS-2	2.0	4.0	0.3	2.3	4		2	36	18	18	24	68	92	25	16	A-6b	11			N_{60} & Mc		24"	204 Geotextile
	21	ST-3	4.0	6.0	2.3	4.3	ST		2.5	34	17	17	23	56	79	21	16	A-6b	11						
		SS-4	6.0	8.5	4.3	6.8	8	4	1							27	16	A-6b	16						
6	B	SS-1	2.0	3.5	0.3	1.8	11		4.5	28	15	13	22	53	75	15	14	A-6a	9	190		N_{60}		12"	12"
	006-0	ST-2	3.5	5.5	1.8	3.8	ST		4.5	26	15	11	22	42	64	13	14	A-6a	6						204 Geotextile
	21	SS-3	5.5	7.0	3.8	5.3	12		2.5							26	14	A-6a	10						
		SS-4	7.0	8.5	5.3	6.8	15	11	4.5							17	10	A-4a							
7	B	SS-1	1.0	2.5	-0.8	0.8	18		4.5	31	17	14	29	59	88	15	14	A-6a	10	210					0"
	007-0	SS-2	2.5	4.0	0.8	2.3	18		4.5	26	14	12	22	59	81	14	14	A-6a	9						
	21	SS-3a	4.0	5.0	2.3	3.3	20		4.5							19	14	A-6a	10			Mc			
		SS-4	5.0	8.5	3.3	6.8	10	10	2							27	16	A-6b	16						
8	B	SS-1	2.0	3.5	0.3	1.8	11		4.5	28	16	12	20	68	88	14	14	A-6a	9			N_{60}		12"	12"
	008-0	SS-2	3.5	5.0	1.8	3.3	10		4.5	29	16	13	30	63	93	15	14	A-6a	9	210		N_{60}			204 Geotextile
	21	SS-3	5.0	6.5	3.3	4.8	12		4.25							16	14	A-6a	10						
		SS-4	6.5	8.5	4.8	6.8	11	10	3							16	14	A-6a	10						
9	B	SS-1	1.7	3.0	-0.1	1.3	19		4.5	25	17	8	41	30	71	15	12	A-4a	7	210		Mc			0"
	009-0	SS-2	3.0	4.5	1.3	2.8	14		4.5							14	10	A-4a	8			N_{60} & Mc			
	21	SS-3	4.5	6.0	2.8	4.3	19		2.5	24	16	8	41	22	63	15	11	A-4a	6						
		SS-4	6.0	8.5	4.3	6.8	18	14	4.5							20	10	A-4a	8						

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
10	B	SS-1	2.2	3.5	0.5	1.8	9		4.5	25	14	11	21	53	74	13	14	A-6a	8			N_{60}		12''	12''
	010-0	SS-2a	3.5	4.0	1.8	2.3	13		-							-	14	A-6a	10			N_{60} & Mc			204 Geotextile
	21	SS-2b	4.0	5.0	2.3	3.3	14		4.5							13	10	A-4a	8	210		N_{60} & Mc			
		SS-3	5.0	6.0	3.3	4.3	15	9	-	25	17	8	47	8	55	15	12	A-4a	4						
11	B	SS-1	1.5	3.0	-0.3	1.3	9		4.5	26	15	11	28	52	80	15	14	A-6a	8	200		N_{60}		12''	12''
	011-0	SS-2	3.0	4.5	1.3	2.8	14		4.5	27	15	12	21	56	77	15	14	A-6a	9						204 Geotextile
	21	SS-3	4.5	6.0	2.8	4.3	22		4.5							16	10	A-4b	8						
		SS-4	6.0	8.5	4.3	6.8	8	8	1.5							23	16	A-6b	16						
12	B	SS-1	2.0	3.5	0.3	1.8	22		4.5	23	16	7	45	16	61	14	11	A-4a	5			Mc			0''
	012-0	SS-2	3.5	5.0	1.8	3.3	29		-	26	16	10	45	27	72	15	11	A-4a	7	220		Mc			
	21	SS-3	5.0	6.5	3.3	4.8	19		4.5							13	10	A-4a	8						
		SS-4	6.5	8.5	4.8	6.8	8	8	1							28	16	A-6b	16						
13	B	SS-1	1.5	3.0	-0.3	1.3	13		4.5	42	21	21	27	68	95	13	18	A-7-6	13	220					0''
	013-0	SS-2	3.0	4.5	1.3	2.8	18		4.5	23	14	9	44	13	57	15	10	A-4a	4			Mc			
	21	SS-3	4.5	6.0	2.8	4.3	24		3.5	24	15	9	48	8	56	15	10	A-4a	4						
		SS-4a	6.0	7.0	4.3	5.3	6	6	-							-	10	A-4a	8						
14	B	SS-1	2.0	3.5	0.3	1.8	15		4.5	24	15	9	47	19	66	14	10	A-4a	6			Mc			0''
	014-0	SS-2	3.5	5.0	1.8	3.3	20		4.5	24	16	8	41	6	47	15	11	A-4a	2	210		Mc			
	21	SS-3	5.0	6.5	3.3	4.8	23		4.5							20	16	A-6b	16						
		SS-4	6.5	8.5	4.8	6.8	12	12	2							26	16	A-6b	16						
15	B	SS-1	2.0	3.5	0.3	1.8	13		4.5	27	14	13	37	34	71	15	14	A-6a	8	250					0''
	015-0	SS-2	3.5	5.0	1.8	3.3	9		4.25	28	17	11	28	27	55	18	14	A-6a	4			N_{60} & Mc			
	21	SS-3	5.0	6.5	3.3	4.8	17		1.5							20	10	A-4a	8						
		SS-4	6.5	8.5	4.8	6.8	8	8	2.75							28	16	A-6b	16						
16	B	SS-1	2.0	3.5	0.3	1.8	15		-	NP	NP	NP	47	4	51	13	11	A-4a	3						0''
	016-0	SS-2	3.5	5.0	1.8	3.3	12		3.75							23	16	A-6b	16	240		N_{60} & Mc			
	21	SS-3a	5.0	6.0	3.3	4.3	12		3	37	19	18	23	68	91	25	16	A-6b	11						
		SS-3b	6.0	6.5	4.3	4.8	13	12	-							-	16	A-6b	16						
17	B	SS-1	2.0	3.5	0.3	1.8	13		2.5	25	17	8	42	41	83	16	12	A-4a	8	240		N_{60} & Mc		12''	12''
	017-0	SS-2	3.5	5.0	1.8	3.3	8		1.5	40	22	18	28	41	69	27	17	A-6b	10			HP & Mc			204 Geotextile
	21	SS-3a	5.0	6.0	3.3	4.3	10		-							-	16	A-6b	16						
		SS-3b	6.0	6.5	4.3	4.8	11	8	2.75							21	16	A-6b	16						
18	B	SS-1	2.0	4.0	0.3	2.3	11		4.5	27	16	11	25	46	71	14	14	A-6a	8			N_{60}		12''	12''
	018-0	SS-2b	4.0	5.0	2.3	3.3	11		3.5	33	19	14	24	68	92	21	14	A-6a	10	210		N_{60} & Mc			204 Geotextile
	21	SS-3	5.0	6.7	3.3	5.0	14		1	31	18	13	24	68	92	26	14	A-6a	9						
		SS-4	6.7	8.5	5.0	6.8	10	10	1							26	14	A-6a	10						

