Geohazard Exploration Report
HAM-275-11.40 Landslide
(PID: 121506)
Hamilton County, Ohio
S&ME Project No. 24780173

PREPARED FOR:

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January 17, 2026

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Attention: Mr. Eric M. Kistner, P.E.
E: eric.kistner@stantec.com

Reference: **Geohazard Exploration Report**
HAM-275-11.40 Landslide (PID: 121506)
Hamilton County, Ohio
S&ME Project No. 24780173

Dear Eric:

S&ME, Inc. (S&ME) has completed the geohazard exploration at the location of a failing embankment along westbound I-275 east of I-74 interchange in Cincinnati, Hamilton County, Ohio. The work was performed in general accordance with S&ME Proposal No. 24780173, dated November 25, 2024. The purpose of our exploration was to explore subsurface conditions and to provide recommendations regarding site grading and retaining wall construction considerations for this project. This "draft" report describes our understanding of the project, presents the results of the field exploration and laboratory testing, and provides our recommendation. Geotechnical Profile – Geohazard sheets will be submitted under separate cover.

We appreciate having been given the opportunity to be of service on this project. If you require additional assistance or have any questions, please feel free to contact our office at 513-771-8471.

Sincerely,

S&ME, Inc.

Sudip B. Khadka, P.E.
Geotechnical Service Manager

Benjamin C. Dusina, P.E.
Principal Engineer

EXECUTIVE SUMMARY

S&ME has completed the geohazard exploration at the location of a failing embankment along westbound I-275 east of I-74 interchange in Cincinnati, Hamilton County, Ohio. The summary provided below is based on the information provided by the client at the time of this report and our subsurface drilling operations. The information presented below is the summary intended for providing an overview of the project and site conditions. This summary cannot be used in lieu of reading the entire geotechnical report. This summary should not be considered apart from the entire text of the report with all the qualifications and considerations mentioned herein. Information related to the site is presented in the report text.

Category	Key Geotechnical Finding
Project Description	The site is located along westbound lane of I-275 east of the I-74 interchange in Cincinnati, Hamilton County, Ohio. The existing landslide is located between the WB, outside shoulder of I-275 and residential property. ODOT D08 is planning to repair the slope and restore the pavement along westbound I-275. The landslide is approximately 400 feet long.
Regional Geology	Per the USDA Web Soil Survey, the prevailing near surface soil consists of Urban land-Udorthents complex (UsUXF), 0 to 50 percent slopes, and Eden Silty Clay Loam (ECE), 25 to 40 percent slopes derived from residuum weathered from limestone and shale bedrock. Ohio Geology Interactive Map maintained by the Ohio Department of Natural Resources (ODNR) indicates most of the site is in the Kope formation from the Ordovician age. This formation consists of gray to blueish gray interbedded shale and limestone that weathers light gray to yellow gray. This formation consists of 75% shale and 25% limestone with the bedrock thickness ranging from 200 to 260 feet. However, a small portion of the eastern part of the site is in Miamitown Shale-Fairview Formation Undivided of Ordovician age. According to historical boring data and cross sections provided by ODOT D08, bedrock ranges from 20 to 35 feet below the grade of I-275. Based on the subsurface information on the geohazard borings performed for this site, the bedrock depth ranges from 19 feet to 36 feet below existing ground surface. Based on this information, the bedrock depth is consistent with published geology.
Subsurface Conditions	Five (5) geohazard borings were drilled to depths between 29.2 and 46.0 feet, with continuous SPT sampling and rock coring of 10 feet in each of the borings. Each borings penetrated embankment fill consisting of various soils, including Clay (A-7-6), Silty Clay (A-6b), Sandy Silt (A-4a), Silt and Clay (A-6a), Gravel and/or Stone Fragments (A-1-a), Gravel and/or Stone Fragments with Sand, Silt, and Clay (A-2-6), to depths of 0.0 to 36.0 feet. Highly weathered shale interbedded with limestone was encountered below the embankment fill at depths ranging from 19.2 to 36.0 feet.
Remediation	We recommend a Cantilever Soldier Pile Wall with Precast Concrete Lagging as a structural remediation for this landslide along with special benching below the wall alignment. The recommended retaining wall should consist of 36-in diameter drilled shafts with W24x176 beams, and 10-ft rock socket. Refer to Section 5.5 for details.

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Appendices

1.0 Introduction

S&ME, Inc. (S&ME) has completed the geohazard exploration at a failing embankment along westbound I-275 east of I-74 interchange in Cincinnati, Hamilton County, Ohio. The work was performed in general accordance with S&ME Proposal No. 24780173, dated November 25, 2024. The purpose of our exploration was to explore subsurface conditions and to provide recommendations regarding retaining wall construction considerations for this project. This "draft" report describes our understanding of the project, presents the results of the field exploration and laboratory testing, and provides our recommendation.

Project information was provided to us by Mr. Eric Kistner, P.E., of Stantec Consulting Services, Inc. (Stantec) to Mr. Benjamin C. Dusina, P.E. of S&ME via email on October 29, 2024. Based on the project information S&ME understands that the project involves repairing the slope and restoring the pavement along westbound I-275 east of the I-74 interchange by constructing a retaining wall along the failing embankment. The existing landslide is located between the WB, outside shoulder of I-275 and residential property. The landslide is approximately 400 feet long and has damaged the shoulder pavement. The project information and considerations detailed above should be reviewed and confirmed by the appropriate team members. Modifications to our recommendations may be required if the actual conditions vary from the project information and considerations described herein.

2.0 Geology and Observations of the Project

2.1 Regional Geology

Per the USDA Web Soil Survey, the prevailing near surface soil consists of Urban land-Udorthents complex (UsUXF), 0 to 50 percent slopes, with smaller amounts consisting of Eden Silty Clay Loam (ECE), 25 to 40 percent slopes derived from residuum weathered from limestone and shale bedrock.

The physiographic region of the site is the Outer Bluegrass Region. This region consists of silt-loam colluvium underlain by Ordovician and Silurian age dolomites, limestones, and calcareous shales.

A review of the Ohio Geology Interactive Map maintained by the Ohio Department of Natural Resources (ODNR) indicates the majorty of the site is in the Kope formation from the Ordovician age. This formation consists of gray to blueish gray interbedded shale and limestone that weathers light gray to yellow gray. This formation consists of 75% shale and 25% limestone with the bedrock thickness ranging from 200 to 260 feet. A small portion of the eastern part of the site is underlain by bedrock consisting of Miamitown Shale-Fairview Formation Undivided of Ordovician age. According to historical boring data and cross sections provided by ODOT D08, bedrock ranges from 20 to 35 feet below grade. The borings performed at this site for this project encountered bedrock ranging at depths from 19.2 feet to 36 feet. Based on this information, the bedrock depths encountered are consistent with published geologic infomraiton.

2.2 Review of Regional Mining Activities

Our review of the available mines record maintained by ODNR indicates there are no active or previous mining activities within the immediate vicinity of the site. The nearest surface mine is an active sand and gravel mine

located 1.6-miles southwest of the project site (State Mine ID: IM-0746). There are additional active and past sand and gravel surface mines (State Mine ID: IM-1106, and IM-0821) located west and southwest of the project site. Figure 3-1 below illustrates the nearby regional mining activities.

