Pro Geotech, Inc.
CLEVELAND: 26285 Broadway Avenue, Units A-1 & A-2, Cleveland, Ohio 44146 - Phone 440-717-1415
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May 27, 2022

Mr. Willian Baker, Jr, P.E.
CT Consultants
8150 Sterling Court
Mentor, Ohio 44060

Reference: **Draft Structure Foundation Exploration Report for Replacement of Bridge Number LAK-283-4.58**
East Lake, Lake County, Ohio
PID No.: 110807
PGI's Project No. G22002G

Dear Mr. Baker:

Enclosed please find our Draft Structure Foundation Exploration Report for the above referenced project. Our services included a geotechnical field exploration, laboratory testing, engineering analysis, and related design and construction recommendations. These services have been provided in accordance with our proposal dated January 6, 2022. It is important that the items under "Limitations" be precisely followed and complied with.

We appreciate the opportunity of working with you on this project and we invite you to contact us at (440) 717-1415 when we can be of further assistance.

Respectfully,

PRO GEOTECH, INC.

Shan Sivakumaran, P.E.
Project Manager/Geotechnical Engineer

Walid I. Najjar, P.E.
Senior Geotechnical Engineer

Enclosure
G22002Grpt/SS/5/27/2022

DRAFT STRUCTURE FOUNDATION EXPLORATION REPORT
FOR
BRIDGE NO. LAK-283-4.58 REPLACEMENT
LAKE COUNTY, OHIO
PROJECT NO. G22002G AND PID NO.: 110807

PREPARED FOR:

CT CONSULTANTS

PREPARED BY:

PRO GEOTECH, INC.

MAY 27, 2022

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APPENDIX

1.0 EXECUTIVE SUMMARY

This report has been prepared for the proposed replacement of Bridge Number LAK-283-4.58 in East Lake, Lake County, Ohio. The existing bridge site is located 225 feet west of River Drive East. The existing superstructure and substructure units; abutments and piers are to be removed. The option to reuse the existing strip footing foundations will be investigated.

A total of six (6) test borings identified as B-001-0-22 through B-006-0-22 were advanced for bridge foundation and approach design purposes. Test borings B-001-0-22 and B-006-0-22 were advanced along SR 283 for roadway design purposes while test boring B-002-0-22 through B-005-0-22 were advanced in the vicinity of existing bridge for foundation design purposes. The roadway test borings were advanced to approximate depth of 10.0 feet each below the existing pavement surface. The bridge test borings were advanced to approximate depths ranging from 29.0 to 39.0 feet below the existing pavement or ground surface.

Pavement: The subsurface soils encountered in test boring B-001-0-22 and in test boring B-006-0-22 consisted of predominantly fill soils. The fill soils were encountered above the natural soils in test boring B-001-0-22 and to termination depth in test boring B-006-0-22. The fill soils consisted silt (A-4b), shale fragments with sand and silt (A-2-4), red brick, sandy silt (A-4a), and silty clay (A-6b). Natural soils encountered in test boring B-001-0-22 consisted of gravel and stone fragments sand (A-1-b). The laboratory test results indicated that the moisture contents of the tested cohesive soil samples ranged from 12% to 29% and the consistency of these soils ranged from “very soft” to “very stiff”. The laboratory test results indicated that the moisture contents of the tested non-cohesive/granular soil samples ranged from 12% to 18% and the relative density of these soils ranged from “loose” to “medium dense”.

Bridge: The subsurface soils encountered are predominantly cohesive in nature and consisted of fill and natural soils. The fill soils were encountered consisted of silt (A-4b), sandy silt (A-4a), stone fragments (A-1-a), stone fragments with sand, silt, clay (A-2-6), gravel and stone fragments (A-1-a). The approximate thickness of the fill soils ranged from four (4) feet to 11 feet below the pavement or existing ground surface. The natural soils encountered at all test borings above bedrock and consisted of gravel and stone fragments with sand (A-1-b), sandy silt (A-4a), and coarse and fine sand (A-3a). Bedrock consisting of shale was encountered in all test borings below approximate depths ranging from 16.5 feet (Elevation 558.6 feet) to 28.5 feet (Elevation 555.1 feet) below the pavement or existing ground surface. The laboratory test results indicated that the moisture contents of the tested cohesive soil samples obtained from the structure test borings ranged from 8% to 29% and the consistency of these soils ranged

from “very soft” to “hard” but was primarily “very stiff” to “hard”. The laboratory test results indicated that the moisture contents of the tested non-cohesive soils ranged from 4% to 25% and the relative density of these soils ranged from “loose” to “medium dense”.

Bedrock core samples were then obtained using NQ diamond impregnated core barrels. The core samples consisted of gray shale. The shale was moderately to slightly weathered, and very weak to slightly strong. Bedding within the shale was generally very thin to thin and was fractured to slightly fractured. The Rock Quality Designation (RQD) obtained for the bedrock core samples varied from 55% to 73% and the recovery ranged from 95% to 99% for the individual rock core runs. The results of compressive strength tests performed on the selected rock core samples ranged from 389 psi to 3412 psi which characterizes them as “very weak” to “slightly strong”, respectively.

Recommendations

Bearing capacity analyses was performed in accordance with the ODOT *Bridge Design Manual* issued in 2004 using Allowable Stress Design (ASD) method. Tables 6.1.1 and 6.1.2 summarize the maximum allowable bearing capacity below bearing elevations of existing abutments and Piers locations, respectively. It is expected that the existing abutment and pier footings will incur some additional settlement if proposed applied loads from new bridge loading are greater than current applied design loads.

Table 6.1.1– Summary of Soil Bearing Capacities for Existing Bridge Abutments

Boring No.	Substructure Location	Effective Footing Width of Continuous Footing (feet)	Bearing Elevation (feet)	Allowable Bearing Capacity (ksf)
B-002-0-22	Rear AB	4.0	570.9	3.0
B-005-0-22	Forward AB	4.0	570.1	4.0

Table 6.1.2– Summary of Soil Bearing Capacities for Existing Bridge Piers

Boring No.	Substructure Location	Footing Width of Continuous Footing (feet)	Bearing Elevation (feet)	Allowable Bearing Capacity (ksf)
B-004-0-22	Pier C	4.0	570.1	6.0
B-004-0-22	Pier D	4.0	570.1	6.0

If existing bridge is completely replaced, shallow foundation system consisting of strip footing may be used to transfer the loads to the underlying hard soils at the proposed abutment and pier locations. Bearing capacity analyses was performed in accordance with the ODOT *Bridge Design Manual* issued *in*

accordance with the ODOT Bridge Design Manual issued in 2020 and using AASHTO LRFD Bridge Design Specifications, Latest Edition. Table 6.1.3 and 6.1.4 summarize the factored bearing resistance on soils below bearing elevation at abutment and pier locations so that CT personnel can evaluate or compare the factored bearing resistance to the factored bearing pressure. Settlement analyses will be performed once the design factored at the Service Limit is finalized at each substructure and provide the information to PGI.

Table 6.1.3– Summary of Soil Bearing Capacities for Proposed Bridge Abutments

Boring No.	Substructure Location	Effective Footing Width of Continuous Footing (feet)	Bearing Elevation (feet)	Factored Bearing Resistance (ksf)
B-002-0-22	Rear AB	4.0	570.9	3.0
B-005-0-22	Forward AB	4.0	570.1	4.0

Table 6.1.4– Summary of Soil Bearing Capacities for Proposed Bridge Piers

Boring No.	Substructure Location	Footing Width of Continuous Footing (feet)	Bearing Elevation (feet)	Factored Bearing Resistance (ksf)
B-003-0-22	Pier C	4.0	570.1	7.5
B-004-0-22	Pier D	4.0	570.1	7.5

The subgrade analysis was performed in accordance with *Geotechnical Bulletin-GB1* from ODOT released January 15, 2021. All laboratory test data obtained from the test borings was entered into the ODOT *GB1 Subgrade Analysis* spreadsheet Version 14.5 dated 1/18/2019. . The pavement design parameter information is summarized in Table 6.3.1.

Table 6.3.1 – Summary of Pavement Design Parameters

Parameter	Value
Average N_{60L}	6
Average PI	8
Average Group Index	6
Average CBR	7
Resilient Modulus (M_R, psi)	8,400

2.0 INTRODUCTION

This report has been prepared for the proposed replacement of Bridge Number LAK-283-4.58 in East Lake, Lake County, Ohio. It represents the intent of CT Consultants (CT) the design engineer, and ODOT District 12, the owner, to secure subsurface information at selected locations in accordance with the Ohio Department of Transportation's (ODOT's) *Specifications for Geotechnical Explorations*, and to obtain recommendations regarding geotechnical factors pertaining to the design and construction of this project.

This report has been developed based on the field exploration program, laboratory testing, and information secured for site-specific studies. It must be noted that, as with any exploration program, the site exploration identifies actual subsurface conditions only at those locations where samples were obtained. The data derived through sampling and laboratory testing is reduced by geotechnical engineers and geologists who then render an opinion regarding the overall subsurface conditions and their likely reaction on the site. The actual site conditions may differ from those inferred to exist. Therefore, although a fair amount of subsurface data has been assembled during this exploration, this report may not provide all of the geotechnical data needed for construction of this project. This report was prepared using English units.

2.1 Project Description

Present plans call for the replacement of Bridge No. LAK-283-4.58 which carries State Route 283 vehicular traffic in the Lake County, Ohio. The existing bridge site is located 225 feet west of River Drive East. The existing bridge is a three-span continuous reinforced concrete slab superstructure on wall abutments and piers supported by shallow foundations. The total span length of the existing bridge is approximately 49 feet. Design information provided by CT personnel indicates that they will investigate the option to reuse the existing strip footing foundations. The existing strip footings will be evaluated to verify that it will safely transfer the design loads from new bridge loadings to underlying soils or bedrock. The existing superstructure and substructure units; abutments and piers are to be removed and replaced and the proposed superstructure type will be same as existing. The proposed vertical and horizontal alignments of this section the SR 283 including bridge will be more or less similar to existing. The structure is to be designed for HL-93 and alternate military loading. The Site Location Map is shown in Figure 2.1.

2.2 Scope of Services

The scope of services for this project was in accordance with Pro Geotech, Inc. (PGI) Proposal No. PG21086 dated January 6, 2022 and was governed by ODOT's *Specifications for Geotechnical Explorations* dated January 14, 2021, ODOT's *Bridge Design Manual*, issued 2020 including current AASHTO LRFD specifications, hereafter referred to as ODOT Specifications. Our scope of services consisted of the execution of the following phases:

Phase I – Planning and Marking Test Borings, which primarily consisted of planning the field portion of our subsurface exploration, performing the site reconnaissance to evaluate the proposed project site from a geotechnical standpoint, reviewing and compiling all existing geology of the project site obtained from ODOT and ODNR sources, marking the test boring locations, obtaining necessary permits, and notifying the Ohio Utility Protection Services (OUPS) about the proposed drilling operations.

Phase II - Test Boring and Sampling Program, which primarily consisted of field verification of the test boring locations with regards to underground utilities, advancing the test borings at the site, conducting field tests, sampling the subsurface materials, and preparing field drilling logs.

Our scope of services included advancing six (6) test borings at the existing bridge site for structure foundation and roadway design purposes. Two (2) of these test borings were to be advanced for the bridge approach design purposes. These roadway test borings were to be advanced to an approximate depth 10 feet each below the existing ground surface. Four (4) of these test borings were to be advanced for structure foundation design purposes. These structural test borings were to be advanced to approximate depth of 35 feet each below the existing ground surface including 10 feet of rock core at each boring location. The groundwater conditions were monitored during and upon completion of the drilling operations. PGI provided all of the traffic control needed during the fieldwork.

Phase III - Testing Program, which consisted of performing soil classification and engineering properties tests on selected soil and rock samples and classifying the soils in accordance with the ODOT Soil Classification System.

Phase IV - Geotechnical Exploration Report, which included the following:

- A brief description of the project and our exploration methods
- Geology of the site

- Typed drilling logs and laboratory test results
- A description of subsurface soil, rock, and groundwater conditions
- Recommendations and discussion pertaining to structure foundation design including shallow and deep foundations
- Discussions pertaining to earthwork considerations, groundwater management, and construction monitoring and recommendations for shoring during construction
- Recommendations for shoring during construction
- Preparation of Geotechnical Exploration Plans

The scope of services did not include any environmental assessments for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater or air, on, below, or around this site. Any statement in this report or on the boring logs regarding odors, colors or unusual or suspicious items or conditions is strictly for the client's information.

3.0 GEOLOGY AND OBSERVATIONS OF THE PROJECT

3.1 Geology

Based on information obtained from the Physiographic Regions of Ohio map, the project site lies at approximate elevations ranging from 574 feet to 586 feet within the Erie Lake Plain Physiographic Region of the Huron-Erie Lake Plains Section of Ohio. This Huron-Erie Lake Plains Section is located within the Central Lowland Province. The Erie Lake Plain region is characterized by edges of very low-relief (10 feet) Ice-Age lake basin separated from modern Lake Erie by shoreline cliffs; major streams in deep gorges; elevation 570 to 800 feet. The geology of the Erie Lake Plain region generally consist of Pleistocene-Age lacustrine sand, silt, clay, and wave planed till over Devonian-age and Mississippian-age shales and sandstones. According to Bulletin 44, *Geology of Water in Ohio*, Wisconsinan and Kansan or pre-Kansan Glaciers passed over the area but left a thin coating of drift averaging less than 25 feet. Based on the *Quaternary Geology of Ohio,* the main geologic deposits of the project site consists of alluvium and alluvial terraces, deposited in present and former floodplains; ranging from silty clay in areas of fine-grained deposits to coarse sand, gravel, or cobbles in areas of shallow bedrock. The Chagrin River runs just east of the bridge site.

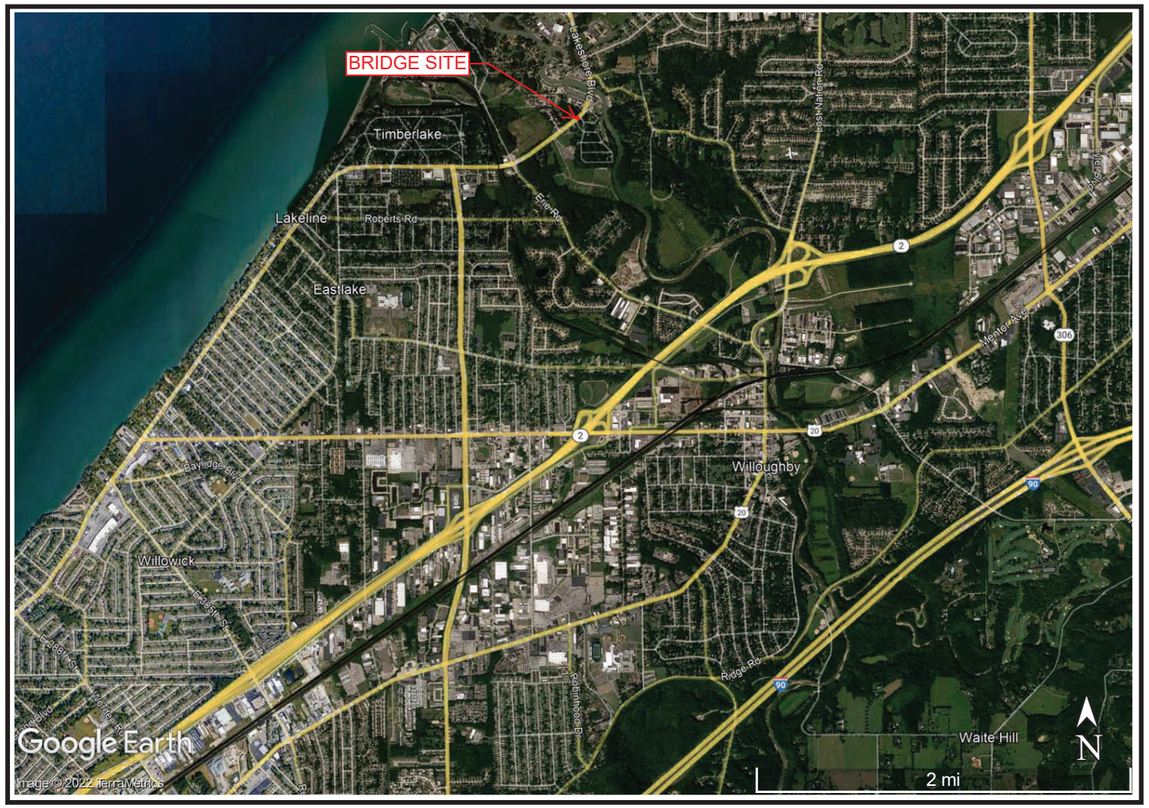
Based on the *Soil Survey of Lake County, Ohio*, the natural site soils in the vicinity of the project area, consist primarily of layer of Tioga loam which can be classified as A-4 soils based on the ODOT

Soil Classification System. However, the project site is located in an urban area and has incurred cut and fill operations due to the construction of the existing bridge and SR 283. Thus the composition of the surface soils has changed from natural in some areas. Based on the information obtained from the Ohio Geological Survey, the top of the bedrock in the vicinity of the project site is anticipated to be present at approximate elevations ranging from 555 feet to 559 feet. At these elevations, bedrock was deposited during the Upper Devonian Period and is expected to consist of black dense, siliceous shales and hard, thin sandstone of the Chagrin formation.

This soil and bedrock information has been obtained from the *Physiographic Regions of Ohio*, printed in April 1998, the *Geology of Water in Ohio* issued in 1943 (reprinted in 1968), the USDA *Web Soil Survey of Lake County, Ohio*, Version 19 issued in September 2021, the *Eastlake Quadrangle,* photorevised in 1992, the *Bedrock Geologic Map of Ohio*, printed in 2006 and the Ohio Department of Natural Resources Website.

3.2 Observation of the Project

The reconnaissance of the project site was performed by one of PGI's geotechnical engineers in March 2022. The project site is located in a residential/commercial neighborhood with the closest building located within 50 feet from bridge site. The over flow water from Chagrin River pass through bridge. However, at this time, water pond was observed below the deck. The concrete abutment walls and pier walls generally appeared to be in poor condition. Some areas of spalled concrete and exposed reinforcement were observed. Rust was observed in many places on the exposed steel rebar of the deck. In addition, the wingwalls were affected by scour of the stream. The reinforced concrete slab superstructure is overlaid with an asphalt wearing surface. This section of SR 283 consists of one lane in each direction with the existing pavement surface consisting of asphaltic concrete which generally appeared to be in good condition. Overhead electric and communication lines and underground utilities exist in the area of the project site.



LAK-283-4.58
EASTLAKE, LAKE COUNTY, OHIO
SITE LOCATION MAP (FIG. 2.1)

4.0 EXPLORATION

4.1 Historic and Project Exploration Program

Historic geotechnical information was obtained from the ODOT *Transportation Information Mapping System (TIMS)* Website and is included in the Appendix. The original construction drawings which were prepared in 1931 under the project designation of LA-283-46 for the bridge construction are available. The bridge plan and profile sheet shows the soil and rock columns obtained from the two test holes.