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.6 2/11/2022

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
19	B	SS-1	2.0	3.5	0.3	1.8	8		2.75	32	18	14	24	66	90	21	14	A-6a	10	210		N_{60} & Mc		12''	12''
	019-0	SS-2	3.5	5.0	1.8	3.3	7		0.75	30	19	11	25	68	93	26	14	A-6a	8			HP & Mc			204 Geotextile
	21	SS-3	5.0	7.0	3.3	5.3	11		2.25							24	10	A-4b	8						
		SS-4b	7.0	8.5	5.3	6.8	7	7	0.75							26	16	A-6b							
20	B	SS-1	2.0	3.5	0.3	1.8	9		4.25	27	17	10	40	52	92	19	12	A-4a	8			N_{60} & Mc		12''	12''
	020-0	SS-2	3.5	5.5	1.8	3.8	6		1.5	29	15	14	25	68	93	24	14	A-6a	10	220					204 Geotextile
	21	SS-3	5.5	6.5	3.8	4.8	10		1.75	26	15	11	28	52	80	17	14	A-6a	8						
		SS-4	6.5	8.5	4.8	6.8	8	6	0.5							23	16	A-6b	16						
21	B	SS-1	2.0	4.0	0.3	2.3	9		2	30	13	17	21	63	84	18	16	A-6b	11	220		N_{60}		12''	12''
	021-0	SS-2	4.0	5.0	2.3	3.3	9		0.75	32	17	15	25	68	93	24	14	A-6a	10			HP & Mc			204 Geotextile
	21	SS-3	5.0	6.5	3.3	4.8	10		0.75	32	18	14	24	68	92	26	14	A-6a	10						
		SS-4	6.5	8.5	4.8	6.8	7	7	0.5							17	16	A-6b	16						
22	B	SS-1	2.0	3.5	0.3	1.8	7		1.25	24	13	11	19	57	76	15	14	A-6a	8	270		HP		15''	24''
	022-0	ST-2	3.5	6.0	1.8	4.3	ST		0.5	27	16	11	20	60	80	18	14	A-6a	8						204 Geotextile
	21	SS-3	6.0	7.0	4.3	5.3	8		0.5	26	15	11	20	47	67	18	14	A-6a	7						
		SS-4a	7.0	8.0	5.3	6.3	3	3	0.5							18	14	A-6a							
23	B	SS-1	2.0	3.5	0.3	1.8	19		1	28	15	13	18	47	65	15	14	A-6a	7			HP		12''	42''
	023-0	SS-2	3.5	5.0	1.8	3.3	6		0.25	32	16	16	24	52	76	25	16	A-6b	10	260		HP & Mc			204 Geotextile
	21	SS-3	5.0	6.5	3.3	4.8	4		0.25							27	16	A-6b	16						
		SS-4	6.5	8.5	4.8	6.8	3	3	-							21	16	A-6b	16						
24	B	SS-1	2.0	4.0	0.3	2.3	6		3.75	29	15	14	26	46	72	15	14	A-6a	9	230		N_{60}		18''	42''
	024-0	SS-2b	4.0	5.0	2.3	3.3	8		0.25							28	16	A-6b	16			HP & Mc			204 Geotextile
	21	SS-3	5.0	6.5	3.3	4.8	9		0.25	34	17	17	28	68	96	31	16	A-6b	11						
		SS-4	6.5	8.5	4.8	6.8	6	6	0.25							19	16	A-6b	16						
25	B	SS-1	2.0	3.5	0.3	1.8	9		3.5	28	15	13	26	40	66	17	14	A-6a	7	240		N_{60} & Mc		12''	12''
	025-0	SS-2	3.5	5.0	1.8	3.3	11		4.25	31	19	12	25	68	93	22	14	A-6a	9			N_{60} & Mc			204 Geotextile
	21	SS-3	5.0	6.5	3.3	4.8	8		0.5							29	10	A-4b	8						
		SS-4	6.5	8.5	4.8	6.8	7	7	0.5							17	16	A-6b	16						
26	B	SS-1	2.0	3.5	0.3	1.8	10		4.5	27	15	12	20	53	73	12	14	A-6a	8			N_{60}		12''	42''
	026-0	SS-2	3.5	5.0	1.8	3.3	6		0.25	25	15	10	35	39	74	16	10	A-4a	8	220		HP & Mc			204 Geotextile
	21	SS-3	5.0	6.5	3.3	4.8	7		0.25							17	10	A-4a	8						
		SS-4	6.5	8.5	4.8	6.8	7	6	0.5							18	10	A-4a	8						
27	B	SS-1	2.0	3.5	0.3	1.8	15		4.5	27	15	12	23	47	70	15	14	A-6a	8	230					42''
	027-0	SS-2	3.5	5.0	1.8	3.3	7		0.25	27	14	13	20	57	77	19	14	A-6a	9			HP & Mc			204 Geotextile
	21	SS-3a	5.0	6.0	3.3	4.3	6		-							-	14	A-6a	10						
		SS-3b	6.0	7.0	4.3	5.3	7	6	0.25							18	14	A-6a	10						

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.6 2/11/2022

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
28	B	SS-1	2.0	3.5	0.3	1.8	7		4.5	26	15	11	19	56	75	13	14	A-6a	8			N_{60}		15"	**15"** **204 Geotextile**
	028-0	ST-2	3.5	5.5	1.8	3.8	-		0.75	28	15	13	19	51	70	18	14	A-6a	8	230					
	21	SS-3	5.5	7.0	3.8	5.3	6		0.5							17	14	A-6a	10						
		SS-4	7.0	8.5	5.3	6.8	2	2	0.5							18	16	A-6b							
29	B	SS-1	2.0	4.0	0.3	2.3	13		4.5	19	12	7	46	22	68	12	10	A-4a	7	240					**0"**
	029-0	SS-2	4.0	5.0	2.3	3.3	8		3							14	10	A-4a	8			N_{60} & Mc			
	21	SS-3a	5.0	6.0	3.3	4.3	8		-							-	10	A-4a	8						
		SS-3b	6.0	7.0	4.3	5.3	11	8	1.25	27	15	12	20	63	83	17	14	A-6a	9						
30	B	SS-1	2.0	3.5	0.3	1.8	13		4.5	31	17	14	25	40	65	14	14	A-6a	8	250					**0"**
	030-0	SS-2	3.5	5.0	1.8	3.3	7		2.5	31	16	15	21	58	79	19	14	A-6a	10			N_{60} & Mc			
	21	SS-3	5.0	6.5	3.3	4.8	9		1.75							17	14	A-6a	10						
		SS-4	6.5	8.5	4.8	6.8	7	7	1.5							16	14	A-6a	10						

PID: 108584

County-Route-Section: WOO/LUC-280-06.20/00.00
No. of Borings: 30

Geotechnical Consultant: TTL Associates, Inc.
Prepared By: Luke G. Holmes, EIT
Date prepared: 8/3/2022

Chemical Stabilization Options		
320	Rubblize & Roll	No
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	14"

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L): Average(HP):	 15" 0"
Global Geogrid Average(N60L): Average(HP):	 0" 0"

Design CBR	6

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	4%	$HP \leq 0.5$	16%
$N_{60} < 12$	62%	$0.5 < HP \leq 1$	8%
$12 \leq N_{60} < 15$	16%	$1 < HP \leq 2$	13%
$N_{60} \geq 20$	5%	$HP > 2$	52%
M+	28%		
Rock	0%		
Unsuitable	3%		

Excavate and Replace at Surface	
Average	13"
Maximum	42"
Minimum	0"