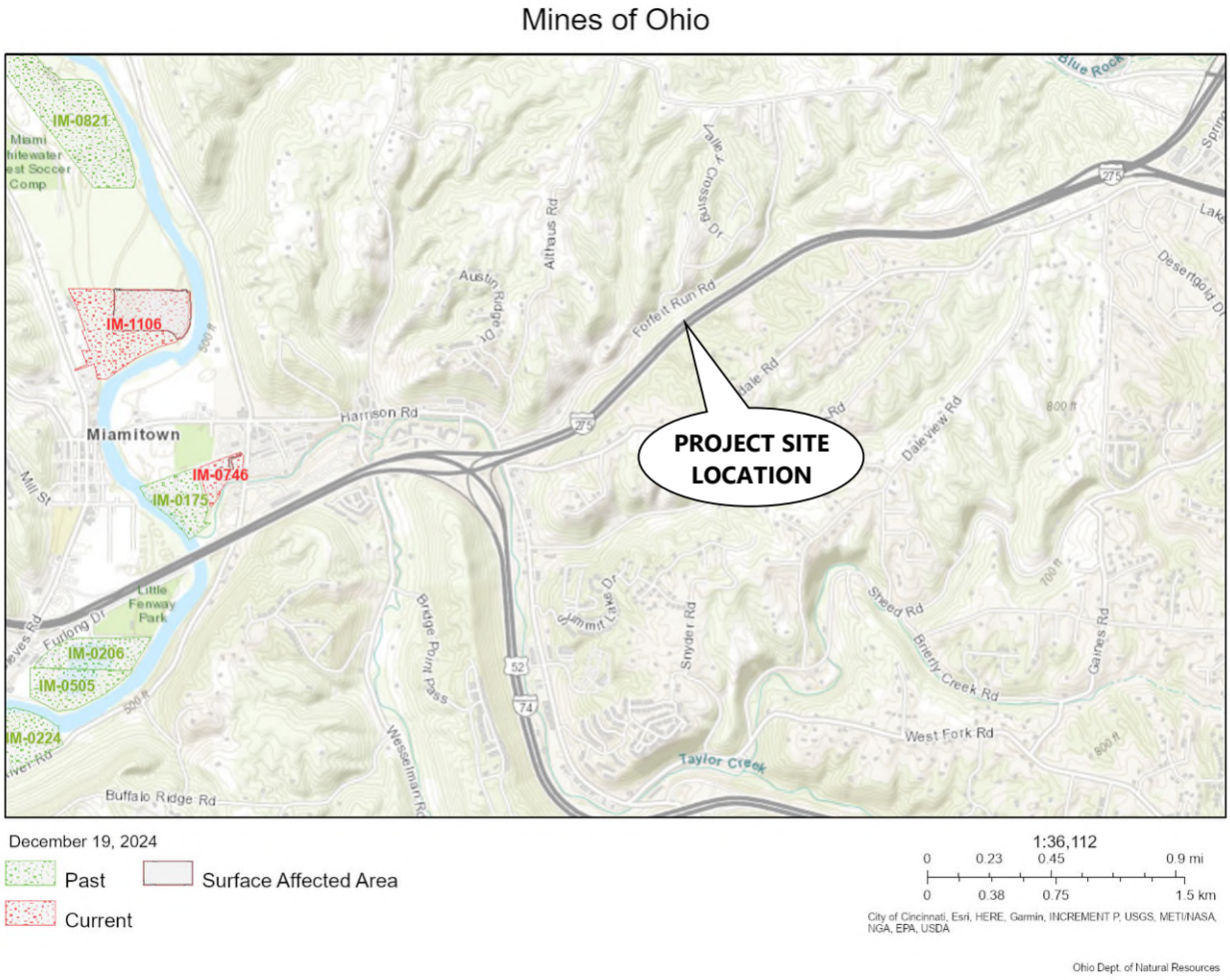


Figure 2-1 – Regional Mining Activities

2.3 Potential Karst Activity

Based on the review of Karst Mapping maintained by the ODNR, there are no suspected or verified Karst features within the immediate vicinity of the site. There is a pocket of suspected Karst 0.6-miles southeast and a pocket of verified Karst 0.7-miles north of the project site. There are also verified and suspected Karst and Springs throughout a 10-mile radius of the site, with many being 1- to 3-miles northwest. Figure 3-2 on the following page illustrates the nearby regional Karst activities.

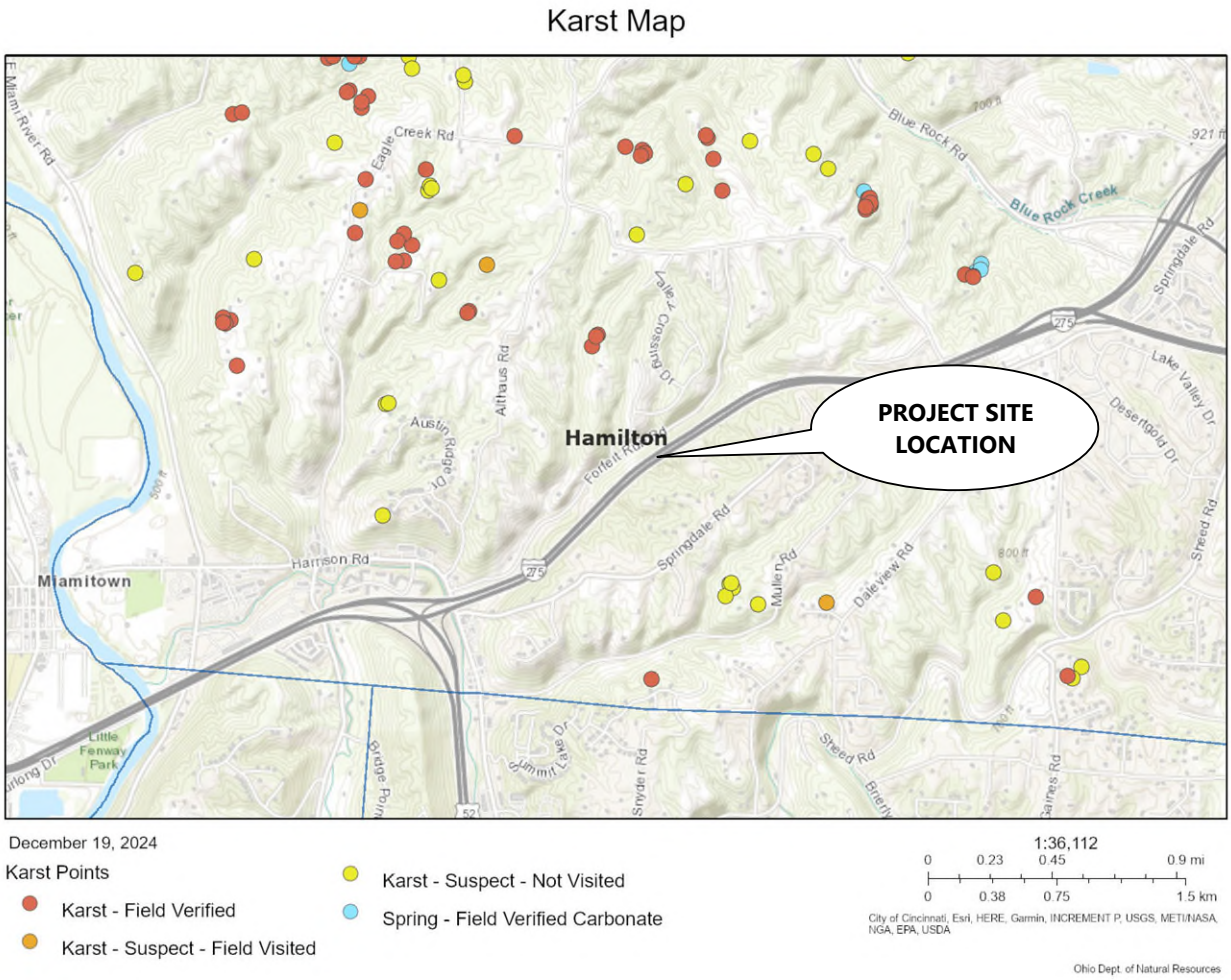


Figure 2-2 – Regional Karst Activity

2.4 Potential Oil & Gas Wells

Based on the review of oil and gas wells maintained by the ODNR, there are no active or historic oil or gas wells within the immediate vicinity of the site. There are three active wells 8.4-miles east of the project site, with Well Numbers CUFA-1 to 3. Figure 3-3 below illustrates the nearby regional wells.

