Stantec Consulting Services Inc.
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December 14, 2022
File: 175538112

Attention: Alec Sadowski
District Geotechnical Engineer
Ohio Department of Transportation, District 8
505 South SR 741
Lebanon, Ohio 45036

Reference: HAM-74-14.20
Report of Landslide Exploration - FINAL
PID No. 110174

Dear Mr. Sadowski:

Stantec Consulting Services Inc. (Stantec) is pleased to submit the attached draft "Report of Landslide Exploration, HAM-74-14.20". Stantec performed the geotechnical exploration at the site from June 25 to July 3, 2019, with additional borings advanced in 2022. The exploration, analyses, and report were conducted and compiled in accordance with the ODOT Specifications for Geotechnical Explorations (SGE). The report includes sections regarding the geology and observations of the project, the exploration, findings, and analysis and recommendations. Also included are soil profile drawings and results of analyses.

Thank you for the opportunity to provide these geotechnical engineering services. If you have any questions, or if you need more information, please contact our office.

Regards,

Stantec Consulting Services Inc.

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Attachment: Report of Landslide Exploration (FINAL)

STATE OF OHIO
ERIC M. KISTNER
E-65507
12/14/22
REGISTERED PROFESSIONAL ENGINEER

HAM-74-14.20
Report of Landslide Exploration (FINAL)

PID No. 110174

Hamilton County, Ohio

December 14, 2022

Prepared for:

Ohio Department of Transportation,
District 8

Prepared by:

Stantec Consulting Services Inc.
Cincinnati, Ohio

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Executive Summary

Two landslides on an embankment slope are impacting approximately 450 feet of the outside shoulder of eastbound IR-74, a short distance west of the off ramp for North Bend Road (Exit 14). The Ohio Department of Transportation (ODOT) is planning to stabilize the roadway shoulder along the alignment. Stantec Consulting Services Inc. (Stantec) was originally contracted by ODOT in 2019 to perform the geotechnical exploration and preliminary design for this project and was retained in 2022 to perform design services for the repair project.

The landslides are occurring on an embankment slope constructed when the highway was built in the mid-1960s. There are two culverts running underneath the embankment, with the outlets located near the toe of each landslide. The landslides appear to have been caused by softening of the embankment slopes from periods of saturation, freezing and thawing, and possibly by erosion around the culvert outlets causing a reduction of resisting force at the embankment toe.

Six borings were advanced in 2019, and two additional borings were advanced in 2022, in general accordance with the ODOT Specifications for Geotechnical Explorations (SGE). Four borings were drilled through the embankment on the shoulder of the westbound deceleration lane of the North Bend Road Exit (Exit 14). Two borings were drilled in the grass median. The additional 2022 borings were advanced near the toe of each landslide. Surface elevations of the 2019 borings ranged from 873 to 885 feet and the 2022 borings ranged from 830 to 836 feet. Surface materials consisted of either 8 inches of asphalt pavement underlain by 10 inches of granular base at the borings advanced on the shoulder of IR-74 or topsoil in the borings drilled in the median and at the toe.

For borings drilled from the top of the slope, the embankment fill material underlying the surface materials consisted of medium stiff to hard clay (A-7-6) or silty clay (A-6b) with some intermixed limestone slabs. The embankment fill soil appeared to be approximately 25 to 40 feet thick. The fill was underlain by naturally deposited clay (A-7-6), silty clay (A-6b), and silt and clay (A-6a) with a thickness of approximately 8 to 14 feet. Borings at the toe of each landslide encountered silt and clay (A-6a) and silty clay (A-6b) below surface topsoil to a depth of 4.5 to 6 feet. Boring B-002-2-22 encountered sandy silt at a depth of 4.5 feet to 8 feet.

Bedrock was encountered in 6 of the 8 borings at depths ranging from 6.5 to 54 feet (Elevation 822 to 839). The bedrock was described as interbedded limestone and shale comprised of approximately 65 percent to 80 limestone.

It is recommended that special benching be performed at the site from Station 767+25 to 773+00 (total length of 575 feet) to remove most of the unstable soil mass. The slope then be rebuilt with flattened slopes and internal drainage (explained further in Section 5.2). To keep current lanes of traffic open on I-74, a shoring system will need to be constructed along the eastbound shoulder (explained further in Section 5.3). Inspection and possible repair or modifications to the existing culverts may be necessary.

1.0 INTRODUCTION

Two adjacent landslides on an embankment slope are impacting approximately 450 feet of the outside shoulder of eastbound IR-74, a short distance west of the off ramp for North Bend Road (Exit 14). The Ohio Department of Transportation (ODOT) is planning to stabilize the roadway shoulder along the alignment. Stantec Consulting Services Inc. (Stantec) was originally contracted by ODOT in 2019 to perform the geotechnical exploration and preliminary design for this project and was retained in 2022 to perform additional exploratory drilling and design services for the repair project. Figure 1 shows the site and vicinity.

Figure 1. Portion of USGS topographic map (Cincinnati West, Ohio quadrangle) showing project site.

2.0 GEOLOGY AND OBSERVATIONS OF THE PROJECT

2.1 GENERAL

The Physiographic Regions of Ohio Map (Ohio Department of Natural Resources (ODNR), 1998) indicates that the project site is located in the Outer Bluegrass Region of the Bluegrass Section of the Intermediate Low Plateaus province of the Interior Plains. The Outer Bluegrass Region is described as a moderately high relief (300') dissected plateau of carbonate rocks which may, in the east, have caves and other karst features or, in the west, have glacial drift that caps narrow ridges. Silt-loam colluvium overlies Ordovician- and Silurian-age dolomites, limestones, and calcareous shales and, in the west, thin pre-Wisconsinan drift on ridges.

2.2 SOIL GEOLOGY

According to the Quaternary Geology of Ohio map (ODNR, 1999), the project site is underlain by Illinoian-age water-deposited units as dissected ground moraine occurring on ridgetops and mixed with weathered bedrock as colluvium on slopes.

The soil survey (Web Soil Survey of Hamilton County, Ohio, United States Department of Agriculture (USDA), 2020) indicates that the project site is underlain primarily by the Urban land-Udorthents complex (UsUXF) and Eden silty clay loam (EcE). Udorthents are areas of wet substratum consisting of disturbed soils where the upper soil material has been removed, filled or graded. They are moderately well-drained, gravelly and sandy soil areas located within areas of glacial fluvial deposits. Eden soils are described as silty clay found on hills and formed from underlying weathered bedrock.

2.3 BEDROCK GEOLOGY

Bedrock mapping (Bedrock Geology of the Cincinnati West, Ohio Quadrangle, [ODNR, 1996]) and Descriptions of Geologic Map Units (ODNR, 2000) indicates that the overburden soils at the project site are underlain primarily by sedimentary bedrock from the undivided Waynesville and Arnheim formations of the Ordovician geologic period. The Waynesville and Arnheim formations are comprised of interbedded shale (60 to 70%) and limestone (30 to 40%). The bedrock is described as gray to bluish gray, weathering light gray. The Waynesville formation bedding is planar to irregular and the thickness ranges from 90 to 120 feet. The Arnheim formation bedding is planar, wavy, irregular, and nodular and the thickness ranges from 50 to 100 feet.

According to the online Ohio Mine Locator (ODNR, 2015), there are no known abandoned underground mines in the project footprint. The Ohio Karst Areas map (ODNR, 2009) indicates the bedrock beneath the site is interbedded Ordovician-age limestone and shale overlain by glacial drift and/or alluvium. It also indicates that there are no probable karst areas near the site in western Hamilton County.

2.4 SEISMIC

A review of the seismic data available in the project vicinity included the OhioSeis database developed by the ODNR, Division of Geological Survey. The review was performed using the internet mapping service (rev. 2012) at the following website: https://gis.ohiodnr.gov/website/dgs/earthquakes. For Indiana, the following website was used: https://maps.indiana.edu/previewMaps/Geology/Seismic_Earthquake_ Epicenters. Data for this website is a compilation of data from U.S. Nuclear Regulatory Commission and the U.S.G.S. All values are in Moment Magnitude (Mw).

Overall, Ohio has a relatively limited amount of seismic activity. Within a 10-mile radius of the project, there have been four historical (vs. instrumental) earthquakes with recorded magnitudes ranging from 3.0 to 4.0. The epicenters are in the Cincinnati downtown area approximately 6 to 8 miles to the southeast. The available data reviewed included events that occurred from 1804 to present day.

2.5 HYDROLOGY

Two box culverts within the project limits convey drainage from the north side of IR-74 and create a drainage swale near the toe of the south embankment slope that drains to Taylor Creek, which eventually drains to the Great Miami River near Miamitown, Ohio.

2.6 HYDROGEOLOGY

According to the map Ground-Water Resources of Hamilton County (ODNR, 1986), the project site is *"characterized as a poor source of ground water. Bedrock consists of interbedded plastic shales and thin limestone layers. If water is present in the rock, it usually occurs in the upper few feet where the strata have been somewhat weathered and broken. Wells seldom produce more than 3 gallons per minute…Overlying glacial cover generally ranges from 20 to 50 feet thick and consists largely of clay. Occasional lenses of sand and gravel will supply limited yields."*

2.7 RECONNAISSANCE

Stantec representatives visited the site on June 20, 2019. The slope instability was observed along the south roadway embankment. Two landslides were observed, the first of which was from approximate Station 767+60 to 769+05, for a total length of 145 feet. The second landslide was observed from approximate Station 770+50 to 772+50, for a total length of 200 feet. There is a length of about 150 feet between the two landslides where the roadway is unaffected. Along the affected alignment, the eastbound shoulder pavement is showing signs of distress (cracking and sloughing of pavement) with some guardrail misalignment. The scarps of the landslide are located from approximately along the guardrail to about 25 feet downhill from the guardrail. The distances from the scarps to the toe bulges are 30 to 40 feet vertically and 80 to 100 feet horizontally. The side of the embankment is vegetated with brush. No earth retaining systems were observed at the project location. Two box culverts, one within each landslide area, convey water from the north side of the roadway to a drainage channel at the toe of the slope on the south side of the embankment.

Stantec representatives later visited the site on March 9, 2022 prior to additional exploratory drilling. Further slope instability was observed, with guardrail foundations now exposed along the south roadway embankment. When staking the borings near the toe of each landslide, it was observed that surficial water drainage made soils at the ground surface wet and soft. Significant soil erosion was observed near the outlets of the two box culverts.

3.0 EXPLORATION

3.1 HISTORIC EXPLORATION PROGRAMS

The ODOT Traffic Information Management System (TIMS) provides information for the HAM-52-11.37 realignment project from 1963, which was along the current alignment of IR-74. The soil profile drawing for the alignment near the current landslides indicates shallow cohesive soil (generally less than 10 feet deep) underlain by shale with interbedded limestone bedrock. The drawings show a planned centerline fill ranging from about 40 to 60 feet deep where the current landslides are located.

A search of the ODNR Oil & Gas Well Locator (2018) indicates no oil or gas wells are located nearby.

3.2 PROJECT EXPLORATION PROGRAM

Six borings were advanced in 2019, and two additional borings were advanced in 2022, in general accordance with the ODOT Specifications for Geotechnical Explorations (SGE). Four borings were drilled through the embankment on the shoulder of the westbound deceleration lane of the North Bend Road Exit (Exit 14). Two borings were drilled in the grass median. The additional 2022 borings were advanced near the toe of each landslide. A summary of the borings is shown in Table 1. The logs of borings and a site plan showing boring locations is presented in Appendix A.

Table 1. Boring Summary

Boring No.	Station[1] (feet)	Offset[1] (feet)	Ground Surface Elevation (feet)	Top of Bedrock Elevation (feet)	Bottom of Boring Elevation (feet)
B-001-0-19	767+70	63’ Rt.	873.0	836.2	820.2
B-002-0-19	768+35	63’ Rt.	875.8	829.3	814.2
B-002-1-19	769+35	14’ Rt.	875.2	828.0	828.0
B-002-2-22	769+06	206 Rt.	829.5	821.5	817.7
B-003-0-19	770+06	63’ Rt.	879.6	838.5	822.3
B-003-1-19	770+04	15’ Rt.	879.1	844.0	844.0
B-003-2-22	771+60	215’ Rt.	836.0	829.5	827.7
B-004-0-19	771+91	62’ Rt.	884.7	830.8	815.4

[1]Stations and offsets are measured along and perpendicular to the centerline of IR-74.

The 2019 borings were performed with a CME 45 truck-mounted drill rig using 3¼-inch inside diameter (ID) hollow stem augers to advance the borings through soil. Standard Penetration Test (SPT) sampling was performed continuously or at 2.5-foot intervals until bedrock was encountered. The energy ratio (ER) of the automatic hammer and drill rod system was measured to be 90 percent on July 10, 2019. The 2022 borings were performed with a CME 55 track-mounted drill rig using 3¼-inch inside diameter (ID) hollow stem augers to advance the borings through soil. Standard Penetration Test (SPT) sampling was performed continuously until bedrock was encountered. The energy ratio (ER) of the automatic hammer and drill rod system was measured to be 90 percent on March 3, 2021.

The SPT is performed by advancing a split-spoon sampler, 18 inches in length, with a 140-pound automatic hammer dropping 30 inches at select depth intervals in the boring. The number of hammer blows needed to advance the sampler each 6-inch increment is recorded. The blow count from the first 6-inch increment is discarded due to ground disturbance at the bottom of the borehole. The sum of the blow counts from the last two 6-inch increments is called the field N-value (N_{field}). The field N-value is corrected to an equivalent rod energy ratio of 60 percent (N_{60}) according to the equation below.

$$N_{60} = N_{field}\left(\frac{ER}{60}\right)$$

The depths/elevations of the SPTs with the corresponding N_{60}-values are shown on the boring logs in Appendix A.

Upon encountering bedrock, rock coring was performed in Borings B-001-0-19, B-002-0-19, B-003-0-19, and B-004-0-19 using NQ-size equipment. Recovery, core loss, and rock quality designation (RQD) values were recorded as percentages for each coring run. The recovery is a measurement of the core sample obtained from a core run. The loss is the difference between the core run and the recovery. The RQD is measured by dividing the sum of all pieces of intact rock core longer than four inches in a run by the total length of the core run. These values are shown on the boring logs contained in Appendix A.

The materials encountered were logged by a geotechnical engineer, with particular attention given to soil type, consistency, and moisture content. The borings were checked for the presence of groundwater during drilling and at its conclusion with the depth of water recorded. The borings advanced through the roadway were sealed according the ODOT SGE and capped with asphalt cold patch.

The soil samples obtained from the borings were returned to a Stantec geotechnical laboratory for visual classification and tested for water content. Engineering classification testing was also performed on the samples reflecting each of the main soil horizons. The engineering classification tests conducted on the samples were sieve and hydrometer analysis (ASTM D 422) and Atterberg limits (ASTM D 4318). The samples were classified according to the ODOT classification method. Bedrock samples were subject to unconfined compressive strength testing (ASTM D7012, Method C).

4.0 FINDINGS

Surface materials consisted of either 8 inches of asphalt pavement underlain by 10 inches of granular base or topsoil in the borings drilled in the median and at the toe of each landslide. The embankment fill material underlying the surface materials consisted of medium stiff to hard clay (A-7-6) or silty clay (A-6b) with some intermixed limestone slabs. The embankment fill soil ranged in thickness from 24 to 40 feet. SPT N_{60} values ranged from 6 to over 50 with an average of 18. Water contents varied from 8 to 31 percent with an average of 20 percent. Liquid limits ranged from 36 to 56 and plasticity indices varied from 18 to 34.

The fill was underlain by naturally deposited medium stiff to hard clay (A-7-6), silty clay (A-6b), and silt and clay (A-6a) with a thickness of approximately 8 to 14 feet. SPT N_{60} values varied from 8 to over 50 with an average of 25. Water contents varied from 10 to 29 percent with an average of 21 percent. Liquid limits ranged from 26 to 67 and plasticity indices varied from 12 to 44.

Borings at the toe of each landslide encountered silt and clay (A-6a) and silty clay (A-6b) below surface topsoil to a depth of 4.5 to 6 feet. SPT N_{60} values varied from 0 to 29 with an average of 14. Water contents varied from 13 to 24 percent with an average of 20 percent. Liquid limits ranged from 27 to 34 and plasticity indices varied from 10 to 15. Boring B-002-2-22 encountered sandy silt (A-4a) at a depth of 4.5 feet to a depth of 8 feet. SPT N_{60} values ranged from 47 to 56 in the two samples encountered. Water content was 15 percent in both samples. The liquid limit of this material was 27 with a plasticity index of 10. Each boring was advanced until auger refusal was reached at a depth of 11.8 feet in B-002-2-22 and 8.3 feet in B-003-2-22.

Bedrock was encountered in six of the eight borings at depths ranging from 6.5 to 54 feet (Elevation 822 to 839). The bedrock was described as interbedded limestone and shale comprised of approximately 65 to 80 percent limestone. The limestone was further described as gray, slightly to moderately weathered, and moderately strong. The shale was further described as dark gray, moderately weathered, and weak to slightly strong. Seven laboratory UCR tests on limestone with interbedded shale samples resulted in compressive strengths ranging from 2,911 to 3,910 pounds per square inch with an average of 3,090 pounds per square inch.

Groundwater was not observed in any of the borings.

5.0 ANALYSIS AND RECOMMENDATIONS

5.1 GENERAL

Two landslides are occurring along IR-74 that affect the shoulder of the road along a distance of about 450 feet. The landslides are occurring on an embankment slope constructed when the highway was built in the mid-1960s. There are two culverts running underneath the embankment, with the outlets located at the toe of each landslide. The landslides appear to have been caused by softening of the embankment

slopes from periods of saturation, freezing and thawing, and possibly by erosion around the culvert outlets causing a reduction of resisting force at the embankment toe.

Two remediation solutions were considered. The first was a wall along the shoulder that would protect the roadway from further movement and damage. The second was a benched excavation of most of the failed material and replacement of the slope at approximately 3:1 (horizontal to vertical slope, or flatter if necessary to stay within right-of-way) with embankment material and internal drainage. With the first option, continued movement of the slope would be likely downhill from the wall, which could damage the culverts. The second option was considered preferable.

It is recommended that special benching be performed at the site from Station 767+25 to 773+00 (total length of 575 feet) to remove most of the unstable soil mass and the slope be rebuilt with added internal drainage (explained further is Section 5.2). The rebuilt embankment should have a slope of 3H:1V (horizontal to vertical), where possible. In some areas along the alignment, however, a steeper slope will need to be used to stay within ODOT right-of-way limits. Current design plans show proposed slopes ranging from 2.3H:1V to 2.7H:1V. To keep current lanes of traffic open on I-74, a shoring system will need to be constructed along the eastbound shoulder (explained further in Section 5.3). After the excavation benching is performed, the existing culverts should be inspected for damage and extended beyond the proposed embankment if necessary.

The recommendations that follow are based on the information discussed in this report and the interpretation of the subsurface conditions encountered at the site during our fieldwork. If future design changes are made, Stantec should be notified so that such changes can be reviewed, and the recommendations amended as necessary.

These conclusions and recommendations are based on data and subsurface conditions from the borings advanced during this exploration using the degree of care and skill ordinarily exercised under similar circumstances by competent members of the engineering profession. No warranties can be made regarding the continuity of conditions.

5.2 EXCAVATION BENCHING AND SLOPE REBUILD

A stability back analysis was performed at Station 771+84 using the results of the borings and existing topography to estimate the shear strength parameters of the existing slope, assuming a current factor of safety of 1.0. Through this process, the embankment soil was estimated to have residual shear strength of zero cohesion and a drained angle of internal friction of 14.5 degrees. A graphical output showing the results of the stability back analysis is presented in Appendix B.

Excavation benching in accordance with ODOT Geotechnical Bulletin 2 (GB 2: “Special Benching and Sidehill Embankment Fills”) for landslide stabilization is recommended. The recommended configuration of the excavation slopes and benches were based on Figure 4 in GB2 and are shown on the cross sections in Appendix A. The bottom of the excavation should extend to an elevation that removes failed material at the toe of the slope. This bottom of excavation varied across the alignment between elevations of 824 and 850.

One excavation bench is proposed that ranges in elevation from 845 to 860 feet. Slope drains should be installed that consist of an 18-inch layer of Item 203 Granular Embankment (No. 8 Stone) with Item 690E12010 Special Geotextile Fabric, Item 712.09 Type A, to prevent infiltration of fines into the drain. A 6-inch diameter Item 611 Conduit Type E, 707.31 (perforated) should be installed along the bottom of the slope drain. The bench should be designed with a minimum 1 percent grade to allow drainage to convey to drains (Item 611 Conduit Type F 707.33) that outlet through the face of the slope.

Slope stability analyses were performed for the proposed bench and slope configurations at Station 768+50 and 770+50. The soil parameters estimated from the stability back analysis were used to analyze model the weakened soil near the existing failure surface. The existing embankment was modelled using an undrained cohesion of 1,500 psf, drained cohesion of 150 psf, and a drained friction angle of 24 degrees. The shear strength parameters used for the new embankment material were assumed to be a drained cohesion of 200 psf, a drained friction angle of 26 degrees, and an undrained cohesion of 2,000 psf based on Table 1 from GB 2 for an assumed borrow source of A-7-6 soil. The resulting factor or safety was 1.5 to 1.6 for drained conditions and 2.2 to 2.3 for undrained conditions. Graphical output showing the results of this stability analyses are shown in Appendix B.