In order to explore the subsurface conditions at the project site, drilling, sampling, and field testing operations were performed in March and April 2022. A total of six (6) test borings identified as B-001-0-22 through B-006-0-22 were advanced for bridge foundation and approach design purposes. Test borings B-001-0-22 and B-006-0-22 were advanced along SR 283 for roadway design purposes while test boring B-002-0-22 through B-005-0-22 were advanced in the vicinity of existing bridge for foundation design purposes. Roadway test boring B-001-0-22 was advanced along westbound lane, approximately 50 feet behind the rear abutment while B-006-0-22 was advanced along eastbound lane, approximately 75 feet behind the forward abutment. Bridge test boring B-002-0-22 was advanced along eastbound lane just behind the rear abutment while bridge test boring B-005-0-22 was advanced along westbound lane just behind the forward abutment. Bridge test borings B-003-0-22 was advanced in the vicinity of existing Pier C on the north side of bridge. This boring was moved 10 feet to the northwest from original location due to conflict underground utilities. Test boring B-004-0-22 was advanced along east bound lane through bridge deck in the vicinity of existing Pier D. The bridge deck concrete was cored before start of drilling. The roadway test borings were advanced to approximate depth of 10.0 feet each below the existing pavement surface. The bridge test borings were advanced to approximate depths ranging from 29.0 to 39.0 feet below the existing pavement or ground surface. All test borings were advanced in accordance with ODOT Specifications for Geotechnical Explorations (SGE). The test boring locations are shown on the “Boring Locations Plan” included in the Appendix.

The test borings were marked in the field by PGI based on boring location plans developed by PGI personnel and approved by CT personnel. Site geometry, existing structure foundations, utility locations, overhead height, and accessibility were also taken into account when locating the test borings**.** At the time of test boring location selection, the vertical soil sampling intervals were determined based on the needs for design and construction of the project. A Mobile B-57 truck mounted drill rig and Diedrich D50 ATV track mounted drill rig were used to advance the test borings. Borings were advanced using 2.25-inch and 3.25-inch inside diameter continuous flight hollow stem augers (HSA). Representative disturbed samples

of the soils were collected at intervals in accordance with the ODOT Specifications. Continuous soil sampling was performed below the creek bed in test boring B-004-0-22 between depths of 1.0 and 7.0 feet for scour analyses. A standard 2.0-inch outside diameter split-barrel sampler was driven into the soil by means of a 140-lb hammer falling freely through a distance of 30-inches in accordance with the Standard Penetration Test (ASTM D 1586). Where bedrock was encountered, all bridge test borings were advanced and the rock was sampled using a type NQ series core barrel, water method. Both roadway test borings were monitored for the presence of groundwater during drilling and upon completion of drilling operations. All bridge borings were monitored for the presence of groundwater during drilling operations and before coring operations. These test borings were backfilled with mixture of bentonite and soil cuttings and capped with 6 inches of asphalt cold patch upon completion of backfilling operations. PGI provided all traffic control needed during the fieldwork.

The N-values (N_m) as measured in the field have been corrected to equivalent rod energy ratio of 60% (N_{60}) in accordance with ODOT's *Specifications for Geotechnical Explorations*. Drill Rig hammer system was calibrated by energy testing in accordance with ASTM D4633 and drill rod energy ratio; ER was determined. Automatic Hammer was calibrated on 11/1/2020 for Mobile B-57 (Truck) drill Rig with Drill Rod Energy Ratio of 98.6.1% and 11/11/2020 for Diedrich D50 ATV (Track) drill Rig with Drill Rod Energy Ratio of 82.0%. The measured N-values (N_m) were corrected to equivalent rod energy ratio of 60 percent, N_{60}, using the equation: $N_{60} = N_m$ x (ER/60).

Station, offset and surface elevations at the drilled test boring locations were provided to PGI by CT personnel. The typed drilling logs are included in the Appendix. These logs show the SPT resistance values (N-values) for each soil sample taken in the test borings and present the classification and description of soils encountered at various depths in the test borings. The N values as measured in the field have been corrected to an equivalent rod energy ratio of 60% (N_{60}) in accordance with ODOT's *Specifications for Geotechnical Explorations*. The sample depth shown on the logs and laboratory test results indicate the top of each sampling or testing interval.

4.2 Laboratory Testing Program

All soil and rock samples obtained during the drilling and sampling operations were returned to PGI’s geotechnical soils laboratory in Cleveland, Ohio. Upon arrival, the samples were visually examined and classified by a geotechnical engineer and a geologist to verify the classifications made in the field and to note any additional characteristics which may not have been observed in the field.

Moisture content determination tests were performed on all soil samples as per ODOT specifications. Additional laboratory soil tests were performed on selected soil and rock core samples for the purpose of soil classification and for analysis of engineering characteristics. These tests consisted of Particle Size Analysis, Atterberg Limits, and Compressive Strength of Rock Core Specimens. All laboratory tests were performed in accordance with the ASTM or other standards listed in "Laboratory Test Standards" located in the Appendix. The results of the laboratory tests are also included in the Appendix. The soils were classified in accordance with the ODOT Soil Classification System, a description of which is also included in the Appendix.

Upon completion of the laboratory testing, all samples were placed in storage at PGI's Cleveland facility. Unless otherwise requested in writing, the soil and bedrock core samples will be retained through completion and ODOT approval of Stage 2 plans.

5.0 FINDINGS

5.1 Surficial Condition

The surficial conditions in the vicinity of this existing bridge were determined from test borings B-001-0-22 through B-006-0-22. An asphaltic concrete layer was encountered in test borings B-001-0-22, B-002-0-22, B-005-0-22, and B-006-0-22 which were drilled through pavement. The approximate thickness of the asphaltic concrete ranged from 7.0 to 11.0 inches with an average thickness of 9.5 inches. The concrete layer was encountered below the asphaltic concrete in test borings B-001-0-22, B-002-0-22, and B-005-0-22 and roadbase consisted of limestone fragments encountered in test boring B-006-0-22. The approximate thickness of the concrete ranged from 3.5 to 8.0 inches with an average thickness of 5.2 inches. The approximate thickness of the roadbase was 7 inches. Test boring B-004-0-22 was advanced through bridge deck which consisted of 11 inches of asphalt and 12" of concrete. Test boring B-003-0-20 was advanced off road through topsoil with the thickness 14.5 inches.

5.2 Subsurface Soil Conditions

Pavement: The subsurface soil conditions were determined from the soil information obtained from roadway test borings B-001-0-22 and B-006-0-22. The subsurface soils encountered below the concrete in test boring B-001-0-22 and below the roadbase in test boring B-006-0-22 consisted of predominantly fill soils. The fill soils were encountered above the natural soils in test boring B-001-0-22 and to termination depth in test boring B-006-0-22. The fill soils consisted silt (A-4b), shale fragments with

sand and silt (A-2-4), red brick, sandy silt (A-4a), and silty clay (A-6b). Natural soils encountered in test boring B-001-0-22 consisted of gravel and stone fragments sand (A-1-b). One foot thickness of existing old road consisted of red brick and base was encountered at a depth of 4.5 feet in test boring B-006-0-22.

The laboratory test results indicated that the moisture contents of the tested cohesive soil samples ranged from 12% to 29% and the consistency of these soils ranged from "very soft" to "very stiff". The laboratory test results indicated that the moisture contents of the tested non-cohesive/granular soil samples ranged from 12% to 18% and the relative density of these soils ranged from "loose" to "medium dense". One (1) of the two (2) cohesive soil samples tested for Atterberg limits contained of natural moisture content greater than its plastic limit but less than its liquid limit.

Bridge: The subsurface soil conditions in the vicinity of this existing bridge were determined from the soil information obtained from bridge test borings B-002-0-22 through B-005-0-22. The subsurface soils encountered are predominantly cohesive in nature and consisted of fill and natural soils. The fill soils were encountered consisted of silt (A-4b), sandy silt (A-4a), stone fragments (A-1-a), stone fragments with sand, silt, clay (A-2-6), gravel and stone fragments (A-1-a). The approximate thickness of the fill soils ranged from four (4) feet to 11 feet below the pavement or existing ground surface. The bottom of fill soils layer was encountered at approximate elevations ranging from 567.7 feet to 573.9 feet. The natural soils encountered at all test borings above bedrock and consisted of gravel and stone fragments with sand (A-1-b), sandy silt (A-4a), and coarse and fine sand (A-3a). Bedrock consisting of shale was encountered in all test borings below approximate depths ranging from 16.5 feet (Elevation 558.6 feet) to 28.5 feet (Elevation 555.1 feet) below the pavement or existing ground surface.

The laboratory test results indicated that the moisture contents of the tested cohesive soil samples obtained from the structure test borings ranged from 8% to 29% and the consistency of these soils ranged from "very soft" to "hard" but was primarily "very stiff" to "hard". The laboratory test results indicated that the moisture contents of the tested non-cohesive soils ranged from 4% to 25% and the relative density of these soils ranged from "loose" to "medium dense". Eight (8) of the thirteen cohesive soil samples that were tested for Atterberg limits had natural moisture contents less than their plastic limits.

General: For specific conditions of the project and historic test borings at various depths, please refer to the individual test boring logs located in the Appendix of this report. For complete moisture contents and Atterberg limit test results for project test borings, refer to the laboratory test results located in the Appendix.

5.3 Bedrock Conditions

Bedrock was encountered in bridge test borings B-002-0-22 through B-005-0-22. Bedrock was split spoon sampled until little or no penetration or recovery was encountered. Generally, coring was attempted when the split-spoon sampler indicated very little penetration and recovery. Bedrock core samples were then obtained using NQ diamond impregnated core barrels. The coring operations were performed in accordance with the procedure for Diamond Core Drilling for Site Investigations (ASTM D 2113). The core samples consisted of gray shale. The shale was moderately to slightly weathered, and very weak to slightly strong. Bedding within the shale was generally very thin to thin and was fractured to slightly fractured. No slickensides were observed and the fractures were typically tight to narrow and slightly rough to very rough. The Rock Quality Designation (RQD) obtained for the bedrock core samples varied from 55% to 73% and the recovery ranged from 95% to 99% for the individual rock core runs. The results of compressive strength tests performed on the selected rock core samples ranged from 389 psi to 3412 psi which characterizes them as “very weak” to “slightly strong”, respectively.

Table 5.3.1 summarizes the elevation, length, recovery, and RQD for each rock core run obtained at the test borings. Table 5.3.2 summarizes the results of compressive strength tests performed at the laboratory on the different rock type core specimens at various depths. Refer to the drilling logs, soil profile, and rock core photos in the Appendix for additional bedrock information. Also refer to “Bedrock Descriptions” in the Appendix for general bedrock information.

Table 5.3.1 – Bedrock Core Information

Boring Number	Rock Core Run No.	Rock Core Elevations (ft)	Rock Core Depths (ft)	Length of Core Run (ft)	Recovery (%)	RQD (%)
B-002-0-22	NQ-1	553.9 to 548.9	29.0 to 34.0	5.0	95	55
	NQ-2	548.9 to 543.9	34.0 to 39.0	5.0	98	73
B-003-0-22	NQ-1	553.2 to 543.2	25.0 to 35.0	10.0	99	72
B-004-0-22	NQ-1	556.1 to 546.1	19.0 to 29.0	10.0	96	68
B-005-0-22	NQ-1	554.6 to 544.6	29.0 to 39.0	10.0	95	55

Elevations were provided by CT Personnel

Table 5.3.2 – Compressive Strength Test Results of Rock Core Specimens

Boring No.	Specimen Depth (ft)	Rock Type	Unit Weight (pcf)	CS (psi)
B-002-0-22	30.1	Shale	160.3	593
	36.3	Shale	159.0	389
B-003-0-22	28.2	Shale	149.1	2722
	33.9	Shale	149.6	2255
B-004-0-22	21.7	Shale	153.2	3256
	27.8	Shale	159.2	3395
B-005-0-22	32.6	Shale	158.3	3412
	37.3	Shale	157.8	3171

CS - Compressive Strength

5.4 Groundwater Conditions

Groundwater levels were measured at the test boring locations during and upon completion of drilling operations. In bridge test borings, no readings were taken upon completion of drilling due to water added to the boreholes during the rock coring operations. The results of these measurements are summarized in Table 5.4.1. It should be noted that groundwater elevations are subject to seasonal fluctuations. All test borings were backfilled immediately upon completion of drilling for safety purposes.

Table 5.4.1 – Groundwater Information

Test Boring	Surface Elevation (ft)	Depth of Groundwater		Groundwater Elevation	
		During Drilling	Upon Completion	During Drilling	Upon Completion
B-001-0-22	582.0	5.5’	7.2’	576.5	574.8
B-002-0-22	582.9	9.0’	NR	573.9	NR
B-003-0-22	578.2	6.5’	NR	571.7	NR
B-004-0-22	575.1	8.25’*	NR	575.9	NR
B-005-0-22	583.6	13.5’	NR	570.1	NR
B-006-0-22	585.2	Dry.	Dry	Dry	Dry

Elevations were provided by CT personnel, NR = No Reading. *measured from Bridge Deck surface

5.5 Bridge Scour Information

Bridge scour samples were obtained from test boring B-004-0-22 between elevations as indicated in Table 5.5.1. The size (D_{50}) of the scour samples at each depth are summarized in Table 5.5.1. The computer output of the grain size table for the D_{50} determinations is included in the Appendix.

5.5.1 – Summary of D_{50} Results

Boring No.	Depth Range (feet)	Elevation Range (feet)	D_{50} (mm)	ODOT Soil Classification
B-004-0-22	1.0 – 2.5	574.1 – 572.6	1.89	A-2-6
B-004-0-22	2.5 – 4.0	572.6 – 571.1	11.298	A-1-4
B-004-0-22	4.0 – 5.5	571.1 – 569.6	0.019	A-4a
B-004-0-22	5.5 – 7.0	569.6 – 568.1	0.019	A-4a

6.0 ANALYSIS AND RECOMMENDATIONS

Based upon the findings of the field exploration program, laboratory testing, and subsequent engineering analysis, the following sections have been prepared to address the geotechnical aspects related to investigating the option to reuse the strip footing foundations of the existing Bridge. Existing strip footings will be evaluated to verify that it will safely transfer the design loads from new bridge loadings to underlying soils or bedrock. Design information provided by CT personnel indicates that the existing superstructure and substructure units; abutments and piers are to be removed and replaced. The width and length of existing strip footing is 4.3 feet and 59.0 feet, respectively at the rear abutment. The width and length of existing strip footing is 4.3 feet and 57.0 feet, respectively at the forward abutment. The width and length of existing strip footing size is 4.0 feet and 44.0 feet at both Piers C & D. The abutment external stability checks will be performed by CT personnel to provide effective width of strip footings at the rear and forward abutments in order to calculate soil bearing capacities by PGI. The proposed vertical and horizontal alignments of this section the SR 283 including bridge will be more or less similar to existing. Soil Parameters for the existing bridge abutment and pier foundations are provided in accordance with the ODOT *Bridge Design Manual* issued in 2004 using Allowable Stress Design (ASD) method. The foundation recommendations for the proposed bridge are provided in accordance with the ODOT *Bridge Design Manual* issued in 2020 and using *AASHTO LRFD Bridge Design Specifications, Latest Edition.*

6.1 Bridge Foundation Systems

Existing Bridge Foundation: Soil and rock information obtained from these bridge test borings was used to estimate the soil/rock parameters for the existing and proposed bridge foundations. As outlined in Section 5.2 - "Subsurface Soil Conditions" for bridge, the subsurface soils encountered above bedrock are predominantly cohesive in nature and consisted of fill and natural soils. Natural soils were encountered

below approximate elevations ranging from 567.7 feet to 573.9 feet. Bedrock was encountered at approximate elevations ranging from 555.1 and 558.6 feet.

Bearing capacity analysis was performed by using effective stress parameters for granular soils and un-drained strength soil parameters for cohesive soils to estimate the ultimate bearing capacity of the continuous footings. A Factor of Safety of 2.5 was used to calculate the maximum allowable bearing capacity from the ultimate bearing capacity. The groundwater level was assumed to be at the bottom of the footing. Bearing capacity analysis calculation spreadsheets are included in the Appendix. Tables 6.1.1 and 6.1.2 summarize the maximum allowable bearing capacity below bearing elevations of existing abutments and Piers locations, respectively. The abutment strip footing may experience horizontal movement between the interface of footing and the soil. The friction resistance between a concrete footing and a cohesionless soil may be taken as the vertical pressure on the base times the coefficient of friction "f" of concrete on soil. For the soils consisting of gravel and rock fragments with sand (A-1-b), the coefficient of friction "f" can be assumed to be 0.45. If the footings bear on clay, the resistance against sliding shall be based upon the cohesion of the clay, which may be taken as one-half the provided unconfined compressive strength, however, the frictional resistance against sliding should not be considered to be greater than that obtained using the coefficient "f" of 0.35. Settlement of the existing footings at the abutment and pier locations were already occurred for the current applied design load due to consolidation of cohesive soils. It is expected that the existing abutment and pier footings will incur some additional settlement if proposed applied loads from new bridge loading are greater than current applied design loads. If that is the case, Please provide the additional design pressure to be applied to the foundation soils at each substructure unit to estimate the additional settlement,

Table 6.1.1– Summary of Soil Bearing Capacities for Existing Bridge Abutment Footings

Boring No.	Substructure Location	Effective Footing Width of Continuous Footing (feet)	Bearing Elevation (feet)	Allowable Bearing Capacity (ksf)
B-002-0-22	Rear AB	4.0	570.9	3.0
B-005-0-22	Forward AB	4.0	570.1	4.0

Table 6.1.2– Summary of Soil Bearing Capacities for Existing Bridge Pier Footings

Boring No.	Substructure Location	Footing Width of Continuous Footing (feet)	Bearing Elevation (feet)	Allowable Bearing Capacity (ksf)
B-004-0-22	Pier C	4.0	570.1	6.0
B-004-0-22	Pier D	4.0	570.1	6.0

Proposed Bridge Foundation**:** If existing bridge is completely replaced, shallow foundation system consisting of strip footing may be used to transfer the loads to the underlying hard soils at the proposed abutment and pier locations. Bearing resistance for strip footings on soils was evaluated as per AASHTO Article 10.6.3.2.2 (semi-empirical method). For these bearing resistance calculations, the width of strip footing at the abutment and pier locations were assumed as existing footings. The bearing resistance calculation spreadsheets are included in the Appendix. Table 6.1.3 and 6.1.4 summarize the factored bearing resistance on soils below bearing elevation at abutment and pier locations so that CT personnel can evaluate or compare the factored bearing resistance to the factored bearing pressure. Settlement analyses will be performed once the design factored at the Service Limit is finalized at each substructure and provide the information to PGI. A Resistance Factor (ϕ) of 0.45 should be applied to compute the Factored Bearing Resistance at the Strength Limit State. A Resistance Factor (ϕ) of 1.0 should be used to compute the Factored Bearing Resistance at the Service Limit State.