Ohio Oil & Gas Wells

LEGEND

Land Base

- Counties
- Township
- Land Subdivision
- Statewide Parcels

Oil and Gas Wells

Active
- Permitted
- Producing
- Drilling
- UIC
- Storage

Inactive
- Plugged
- Inactive
- Dry and Abandoned
- Unknown; Other

Horizontal Well
- Horizontal Well Head
- Horizontal Line

Symbology (All Wells)
- Unknown status
- Brine for dust control
- Coalbed methane
- Dry hole
- Dry hole with gas show
- Dry hole with oil and gas show
- Dry hole with oil show
- Expired permit
- Gas
- Gas with oil show
- Gas show
- Gas and oil show
- Injection
- Lost hole
- Observation
- Oil and gas converted to water
- Oil
- Oil and gas
- Oil with gas show
- Oil show
- Permitted location
- Plugged brine for dust control
- Plugged gas
- Plugged gas show
- Plugged oil show
- Plugged gas with oil show
- Plugged injection
- Plugged oil
- Plugged oil and gas
- Plugged oil with gas show
- Solution mining
- Gas storage
- Stratigraphy test
- Water supply
- Plugged water supply
- Radioactive tools lost
- Core Hole Samples

Figure 2-3 – Regional Oil and Gas Wells

2.5 Site Reconnaissance

S&ME performed initial site visits on October 31, 2024, to assess the affected landslide area, identify a suitable access route for the drill rig, determine the number and locations of borings and develop a geohazard exploration plan. During the initial site reconnaissance, it was observed that approximately a 400-foot section of the westbound lane of I-275 at MM11.40 in Hamilton County, Cincinnati, Ohio had been impacted by a landslide. Visible signs of movement along the shoulder lane with pavement cracking in the shoulder were noted. Cracks along the slopes were also visible. A portable Jersey barrier had been installed by ODOT D08 due to dropped/missing portions of the guardrail from the landslide movement. Two (2) existing culverts are within the landslide mass and are damaged.

Following the initial site reconnaissance, multiple site visits were conducted to stake the boring locations, to observe bench areas for drill rig access, drilling, etc. Photographs taken during the multiple site visits are provided in Appendix I of this report.

3.0 Explorations

3.1 Geohazard Exploration

For the geohazard exploration, five (5) borings were performed on site between May 12 and May 21, which were extended to depths ranging from 29.2 to 46.0 feet below the existing grade. The borings were advanced with continuous sampling from the ground surface with rock coring performed on each boring. The boring locations were staked in the field prior to our exploration by S&ME personnel and surveyed by Stantec personnel after the drilling was completed.

The borings were performed using a D-50 track mounted drill rig using 3¼-inch hollow stem augers with an 87.5% efficiency. Soil samples were obtained using a split-barrel sampler (SPT) driven by an automatic hammer system in general accordance with ASTM D1586. Split-barrel soil samples were placed in air-tight containers and retained for visual classification and subsequent laboratory testing. Bedrock coring was performed using an NQ2 core barrel.

A general description of our field procedures, a test boring log legend, and boring logs are provided in Appendix II of this report. The stratification lines shown on the Boring Logs represent the approximate boundaries between soil types. The actual transitions may be more gradual than shown.

Boring coordinates and elevations are summarized in Table 3-1 below. The approximate locations of the borings are shown on the Boring Location Plan (Figure 2) in Appendix I.

Table 3-1 – Boring Coordinate Summary

Boring No.	Latitude (°)	Longitude (°)	Surface Elevation (ft)	Depth to Bedrock (ft)	Termination Depth (ft)
B-001-0-24	39.21925503	-84.66837191	633.7	28.8	38.8
B-002-0-24	39.21963077	-84.66789490	639.7	36.0	46.0
B-002-1-24	39.21967114	-84.66811491	614.3	28.7	38.7
B-002-2-24	39.21972042	-84.66823578	598.4	19.2	29.2
B-003-0-24	39.21978809	-84.66769863	644.3	33.5	43.5

Note:
1. Coordinates and surface elevations were obtained from surveying performed by Stantec.

3.2 Laboratory Testing

Following retrieval, the S&ME staff on-site preserved the recovered soil samples in airtight jars. The recovered samples were returned to our laboratory where applicable laboratory tests were assigned. These tests are used to assess the engineering properties of the soil. The soil and rock samples were visually classified by a geotechnical engineer. S&ME conducted the following laboratory tests for the obtained split spoons and rock core samples. The general summary of the lab tests performed are presented in Table 3-2 below.

- Moisture Content Determinations
- Atterberg Limits
- Gradation Analyses
- Loss of Ignition (LOI)
- Uniaxial Compressive Strength of Rock

Table 3-2 – Summary of Laboratory Tests on Soil and Rock

Boring No.	Sample Depth (ft)	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Percent Fines (%)	Unconfined Compression (psi)	Soil/Rock Type
B-001-0-24	0.0-1.5	16	41	18	23	75		A-7-6 (13)
B-001-0-24	3.0-4.5	16	32	22	10	67		A-4a (6)
B-001-0-24	6.0-7.5	20	43	18	25	94		A-7-6 (15)
B-001-0-24	10.5-12.0	16	35	17	18	69		A-6b (10)
B-001-0-24	18.0-19.5	19	38	20	18	82		A-6b (11)
B-001-0-24	24.0-25.5	18	43	20	23	92		A-7-6 (14)
B-001-0-24	32.1-32.5	--	--	--	--	--	137.0	Shale
B-002-0-24	1.5-3.0	16	41	20	21	74		A-7-6 (12)
B-002-0-24	9.0-10.5	13	34	17	17	62		A-6b (8)

Boring No.	Sample Depth (ft)	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Percent Fines (%)	Unconfined Compression (psi)	Soil/Rock Type
B-002-0-24	13.5-15.0	13	43	22	21	64		A-7-6 (11)
B-002-0-24	19.5-21.0	17	44	23	21	81		A-7-6 (13)
B-002-0-24	25.5-27.0	16	39	18	21	66		A-6b (11)
B-002-0-24	30.0-31.5	21	44	19	25	94		A-7-6 (15)
B-002-0-24	34.5-36.0	9	39	21	18	68		A-6b (10)
B-002-0-24	43.3-43.6	--	--	--	--	--	5,826	Shale
B-002-1-24	1.5-3.0	15	41	22	19	85		A-7-6 (12)
B-002-1-24	8.5-10.0	29	41	19	22	77		A-7-6 (13)
B-002-1-24	12.0-13.5	18	50	21	29	85		A-7-6 (18)
B-002-1-24	15.0-16.5	27	55	23	32	97		A-7-6 (19)
B-002-1-24	19.5-21.0	18	52	20	32	97		A-7-6 (18)
B-002-1-24	25.5-27.0	12	41	17	24	61		A-7-6 (11)
B-002-1-24	37.6-38.0	--	--	--	--	--	113.0	Shale
B-002-2-24	1.5-3.0	19	45	19	26	82		A-7-6 (15)
B-002-2-24	4.5-6.0	14	37	20	17	42		A-6b (3)
B-002-2-24	7.5-9.0	13	37	19	18	40		A-6b (3)
B-002-2-24	13.5-15.0	16	46	23	23	82		A-7-6 (14)
B-002-2-24	21.5-21.9	--	--	--	--	--	157.0	Shale
B-003-0-24	3.0-4.5	15	42	21	21	82		A-7-6 (13)
B-003-0-24	7.5-9.0	17	43	20	23	87		A-7-6 (14)
B-003-0-24	12.0-13.5	15	39	19	20	77		A-6b (12)
B-003-0-24	15.0-16.5	9	37	19	18	40		A-6b (3)
B-003-0-24	19.5-21.0	17	46	21	25	77		A-7-6 (15)
B-003-0-24	24.0-25.5	25	52	24	28	92		A-7-6 (18)
B-003-0-24	27.0-28.5	24	49	21	28	81		A-7-6 (17)
B-003-0-24	39.9-40.3	--	--	--	--	--	521.0	Shale