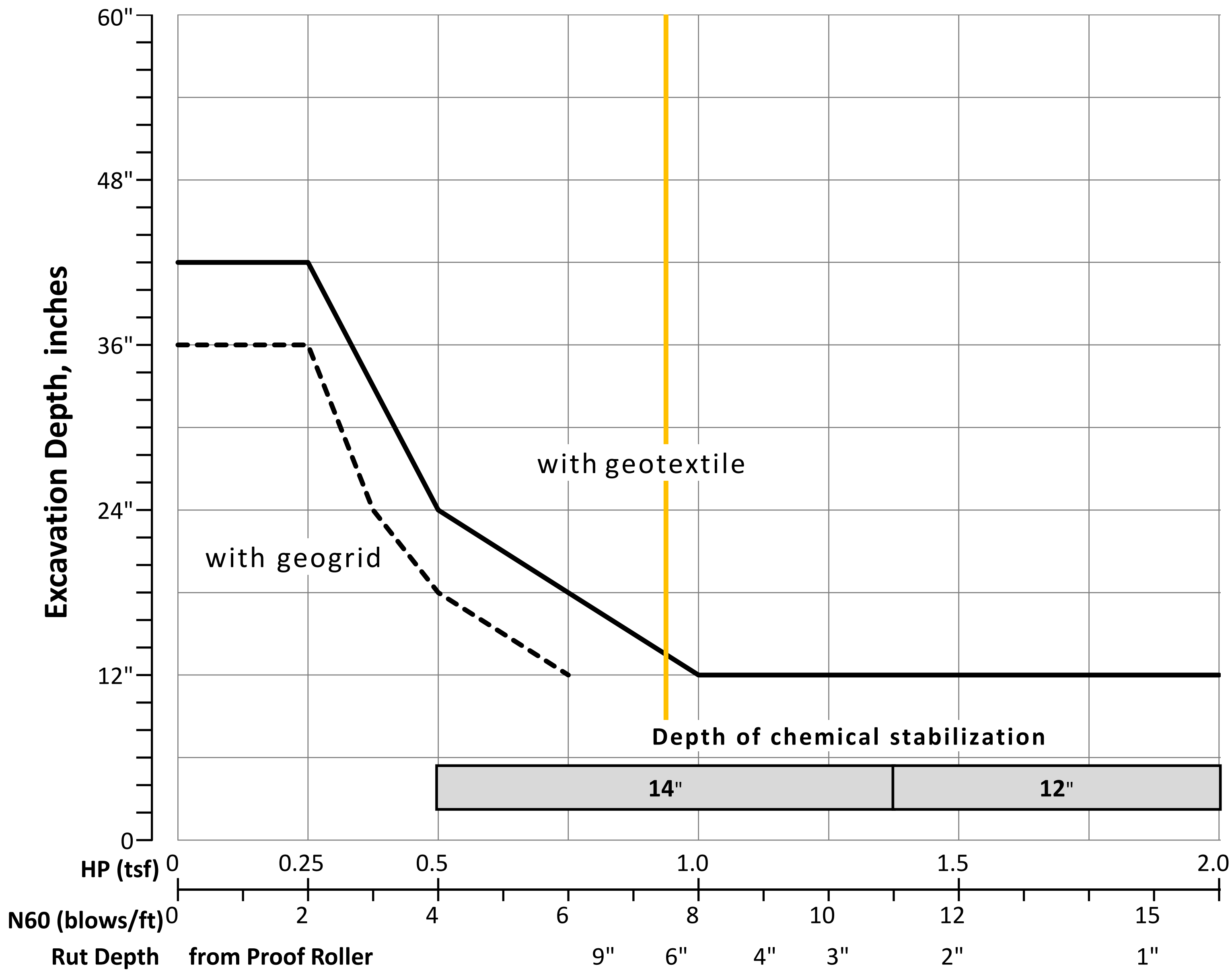
% Proposed Subgrade Surface	
Unstable & Unsuitable	69%
Unstable	69%
Unsuitable	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	11	8	2.64	29	16	13	28	49	77	19	14	10
Maximum	29	14	4.50	42	22	21	51	68	96	31	18	16
Minimum	2	2	0.25	19	12	7	18	4	47	10	8	0

Classification Counts by Sample

ODOT Class	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	0	0	0	0	0	0	1	0	26	4	0	54	33	0	2	0	0	120
Percent	0%	0%	0%	0%	0%	0%	0%	1%	0%	22%	3%	0%	45%	28%	0%	2%	0%	0%	100%
% Rock|Granular|Cohesive	0%	23%									78%								100%
Surface Class Count	0	0	0	0	0	0	0	1	0	17	1	0	36	11	0	2	0	0	68
Surface Class Percent	0%	0%	0%	0%	0%	0%	0%	1%	0%	25%	1%	0%	53%	16%	0%	3%	0%	0%	100%

GB1 Figure B – Subgrade Stabilization



OVERRIDE TABLE

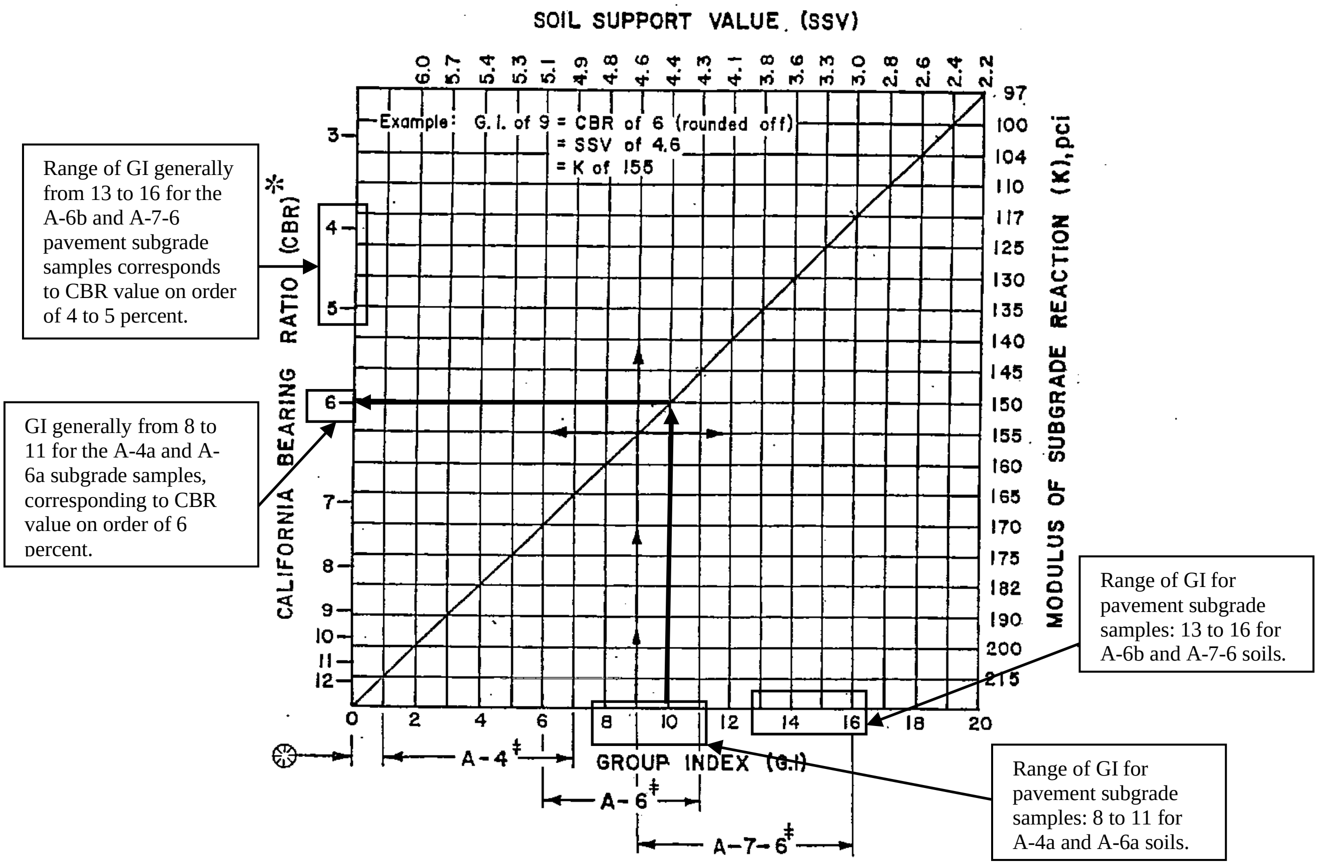
Calculated Average	New Values	Check to Override
2.64		☐ HP
7.50		☐ N60L