5.3 SHORING SYSTEM

A cantilever pile and lagging wall was analyzed along the I-74 eastbound shoulder to allow for excavation benching while keeping current lanes of traffic open. The design of temporary shoring is typically the responsibility of the contractor. This analysis was done to demonstrate the feasibility of this approach. The contractor should be required to provide design of the actual system, stamped by a licensed engineer.

The exposed height of the shoring during the excavation of the stability benches will range from 5 to 10 feet. A section where the wall was 10 feet tall was used to design the pile size for the shoring. Coulomb active earth pressure was used to determine the loading on the wall. An LPILE analysis was performed to determine the required pile size, spacing, and embedment length. HP14x73 piles at 6-foot center-to-center spacing met the requirements for deflection, shear, and moment. The analysis showed that a minimum embedment length of 25 feet was necessary, resulting in total pile lengths of 35 feet. The piles can be driven or prebored with the anulus around the pile backfilled with flowable fill or lean concrete with a compressive strength of at least 4,000 pounds per square foot (roughly equivalent to the surrounding soil) or greater. A maximum deflection of 1.8 inches (Service I Loading), a maximum shear of 29 kips per pile (Strength 1 Loading), and a maximum moment of 207 kip-feet per pile (Strength I Loading) were estimated. Calculations are presented in Appendix C.

APPENDIX A

Soil Profile Drawings

PROJECT DESCRIPTION

THIS PROJECT, HAM-74-14.20, IS THE EXPLORATION OF TWO ADJACENT LANDSLIDE GEOHAZARDS LOCATED ON THE EASTBOUND EMBANKMENT SLOPES OF IR-74 WEST OF THE NORTH BEND ROAD EXIT NEAR MILE MARKER 14.20 IN HAMILTON COUNTY.

HISTORIC RECORDS

AN EXPLORATION FOR THE HAM-52-11.37 REALIGNMENT PROJECT FROM 1963 WAS ALONG THE CURRENT ALIGNMENT OF IR-74. THE SOIL PROFILE DRAWING FOR THE ALIGNMENT NEAR THE CURRENT LANDSLIDES INDICATES SHALLOW COHESIVE SOIL (GENERALLY LESS THAN 10 FEET DEEP) UNDERLAIN BY SHALE WITH INTERBEDDED LIMESTONE BEDROCK. THE DRAWINGS SHOW A PLANNED CENTERLINE FILL RANGING FROM ABOUT 40 TO 60 FEET DEEP WHERE THE CURRENT LANDSLIDES ARE LOCATED.

GEOLOGY

THE PROJECT SITE IS LOCATED WITHIN THE OUTER BLUEGRASS REGION OF THE BLUEGRASS SECTION OF THE INTERMEDIATE LOW PLATEAUS PROVINCE OF THE INTERIOR PLAINS. THE OUTER BLUEGRASS REGION IS DESCRIBED AS A MODERATELY HIGH RELIEF (300 FEET) DISSECTED PLATEAU OF CARBONATE ROCKS WHICH CONSISTS OF THIN PRE-WISCONSINAN DRIFT ON RIDGES. OVERBURDEN SOILS AT THE PROJECT SITE ARE UNDERLAIN PRIMARILY BY SEDIMENTARY BEDROCK FROM THE WAYNESVILLE AND ARNHEIM FORMATIONS OF THE ORDOVICIAN GEOLOGIC PERIOD. THE WAYNESVILLE AND ARNHEIM FORMATIONS ARE COMPRISED OF INTERBEDDED SHALE (60 TO 70% OF THE UNIT) AND LIMESTONE (30 TO 40% OF THE UNIT). THE BEDROCK IS DESCRIBED AS GRAY TO BLUISH GRAY, WEATHERING TO LIGHT GRAY. BEDDING OF THE WAYNESVILLE FORMATION IS PLANAR TO IRREGULAR AND BEDDING OF THE ARNHEIM FORMATION IS PLANAR, WAVY, IRREGULAR, AND NODULAR.

RECONNAISSANCE

STANTEC REPRESENTATIVES VISITED THE SITE ON JUNE 20, 2019. THE SLOPE INSTABILITY WAS OBSERVED ALONG THE SOUTH ROADWAY EMBANKMENT. TWO LANDSLIDES WERE OBSERVED, THE FIRST OF WHICH WAS FROM APPROXIMATE STATION 767+60 TO 769+05, FOR A TOTAL LENGTH OF 145 FEET. THE SECOND LANDSLIDE WAS OBSERVED FROM APPROXIMATE STATION 770+50 TO 772+50, FOR A TOTAL LENGTH OF 200 FEET. THERE IS A LENGTH OF ABOUT 150 FEET BETWEEN THE TWO LANDSLIDES WHERE THE ROADWAY IS UNAFFECTED. ALONG THE AFFECTED ALIGNMENT, THE EASTBOUND SHOULDER PAVEMENT IS SHOWING SIGNS OF DISTRESS (CRACKING AND SLOUGHING OF PAVEMENT) WITH SOME GUARDRAIL MISALIGNMENT. THE SCARPS OF THE LANDSLIDE ARE LOCATED FROM APPROXIMATELY ALONG THE GUARDRAIL TO ABOUT 25 FEET DOWNHILL FROM THE GUARDRAIL. THE DISTANCES FROM THE SCARPS TO THE TOE BULGES ARE 30 TO 40 FEET VERTICALLY AND 80 TO 100 FEET HORIZONTALLY. THE SIDE OF THE EMBANKMENT IS VEGETATED WITH BRUSH. NO EARTH RETAINING SYSTEMS WERE OBSERVED AT THE PROJECT LOCATION. TWO BOX CULVERTS, ONE WITHIN EACH LANDSLIDE AREA, CONVEY WATER FROM THE NORTH SIDE OF THE ROADWAY TO A DRAINAGE CHANNEL AT THE TOE OF THE SLOPE ON THE SOUTH SIDE OF THE EMBANKMENT.

STANTEC REPRESENTATIVES ALSO VISITED THE SITE ON MARCH 9, 2022. FURTHER SLOPE INSTABILITY WAS OBSERVED, WITH GUARDRAIL FOUNDATIONS NOW EXPOSED ALONG THE SOUTH ROADWAY EMBANKMENT. WHEN STAKING THE BORINGS NEAR THE TOE OF EACH LANDSLIDE, IT WAS OBSERVED THAT SURFICIAL WATER DRAINAGE MADE SOILS AT THE GROUND SURFACE WET AND SOFT. HIGH AMOUNTS OF SOIL EROSION WERE OBSERVED AT THE LOCATIONS OF THE TWO BOX CULVERTS.

SUBSURFACE EXPLORATION

SIX BORINGS WERE ADVANCED IN JUNE AND JULY 2019 AND TWO ADDITIONAL BORINGS WERE ADVANCED IN APRIL 2022 IN GENERAL ACCORDANCE WITH THE ODOT SPECIFICATIONS FOR GEOTECHNICAL EXPLORATIONS (SGE). FOUR BORINGS WERE DRILLED THROUGH THE EMBANKMENT ON THE SHOULDER OF THE WESTBOUND DECELERATION LANE OF THE NORTH BEND ROAD EXIT (EXIT 14). TWO BORINGS WERE DRILLED IN THE GRASS MEDIAN. THE ADDITIONAL BORINGS DRILLED IN 2022 WERE LOCATED NEAR THE TOE OF EACH LANDSLIDE.. THE BORINGS WERE DRILLED WITH A TRACK-MOUNTED DRILL RIGS USING 3.25-INCH I.D. HOLLOW-STEM AUGERS. DISTURBED SOIL SAMPLES WERE OBTAINED IN ACCORDANCE WITH THE STANDARD PENETRATION TEST (AASHTO T206) AT CONTINUOUS OR 2.5-FOOT INTERVALS. THE AUTOMATIC SAMPLING HAMMER FOR THE 2019 BORINGS WAS CALIBRATED ON JULY 10, 2019 AND HAS A DRILL ROD ENERGY RATIO (ER) OF 90 PERCENT. THE AUTOMATIC SAMPLING HAMMER FOR THE 2022 BORINGS WAS CALIBRATED ON MARCH 3, 2021 AND HAS A DRILL ROD ENERGY RATIO (ER) OF 90 PERCENT. ROCK CORING WAS PERFORMED IN 4 OF THE BORINGS USING NQ-SIZE CORING EQUIPMENT.

EXPLORATION FINDINGS

SURFACE MATERIALS CONSISTED OF EITHER 8 INCHES OF ASPHALT PAVEMENT UNDERLAIN BY 10 INCHES OF GRANULAR BASE OR TOPSOIL IN THE BORINGS DRILLED IN THE MEDIAN AND AT THE TOE OF EACH LANDSLIDE.

IN THE BORINGS ADVANCED FROM THE TOP OF THE SLOPE, EMBANKMENT FILL MATERIAL WAS OBSERVED UNDERLYING THE SURFACE MATERIALS AND WAS COMPRISED OF MEDIUM STIFF TO HARD CLAY (A-7-6) OR SILTY CLAY (A-6B) WITH SOME INTERMIXED LIMESTONE SLABS. THE EMBANKMENT FILL SOIL RANGED IN THICKNESS FROM 24 TO 40 FEET. SPT N60 VALUES RANGED FROM 6 TO OVER 50 WITH AN AVERAGE OF 18. WATER CONTENTS VARIED FROM 8 TO 31 PERCENT WITH AN AVERAGE OF 20 PERCENT. LIQUID LIMITS RANGED FROM 36 TO 56 AND PLASTICITY INDICES VARIED FROM 18 TO 34. THE FILL WAS UNDERLAIN BY NATURALLY DEPOSITED MEDIUM STIFF TO HARD CLAY (A-7-6), SILTY CLAY (A-6B), AND SILT AND CLAY (A-6A) WITH A THICKNESS OF APPROXIMATELY 8 TO 14 FEET. SPT N60 VALUES VARIED FROM 8 TO OVER 50 WITH AN AVERAGE OF 25. WATER CONTENTS VARIED FROM 10 TO 29 PERCENT WITH AN AVERAGE OF 21 PERCENT. LIQUID LIMITS RANGED FROM 26 TO 67 AND PLASTICITY INDICES VARIED FROM 12 TO 44.

IN THE BORINGS AT THE TOE OF THE SLOPE, SILT AND CLAY (A-6A) AND SILTY CLAY (A-6B) WERE OBSERVED BELOW THE SURFACE TOPSOIL TO A DEPTH OF 4.5 TO 6 FEET. SPT N60 VALUES VARIED FROM 0 TO 29 WITH AN AVERAGE OF 14. WATER CONTENTS VARIED FROM 13 TO 24 PERCENT WITH AN AVERAGE OF 20 PERCENT. LIQUID LIMITS RANGED FROM 27 TO 34 AND PLASTICITY INDICES VARIED FROM 10 TO 15. BORING B-002-2-22 ENCOUNTERED SANDY SILT AT A DEPTH OF 4.5 FEET TO A DEPTH OF 8 FEET. SPT N60 VALUES RANGED FROM 47 TO 56 IN THE TWO SAMPLES ENCOUNTERED.

EXPLORATION FINDINGS (CONTINUED)

WATER CONTENT WAS 15 PERCENT IN BOTH SAMPLES. THE LIQUID LIMIT OF THIS MATERIAL WAS 27 WITH A PLASTICITY INDEX OF 10. EACH BORING WAS ADVANCED UNTIL AUGER REFUSAL WAS REACHED AT A DEPTH OF 11.8 FEET IN B-002-2-22 AND 8.3 FEET IN B-003-2-22.

BEDROCK WAS ENCOUNTERED IN SIX OF THE EIGHT BORINGS AT DEPTHS RANGING FROM 6.5 TO 54 FEET (ELEVATION 822 TO 839). THE BEDROCK WAS IDENTIFIED AS INTERBEDDED LIMESTONE AND SHALE COMPRISED OF APPROXIMATELY 65 TO 80 PERCENT LIMESTONE. THE LIMESTONE WAS DESCRIBED AS GRAY, SLIGHTLY TO MODERATELY WEATHERED, AND MODERATELY STRONG. THE SHALE WAS DESCRIBED AS DARK GRAY, MODERATELY WEATHERED, AND WEAK TO SLIGHTLY STRONG.

GROUNDWATER WAS NOT OBSERVED IN ANY OF THE BORINGS.

SPECIFICATIONS

THIS GEOTECHNICAL EXPLORATION WAS PERFORMED IN ACCORDANCE WITH THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, OFFICE OF GEOTECHNICAL ENGINEERING, SPECIFICATIONS FOR GEOTECHNICAL EXPLORATIONS, DATED JANUARY 2022.

AVAILABLE INFORMATION

THE SOIL, BEDROCK, AND GROUNDWATER INFORMATION COLLECTED FOR THIS SUBSURFACE EXPLORATION THAT CAN BE CONVENIENTLY DISPLAYED ON THE SOIL PROFILE SHEETS HAS BEEN PRESENTED. GEOTECHNICAL REPORTS, IF PREPARED, ARE AVAILABLE FOR REVIEW ON THE OFFICE OF CONTRACT SALES WEBSITE.

LEGEND

DESCRIPTION	ODOT CLASS	CLASSIFIED MECH./VISUAL	
GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT	A-2-6	1	1
SANDY SILT	A-4a	1	1
SILT AND CLAY	A-6a	3	10
SILTY CLAY	A-6b	8	22
CLAY	A-7-6	19	92
	TOTAL	32	126
LIMESTONE	VISUAL		
SHALE	VISUAL		
PAVEMENT OR BASE = X = APPROXIMATE THICKNESS	VISUAL		
SOD AND TOPSOIL = X = APPROXIMATE THICKNESS	VISUAL		

BORING LOCATION - PLAN VIEW.

DRIVE SAMPLE AND/OR ROCK CORE BORING PLOTTED TO VERTICAL SCALE ONLY. HORIZONTAL BAR INDICATES A CHANGE IN STRATIGRAPHY.

WC — INDICATES WATER CONTENT IN PERCENT.

N_{60} — INDICATES STANDARD PENETRATION RESISTANCE NORMALIZED TO 60% DRILL ROD ENERGY RATIO.

X/Y/Z — NUMBER OF BLOWS FOR STANDARD PENETRATION TEST (SPT):
X= NUMBER OF BLOWS FOR FIRST 6 INCHES.
Y= NUMBER OF BLOWS FOR SECOND 6 INCHES.
Z= NUMBER OF BLOWS FOR THIRD 6 INCHES.

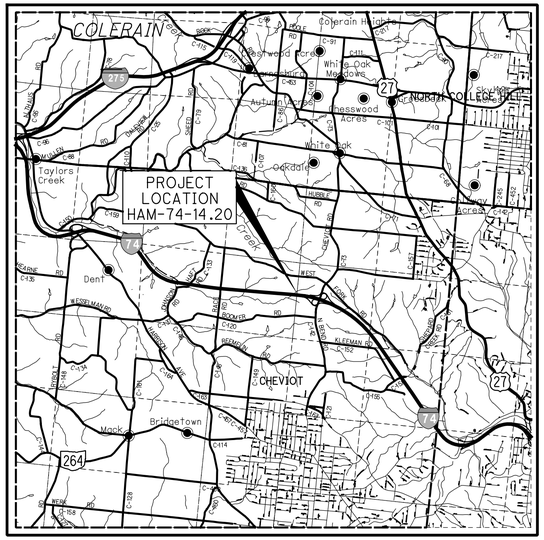
INDICATES FREE WATER ELEVATION.

TR — INDICATES TOP OF ROCK.

SS — INDICATES A SPLIT SPOON SAMPLE.

NP — INDICATES A NON-PLASTIC SAMPLE.

UCR — UNCONFINED COMPRESSIVE STRENGTH (ROCK) SHOWN IN (PSI).



LOCATION MAP

SCALE IN MILES

0 1 2 3 4

N

PARTICLE SIZE DEFINITIONS

12"	3"	2.0 mm	0.42 mm	0.074 mm	0.005 mm
BOULDERS	COBBLES	GRAVEL	COARSE SAND	FINE SAND	SILT	CLAY
		No. 10 SIEVE	No. 40 SIEVE	No. 200 SIEVE		

RECON. - JS &RL 06/26/2019

DRILLING - KC & JL 07/08/2019-07/16/2019
EC & JS 04/14/2022

DRAWN - MJ 06/2022, 12/2022

REVIEWED - EMK 12/13/2022

BEDROCK TEST SUMMARY

EXPLOR. ID	DEPTH	QU (PSI)
B-001-0-19	43.7'-44.1' 49.5'-49.9'	2,474 3,033
B-002-0-19	51.1'-51.5' 60.0'-60.4'	2,647 2,911
B-003-0-19	48.3'-48.7' 52.5'-52.9'	3,910 3,150
B-004-0-19	58.3'-58.7'	3,510

SOIL PROFILE - LANDSLIDE
HAM-74-14.20

DESIGN AGENCY
Stantec
11687 Lebanon Road
Cincinnati OH 45241
(513) 842-8200

DESIGNER MSJ
REVIEWER EMK 12-13-22
PROJECT ID 110174
SUBSET 0 TOTAL 0
SHEET 28 TOTAL 55

HAM-74-14.20

MODEL: II0I74_YC00I PAPERSIZE: 34x22 (in.) DATE: 12/28/2022 TIME: 8:42:53 AM USER: MJennings
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BEGIN PROJECT
STA. 767+25.00

BEGIN WORK
STA. 767+00.00

END PROJECT
STA. 773+00.00

END WORK
STA. 773+25.00

36" CMP

54" CMP

℄ R/W & SURVEY INTERSTATE 74

S85°18'24"E

766 767 768 769 770 771 772 773 774

B-002-1-19

B-003-1-19

B-001-0-19 B-002-0-19 B-003-0-19 B-004-0-19

CONSTRUCTION LIMITS

BEGIN TEMPORARY SHORING
(HP14x73 6' C/C SPACING)
STA. 767+25.00, 77' RT.

END TEMPORARY SHORING
(HP14x73 SPACE 6' C/C)
STA. 773+00.67, 84.21' RT.