The results of the laboratory index tests are recorded numerically on individual boring logs and the results of the strength tests are presented in Appendix II. Based upon the results of the laboratory testing program, the field logs were modified as necessary, and copies of the laboratory corrected boring logs are presented in Appendix II. Shown on these logs are descriptions of the soil stratigraphy encountered; depths from which samples were preserved; sampling efforts (blow-counts) required to obtain the specimens in the borings; laboratory testing results; seepage and groundwater observations made at the time of drilling; and values of hand-penetrometer

measurements made in soil samples exhibiting cohesion. For your reference, hand-penetrometer values are roughly equivalent to the unconfined compressive strength of the cohesive fraction of the soil sample. An explanation of the symbols and terms used on the boring logs, definitions of the special adjectives used to denote the minor soil components, and information pertaining to sampling and identification are presented in Appendix II.

4.0 Findings

The following is a general description of the subsurface conditions. The stratification of the soil, as shown on the Boring Logs in Appendix II, represents the conditions at the actual boring locations. Lines of demarcation represent the approximate boundary between the soil types, but the transition may be gradual or not clearly defined.

4.1 General Subsurface Profile

Each of the borings were drilled through Embankment Fill. Table 4-1 on the following page provides the generalized subsurface conditions of the soils encountered.

Table 4-1 – Boring Location Summary

Depth (ft.)	Group	Description [1]	Range of SPT N-Values (blows per foot)
0.0-36.0	A	Embankment Fill: Clay (A-7-6), Silty Clay (A-6b), Sandy Silt (A-4a), Silt and Clay (A-6a), stiff to hard, brown to greenish brown to gray to dark gray, dry to wet	4-50/1”
0.0-16.5	B	Embankment Fill: Gravel and/or Stone Fragments (A-1-a), Gravel and/or Stone Fragments with Sand, Silt, and Clay (A-2-6), Very dense, brown to gray, dry to moist	55-50/1”
3.0-25.5	C	Embankment Fill: Cobbles and Boulders	--
19.2-46.0	D	Bedrock: Shale interbedded with Limestone Shale: dark gray highly weathered, very weak, fractured to moderately fractured Limestone: light gray, moderately weathered, strong to very strong, fractured to moderately fractured	--

Note:
1. This is a generalized summary and may not accurately depict the actual conditions encountered in the test borings. These groups may not be encountered at each boring location.

4.2 Groundwater Observations

Seepage and groundwater observations were made during drilling operation. Each of the five (5) borings remained dry throughout the SPT drilling process. Since rock coring techniques were conducted in each of the borings using water, groundwater levels were not measured after the drilling was completed. Due to safety concerns, the borings were backfilled immediately upon completion; therefore, extended water level measurements were not obtained.

Fluctuations in the level of the groundwater table (or saturated soils/perched water levels) will occur due to seasonal variances in rainfall, drainage, types of soils present and other factors. We caution that groundwater can be perched at various elevations above the general static groundwater level after periods of rainfall, especially in the lower elevations and natural drainage paths of the site.

For further details of subsurface conditions encountered, refer to the individual Boring Logs presented in Appendix II. The stratum lines shown on the boring logs should be considered approximate.

5.0 Analyses and Recommendations

5.1 Back Analysis

Following completion of our exploration and laboratory testing, we developed a subsurface model of the slope at near the middle boring locations for stability analysis. Back analysis was performed in accordance with the recommendations presented in Section 704 of the ODOT Geotechnical Design Manual (GDM). The model was constructed with historic construction information provided by ODOT, our measurements made from the soil test borings and rock cores, as well as our observations of the slope. One (1) cross section was evaluated for slope stability along a profile extending near the middle borings. The results of back analysis is presented in Appendix IV of this report.

For our stability analysis, we used the computer program SLIDE2 developed by RocScience, Inc, which uses limit equilibrium slope stability analyses. Shear strength parameters of the soil for our analysis were assessed by performing a back analysis on a translational failure slip surface passing through an assumed shallow failure surface around 8 feet deep and yielding a Factor of Safety of about 1.0. The Factor of Safety is the ratio of Resisting Forces to Driving Forces. A Factor of Safety (FOS) greater than 1.0 indicates the Resisting Forces are greater than the Driving Forces while a Factor of Safety of less than 1.0 indicates the Resisting Forces are less than the Driving Forces and the slope is likely unstable. A landslide design load to resist the driving forces was calculated after the back analysis was performed that would yield a FOS of about 1.5 and was calculated to be 17,100 lb/ft. During our back analysis at the wall location, we assumed that the soil in front of the retaining wall above the failure surface will not provide any passive resistance.

Slope stability analysis for static existing conditions were performed to evaluate the factor of safety against translational failures for the roadway using drained soil strength parameters consistent with the effective stress (long-term/drained) condition because the roadway has been in-place for many years.

5.1.1 Shear Strength Parameters

Soil parameters (e.g., cohesion, unit weight, angle of internal friction) were based on a combination of our laboratory and field-testing results, index property correlations, our experience with similar soil conditions, and our back analysis. Table 5-1 summarizes the shear strength parameters calculated as part of our back analyses to produce a factor of safety near 1.0.

Table 5-1 – Summary of Shear Strength Properties

Material Type	Unit Weight (lbs/ft³)	Cohesion (psf)	Internal Angle of Friction – Phi (deg)
Embankment Fill	120	0	23
Bedrock (Shale)	150	1,000	40

5.2 Landslide Analysis Conclusions

The stability analyses, laboratory test results, and our field observations indicate that landslide is localized and includes shallow rotational and/or translational failures. A translational slide is when a mass (or block) of material essentially moves as a unit over a weaker plane of material. Translational slides often occur in stages. As the lower mass of material slides, resisting forces holding the next blocks uphill in-place are reduced resulting in progressive movement of blocks of soil extending up the slope. The damaged culverts are likely contributing to the instability in this area and should be repaired as part of the overall remediation.

5.3 Basis of Conclusions

The above referenced analyses and conclusions below were based on a field exploration plan consisting of soil test borings, laboratory testing, and our experience with similar projects in similar geologic settings.

5.4 Landslide Repair

When selecting a repair approach numerous factors must be considered including construction cost, constructability, construction time and its impact on traffic, etc. Based on our findings and considerations of numerous factors, we incorporated a structural remediation approach to repair the landslide consisting of the construction of a cantilevered soldier pile wall with concrete lagging (CSPL).