Average HP

Average N_{60L}

WOO/LUC-280-06.20/00.00
PID No. 108584

Fig.1301-3
Feb.1978



⊛ AASHTO Classes A-1, A-2 & A-3 lie below 0. SSV=6-10; K=200+.

‡ Usual range of AASHTO Classes.

* 5-1/2 Lb. hammer, 12" drop, 4 layers, 45 blows per layer, compacted at optimum moisture as determined by AASHTO T-99.

CORRELATION CHART FOR
SUBGRADE STRENGTHS

ODOT GB-1 “Subgrade Analysis” worksheet resulted in a CBR value of 6 percent for the project site. It should be noted that the CBR determination by the GB-1 spreadsheet is based on an average Group Index of all the evaluated samples. Group indices for the tested samples generally varied from 8 to 16, which would correlate with a CBR value of 4 to 6 percent. The lower Group Indices associated with the A-4a and A-6a cohesive soils that were prominent in the borings performed and would correlate with a CBR value of 6 percent. The higher Group Indices associated with the A-6b and A-7-6 cohesive soils would correlate with CBR values of 5 to 4 percent. However, these where not the predominant soil types and generally were encountered at depths below 3 feet. As such, based on the average design value calculations from GB-1, it does not appear to be unconservative to use the GB-1 design CBR value of 6 percent.

for Geotechnical Explorations published by the Office of Geotechnical Engineering. Additional information on soil boring analysis, stabilization and treatment methods, and design procedures, can be found in Geotechnical Bulletin 1: Plan Subgrades (GB1) also published by the Office of Geotechnical Engineering.

General planning information about soil types and properties can be found in the Soil Survey books, which are published for every county in Ohio. Additional information on soils and proper construction practices can be found in the Construction Inspection Manual of Procedures published by the Office of Construction Administration. The ODOT soil classification method is presented in the Specifications for Geotechnical Exploration.

ODOT's pavement design procedure uses a statistical reliability factor (see Section 204) to account for variability in subgrade stiffness. Because of this, the average CBR is to be used for pavement design. Often designers want to use the lowest CBR value to add an additional safety factor but this results in unnecessarily thick, wasteful designs.

203.1 Subgrade Resilient Modulus

The subgrade resilient modulus is a measure of the ability of a soil to resist elastic deformation under repeated loading. Many soils are stress dependent. As the stress level increases, these soils will behave in a non-linear fashion. Fine-grained soils tend to be stress-softening, whereas granular soils tend to be stress-hardening. The laboratory resilient modulus test, AASHTO T 307 or NCHRP 1-28A, is designed to determine the strain due to a repeated load (deviator stress) which simulates the effect of loads passing over a section of pavement.

Based on limited research and several current publications, ODOT has adopted a standard relationship between modulus of resilience (M_r) and the California bearing ratio (CBR) shown below. The units for resilient modulus are pounds per square inch (psi).

M_r = 1200 * CBR

GB-1 Calculated CBR = 6 percent
M_r = 1200 * CBR = 1200 * 6 = 7,200 psi

203.2 California Bearing Ratio

The California bearing ratio (CBR) is a value representing a soil's resistance to shearing under a standard load, compared to the resistance of crushed stone subjected to the same load. The CBR is obtained by performing a laboratory penetration test of a soaked sample of soil. The load required to produce a penetration at each 0.1 inch depth in the soaked sample is divided by a standard, which has been developed for crushed stone, then multiplied by 100.

203.3 Group Index

In order to reduce the amount of laboratory testing required to characterize the soil stiffness, ODOT developed a relationship between CBR and group index. This relationship was developed in the 1950's by testing hundreds of soil samples. Group Index is a function of a soil's Atterberg Limits and gradation. The equation for group index is given in Appendix A of the Specifications for Geotechnical Exploration published by the Office of Geotechnical Engineering. Figure 203-1 contains a nomograph that solves the group index equation. Group index is then correlated to CBR using the chart in Figure 203-2.

203.4 Subgrade Stabilization

Undercutting or chemical stabilization of the subgrade should be determined in accordance with GB1. Questions regarding subgrade stabilization should be directed to the Office of Geotechnical Engineering.

203.4.1 Global Chemical Stabilization

When the entire subgrade is chemically stabilized without exception (global chemical stabilization), the subgrade resilient modulus of the native soil is increased. Research has shown that global chemical stabilization increases the stiffness of the subgrade and the effects are long lasting. The increased resilient modulus is calculated using the following formula:

M_r = 7,200 psi @ CBR = 6 percent
$M_{r\text{-}GCS}$ = 1.36 * M_r = 1.36 * 7,200 = 9792 psi
$CBR_{\text{-}GCS}$ = $M_{r\text{-}GCS}$ / 1200 = 9792 / 1200 = 8.16 %
Design $CBR_{\text{-}GCS}$ = 8 percent

$$M_{r\text{-}GCS} = 1.36 * M_r$$

Where:

$M_{r\text{-}GCS}$ = Improved subgrade resilient modulus due to global chemical stabilization (psi)
M_r = Subgrade resilient modulus of the native soil (psi)

204 Reliability

AASHTO defines reliability as the probability that the load applications a pavement can withstand in reaching a specified minimum serviceability level is not exceeded by the number of load applications that are actually applied to the pavement. Reliability is a statistical tool used in pavement design that assumes a standard normal distribution exists for all pavement design parameters and allows the designer to account for deviation from the average equally for all parameters. Reliability can be thought of as a safety factor. Figure 201-1 lists the reliability factors to be used in pavement design for various classifications of highways.

204.1 Overall Standard Deviation

The overall standard deviation (variance) is a measure of the spread of the probability distribution for ESALs vs. Serviceability, considering all the parameters used to design a pavement. Figure 201-1 lists the overall standard deviation to be used in pavement design.

205 Subsurface Pavement Drainage

Subsurface pavement drainage is required on all projects greater than 0.5 miles (0.8 km) long that consist of constructing new pavement on subgrade or rubblizing the existing pavement. Subsurface drainage may be installed on any type of project and any length, if needed.

Lack of adequate pavement drainage is a primary cause of distress in many pavements. Excess moisture in the base and subgrade reduces the amount of stress the subgrade can tolerate without permanent strain. Strain in the subgrade transfers stress into the upper pavement layers resulting in deformation and ultimately distress. Trapped moisture in flexible pavement systems leads to stripping, raveling, debonding, and rutting. Excess moisture in rigid pavement systems leads to pumping, faulting, cracking, and joint failure.