Table 6.1.3– Estimated Design Parameters for Proposed Abutment Footings

Boring No.	Substructure Location	Effective Footing Width of Continuous Footing (feet)	Bearing Elevation (feet)	Factored Bearing Resistance (ksf)
B-002-0-22	Rear AB	4.0	570.9	3.0
B-005-0-22	Forward AB	4.0	570.1	4.0

Table 6.1.4– Estimated Design Parameters for Proposed Pier Footings

Boring No.	Substructure Location	Footing Width of Continuous Footing (feet)	Bearing Elevation (feet)	Factored Bearing Resistance (ksf)
B-003-0-22	Pier C	4.0	570.1	7.5
B-004-0-22	Pier D	4.0	570.1	7.5

In order to analyze nominal sliding resistance between the interface of the footings and the soils, an undrained Shear Strength of 2000 psf may be assumed for clay cohesion at forward abutment and pier locations. In order to analyze nominal sliding resistance between the interface of the footings and the granular soils, a friction angle of 30 degrees is estimated for the engineered granular soils at rear abutment location. A resistance factor (ϕ) of 1.00 (per AASHTO Table 11.5.7-1) should be applied to compute factored sliding resistance for cast-in-place footings when checking for sliding at the Strength Limit State.

Since the abutments foundations will be placed on relatively level area, global stability of the footing is not a concern.

Abutment and Pier footings must be placed below the scour depths. The excavated footing subgrades should be examined by competent geotechnical personnel. If any highly compressible fill materials and/or areas of low bearing capacity with excessive moisture (soft pockets) are encountered, they should be removed as directed by geotechnical personnel. All footings must be placed at least 3.5 feet below the proposed finished outside grade elevation to be protected against frost penetration and heave. In order to minimize the effects of any slight differential movement that may occur due to variations in the character of the supporting soils and any variations in seasonal moisture contents, it is recommended that all footings be suitably reinforced to make them as rigid as possible.

Temporary Retaining Walls: Design information provided by CT personnel indicates that Temporary Retaining Walls are required to perform stage construction. Soldier Piles with Lagging Wall System will be used to retain the soils at the rear and forward abutment locations. Soil information obtained from test borings B-002-0-22 and B-005-0-22 was used to design the foundation system for these walls. The maximum wall height of the retaining wall will be approximately 10.0 feet. A soldier pile consisting of H-pile will be installed into a pre-drilled hole with concrete placed around it. HP-10X42 or smaller size may be selected for this purpose. Lagging may be pre-cast concrete or wood panels set in the pile flanges. The size of the holes should be selected in such a way that clearance should be a minimum of 3 inches all around the H-pile. It is assumed that the bottom grade elevation in front retaining wall will be approximately at 575 feet. As outlined in Section 5.2, hard soils and bedrock were encountered to the termination depths in both test boring locations. Therefore, the soldier piles may be installed into soils with the consistency of "hard" or socket in to bedrock.

The soldier pile walls must be designed to resist lateral pressures exerted by the retained soils and traffic loads. Embedment depth of soldier piles into soils must be determined from retaining wall design. The soldier pile wall may experience horizontal movement caused by lateral earth pressure from the retained fills. A lateral load analysis should be performed for selected shaft diameter and embedment length to check whether maximum deflection on top of the wall will be less than one inch. This maximum deflection value is based on the assumption that no structure is to be supported on top of retaining wall. Tables 6.1.5 and 6.1.6 summarize the soil and rock parameters, respectively to perform lateral load analyses by CT using LPILE computer software by Ensoft or other comparable pile lateral load analysis software.

Table 6.1.5 – Estimated Soil Parameters for Lateral Load Analysis

Depth Below Channel Bottom EL. 575.0 (±)	Bulk Unit Weight (γ, pcf)	Submerged Unit Weight (γ', pcf)	Angle of Internal Friction (degrees)	Undrained Shear Strength (psf)	Soil Modulus (k) (pci)	Soil Strain (E50 for clays)
Boring B-002-0-22						
7.9 to 9.0	120	57.6	--	750	--	0.01
9.0 to 16.5	125	62.6	30	--	20	--
16.5 to 23.5	135	72.6	--	4000	--	0.005
23.5 to 27.5	140	77.6	--	6000	--	0.004
Boring B-005-0-22						
8.6 to 11.0	120	57.6	--	500	--	0.01
11.0 to 13.5	120	57.6	28	--	10	--
13.5 to 15.5	120	57.6	--	2000	--	0.007
15.5 to 23.5	135	72.6	--	4000	--	0.005
23.5 to 28.5	140	77.6	--	6000	--	0.004

Note: Groundwater Table was assumed at elevation 575.0 feet.

Table 6.1.6 - Estimated Weak Rock Parameters for Lateral Load Analyses

Boring No.	Top Bedrock Elevation(ft)	Unit Weight (pci)	E_i Modulus (psi)	E_m Modulus (psi)	Compressive Strength (psi)	RQD (%)	K_rm
B-002-0-22	555.4±	0.093	100,000	8,000	400	64	0.00007
B-005-0-22	555.1±	0.091	180,000	16,000	2000	55	0.00007

6.2 Lateral Earth Pressures and Abutment Drainage

The bridge abutments must be designed to resist lateral pressures exerted by both dead and live loads. The active lateral earth pressures exerted behind the bridge abutments may be approximated by an equivalent fluid weighing 40 pcf above the water table and 80 pcf below the water table; provided that level ground exists behind the abutments and that no surcharge loads are placed behind the walls. Freely draining material must be placed behind the wingwalls in accordance with ODOT Item 518 - “Drainage of Structures”. The porous backfill should be placed a minimum of two (2) feet in thickness normal to these walls. It is suggested that filter fabric, ODOT Item 712.09, Type A, be placed between Item 518 porous backfill material and Item 203 embankment material. This will ensure that fine particles do not migrate into the voids of the porous backfill.

6.3 Pavement Design Parameters

The soil information obtained from the four (4) test borings; B-001-0-22, B-002-0-22, and B-005-0-22 and B-006-0-22 were used to obtain pavement design parameters. The subgrade analysis was performed in accordance with *Geotechnical Bulletin-GB1* from ODOT released January 15, 2021. All laboratory test data obtained from the test borings was entered into the ODOT *GB1 Subgrade Analysis* spreadsheet Version 14.5 dated 1/18/2019. Based on the analysis, the following conclusions are presented. An average Group Index was obtained from the ODOT *GB1 Subgrade Analysis.* This Average Group Index is based on the soils encountered within a depth of approximately 6.0 feet below the proposed bottom of pavement. The Design CBR value was obtained by correlating the Group Index on the chart illustrated in Figure 203-2 of the ODOT Pavement Design Manual, issued 2008. The Resilient Modulus was calculated using the relationship to the CBR shown in Figure 203-2 of the ODOT Pavement Design Manual, issued 2008. The pavement design parameter information is summarized in Table 6.3.1.

Table 6.3.1 – Summary of Pavement Design Parameters

Parameter	Value
Average N_{60L}	6
Average PI	8
Average Group Index	6
Average CBR	7
Resilient Modulus (M_R, psi)	8,400

Appropriate drainage systems, such as edge drains or underdrains are strongly recommended to minimize subgrade weakening resulting from excessive moisture penetration. All drain pipes should be installed in accordance with ODOT's "Construction and Materials Specifications," Item 605 - "Underdrains" issued January 1, 2019.

6.4 Groundwater Management

Groundwater was encountered in all roadway and bridge test boring locations with the exception of B-006-0-22. Groundwater was measured at approximate depths ranging from 5.5 feet to 13.5 feet below the pavement, existing ground, or bridge deck surface during drilling operations. If structure foundation excavations extend below the water level encountered in bridge test boring locations, water infiltration is

anticipated in the proposed excavations. Therefore, low to moderate volume pumping or dewatering may be required during excavation of structure foundations. Please note that the groundwater levels may vary due to seasonal fluctuations and groundwater may appear during excavation where it was not previously encountered.

6.5 Earthwork and Construction Monitoring

Unsuitable soil classified as silt (A-4b) was encountered in test borings in test borings B-001-0-22, B-002-0-22, B-005-0-22 at depths ranging from 6.0 feet to 11.0 feet. Due to the susceptibility of silt soils to frost penetration and heave, the removal of the silt soil is required to a depth of three (3) feet below the bottom of proposed subgrade if pavement is to be replaced to full depth. Table 6.5.1 summarizes the boring numbers, depth of excavation below the proposed subgrade, and the station limits of recommended depth of excavation. All excavated soils must be replaced with select Granular Material Type B, underlain by Item 204 geotextile fabric. All lateral limits for excavation should be 18 inches beyond edge of pavement. Adjustment of depth and limits may be necessary during construction. The proof rolling or test rolling must be performed under the supervision of the field engineer to determine the yielding subgrade areas.

Table 6.5.1 – Summary of Excavation Limits for Unsuitable Soils

Roadway Approach	Boring No.	Excavation Depth Below subgrade (feet)	Approximate Station Limits	Problem
West Side	B-001/B-002	3.0	166+00 to 166+70	Silt (A-4b)
East Side Existing	B-005	3.0	167+22 to 167+60	Silt (A-4b)

All excavation and backfilling operations against the proposed structure walls should be conducted in accordance with ODOT's "Construction and Materials Specifications," Item 503 - "Excavation for Structures" issued in January 2019 and under the supervision of competent geotechnical personnel. All excavations should comply with all current and applicable local, state, and federal safety codes, regulations and practices, including the Occupational Safety and Health Administration (OSHA). If proposed cut slopes for the structure foundation are to be exposed for an extended period of time, they must be constructed using a two (2) horizontal to one (1) vertical slope for excavation above the water table and a three (3) horizontal to one (1) vertical slope for excavation below the water table or in granular soils. Soil excavations are expected during construction of the project. Prior to any backfill placement against the proposed structure walls, exposed subgrade should be subjected to inspection under

the direction of competent geotechnical personnel. Any areas that exhibit local soft/loose soil zones and areas of unacceptable material must be undercut to a minimum depth of two (2) feet below the elevation of the soil being inspected. All removed soils should be replaced with compacted, engineered fill materials.

All fill material must be approved by a qualified geotechnical engineer prior to placement. The fill materials should be placed in lifts of eight (8) inches in thickness (loose measure) and be compacted to an unyielding condition in accordance with ODOT 203.07 “Compaction and Moisture Requirements” specifications. The top 12 inches of the fill in pavement subgrade areas should be placed in lifts of eight (8) inches in thickness (loose measure) and be compacted to an unyielding condition in accordance with ODOT 204.03 “Compaction of the Subgrade” specifications. All in-place density tests should be performed as per Supplement 1015 “Compaction Testing of Unbound Materials” during earthwork construction. All earthwork operations should be conducted in accordance with ODOT *Construction and Material Specifications*, Item 203, issued 2019.

7.0 LIMITATIONS

This report is subject to the following conditions and limitations:

7.1 The subsurface conditions described are based on an examination of the soil and rock samples at the sampling intervals. Varying soil deposits, including fill material, may exist between the sampling intervals and between or beyond the test boring locations. Variation in subsurface conditions from those indicated in this report may become apparent during the earthwork and/or installation of the foundations. Such variations may require changes and/or modifications in our recommendations. Such changes may cause time delays and/or additional costs. Owners must be made aware of these limitations and must incorporate them in the design budget and scheduling of the project.

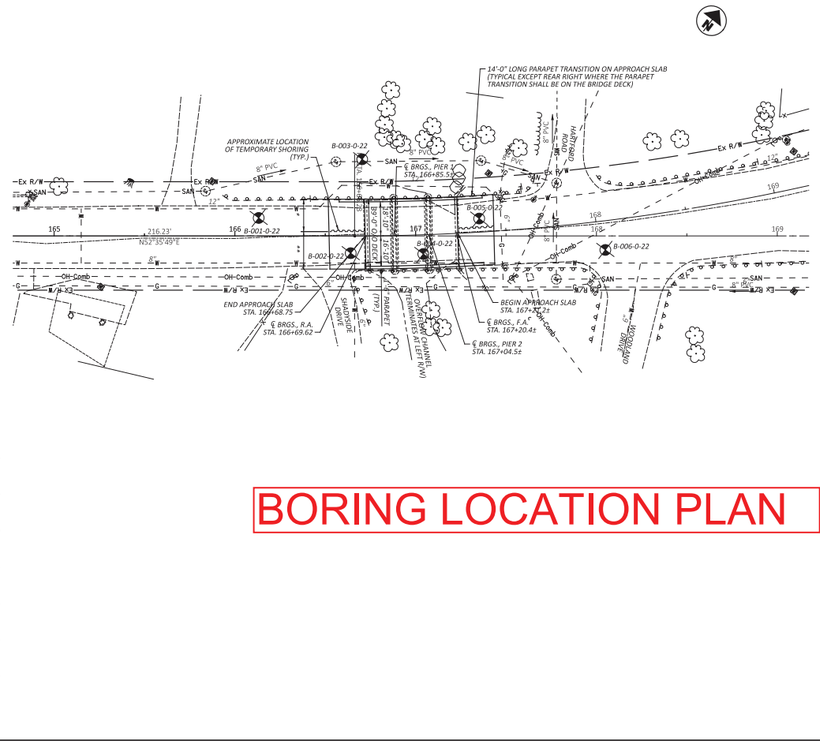
7.2 The design of the proposed project does not vary from the technical information provided and specified in this report. All changes in the design must be reviewed by our geotechnical engineers. PGI cannot assume any responsibility for interpretations made by others of the subsurface conditions and their behavior based on this report.

7.3 All earthwork and foundation construction must be performed under the supervision of a Professional Engineer in accordance with ODOT Construction Specifications.

7.4 The subsurface exploration for this project is strictly from a geotechnical standpoint. An environmental site assessment was not included in the scope of these geotechnical services.

7.5 All sheeting, shoring, and bracing of trenches, pits and excavations should be made the responsibility of the contractor and should comply with all current and applicable local, state and federal safety codes, regulations and practices, including the Occupational Safety and Health Administration (OSHA).

APPENDIX



BORING LOCATION PLAN

PROJECT: LAK-283-4.58	DRILLING FIRM / OPERATOR: OTB / OTB	DRILL RIG: MOBILE B-57 (TRUCK)/2	STATION / OFFSET: 166+13, 10' LT.
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: PGI / COREY	HAMMER: SAFETY HAMMER	ALIGNMENT: SR 283 BASELINE
PID: 110807 STR ID: LAK-283-4.58	DRILLING METHOD: 2.25" HSA	CALIBRATION DATE: 11/1/20	ELEVATION: 582.0 (MSL) EOB: 10.0 ft.
START: 3/29/22 END: 3/29/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 98.6	COORD: 41.666873, -81.425637

EXPLORATION ID B-001-0-22 — PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 582.0	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 PAVEMENT (11.0" IN THICKNESS)	581.1																	
CONCRETE (3.5" IN THICKNESS)	580.8																	
VERY SOFT TO STIFF, BROWN, **SILT**, LITTLE TO SOME SAND, LITTLE TO SOME CLAY, FILL, MOIST TO DAMP		1	2 2	7	100	SS-1	1.50	0	1	13	67	19	27	18	9	23	A-4b (8)	
@3.5'; NO SPILT SPOON RECOVERY AND AUGER SAMPLE WAS OBTAINED. @3.5'; STIFF, SOME CLAY, SOME SAND, TRACE STONE FRAGMENTS, DAMP	576.0	2 3 4 5 W	5 3 2	8	0	SS-2	-	2	2	20	55	21	26	18	8	15	A-4b (8)	
LOOSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE FINES, WET		6 7	3 3 3	10	39	SS-3	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
	572.0	8 9 EOB 10	2 2 3	8	100	SS-4	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	

NOTES: GROUNDWATER WAS ENCOUNTERED AT 5.5' DURING DRILLING AND AT 7.2' UPON COMPLETION OF DRILLING OPERATIONS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PAVEMENT WAS REPLACED WITH 0.5 BAG ASPHALT COLD PATCH; BACKFILLED WITH 0.5 BAG BENTONITE PELLETS/SOIL CUTTINGS MIXTURE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/27/22 14:16 - C:\GINT PROJECT FOLDER\G2202G GINT (4).GPJ

PROJECT: LAK-283-4.58 | DRILLING FIRM / OPERATOR: OTB / OTB | DRILL RIG: MOBILE B-57 (TRUCK)/2 | STATION / OFFSET: 166+64, 10' RT. | EXPLORATION ID B-002-0-22

TYPE: BRIDGE REPLACEMENT | SAMPLING FIRM / LOGGER: PGI / COREY | HAMMER: SAFETY HAMMER | ALIGNMENT: SR 283 BASELINE

PID: 110807 STR ID: LAK-283-4.58 | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 11/1/20 | ELEVATION: 582.9 (MSL) EOB: 39.0 ft. | PAGE 1 OF 2

START: 3/24/22 END: 3/24/22 | SAMPLING METHOD: SPT / NQ | ENERGY RATIO (%): 98.6 | COORD: 41.666914, -81.425445

MATERIAL DESCRIPTION AND NOTES	ELEV. 582.9	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 PAVEMENT (7.0" IN THICKNESS)	582.3																	
CONCRETE (4.0" IN THICKNESS)	582.0																	
STIFF TO VERY SOFT, BROWN, **SILT**, SOME SAND, SOME TO LITTLE CLAY, TRACE STONE FRAGMENTS, FILL, MOIST TO WET			2 2 3	8	67	SS-1	-	1	2	20	56	21	26	18	8	19	A-4b (8)	
@3.5'; LITTLE CLAY			2 1 1	3	100	SS-2	1.50	2	4	27	52	15	26	18	8	20	A-4b (6)	
@6.0'; VERY SOFT, LITTLE CLAY			1 1 2	5	100	SS-3	-	-	-	-	-	-	-	-	-	29	A-4b (V)	
	573.9 W		1 1 3	7	78	SS-4	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
LOOSE TO MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE FINES, WET																		
@13.5'; MEDIUM DENSE			6 5 4	15	56	SS-5	-	38	30	19	10	3	NP	NP	NP	13	A-1-b (0)	
	566.4																	
HARD, GRAY, **SANDY SILT**, LITTLE CLAY, LITTLE STONE FRAGMENTS, TILL, DAMP			7 11 12	38	100	SS-6	4.5+	13	27	17	27	16	22	14	8	10	A-4a (2)	
	559.4																	
HARD, GRAY, **SANDY SILT**, LITTLE CLAY, LITTLE SHALE FRAGMENTS, DAMP			8 15 15	49	100	SS-7	-	-	-	-	-	-	-	-	-	8	A-4a (V)	
	555.4 TR																	
SHALE, GRAY, HIGHLY WEATHERED, WEAK TO SLIGHTLY STRONG. NOTE: AUGERED TO 29.0' AND STARTED CORING BEDROCK.	553.9		50/4"	-	100	SS-8	-	-	-	-	-	-	-	-	-	6	Rock (V)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/27/22 14:16 - C:\GINT PROJECT FOLDER\G2002G GINT (4).GPJ