5.5 Cantilevered Soldier Pile Wall with Precast Concrete Lagging (CSPL)

For this project, we recommend the construction of a CSPL as presented in Section 1505.3 Soldier Pile Walls of Section 1505 Drilled Shaft Walls of the ODOT GDM. We recommend the design of CSPL to consist of a W24x176 steel section installed within a 36-inch diameter drilled shafts (primary reinforced shaft) spaced 6 feet center-to-center. Precast concrete lagging is recommended between the primary reinforced shafts. A rock socket of 10 feet into competent bedrock is recommended for the primary reinforced shafts at each location to satisfy the service limit and strength limit state design criteria. The precast concrete lagging panels shall be installed between primary piers and extend 10 feet below the top of primary reinforced shaft. Concrete on the primary reinforced shafts shall extend from the tip of drilled shaft to the bottom of the precast concrete panels.

The installation of the CSPL is planned to commence at either end of the existing 42-inch diameter culvert (storm sewer pipe) and progress outward along with the proposed alignment. At this location, the precast concrete panels are expected to require a width of approximately 6.5 feet or greater, contingent upon the spacing of the adjacent primary reinforced soldier piers. Similarly, in the vicinity of the 18-inch diameter culvert (storm sewer pipe), the pile spacing may necessitate the use of a custom precast concrete panel configuration to accommodate geometric and structural constraints. Beyond these utility crossings, the retaining wall system can be standardized with primary soldier pile spacing of 6-feet center to center. Both culverts should be repaired as part of the overall landslide remediation.

Table 5-1 on the following presents the summary of the CSPL wall. Refer to cross section detail presented in Appendix IV to this report.

Table 5-1 – CSPL Summary

Shaft Type	Shaft Diameter (inch)	Steel Beam (Grade 50)	Min. Rock Socket (ft)	Spacing (ft)	Length (ft)
Primary Shaft	36	W24x176	10	6	Varies, 29 to 46 feet

5.6 Slope Protection and Regrading

The CSPL is designed to include passive resistance from the soil above the top of bedrock and below the anticipated failure surface. As such, the slope downhill of the CSPL shall be regraded with slope protection. The regraded slope steepness shall be limited to 2H:1V (Horizontal : Vertical) or flatter. The downhill slope shall be regraded and benched in accordance with Section 803 General Case of the ODOT GDM.

5.7 Shoring Design Parameters

S&ME understands that ODOT D08 will include repairing the existing 18-inch and 42-inch culverts (storm sewer pipes) located within the landslide zone. A temporary shoring system may be designed to withstand the lateral earth pressures exerted by the embankment fill material as well as the hydrostatic pressures, that may develop being the shoring system.

If it is anticipated that the walls of the proposed structures will be fixed at both the top and bottom preventing significant lateral deflections or rotations from occurring, then an "at-rest" earth pressure condition exists. In cases where the walls are capable of deflecting a distance of at least 1.0 percent of their height, then an "active" earth pressure condition may be assumed for design purposes. The lateral earth pressures acting on below grade walls will be resisted by the sliding resistance forces along the base of the wall footing base and the passive resistance resulting from footing embedment at the wall toe. Passive resistance could be neglected for a safer design (due to possible excavation or erosion in front of the wall at a future time).

The magnitude of lateral earth pressures varies on the basis of soil type, permissible wall movement, and configuration of backfill. The embankment fill soils are generally cohesive in nature. The lateral earth pressures applied to the wall below the ground surface will be through surrounding soil. We recommend that the values for

cohesive soil be used for this condition. Table 5-2 below presents a summary of the recommended lateral earth pressures for use in design.

Table 5-2 – Summary of Lateral Earth Pressures

Material	Φ′	Unit Weight	*γ_{eq} (drained)	*γ_{eq} (undrained)	K_O	K_a	K_p
Cohesive Soil	23^0	125 pcf	87 pcf	105 pcf	0.61	0.44	2.28

* γ_{eq} = Equivalent fluid unit weight – at-rest condition.

For temporary retaining structures, we recommend at-rest conditions be used for design, unless the retention structure can allow enough lateral movement to utilize active earth pressure values. However, the designer may elect to utilize the drained values based on the way hydrostatic pressures can be dissipated by the structure or planned dewatering system.

6.0 Limitations of Report

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions and recommendations contained in this report are based upon applicable standards of our practice in this geographic area at the time this report was prepared. No other representation or warranty, either express or implied, is made.

We relied on project information given to us to develop our conclusions and recommendations. If the project information described in this report is not accurate, or if it changes during project development, we should be notified of the changes so that we can modify our recommendations based on this additional information if necessary.

Our conclusions and recommendations are based on limited data from a field exploration program. Subsurface conditions can vary widely between explored areas. Some variations may not become evident until construction. If conditions are encountered which appear different than those described in our report, we should be notified. This report should not be construed to represent subsurface conditions for the entire site.

Unless specifically noted otherwise, our field exploration program did not include an assessment of regulatory compliance, environmental conditions or pollutants or presence of any biological materials (mold, fungi, bacteria). If there is a concern about these items, other studies should be performed. S&ME can provide a proposal and perform these services if requested.

S&ME should be retained to review the final plans and specifications to confirm that earthwork, and other recommendations are properly interpreted and implemented.

For more information on the use and limitations of this report, please read the Geoprofessional Business Association (GBA) document that follows this page.

Appendix I– Additional Figures

Geotechnical Engineering Report Information
Vicinity Map
Boring Location Plan
Site Recon Photos

Important Information About Your
Geotechnical Engineering Report

Variations in subsurface conditions can be a principal cause of construction delays, cost overruns and claims. The following information is provided to assist you in understanding and managing the risk of these variations.

Geotechnical Findings Are Professional Opinions

Geotechnical engineers cannot specify material properties as other design engineers do. Geotechnical material properties have a far broader range on a given site than any manufactured construction material, and some geotechnical material properties may change over time because of exposure to air and water, or human activity.

Site exploration identifies subsurface conditions at the time of exploration and only at the points where subsurface tests are performed or samples obtained. Geotechnical engineers review field and laboratory data and then apply their judgment to render professional opinions about site subsurface conditions. Their recommendations rely upon these professional opinions. Variations in the vertical and lateral extent of subsurface materials may be encountered during construction that significantly impact construction schedules, methods and material volumes. While higher levels of subsurface exploration can mitigate the risk of encountering unanticipated subsurface conditions, no level of subsurface exploration can eliminate this risk.

Scope of Geotechnical Services

Professional geotechnical engineering judgment is required to develop a geotechnical exploration scope to obtain information necessary to support design and construction. A number of unique project factors are considered in developing the scope of geotechnical services, such as the exploration objective; the location, type, size and weight of the proposed structure; proposed site grades and improvements; the construction schedule and sequence; and the site geology.

Geotechnical engineers apply their experience with construction methods, subsurface conditions and exploration methods to develop the exploration scope. The scope of each exploration is unique based on available project and site information. Incomplete project information or constraints on the scope of exploration increases the risk of variations in subsurface conditions not being identified and addressed in the geotechnical report.

Services Are Performed for Specific Projects

Because the scope of each geotechnical exploration is unique, each geotechnical report is unique. Subsurface conditions are explored and recommendations are made for a specific project.