205.1 Types of Drainage Systems

There are three means of draining the pavement subsurface - pipe underdrains, prefabricated edge underdrains, and aggregate drains. Pipe underdrains are the primary method to provide drainage and are generally used with paved shoulders and curbed sections. Occasionally, when an existing pavement is being overlaid, prefabricated edge underdrains are installed to provide drainage. Aggregate drains are generally used with aggregate shoulders, bituminous surface treated shoulders, and for spot improvements. In the past, another type of subsurface drainage, free draining base (FDB), was used but is no longer approved for use on ODOT projects and the specifications have been rescinded.

Figures 205-1 to 205-10 provide details on the placement of subsurface drainage systems. Additional examples are found in the Sample Plan Sheets.

Appendix B:
Geotechnical Engineering Design Checklists

Ohio Department of Transportation
Geotechnical Engineering
Design Checklists

Version 5.0
January 17, 2020

Preface

Geotechnical design features that arise in the development of roadway projects vary both in type and complexity. Cuts, embankments, wetlands, mine issues, and rock slopes are just some geotechnical issues encountered on transportation projects. Consistent and comprehensive reconnaissance, analysis, and plan preparation are necessary to ensure that all possible geotechnical issues that may occur on a project will be adequately identified and accounted for on the final plans.

A set of topical review checklists, a reference list, and a technical publications list have been developed to aid the project development personnel in their production of geotechnically sound project plans. All projects that contain geotechnical related issues will benefit from the use of this document. Although it is expected that the District Geotechnical Engineer will be one of the main users of these checklists, any personnel responsible for a geotechnical aspect of the project plan development will use this document. Possible users of this checklist include, but are not limited to, design and geotechnical Consultants and District and Central Office Planning and Production staff.

The design checklists are provided to assist the project development personnel in:

- Developing a comprehensive geotechnical scope of services
- Developing and reviewing geotechnical reports and assimilating information
- Analyzing, designing, and reviewing geotechnical related aspects of a transportation project, including needs assessment, plans, and specifications
- Recognizing cost-saving opportunities
- Identifying deficiencies due to inadequate geotechnical investigation, analysis, or design
- Recognizing when to request additional technical assistance from a geotechnical specialist
- Defining areas of needed training

At first glance, the design checklist will seem to be inordinately lengthy. One, however, should not avoid using the checklist because of this. Only on major and complex projects will it be necessary to complete most of the checklist. Just those checklists that pertain to a specific geotechnical feature encountered on the project should be completed. Therefore, for most projects, only a small portion of the checklist will need to be completed.

Since several entities may be involved in the geotechnical development of a transportation project, it is possible that there may be more than one set of checklists completed for a specific project, or different entities may fill out different sections of the checklist. It is anticipated that all completed checklists will be included with the project file in District or Central Office.

<u>To utilize the checklists,</u>

- First fill out the project information on the Checklist Cover tab. The project information in the headings of the rest of the checklists will autopopulate. Also indicate which checklists will be utilized.
- Complete only the checklists that apply to the project by using the dropdown boxes.
- Submit the checklist cover along with all completed checklists with the report and plan submission

Additional topics and questions may be added as the development of these checklists continues and input is received from the users. All additional updates, bulletins, and design guidance will be issued from the Office of Geotechnical Engineering and available on the internet at the Design Reference Resource Center. The Administrator of the Office of Geotechnical Engineering will be the point of contact regarding the checklist, and any questions, recommendations, and training requests should be directed to the Office Administrator.

Table of Contents

Symbols and Abbreviations

Y	Yes
N	No
X	Not Applicable (Reason should be explained in the "Notes" area of the checklist)
✓	Selected item utilized
AASHTO	American Association of State Highway and Transportation Officials
AML	Abandoned Mine Land Reclamation Program, DMRM, ODNR
AUMIRA	Manual for Abandoned Underground Mine Inventory and Risk Assessment, ODOT
BDM	Bridge Design Manual, ODOT
CBR	California Bearing Ratio
C&MS	Construction and Material Specifications, ODOT
DGE	District Geotechnical Engineer, ODOT District
DGS	Division of Geological Survey, ODNR
DMRM	Division of Mineral Resources Management, ODNR
DSWC	Division of Soil and Water Conservation, ODA
EPA	Ohio Environmental Protection Agency
FHWA	Federal Highway Administration
F.S.	Factor of Safety
GB	Geotechnical Bulletin, OGE (Always followed by the applicable number (e.g., GB4))
L&D1	Location & Design Manual, Volume 1, ODOT
L&D3	Location & Design Manual, Volume 3, ODOT
LRFD	Load and Resistance Factor Design
N_{60}	Standard Penetration Value, normalized to 60 percent of drill rod energy ratio
ODNR	Ohio Department of Natural Resources
ODOT	Ohio Department of Transportation
OGE	Office of Geotechnical Engineering, ODOT
OSMRE	Office of Surface Mining Reclaimation and Enforcement, U.S. Department of the Interior
ROW	Right of Way
RQD	Rock Quality Designation
SDI	Slake Durability Index
SGE	Specifications for Geotechnical Explorations, ODOT
SPT	Standard Penetration Test
TIMS	Transportation Information Mapping System, ODOT
UBV	Ultimate Bearing Value
USGS	U.S. Geological Survey
WEAP	Wave Equation Analysis of Pile Driving (Software)

I. Geotechnical Design Checklists

Project: WOO/LUC-280-06.20/00.00	PDP Path:
PID: 108584	Review Stage: 1

Checklist	Included in This Submission
II. Reconnaissance and Planning	✓
III. A. Centerline Cuts	
III. B. Embankments	
III. C. Subgrade	✓
IV. A. Foundations of Structures	
IV. B. Retaining Wall	
V. A. Landslide Remediation	
V. B. Rockfall Remediation	
V. C. Wetland or Peat Remediation	
V. D. Underground Mine Remediation	
V. E. Surface Mine Remediation	
V. F. Karst Remediation	
VI. A. Soil Profile	✓
VI. D. Geotechnical Reports	✓

II. Reconnaissance and Planning Checklist

C-R-S: WOO/LUC-280-06.20/00.00	PID: 108584	Reviewer: LGH	Date: 7/11/2023

Reconnaissance		(Y/N/X)	Notes:
1	Based on Section 302.1 in the SGE, have the necessary plans been developed in the following areas prior to the commencement of the subsurface exploration reconnaissance:	X	Plans to be prepared by others.
	Roadway plans		
	Structures plans		
	Geohazards plans		
2	Have the resources listed in Section 302.2.1 of the SGE been reviewed as part of the office reconnaissance?	Y	
3	Have all the features listed in Section 302.3 of the SGE been observed and evaluated during the field reconnaissance?	Y	
4	If notable features were discovered in the field reconnaissance, were the GPS coordinates of these features recorded?	X	

Planning - General		(Y/N/X)	Notes:
5	In planning the geotechnical exploration program for the project, have the specific geologic conditions, the proposed work, and historic subsurface exploration work been considered?	Y	
6	Has the ODOT Transportation Information Mapping System (TIMS) been accessed to find all available historic boring information and inventoried geohazards?	Y	
7	Have the borings been located to develop the maximum subsurface information while using a minimum number of borings, utilizing historic geotechnical explorations to the fullest extent possible?	Y	
8	Have the topography, geologic origin of materials, surface manifestation of soil conditions, and any other special design considerations been utilized in determining the spacing and depth of borings?	Y	
9	Have the borings been located so as to provide adequate overhead clearance for the equipment, clearance of underground utilities, minimize damage to private property, and minimize disruption of traffic, without compromising the quality of the exploration?	Y	