Ex LA

PRECAST REINFORCED
CONCRETE OUTLET
STA. 767+25.00, 139.43' RT.
℄ ELEV. = 844.05

Ex CH

B-002-2-22

B-003-2-22

24" CONDUIT, TYPE A

EXISTING GROUNDLINE
℄ E.B. LANE I.R. 74

B-001-0-19
STA. 767+70, 63' RT.
ASPHALT = 0.7'
GRANULAR BASE = 0.8'
Qu(psi) TR= 50/4"
2,474
3,033
Neo WC

B-002-0-19
STA. 768+85, 63' RT.
ASPHALT = 0.7'
GRANULAR BASE = 0.8'
Qu(psi) TR= 65
2,647
2,911
Neo WC

B-003-0-19
STA. 770+06, 63' RT.
ASPHALT = 0.7'
GRANULAR BASE = 0.8'
Qu(psi) TR= 50/1"
2,474
3,033
Neo WC

B-004-0-19
STA. 771+91, 62' RT.
ASPHALT = 0.7'
GRANULAR BASE = 0.8'
Qu(psi) TR= 50/4"
3,510
Neo WC

880 870 860 850 840 830 820 810 800

767 768 769 770 771 772 773 774

HORIZONTAL
SCALE IN FEET
0 15 30 60

SOIL PROFILE - LANDSLIDE
STATION 767+25.00 - 773+00.00 - I.R. 74

DESIGN AGENCY
Stantec
11687 Lebanon Road
Cincinnati OH 45241
(513) 842-8200

DESIGNER MSJ
REVIEWER EMK 12-13-22
PROJECT ID 110174
SUBSET 0 TOTAL 0
SHEET 29 TOTAL 55

HAM-74-14.20

MODEL: Plan (Sheet) PAPERSIZE: 34x22 (in.) DATE: 12/28/2022 TIME: 8:51:22 AM USER: MJennings
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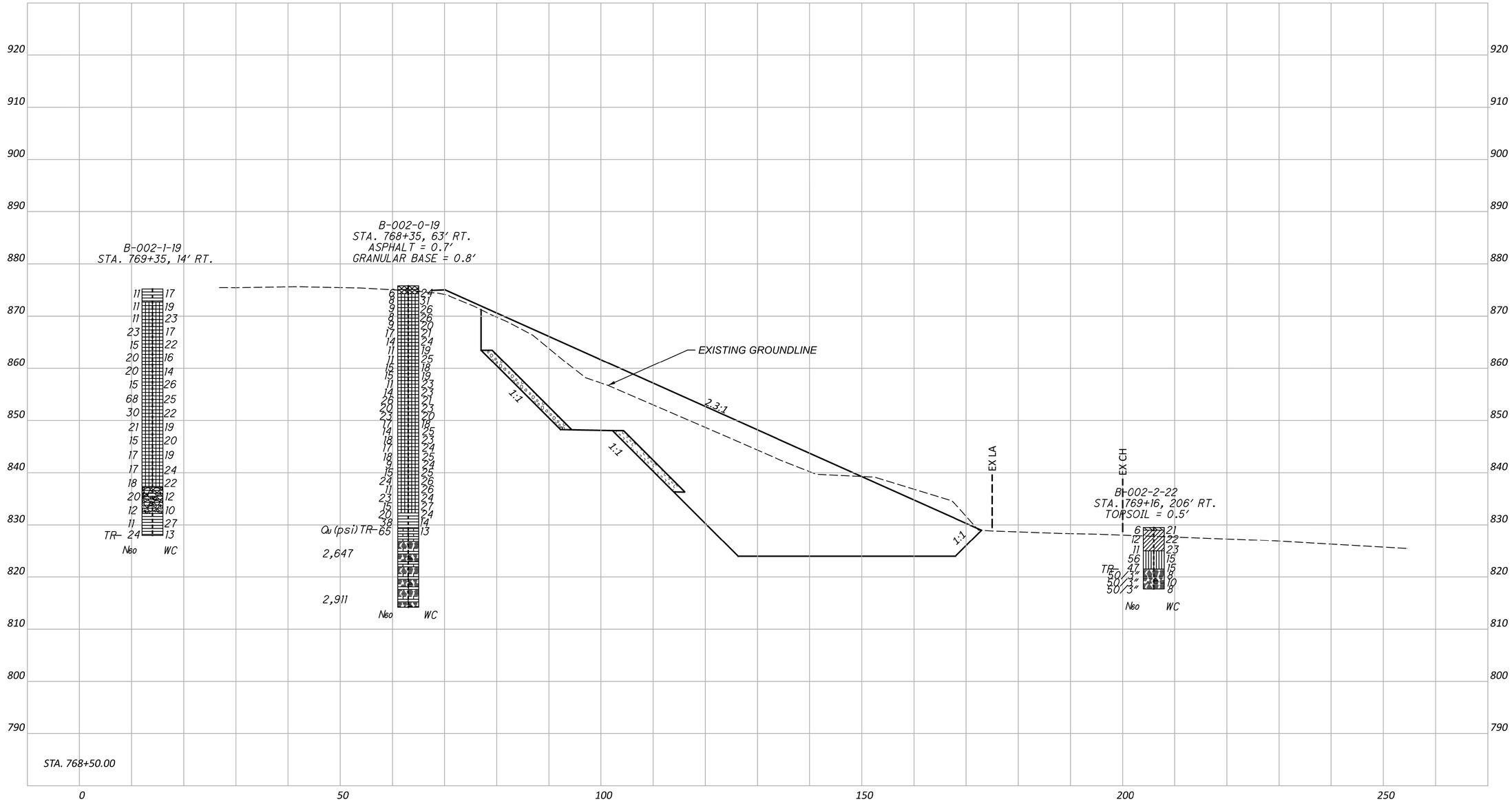

CROSS SECTION - I.R. 74
STATION 768+50

HAM-74-14.20

MODEL: 74 - 768+50.00 [Sheet] PAPERSIZE: 34x22 (in.) DATE: 12/28/2022 TIME: 9:04:19 AM USER: MJennings
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DESIGN AGENCY
Stantec
11687 Lebanon Road
Cincinnati OH 45241
(513) 842-8200

DESIGNER	MSJ
REVIEWER	EMK 12-13-22
PROJECT ID	110174
SUBSET	0
TOTAL	0
SHEET	30
TOTAL	55

B-003-1-19
STA. 770+04, 15' RT.

B-003-0-19
STA. 770+06, 63' RT.
ASPHALT = 0.7'
GRANULAR BASE = 0.8'

B-003-2-22
STA. 771+60, 215' RT.
TOPSOIL = 1.0'

EXISTING GROUNDLINE

2.5:1

1:1

1:1

1:1

EX LA

TR=50/1"

TR=50/1"

TR=50/2"
50/1"

Qu (psi)
2,474
3,033

N60 WC

STA. 770+50.00

920 910 900 890 880 870 860 850 840 830 820 810 800 790

0 50 100 150 200 250

CROSS SECTION - I.R. 74
STATION 770+50

DESIGN AGENCY
Stantec
11687 Lebanon Road
Cincinnati OH 45241
(513) 842-8200

DESIGNER MSJ
REVIEWER EMK 12-13-22
PROJECT ID 110174
SUBSET 0 TOTAL 0
SHEET 31 TOTAL 55

HAM-74-14.20

MODEL: 74 - 770+50.00 [Sheet] PAPERSIZE: 34x22 (in.) DATE: 12/28/2022 TIME: 9:05:36 AM USER: MJennings
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MODEL: Sheet PAPERSIZE: 34x22 (in.) DATE: 12/28/2022 TIME: 9:22:48 AM USER: MJennings
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OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / TC	DRILL RIG: CME 45#2T (814)	STATION / OFFSET: 767+70, 63' RT.	EXPLORATION ID B-001-0-19
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / TC	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 7/10/19	ELEVATION: 873.0 (MSL) EOB: 52.8 ft.	PAGE 1 OF 2
START: 7/1/19 END: 7/2/19	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 90*	LAT / LONG: 39.185816, -84.611581	

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)	HOLE SEALED
ASPHALT	873.0																	
	872.3																	
GRANULAR BASE	871.5																	
STIFF TO VERY STIFF, LIGHT BROWN WITH GRAY MOTTLING, **CLAY**, TRACE TO LITTLE GRAVEL, TRACE TO LITTLE SAND, SOME TO "AND" SILT, WITH LIMESTONE FRAGMENTS, DAMP TO MOIST		2	2 2 5	11	78	SS-1	3.50	-	-	-	-	-	-	-	-	21	A-7-6 (V)	
@ SS-2 AND SS-3, MEDIUM STUFF		4	2 2 2	6	33	SS-2	2.25	-	-	-	-	-	-	-	-	12	A-7-6 (V)	
		5	2 1 4	8	78	SS-3	2.50	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
		7	3 4 7	17	67	SS-4	2.50	-	-	-	-	-	-	-	-	9	A-7-6 (V)	
		8	2 3 4	11	100	SS-5	2.50	4	3	6	41	46	43	18	25	23	A-7-6 (15)	
		10	14 18 5	35	72	SS-6	2.75	-	-	-	-	-	-	-	-	20	A-7-6 (V)	
		11	1 2 6	12	100	SS-7	2.00	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
		13	1 4 2	9	100	SS-8	1.50	-	-	-	-	-	-	-	-	19	A-7-6 (V)	
		14	1 3 5	12	100	SS-9	3.00	-	-	-	-	-	-	-	-	26	A-7-6 (V)	
		16	2 4 7	17	100	SS-10	3.50	13	3	7	30	47	48	20	28	23	A-7-6 (17)	
		17	6 7 9	24	100	SS-11	2.50	-	-	-	-	-	-	-	-	20	A-7-6 (V)	
		19	4 3 13	24	100	SS-12	2.75	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
		20	18 7 7	21	22	SS-13	3.00	-	-	-	-	-	-	-	-	21	A-7-6 (V)	
		22	4 6 7	20	28	SS-14	-	-	-	-	-	-	-	-	-	10	A-7-6 (V)	
		23	3 3 6	14	100	SS-15	3.00	1	1	3	37	58	51	22	29	21	A-7-6 (18)	
	848.5																	

BORING CONTINUES

SOIL PROFILE - LANDSLIDE
BORING LOG B-001-0-19

LOG OF BORING (CONTINUED)

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / TC	DRILL RIG: CME 45#2T (814)	STATION / OFFSET: 767+70, 63' RT.	EXPLORATION ID B-001-0-19
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / TC	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 7/10/19	ELEVATION: 873.0 (MSL) EOB: 52.8 ft.	PAGE 2 OF 2
START: 7/1/19 END: 7/2/19	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 90*	LAT / LONG: 39.185816, -84.611581	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
STIFF TO HARD, GRAY TO LIGHT BROWN, **CLAY**, TRACE TO LITTLE GRAVEL, TRACE TO LITTLE SAND, SOME SILT, WITH LIMESTONE COBBLES, DAMP TO MOIST	848.5	25	3 3 4	11	100	SS-16	4.00	-	-	-	-	-	-	-	-	22	A-7-6 (V)	
		26	3 4 7	17	100	SS-17	3.25	11	3	4	32	50	45	21	24	20	A-7-6 (15)	
		27	1 2 3	8	100	SS-18	1.75	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
		28	4 8 11	29	100	SS-19	4.50	-	-	-	-	-	-	-	-	20	A-7-6 (V)	
		29	4 9 12	32	100	SS-20	4.50	-	-	-	-	-	-	-	-	21	A-7-6 (V)	
		30	8 11 21	48	100	SS-21	4.00	-	-	-	-	-	-	-	-	21	A-7-6 (V)	
		31	5 7 10	26	33	SS-22	4.50	-	-	-	-	-	-	-	-	21	A-7-6 (V)	
		32	5 5 12	26	100	SS-23	3.75	8	6	13	30	43	44	21	23	22	A-7-6 (14)	
		33	19 50/4"	-	100	SS-24	4.50	-	-	-	-	-	-	-	-	14	A-7-6 (V)	
	836.2	TR																
INTERBEDDED LIMESTONE (65%) AND SHALE (35%), FRACTURED, RQD 46%, REC. 93%; **LIMESTONE**, GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG; **SHALE**, DARK GRAY, MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, HIGHLY FRACTURED TO FRACTURED. @ 36.8 FT. TO 38.8 FT., CLAY SEAMS.		34	11		73	NQ-1												CORE
		35																
		36																
		37																
		38																
		39																
@ 43.7 FT. TO 44.1 FT., Qu = 2,474 PSI		40	32		100	NQ-2												CORE
		41																
		42																
		43																
		44																
		45																
@ 49.5 FT. TO 49.9 FT., Qu = 3,033 PSI		46	78		100	NQ-3												CORE
		47																
		48																
		49																
		50																
		51																
		52	81		100	NQ-4												CORE
	820.2	EOB																

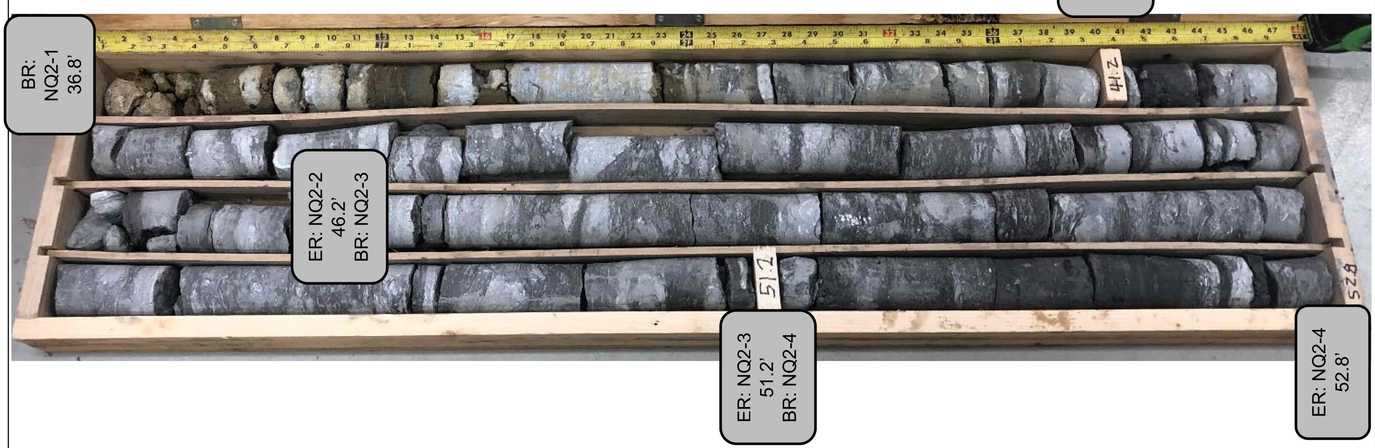
NOTES: NO GROUNDWATER ENCOUNTERED

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; CEMENT/BENTONITE GROUT

SOIL PROFILE - LANDSLIDE

BORING LOG B-001-0-19 (CONTINUED)

B-001-0-19



Run #:	Depth		Recovery		RQD	
NQ2-1	36.8’	41.2’	38.5/53	73%	6/53	11%
NQ2-2	41.2’	46.2’	60/60	100%	19/60	32%
NQ2-3	46.2’	51.2’	60/60	100%	47/60	78%
NQ2-4	51.2’	52.8’	19/19	100%	15.4/19	81%
HAM-74-14.20; PID 110174						

OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / TC	DRILL RIG: CME 45#2T (814)	STATION / OFFSET: 768+85, 63' RT.	EXPLORATION ID B-002-0-19
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / TC	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 7/10/19	ELEVATION: 875.8 (MSL) EOB: 61.6 ft.	PAGE 1 OF 3
START: 6/27/19 END: 7/1/19	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 90*	LAT / LONG: 39.185798, -84.611177	

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)	HOLE SEALED
ASPHALT	875.1																	
GRANULAR BASE	874.3																	
STIFF TO VERY STIFF, BROWN, **CLAY**, TRACE TO LITTLE GRAVEL, TRACE SAND, SOME SILT, WITH LIMESTONE FRAGMENTS, DAMP TO MOIST @ SS-1, SS-2, SS-4, MEDIUM STIFF		1	2 2 2	6	33	SS-1	-	-	-	-	-	-	-	-	-	24	A-7-6 (V)	
		2	3 2 3	8	100	SS-2	2.50	11	5	4	28	52	49	21	28	31	A-7-6 (17)	
		3	2 2 4	9	100	SS-3	2.00	-	-	-	-	-	-	-	-	26	A-7-6 (V)	
		4	2 2 3	8	67	SS-4	0.50	-	-	-	-	-	-	-	-	26	A-7-6 (V)	
		5	1 2 4	9	100	SS-5	1.75	-	-	-	-	-	-	-	-	20	A-7-6 (V)	
		6	3 5 6	17	72	SS-6	1.00	-	-	-	-	-	-	-	-	21	A-7-6 (V)	
		7	4 4 5	14	100	SS-7	2.00	-	-	-	-	-	-	-	-	24	A-7-6 (V)	
		8	4 4 3	11	100	SS-8	2.00	-	-	-	-	-	-	-	-	19	A-7-6 (V)	
		9	1 2 5	11	78	SS-9	2.25	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
		10	2 3 7	15	100	SS-10	1.75	-	-	-	-	-	-	-	-	18	A-7-6 (V)	
		11	4 4 6	15	100	SS-11	2.00	-	-	-	-	-	-	-	-	19	A-7-6 (V)	
		12	3 2 5	11	100	SS-12	2.25	10	3	5	29	53	53	23	30	23	A-7-6 (19)	
		13	2 3 6	14	100	SS-13	2.00	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
		14	6 7 10	26	100	SS-14	3.00	-	-	-	-	-	-	-	-	21	A-7-6 (V)	
		15	4 6 7	20	100	SS-15	2.75	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
		16	4 7 8	23	100	SS-16	3.25	-	-	-	-	-	-	-	-	20	A-7-6 (V)	
	848.8	17	3 4 7	17	100	SS-17	2.50	-	-	-	-	-	-	-	-	18	A-7-6 (V)	

BORING CONTINUES

SOIL PROFILE - LANDSLIDE

BORING LOG B-002-0-19

LOG OF BORING (CONTINUED)

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / TC	DRILL RIG: CME 45#2T (814)	STATION / OFFSET: 768+85, 63' RT.	EXPLORATION ID B-002-0-19
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / TC	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 7/10/19	ELEVATION: 875.8 (MSL) EOB: 61.6 ft.	PAGE 2 OF 3
START: 6/27/19 END: 7/1/19	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 90*	LAT / LONG: 39.185798, -84.611177	

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)	HOLE SEALED
STIFF TO VERY STIFF, BROWN, **CLAY**, TRACE TO LITTLE GRAVEL, TRACE SAND, SOME SILT, WITH LIMESTONE FRAGMENTS, DAMP TO MOIST	848.8	27	2 4 5	14	94	SS-18	2.75	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
		28																
		29	4 4 8	18	89	SS-19	2.50	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
		30																
		31	2 4 7	17	100	SS-20	2.00	-	-	-	-	-	-	-	-	24	A-7-6 (V)	
		32	4 5 7	18	78	SS-21	2.75	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
		33																
		34	2 2 4	9	100	SS-22	2.00	-	-	-	-	-	-	-	-	24	A-7-6 (V)	
		35	3 5 5	15	100	SS-23	3.00	8	4	6	29	53	45	21	24	25	A-7-6 (15)	
		36																
	838.8	37	6 7 9	24	61	SS-24	3.00	-	-	-	-	-	-	-	-	26	A-7-6 (V)	
STIFF TO VERY STIFF, LIGHT BROWN TO GRAY, **CLAY**, TRACE GRAVEL, TRACE SAND, SOME SILT, WITH LIMESTONE, SHALE, AND WOOD FRAGMENTS, MOIST		38	4 2 5	11	100	SS-25	2.75	-	-	-	-	-	-	-	-	26	A-7-6 (V)	
		39																
		40	4 6 9	23	100	SS-26	3.25	4	3	6	34	53	49	21	28	22	A-7-6 (17)	
		41	2 4 6	15	72	SS-27	2.50	-	-	-	-	-	-	-	-	27	A-7-6 (V)	
		42																
		43	2 4 9	20	100	SS-28	2.75	-	-	-	-	-	-	-	-	24	A-7-6 (V)	
	832.3																	
HARD, LIGHT BROWN TO GRAY, **SILTY CLAY**, SOME GRAVEL, SOME SAND, WITH LIMESTONE AND SHALE FRAGMENTS, DAMP		44	4 7 18	38	100	SS-29	2.75	30	7	15	19	29	34	17	17	14	A-6b (5)	
		45																
		46	15 18 25	65	100	SS-30	4.50	-	-	-	-	-	-	-	-	13	A-6b (V)	
	829.3	TR																

BORING CONTINUES

SOIL PROFILE - LANDSLIDE

BORING LOG B-002-0-19 (CONTINUED)

LOG OF BORING (CONTINUED)

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / TC	DRILL RIG: CME 45#2T (814)	STATION / OFFSET: 768+85, 63' RT.	EXPLORATION ID B-002-0-19
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / TC	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 7/10/19	ELEVATION: 875.8 (MSL) EOB: 61.6 ft.	PAGE 3 OF 3
START: 6/27/19 END: 7/1/19	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 90*	LAT / LONG: 39.185798, -84.611177	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS TR	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
INTERBEDDED LIMESTONE (80%) AND SHALE (20%), FRACTURED TO MODERATELY FRACTURED, RQD 44%, REC. 98%; **LIMESTONE**, GRAY, MODERATELY TO HIGHLY WEATHERED, SLIGHTLY TO MODERATELY STRONG; **SHALE**, DARK GRAY, MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, FRACTURED TO MODERATELY FRACTRURED. @ 46.5 FT. TO 48.0 FT., CLAY SEAMS	829.3	47	12		93	NQ-1											CORE	
@ 51.1 FT. TO 51.5 FT., Qu = 2,647 PSI		48 49 50																
		51	58		100	NQ-2											CORE	
		52 53 54 55																
@ 60.0 FT. TO 60.4 FT., Qu = 2,911 PSI		56	56		100	NQ-3											CORE	
		57 58 59 60																
	814.2	61 EOB	50		100	NQ-4											CORE	

NOTES: NO GROUNDWATER ENCOUNTERED

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; CEMENT/BENTONITE GROUT

SOIL PROFILE - LANDSLIDE

BORING LOG B-002-0-19 (CONTINUED)

MODEL: Sheet PAPERSIZE: 34x22 (in.) DATE: 12/28/2022 TIME: 9:51:11 AM USER: MJennings
V:\1736\active\175538112\engineering\110174\400-Engineering\Geotechnical\Sheets\110174_YL003-4.dgn

B-002-0-19

Run #:	Depth		Recovery		RQD	
NQ2-1	46.5’	50.8’	6/52	93%	6/52	12%
NQ2-2	50.8’	55.8’	60/60	100%	35/60	58%
NQ2-3	55.8’	60.8’	60/60	100%	33.5/60	56%
NQ2-4	60.8’	61.6’	10/10	100%	5/10	50%
HAM-74-14.20; PID 110174						

SOIL PROFILE - LANDSLIDE

ROCK CORE PHOTO BORING LOG B-002-0-19

LOG OF BORING (CONTINUED)

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / TC	DRILL RIG: CME 45#2T (814)	STATION / OFFSET: 769+35, 14' RT.	EXPLORATION ID B-002-1-19
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / TC	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 7/10/19	ELEVATION: 875.2 (MSL) EOB: 47.2 ft.	PAGE 1 OF 2
START: 7/2/19 END: 7/2/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 90*	LAT / LONG: 39.185932, -84.611166	