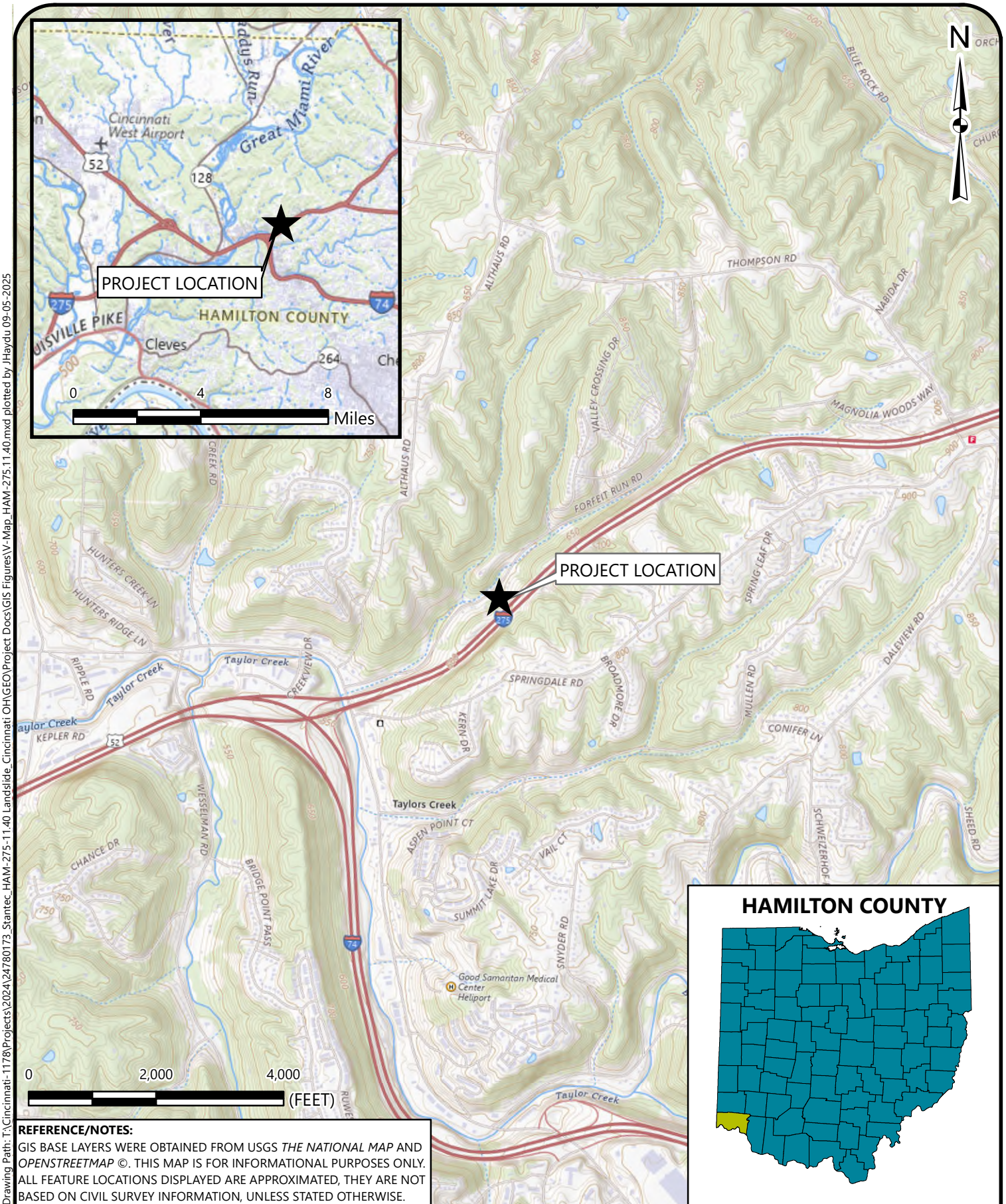
Subsurface information and recommendations may not be adequate for other uses. Changes in a proposed structure location, foundation loads, grades, schedule, etc. may require additional geotechnical exploration, analyses, and consultation. The geotechnical engineer should be consulted to determine if additional services are required in response to changes in proposed construction, location, loads, grades, schedule, etc.

Geo-Environmental Issues

The equipment, techniques, and personnel used to perform a geo-environmental study differ significantly from those used for a geotechnical exploration. Indications of environmental contamination may be encountered incidental to performance of a geotechnical exploration but go unrecognized. Determination of the presence, type or extent of environmental contamination is beyond the scope of a geotechnical exploration.

Geotechnical Recommendations Are Not Final

Recommendations are developed based on the geotechnical engineer's understanding of the proposed construction and professional opinion of site subsurface conditions. Observations and tests must be performed during construction to confirm subsurface conditions exposed by construction excavations are consistent with those assumed in development of recommendations. It is advisable to retain the geotechnical engineer that performed the exploration and developed the geotechnical recommendations to conduct tests and observations during construction. This may reduce the risk that variations in subsurface conditions will not be addressed as recommended in the geotechnical report.



REFERENCE/NOTES:
GIS BASE LAYERS WERE OBTAINED FROM USGS *THE NATIONAL MAP* AND *OPENSTREETMAP* ©. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED, THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

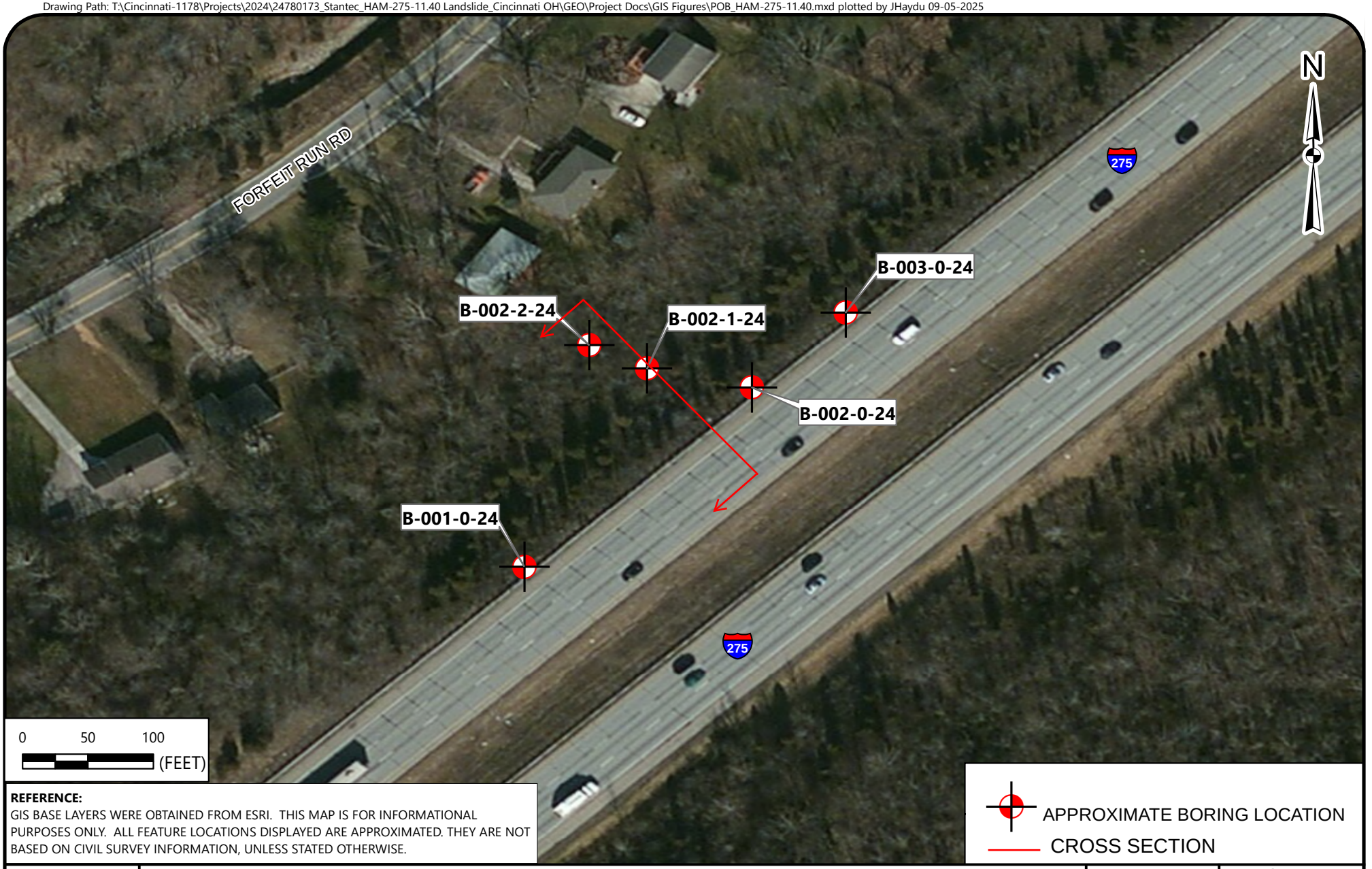
Drawing Path: T:\Cincinnati-1178\Projects\2024\24780173_Stantec_HAM-275-11.40 Landslide_Cincinnati OH\GEO\Project Docs\GIS Figures\V-Map_HAM-275.11.40.mxd plotted by JHaydu 09-05-2025