II. Reconnaissance and Planning Checklist

Planning - General		(Y/N/X)	Notes:
10	Have the scaled boring plans, showing all project and historic borings, and a schedule of borings in tabular format, been submitted to the District Geotechnical Engineer?	N	Boring location plan is included in this report submittal.
	The schedule of borings should present the following information for each boring:		
a.	exploration identification number	Y	
b.	location by station and offset	Y	
c.	estimated amount of rock and soil, including the total for each for the entire program.	Y	

Planning – Exploration Number		(Y/N/X)	Notes:
11	Have the coordinates, stations and offsets of all explorations (borings, probes, test pits, etc.) been identified?	Y	
12	Has each exploration been assigned a unique identification number, in the following format X-ZZZ-W-YY, as per Section 303.2 of the SGE?	Y	
13	When referring to historic explorations that did not use the identification scheme in 12 above, have the historic explorations been assigned identification numbers according to Section 303.2 of the SGE?	Y	

II. Reconnaissance and Planning Checklist

Planning – Boring Types		(Y/N/X)	Notes:
14	Based on Sections 303.3 to 303.7.6 of the SGE, have the location, depth, and sampling requirements for the following boring types been determined for the project?	Y	Borings were extended to 15 feet below existing grade due to the proposed low-mast lighting poles.
	Check all boring types utilized for this project:		
	Existing Subgrades (Type A)	✓	
	Roadway Borings (Type B)		
	Embankment Foundations (Type B1)		
	Cut Sections (Type B2)		
	Sidehill Cut Sections (Type B3)		
	Sidehill Cut-Fill Sections (Type B4)		
	Sidehill Fill Sections on Unstable Slopes (Type B5)		
	Geohazard Borings (Type C)		
	Lakes, Ponds, and Low-Lying Areas (Type C1)		
	Peat Deposits, Compressible Soils, and Low Strength Soils (Type C2)		
	Uncontrolled Fills, Waste Pits, and Reclaimed Surface Mines (Type C3)		
	Underground Mines (C4)		
	Landslides (Type C5)		
	Rockfall (Type C6)		
	Karst (Type C7)		
	Proposed Underground Utilities (Type D)		
	Structure Borings (Type E)		
	Bridges (Type E1)		
	Culverts (Type E2 a,b,c)		
	Retaining Walls (Type E3 a,b,c)		
	Noise Barrier (Type E4)		
	CCTV & High Mast Lighting Towers (Type E5)		
	Buildings and Salt Domes (Type E6)		

III.C. Subgrade Checklist

C-R-S: WOO/LUC-280-06.20/00.00	PID: 108584	Reviewer: LGH	Date: 7/11/2023

If you do not have any subgrade work on the project, you do not have to fill out this checklist.

Subgrade	(Y/N/X)	Notes:
1 Has the subsurface exploration adequately characterized the soil or rock according to Geotechnical Bulletin 1: Plan Subgrades (GB1)?	Y	
a. Has each sample been visually classified and inspected for the presence of gypsum? Has a moisture content been performed on each sample?	Y	
b. Has mechanical classification (Plastic Limit (PL), Liquid Limit (LL), and gradation testing) been done on at least two samples from each boring within six feet of the proposed subgrade?	Y	
c. Has the sulfate content of at least one sample from each boring within 3 feet of the proposed subgrade been determined, per Supplement 1122, Determining Sulfate Content in Soils?	Y	
d. Has the sulfate content of all samples that exhibit gypsum crystals been determined?	X	No gypsum observed in samples.
e. Have A-2-5, A-4b, A-5, A-7-5, A-8a, or A-8b soils within the top 3 feet of the proposed subgrade been mechanically classified?	X	None present.
2 If soils classified as A-2-5, A-4b, A-5, A-7-5, A-8a, or A-8b, or having a LL>65, are present at the proposed subgrade (soil profile), do the plans specify that these materials need to be removed and replaced or chemically stabilized?	X	None present.
a. If these materials are to be removed and replaced, have the station limits, depth, and lateral limits for the planned removal been provided?	X	
3 If there is any rock, shale, or coal present at the proposed subgrade (C&MS 204.05), do the plans specify the removal of the material?	X	None present.
a. If removal of any rock, shale, or coal is required, have the station limits, depth, and lateral limits for the planned removal of the material at proposed subgrade been provided?	X	

III.C. Subgrade Checklist

Subgrade		(Y/N/X)	Notes:
4	In accordance with GB1, do the SPT (N_{60})/HP values and existing moisture contents for the proposed subgrade soils indicate the need for subgrade stabilization?	N	
a.	If removal and replacement is applicable, has the detail of subgrade removal been shown on the plans, including depth of removal, station limits, lateral extent, replacement material, and plan notes (Item 204 - Subgrade Compaction and Proof Rolling)?	N	Plans to be prepared by others.
b.	If chemical stabilization is applicable, has the detail of this treatment been shown on the plans, including depth, percentage of chemical, station limits, lateral extent, and plan notes?	N	Plans to be prepared by others.
	Indicate type of chemical stabilization specified:		
	cement stabilization	✓	
	lime stabilization		
5	If removal and replacement has been specified, do the plans include Plan Note G121 from L&D3?	X	Plans to be prepared by others.
6	If drainage or groundwater is an issue with the proposed subgrade, has an appropriate drainage system (e.g., pipe, underdrains) been provided?	X	Plans to be prepared by others.
7	Has an appropriate quantity of Proof Rolling (C&MS 204.06) and has Plan Note G111 from L&D3 been included in the plans?	X	Plans to be prepared by others.
8	Has a design CBR value been provided?	Y	

VI.A. Soil Profile Checklist

C-R-S: WOO/LUC-280-06.20/00.00	PID: 108584	Reviewer: LGH	Date: 7/11/2023

General Presentation		(Y/N/X)	Notes:
1	Has an electronic copy of all geotechnical submissions been provided to the District Geotechnical Engineer (DGE)?	X	This submittal is being provided to Prime Consultant, whom will forward to DGE.
2	Have the cadd files been prepared using the appropriate version of the ODOT CADD standards?	Y	
3	Has the geotechnical specification (title and date) under which the work was performed been clearly identified on every submission (reports, plans, etc.)?	Y	
4	Has the first complete version of all documents being submitted been labeled as 'Draft'?	Y	File name for draft submittal was marked as draft. This is the draft submittal.
5	Subsequent to ODOT's review and approval, has the complete version of the revised documents being submitted been labeled as 'Final'?	Y	This is the draft submittal.
a.	Have the C-R-S, PID number, and product title been included in the folder name?	Y	
6	If the project includes structures, have all structure explorations been presented together under the same cover sheet? (Do not create separate Structure Foundation Exploration Sheets)	X	
7	Has a scale of 1"=1' been used for cover sheets, laboratory test data sheets, and boring log sheets, if applicable?	Y	Scale not shown on plans.
8	Based on the project length, has the correct horizontal scale been used to plot the project data?	Y	
	Check scale used:		
	1" = 5', 10', 20', 25', 40', or 50' for projects 1500' or less (use largest scale appropriate to present entire plan on one sheet)		
	1" = 50' projects greater than 1500'	✓	
9	Has a scale of 1" = 10' been utilized for the vertical scale of the project data?	Y	
10	If the project includes structures, has the plan and profile view been shown at the same scale as the Site Plan for the proposed structure(s), when possible?	X	