PID: 110807 | STR ID: LAK-283-4.58 | PROJECT: LAK-283-4.58 | STATION / OFFSET: 166+64, 10' RT. | START: 3/24/22 | END: 3/24/22 | PG 2 OF 2 | B-002-0-22

MATERIAL DESCRIPTION AND NOTES	ELEV. 552.9	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
SHALE, GRAY, MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO MODERATELY FRACTURED, SLIGHTLY ROUGH, TIGHT APERTURE WIDTH. *(continued)* @30.1'; COMPRESSIVE STRENGTH OF INTACT ROCK = 593 PSI	548.9		55		95	NQ-1											CORE	
SHALE, GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THIN BEDDED, MODERATELY TO SLIGHTLY FRACTURED, SLIGHTLY ROUGH, TIGHT APERTURE WIDTH. @36.3'; COMPRESSIVE STRENGTH OF INTACT ROCK = 389 PSI	543.9	EOB	73		98	NQ-2											CORE	

NOTES: GROUNDWATER WAS ENCOUNTERED AT 9.0' DURING DRILLING AND NO WATER READING WAS TAKEN UPON COMPLETION BECAUSE WATER WAS USED FOR ROCK CORING OPERATIONS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PAVEMENT WAS REPLACED WITH 0.5 BAG ASPHALT COLD PATCH; BACKFILLED WITH 0.5 BAG BENTONITE PELLETS/SOIL CUTTINGS MIXTURE

PROJECT: LAK-283-4.58	DRILLING FIRM / OPERATOR: OTB / OTB	DRILL RIG: DIEDRICH D-50 TRACKED ATV	STATION / OFFSET: 166+70, 42' LT.	EXPLORATION ID B-003-0-22
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: PGI / JOHN	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 283 BASELINE	
PID: 110807 STR ID: LAK-283-4.58	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 11/1/20	ELEVATION: 578.2 (MSL) EOB: 35.0 ft.	PAGE 1 OF 2
START: 4/8/22 END: 4/8/22	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 82	COORD: 41.667039, -81.425540	

MATERIAL DESCRIPTION AND NOTES	ELEV. 578.2	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
TOPSOIL (14.5" IN THICKNESS)	577.0																	
STIFF, BROWN, **SILT**, SOME CLAY, LITTLE SAND, TRACE STONE FRAGMENTS, FILL, MOIST TO WET	573.2		2 3 4	10	89	SS-1	1.50	-	-	-	-	-	-	-	-	18	A-4b (V)	
STIFF, BROWN, **SANDY SILT**, SOME STONE FRAGMENTS, LITTLE CLAY, FILL, MOIST	571.7	W	2 1 1	3	44	SS-2	-	-	-	-	-	-	-	-	-	24	A-4b (V)	
LOOSE, GRAY, **STONE FRAGMENTS**, BACKFILL, WET	570.0		1 1 1	3	28	SS-3	1.50	26	18	16	27	13	29	19	10	20	A-4a (1)	
VERY SOFT, GRAY, **SANDY SILT**, LITTLE STONE FRAGMENTS, LITTLE CLAY, FILL, WET	567.7		2 3 2	7	28	SS-4	-	-	-	-	-	-	-	-	-	4	A-1-a (V)	
HARD, GRAY, **SANDY SILT**, SOME CLAY, LITTLE STONE FRAGMENTS, TILL, DAMP	559.7		1 0 0 0	0	42	SS-5	-	-	-	-	-	-	-	-	-	19	A-4a (V)	
HARD, GRAY, **SANDY SILT**, SOME CLAY, LITTLE SHALE FRAGMENTS, DAMP	557.4		4 7 9	22	56	SS-6	4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
SHALE, GRAY, HIGHLY WEATHERED, WEAK TO MODERATELY STRONG. NOTE: AUGERED TO 25.0' AND STARTED CORING BEDROCK.	553.2	TR	8 10 13	31	100	SS-7	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	
SHALE, GRAY, MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO SLIGHTLY FRACTURED, SLIGHTLY ROUGH, TIGHT APERTURE WIDTH. @28.2'; COMPRESSIVE STRENGTH OF INTACT ROCK = 2722 PSI			17 13 17	41	100	SS-8	4.5+	13	12	16	32	27	23	13	10	11	A-4a (5)	
			9 11 11	30	100	SS-9	4.5+	21	20	12	29	18	28	18	10	12	A-4a (2)	
			50/3"	-	100	SS-10	-	-	-	-	-	-	-	-	-	7	Rock (V)	
			50/4"	-	100	SS-11	-	-	-	-	-	-	-	-	-	8	Rock (V)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/27/22 14:16 - C:\GINT PROJECT FOLDER\G2202G GINT (4).GPJ

PID: 110807	STR ID: LAK-283-4.58	PROJECT: LAK-283-4.58	STATION / OFFSET: 166+70, 42' LT.	START: 4/8/22	END: 4/8/22	PG 2 OF 2	B-003-0-22

MATERIAL DESCRIPTION AND NOTES	ELEV. 548.2	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
SHALE, GRAY, MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO SLIGHTLY FRACTURED, SLIGHTLY ROUGH, TIGHT APERTURE WIDTH. *(continued)* @33.9'; COMPRESSIVE STRENGTH OF INTACT ROCK = 2255 PSI	543.2	EOB	72		99	NQ-1											CORE	

NOTES: GROUNDWATER WAS ENCOUNTERED AT 3.5' DURING DRILLING AND NO WATER READING WAS TAKEN UPON COMPLETION BECAUSE WATER WAS USED FOR ROCK CORING OPERATIONS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PAVEMENT WAS REPLACED WITH 0.5 BAG ASPHALT COLD PATCH; BACKFILLED WITH 0.5 BAG BENTONITE PELLETS/SOIL CUTTINGS MIXTURE

PROJECT: LAK-283-4.58 | DRILLING FIRM / OPERATOR: OTB / OTB | DRILL RIG: MOBILE B-57 (TRUCK)/2 | STATION / OFFSET: 167+04, 10' RT. | EXPLORATION ID B-004-0-22

TYPE: BRIDGE REPLACEMENT | SAMPLING FIRM / LOGGER: PGI / COREY | HAMMER: SAFETY HAMMER | ALIGNMENT: SR 283 BASELINE

PID: 110807 STR ID: LAK-283-4.58 | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 11/1/20 | ELEVATION: 575.1 (MSL) EOB: 29.0 ft. | PAGE 1 OF 1

START: 3/28/22 END: 3/28/22 | SAMPLING METHOD: SPT / NQ | ENERGY RATIO (%): 98.6 | COORD: 41.666979, -81.425326

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
LOOSE, DARK GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, RIVER MUG, WET			1 2 3	8	67	SS-1	-	49	21	9	11	10	31	18	13	22	A-2-6 (0)	
NOTE: ADVANCED THROUGH BRIDGE DECK, ASPHALT PAVEMENT (11.0" IN THICKNESS) AND CONCRETE DECK (12.0" IN THICKNESS)	572.1		3 4 4	13	0	SS-2	-	0	0	0	-	-	NP	NP	NP	5	A-1-a (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS**, FILL, WET	571.1		3 5 7	20	67	SS-3	4.00	9	11	14	39	27	24	14	10	13	A-4a (6)	
VERY STIFF TO HARD, GRAY, **SANDY SILT**, SOME CLAY, TRACE TO LITTLE STONE FRAGMENTS, DAMP			5 7 9	26	100	SS-4	4.5+	13	10	13	36	28	24	15	9	12	A-4a (6)	
@5.5'; HARD																		
@8.5'; DENSE TO LOOSE			8 10 12	36	100	SS-5	4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
HARD, GRAY, **SANDY SILT**, SOME SHALE FRAGMENTS, LITTLE CLAY, DAMP	564.1		9 13 16	48	100	SS-6	4.5+	23	16	16	28	17	19	12	7	11	A-4a (2)	
			10 10 24	56	100	SS-7	-	-	-	-	-	-	-	-	-	9	A-4a (V)	
SHALE, GRAY, HIGHLY WEATHERED, VERY WEAK TO WEAK. NOTE: AUGERED TO 19.0' AND STARTED CORING BEDROCK.	558.6	TR	50/3"	-	100	SS-8	-	-	-	-	-	-	-	-	-	9	Rock (V)	
SHALE, GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO SLIGHTLY FRACTURED, SLIGHTLY ROUGH, TIGHT APERTURE WIDTH. @21.7'; COMPRESSIVE STRENGTH OF INTACT ROCK = 3256 PSI	556.1		68		96	NQ-1											CORE	
@27.8'; COMPRESSIVE STRENGTH OF INTACT ROCK = 3395 PSI	546.1	EOB																

NOTES: GROUNDWATER WAS MEASURED AT 0.75' ABOVE GROUND BEFORE DRILLING AND NO WATER READING WAS TAKEN UPON COMPLETION BECAUSE WATER WAS USED FOR ROCK CORING OPERATIONS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PAVEMENT WAS REPLACED WITH 0.5 BAG ASPHALT COLD PATCH; BACKFILLED WITH 0.5 BAG BENTONITE PELLETS/SOIL CUTTINGS MIXTURE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT GDT - 5/27/22 14:17 - C:\GINT PROJECT FOLDER\G2002G GINT (4).GPJ

PROJECT: LAK-283-4.58 | DRILLING FIRM / OPERATOR: OTB / OTB | DRILL RIG: MOBILE B-57 (TRUCK)/2 | STATION / OFFSET: 167+35, 10' LT. | EXPLORATION ID B-005-0-22

TYPE: BRIDGE REPLACEMENT | SAMPLING FIRM / LOGGER: PGI / COREY | HAMMER: SAFETY HAMMER | ALIGNMENT: SR 283 BASELINE

PID: 110807 STR ID: LAK-283-4.58 | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 11/1/20 | ELEVATION: 583.6 (MSL) EOB: 39.0 ft. | PAGE 1 OF 2

START: 3/25/22 END: 3/25/22 | SAMPLING METHOD: SPT / NQ | ENERGY RATIO (%): 98.6 | COORD: 41.667073, -81.425278

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT PAVEMENT (10.0" IN THICKNESS)	582.8																	
CONCRETE (8.0" IN THICKNESS)	582.1																	
STIFF TO VERY SOFT, BROWN, **SILT**, LITTLE TO SOME CLAY, LITTLE SAND, FILL, MOIST TO WET			2 2 2	7	89	SS-1	1.50	1	1	19	60	19	25	18	7	20	A-4b (8)	
@3.5'; MEDIUM STIFF			1 1 2	5	100	SS-2	1.00	0	1	12	66	21	30	19	11	17	A-4b (V)	
@6.0'; VERY SOFT, WET			1 1 1	3	100	SS-3	0.50	-	-	-	-	-	-	-	-	32	A-4b (V)	
@8.5'; VERY SOFT, WET	572.6		1 1 1	3	100	SS-4	-	-	-	-	-	-	-	-	-	27	A-4b (V)	
LOOSE, BROWN, **COARSE AND FINE SAND**, SOME FINES, TRACE STONE FRAFMENTS, WET	570.1	W	1 1 1	3	100	SS-5	-	4	39	29	21	7	NP	NP	NP	25	A-3a (0)	
VERY STIFF TO HARD, GRAY, **SANDY SILT**, SOME CLAY, TRACE STONE FRAGMENTS, MOIST TO DAMP			2 2 3	8	89	SS-6	2.50	-	-	-	-	-	-	-	-	14	A-4a (V)	
@16.0'; HARD, TILL, DAMP			5 9 10	31	100	SS-7	4.5+	10	11	15	39	25	24	14	10	12	A-4a (6)	
@18.5'; HARD, TILL, DAMP	560.1		5 7 10	28	100	SS-8	4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
HARD, GRAY, **SANDY SILT**, SOME SHALE FRAGMENTS, LITTLE CLAY, DAMP	555.1		9 13 15	46	100	SS-9	-	23	20	17	28	12	22	15	7	9	A-4a (1)	
SHALE, GRAY, HIGHLY WEATHERED, WEAK TO MODERATELY STRONG.	554.6	TR	50/4"	-	125	SS-10	-	-	-	-	-	-	-	-	-	5	Rock (V)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT GDT - 5/27/22 14:17 - C:\GINT PROJECT FOLDER\G2002G GINT (4).GPJ

PID: 110807	STR ID: LAK-283-4.58	PROJECT: LAK-283-4.58	STATION / OFFSET: 167+35, 10' LT.	START: 3/25/22	END: 3/25/22	PG 2 OF 2	B-005-0-22

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
NOTE: AUGERED TO 29.0' AND STARTED CORING BEDROCK. **SHALE**, GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO SLIGHTLY FRACTURED, SLIGHTLY ROUGH, TIGHT APERTURE WIDTH. *(continued)* @32.6'; COMPRESSIVE STRENGTH OF INTACT ROCK = 3412 PSI @37.3'; COMPRESSIVE STRENGTH OF INTACT ROCK = 3171 PSI	553.6	31 32 33 34 35 36 37 38 39	55		95	NQ-1											CORE	
	544.6	EOB																

NOTES: GROUNDWATER WAS ENCOUNTERED AT 13.5' DURING DRILLING AND NO WATER READING WAS TAKEN UPON COMPLETION BECAUSE WATER WAS USED FOR ROCK CORING OPERATIONS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PAVEMENT WAS REPLACED WITH 0.5 BAG ASPHALT COLD PATCH; BACKFILLED WITH 0.5 BAG BENTONITE PELLETS/SOIL CUTTINGS MIXTURE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/27/22 14:17 - C:\GINT PROJECT FOLDER\G2202G GINT (4).GPJ

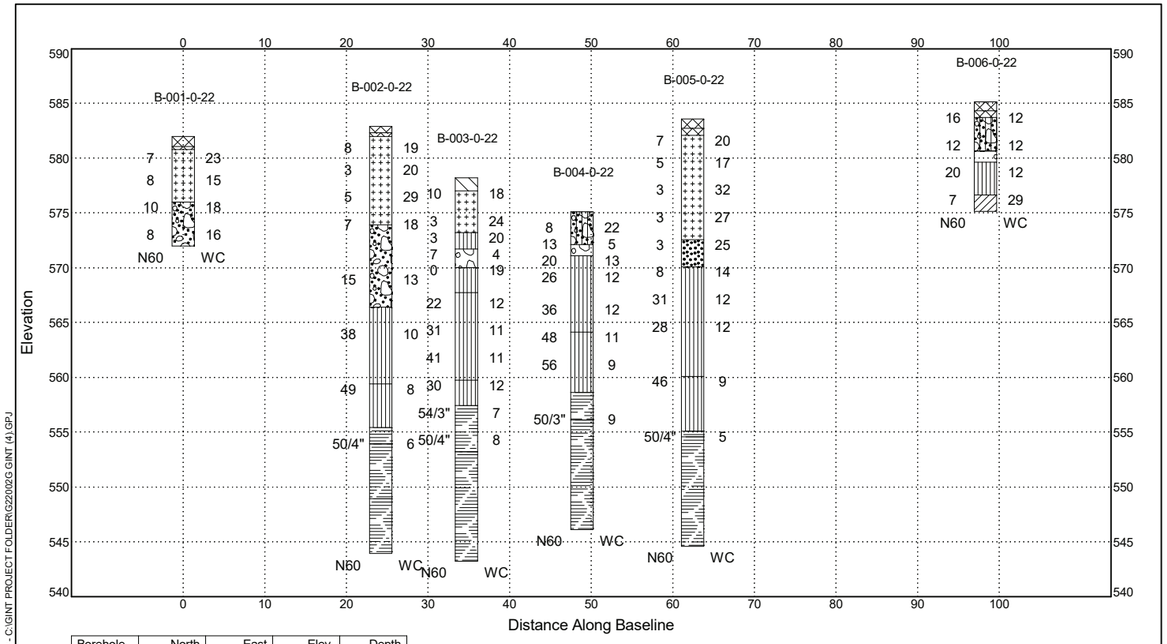
PROJECT: LAK-283-4.58	DRILLING FIRM / OPERATOR: OTB / OTB	DRILL RIG: MOBILE B-57 (TRUCK)/2	STATION / OFFSET: 168+05, 6' RT.	EXPLORATION ID B-006-0-22
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: PGI / COREY	HAMMER: SAFETY HAMMER	ALIGNMENT: SR 283 BASELINE	
PID: 110807 STR ID: LAK-283-4.58	DRILLING METHOD: 2.25" SSA	CALIBRATION DATE: 11/1/20	ELEVATION: 585.2 (MSL) EOB: 10.0 ft.	PAGE 1 OF 1
START: 3/29/22 END: 3/29/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 98.6	COORD: 41.667149, -81.425035	

MATERIAL DESCRIPTION AND NOTES	ELEV. 585.2	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 PAVEMENT (10.0" IN THICKNESS)	584.3																	
ROADBASE: LIMESTONE FRAGMENTS (7.0" IN THICKNESS)	583.7																	
MEDIUM DENSE, BROWN, **SHALE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, FILL, MOIST	580.7	1 2 3 4 5 6 7 8 9 10	5 6 4	16	100	SS-1	-	33	16	21	23	7	22	17	5	12	A-2-4 (0)	
			3 3 4	12	100	SS-2	-	27	17	29	22	5	NP	NP	NP	12	A-2-4 (0)	
OLD RED BRICK ROAD (FILL)	579.7																	
VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE STONE FRAGMENTS, FILL, DAMP	576.7		6 8 4	20	67	SS-3	4.00	-	-	-	-	-	-	-	-	12	A-4a (V)	
MEDIUM STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE STONE FRAGMENTS, FILL, MOIST	575.2	EOB	1 2 2	7	44	SS-4	1.00	-	-	-	-	-	-	-	-	29	A-6b (V)	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING AND UPON COMPLETION OF DRILLING OPERATIONS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PAVEMENT WAS REPLACED WITH 0.5 BAG ASPHALT COLD PATCH; BACKFILLED WITH 0.5 BAG BENTONITE PELLETS/SOIL CUTTINGS MIXTURE

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/27/22 14:17 - C:\GINT PROJECT FOLDER\G2202G GINT (4).GPJ



Borehole	North	East	Elev.	Depth
B-001-0-22	730541	2262046	582.0	10.0
B-002-0-22	730546	2262099	582.9	39.0
B-003-0-22	730611	2262072	578.2	35.0
B-004-0-22	730591	2262131	575.1	29.0
B-005-0-22	730625	2262144	583.6	39.0
B-006-0-22	730654	2262210	585.2	10.0

DISTANCES:

Beginning	0
Ending	100

VIEWING ANGLES (degrees):

Horizontal	0.0
Vertical	0.0

Position	North	East
Left, Front	365279	1131019
Right, Front	365326	1131107
Left, Back	365279	1131019
Right, Back	365326	1131107