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)	HOLE SEALED
STIFF, BROWN, **SILTY CLAY**, LITTLE GRAVEL, LITTLE SAND, DAMP	875.2		5 4 3	11	78	SS-1	3.00	20	10	8	23	39	38	20	18	17	A-6b (9)	
STIFF TO VERY STIFF, LIGHT BROWN WITH GRAY MOTTLING, **CLAY**, SOME GRAVEL, TRACE SAND, SOME SILT, WITH LIMESTONE FRAGMENTS, DAMP TO MOIST	872.7		2 3 4	11	100	SS-2	2.00	-	-	-	-	-	-	-	-	19	A-7-6 (V)	
			5 2 5	11	100	SS-3	2.00	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
			3 6 9	23	100	SS-4	4.50	-	-	-	-	-	-	-	-	17	A-7-6 (V)	
			6 6 4	15	100	SS-5	2.25	-	-	-	-	-	-	-	-	22	A-7-6 (V)	
			6 6 7	20	100	SS-6	2.75	-	-	-	-	-	-	-	-	16	A-7-6 (V)	
			4 6 7	20	100	SS-7	4.50	-	-	-	-	-	-	-	-	14	A-7-6 (V)	
			3 4 6	15	100	SS-8	3.75	-	-	-	-	-	-	-	-	26	A-7-6 (V)	
			6 5 40	68	100	SS-9	4.00	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
			7 6 14	30	100	SS-10	3.75	21	2	2	27	48	51	22	29	22	A-7-6 (18)	
			8 5 9	21	33	SS-11	-	-	-	-	-	-	-	-	-	19	A-7-6 (V)	
	848.2																	

BORING CONTINUES

SOIL PROFILE - LANDSLIDE

BORING LOG B-002-1-19

LOG OF BORING (CONTINUED)

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / TC	DRILL RIG: CME 45#2T (814)	STATION / OFFSET: 769+85.5, 14' RT.	EXPLORATION ID B-002-1-19
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / TC	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 7/10/19	ELEVATION: 875.2 (MSL) EOB: 47.2 ft.	PAGE 2 OF 2
START: 7/2/19 END: 7/2/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 90*	LAT / LONG: 39.185932, -84.611166	

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)	HOLE SEALED
STIFF TO VERY STIFF, LIGHT BROWN WITH GRAY MOTTLING, **CLAY**, SOME GRAVEL, TRACE SAND, SOME SILT, WITH LIMESTONE FRAGMENTS, DAMP TO MOIST	848.2	27																
		28	8 4 6	15	100	SS-12	2.00	-	-	-	-	-	-	-	-	20	A-7-6 (V)	
		29																
		30																
		31	9 5 6	17	39	SS-13	3.25	-	-	-	-	-	-	-	-	19	A-7-6 (V)	
		32																
	842.2	33	3 5 6	17	100	SS-14	3.75	4	2	3	50	41	43	21	22	24	A-7-6 (13)	
VERY STIFF, LIGHT BROWN TO GRAY, **CLAY**, TRACE GRAVEL, TRACE SAND, "AND" SILT, WITH LIMESTONE COBBLES, MOIST		34																
		35																
		36	3 5 7	18	100	SS-15	2.75	-	-	-	-	-	-	-	-	22	A-7-6 (V)	
		37																
	837.2	38	4 6 7	20	100	SS-16	2.00	50	16	13	12	9	26	14	12	12	A-2-6 (0)	
MEDIUM DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, WITH LIMESTONE FRAGMENTS, DAMP		39																
		40																
		41	2 2 6	12	100	SS-17	1.00	-	-	-	-	-	-	-	-	10	A-2-6 (V)	
		42																
	832.2	43	2 2 5	11	100	SS-18	1.50	2	2	4	56	36	36	20	16	27	A-6b (10)	
STIFF TO VERY STIFF, GRAY, **SILTY CLAY**, TRACE GRAVEL, TRACE SAND, WITH WOOD FRAGMENTS, DAMP TO MOIST		44																
		45																
		46	2 5 11	24	100	SS-19	4.50	-	-	-	-	-	-	-	-	13	A-6b (V)	
	828.0	47	TR EOB															

NOTES: NO GROUNDWATER ENCOUNTERED, AUGER REFUSAL AT 47.2 FT.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE; BENTONITE CHIPS

SOIL PROFILE - LANDSLIDE

BORING LOG B-002-1-19 (CONTINUED)

MODEL: Sheet PAPERSIZE: 34x22 (in.) DATE: 12/28/2022 TIME: 10:37:30 AM USER: MJennings
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OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / EC	DRILL RIG: CME 55T#2 (714)	STATION / OFFSET: 769+06, 206' RT.	EXPLORATION ID B-002-2-22
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / JS	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/3/21	ELEVATION: 829.5 (MSL) EOB: 11.8 ft.	PAGE 1 OF 1
START: 4/14/22 END: 4/14/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 90*	LAT / LONG: 39.185279, -84.611582	

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
DARK BROWN, **TOPSOIL**	829.5																	
	829.0																	
MEDIUM STIFF TO STIFF, LIGHT BROWN TO GRAY, **SILTY CLAY**, TRACE GRAVEL, LITTLE SAND, DAMP TO MOIST		1	1 2 2	6	61	SS-1	1.00	-	-	-	-	-	-	-	-	21	A-6b (V)	
		2	3 3 5	12	94	SS-2	0.75	4	7	7	41	41	38	21	17	22	A-6b (11)	
		3	3 2 5	11	78	SS-3	2.75	-	-	-	-	-	-	-	-	23	A-6b (V)	
	825.0	4																
HARD, LIGHT BROWN TO GRAY, **SANDY SILT**, LITLE GRAVEL, SOME CLAY, DAMP TO MOIST		5	6 9 28	56	94	SS-4	4.50	17	12	16	26	29	27	17	10	15	A-4a (4)	
		6																
		7	7 12 19	47	89	SS-5	4.50	-	-	-	-	-	-	-	-	15	A-4a (V)	
	821.5	TR																
SHALE, LIGHT BROWN TO GRAY, SEVERELY WEATHERED, WEAK, ARGILLACEOUS.		8	12 26 50/3"	-	80	SS-6	4.50	-	-	-	-	-	-	-	-	8	Rock (V)	
		9																
		10	12 40 50/3"	-	87	SS-7	4.50	8	2	1	39	50	38	21	17	10	Rock (V)	
		11	32 44 50/3"	-	80	SS-8	4.50	-	-	-	-	-	-	-	-	8	Rock (V)	
	817.7	EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SOIL CUTTINGS

SHEET	PROJECT ID	REVIEWER	DESIGNER	DESIGN AGENCY
41 / TOTAL 55	110174	EMK 12-13-22	MSJ	Stantec 11687 Lebanon Road Cincinnati OH 45241 (513) 842-0200

SOIL PROFILE - LANDSLIDE
BORING LOG B-002-2-22

MODEL: Sheet PAPERSIZE: 34x22 (in.) DATE: 12/28/2022 TIME: 10:38:49 AM USER: MJennings
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OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / TC	DRILL RIG: CME 45#2T (814)	STATION / OFFSET: 770+06, 63' RT.	EXPLORATION ID B-003-0-19
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / TC	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 7/10/19	ELEVATION: 879.6 (MSL) EOB: 57.3 ft.	PAGE 1 OF 2
START: 6/27/19 END: 6/27/19	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 90*	LAT / LONG: 39.185778, -84.610751	

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)	HOLE SEALED
ASPHALT	879.6																	
GRANULAR BASE	878.9																	
STIFF TO VERY STIFF, LIGHT BROWN TO GRAY, **CLAY**, TRACE GRAVEL, TRACE TO LITTLE SAND, SOME SILT, WITH LIMESTONE COBBLES, DAMP TO MOIST	878.1	1																
		2	2 2 4	9	67	SS-1	2.50	-	-	-	-	-	-	-	-	20	A-7-6 (V)	
		3	5 7 5	18	78	SS-2	2.50	-	-	-	-	-	-	-	-	22	A-7-6 (V)	
		4	5 3 5	12	78	SS-3	1.50	-	-	-	-	-	-	-	-	18	A-7-6 (V)	
		5	3 5 30	53	61	SS-4	3.50	-	-	-	-	-	-	-	-	15	A-7-6 (V)	
		6	7 2 3	8	89	SS-5	1.75	-	-	-	-	-	-	-	-	17	A-7-6 (V)	
		7	4 5 5	15	94	SS-6	3.25	-	-	-	-	-	-	-	-	17	A-7-6 (V)	
		8	3 3 4	11	100	SS-7	2.25	9	4	8	31	48	42	21	21	8	A-7-6 (13)	
		9	7 7 5	18	39	SS-8	2.50	-	-	-	-	-	-	-	-	15	A-7-6 (V)	
		10	6 4 3	11	100	SS-9	1.50	-	-	-	-	-	-	-	-	21	A-7-6 (V)	
		11	5 7 8	23	72	SS-10	1.50	-	-	-	-	-	-	-	-	15	A-7-6 (V)	
		12	3 3 6	14	56	SS-11	1.75	-	-	-	-	-	-	-	-	22	A-7-6 (V)	
		13	4 4 3	11	67	SS-12	3.20	-	-	-	-	-	-	-	-	17	A-7-6 (V)	
		14	2 3 4	11	100	SS-13	3.50	3	3	5	32	57	55	21	34	16	A-7-6 (19)	
		15	3 6 11	26	78	SS-14	3.25	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
		16	4 4 7	17	100	SS-15	4.25	-	-	-	-	-	-	-	-	19	A-7-6 (V)	
		17	3 5 7	18	67	SS-16	2.00	-	-	-	-	-	-	-	-	18	A-7-6 (V)	
		18	4 6 8	21	67	SS-17	2.00	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
	851.6	19	4 4 10	21	100	SS-18	3.00	-	-	-	-	-	-	-	-	19	A-7-6 (V)	

BORING CONTINUES

SHEET	PROJECT ID	REVIEWER	DESIGNER	DESIGN AGENCY
42 / TOTAL 55	110174	EMK 12-13-22	MSJ	Stantec 11687 Lebanon Road Cincinnati OH 45241 (513) 842-8200

SOIL PROFILE - LANDSLIDE
BORING LOG B-003-0-19

MODEL: Sheet PAPERSIZE: 34x22 (in.) DATE: 12/28/2022 TIME: 10:40:16 AM USER: MJennings
V:\1736\active\175538112\engineering\110174\400-Engineering\Geotechnical\Sheets\110174_YL005-1.dgn

LOG OF BORING (CONTINUED)

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / TC	DRILL RIG: CME 45#2T (814)	STATION / OFFSET: 770+06, 63' RT.	EXPLORATION ID B-003-0-19
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / TC	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 7/10/19	ELEVATION: 879.6 (MSL) EOB: 57.3 ft.	PAGE 2 OF 2
START: 6/27/19 END: 6/27/19	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 90*	LAT / LONG: 39.185778, -84.610751	

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)	HOLE SEALED
STIFF TO VERY STIFF, LIGHT BROWN TO GRAY, **CLAY**, TRACE GRAVEL, TRACE TO LITTLE SAND, SOME SILT, WITH LIMESTONE COBBLES, DAMP TO MOIST	851.6	28																
		29	3 10 10	30	100	SS-19	4.00	9	1	2	33	55	44	20	24	20	A-7-6 (14)	
		30	4 5 7	18	100	SS-20	3.50	-	-	-	-	-	-	-	-	30	A-7-6 (V)	
	847.6	31																
VERY STIFF TO HARD, GRAY, **SILTY CLAY**, TRACE GRAVEL, TRACE SAND, WITH LIMESTONE COBBLES AND WOOD FRAGMENTS, DAMP TO MOIST		32	7 10 11	32	100	SS-21	4.00	-	-	-	-	-	-	-	-	23	A-6b (V)	
		33	3 4 50/2"	-	100	SS-22	4.00	-	-	-	-	-	-	-	-	22	A-6b (V)	
		34																
		35	4 5 9	21	11	SS-23	2.25	-	-	-	-	-	-	-	-	22	A-6b (V)	
		36																
		37	7 8 10	27	100	SS-24	4.50	1	1	3	49	46	40	18	22	20	A-6b (13)	
		38	6 9 9	27	11	SS-25	-	-	-	-	-	-	-	-	-	21	A-6b (V)	
		39																
		40	9 19 13	48	100	SS-26	4.25	-	-	-	-	-	-	-	-	17	A-6b (V)	
	838.5	41	14 50/1"	-	100	SS-27	4.25	-	-	-	-	-	-	-	-	18	A-6b (V)	
INTERBEDDED LIMESTONE (60%) AND SHALE (40%), FRACTURED, RQD 0%, REC. 90%; **LIMESTONE**, GRAY, MODERATELY WEATHERED, MODERATELY STRONG; **SHALE**, TAN, MODERATELY TO HIGHLY WEATHERED, WEAK TO SLIGHTLY STRONG, HIGHLY FRACTURED TO FRACTURED.	TR	42																
		43																
		44	0		88	NQ-1											CORE	
		45																
		46																
	832.5	47																
INTERBEDDED LIMESTONE (80%) AND SHALE (20%), FRACTURED TO MODERATELY FRACTURED, RQD 54%, REC. 98%; **LIMESTONE**, GRAY, SLIGHTLY TO MODERATELY WEATHERED, MODERATELY STRONG; **SHALE**, DARK GRAY, MODERATELY WEATHERED, SLIGHTLY STRONG, FRACTURED. @ 48.3 FT. TO 48.7 FT., Qu = 3,910 PSI		48																
		49	38		96	NQ-2											CORE	
		50																
		51																
@ 52.5 FT. TO 52.9 FT., Qu = 3,150 PSI		52																
		53																
		54	58		100	NQ-3											CORE	
		55																
		56																
	822.3	57	80		100	NQ-4											CORE	
	EOB																	

NOTES: NO GROUNDWATER ENCOUNTERED

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; CEMENT/BENTONITE GROUT

SHEET	PROJECT ID	REVIEWER	DESIGNER	DESIGN AGENCY
43 / TOTAL 55	110174	EMK 12-13-22	MSJ	Stantec 11687 Lebanon Road Cincinnati OH 45241 (513) 842-8200

SOIL PROFILE - LANDSLIDE

BORING LOG B-003-0-19 (CONTINUED)

MODEL: Sheet PAPERSIZE: 34x22 (in.) DATE: 12/28/2022 TIME: 10:41:55 AM USER: MJennings
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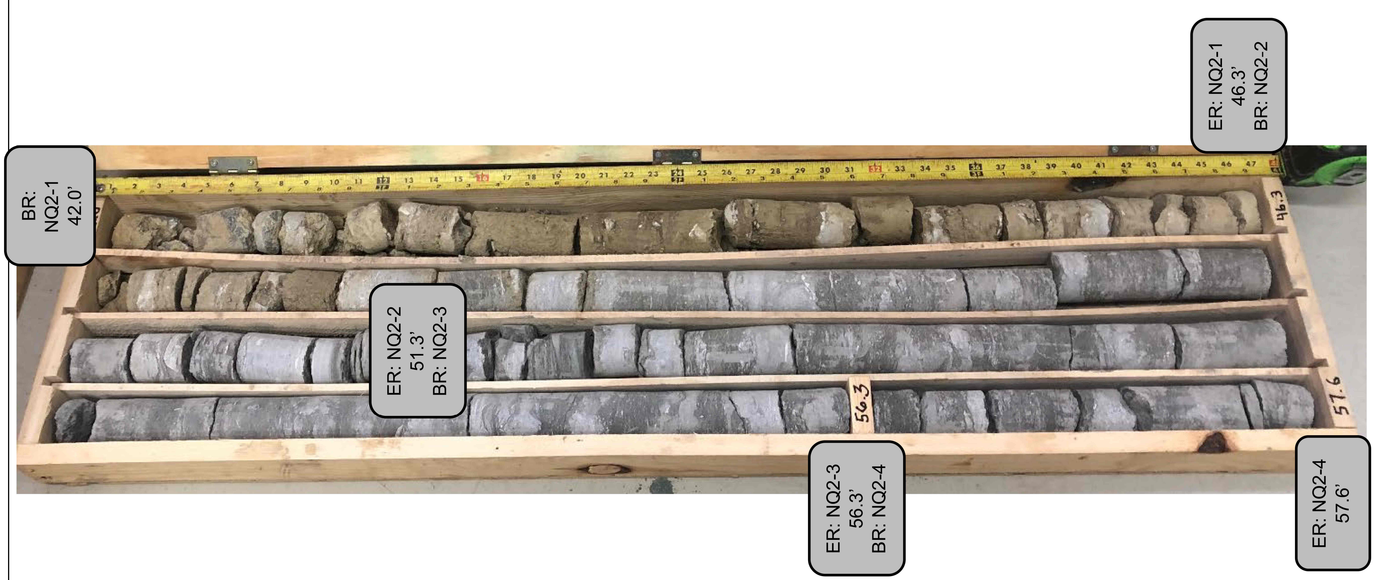
B-003-0-19



Run #:	Depth		Recovery		RQD	
NQ2-1	42.0’	46.3’	46/52	88%	0/52	0%
NQ2-2	46.3’	51.3’	57.5/60	96%	23/60	38%
NQ2-3	51.3’	56.3’	60/60	100%	35/60	58%
NQ2-4	56.3’	57.6’	16/16	100%	12.8/16	80%
HAM-74-14.20; PID 110174						

SHEET 44 | TOTAL 55
PROJECT ID 110174
REVIEWER EMK 12-13-22
DESIGNER MSJ
DESIGN AGENCY
Stantec
11687 Lebanon Road
Cincinnati OH 45241
(513) 842-8200

SOIL PROFILE - LANDSLIDE

ROCK CORE PHOTO BORING LOG B-003-0-19

MODEL: Sheet PAPERSIZE: 34x22 (in.) DATE: 12/28/2022 TIME: 10:43:35 AM USER: MJennings
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OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / TC	DRILL RIG: CME 45#2T (814)	STATION / OFFSET: 770+04, 15' RT.	EXPLORATION ID B-003-1-19
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / TC	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 7/10/19	ELEVATION: 879.1 (MSL) EOB: 35.1 ft.	PAGE 1 OF 2
START: 7/3/19 END: 7/3/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 90*	LAT / LONG: 39.185909, -84.610748	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
STIFF TO HARD, BROWN, **SILTY CLAY** , LITTLE TO SOME GRAVEL, TRACE TO LITTLE SAND, WITH LIMESTONE COBBLES, DAMP TO MOIST	879.1	1	4 8 6	21	67	SS-1	4.50	-	-	-	-	-	-	-	-	11	A-6b (V)	
		3	4 3 21	36	67	SS-2	4.50	-	-	-	-	-	-	-	-	18	A-6b (V)	
		6	7 8 6	21	83	SS-3	2.50	18	3	7	36	36	37	18	19	21	A-6b (11)	
		8	6 4 4	12	83	SS-4	2.50	-	-	-	-	-	-	-	-	19	A-6b (V)	
		11	7 38 12	75	78	SS-5	2.00	-	-	-	-	-	-	-	-	18	A-6b (V)	
		13	2 3 4	11	100	SS-6	2.00	-	-	-	-	-	-	-	-	19	A-6b (V)	
		16	3 4 2	9	100	SS-7	1.75	23	4	9	26	38	36	18	18	21	A-6b (9)	
		18	4 4 11	23	94	SS-8	3.75	-	-	-	-	-	-	-	-	22	A-6b (V)	
		21	3 6 7	20	100	SS-9	3.00	-	-	-	-	-	-	-	-	20	A-6b (V)	
		23	5 7 9	24	44	SS-10	2.50	-	-	-	-	-	-	-	-	21	A-6b (V)	
		26	7 8 8	24	61	SS-11	2.75	-	-	-	-	-	-	-	-	18	A-6b (V)	
	851.6																	

BORING CONTINUES

SOIL PROFILE - LANDSLIDE
BORING LOG B-003-1-19

LOG OF BORING (CONTINUED)

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / TC	DRILL RIG: CME 45#2T (814)	STATION / OFFSET: 770+04, 15' RT.	EXPLORATION ID B-003-1-19
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / TC	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 7/10/19	ELEVATION: 879.1 (MSL) EOB: 35.1 ft.	PAGE 2 OF 2
START: 7/3/19 END: 7/3/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 90*	LAT / LONG: 39.185909, -84.610748	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD		REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
STIFF TO VERY STIFF, BROWN WITH GRAY MOTTLING, **CLAY**, TRACE TO LITTLE GRAVEL, TRACE SAND, SOME TO "AND" SILT, WITH LIMESTONE COBBLES, DAMP TO MOIST	851.6	28	3 5 6	17	100	SS-12	4.00	4	4	5	36	51	45	21	24	23	A-7-6 (15)	
		29																
		30	3 3 3	9	100	SS-13	2.00	-	-	-	-	-	-	-	-	16		
		31																
		32																
		33	1 4 11	23	100	SS-14	2.50	13	2	5	23	57	67	23	44	29	A-7-6 (20)	
		34																
	844.0 EOB TR	35	50/1"	-	100	SS-15	-	-	-	-	-	-	-	-	-	25	A-7-6 (V)	