VI.A. Soil Profile Checklist

General Presentation		(Y/N/X)	Notes:
11	If the project includes culverts, have the plan and profile been presented along the flowline of the culvert?	X	
12	Have the cross-sections been plotted at a scale of 1” = 10’ (preferred) or 1” = 20’ (for higher or wider slopes)?	X	
Cover Sheet		**(Y/N/X)**	**Notes:**
13	Has the following general information been provided on the cover sheet:		
a.	Brief description of the project, including the bridge number of each bridge involved in the plan set, if any?	Y	
b.	Brief description of historic geotechnical explorations referenced in this exploration? State if no historic records are available.	Y	
c.	Generalized information about the geology of the project area, including terrain, soil origin, bedrock types, and age?	Y	
d.	Brief presentation of geological and topographical information derived from the field reconnaissance? Include comments on structure and pavement conditions.	Y	
e.	Brief presentation of test boring and sampling methods? Include date of last calibration and drill rod energy ratio as a percent for the hammer systems used.	Y	
f.	Summary of general soil, bedrock, and groundwater conditions, including a generalized interpretation of findings?	Y	
g.	A statement of which version (date) of the SGE specification the exploration was performed in accordance with?	Y	
h.	Statement of where geotechnical reports are available for review?	Y	
i.	Initials of personnel and dates they performed field reconnaissance, subsurface exploration and preparation of the soil profile?	Y	

VI.A. Soil Profile Checklist

Cover Sheet		(Y/N/X)	Notes:
14	Has a Legend been provided?	Y	
15	Have the following items been included in the Legend:		
a.	Symbols and usual descriptions for only the soil and bedrock types presented in the Soil Profile, as per the Soil and Rock Symbology Chart in Appendix D of the SGE?	Y	
b.	All miscellaneous symbols and acronyms, used on any of the sheets, defined?	Y	
c.	The number of soil samples for each classification that were mechanically classified and visually described in the current exploration?	Y	
16	Has a Location Map, showing the beginning and end stations for the project, been shown on the cover sheet, sized per the L&D3 Manual?	Y	
17	Have the station limits for each plan and profile sheet for projects with multiple alignments, or greater than 1500', been identified in a table?	Y	
18	Have the station limits for any cross section sheets been identified in the same table?	X	
19	Has a list of any structures for which structure foundation explorations been performed been identified in the same table?	X	
20	If sampling and testing for a scour analysis was performed, has this data been shown in tabular form?	X	
21	Has a summary table of test data for all roadway and subgrade boring samples been shown?	Y	
22	If borings from previous subsurface explorations are being used, has that data been shown in a separate table?	X	No relevent historic borings data
23	In the summary table, has the data been displayed by roadway and subgrade boring in ascending stationing order for each roadway?	Y	
24	Have the centerline or baseline station, offset, and exploration identification number been provided for each boring presented in the table?	Y	

VI.A. Soil Profile Checklist

Cover Sheet		(Y/N/X)	Notes:
25	For each sample, has the following information been provided in the summary table:		
a.	Sample depth interval?	Y	
b.	Sample number and type?	Y	
c.	N_{60}?	Y	
d.	Percent recovery?	Y	
e.	Hand Penetrometer?	Y	
f.	Percentage of aggregate, coarse sand, fine sand, silt, and clay size particles?	Y	
g.	Liquid limit, plastic limit, plasticity index, and water content, all rounded to the nearest percent or whole number?	Y	
h.	ODOT classification and Group Index?	Y	
i.	Visual description of samples not mechanically classified, including water content, and estimated ODOT classification with 'Visual' in parentheses?	Y	
j.	Sulfate Content test results?	Y	
26	Have all undisturbed test results been displayed in graphical format on the sheet prior to the plan and profile sheets?	Y	

Surface Data		(Y/N/X)	Notes:
27	Has the following information been shown on each roadway plan drawing:		
a.	Existing surface features described in Section 702.5.1?	Y	
b.	Proposed construction items, as described in Section 702.5.2?	Y	
c.	Project and historic boring locations, with appropriate exploration targets and exploration identification numbers?	Y	
d.	Notes regarding observations not readily shown by drawings?	Y	
28	Have the existing ground surface contours been presented?	Y	
29	If cross sections are to be developed for stationing covered on a plan sheet, has an index for the appropriate cross section sheets been included on the plan sheet?	X	

VI.A. Soil Profile Checklist

Subsurface Data		(Y/N/X)	Notes:
30	Has all the subsurface data been presented in the form of a profile along the centerline or baseline, and on cross sections where applicable?		
31	Have the graphical boring logs been correctly shown, as follows:		
a.	Location and depth of boring indicated by a heavy dashed vertical line?	Y	
b.	Exploration identification number above the boring?	Y	
c.	Logs indicate soil and bedrock layers with symbols 0.4” wide and centered on the heavy dashed vertical line where possible?	N	Stick log width set to match width presented in SGE example sheets.
d.	Bedrock exposures with 0.4” wide symbols, but without a heavy dashed vertical line?	N	Stick log width set to match width presented in SGE example sheets.
e.	Soil and bedrock symbols as per ODOT Soil and Rock Symbology chart (SGE - Appendix D)?	Y	
f.	Historical borings shown in same manner with the exploration identification number above the boring?	Y	
32	Have the proposed groundline and existing groundline been shown on the profile view, according to ODOT CADD standards?	Y	
33	Have the locations of the proposed structure foundation elements been shown on the profile view?	N	
34	Have the offsets from centerline or baseline been indicated above the borings in the profile view?	Y	
35	Have borings located immediately adjacent to the centerline or baseline and considered representative of centerline or baseline subsurface conditions been referenced directly to the centerline or baseline?	Y	
36	Have offset borings in or near the same elevation interval of a centerline or baseline boring been plotted either on a cross section or immediately above or below the centerline boring in a box containing an elevation scale?	X	
37	Have cross-sections been developed to show subsurface conditions disclosed by a series of borings drilled transverse to centerline or baseline?	X	

VI.A. Soil Profile Checklist

Subsurface Data		(Y/N/X)	Notes:
38	Have the existing and proposed groundlines been displayed on cross section sheets according to ODOT CADD standards?	Y	
39	Have bedrock exposures shown on the cross sections been plotted along the contour of the cross section?	X	
40	Has the following information been provided adjacent to the graphical logs or bedrock exposure:		
a.	Thickness, to the nearest inch, of sod/topsoil or other shallow surface material written above the boring (with corresponding symbology at top of log)?	Y	
b.	Moisture content, to nearest whole percent, with the bottom of the text aligned with the bottom of the sample? Label this column as 'WC' at bottom of the boring.	Y	
c.	N_{60}, aligned with the bottom of sample? Label column as 'N_{60}' at bottom of boring.	Y	
d.	Free water indicated by a horizontal line with a 'w' attached, and water level at the end of drilling indicated by an open equilateral triangle, point down?	Y	
e.	Complete geologic description of each bedrock unit, including unit core loss, unit RQD, SDI, and compressive strength test results? (Do not present geologic descriptions for structure borings for which this information is presented on the boring logs as described in 703.3)	Y	
f.	Visual description of any uncontrolled fill or interval not adequately defined by a graphical symbol?	X	
g.	Organic content with modifiers, per 603.5?	X	No organic content testing was deemed necessary.
h.	Designate a plastic soil with moisture content equal to or greater than the liquid limit minus three with a 1/8" solid black circle adjacent to the moisture content?	Y	
i.	Designate a non-plastic soil with moisture content exceeding 25% or exceeding 19% but appearing wet initially, with a 1/8" open circle with a horizontal line through it adjacent to the moisture content?	X	
j.	The reason for discontinuing a boring prior to reaching the planned depth indicated immediately below the boring?	X	