SOIL/ROCK BORINGS PROFILE

LAK-283-4.58

LAKE COUNTY, OHIO

PID #	DATE	PLATE
110807	May 22	1

Boring Number	Sample Number	Depth (ft)	Water Content %	Liquid Limit %	Plastic Limit %	Plast. Index	Specific Gravity	Agg. %	Coarse Sand %	Fine Sand %	Silt %	Silt&Clay Comb. %	Clay %	Soil Description	Class. Symbol
B-001-0-22	SS-1	1.5	23	27	18	9		0	1	13	67	86	19	BROWN SILT, LITTLE CLAY, LITTLE SAND (FILL)	A-4b (8)
B-001-0-22	SS-2	3.5	15	26	18	8		1	2	20	55	76	21	BROWN SILT, SOME CLAY, SOME SAND, TRACE STONE FRAGMENTS (FILL)	A-4b (8)
B-001-0-22	SS-3	6.0	18											BROWN GRAVEL AND STINE FRAGMENTS WITH SAND, LITTLE FINES	A-1-b (V)
B-001-0-22	SS-4	8.5	16											BROWN GRAVEL AND STINE FRAGMENTS WITH SAND, LITTLE FINES	A-1-b (V)
B-002-0-22	SS-1	1.5	19	26	18	8		1	2	20	56	77	21	BROWN SILT, SOME CLAY, SOME SAND, TRACE STONE FRAGMENTS (FILL)	A-4b (8)
B-002-0-22	SS-2	3.5	20	26	18	8		2	4	27	52	67	15	BROWN SILT, SOME SAND, LITTLE CLAY, TRACE STONE FRAGMENTS (FILL)	A-4b (6)
B-002-0-22	SS-3	6.0	29											BROWN SILT, SOME SAND, LITTLE CLAY, TRACE STONE FRAGMENTS (FILL)	A-4b (V)
B-002-0-22	SS-4	8.5	18											BROWN GRAVEL AND STONE FRAGMENTS WITH SILT FILL LAYER	A-1-b (V)
B-002-0-22	SS-5	13.5	13	NP	NP	NP		39	30	19	10	13	3	BROWN GRAVEL AND STONE FRAGMENTS WITH SAND, LITTLE FINES	A-1-b (0)
B-002-0-22	SS-6	18.5	10	22	14	8		13	27	17	26	43	16	GRAY SANDY SILT, LITTLE CLAY, LITTLE STONE FRAGMENTS (TILL)	A-4a (2)
B-002-0-22	SS-7	23.5	8											GRAY SANDY SILT, LITTLE CLAY, SOME SHALE FRAGMENTS	A-4a (V)
B-002-0-22	SS-8	28.5	6											GRAY HIGHLY WEATHERED SHALE	Rock (V)
B-003-0-22	SS-1	1.0	18											BROWN SILT, SOME CLAY, LITTLE SAND, TRACE STONE FRAGMENTS (FILL)	A-4b (V)
B-003-0-22	SS-2	3.5	24											BROWN SILT, SOME CLAY, LITTLE SAND, TRACE STONE FRAGMENTS (FILL)	A-4b (V)
B-003-0-22	SS-3	5.0	20	29	19	10		26	18	16	27	40	13	BROWN SANDY SILT, SOME STONE FRAGMENTS, LITTLE CLAY (FILL)	A-4a (1)
B-003-0-22	SS-4	6.5	4											GRAY STONE FRAGMENTS (BACKFILL)	A-1-a (V)
B-003-0-22	SS-5	8.0	19											GRAY SANDY SILT, LITTLE STONE FRAGMENTS, LITTLE CLAY (FILL)	A-4a (V)
B-003-0-22	SS-6	11.0	12											GRAY SANDY SILT, SOME CLAY, LITTLE STONE FRAGMENTS (TILL)	A-4a (V)
B-003-0-22	SS-7	13.5	11											GRAY SANDY SILT, SOME CLAY, LITTLE STONE FRAGMENTS (TILL)	A-4a (V)
B-003-0-22	SS-8	16.0	11	23	13	10		13	12	16	32	59	27	GRAY SANDY SILT, SOME CLAY, LITTLE STONE FRAGMENTS (TILL)	A-4a (5)
B-003-0-22	SS-9	18.5	12	28	18	10		21	20	12	29	47	18	GRAY SANDY SILT, SOME SHALE FRAGMENTS, LITTLE CLAY	A-4a (2)
B-003-0-22	SS-10	21.0	7											GRAY HIGHLY WEATHERED SHALE	Rock (V)
B-003-0-22	SS-11	23.5	8											GRAY HIGHLY WEATHERED SHALE	Rock (V)
B-004-0-22	SS-1	1.0	22	31	18	13		49	21	9	11	21	10	DARK GRAY STONE FRAGMENTS WITH SAND, SILT AND CLAY (RIVER MUG)	A-2-6 (0)
B-004-0-22	SS-2	2.5	5	NP	NP	NP		94						BROWN GRAVEL AND STONE FRAGMENTS (FILL)	A-1-a (V)
B-004-0-22	SS-3	4.0	13	24	14	10		9	11	14	39	66	27	GRAY SANDY SILT, SOME CLAY, TRACE STONE FRAGMENTS	A-4a (6)
B-004-0-22	SS-4	5.5	12	24	15	9		13	10	13	36	64	28	GRAY SANDY SILT, SOME CLAY, LITTLE STONE FRAGMENTS (TILL)	A-4a (6)
B-004-0-22	SS-5	8.5	12											GRAY SANDY SILT, SOME CLAY, LITTLE STONE FRAGMENTS (TILL)	A-4a (V)
B-004-0-22	SS-6	11.0	11	19	12	7		23	16	16	28	45	17	GRAY SANDY SILT, SOME SHALE FRAGMENTS, LITTLE CLAY	A-4a (2)

PRO US_LAB_ODOT_SUMMARY_ODOT - OH DOT.GDT - 5/27/22 14:21 - C:\GINT PROJECT FOLDER\G22002G GINT (4).GPJ

Pro Geotech, Inc.

TR.-TRACE, BR.-BROWN, LI.-LITTLE, S/F-STONE FRAGMENTS, SO.-SOME, RB-ROADBASE, NP-NON-PLASTIC, POSS-POSSIBLE

Summary of Laboratory Results

Client: CT CONSULTANT, INC.
Project: LAK-283-4.58
Location: LAKE COUNTY, OHIO
Pro. Number: G22002G

Sheet 1 of 2

Boring Number	Sample Number	Depth (ft)	Water Content %	Liquid Limit %	Plastic Limit %	Plast. Index	Specific Gravity	Agg. %	Coarse Sand %	Fine Sand %	Silt %	Silt&Clay Comb. %	Clay %	Soil Description	Class. Symbol
B-004-0-22	SS-7	13.5	9											GRAY SANDY SILT, SOME SHALE FRAGMENTS, LITTLE CLAY	A-4a (V)
B-004-0-22	SS-8	18.5	9											GRAY HIGHLY WEATHERED SHALE	Rock (V)
B-005-0-22	SS-1	1.5	20	25	18	7		0	1	19	60	79	19	BROWN SILT, LITTLE CLAY, LITTLE SAND (FILL)	A-4b (8)
B-005-0-22	SS-2	3.5	17	30	19	11		0	0	12	67	87	21	BROWN SILT, SOME CLAY, LITTLE SAND (FILL)	A-4b (V)
B-005-0-22	SS-3	6.0	32											BROWN SILT, SOME CLAY, LITTLE SAND (FILL)	A-4b (V)
B-005-0-22	SS-4	8.5	27											BROWN SILT, SOME CLAY, LITTLE SAND (FILL)	A-4b (V)
B-005-0-22	SS-5	11.0	25	NP	NP	NP		5	39	29	21	28	7	BROWN COARSE AND SAND, SOME FINES, TRACE STONE FRAGMENTS	A-3a (0)
B-005-0-22	SS-6	13.5	14											GRAY SANDY SILT, SOME CLAY, TRACE STONE FRAGMENTS (TILL)	A-4a (V)
B-005-0-22	SS-7	16.0	12	24	14	10		10	11	15	39	64	25	GRAY SANDY SILT, SOME CLAY, TRACE STONE FRAGMENTS (TILL)	A-4a (6)
B-005-0-22	SS-8	18.5	12											GRAY SANDY SILT, SOME CLAY, TRACE STONE FRAGMENTS (TILL)	A-4a (V)
B-005-0-22	SS-9	23.5	9	22	15	7		23	20	17	28	40	12	GRAY SANDY SILT, SOME STONE FRAGMENTS, LITTLE CLAY	A-4a (1)
B-005-0-22	SS-10	28.5	5											GRAY HIGHLY WEATHERED SHALE	Rock (V)
B-006-0-22	SS-1	1.0	12	22	17	5		32	16	21	23	30	7	BROWN STONE FRAGMENTS WITH SAND AND SILT, TRACE CLAY (FILL)	A-2-4 (0)
B-006-0-22	SS-2	3.5	12	NP	NP	NP		28	17	29	22	27	5	BROWN STONE FRAGMENTS WITH SAND AND SILT, TRACE CLAY (FILL)	A-2-4 (0)
B-006-0-22	SS-3	6.0	12											BROWN SANDY SILT, SOME CLAY, TRACE STONE FRAGMENTS (FILL)	A-4a (V)
B-006-0-22	SS-4	8.5	29											BROWN SILTY CLAY, LITTLE SAND, TRACE STONE FRAGMENTS (FILL)	A-6b (V)

PRO US_LAB_ODOT_SUMMARY_ODOT - OH DOT.GDT - 5/27/22 14:21 - C:\GINT PROJECT FOLDER\G22002G GINT (4).GPJ

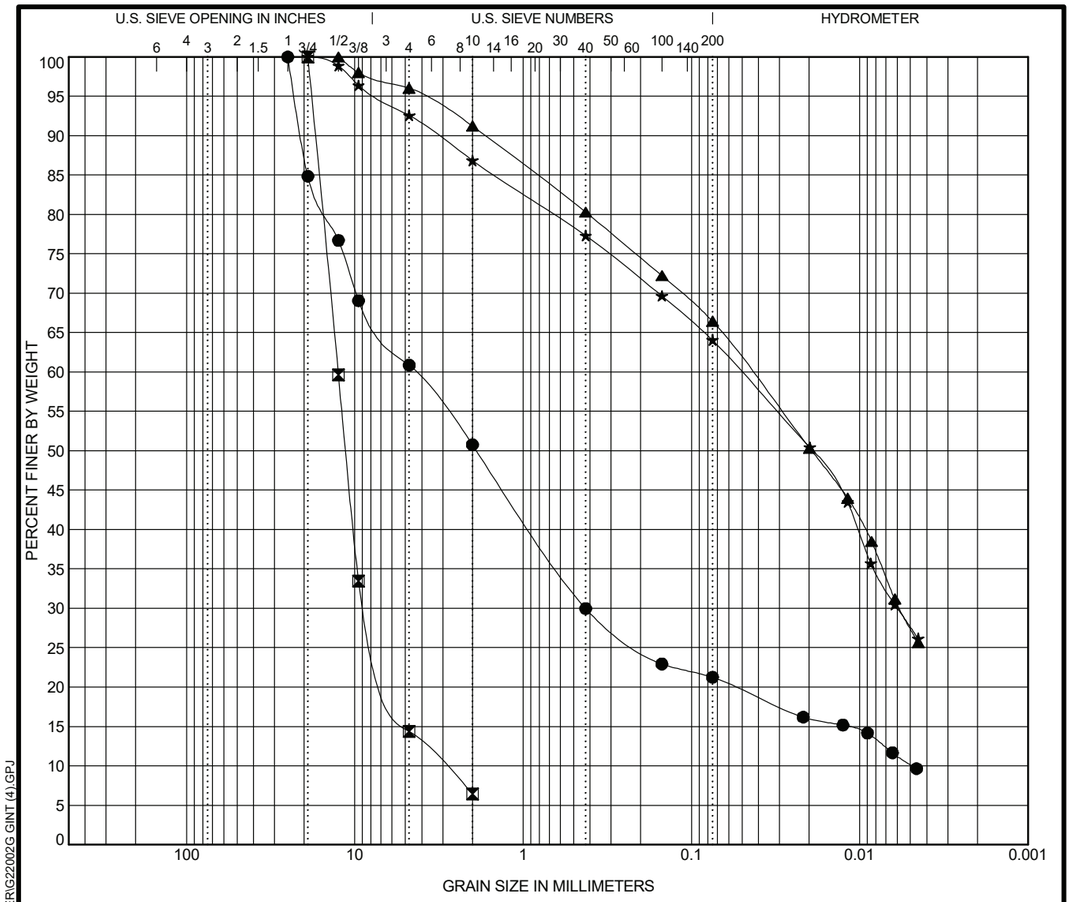
Pro Geotech, Inc.

TR.-TRACE, BR.-BROWN, LI.-LITTLE, S/F-STONE FRAGMENTS, SO.-SOME, RB-ROADBASE, NP-NON-PLASTIC, POSS-POSSIBLE

Summary of Laboratory Results

Client: CT CONSULTANT, INC.
Project: LAK-283-4.58
Location: LAKE COUNTY, OHIO
Pro. Number: G22002G

Sheet 2 of 2



	Boring No.	Depth/ft	Soil Description and Classification Symbol	D50 (mm)	D50 (in.)
●	B-004-0-22	1.0	DARK GRAY STONE FRAGMENTS WITH SAND, SILT AND CLAY (RIVER MUG), A-2-6	1.89	0.0744
⊠	B-004-0-22	2.5	BROWN GRAVEL AND STONE FRAGMENTS (FILL), A-1-a	11.298	0.4448
▲	B-004-0-22	4.0	GRAY SANDY SILT, SOME CLAY, TRACE STONE FRAGMENTS, A-4a	0.019	0.0008
★	B-004-0-22	5.5	GRAY SANDY SILT, SOME CLAY, LITTLE STONE FRAGMENTS (TILL), A-4a	0.019	0.0008

	Boring No.	Depth/ft	LL	PL	PI	%Gravel	%Sand	%Silt&clay	%Silt	%Clay
●	B-004-0-22	1.0	31	18	13	49	30		11	10
⊠	B-004-0-22	2.5	NP	NP	NP	94				
▲	B-004-0-22	4.0	24	14	10	9	25		39	27
★	B-004-0-22	5.5	24	15	9	13	23		36	28

PRO D50-GRAIN SIZE DETERMINATION - PRIMENG.GDT - 5/23/22 15:08 - C:\GINT PROJECT FOLDER\G22002G GINT (4).GPJ

Pro Geotech, Inc.

D50 - GRAIN SIZE DETERMINATION

Client: CT CONSULTANT, INC.
Project: LAK-283-4.58
Location: LAKE COUNTY, OHIO
Pro. Number: G22002G

Pro Geotech, Inc.

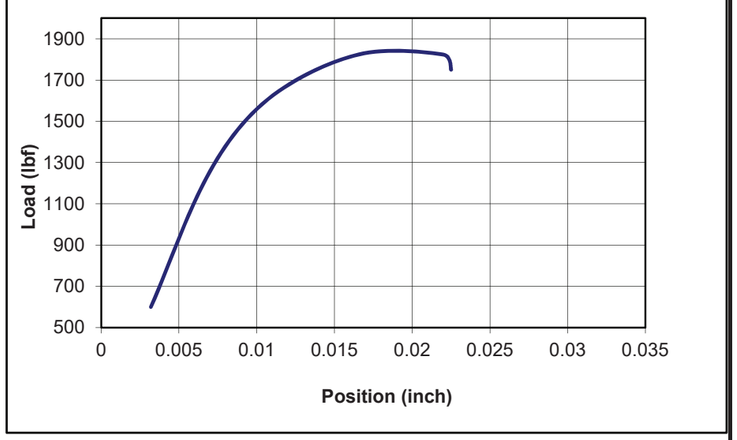
Compressive Strength of Rock
ASTM D 7012

PROJECT	LAK-283-4.58	PGI PROJECT NO.	G22002G	DATE	4/21/2022
	STRUCTURE	LAK-283-4.58			
BORING NUMBER	B-002-0-22	TOP DEPTH (FT)	30.13	BOTTOM DEPTH (FT)	30.48
SAMPLE NUMBER	NQ-1	DISTRICT	NA	PID NO.	110807
COUNTY	LAK	ROUTE	283	SECTION	4.58
STATION	166+64	OFFSET	10	OFFSET DIRECTION	RT

FORMATION	SHALE
DESCRIPTION	GRAY, MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO MODERATELY FRACTURED

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)			
1	4.133	1.977		LENGTH/DIAMETER	2.11
2	4.176	1.978		CORRECTION FACTOR	1.00
3	4.180	1.978		AREA (SQ. INCH)	3.072
AVERAGE	4.163	1.978		MASS (GRAMS)	538.22
				UNIT WEIGHT (LBS/FT^3)	160.34

MAXIMUM LOAD (LBS)
1823
COMPRESSIVE STRENGTH (PSI)
593
TIME OF TEST (MINUTES)
2:20
LOADING DIRECTION
PERPENDICULAR TO BEDDING
TECHNICIAN
NA/EH



BEFORE TESTING

AFTER FAILURE

Pro Geotech, Inc.

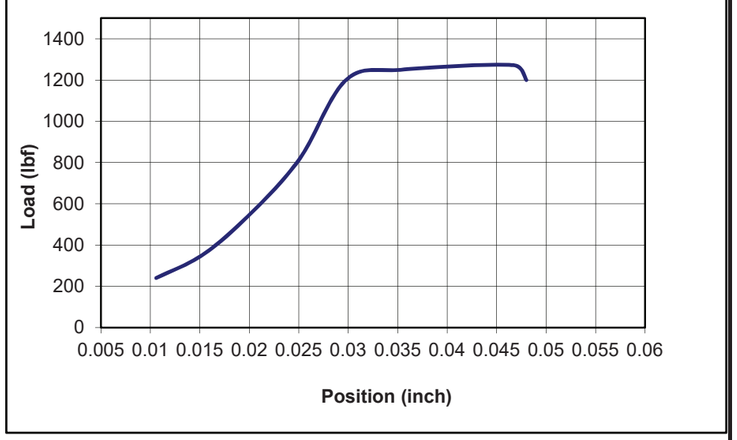
Compressive Strength of Rock
ASTM D 7012

PROJECT	LAK-283-4.58	PGI PROJECT NO.	G22002G	DATE	4/21/2022
	STRUCTURE	LAK-283-4.58			
BORING NUMBER	B-002-0-22	TOP DEPTH (FT)	36.25	BOTTOM DEPTH (FT)	36.6
SAMPLE NUMBER	NQ-2	DISTRICT	NA	PID NO.	110807
COUNTY	LAK	ROUTE	283	SECTION	4.58
STATION	166+64	OFFSET	10'	OFFSET DIRECTION	RT

FORMATION	SHALE
DESCRIPTION	GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THIN BEDDED, MODERATLY TO SLIGHTLY FRACTURED

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)			
1	4.206	2.043		LENGTH/DIAMETER	2.09
2	4.285	2.038		CORRECTION FACTOR	1.00
3	4.286	2.039		AREA (SQ. INCH)	3.269
AVERAGE	4.259	2.040		MASS (GRAMS)	581.10
				UNIT WEIGHT (LBS/FT^3)	159.03

MAXIMUM LOAD (LBS)
1272
COMPRESSIVE STRENGTH (PSI)
389
TIME OF TEST (MINUTES)
3:20
LOADING DIRECTION
PERPENDICULAR TO BEDDING
TECHNICIAN
NA/EH



BEFORE TESTING

AFTER FAILURE

Pro Geotech, Inc.