NOTES: NO GROUNDWATER ENCOUNTERED, AUGER REFUSAL AT 35.1 FT.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE

MODEL: Sheet PAPERSIZE: 34x22 (in.) DATE: 12/28/2022 TIME: 10:50:54 AM USER: MJennings
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OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / EC	DRILL RIG: CME 55T#2 (714)	STATION / OFFSET: 771+60, 215' RT.	EXPLORATION ID B-003-2-22
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / JS	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/3/21	ELEVATION: 836.0 (MSL) EOB: 8.3 ft.	PAGE 1 OF 1
START: 4/14/22 END: 4/14/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 90*	LAT / LONG: 39.185216, -84.610692	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
VERY SOFT, DARK BROWN, **TOPSOIL**, DAMP	836.0		0 0 0	0	33	SS-1	1.00	-	-	-	-	-	-	-	-	17	A-6a (V)	
STIFF TO VERY STIFF, LIGHT BROWN, **SILT AND CLAY**, TRACE TO LITTLE GRAVEL, LITTLE TO SOME SAND, DAMP TO MOIST	835.0	1	1 4 3	11	72	SS-2	4.50	10	8	5	45	32	34	22	12	24	A-6a (9)	
		2																
		3	6 7 9	24	0	SS-3	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
		4																
		5	6 9 10	29	78	SS-4	4.50	11	15	13	24	37	33	18	15	13	A-6a (7)	
	829.5	6 TR																
SHALE, GRAY, SEVERELY WEATHERED, WEAK, ARGILLACEOUS.			19 35 50/2"	-	100	SS-5	4.50	47	12	7	15	19	28	17	11	10	Rock (V)	
		7																
			30 50/1"	-	86	SS-6	4.50	-	-	-	-	-	-	-	-	9	Rock (V)	
	827.7	8 EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SOIL CUTTINGS

SOIL PROFILE - LANDSLIDE

BORING LOG B-003-2-22

MODEL: Sheet PAPERSIZE: 34x22 (in.) DATE: 12/28/2022 TIME: 10:52:26 AM USER: MJennings
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OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / TC	DRILL RIG: CME 45#2T (814)	STATION / OFFSET: 771+91, 62' RT.	EXPLORATION ID B-004-0-19
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / TC	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 7/10/19	ELEVATION: 884.7 (MSL) EOB: 69.3 ft.	PAGE 1 OF 3
START: 6/25/19 END: 6/26/19	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 90*	LAT / LONG: 39.185751, -84.610099	

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)	HOLE SEALED
ASPHALT	884.0																	
GRANULAR BASE	883.2																	
MEDIUM STIFF TO STIFF, BROWN, **SILTY CLAY** , LITTLE GRAVEL, LITTLE SAND, WITH LIMESTONE FRAGMENTS, DAMP TO MOIST			2 3 21	36	100	SS-1	3.25	-	-	-	-	-	-	-	-	16	A-6b (V)	
			7 3 3	9	39	SS-2	4.25	-	-	-	-	-	-	-	-	11	A-6b (V)	
			1 2 3	8	100	SS-3	1.50	18	5	7	28	42	39	20	19	22	A-6b (11)	
	877.7		2 4 6	15	100	SS-4	1.75	-	-	-	-	-	-	-	-	20	A-6b (V)	
MEDIUM STIFF TO STIFF, LIGHT BROWN TO GRAY, **CLAY**, LITTLE GRAVEL, TRACE SAND, SOME SILT, DAMP			2 2 3	8	78	SS-5	4.00	-	-	-	-	-	-	-	-	20	A-7-6 (V)	
			1 2 2	6	100	SS-6	2.75	11	3	6	32	48	41	21	20	20	A-7-6 (12)	
			1 3 7	15	67	SS-7	2.50	-	-	-	-	-	-	-	-	21	A-7-6 (V)	
	871.7		3 3 4	11	61	SS-8	2.50	-	-	-	-	-	-	-	-	20	A-7-6 (V)	
STIFF TO HARD, BROWN, **CLAY**, "AND" GRAVEL, TRACE SAND, SOME SILT, WITH LIMESTONE FRAGMENTS, DAMP TO MOIST			4 8 9	26	78	SS-9	2.25	-	-	-	-	-	-	-	-	19	A-7-6 (V)	
			13 5 6	17	100	SS-10	3.75	36	3	5	26	30	41	19	22	17	A-7-6 (9)	
			5 9 10	29	39	SS-11	4.50	-	-	-	-	-	-	-	-	16	A-7-6 (V)	
			4 4 6	15	67	SS-12	2.75	-	-	-	-	-	-	-	-	16	A-7-6 (V)	
			2 3 5	12	100	SS-13	4.50	-	-	-	-	-	-	-	-	18	A-7-6 (V)	
			6 7 8	23	100	SS-14	4.25	-	-	-	-	-	-	-	-	20	A-7-6 (V)	
			1 3 6	14	100	SS-15	3.25	-	-	-	-	-	-	-	-	20	A-7-6 (V)	
			4 5 8	20	89	SS-16	4.50	-	-	-	-	-	-	-	-	17	A-7-6 (V)	
			4 9 13	33	72	SS-17	2.25	-	-	-	-	-	-	-	-	21	A-7-6 (V)	
	856.7		3 5 6	17	94	SS-18	3.00	-	-	-	-	-	-	-	-	19	A-7-6 (V)	

BORING CONTINUES

SHEET	PROJECT ID	REVIEWER	DESIGNER	DESIGN AGENCY
48 / TOTAL 55	110174	EMK 12-13-22	MSJ	Stantec, 11687 Lebanon Road, Cincinnati OH 45241, (513) 842-8200

SOIL PROFILE - LANDSLIDE
BORING LOG B-004-0-19

LOG OF BORING (CONTINUED)

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / TC	DRILL RIG: CME 45#2T (814)	STATION / OFFSET: 771+91, 62' RT.	EXPLORATION ID B-004-0-19
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / TC	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 7/10/19	ELEVATION: 884.7 (MSL) EOB: 69.3 ft.	PAGE 2 OF 3
START: 6/25/19 END: 6/26/19	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 90*	LAT / LONG: 39.185751, -84.610099	

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)	HOLE SEALED
STIFF TO HARD, BROWN, **CLAY**, "AND" GRAVEL, TRACE SAND, SOME SILT, WITH LIMESTONE FRAGMENTS, DAMP TO MOIST	856.7	28																
		29	3 7 6	20	100	SS-19	3.00	-	-	-	-	-	-	-	-	20	A-7-6 (V)	
		30																
		31	2 7 7	21	39	SS-20	4.00	-	-	-	-	-	-	-	-	19	A-7-6 (V)	
	852.7	32																
STIFF TO HARD, BROWN, **CLAY**, TRACE GRAVEL, TRACE SAND, SOME SILT, DAMP TO MOIST			3 2 5	11	89	SS-21	2.00	-	-	-	-	-	-	-	-	34	A-7-6 (V)	
		33																
		34	2 4 6	15	100	SS-22	4.00	8	2	3	33	54	56	23	33	21	A-7-6 (19)	
		35	4 4 6	15	100	SS-23	3.50	-	-	-	-	-	-	-	-	24	A-7-6 (V)	
		36																
		37	7 10 12	33	94	SS-24	4.50	-	-	-	-	-	-	-	-	13	A-7-6 (V)	
		38	4 6 7	20	100	SS-25	3.00	-	-	-	-	-	-	-	-	22	A-7-6 (V)	
		39																
	844.2	40	9 9 10	29	67	SS-26	4.25	-	-	-	-	-	-	-	-	22	A-7-6 (V)	
STIFF TO HARD, LIGHT BROWN WITH GRAY MOTTLING, **SILT AND CLAY**, TRACE SAND, DAMP TO MOIST		41	4 6 10	24	100	SS-27	4.25	-	-	-	-	-	-	-	-	22	A-6a (V)	
		42																
		43	3 6 10	24	100	SS-28	3.50	-	-	-	-	-	-	-	-	21	A-6a (V)	
		44	3 6 9	23	100	SS-29	3.00	-	-	-	-	-	-	-	-	21	A-6a (V)	
		45																
		46	4 7 9	24	100	SS-30	2.75	-	-	-	-	-	-	-	-	22	A-6a (V)	
		47	9 9 12	32	100	SS-31	3.00	-	-	-	-	-	-	-	-	23	A-6a (V)	
		48																
		49	4 3 7	15	100	SS-32	3.25	-	-	-	-	-	-	-	-	20	A-6a (V)	
		50	3 3 6	14	100	SS-33	1.75	0	2	5	59	34	34	20	14	24	A-6a (10)	
		51																
		52	4 5 6	17	100	SS-34	1.25	-	-	-	-	-	-	-	-	29	A-6a (V)	
		53																
	830.8		3 17 50/4"	-	100	SS-35	4.50	-	-	-	-	-	-	-	-	11	A-6a (V)	
	TR																	

BORING CONTINUES

SOIL PROFILE - LANDSLIDE

BORING LOG B-004-0-19 (CONTINUED)

LOG OF BORING (CONTINUED)

PROJECT: HAM-74-14.20	DRILLING FIRM / OPERATOR: STANTEC / TC	DRILL RIG: CME 45#2T (814)	STATION / OFFSET: 771+91, 62' RT.	EXPLORATION ID B-004-0-19
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / TC	HAMMER: CME AUTOMATIC	ALIGNMENT: IR 74	
PID: 110174 SFN: N/A	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 7/10/19	ELEVATION: 884.7 (MSL) EOB: 69.3 ft.	PAGE 1 OF 1
START: 6/25/19 END: 6/26/19	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 90*	LAT / LONG: 39.185751, -84.610099	

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)	HOLE SEALED
INTERBEDDED LIMESTONE (80%) AND SHALE (20%), FRACTURED TO MODERATELY FRACTURED, RQD 56%, REC. 98%; **LIMESTONE**, GRAY, SLIGHTLY TO MODERATELY WEATHERED, MODERATELY STRONG; **SHALE**, DARK GRAY, MODERATELY WEATHERED, SLIGHTLY STRONG, FRACTURED.	830.8	TR	43		96	NQ-1											CORE	
@ 58.3 FT. TO 58.7 FT., Qu = 3,510 PSI			58		96	NQ-2											CORE	
			62		100	NQ-3											CORE	
	815.4	EOB	53		100	NQ-4											CORE	

NOTES: NO GROUNDWATER ENCOUNTERED

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; CEMENT/BENTONITE GROUT

B-004-0-19

Run #:	Depth		Recovery		RQD	
NQ2-1	54.0’	56.3’	27/28	96%	12/28	43%
NQ2-2	56.3’	61.3’	57.5/60	96%	35/60	58%
NQ2-3	61.3’	66.3’	60/60	100%	37/60	62%
NQ2-4	66.3’	69.3’	36/36	100%	19/36	53%
HAM-74-14.20; PID 110174						

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name HAM-74-14.20 | Project Number 175538063
Lithology Limestone, gray, moderately hard, shaley | Lab ID UCR-151
Hole Number B-001-0-19 | Depth (ft) 43.7'-44.1' | Date Received 07/10/2019

Temperature (°C) 22 | Moisture Condition As Prepared, Moist | Date Tested 07/25/2019

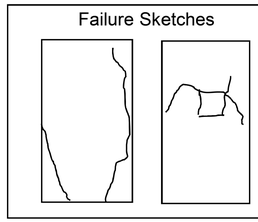
Side Planeness	Fail	Height (in)	4.450	Wet Unit Weight (pcf)	162.1
Perpendicularity	N/A	Diameter (in)	1.976	Dry Unit Weight (pcf)	N/A
End Planeness	Pass	Area (in²)	3.067	Moisture Content (%)	N/A
Parallelism	Pass				

Loading Rate (lbf/sec) 24
Peak Load (lbf) 7588

Failure Type Undetermined

Compressive Strength (psi) 2474
Compressive Strength (psf) 356256
Compressive Strength (tsf) 178

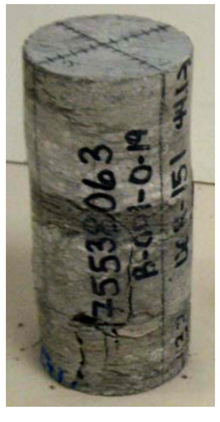
Failure Sketches



Comments Side planeness distortion of core inhibited preparation. Dimensional tolerances were not confir

CORE PREPARATION

POST TEST



Reviewed By JW

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name HAM-74-14.20 | Project Number 175538063
Lithology Limestone, gray, moderately hard, shaley | Lab ID UCR-152
Hole Number B-001-0-19 | Depth (ft) 49.5'-49.9' | Date Received 07/10/2019

Temperature (°C) 22 | Moisture Condition As Prepared, Moist | Date Tested 07/25/2019

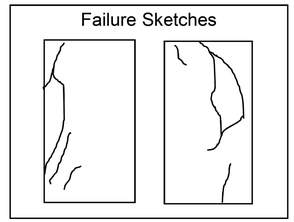
Side Planeness	Fail	Height (in)	4.503	Wet Unit Weight (pcf)	162.0
Perpendicularity	Pass	Diameter (in)	1.972	Dry Unit Weight (pcf)	N/A
End Planeness	Pass	Area (in²)	3.054	Moisture Content (%)	N/A
Parallelism	Pass				

Loading Rate (lbf/sec) 17
Peak Load (lbf) 9262

Failure Type Undetermined

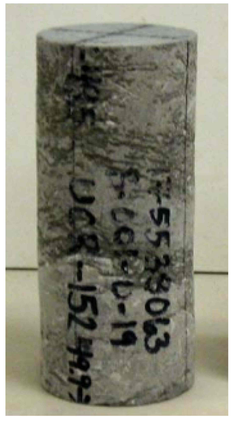
Compressive Strength (psi) 3033
Compressive Strength (psf) 436752
Compressive Strength (tsf) 218

Failure Sketches

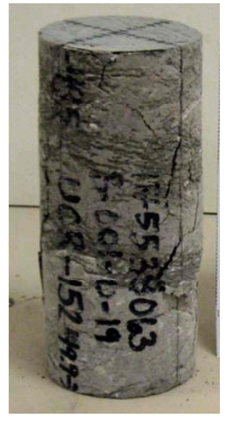


Comments

CORE PREPARATION



POST TEST



Reviewed By JW

SOIL PROFILE - LANDSLIDE
LABORATORY TEST DATA

DESIGN AGENCY
Stantec
11687 Lebanon Road
Cincinnati OH 45241
(513) 842-8200

DESIGNER MSJ
REVIEWER EMK 12-13-22
PROJECT ID 110174
SUBSET 0 | TOTAL 0
SHEET 52 | TOTAL 55

HAM-74-14.20

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Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name HAM-74-14.20 | Project Number 175538063
Lithology Limestone, gray, moderately hard, shaley | Lab ID UCR-153
Hole Number B-002-0-19 | Depth (ft) 51.1'-51.5' | Date Received 07/10/2019

Temperature (°C) 22 | Moisture Condition As Prepared, Moist | Date Tested 07/25/2019

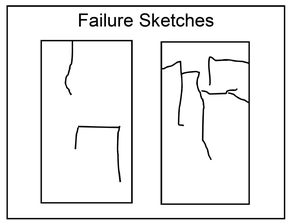
Side Planeness	Fail	Height (in)	4.556	Wet Unit Weight (pcf)	161.5
Perpendicularity	Pass	Diameter (in)	1.975	Dry Unit Weight (pcf)	N/A
End Planeness	Pass	Area (in^2)	3.062	Moisture Content (%)	N/A
Parallelism	Pass				

Loading Rate (lbf/sec) 11
Peak Load (lbf) 8105

Failure Type Undetermined

Compressive Strength (psi) 2647
Compressive Strength (psf) 381168
Compressive Strength (tsf) 191

Failure Sketches



Comments

CORE PREPARATION

POST TEST

Reviewed By

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name HAM-74-14.20 | Project Number 175538063
Lithology Limestone, light gray, moderately hard, shaley | Lab ID UCR-154
Hole Number B-002-0-19 | Depth (ft) 60.0'-60.4' | Date Received 07/10/2019

Temperature (°C) 22 | Moisture Condition As Prepared, Moist | Date Tested 07/25/2019

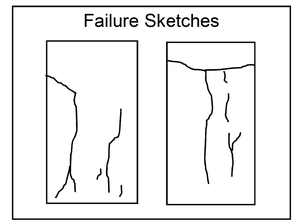
Side Planeness	Fail	Height (in)	4.494	Wet Unit Weight (pcf)	159.2
Perpendicularity	Pass	Diameter (in)	1.981	Dry Unit Weight (pcf)	N/A
End Planeness	Pass	Area (in^2)	3.081	Moisture Content (%)	N/A
Parallelism	Pass				

Loading Rate (lbf/sec) 37
Peak Load (lbf) 8969

Failure Type Undetermined

Compressive Strength (psi) 2911
Compressive Strength (psf) 419184
Compressive Strength (tsf) 210

Failure Sketches



Comments

CORE PREPARATION

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SOIL PROFILE - LANDSLIDE
LABORATORY TEST DATA

DESIGN AGENCY
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DESIGNER MSJ
REVIEWER EMK 12-13-22
PROJECT ID 110174
SUBSET 0 | TOTAL 0
SHEET 53 | TOTAL 55

HAM-74-14.20

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Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name HAM-74-14.20 | Project Number 175538063
Lithology Limestone, gray, moderately hard, shaley | Lab ID UCR-155
Hole Number B-003-0-19 | Depth (ft) 48.3'-48.7' | Date Received 07/10/2019

Temperature (°C) 22 | Moisture Condition As Prepared, Moist | Date Tested 07/25/2019

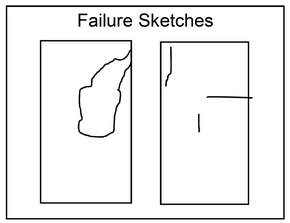
Side Planeness	Fail	Height (in)	4.255	Wet Unit Weight (pcf)	162.7
Perpendicularity	Pass	Diameter (in)	1.980	Dry Unit Weight (pcf)	N/A
End Planeness	Pass	Area (in^2)	3.080	Moisture Content (%)	N/A
Parallelism	Pass				

Loading Rate (lbf/sec) 26
Peak Load (lbf) 12038

Failure Type Undetermined

Compressive Strength (psi) 3910
Compressive Strength (psf) 563040
Compressive Strength (tsf) 281

Failure Sketches



Comments

CORE PREPARATION

POST TEST

Reviewed By

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name HAM-74-14.20 | Project Number 175538063
Lithology Limestone, gray, moderately hard, shaley | Lab ID UCR-156
Hole Number B-003-0-19 | Depth (ft) 52.5'-52.9' | Date Received 07/10/2019

Temperature (°C) 22 | Moisture Condition As Prepared, Moist | Date Tested 07/25/2019

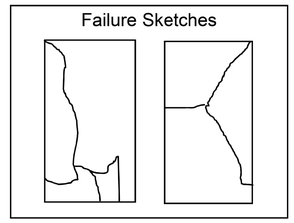
Side Planeness	Fail	Height (in)	4.370	Wet Unit Weight (pcf)	158.7
Perpendicularity	Pass	Diameter (in)	1.979	Dry Unit Weight (pcf)	N/A
End Planeness	Pass	Area (in^2)	3.075	Moisture Content (%)	N/A
Parallelism	Pass				

Loading Rate (lbf/sec) 24
Peak Load (lbf) 9687

Failure Type Cone and Split

Compressive Strength (psi) 3150
Compressive Strength (psf) 453600
Compressive Strength (tsf) 227

Failure Sketches



Comments

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SOIL PROFILE - LANDSLIDE
LABORATORY TEST DATA

DESIGN AGENCY
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Cincinnati OH 45241
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DESIGNER MSJ
REVIEWER EMK 12-13-22
PROJECT ID 110174
SUBSET 0 | TOTAL 0
SHEET 54 | TOTAL 55

HAM-74-14.20

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Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name HAM-74-14.20 | Project Number 175538063
Lithology Limestone, gray, moderately hard, shaley | Lab ID UCR-157
Hole Number B-004-0-19 | Depth (ft) 58.3'-58.7' | Date Received 07/10/2019

Temperature (°C) 22 | Moisture Condition As Prepared, Moist | Date Tested 07/25/2019

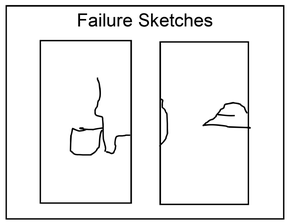
Side Planeness	Fail	Height (in)	4.384	Wet Unit Weight (pcf)	159.7
Perpendicularity	Pass	Diameter (in)	1.977	Dry Unit Weight (pcf)	N/A
End Planeness	Pass	Area (in^2)	3.069	Moisture Content (%)	N/A
Parallelism	Pass				

Loading Rate (lbf/sec) 34
Peak Load (lbf) 10776

Failure Type Undetermined

Compressive Strength (psi) 3510
Compressive Strength (psf) 505440
Compressive Strength (tsf) 253