VICINITY MAP

HAM-275-11.40 LANDSLIDE (PID 121506)
HAMILTON COUNTY, OHIO

SCALE:	1 " = 2,000 '
DATE:	9-5-25
PROJECT NUMBER	24780173
FIGURE No.	1

Drawing Path: T:\Cincinnati-1178\Projects\2024\24780173_Stantec_HAM-275-11.40 Landslide_Cincinnati OH\GEO\Project Docs\GIS Figures\POB_HAM-275-11.40.mxd plotted by JHaydu 09-05-2025



REFERENCE:
GIS BASE LAYERS WERE OBTAINED FROM ESRI. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

PLAN OF BORINGS

HAM-275-11.40 LANDSLIDE (PID 121506)
HAMILTON COUNTY, OHIO

SCALE:	FIGURE No.
1 " = 100 '	2
DATE: 9-5-25	
PROJECT NUMBER 24780173	

Date: 10/31/2024

Photographer: Jason Hyadu

1	**Location / Orientation**	Slide Area – Looking Northeast
	Remarks	Failing Guardrail

Date: 10/31/20244

Photographer: Jason Hyadu

2	**Location / Orientation**	Slide Area – Looking Northeast
	Remarks	Failing Crest Slope

Date: 10/31/20244

Photographer: Jason Hyadu

3	**Location / Orientation**	Slide Area – Looking Southwest
	Remarks	Cracks near Shoulder Lane

Date: 10/31/20244

Photographer: Jason HyaduJason Hyadu

4	**Location / Orientation**	Slide Area
	Remarks	Crack Underneath Shoulder Lane

Date: 10/31/20244

Photographer: Jason Hyadu

5	**Location / Orientation**	Slide Area
	Remarks	Looking Further Northeast near B-003-0-24

Date: 01/22/2025

Photographer: Jason Hyadu

6	**Location / Orientation**	Slide Area – Looking Downhill
	Remarks	Cracks Along the Slope

Date: 01/22/2025

Photographer: Jason Hyadu

7	**Location / Orientation**	Slide Area – Looking Upslope
	Remarks	18" diameter Storm Pipe Outlet

Date: 01/22/2025

Photographer: Jason Hyadu

8	**Location / Orientation**	Slide Area – Downhill Slope
	Remarks	Looking Northeast

Date: 01/22/2025

Photographer: Jason Hyadu

9	**Location / Orientation**	Slide Area – Looking Downstream
	Remarks	After Tree Clearance

Date: 01/22/2025

Photographer: Jason Hyadu

10	**Location / Orientation**	Slide Area
	Remarks	After Tree Clearance

Date: 05/19/2025

Photographer: Sudip Khadka

11	**Location / Orientation**	Slide Area – After Benching
	Remarks	First Bench

Date: 05/19/2025

Photographer: Sudip Khadka

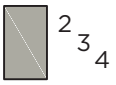
12	**Location / Orientation**	Slide Area – Looking Downslope
	Remarks	Benching

Appendix II – Field Exploration

Soil Log Legend
Rock Log Legend
Test Boring Logs
Rock Core Photographs
Summary of Field Procedures

ODOT SOIL LOG LEGEND

The STANDARD PENETRATION TEST (SPT) as defined by AASHTO T206 (or ASTM D1586) is a method to obtain a disturbed soil sample for examination and testing and to obtain relative density and consistency information. A standard 1.4-inch I.D./2-inch O.D. split-barrel sampler is driven three 6-inch increments (see graphic at right) with a 140 lb. hammer freely falling 30 inches. The hammer can either be of a trip, free-fall design, or actuated by a rope and cathead. The SPT N Value is determined by adding the number of blows from the 2nd and 3rd 6-inch increments.



SPT BLOWCOUNT CORRECTION FOR HAMMER EFFICIENCY (N_{60}) is determined by the following equation: $N_{60} = N * [$ Drill Rod Energy Ratio (%) / 60], and where the drill rod energy ratio is determined in accordance with ASTM D4633. If the drill rod energy ratio exceeds 90%, it is limited to 90% to determine the N_{60} value and is shown on the log as 90*.

SHELBY TUBE (ST) samples are obtained by hydraulically pushing a thin-walled tube (typically 3-inches in diameter) to obtain a relatively undisturbed sample for testing of fine-grained soils to determine engineering properties such as strength, compressibility, permeability, and density. Shelby tubes are sampled in general accordance with ASTM D1587 (AASHTO T207).

DESCRIPTIVE ORDER OF SOIL STRATA: Consistency/Density, color, ODOT soil classification description, minor soil constituents with percentage modifiers, organic content, miscellaneous constituents or descriptions, relative moisture condition.

ODOT SOIL CLASSIFICATION DESCRIPTION AND SYMBOL

- **GRAVEL** (A-1-a)
- **GRAVEL WITH SAND** (A-1-B)
- **FINE SAND** (A-3)
- **COARSE AND FINE SAND** (A-3a)
- **GRAVEL WITH SAND AND SILT** (A-2-4 OR A-2-5)
- **GRAVEL WITH SAND, SILT AND CLAY** (A-2-6 OR A-2-7)
- **SANDY SILT** (A-4a)
- **SILT** (A-4b)
- **ELASTIC SILT AND CLAY** (A-5)
- **SILT AND CLAY** (A-6a)
- **SILTY CLAY** (A-6b)
- **ELASTIC CLAY** (A-7-5)
- **CLAY** (A-7-6)
- **ORGANIC SILT** (A-8a)
- **ORGANIC CLAY** (A-8b)
- **PEAT**
- **UNCONTROLLED FILL**
- **BOULDERY ZONE**
- **SOD/ROOTMAT/ TOPSOIL**
- **PAVEMENT OR BASE**
- **CONCRETE**

SOIL LOG SYMBOLS

SS - Split-Spoon Sample

ST - Shelby Tube Sample

TR - Top of Rock

REC - Sample Recovery, %

HP - Hand Penetrometer Value, tsf

LOI - Loss on Ignition Test, %

Qu - Unconfined Compressive Strength

γd - Dry Unit Weight, pcf

γm - Moist Unit Weight, pcf

GR - Gravel Content, %

CS - Coarse Sand Content, %

FS - Fine Sand Content, %

SI - Silt Content, %

CL - Clay Content, %

LL - Liquid Limit

PL - Plastic Limit

PI - Plasticity Index

WC - Natural Water Content, %

NOTE: Particle size contents are expressed % by weight.