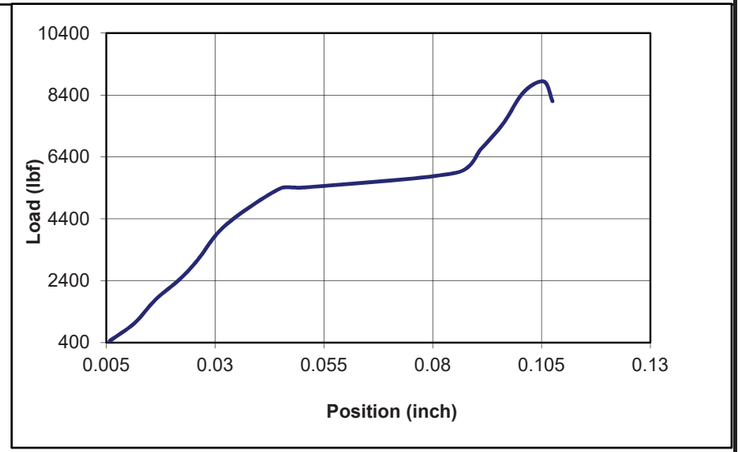
Compressive Strength of Rock
ASTM D 7012

PROJECT	LAK-283-4.58	PGI PROJECT NO.	G22002G	DATE	4/21/2022
	STRUCTURE	LAK-283-4.58			
BORING NUMBER	B-003-0-22	TOP DEPTH (FT)	28.21	BOTTOM DEPTH (FT)	28.59
SAMPLE NUMBER	NQ-1	DISTRICT	NA	PID NO.	110807
COUNTY	LAK	ROUTE	283	SECTION	4.58
STATION	166+70	OFFSET	42'	OFFSET DIRECTION	LT

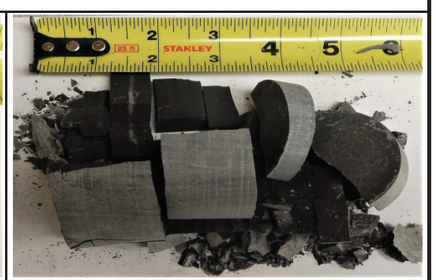
FORMATION	SHALE
DESCRIPTION	GRAY, MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO SLIGHTLY FRACTURED

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)			
1	4.514	2.032		LENGTH/DIAMETER	2.21
2	4.482	2.032		CORRECTION FACTOR	1.00
3	4.491	2.035		AREA (SQ. INCH)	3.246
				MASS (GRAMS)	571.10
AVERAGE	4.496	2.033		UNIT WEIGHT (LBS/FT^3)	149.08

MAXIMUM LOAD (LBS)	COMPRESSIVE STRENGTH (PSI)	TIME OF TEST (MINUTES)	LOADING DIRECTION	TECHNICIAN
8835	2722	6:20	PERPENDICULAR TO BEDDING	NA/EH



BEFORE TESTING



AFTER FAILURE

Pro Geotech, Inc.

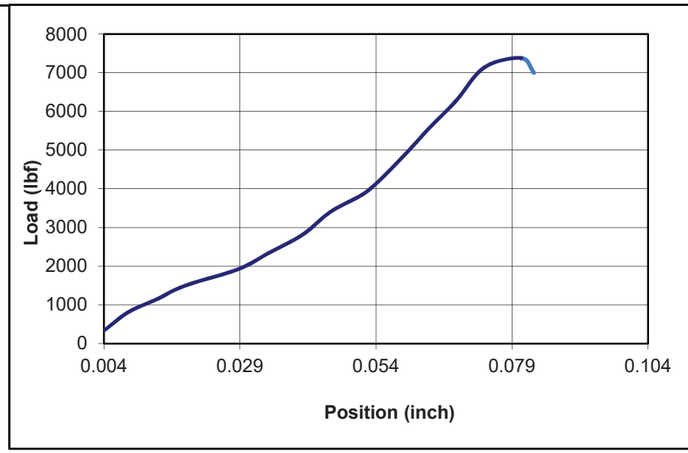
Compressive Strength of Rock
ASTM D 7012

PROJECT	LAK-283-4.58	PGI PROJECT NO.	G22002G	DATE	4/21/2022
	STRUCTURE	LAK-283-4.58			
BORING NUMBER	B-003-0-22	TOP DEPTH (FT)	33.92	BOTTOM DEPTH (FT)	34.28
SAMPLE NUMBER	NQ-1	DISTRICT	NA	PID NO.	110807
COUNTY	LAK	ROUTE	283	SECTION	4.58
STATION	166+70	OFFSET	42'	OFFSET DIRECTION	LT

FORMATION	SHALE
DESCRIPTION	GRAY, MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO SLIGHTLY FRACTURED

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)			
1	4.361	2.042		LENGTH/DIAMETER	2.13
2	4.356	2.041		CORRECTION FACTOR	1.00
3	4.334	2.040		AREA (SQ. INCH)	3.272
				MASS (GRAMS)	558.75
AVERAGE	4.350	2.041		UNIT WEIGHT (LBS/FT^3)	149.55

MAXIMUM LOAD (LBS)	COMPRESSIVE STRENGTH (PSI)	TIME OF TEST (MINUTES)	LOADING DIRECTION	TECHNICIAN
7379	2255	5:00	PERPENDICULAR TO BEDDING	NA/EH



BEFORE TESTING

AFTER FAILURE

Pro Geotech, Inc.

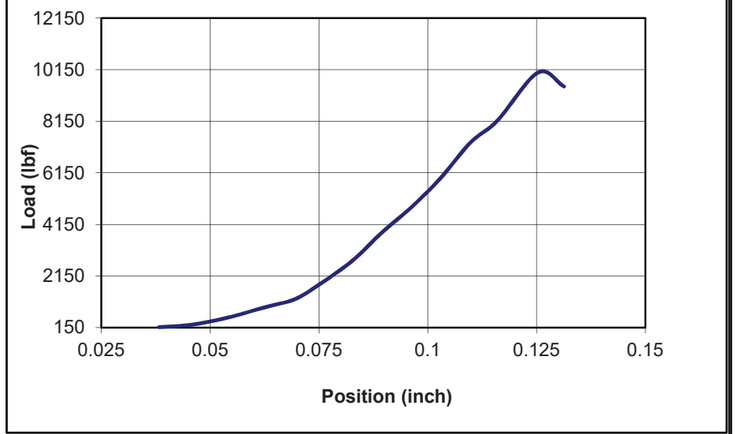
Compressive Strength of Rock
ASTM D 7012

PROJECT	LAK-283-4.58	PGI PROJECT NO.	G22002G	DATE	4/21/2022
	STRUCTURE	LAK-283-4.58			
BORING NUMBER	B-004-0-22	TOP DEPTH (FT)	21.67	BOTTOM DEPTH (FT)	22.01
SAMPLE NUMBER	NQ-1	DISTRICT	NA	PID NO.	110807
COUNTY	LAK	ROUTE	283	SECTION	4.58
STATION	167+04	OFFSET	10'	OFFSET DIRECTION	RT

FORMATION	SHALE
DESCRIPTION	GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO SLIGHTLYFRACTURED

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)			
1	4.016	1.979		LENGTH/DIAMETER	2.04
2	4.018	1.982		CORRECTION FACTOR	1.00
3	4.085	1.982		AREA (SQ. INCH)	3.082
AVERAGE	4.040	1.981		MASS (GRAMS)	500.58
				UNIT WEIGHT (LBS/FT^3)	153.16

MAXIMUM LOAD (LBS)
10037
COMPRESSIVE STRENGTH (PSI)
3256
TIME OF TEST (MINUTES)
5:20
LOADING DIRECTION
PERPENDICULAR TO BEDDING
TECHNICIAN
NA/EH



BEFORE TESTING

AFTER FAILURE

Pro Geotech, Inc.

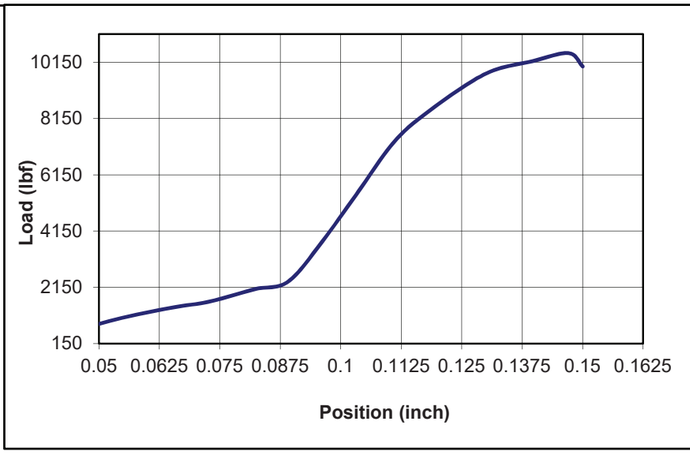
Compressive Strength of Rock
ASTM D 7012

PROJECT	LAK-283-4.58	PGI PROJECT NO.	G22002G	DATE	4/21/2022
	STRUCTURE	LAK-283-4.58			
BORING NUMBER	B-004-0-22	TOP DEPTH (FT)	27.83	BOTTOM DEPTH (FT)	28.16
SAMPLE NUMBER	NQ-1	DISTRICT	NA	PID NO.	110807
COUNTY	LAK	ROUTE	283	SECTION	4.58
STATION	167+04	OFFSET	10'	OFFSET DIRECTION	RT

FORMATION	SHALE
DESCRIPTION	GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO SLIGHTLYFRACTURED

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)			
1	3.961	1.982		LENGTH/DIAMETER	2.02
2	4.032	1.980		CORRECTION FACTOR	1.00
3	4.018	1.984		AREA (SQ. INCH)	3.085
AVERAGE	4.004	1.982		MASS (GRAMS)	516.10
				UNIT WEIGHT (LBS/FT^3)	159.17

MAXIMUM LOAD (LBS)
10475
COMPRESSIVE STRENGTH (PSI)
3395
TIME OF TEST (MINUTES)
5:40
LOADING DIRECTION
PERPENDICULAR TO BEDDING
TECHNICIAN
NA/EH



BEFORE TESTING

AFTER FAILURE

Pro Geotech, Inc.

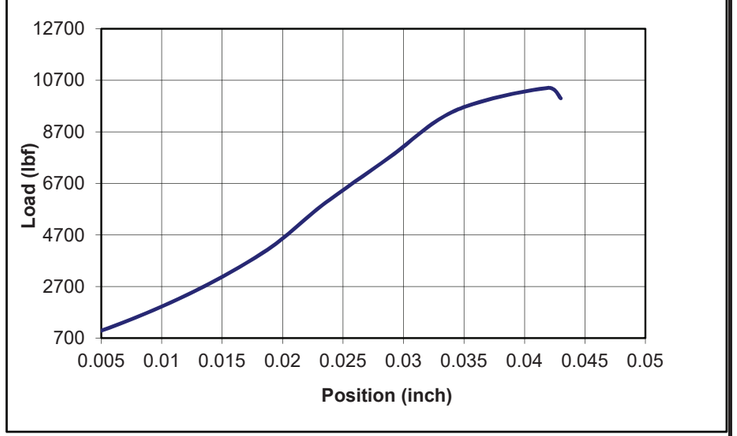
Compressive Strength of Rock
ASTM D 7012

PROJECT	LAK-283-4.58	PGI PROJECT NO.	G22002G	DATE	4/21/2022
	STRUCTURE	LAK-283-4.58			
BORING NUMBER	B-005-0-22	TOP DEPTH (FT)	32.58	BOTTOM DEPTH (FT)	32.91
SAMPLE NUMBER	NQ-1	DISTRICT	NA	PID NO.	110807
COUNTY	LAK	ROUTE	283	SECTION	4.58
STATION	167+35	OFFSET	10'	OFFSET DIRECTION	LT

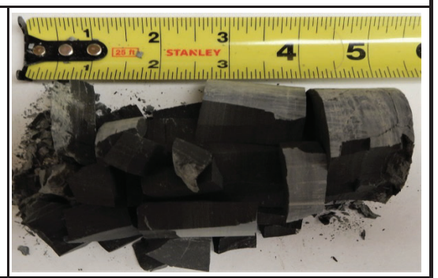
FORMATION	SHALE
DESCRIPTION	GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO SLIGHTLYFRACTURED

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)			
1	4.004	1.969		LENGTH/DIAMETER	2.03
2	3.986	1.977		CORRECTION FACTOR	1.00
3	3.984	1.965		AREA (SQ. INCH)	3.049
AVERAGE	3.991	1.970		MASS (GRAMS)	505.57
				UNIT WEIGHT (LBS/FT^3)	158.26

MAXIMUM LOAD (LBS)
10404
COMPRESSIVE STRENGTH (PSI)
3412
TIME OF TEST (MINUTES)
3:00
LOADING DIRECTION
PERPENDICULAR TO BEDDING
TECHNICIAN
NA/EH



BEFORE TESTING



AFTER FAILURE

Pro Geotech, Inc.

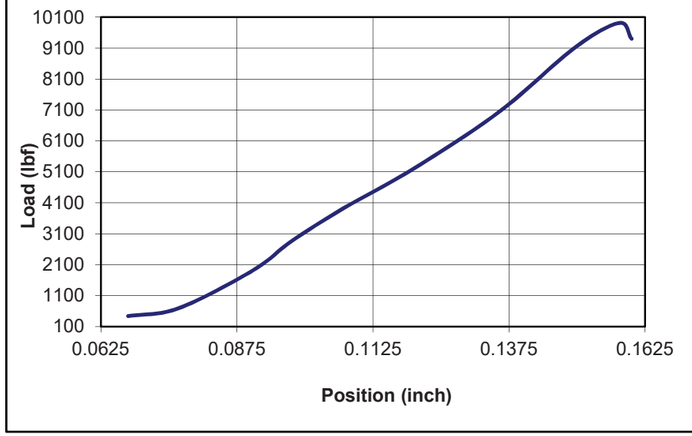
Compressive Strength of Rock
ASTM D 7012

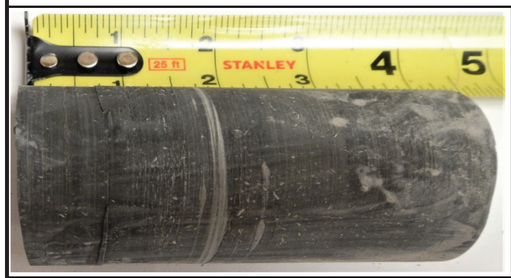
PROJECT	LAK-283-4.58	PGI PROJECT NO.	G22002G	DATE	4/21/2022
	STRUCTURE	LAK-283-4.58			
BORING NUMBER	B-005-0-22	TOP DEPTH (FT)	37.33	BOTTOM DEPTH (FT)	37.66
SAMPLE NUMBER	NQ-1	DISTRICT	NA	PID NO.	110807
COUNTY	LAK	ROUTE	283	SECTION	4.58
STATION	167+35	OFFSET	10'	OFFSET DIRECTION	LT

FORMATION	SHALE
DESCRIPTION	GRAY, MODERATELY TO SLIGHTLY WEATHERED, VERY WEAK TO WEAK, VERY THIN TO THIN BEDDED, FRACTURED TO MODERATELY FRACTURED

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)			
1	3.910	1.997		LENGTH/DIAMETER	1.97
2	3.908	1.987		CORRECTION FACTOR	1.00
3	3.990	1.996		AREA (SQ. INCH)	3.121
AVERAGE	3.936	1.993		MASS (GRAMS)	508.70
				UNIT WEIGHT (LBS/FT^3)	157.77

MAXIMUM LOAD (LBS)
9910
COMPRESSIVE STRENGTH (PSI)
3171
TIME OF TEST (MINUTES)
4:20
LOADING DIRECTION
PERPENDICULAR TO BEDDING
TECHNICIAN
NA/EH





BEFORE TESTING

AFTER FAILURE

COMPANY: PGI DRILLED BY: OTB
PROJECT: LAK-283-4.58
BORING: B-002-0-22 BOX 1/1
DATE of CORING: 3/24/22
RUN-1: 29.0' - 34.0' REC: 95% RQD: 55%
RUN-2: 34.0' - 39.0' REC: 98% RQD: 73%

COMPANY: PGI DRILLED BY: OTB
PROJECT: LAK-283-4.58
BORING: B-003-0-22 BOX 1/1
DATE of CORING: 4/08/22
RUN-1: 25.0' - 35.0' REC: 99% RQD: 72%

COMPANY: PGI DRILLED BY: OTB
PROJECT: LAK-283-4.58
BORING: B-004-0-22 BOX 1/1
DATE of CORING: 3/28/22
RUN-1: 19.0' - 29.0' REC: 96% RQD: 68%

COMPANY: PGI DRILLED BY: OTB
PROJECT: LAK-283-4.58
BORING: B-005-0-22 BOX 1/1
DATE of CORING: 3/25/22
RUN-1: 29.0' - 39.0' REC: 95% RQD: 55%

BEARING CAPACITY ANALYSIS (ASD Method)	
AASHTO Article 11.6.3: ABUTMENT & RETAINING WALL	
Project	**LAK-283-4.58**
Project#	**G22002G**
Bore#	**B-002-0-22 - Rear Abutment**
Method	**AASHTO Eqn 10.6.3.1.2a**
Foundation Dimension	
Effective Width of Footing (B') (feet)	4.0
Length of Footing (L) (feet)	59.0
Length (L')/Width (B') (>5 is continous footing)	14.8
Type of Footing	Strip
Footing Bearing Elevation (feet)	570.9
Depth of Footing (D_f) Feet below Proposed Grade	3.5
Depth of Groundwater Table below Footing (ft)	0.0
Height of Slope (Hs) (feet)	Flat Ground
Soil Parameters	
Ave. Undrained Shear Strength/Cohesion (psf)	0
Angle of internal friction (Phi) Degrees	31
Unit Weight of soil above base of footing (pcf)	120
Unit Weight of soil below base of footing (pcf)	125
Bearing Capacity Factors per LRFD Table 10.6.3.1.2a-1	
N_c	32.70
N_q	20.60
$N\gamma$	26.00
Shape Correction Factors	
s_c	1.043
s_q	1.041
s_γ	0.973
Load Inclination Factors	
ic	1.0
iq	1.0
i_γ	1.0
Correction for Water Table	
D_f+1.5B'	9.5
C_{wq}	0.5
$C_{w\gamma}$	0.5
Embedment Depth Correction Factor	
Df/B'	0.9
d_q	1.0
Bearing Capacity Terms	
Cohesion Term	0
Surcharge Term	4502
Unit Weight Term	3162
Ultimate Bearing Capacity (psf)	7664
Factor of Safety	2.50
Allowable Bearing Capacity (psf)	3066