VI.A. Soil Profile Checklist

Boring Logs		(Y/N/X)	Notes:
41	Have the boring logs of all structure borings, all geohazard borings, and any roadway borings drilled in the vicinity of the structures or geohazard been shown on the boring log sheets following the plan and profile sheets? (Create the logs in accordance with 703.3)	Y	
42	Have the boring logs been developed by integrating the driller's field logs, laboratory test data, and visual descriptions?	Y	
43	Has the following boring information been included in the heading of each boring log:	Y	
a.	Exploration identification number?	Y	
b.	Project designation (C-R-S) and PID?	Y	
c.	Structure File Number (if applicable) and project type.	X	
d.	Centerline or baseline name, station, offset, and surface elevation?	Y	
e.	Coordinates?	Y	
f.	Method of drilling?	Y	
g.	Date started and date completed?	Y	
h.	Method and material (including quantity) used for backfilling or sealing, including type of instrumentation, if any?	Y	
i.	Date of last calibration and drill rod energy ratio (ER) in percent for the hammer system(s) used?	Y	
44	Has the following boring information been included in each boring log:		
a.	A depth and elevation scale?	Y	
b.	Indication of stratum change?	Y	
c.	Description of material in each stratum?	Y	
d.	Depth of bottom of boring?	Y	
e.	Depth of boulders or cobbles, if encountered?	Y	
f.	Caving depth?	X	
g.	Water level observations?	Y	
h.	Artesian water level and height of rise?	X	
i.	Heaving sand?	X	
j.	Cavities or other unusual conditions?	X	
k.	Depth interval represented by sample?	Y	
l.	Sample number and type?	Y	
m.	Percent recovery for each sample?	Y	
n.	Measured blow counts for each 6 inches of drive for split spoon samples?	Y	
o.	N_{60} to the nearest whole number?	Y	
p.	Hand penetrometer?	Y	

VI.A. Soil Profile Checklist

Boring Logs		(Y/N/X)	Notes:
q.	Particle-size analysis?	Y	
r.	Liquid limit, plastic limit, plasticity index?	Y	
s.	Water content?	Y	
t.	ODOT soil classifications, with "V" in parentheses for those samples that are not mechanically classified?	Y	
u.	Top of bedrock and bedrock descriptions?	X	
v.	Run rock core percent recovery?	X	
w.	Run RQD?	X	
x.	Unit rock core percent recovery?	X	
y.	Unit RQD?	X	
z.	SDI, if applicable?	X	
aa.	Rock compressive strength test results, if applicable?	X	

VI.B. Geotechnical Reports

C-R-S: WOO/LUC-280-06.20/00.00	PID: 108584	Reviewer: LGH	Date: 7/11/2023

General		(Y/N/X)	Notes:
1	Has an electronic copy of all geotechnical submissions been provided to the District Geotechnical Engineer (DGE)?	X	This submittal is being provided to Prime Consultant, whom will forward to DGE.
2	Has the first complete version of a geotechnical report being submitted been labeled as 'Draft'?	Y	Yes. This is the final submittal.
3	Subsequent to ODOT's review and approval, has the complete version of the revised geotechnical report being submitted been labeled 'Final'?	Y	Yes. This is the final submittal.
4	Has the boring data been submitted in a native format that is DIGGS (Data Interchange for Geotechnical and Geoenvironmental) compatable? gINT files may be used for this.	Y	For this final report submittal, gINT files have been provided.
5	Does the report cover format follow ODOT's Brand and Identity Guidelines Report Standards found at http://www.dot.state. oh.us/brand/Pages/default.aspx ?	Y	
6	Have all geotechnical reports being submitted been titled correctly as prescribed in Section 705.1 of the SGE?	Y	
Report Body		(Y/N/X)	Notes:
7	Do all geotechnical reports being submitted contain the following:		
a.	an Executive Summary as described in Section 705.2 of the SGE?	Y	
b.	an Introduction as described in Section 705.3 of the SGE?	Y	
c.	a section titled "Geology and Observations of the Project," as described in Section 705.4 of the SGE?	Y	
d.	a section titled "Exploration," as described in Section 705.5 of the SGE?	Y	
e.	a section titled "Findings," as described in Section 705.6 of the SGE?	Y	
f.	a section titled "Analyses and Recommendations," as described in Section 705.7 of the SGE?	Y	
Appendices		(Y/N/X)	Notes:
8	Do all geotechnical reports being submitted contain all applicable Appendices as described in Section 705.8 of the SGE?	Y	
9	Do the Appendices present a site Boring Plan showing all boring locations as described in Section 705.8.1 of the SGE?	Y	

VI.B. Geotechnical Reports

Appendices		(Y/N/X)	Notes:
10	Do the Appendices include boring logs and color pictures of rock, if applicable, as described in Section 705.8.2 of the SGE?	Y	
11	Do the Appendices include reports of undisturbed test data as described in Section 705.8.3 of the SGE?	Y	
12	Do the Appendices include calculations in a logical format to support recommendations as described in Section 705.8.4 of the SGE?	Y	

VII. References

Publications - FHWA

Advanced Course on Slope Stability, Volume 1 and 2, Abramson, Lee, Boyce, Glenn, et al., Publication No. FHWA-SA-94-005 and 006

Corrosion/Degradation of Soil Reinforcement for Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, Elias, Publication No. FHWA-NHI-09-087

Geotechnical Engineering Circular No. 2 - Earth Retaining Systems, Sabitini, Elias, et al., Publication No. FHWA-SA-96-038

Geotechnical Engineering Circular No. 3 - LRFD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations, Kavazanjian, Publication No. FHWA-NHI-11-032

Geotechnical Engineering Circular No. 4 - Ground Anchors and Anchor Systems, Sabitini, Pass and Bachus, Publication No. FHWA-IF-99-015

Geotechnical Engineering Circular No. 5 – Geotechnical Site Characterization, Loehr, et. al., Publication No. FHWA-NHI-16-072

Geotechnical Engineering Circular No. 6 – Shallow Foundations, Kimmerling, Publication No. FHWA-IF-02-054

Geotechnical Engineering Circular No. 7 – Soil Nail Walls Reference Manual, Lazarte, et. al., Publication No. FHWA-NHI-14-007

Geotechnical Engineering Circular No. 10 - Drilled Shafts: Construction Procedures and Design Methods, Brown, et. al., Publication No. FHWA-NHI-18-024

Geotechnical Engineering Circular No. 11 - Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, Volume I and II, Berg, Christopher, and Samtani, Publication No. FHWA-NHI-10-024 and 025

Geotechnical Engineering Circular No. 12 - Design and Construction of Driven Pile Foundations, Volume I and II, Hannigan, Rausche, Likins, Robinson, and Becker, Publication No. FHWA-NHI-16-009 and 010

Geotechnical Engineering Circular No. 13 – Ground Modification Methods Reference Manual, Volume I and II, Schaefer, et. al., Publication No. FHWA-NHI-16-027 and 028

Geotechnical Instrumentation Reference Manual, Dunnicliff, NHI Course No. 13241 - Module 11

Prefabricated Vertical Drains: Volume 1: Engineering Guidelines, Rixner, Kraemer, and Smith, Publication No. FHWA-RD-86-168

Soils and Foundations Workshop, Reference Manual and Participant Workbook, Cheney and Chassie, Publication No. NHI-00-045

Soils and Foundations Reference Manual, Volume I and II, Samtani and Nowatzki, Publication No. NHI-06-088 and 089

Highway Subdrainage Design, Moulton, Publication No. FHWA-TS-80-224

Tiebacks, Weatherby, Publication No. FHWA/RD-82/047