Failure Sketches



Comments

CORE PREPARATION

POST TEST

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SOIL PROFILE - LANDSLIDE
LABORATORY TEST DATA

HAM-74-14.20

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V:\1736\active\175538112\engineering\110174\400-Engineering\Geotechnical\Sheets\110174_YD004.dgn

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Cincinnati OH 45241
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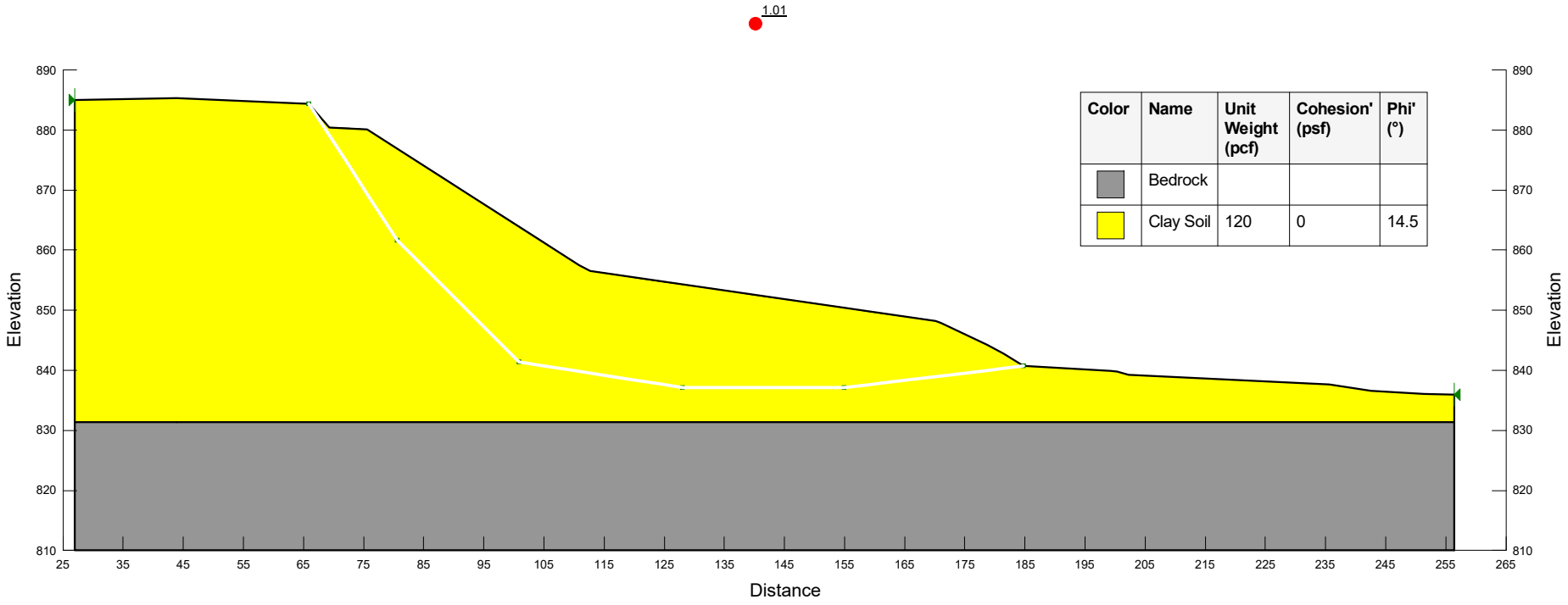
DESIGNER MSJ
REVIEWER EMK 12-13-22
PROJECT ID 110174
SUBSET 0 | TOTAL 0
SHEET 55 | TOTAL 55

APPENDIX B

Slope Stability Analyses

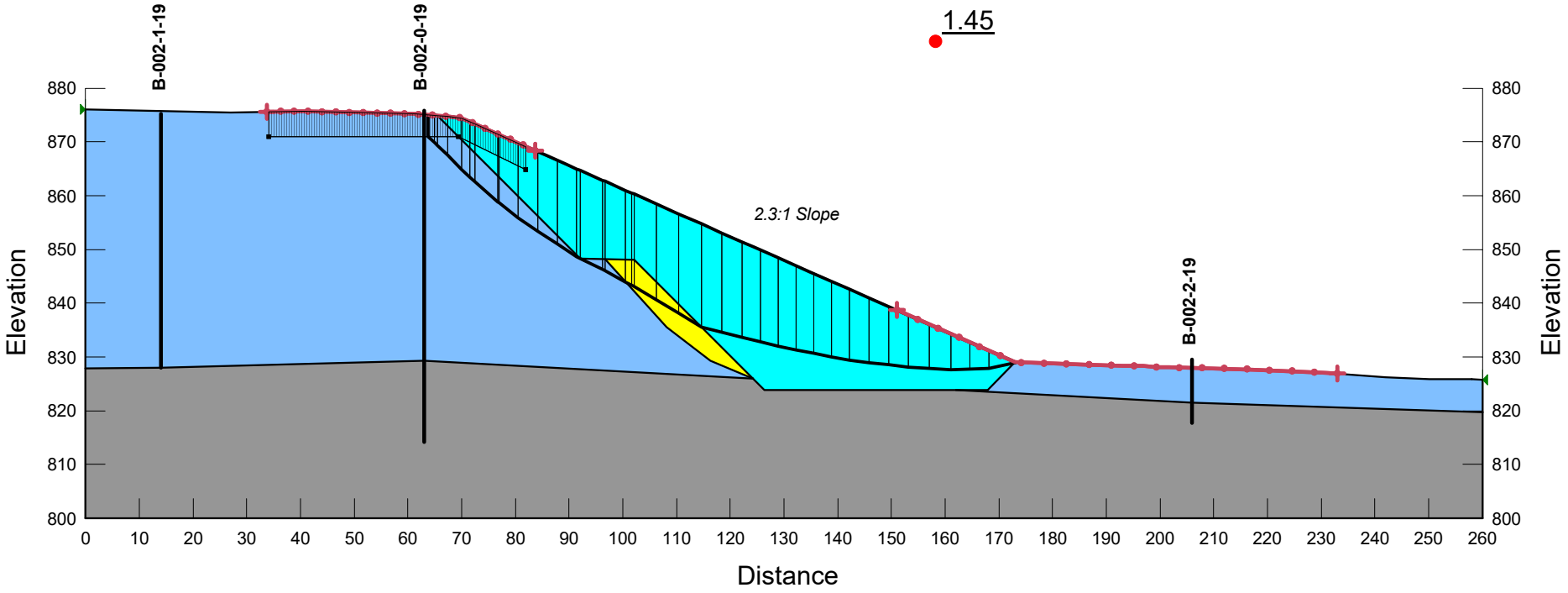


Slope Stability (back analysis)

HAM-74_North Bend Slide.gsz

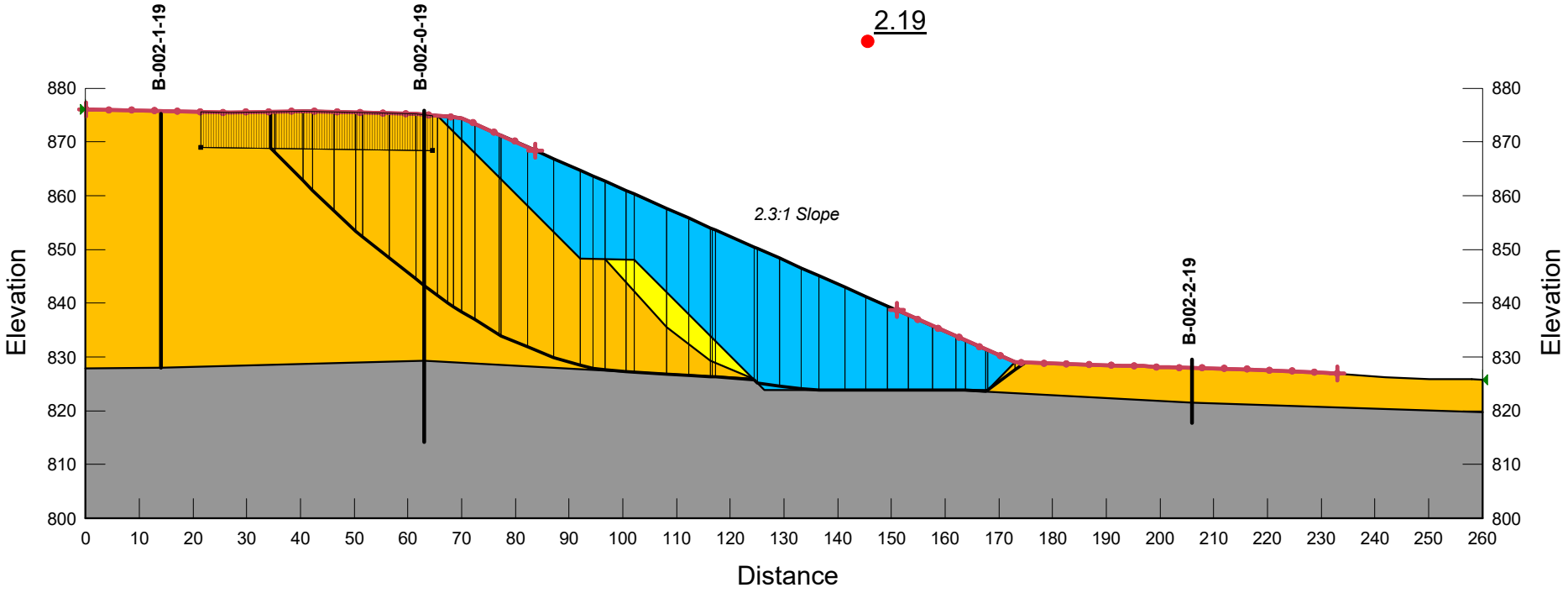
08/28/2020 1:325

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Bedrock	Bedrock (Impenetrable)			
	Clay Soil (existing)	Mohr-Coulomb	120	150	24
	Clay Soil (weakened)	Mohr-Coulomb	120	0	14.5
	Embankment Fill	Mohr-Coulomb	125	200	26



Slope Stability (cut/fill stability)_drained	
HAM-74_North Bend Slide_768+50.gsz	
06/24/2022	1:360

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Bedrock	Bedrock (Impenetrable)			
	Clay Soil (undrained)	Mohr-Coulomb	120	1,500	0
	Clay Soil (weakened)	Mohr-Coulomb	120	0	14.5
	Embankment Fill (undrained)	Mohr-Coulomb	125	2,000	0

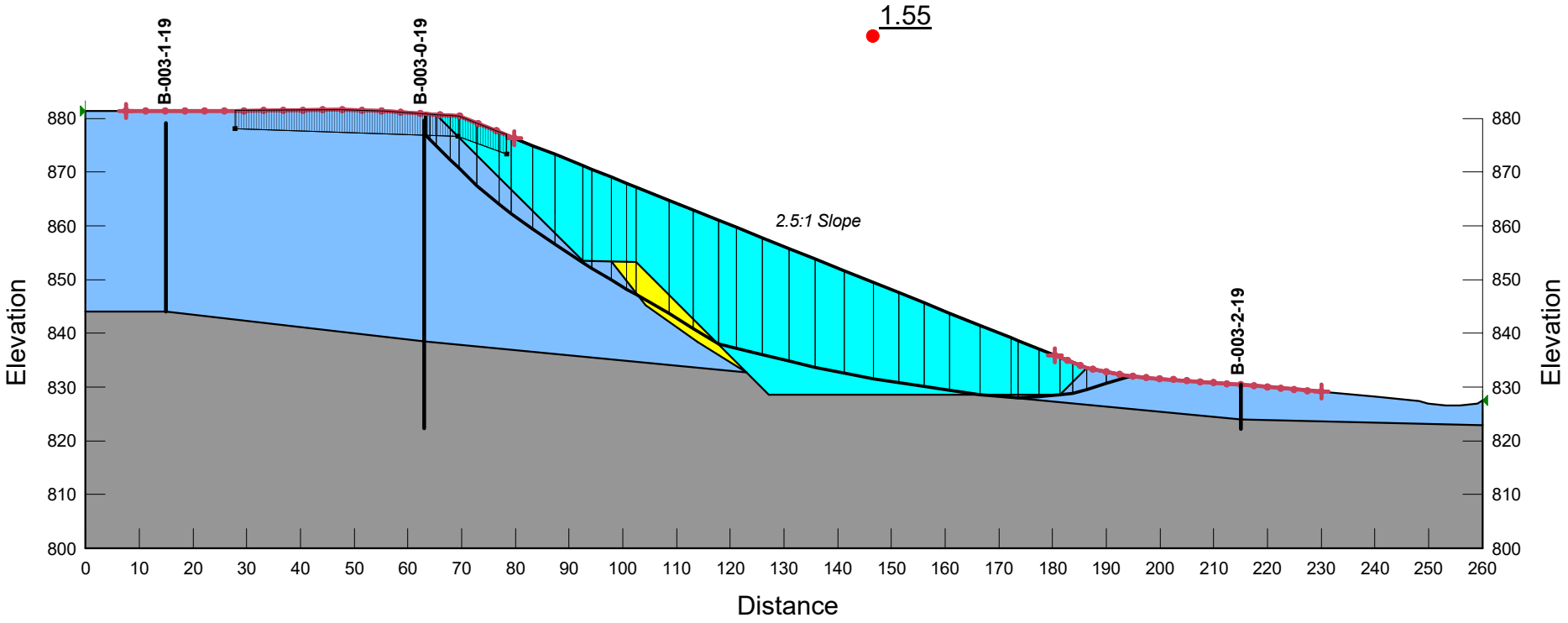


Slope Stability (cut/fill stability)_undrained

HAM-74_North Bend Slide_768+50.gsz

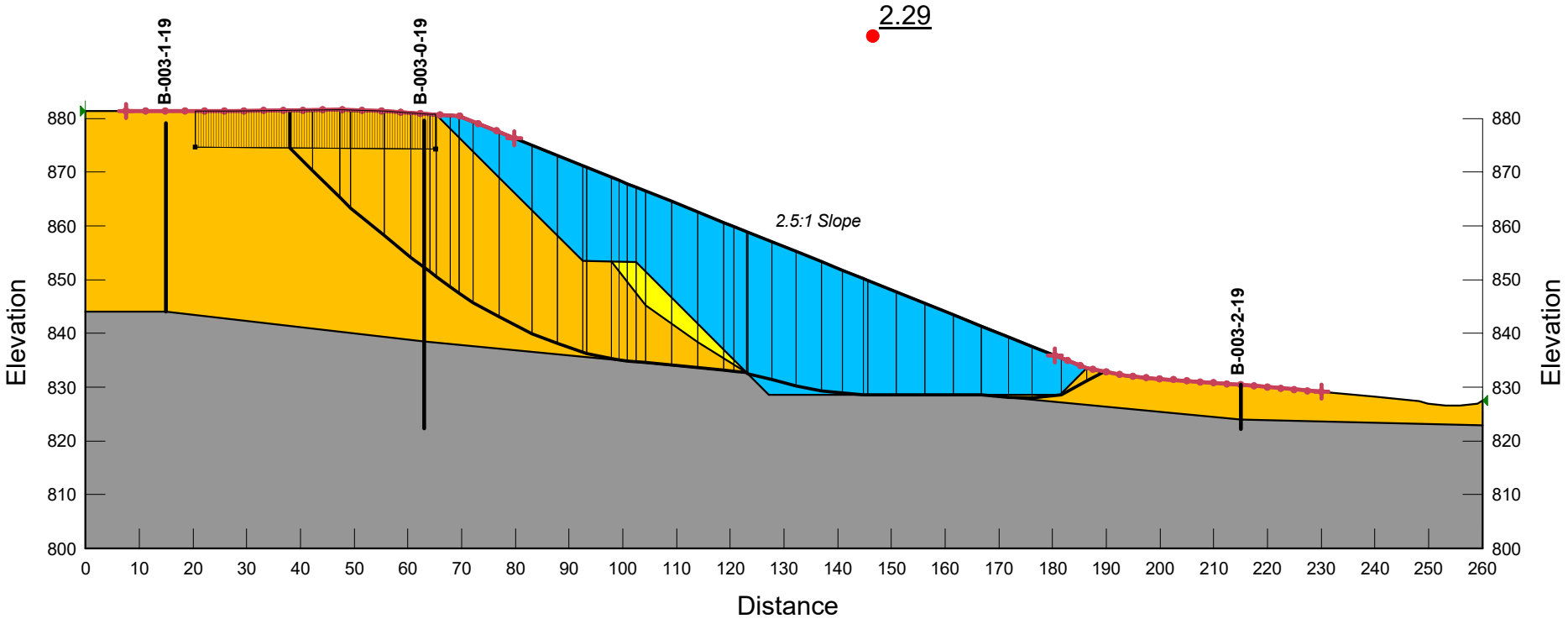
06/27/2022 1:360

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Bedrock	Bedrock (Impenetrable)			
	Clay Soil (existing)	Mohr-Coulomb	120	150	24
	Clay Soil (weakened)	Mohr-Coulomb	120	0	14.5
	Embankment Fill	Mohr-Coulomb	125	200	26



Slope Stability (cut/fill stability)_drained	
HAM-74_North Bend Slide_770+50.gsz	
06/24/2022	1:360

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Bedrock	Bedrock (Impenetrable)			
	Clay Soil (undrained)	Mohr-Coulomb	120	1,500	0
	Clay Soil (weakened)	Mohr-Coulomb	120	0	14.5
	Embankment Fill (undrained)	Mohr-Coulomb	125	2,000	0



Slope Stability (cut/fill stability)_undrained

HAM-74_North Bend Slide_770+50.gsz

06/27/2022 1:360

APPENDIX C

Shoring Analysis

Stantec

HAM-74-14.20 TEMPORARY SHORING

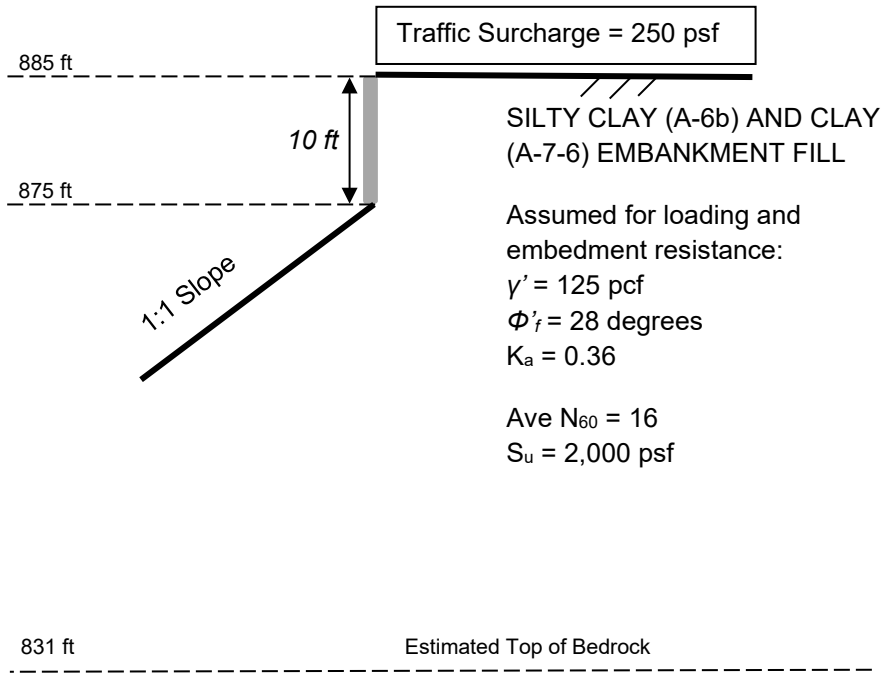
The temporary shoring provides support to the roadway while excavation and rebuilding of the embankment slope is performed.

SHORING CONDITIONS

Assume height of exposed wall = 10 feet, with the top of the wall at Elevation 880 and base of the exposed lagging at Elevation 870 feet.

Base subsurface conditions on borings B-004-0-19.

Assume a flat backslope behind the shoring and 1:1 slope in front of wall.



Calcs by: EK
Checked by: JS
Date: 6/28/22

Stantec

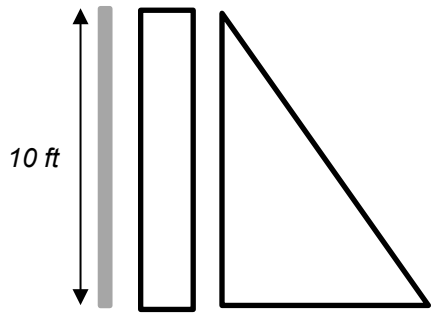
Loading Conditions

Loading is from the active earth pressures from the retained soil and traffic surcharge.