AASHTO Eqn 10.6.3.1.2a
qn = c*Nc*Sc*ic + (Gamma)*Df*Nq*sq*dq*iq*Cwq+0.5*(Gamma)*Bf*Nγ*sγ*iγ*Cwγ

BEARING CAPACITY ANALYSIS (ASD Method)	
AASHTO Article 11.6.3: ABUTMENT & RETAINING WALL	
Project	**LAK-283-4.58**
Project#	**G22002G**
Bore#	**B-005-0-22 - Forward Abutment**
Method	**AASHTO Eqn 10.6.3.1.2a**
Foundation Dimension	
Effective Width of Footing (B') (feet)	4.0
Length of Footing (L) (feet)	57.0
Length (L')/Width (B') (>5 is continous footing)	14.3
Type of Footing	Strip
Footing Bearing Elevation (feet)	570.1
Depth of Footing (D_f) Feet below Proposed Grade	3.5
Depth of Groundwater Table below Footing (ft)	0.0
Height of Slope (Hs) (feet)	Flat Ground
Soil Parameters	
Ave. Undrained Shear Strength/Cohesion (psf)	2000
Angle of internal friction (Phi) Degrees	0
Unit Weight of soil above base of footing (pcf)	120
Unit Weight of soil below base of footing (pcf)	125
Bearing Capacity Factors per LRFD Table 10.6.3.1.2a-1	
N_c	5.14
N_q	1.00
$N\gamma$	0.00
Shape Correction Factors	
s_c	1.014
s_q	1.000
s_γ	1.000
Load Inclination Factors	
ic	1.0
iq	1.0
i_γ	1.0
Correction for Water Table	
D_f+1.5B'	9.5
C_{wq}	0.5
$C_{w\gamma}$	0.5
Embedment Depth Correction Factor	
Df/B'	0.9
d_q	1.0
Bearing Capacity Terms	
Cohesion Term	10424
Surcharge Term	210
Unit Weight Term	0
Ultimate Bearing Capacity (psf)	10634
Factor of Safety	2.50
Allowable Bearing Capacity (psf)	4254

AASHTO Eqn 10.6.3.1.2a
qn = c*Nc*Sc*ic + (Gamma)*Df*Nq*sq*dq*iq*Cwq+0.5*(Gamma)*Bf*Nγ*sγ*iγ*Cwγ

BEARING CAPACITY ANALYSIS (ASD Method)	
AASHTO Article 10.6.3.2 and Munfakh, et al. (2001)	
Project	**LAK-283-4.58**
Project#	**G22002G**
Bore#	**B-004-0-22 - Piers C & D**
Method	**AASHTO 10.6.3.1.2**
Foundation Dimension	
Width of Footing (B) (feet)	4.00
Length of Footing (L) (feet)	44.00
Length (L_f)/Width (B_f) (>5 is continous footing)	11.0
Type of Footing	Strip
Footing Bearing Elevation (feet)	570.1
Depth of Footing (D_f) Feet below Proposed Grade	3.5
Depth of groundwater Table (D_w) below Footing (ft)	0.0
Height of Slope (Hs) (feet)	Flat Ground
Soil Parameters	
Undrained Shear Strength/Cohesion (psf)	3500
Angle of internal friction (Phi) Degrees	0
Unit Weight of soil above base of footing (pcf)	120
Unit Weight of soil below base of footing (pcf)	130
Bearing Capacity Factors	
N_c	5.14
N_q	1.00
$N\gamma$	0.00
Shape Correction Factors	
s_c	1.018
s_q	1.000
s_γ	1.000
Load Inclination Factors	
ic	1.0
iq	1.0
i_γ	1.0
Correction for Water Table	
D_f+1.5B_f	9.5
C_{wq}	0.500
$C_{w\gamma}$	0.500
Embedment Depth Correction Factor	
Df/Bf	0.9
d_q	1.0
Bearing Capacity Terms	
Cohesion Term	18317
Surcharge Term	210
Unit Weight Term	0
Nominal Bearing Resistence (psf)	18527
Factor of Safety	2.50
Allowable Bearing Capacity (psf)	7411

AASHTO Eqn 10.6.3.1.2a
qn = c*Nc*Sc*ic + (Gamma)*Df*Nq*sq*dq*iq*Cwq+0.5*(Gamma)*Bf*Nγ*sγ*iγ*Cwγ

AASHTO Article 11.6.3: ABUTMENT & RETAINING WALL	
Project	**LAK-283-4.58**
Project#	**G22002G**
Bore#	**B-002-0-22 - Rear Abutment**
Method	**AASHTO Eqn 10.6.3.1.2a**
Foundation Dimension	
Width of Footing (B') (feet)	4.0
Length of Footing (L') (feet)	59.0
Length (L')/Width (B') (>5 is continous footing)	14.8
Type of Footing	strip
Footing Bearing Elevation (feet)	570.9
Depth of Footing (D_f) Feet below Proposed Grade	3.5
Depth of groundwater Table (D_w) below proposed grade (ft)	0.0
Height of Slope (Hs) (feet)	Flat Ground
Soil Parameters	
Ave. Undrained Shear Strength/Cohesion (psf)	0
Angle of internal friction (Phi) Degrees	31
Unit Weight of soil above base of footing (pcf)	120
Unit Weight of soil below base of footing (pcf)	125
Bearing Capacity Factors per LRFD Table 10.6.3.1.2a-1	
N_c	32.70
N_q	20.60
$N\gamma$	26.00
Shape Correction Factors	
s_c	1.043
s_q	1.041
s_γ	0.973
Load Inclination Factors	
ic	1.0
iq	1.0
i_γ	1.0
Correction for Water Table	
D_f+1.5B'	9.5
C_{wq}	0.5
$C_{w\gamma}$	0.5
Embedment Depth Correction Factor	
Df/B'	0.9
d_q	1.0
Bearing Capacity Terms	
Cohesion Term	0
Surcharge Term	4502
Unit Weight Term	3162
Nominal Bearing Resistance (psf)	7664
Resistance Factor for bearing (per AASHTO Table 11.5.7-1)	0.45
Factored Bearing Resistence (psf)	3449

AASHTO Eqn 10.6.3.1.2a
qn = c*Nc*Sc*ic + (Gamma)*Df*Nq*sq*dq*iq*Cwq+0.5*(Gamma)*Bf*Nγ*sγ*iγ*Cwγ

AASHTO Article 11.6.3: ABUTMENT & RETAINING WALL	
Project	LAK-283-4.58
Project#	G22002G
Bore#	B-005-0-22 - Forward Abutment
Method	AASHTO Eqn 10.6.3.1.2a
Foundation Dimension	
Width of Footing (B') (feet)	4.0
Length of Footing (L') (feet)	57.0
Length (L')/Width (B') (>5 is continous footing)	14.3
Type of Footing	strip
Footing Bearing Elevation (feet)	570.1
Depth of Footing (D_f) Feet below Proposed Grade	3.5
Depth of groundwater Table (D_w) below proposed grade (ft)	0.0
Height of Slope (Hs) (feet)	Flat Ground
Soil Parameters	
Ave. Undrained Shear Strength/Cohesion (psf)	2000
Angle of internal friction (Phi) Degrees	0
Unit Weight of soil above base of footing (pcf)	120
Unit Weight of soil below base of footing (pcf)	125
Bearing Capacity Factors per LRFD Table 10.6.3.1.2a-1	
N_c	5.14
N_q	1.00
$N\gamma$	0.00
Shape Correction Factors	
s_c	1.014
s_q	1.000
s_γ	1.000
Load Inclination Factors	
ic	1.0
iq	1.0
i_γ	1.0
Correction for Water Table	
D_f+1.5B'	9.5
C_{wq}	0.5
$C_{w\gamma}$	0.5
Embedment Depth Correction Factor	
Df/B'	0.9
d_q	1.0
Bearing Capacity Terms	
Cohesion Term	10424
Surcharge Term	210
Unit Weight Term	0
Nominal Bearing Resistance (psf)	10634
Resistance Factor for bearing (per AASHTO Table 11.5.7-1)	0.45
Factored Bearing Resistence (psf)	4785

AASHTO Eqn 10.6.3.1.2a
qn = c*Nc*Sc*ic + (Gamma)*Df*Nq*sq*dq*iq*Cwq+0.5*(Gamma)*Bf*Nγ*sγ*iγ*Cwγ

BEARING CAPACITY ANALYSIS AASHTO Article 10.6.3.2 and Munfakh, et al. (2001)	
Project	LAK-283-4.58
Project#	G22002G
Bore#	B-004-0-22 - Piers C & D
Method	AASHTO 10.6.3.1.2
Foundation Dimension	
Width of Footing (B) (feet)	4.00
Length of Footing (L) (feet)	44.00
Length (L_f)/Width (B_f) (>5 is continous footing)	11.0
Type of Footing	Spread
Footing Bearing Elevation (feet)	570.1
Depth of Footing (D_f) Feet below Proposed Grade	3.5
Depth of groundwater Table (D_w) below Footing (ft)	0.0
Height of Slope (Hs) (feet)	Flat Ground
Soil Parameters	
Undrained Shear Strength/Cohesion (psf)	3500
Angle of internal friction (Phi) Degrees	0
Unit Weight of soil above base of footing (pcf)	120
Unit Weight of soil below base of footing (pcf)	130
Bearing Capacity Factors	
N_c	5.14
N_q	1.00
$N\gamma$	0.00
Shape Correction Factors	
s_c	1.018
s_q	1.000
s_γ	1.000
Load Inclination Factors	
ic	1.0
iq	1.0
i_γ	1.0
Correction for Water Table	
D_f+1.5B_f	9.5
C_{wq}	0.500
$C_{w\gamma}$	0.500
Embedment Depth Correction Factor	
Df/Bf	0.9
d_q	1.0
Bearing Capacity Terms	
Cohesion Term	18317
Surcharge Term	210
Unit Weight Term	0
Nominal Bearing Resistence (psf)	18527
Resistance Factor for bearing (per AASHTO Table 10.5.5.2.2-1)	0.45
Factored Bearing Resistence (psf)	8337

AASHTO Eqn 10.6.3.1.2a
qn = c*Nc*Sc*ic + (Gamma)*Df*Nq*sq*dq*iq*Cwq+0.5*(Gamma)*Bf*Nγ*sγ*iγ*Cwγ

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.)

<LAK-283-4.58>
<110807>

<PROJECT DESCRIPTION - Structure Foundation Exploration for LAK-283-4.58> **Bridge No.**

<PRO GEOTECH, INC.>

Prepared By: <Shan Sivakumaran>
Date prepared: <5/23/2022>

<Shan Sivakumaran>
<26285 Broadway Ave>
<Units A-1 & A-2>
<Oakwood Village, Ohio 44146>
<440 717 1515>
<shansiva@progeotech.com>

NO. OF BORINGS: 4

OHIO DEPARTMENT OF TRANSPORTATION
Subgrade Analysis
V. 14.5 1/18/2019

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-001-0-22	CENTERLINE OF SR 28	166+13	10	Lt	MOBILE B-57 TrUCK \02	99	582.0	580.5	1.5 C
2	B-002-0-22	CENTERLINE OF SR 28	166+64	10	Rt	MOBILE B-57 TrUCK \02	99	582.9	581.4	1.5 C
3	B-005-0-22	CENTERLINE OF SR 28	167+35	10	Lt	MOBILE B-57 TrUCK \02	99	583.6	582.1	1.5 C
4	B-006-0-22	CENTERLINE OF SR 28	168+05	6	Rt	MOBILE B-57 TrUCK \02	99	585.2	583.7	1.5 C

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

#	Boring	Sample	Sample Depth From	Sample Depth To	Subgrade Depth From	Subgrade Depth To	Standard Penetration N_{60}	Standard Penetration N_{60L}	HP (tsf)	Physical Characteristics LL	PL	PI	% Silt	% Clay	P200	Moisture M_C	Moisture M_{OPT}	Ohio DOT Class	Ohio DOT GI	Sulfate Content (ppm)	Problem Unsuitable	Problem Unstable	Excavate and Replace (Item 204) Unsuitable	Excavate and Replace (Item 204) Unstable	Recommendation (Enter depth in inches)
1	B	1	1.5	3.0	0.0	1.5	7		1.5	27	18	9	67	19	86	23	13	A-4b	8		A-4b	HP & Mc		15"	
	001-0	2	3.5	5.0	2.0	3.5	8		1.5	26	18	8	55	21	76	15	13	A-4b	8		A-4b	HP	42"		
	22	3	6.0	7.5	4.5	6.0	10									18	6	A-1-b	0						
		4	8.5	10.0	7.0	8.5	8	7								16	6	A-1-b							
2	B	1	1.5	3.0	0.0	1.5	8		2	26	18	8	56	21	77	19	13	A-4b	8		A-4b	N_{60} & Mc		12"	
	002-0	2	3.5	5.0	2.0	3.5	3		1.5	26	18	8	52	15	67	20	13	A-4b	6		A-4b	HP & Mc	42"		
	22	3	6.0	7.5	4.5	6.0	5									29	10	A-4b	8						
		4	8.5	10.0	7.0	8.5	7	3								18	6	A-1-b							
3	B	1	1.5	3.0	0.0	1.5			1.5	25	18	7	60	19	79	20	13	A-4b	8		A-4b	HP & Mc		12"	
	005-0	2	3.5	5.0	2.0	3.5	5		1	30	19	11	66	21	87	17	14	A-4b	8		A-4b	HP & Mc	42"		
	22	3	6.0	7.5	4.5	6.0	3		0.5							32	10	A-4b	8						
		4	8.5	10.0	7.0	8.5	3	3								27	10	A-4b							
4	B	1	1.5	3.0	0.0	1.5	16			22	17	5	23	7	30	12	10	A-2-4	0						
	006-0	2	3.5	5.0	2.0	3.5	12			NP	NP	NP	22	5	27	12	10	A-2-4	0						
	22	3	6.0	7.5	4.5	6.0	20		4							12	10	A-4a	8						
		4	8.5	10.0	7.0	8.5	7	12	1							29	16	A-6b							

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

PID: <110807>

County-Route-Section: <LAK-283-4.58>
No. of Borings: 4

Geotechnical Consultant: <PRO GEOTECH, INC.>
Prepared By: <Shan Sivakumaran>
Date prepared: <5/23/2022>

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):	18"
Average(HP):	12"
Global Geogrid Average(N60L):	12"
Average(HP):	0"

Design CBR	7

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	33%	HP ≤ 0.5	8%
$N_{60} < 12$	67%	0.5 < HP ≤ 1	8%
$12 \leq N_{60} < 15$	8%	1 < HP ≤ 2	42%
$N_{60} \geq 20$	8%	HP > 2	8%
M+	42%		
Rock	0%		
Unsuitable	56%		

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

% Proposed Subgrade Surface	
Unstable & Unsuitable	150%
Unstable	75%
Unsuitable	75%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	8	6	1.61	26	18	8	50	16	66	20	11	6
Maximum	20	12	4.00	30	19	11	67	21	87	32	16	8
Minimum	3	3	0.50	22	17	5	22	5	27	12	6	0

Classification Counts by Sample

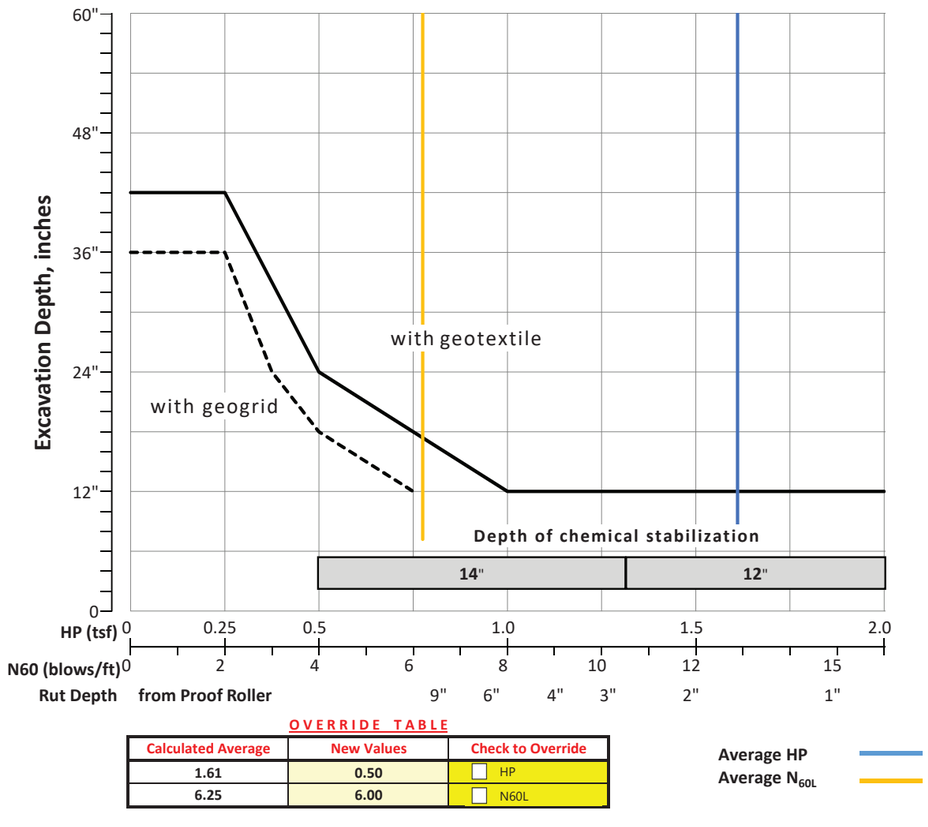
ODOT Class	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	0	3	2	0	0	0	0	0	1	9	0	0	1	0	0	0	0	16
Percent	0%	0%	19%	13%	0%	0%	0%	0%	0%	6%	56%	0%	0%	6%	0%	0%	0%	0%	100%
% Rock|Granular|Cohesive	0%	38%									63%								100%
Surface Class Count	0	0	0	2	0	0	0	0	0	0	6	0	0	0	0	0	0	0	8
Surface Class Percent	0%	0%	0%	25%	0%	0%	0%	0%	0%	0%	75%	0%	0%	0%	0%	0%	0%	0%	100%

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

GB1 Figure B – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
1.61	0.50	☐ HP
6.25	6.00	☐ N60L

Average HP

Average N_{60L}

VI.D. Geotechnical Reports

C-R-S: LAK-283-4.58	PID:110807	Reviewer:SS	Date:5/26/2022

General		
☒ N X 1	Has the first complete version of a geotechnical report being submitted been labeled as 'Draft'?	
Y ☒ X 2	Subsequent to ODOT's review and approval, has the complete version of the revised geotechnical report being submitted been labeled 'Final'?	
☒ N X 3	Have all geotechnical reports being submitted been titled correctly as prescribed in Section 705.1 of the SGE?	