Load factors per Table 3.4.1-2:

- Active Earth Pressure = 1.50
- Live Load Surharge = 1.75

Determine distributed lateral load for input into Lpile:



Wall Pressures:

@ z = 0:

p = (0.36)(250 psf) = 90 pst/foot of wall (unfactored)
p = 1.75(0.36)(250 psf) = 157.5 psf/foot of wall (factored)

@ z = 10':

p = (0.36)(250 psf) + (036)(125 pcf)(10 feet) = 540 psf/foot of wall (unfactored)
p = 1.75(0.36)(250psf) + 1.5(0.36)(125 pcf)(10 feet) = 832.5 psf/foot of wall

Assuming pile spacing of 5.5 feet:

Unfactored Distributed Load

z = 0: p = (90 psf)(5.5 ft) = 495 lb/ft = 41 lb/in
z = 10': p = (540 psf)(5.5 ft) = 2970 lb/ft = 248 lb/in

Factored Distributed Load

z = 0: p = (157.5 psf)(5.5 ft) = 866 lb/ft = 72 lb/in
z = 10': p = (832.5 psf)(5.5 ft) = 4579 lb/ft = 382 lb/in

Stantec

LPILE ANALYSES

Assumptions:

- Use “pinned-head” loading condition in LPile 2019
- HP-section supporting concrete lagging
- 40-foot pile driven to 30 feet of embedment.
- Piles are embedded into soil, bedrock embedment not necessary.
- Deflection of approximately 2 inches or less
- Embedment material properties as follows:

Summary

Beam Size	Spacing (ft)	*Service I*	*Strength I*	
		Maximum Deflection (in)	Maximum Shear (kips)	Maximum Moment (ft-kips)
HP14x73	5.5	1.8	29.0	206.5
Capacity for HP14x73			199.0	445.8
Percentage of Capacity (%)			15%	46%

LPile for Windows, Version 2019-11.001

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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Files Used for Analysis

Path to file locations on this computer:
\1755\active\175538063\technical_production\analysis\

Name of the input data file:
HAM-74_HP14x73_6ftctc_shoring.lp11

Name of the output report file:
HAM-74_HP14x73_6ftctc_shoring.lp11

Name of the plot output file:
HAM-74_HP14x73_6ftctc_shoring.lp11

Name of the runtime message file:
HAM-74_HP14x73_6ftctc_shoring.lp11

Date and Time of Analysis

Date: August 31, 2020 Time: 15:28:24

Problem Title

Project Name: HAM-74-14.20

Job Number: 175538063

Client: ODOT

Engineer: E.Kistner

Description: Shoring Design

Program Options and Settings

Computational Options:
 - Use unfactored loads in computations (conventional analysis)
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - Analysis includes loading by multiple distributed lateral loads acting on pile
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using narrow report formats
   (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 35.000 ft
Depth of ground surface below top of pile = 10.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	14.5850
2	35.000	14.5850

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a H strong axis steel pile
Length of section = 35.000000 ft
Pile width = 14.585000 in
Shear capacity of section = 0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle = 45.000 degrees
= 0.785 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 1 layers

Layer 1 is stiff clay with user-defined k-value

Distance from top of pile to top of layer = 10.000000 ft

Distance from top of pile to bottom of layer	=	50.000000 ft
Effective unit weight at top of layer	=	125.000000 pcf
Effective unit weight at bottom of layer	=	125.000000 pcf
Undrained cohesion at top of layer	=	2000. psf
Undrained cohesion at bottom of layer	=	2000. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000
Subgrade k at top of layer	=	0.0000 pci
Subgrade k at bottom of layer	=	0.0000 pci

NOTE: Default values for Epsilon-50 will be computed for this layer.
NOTE: Default values for subgrade k will be computed for this layer.

(Depth of the lowest soil layer extends 15.000 ft below the pile tip)

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading for Individual Load Cases

Distributed lateral load intensity for Load Case 1 defined using 2 points

Distributed lateral load intensity for Load Case 2 defined using 2 points

---

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 0.0000 lbs	M = 0.0000 in-lbs	0.0000000
2	1	V = 0.0000 lbs	M = 0.0000 in-lbs	0.0000000

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel H Strong Axis:

Length of Section	=	35.000000 ft
Flange Width	=	14.585000 in
Section Depth	=	13.610000 in
Flange Thickness	=	0.505000 in
Web Thickness	=	0.505000 in
Yield Stress of Pipe	=	50.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	21.093850 sq. in.
Moment of Inertia	=	716.968371 in^4
Elastic Bending Stiffness	=	20792083. kip-in^2
Plastic Modulus, Z	=	116.567345in^3
Plastic Moment Capacity = Fy Z	=	5828.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	1054.692 kips
Nominal Axial Tensile Capacity	=	-1054.692 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	0.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 0.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Run Msg

0.0000050241	104.3570730414	20771477.	6.8050000000	
0.0000100481	208.7141460828	20771477.	6.8050000000	
0.0000150722	313.0712191241	20771477.	6.8050000000	
0.0000200962	417.4282921655	20771477.	6.8050000000	
0.0000251203	521.7853652069	20771477.	6.8050000000	
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0.0000351684	730.4995112897	20771477.	6.8050000000	
0.0000401925	834.8565843311	20771477.	6.8050000000	
0.0000452165	939.2136573724	20771477.	6.8050000000	
0.0000502406	1044.	20771477.	6.8050000000	
0.0000552646	1148.	20771477.	6.8050000000	
0.0000602887	1252.	20771477.	6.8050000000	
0.0000653127	1357.	20771477.	6.8050000000	
0.0000703368	1461.	20771477.	6.8050000000	
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0.0000854090	1774.	20771477.	6.8050000000	
0.0000904330	1878.	20771477.	6.8050000000	
0.0000954571	1983.	20771477.	6.8050000000	
0.0001004811	2087.	20771477.	6.8050000000	
0.0001055052	2191.	20771477.	6.8050000000	
0.0001105292	2296.	20771477.	6.8050000000	
0.0001155533	2400.	20771477.	6.8050000000	
0.0001205774	2505.	20771477.	6.8050000000	
0.0001256014	2609.	20771477.	6.8050000000	
0.0001306255	2713.	20771477.	6.8050000000	
0.0001356495	2818.	20771477.	6.8050000000	
0.0001406736	2922.	20771477.	6.8050000000	
0.0001456976	3026.	20771477.	6.8050000000	
0.0001507217	3131.	20771477.	6.8050000000	
0.0001557457	3235.	20771477.	6.8050000000	
0.0001607698	3339.	20771477.	6.8050000000	
0.0001657939	3444.	20771477.	6.8050000000	
0.0001708179	3548.	20771477.	6.8050000000	
0.0001758420	3652.	20771477.	6.8050000000	
0.0001808660	3757.	20771477.	6.8050000000	
0.0001858901	3861.	20771477.	6.8050000000	
0.0001909141	3966.	20771477.	6.8050000000	
0.0001959382	4070.	20771477.	6.8050000000	
0.0002059863	4279.	20771477.	6.8050000000	
0.0002160344	4487.	20771477.	6.8050000000	
0.0002260825	4696.	20771477.	6.8050000000	
0.0002361306	4905.	20771477.	6.8050000000	
0.0002461788	5113.	20771477.	6.8050000000	
0.0002562269	5321.	20765273.	6.8050000000	Y
0.0002662750	5451.	20472702.	6.8050000000	Y
0.0002763231	5498.	19896773.	6.8050000000	Y
0.0002863712	5521.	19277585.	6.8050000000	Y
0.0002964193	5541.	18692722.	6.8050000000	Y
0.0003064674	5559.	18139845.	6.8050000000	Y
0.0003165156	5576.	17616398.	6.8050000000	Y
0.0003265637	5591.	17120753.	6.8050000000	Y
0.0003366118	5605.	16650801.	6.8050000000	Y
0.0003466599	5618.	16204662.	6.8050000000	Y
0.0003567080	5629.	15780648.	6.8050000000	Y

0.0003667561	5640.	15377244.	6.8050000000	Y
0.0003768042	5649.	14993078.	6.8050000000	Y
0.0003868523	5658.	14626906.	6.8050000000	Y
0.0003969005	5667.	14277596.	6.8050000000	Y
0.0004069486	5675.	13944111.	6.8050000000	Y
0.0004169967	5682.	13625501.	6.8050000000	Y
0.0004270448	5688.	13320534.	6.8050000000	Y
0.0004370929	5695.	13028461.	6.8050000000	Y
0.0004471410	5701.	12748818.	6.8050000000	Y
0.0004571891	5706.	12480495.	6.8050000000	Y
0.0004672372	5711.	12222927.	6.8050000000	Y
0.0004772854	5716.	11975798.	6.8050000000	Y
0.0004873335	5720.	11737872.	6.8050000000	Y
0.0004973816	5725.	11509422.	6.8050000000	Y
0.0005074297	5728.	11289125.	6.8050000000	Y
0.0005174778	5732.	11077349.	6.8050000000	Y
0.0005275259	5736.	10872830.	6.8050000000	Y
0.0005375740	5739.	10675957.	6.8050000000	Y
0.0005476221	5742.	10485671.	6.8050000000	Y
0.0005576703	5745.	10302134.	6.8050000000	Y
0.0005677184	5748.	10124784.	6.8050000000	Y
0.0005777665	5751.	9953257.	6.8050000000	Y
0.0005878146	5753.	9787593.	6.8050000000	Y
0.0005978627	5756.	9627005.	6.8050000000	Y
0.0006380552	5764.	9033952.	6.8050000000	Y
0.0006782476	5771.	8509085.	6.8050000000	Y
0.0007184401	5777.	8041305.	6.8050000000	Y
0.0007586325	5782.	7621840.	6.8050000000	Y
0.0007988250	5786.	7243648.	6.8050000000	Y
0.0008390174	5790.	6901013.	6.8050000000	Y
0.0008792099	5793.	6589234.	6.8050000000	Y
0.0009194023	5796.	6304128.	6.8050000000	Y
0.0009595948	5798.	6042609.	6.8050000000	Y
0.0009997872	5801.	5801861.	6.8050000000	Y
0.0010399797	5802.	5579427.	6.8050000000	Y
0.0010801721	5804.	5373400.	6.8050000000	Y
0.0011203646	5806.	5181992.	6.8050000000	Y
0.0011605570	5807.	5003661.	6.8050000000	Y
0.0012007495	5808.	4837269.	6.8050000000	Y
0.0012409419	5809.	4681429.	6.8050000000	Y
0.0012811344	5810.	4535331.	6.8050000000	Y

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	0.00000000	5810.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 0.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness in-lb^2
0.000	1.77701	8.105E-06	3.113E-08	0.000	2.077E+10
0.35000	1.73579	377.59523	191.21812	0.000	2.077E+10
0.70000	1.69457	1606.	409.06163	0.000	2.077E+10
1.05000	1.65336	3814.	657.33413	0.000	2.077E+10
1.40000	1.61214	7128.	936.03563	0.000	2.077E+10
1.75000	1.57093	11676.	1245.	0.000	2.077E+10
2.10000	1.52973	17587.	1585.	0.000	2.077E+10
2.45000	1.48855	24988.	1955.	0.000	2.077E+10
2.80000	1.44739	34007.	2355.	0.000	2.077E+10
3.15000	1.40626	44771.	2786.	0.000	2.077E+10
3.50000	1.36516	57409.	3247.	0.000	2.077E+10
3.85000	1.32411	72048.	3739.	0.000	2.077E+10
4.20000	1.28313	88816.	4261.	0.000	2.077E+10
4.55000	1.24222	107841.	4814.	0.000	2.077E+10
4.90000	1.20140	129251.	5397.	0.000	2.077E+10
5.25000	1.16069	153173.	6010.	0.000	2.077E+10
5.60000	1.12011	179736.	6654.	0.000	2.077E+10
5.95000	1.07969	209066.	7328.	0.000	2.077E+10
6.30000	1.03944	241292.	8033.	0.000	2.077E+10
6.65000	0.99939	276542.	8768.	0.000	2.077E+10
7.00000	0.95959	314944.	9534.	0.000	2.077E+10
7.35000	0.92004	356625.	10330.	0.000	2.077E+10
7.70000	0.88081	401713.	11156.	0.000	2.077E+10
8.05000	0.84191	450335.	12013.	0.000	2.077E+10
8.40000	0.80339	502621.	12900.	0.000	2.077E+10
8.75000	0.76531	558697.	13818.	0.000	2.077E+10
9.10000	0.72769	618691.	14766.	0.000	2.077E+10
9.45000	0.69060	682731.	15745.	0.000	2.077E+10

9.80000	0.65410	750945.	16754.	0.000	2.077E+10
10.15000	0.61823	823461.	16860.	-211.05239	2.077E+10
10.50000	0.58306	892566.	15993.	-219.21698	2.077E+10
10.85000	0.54864	957804.	15056.	-226.97117	2.077E+10
11.20000	0.51504	1019038.	14088.	-234.30297	2.077E+10
11.55000	0.48231	1076140.	13089.	-241.20024	2.077E+10
11.90000	0.45049	1128986.	12062.	-247.65060	2.077E+10
12.25000	0.41963	1177464.	11010.	-253.64150	2.077E+10
12.60000	0.38976	1221467.	9933.	-259.16010	2.077E+10
12.95000	0.36094	1260899.	8834.	-264.19324	2.077E+10
13.30000	0.33319	1295671.	7715.	-268.72745	2.077E+10
13.65000	0.30653	1325702.	6578.	-272.74882	2.077E+10
14.00000	0.28101	1350922.	5425.	-276.24297	2.077E+10
14.35000	0.25663	1371269.	4258.	-279.19496	2.077E+10
14.70000	0.23341	1386692.	3081.	-281.58920	2.077E+10
15.05000	0.21137	1397146.	1894.	-283.40932	2.077E+10
15.40000	0.19052	1402602.	701.19211	-284.63803	2.077E+10
15.75000	0.17086	1403036.	-495.58726	-285.25691	2.077E+10
16.10000	0.15239	1398439.	-1694.	-285.24620	2.077E+10
16.45000	0.13511	1388810.	-2890.	-284.58449	2.077E+10
16.80000	0.11901	1374161.	-4083.	-283.24829	2.077E+10
17.15000	0.10407	1354515.	-5268.	-281.21155	2.077E+10
17.50000	0.09029	1329909.	-6443.	-278.44486	2.077E+10
17.85000	0.07763	1300390.	-7605.	-274.91452	2.077E+10
18.20000	0.06608	1266023.	-8751.	-270.58105	2.077E+10
18.55000	0.05561	1226882.	-9877.	-265.39711	2.077E+10
18.90000	0.04617	1183060.	-10978.	-259.30441	2.077E+10
19.25000	0.03775	1134664.	-12053.	-252.22870	2.077E+10
19.60000	0.03028	1081818.	-13095.	-244.07190	2.077E+10
19.95000	0.02373	1024667.	-14100.	-234.69832	2.077E+10
20.30000	0.01806	963376.	-15063.	-223.90974	2.077E+10
20.65000	0.01320	898135.	-15977.	-211.39559	2.077E+10
21.00000	0.009104	829165.	-16834.	-196.62196	2.077E+10
21.35000	0.005713	756726.	-17622.	-178.53754	2.077E+10
21.70000	0.002964	681139.	-18322.	-154.53672	2.077E+10
22.05000	0.000794	602825.	-18884.	-113.36998	2.077E+10
22.40000	-0.000864	522511.	-18852.	128.62980	2.077E+10
22.75000	-0.002079	444467.	-17957.	297.83785	2.077E+10
23.10000	-0.002916	371676.	-16650.	324.14660	2.077E+10
23.45000	-0.003438	304603.	-15260.	337.76448	2.077E+10
23.80000	-0.003700	243488.	-13829.	344.04680	2.077E+10
24.15000	-0.003756	188443.	-12381.	345.34391	2.077E+10
24.50000	-0.003652	139489.	-10936.	342.92929	2.077E+10
24.85000	-0.003430	96584.	-9506.	337.58393	2.077E+10
25.20000	-0.003125	59635.	-8105.	329.82815	2.077E+10
25.55000	-0.002770	28503.	-6740.	320.02976	2.077E+10
25.90000	-0.002391	3017.	-5420.	308.46019	2.077E+10
26.25000	-0.002009	-17028.	-4152.	295.32483	2.077E+10
26.60000	-0.001641	-31863.	-2943.	280.77817	2.077E+10
26.95000	-0.001301	-41745.	-1797.	264.57327	2.077E+10
27.30000	-0.000996	-46960.	-807.61597	206.72360	2.077E+10
27.65000	-0.000731	-48529.	-48.50272	154.75890	2.077E+10
28.00000	-0.000507	-47368.	506.37671	109.46940	2.077E+10
28.35000	-0.000323	-44276.	885.69268	71.15725	2.077E+10
28.70000	-0.000177	-39928.	1119.	39.73999	2.077E+10
29.05000	-6.495E-05	-34880.	1233.	14.84738	2.077E+10

29.40000	1.757E-05	-29569.	1256.	-4.09144	2.077E+10
29.75000	7.499E-05	-24331.	1210.	-17.77208	2.077E+10
30.10000	0.000112	-19406.	1116.	-26.95112	2.077E+10
30.45000	0.000132	-14957.	991.33984	-32.39455	2.077E+10
30.80000	0.000140	-11079.	850.15177	-34.83786	2.077E+10
31.15000	0.000138	-7815.	703.58292	-34.95683	2.077E+10
31.50000	0.000129	-5169.	560.14291	-33.34793	2.077E+10
31.85000	0.000116	-3110.	426.02679	-30.51689	2.077E+10
32.20000	0.000101	-1590.	305.50575	-26.87409	2.077E+10
32.55000	8.402E-05	-544.02625	201.32540	-22.73560	2.077E+10
32.90000	6.670E-05	101.01248	115.09074	-18.32853	2.077E+10
33.25000	4.946E-05	422.73598	47.62107	-13.79989	2.077E+10
33.60000	3.259E-05	501.02945	-0.73780	-9.22814	2.077E+10
33.95000	1.613E-05	416.53850	-29.85442	-4.63692	2.077E+10
34.30000	3.653E-08	250.25235	-39.61431	-0.01065	2.077E+10
34.65000	-1.585E-05	83.77831	-29.79195	4.68797	2.077E+10
35.00000	-3.166E-05	0.000	0.000	9.49867	2.077E+10

Output Summary for Load Case No. 1:

Pile-head deflection = 1.77701196 inches
Computed slope at pile head = -0.00981413 radians
Maximum bending moment = 1403036. inch-lbs
Maximum shear force = -18884. lbs
Depth of maximum bending moment = 15.75000000 feet below pile head
Depth of maximum shear force = 22.05000000 feet below pile head
Number of iterations = 26
Number of zero deflection points = 3

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 0.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness in-lb^2
0.000	3.73688	9.936E-06	-6.225E-08	0.000	2.077E+10
0.35000	3.65640	658.96426	330.88125	0.000	2.077E+10
0.70000	3.57593	2779.	701.63625	0.000	2.077E+10
1.05000	3.49546	6553.	1118.	0.000	2.077E+10
1.40000	3.41499	12170.	1580.	0.000	2.077E+10
1.75000	3.33454	19824.	2087.	0.000	2.077E+10
2.10000	3.25410	29704.	2640.	0.000	2.077E+10
2.45000	3.17369	42002.	3239.	0.000	2.077E+10
2.80000	3.09331	56911.	3883.	0.000	2.077E+10
3.15000	3.01298	74621.	4573.	0.000	2.077E+10