Report Body		
☒ N X 4	Do all geotechnical reports being submitted contain an Executive Summary as described in Section 705.2 of the SGE?	
☒ N X 5	Do all geotechnical reports being submitted contain an Introduction as described in Section 705.3 of the SGE?	
☒ N X 6	Do all geotechnical reports being submitted contain a section titled "Geology and Observations of the Project," as described in Section 705.4 of the SGE?	
☒ N X 7	Do all geotechnical reports being submitted contain a section titled "Exploration," as described in Section 705.5 of the SGE?	
☒ N X 8	Do all geotechnical reports being submitted contain a section titled "Findings," as described in Section 705.6 of the SGE?	
☒ N X 9	Do all geotechnical reports being submitted contain a section titled "Analyses and Recommendations," as described in Section 705.7 of the SGE?	

VI.D. Geotechnical Reports

Appendices		
[Y] N X 10	Do all geotechnical reports being submitted contain all applicable Appendices as described in Section 705.8 of the SGE?	
[Y] N X 11	Do the Appendices present a site Boring Plan showing all boring locations as described in Section 705.8.1 of the SGE?	
[Y] N X 12	Do the Appendices include boring logs as described in Section 705.8.2 of the SGE?	
[Y] N X 13	Do the Appendices present reports of undisturbed test data as described in Section 705.8.3 of the SGE?	
[Y] N X 14	Do the Appendices present calculations in a logical format to support recommendations as described in Section 705.8.4 of the SGE?	

Notes:

III.C. Subgrade Checklist

C-R-S: LAK-283-4.58	PID:110807	Reviewer:SS	Date:5/26/2022

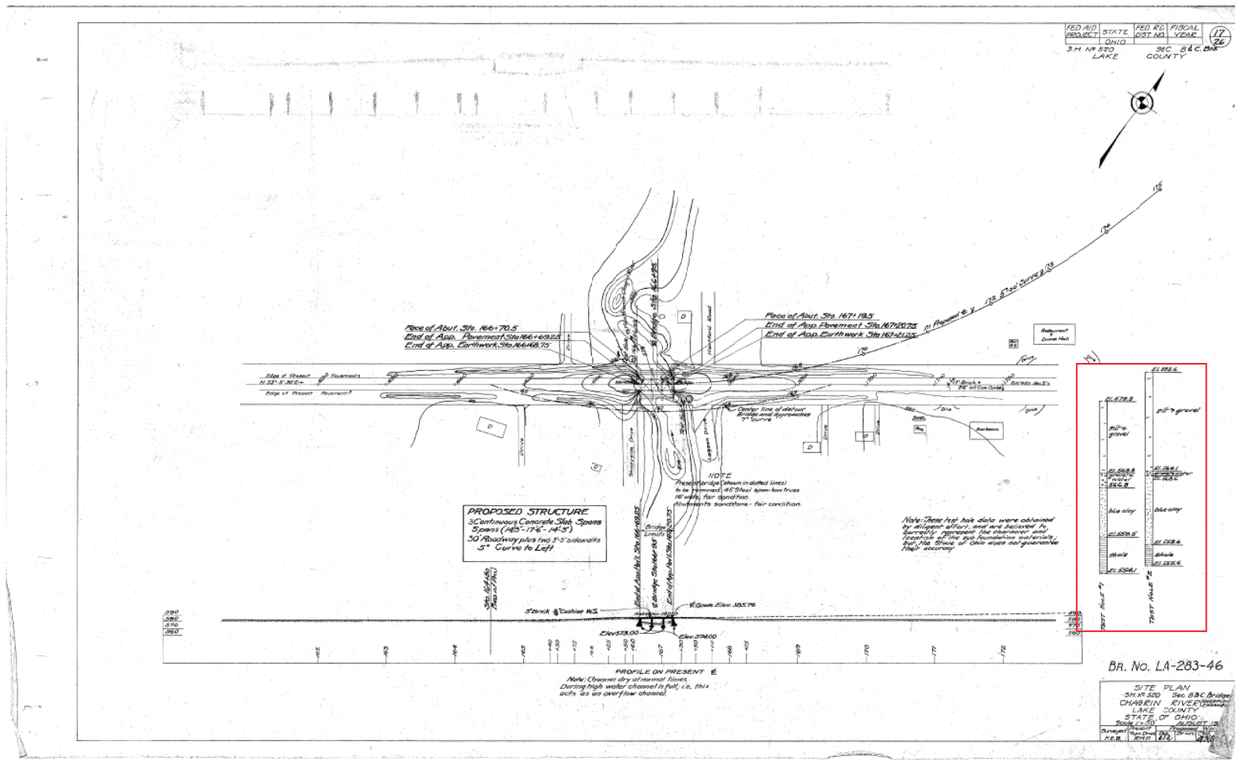
If you do not have any subgrade work on the project, you do not have to fill out this checklist.

[Y] N X 1		Has the subsurface investigation adequately characterized the soil or rock according to Geotechnical Bulletin 1: Plan Subgrades (GB1)?	
[Y] N X 2		If soils classified as A-2-5, A-4b, A-5, or A-7-5 are present at the proposed subgrade (soil profile), do the plans specify that these materials need to be removed and replaced?	
[Y] N X	a	If these materials are to be removed and replaced, have the station limits, depth, and lateral limits for the planned removal been provided?	
Y [N] X 3		If there is any rock, shale, or coal present at the proposed subgrade (CMS 204.05), do the plans specify the removal of the material?	
Y N [X]	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?	
Y [N] X 4		In accordance with GB1, do the SPT values and existing moisture contents for the proposed subgrade soils indicate the need for subgrade stabilization?	
Y N [X]	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)?	
Y N [X]	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?	
		Indicate type of subgrade treatment specified:	
		□ cement treatment □ lime treatment	
		□ other List Other items:	
Y N [X] 5		If drainage or groundwater is an issue with the proposed subgrade, has an appropriate drainage system (e.g., pipe, underdrains) been provided?	
Y [N] X 6		Has an appropriate quantity of Proof Rolling been included in the plans (CMS 204.06)?	To be provided by CT
[Y] N X 7		Has a design CBR value been provided?	

Notes:

III.C. Subgrade Checklist

Stage 1:



LABORATORY TEST STANDARDS

STANDARD **REFERENCE NUMBER**

I. Soil/Rock Testing

Description and Identification of Soils (Visual-Manual Procedures) ..... ASTM D 2488
Classification of Soils for Engineering Purposes (USCS). ..... ASTM D 2487
Laboratory Determination of Water (Moisture) Content of Soil and Rock ..... ASTM D 2216
Classification for Sizes of Aggregate for Road and Bridge Construction ..... ASTM D 488
Liquid Limit, Plastic Limit, and Plasticity Index of Soils ..... ASTM D 4318
Shrinkage Factors of Soils by Mercury Method ..... ASTM D 427
Moisture, Ash, and Organic Matter of Peat and Other Organic Soils ..... ASTM D 2974
Specific gravity of Soils ..... ASTM D 854
Direct Shear Test of Soils under Consolidated Drained Conditions ..... ASTM D 3080
Particle-Size Analysis of Soils ..... ASTM D 422
Unconfined Compressive Strength of Cohesive Soils ..... ASTM D 2166
Compressive Strength of Intact Rock Core Specimens ..... ASTM D 7012
Slake Durability Index of Shale/Similar Weak Rock Test ..... ASTM D 4644
Point Load Test of Rock Core Specimens ..... ISRM* / ASTM D5731
CBR (California Bearing Ration) of Laboratory-Compacted Soils ..... ASTM D 1883
Laboratory Compaction Characteristics of Soil using Standard Effort ..... ASTM D 698
Laboratory Compaction Characteristics of Soil using Modified Effort ..... ASTM D 1557
One-Dimensional Consolidation Properties of Soils ..... ASTM D 2435
One-Dimensional Swell or Settlement Potential of Cohesive Soils ..... ASTM D 4546
Ph of Soil ..... ASTM D 4972

*ISRM – International Society for Rock Mechanics

II. Concrete Testing

Compressive Strength for Cylindrical Concrete Specimens ..... ASTM C-39
Acid-Soluble Chloride in Mortar and Concrete ..... ASTM C 1152

CLASSIFICATION OF SOILS

Ohio Department of Transportation

(The classification of a soil is found by proceeding from top to bottom of the chart. The first classification that the test data fits is the correct classification.)

SYMBOL	DESCRIPTION	Classifcation AASHTO	Classifcation OHIO	$LL_O/LL \times 100$*	% Pass #40	% Pass #200	Liquid Limit (LL)	Plastic Index (PI)	Group Index Max.	REMARKS
	Gravel and/or Stone Fragments	A-1-a			30 Max.	15 Max.		6 Max.	0	Min. of 50% combined gravel, cobble and boulder sizes
	Gravel and/or Stone Fragments with Sand	A-1-b			50 Max.	25 Max.		6 Max.	0	
F.S.	Fine Sand	A-3			51 Min.	10 Max.	NON-PLASTIC		0	
	Coarse and Fine Sand	--	A-3a			35 Max.		6 Max.	0	Min. of 50% combined coarse and fine sand sizes
	Gravel and/or Stone Fragments with Sand and Silt	A-2-4				35 Max.	40 Max.	10 Max.	0	
		A-2-5					41 Min.			
	Gravel and/or Stone Fragments with Sand, Silt and Clay	A-2-6				35 Max.	40 Max.	11 Min.	4	
		A-2-7					41 Min.			
	Sandy Silt	A-4	A-4a	76 Min.		36 Min.	40 Max.	10 Max.	8	Less than 50% silt sizes
	Silt	A-4	A-4b	76 Min.		50 Min.	40 Max.	10 Max.	8	50% or more silt sizes
	Elastic Silt and Clay	A-5		76 Min.		36 Min.	41 Min.	10 Max.	12	
	Silt and Clay	A-6	A-6a	76 Min.		36 Min.	40 Max.	11 - 15	10	
	Silty Clay	A-6	A-6b	76 Min.		36 Min.	40 Max.	16 Min.	16	
	Elastic Clay	A-7-5		76 Min.		36 Min.	41 Min.	≤LL-30	20	
	Clay	A-7-6		76 Min.		36 Min.	41 Min.	>LL-30	20	
	Organic Silt	A-8	A-8a	75 Max.		36 Min.				W/o organics would classify as A-4a or A-4b
	Organic Clay	A-8	A-8b	75 Max.		36 Min.				W/o organics would classify as A-5, A-6a, A-6b, A-7-5 or A-7-6

MATERIAL CLASSIFIED BY VISUAL INSPECTION

Sod and Topsoil
Pavement or Base
Uncontrolled Fill (Describe)
Bouldery Zone
Peat, S-Sedimentary W-Woody F-Fibrous L-Loamy & etc

* Only perform the oven-dried liquid limit test and this calculation if organic material is present in the sample.

APPENDIX A.1 - ODOT Quick Reference for Visual Description of Soils

1) STRENGTH OF SOIL:

Non-Cohesive (granular) Soils - Compactness

Description	Blows Per Ft.
Very Loose	≤ 4
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 – 50
Very Dense	> 50

2) COLOR :

If a color is a uniform color throughout, the term is single, modified by an adjective such as light or dark. If the predominate color is shaded by a secondary color, the secondary color procedes the primary color. If two major and distinct colors are swirled throughout the soil, the colors are modified by the term "mottled"

3) PRIMARY COMPONENT

Use **DESCRIPTION** from ODOT Soil Classification Chart on Back

Cohesive (fine grained) Soils - Consistency

Description	Qu (TSF)	Blows Per Ft.	Hand Manipulation
Very Soft	<0.25	<2	Easily penetrates 2" by fist
Soft	0.25-0.5	2 - 4	Easily penetrates 2" by thumb
Medium Stiff	0.5-1.0	5 - 8	Penetrates by thumb with moderate effort
Stiff	1.0-2.0	9 - 15	Readily indents by thumb, but not penetrate
Very Stiff	2.0-4.0	16 - 30	Readily indents by thumbnail
Hard	>4.0	>30	Indent with difficulty by thumbnail

4) COMPONENT MODIFIERS:

Description	Percentage By Weight
Trace	0% - 10%
Little	10% - 20%
Some	20% - 35%
"And"	35% -50%

5) Soil Organic Content

Description	% by Weight
Slightly Organic	2% - 4%
Moderately Organic	4% - 10%
Highly Organic	> 10%

6) Relative Visual Moisture

Description	Criteria	
	Cohesive Soil	**Non-cohesive Soils**
Dry	Powdery; Cannot be rolled; Water content well below the plastic limit	No moisture present
Damp	Leaves very little moisture when pressed between fingers; Crumbles at or before rolled to $^1/_8$"; Water content below plastic limit	Internal moisture, but no to little surface moisture
Moist	Leaves small amounts of moisture when pressed between fingers; Rolled to $^1/_8$" or smaller before crumbling; Water content above plastic limit to -3% of the liquid limit	Free water on surface, moist (shiny) appearance
Wet	Very mushy; Rolled multiple times to $^1/_8$" or smaller before crumbles; Near or above the liquid limit	Voids filled with free water, can be poured from split spoon.

APPENDIX A.2 - ODOT Quick Reference Guide for Rock Description

1) **ROCK TYPE:** Common rock types are: Claystone; Coal; Dolomite; Limestone; Sandstone; Siltstone; & Shale.

2) **COLOR:** To be determined when rock is wet. When using the GSA Color charts use only Name, not code.

3) **WEATHERING**

Description	Field Parameter
Unweathered	No evidence of any chemical or mechanical alternation of the rock mass. Mineral crystals have a bright appearance with no discoloration. Fractures show little or no staining on surfaces.
Slightly weathered	Slight discoloration of the rock surface with minor alterations along discontinuities. Less than 10% of the rock volume presents alteration.
Moderately weathered	Portions of the rock mass are discolored as evident by a dull appearance. Surfaces may have a pitted appearance with weathering "halos" evident. Isolated zones of varying rock strengths due to alteration may be present. 10 to 15% of the rock volume presents alterations.
Highly weathered	Entire rock mass appears discolored and dull. Some pockets of slightly to moderately weathered rock may be present and some areas of severely weathered materials may be present.
Severely weathered	Majority of the rock mass reduced to a soil-like state with relic rock structure discernable. Zones of more resistant rock may be present, but the material can generally be molded and crumbled by hand pressures.

5) TEXTURE

Component		Grain Diameter
Boulder		>12"
Cobble		3"-12"
Gravel		0.08"-3"
Sand	**Coarse**	0.02"-0.08"
	Medium	0.01"-0.02"
	Fine	0.005"-0.01"
	Very fine	0.003"-0.005"

4) **RELATIVE STRENGTH**

Description	Field Parameter
Very Weak	Core can be carved with a knife and scratched by fingernail. Can be excavated readily with a point of a pick. Pieces 1 inch or more in thickness can be broken by finger pressure.
Weak	Core can be grooved or gouged readily by a knife or pick. Can be excavated in small fragments by moderate blows of a pick point. Small, thin pieces can be broken by finger pressure.
Slightly Strong	Core can be grooved or gouged 0.05 inch deep by firm pressure of a knife or pick point. Can be excavated in small chips to pieces about 1-inch maximum size by hard blows of the point of a geologist's pick.
Moderately Strong	Core can be scratched with a knife or pick. Grooves or gouges to ¼" deep can be excavated by hand blows of a geologist's pick. Requires moderate hammer blows to detach hand specimen.
Strong	Core can be scratched with a knife or pick only with difficulty. Requires hard hammer blows to detach hand specimen. Sharp and resistant edges are present on hand specimen.
Very Strong	Core cannot be scratched by a knife or sharp pick. Breaking of hand specimens requires hard repeated blows of the geologist hammer.
Extremely strong	Core cannot be scratched by a knife or sharp pick. Chipping of hand specimens requires hard repeated blows of the geologist hammer.

6) BEDDING

Description	Thickness
Very Thick	>36"
Thick	18" – 36"
Medium	10" – 18"
Thin	2" – 10"
Very Thin	0.4" – 2"
Laminated	0.1" – 0.4"
Thinly Laminated	<0.1"

7) DESCRIPTORS

Arenaceous – sandy	Argillaceous - clayey	Brecciated – contains angular to subangular gravel
Calcareous - contains calcium carbonate	Carbonaceous - contains carbon	Cherty- contains chert fragments
Conglomeritic - contains rounded to subrounded gravel	Crystalline – contains crystalline structure	Dolomitic- contains calcium/magnesium carbonate
Ferriferous – contains iron	Fissile – thin planner partings	Fossiliferous – contains fossils
Friable – easily broken down	Micaceous – contains mica	Pyritic – contains pyrite
Siliceous – contains silica	Stylolitic – contain stylotites (suture like structure)	Vuggy – contains openings

8) DISCONTINUITIES

a) Discontinuity Types

Type	Parameters
Fault	Fracture which expresses displacement parallel to the surface that does not result in a polished surface.
Joint	Planar fracture that does not express displacement. Generally occurs at regularly spaced intervals.
Shear	Fracture which expresses displacement parallel to the surface that results in polished surfaces or slickensides.
Bedding	A surface produced along a bedding plane.
Contact	A surface produced along a contact plane. (generally not seen in Ohio)

b) Degree of Fracturing

Description	Spacing
Unfractured	> 10 ft
Intact	3 ft. – 10 ft.
Slightly fractured	1 ft – 3 ft
Moderately fractured	4 in. – 12 in.
Fractured	2 in – 4 in.
Highly fractured	< 2 in.

c) Aperture Width

Description	Spacing
Open	> 0.2 in.
Narrow	0.05 in. - 0.2 in.
Tight	<0.05 in.

d) Surface Roughness

Description	Criteria
Very Rough	Near vertical steps and ridges occur on the discontinuity surface.
Slightly Rough	Asperities on the discontinuity surface are distinguishable and can be felt.
Slickensided	Surface has a smooth, glassy finish with visual evidence of striation.

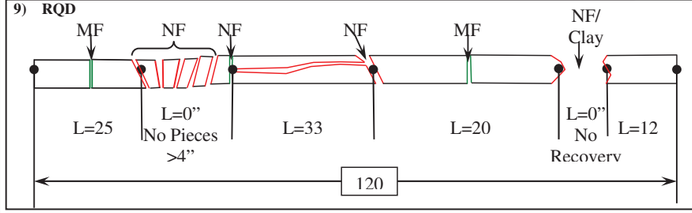
10) LOSS

$$Run\ Loss = \left(\frac{L_R - R_R}{L_R}\right) * 100 \quad Unit\ Loss = \left(\frac{L_U - R_U}{L_U}\right) * 100$$

L_R=Run Length R_R=Run Recovery

L_U=Rock Unit Length R_U=Rock Unit Recovery

9) RQD



$$RQD = \left(\frac{\sum Length\ of\ Pieces > 4inches}{Total\ Length\ of\ Core}\right) * 100$$

$$RQD = \left(\frac{25+33+20+12}{120}\right) * 100 = 75\%$$