3.50000	2.93272	95323.	5308.	0.000	2.077E+10
3.85000	2.85253	119210.	6089.	0.000	2.077E+10
4.20000	2.77245	146472.	6916.	0.000	2.077E+10
4.55000	2.69249	177300.	7788.	0.000	2.077E+10
4.90000	2.61268	211887.	8705.	0.000	2.077E+10
5.25000	2.53305	250424.	9668.	0.000	2.077E+10
5.60000	2.45364	293101.	10677.	0.000	2.077E+10
5.95000	2.37447	340111.	11731.	0.000	2.077E+10
6.30000	2.29559	391644.	12831.	0.000	2.077E+10
6.65000	2.21705	447893.	13977.	0.000	2.077E+10
7.00000	2.13888	509049.	15168.	0.000	2.077E+10
7.35000	2.06115	575302.	16404.	0.000	2.077E+10
7.70000	1.98391	646844.	17686.	0.000	2.077E+10
8.05000	1.90721	723868.	19014.	0.000	2.077E+10
8.40000	1.83113	806563.	20387.	0.000	2.077E+10
8.75000	1.75574	895123.	21806.	0.000	2.077E+10
9.10000	1.68110	989737.	23271.	0.000	2.077E+10
9.45000	1.60731	1090597.	24781.	0.000	2.077E+10
9.80000	1.53444	1197895.	26336.	0.000	2.077E+10
10.15000	1.46259	1311822.	26633.	-261.74772	2.077E+10
10.50000	1.39185	1421613.	25568.	-272.48585	2.077E+10
10.85000	1.32232	1526597.	24402.	-282.80147	2.077E+10
11.20000	1.25409	1626592.	23194.	-292.68338	2.077E+10
11.55000	1.18724	1721425.	21945.	-302.12027	2.077E+10
11.90000	1.12185	1810928.	20657.	-311.10069	2.077E+10
12.25000	1.05800	1894944.	19332.	-319.61305	2.077E+10
12.60000	0.99576	1973321.	17973.	-327.64557	2.077E+10
12.95000	0.93519	2045919.	16581.	-335.18628	2.077E+10
13.30000	0.87636	2112604.	15159.	-342.22298	2.077E+10
13.65000	0.81933	2173252.	13708.	-348.74321	2.077E+10
14.00000	0.76414	2227748.	12230.	-354.73424	2.077E+10
14.35000	0.71084	2275987.	10729.	-360.18298	2.077E+10
14.70000	0.65947	2317872.	9206.	-365.07597	2.077E+10
15.05000	0.61008	2353318.	7664.	-369.39930	2.077E+10
15.40000	0.56268	2382247.	6104.	-373.13858	2.077E+10
15.75000	0.51730	2404594.	4531.	-376.27881	2.077E+10
16.10000	0.47397	2420303.	2945.	-378.80432	2.077E+10
16.45000	0.43270	2429330.	1350.	-380.69864	2.077E+10
16.80000	0.39348	2431642.	-251.66906	-381.94437	2.077E+10
17.15000	0.35633	2427216.	-1857.	-382.52299	2.077E+10
17.50000	0.32124	2416043.	-3463.	-382.41464	2.077E+10
17.85000	0.28821	2398124.	-5068.	-381.59786	2.077E+10
18.20000	0.25721	2373473.	-6667.	-380.04922	2.077E+10
18.55000	0.22823	2342118.	-8259.	-377.74285	2.077E+10
18.90000	0.20123	2304100.	-9839.	-374.64981	2.077E+10
19.25000	0.17619	2259473.	-11404.	-370.73730	2.077E+10
19.60000	0.15307	2208306.	-12951.	-365.96751	2.077E+10
19.95000	0.13183	2150684.	-14476.	-360.29600	2.077E+10
20.30000	0.11241	2086706.	-15976.	-353.66945	2.077E+10
20.65000	0.09477	2016489.	-17445.	-346.02231	2.077E+10
21.00000	0.07884	1940169.	-18880.	-337.27165	2.077E+10
21.35000	0.06455	1857899.	-20275.	-327.30912	2.077E+10
21.70000	0.05184	1769855.	-21626.	-315.98767	2.077E+10
22.05000	0.04064	1676237.	-22926.	-303.09822	2.077E+10
22.40000	0.03086	1577273.	-24168.	-288.32622	2.077E+10
22.75000	0.02242	1473222.	-25343.	-271.16185	2.077E+10

23.10000	0.01523	1364388.	-26439.	-250.68915	2.077E+10
23.45000	0.009196	1251132.	-27438.	-224.97716	2.077E+10
23.80000	0.004227	1133908.	-28307.	-188.53234	2.077E+10
24.15000	0.000221	1013357.	-28781.	-37.58019	2.077E+10
24.50000	-0.002924	892144.	-28179.	324.36400	2.077E+10
24.85000	-0.005311	776653.	-26707.	376.58824	2.077E+10
25.20000	-0.007040	667804.	-25068.	404.06839	2.077E+10
25.55000	-0.008200	566084.	-23338.	419.78923	2.077E+10
25.90000	-0.008881	471768.	-21557.	428.23721	2.077E+10
26.25000	-0.009160	385007.	-19751.	431.56897	2.077E+10
26.60000	-0.009113	305858.	-17940.	431.00975	2.077E+10
26.95000	-0.008805	234313.	-16137.	427.33096	2.077E+10
27.30000	-0.008299	170305.	-14356.	421.05294	2.077E+10
27.65000	-0.007648	113725.	-12605.	412.54405	2.077E+10
28.00000	-0.006901	64422.	-10894.	402.07389	2.077E+10
28.35000	-0.006099	22212.	-9231.	389.84383	2.077E+10
28.70000	-0.005278	-13121.	-7623.	376.00497	2.077E+10
29.05000	-0.004468	-41822.	-6076.	360.66852	2.077E+10
29.40000	-0.003694	-64160.	-4596.	343.91028	2.077E+10
29.75000	-0.002974	-80432.	-3190.	325.76955	2.077E+10
30.10000	-0.002322	-90958.	-1863.	306.24008	2.077E+10
30.45000	-0.001748	-96081.	-620.79708	285.24642	2.077E+10
30.80000	-0.001255	-96172.	529.65579	262.58828	2.077E+10
31.15000	-0.000844	-91632.	1531.	214.30522	2.077E+10
31.50000	-0.000511	-83311.	2258.	131.88788	2.077E+10
31.85000	-0.000249	-72663.	2672.	65.22261	2.077E+10
32.20000	-4.802E-05	-60865.	2836.	12.79204	2.077E+10
32.55000	0.000101	-48842.	2805.	-27.33755	2.077E+10
32.90000	0.000209	-37300.	2628.	-57.32083	2.077E+10
33.25000	0.000284	-26770.	2341.	-79.36976	2.077E+10
33.60000	0.000338	-17640.	1973.	-95.61779	2.077E+10
33.95000	0.000376	-10197.	1545.	-108.00689	2.077E+10
34.30000	0.000405	-4658.	1070.	-118.19158	2.077E+10
34.65000	0.000431	-1205.	554.56394	-127.45399	2.077E+10
35.00000	0.000455	0.000	0.000	-136.62408	2.077E+10

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     3.73687640 inches
Computed slope at pile head      =    -0.01916038 radians
Maximum bending moment           =       2431642. inch-lbs
Maximum shear force              =        -28781. lbs
Depth of maximum bending moment  =    16.80000000 feet below pile head
Depth of maximum shear force     =    24.15000000 feet below pile head
Number of iterations             =             29
Number of zero deflection points =              2
```

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

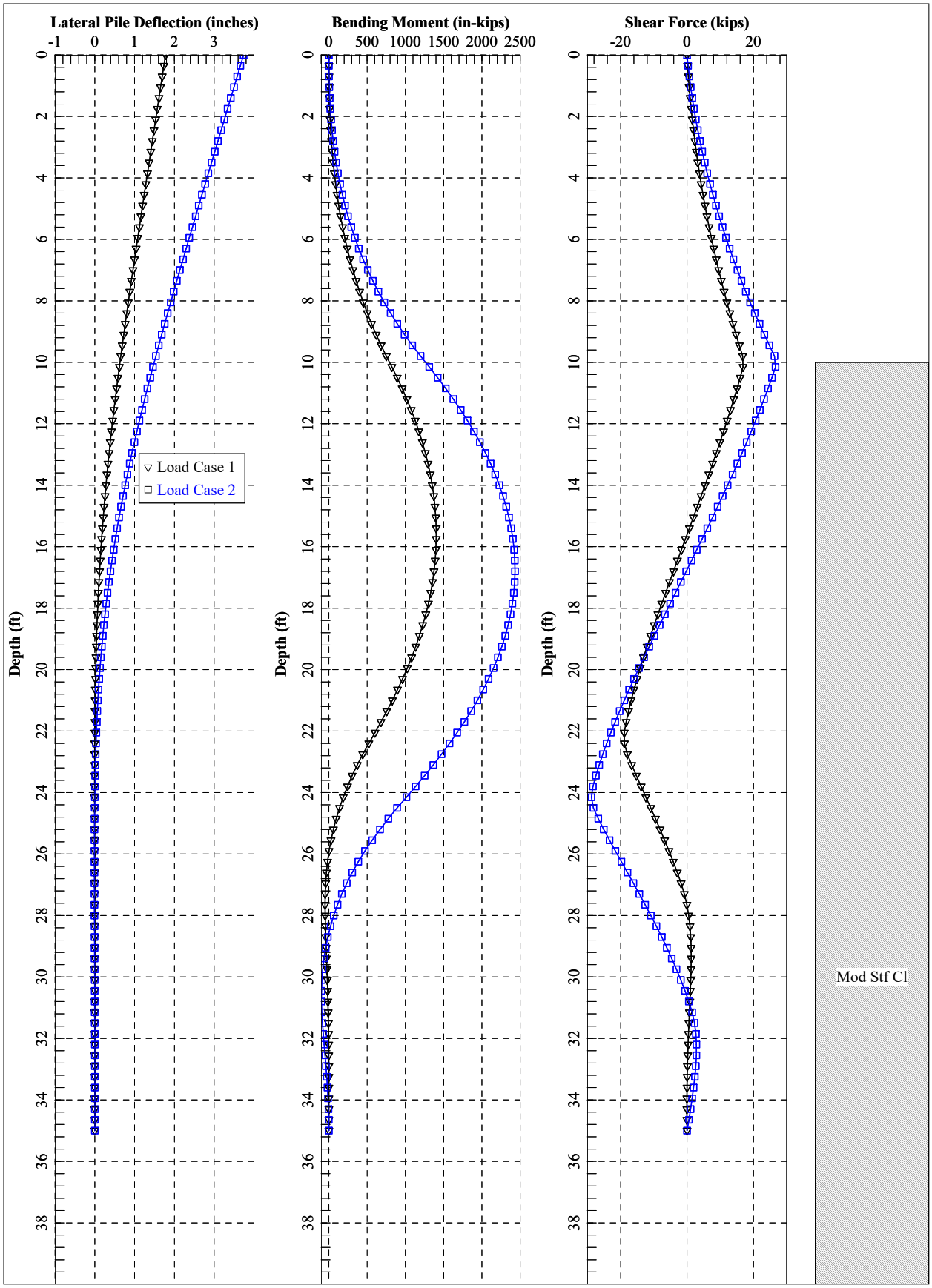
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians

Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	1.777012	-0.009814	-18884.	1403036.
2	1	3.736876	-0.019160	-28781.	2431642.

Maximum pile-head deflection = 3.7368763989 inches
Maximum pile-head rotation = -0.0191603778 radians = -1.097809 deg.

The analysis ended normally.


Lateral Pile Deflection (inches)
-1
0
1
2
3
Bending Moment (in-kips)
0
500
1000
1500
2000
2500
Shear Force (kips)
-20
0
20
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
Load Case 1
Load Case 2
Mod Stf Cl

APPENDIX D

Geotechnical Design Checklists

I. Geotechnical Design Checklists			
Project: HAM-74-14.20		**PDP Path:**	**NA**
PID: 110174		**Review Stage:**	**Final**

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

II. Reconnaissance and Planning Checklist

C-R-S:	HAM-74-14.20	PID:	110174	Reviewer:	J. Samples	Date:	12/14/2022

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

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

II. Reconnaissance and Planning Checklist

Planning - General	(Y/N/X)	Notes:
10 Have the scaled boring plans, showing all project and historic borings, and a schedule of borings in tabular format, been submitted to the District Geotechnical Engineer?	Y	
The schedule of borings should present the following information for each boring:		
a. exploration identification number	Y	
b. location by station and offset	N	Stationing not available at time of proposal.
c. estimated amount of rock and soil, including the total for each for the entire program.	Y	
Planning – Exploration Number	(Y/N/X)	Notes:
11 Have the coordinates, stations and offsets of all explorations (borings, probes, test pits, etc.) been identified?	Y	
12 Has each exploration been assigned a unique identification number, in the following format X-ZZZ-W-YY, as per Section 303.2 of the SGE?	Y	
13 When referring to historic explorations that did not use the identification scheme in 12 above, have the historic explorations been assigned identification numbers according to Section 303.2 of the SGE?	X	

II. Reconnaissance and Planning Checklist

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

V.A. Landslide Remediation Checklist

C-R-S:	HAM-74-14.20	PID:	110174	Reviewer:	J. Samples	Date:	12/14/2022

If you do not have a landslide remediation on the project, you do not have to fill out this checklist.

Exploration		(Y/N/X)	Notes:
1	Is the site included in the GHMS/ Collector Landslide Inventory? If yes, provide the rating.	N	
2	Has a site reconnaissance been conducted to define the limits of the landslide?	Y	
	If yes, check the visible signs observed:		
	cracks in pavement	✓	
	bulging toe		
	sloughed slopes	✓	
	scarp	✓	
	stream channel or ditch pinches		
	hydrophytic vegetation		
	rotated or dropped guardrail	✓	
	bent, cracked, or crushed pipe, culvert, or other structures		
	water seepage, flow from embankment, or ice	✓	
	leaning, curved, J-shaped, deformed, or fallen trees or power poles		
	deflection of linear features	✓	
	other (describe other visible signs)		
3	Have a site plan and cross sections been provided to compare ground surface conditions before and after failure?	Y	
4	Has the history of the landslide area been researched, including movement history, maintenance work, pavement drainage, and past corrective measures?	Y	
5	Has a site specific geotechnical exploration been performed to investigate the landslide area?	Y	
6	Has a groundwater monitoring program been performed to identify the phreatic surface through the landslide area?	N	Groundwater monitoring was outside the scope of this project.
7	Has a landslide failure plane been determined from field observations or instrumentation?	Y	Field observations.

V.A. Landslide Remediation Checklist

Analysis		(Y/N/X)	Notes:
8	Has the landslide mode of failure been determined?	Y	
	Check those that apply:		
	rotational failure		
	translational	✓	
	block failure	✓	
	sheet		
	surface sloughing		
	slump		
	other (describe other failure modes)		
9	Have the subsurface conditions been identified which are the expected source of the failure mode?	Y	
	Check those that apply:		
	general shear strength failure of foundation soils		
	loading		
	along sloped rock surfaces		
	erosion	✓	
	through thin, weak soil layers	✓	
	permeable materials		
	surface / groundwater	✓	
	structure		
	Anthropogenic disturbances		
	weathering		
	impeded drainage		
	other (describe other sources)		
10	If water (static or flowing) significantly influences the stability of the landslide, has the source of water been identified, quantified, and water quality assessed?	Y	Surficial run off
11	Have calculations been performed to determine the F.S. for stability? Indicate which program and which analysis method (Spencer, Bishop, etc) was used.	Y	Slope/W, Spencer
12	Have the following F.S. been met or exceeded, as determined by the calculations, for the given stability conditions:	Y	
a.	1.30 for short term (undrained) condition	X	
b.	1.30 for long term (drained) condition	Y	
c.	1.10 for rapid drawdown, flood condition	X	
d.	1.50 for slope containing or supporting a structural element	X	

V.A. Landslide Remediation Checklist

Analysis		(Y/N/X)	Notes:
13	When differing soil or loading conditions occur throughout the landslide area, have sufficient analyses been completed to evaluate the stability at locations representative of the most critical conditions?	X	

Design		(Y/N/X)	Notes:
14	Has a landslide remediation method been determined?	Y	
	If yes, check the methods that were evaluated and note the chosen remediation:		
	benching and regrading (See GB 2)	✓	
	counter berm and regrading		
	flatten slope		
	geosynthetic reinforced slope		
	install surface / subsurface drainage system		
	shear key (See GB 2)		
	soil nails or tiebacks		
	walls, sheeting, or drilled shafts	✓	
	soil anchoring		
	relocate existing alignments		
	lightweight fills		
	soil removal / treatment		
	chemical treatment		
	Bioengineering		
	other (describe other methods)		
15	Based on accepted design practices, and where applicable, adhering to published guidelines and design recommendations from FHWA, were calculations performed to evaluate the effectiveness of the chosen solutions?	Y	
16	Has a cost comparison been performed to evaluate a recommended solution compared to others?	N	Only one solution evaluated.

V.A. Landslide Remediation Checklist

	Plans and Contract Documents	(Y/N/X)	Notes:
17	Have all necessary notes, specifications, and plan details been developed?	Y	
18	Has the vertical and lateral extent of defined landslide conditions been included on the Cross Sections and Plan and Profile sheets?	Y	
19	Has the information obtained from the exploration and analysis been incorporated into the project design?	Y	
20	Have the need, location, plan notes, and monitoring schedule of instrumentation been determined?	X	No instrumentation required.
21	Have the effects of the stability solution on the construction schedule and maintenance of traffic been accounted for in the plans?	X	Not in scope.
22	Have the effects of the original failure and proposed remediation on any structures (e.g., bridges, buildings, culverts, utilities) or adjacent properties been evaluated and solutions to any issues incorporated into final design?	X	Not in scope.

VI.A. Soil Profile Checklist

C-R-S:	HAM-74-14.20	PID:	110174	Reviewer:	J. Samples	Date:	12/14/2022

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

VI.A. Soil Profile Checklist

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

VI.A. Soil Profile Checklist

Cover Sheet	(Y/N/X)	Notes:
14 Has a Legend been provided?	Y	
15 Have the following items been included in the Legend:	Y	
a. Symbols and usual descriptions for only the soil and bedrock types presented in the Soil Profile, as per the Soil and Rock Symbology Chart in Appendix D of the SGE?	Y	
b. All miscellaneous symbols and acronyms, used on any of the sheets, defined?	Y	
c. The number of soil samples for each classification that were mechanically classified and visually described in the current exploration?	Y	
16 Has a Location Map, showing the beginning and end stations for the project, been shown on the cover sheet, sized per the L&D3 Manual?	Y	
17 Have the station limits for each plan and profile sheet for projects with multiple alignments, or greater than 1500', been identified in a table?	Y	
18 Have the station limits for any cross section sheets been identified in the same table?	Y	
19 Has a list of any structures for which structure foundation explorations been performed been identified in the same table?	X	Project not a structure exploration.
20 If sampling and testing for a scour analysis was performed, has this data been shown in tabular form?	X	No scour analysis conducted.
21 Has a summary table of test data for all roadway and subgrade boring samples been shown?	X	No subgrade borings for project
22 If borings from previous subsurface explorations are being used, has that data been shown in a separate table?	Y	
23 In the summary table, has the data been displayed by roadway and subgrade boring in ascending stationing order for each roadway?	Y	Landslide borings displayed in ascending stationing order.
24 Have the centerline or baseline station, offset, and exploration identification number been provided for each boring presented in the table?	Y	

VI.A. Soil Profile Checklist

Cover Sheet	(Y/N/X)	Notes:
25 For each sample, has the following information been provided in the summary table:	Y	
a. Sample depth interval?	Y	
b. Sample number and type?	Y	
c. N_{60}?	Y	
d. Percent recovery?	Y	
e. Hand Penetrometer?	Y	
f. Percentage of aggregate, coarse sand, fine sand, silt, and clay size particles?	Y	
g. Liquid limit, plastic limit, plasticity index, and water content, all rounded to the nearest percent or whole number?	Y	
h. ODOT classification and Group Index?	Y	
i. Visual description of samples not mechanically classified, including water content, and estimated ODOT classification with 'Visual' in parentheses?	Y	
j. Sulfate Content test results?	X	No sulfate tests conducted
26 Have all undisturbed test results been displayed in graphical format on the sheet prior to the plan and profile sheets?	Y	
Surface Data	(Y/N/X)	Notes:
27 Has the following information been shown on each roadway plan drawing:	Y	
a. Existing surface features described in Section 702.5.1?	Y	
b. Proposed construction items, as described in Section 702.5.2?	Y	
c. Project and historic boring locations, with appropriate exploration targets and exploration identification numbers?	Y	
d. Notes regarding observations not readily shown by drawings?	N	
28 Have the existing ground surface contours been presented?	Y	
29 If cross sections are to be developed for stationing covered on a plan sheet, has an index for the appropriate cross section sheets been included on the plan sheet?	Y	

VI.A. Soil Profile Checklist

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

VI.A. Soil Profile Checklist

Subsurface Data	(Y/N/X)	Notes:
38 Have the existing and proposed groundlines been displayed on cross section sheets according to ODOT CADD standards?	Y	
39 Have bedrock exposures shown on the cross sections been plotted along the contour of the cross section?	X	No bedrock exposures noted.
40 Has the following information been provided adjacent to the graphical logs or bedrock exposure:	Y	
a. Thickness, to the nearest inch, of sod/topsoil or other shallow surface material written above the boring (with corresponding symbology at top of log)?	Y	
b. Moisture content, to nearest whole percent, with the bottom of the text aligned with the bottom of the sample? Label this column as 'WC' at bottom of the boring.	Y	
c. N_{60}, aligned with the bottom of sample? Label column as 'N_{60}' at bottom of boring.	Y	
d. Free water indicated by a horizontal line with a 'w' attached, and water level at the end of drilling indicated by an open equilateral triangle, point down?	Y	
e. Complete geologic description of each bedrock unit, including unit core loss, unit RQD, SDI, and compressive strength test results? (Do not present geologic descriptions for structure borings for which this information is presented on the boring logs as described in 703.3)	Y	
f. Visual description of any uncontrolled fill or interval not adequately defined by a graphical symbol?	X	None encountered
g. Organic content with modifiers, per 603.5?	X	No organic content tests conducted.
h. Designate a plastic soil with moisture content equal to or greater than the liquid limit minus three with a 1/8" solid black circle adjacent to the moisture content?	Y	
i. Designate a non-plastic soil with moisture content exceeding 25% or exceeding 19% but appearing wet initially, with a 1/8" open circle with a horizontal line through it adjacent to the moisture content?	N	None encountered
j. The reason for discontinuing a boring prior to reaching the planned depth indicated immediately below the boring?	X	

VI.A. Soil Profile Checklist

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

VI.A. Soil Profile Checklist

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

VI.B. Geotechnical Reports

C-R-S:	HAM-74-14.20	PID:	110174	Reviewer:	J. Samples	Date:	12/14/2022

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

VI.B. Geotechnical Reports

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