PARTICLE SIZE

Particle	Size	US Sieve Size
Boulder	>300 mm (12 in.)	12 in.
Cobble	75 - 300 mm (3 - 12 in.)	3 - 12 in.
Coarse gravel	19 - 75 mm (3/4 - 3 in.)	3/4 - 3 in.
Fine gravel	2 - 19 mm (0.08 - 3/4 in.)	#10 - 3/4 in.
Coarse sand	0.42 - 2.0 mm	#40 - #10
Fine sand	0.074 - 0.42 mm	#200 - #40
Silt	0.005 - 0.074 mm	NA
Clay	< 0.005 mm	NA

FINE-GRAINED SOIL
(Relative Consistency)

	N_{60}	HP
Very soft	< 2 bpf	< 0.25 tsf
Soft	2 - 4 bpf	> 0.25 - 0.5 tsf
Medium stiff	5 - 8 bpf	> 0.5 - 1.0 tsf
Stiff	9 - 15 bpf	> 1.0 - 2.0 tsf
Very stiff	16 - 30 bpf	> 2.0 - 4.0 tsf
Hard	> 30 bpf	> 4.0 tsf

COARSE-GRAINED SOIL
(Relative Density)

	N_{60}
Very loose	< 5 bpf
Loose	5 - 10 bpf
Medium dense	11 - 30 bpf
Dense	31 - 50 bpf
Very dense	> 50 bpf

MINOR CONSTITUENTS
(% By Weight)

	Percentage
Trace	0% - 10%
Little	>10% - 20%
Some	>20% - 35%
"And"	≥ 35%

ORGANIC CONTENT OF SOIL
(Determined by ASTM D2974 or AASHTO T267)

Classification	Percentage
Slightly organic	2% - 4%
Moderately organic	>4% - 10%
Highly organic	> 10%

RELATIVE MOISTURE CONDITION

Dry	Cohesive - Powdery, WC well below PL Granular - No moisture present
Damp	Cohesive - Leaves very little moisture when pressed, WC < PL Granular - Internal moisture, little to no surface moisture
Moist	Cohesive - Leaves moisture when pressed, PL < WC < LL - 3 Granular - Free water on surface, shiny appearance
Wet	Cohesive - Mushy, WC near or above LL Granular - Voids filled with free water

—W At Time of Drilling

Free water (seepage or groundwater) observation made anytime during the drilling process. Depending on time of reading and drilling methodologies, this value may be influenced by the drilling process.

At end of Drilling

Free water measurement soon after the drilling processes are complete, and the borehole is at final depth. Drilling fluids, if introduced during drilling, may influence this measurement.

24 hrs After Drilling

Free water measurements made in a borehole hours to days after drilling is complete including the time elapsed (i.e., "24 hrs" as shown at left). Depending on subsurface conditions, elapsed time, drilling process, etc. this observation may reflect a stabilized level.

REFERENCES:

Ohio Department of Transportation (ODOT), Specifications for Geotechnical Explorations (SGE)

ODOT ROCK CORE LOG LEGEND

DESCRIPTIVE ORDER FOR ROCK STRATA

Bedrock type, color, weathering, strength, texture, bedding, other descriptors, type and condition of discontinuities, unit RQD, unit recovery.

When alternating layers occur between two distinct rock types, describe the material as "Interbedded" with the major rock type first, with estimated percentage, and the secondary rock type second, with estimated percentage. Provide the unit RQD and unit recovery, then describe each rock type in detail.

For spread footings founded on or into bedrock, describe discontinuities using the modified Rock Mass Rating (RMR) system (degree of fracturing, aperture width and surface roughness). For drilled shafts extending into bedrock, describe discontinuities using the Geologic Strength Index (GSI) system (discontinuity structure and surface condition). For rock cut slopes, describe discontinuities using both the modified RMR and GSI systems.

COMMON OHIO BEDROCK TYPES AND SYMBOLS


SHALE


SILTSTONE


LIMESTONE

COAL


CLAYSTONE/ MUDSTONE


SANDSTONE


DOLOMITE


UNDERCLAY/ FIRECLAY

WEATHERING

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

STRENGTH

		APPROX. UNCONFINED COMPRESSIVE STRENGTH (PSI)
Extremely Strong	Cannot be scratched by a knife or sharp pick. Chipping off hand specimens requires hard repeated blows of a geologist's hammer.	> 30,000
Very Strong	Cannot be scratched by a knife or sharp pick. Breaking off hand specimens requires hard repeated blows of a geologist's hammer.	30,000 - 15,000
Strong	Can be scratched with a knife or pick with difficulty. Requires hard hammer blows to detach hand specimen.	15,000 - 7,500
Moderately Strong	Can be scratched with a knife or pick. Gouges ¼" deep can be excavated by a pick. Requires moderate hammer blows to detach specimen.	7,500 - 3,600
Slightly Strong	Can be gouged 0.05 inch deep by firm pressure with a knife or pick point. Can excavate small pieces (1-inch) by hard blows with a pick.	3,600 - 1,500
Weak	Can be gouged readily by a knife or pick or excavated in small fragments by moderate blows of a pick. Small, thin pieces can be broken by hand.	1,500 - 750
Very Weak	Can be carved with a knife and excavated readily with a pick. Pieces 1 inch or more thick can be broken by hand. Can be scratched by fingernail.	750 - 40

TEXTURE

Boulder	> 12 in.
Cobble	12 - 3 in.
Gravel	3 - 0.08 in.
Coarse Sand	0.08 - 0.02 in.
Medium Sand	0.02 - 0.01 in.
Fine Sand	0.01 - 0.005 in.
Very Fine Sand	0.005 - 0.003 in.

BEDDING

Very Thick Bedded	> 36 in.
Thick Bedded	36 in. - 18 in.
Medium Bedded	18 in. - 10 in.
Thin Bedded	10 in. - 2 in.
Very Thin Bedded	2 in. - 0.4 in.
Laminated	0.4 in. - 0.1 in.
Thinly Laminated	< 0.1 in.

REFERENCES: OHIO DEPARTMENT OF TRANSPORTATION (ODOT), SPECIFICATIONS FOR GEOTECHNICAL EXPLORATIONS (SGE).

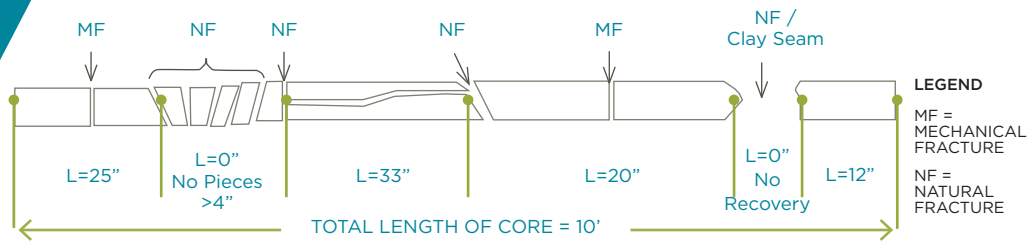
ODOT ROCK CORE LOG LEGEND

ROCK CORE RECOVERY

Recovery to be determined by core run and by rock unit (layer).

$$\text{REC}_{\text{(Recovery)}} = \frac{\text{Length of Rock Core Recovered}}{\text{Length of Core Run}} \times 100$$

ROCK QUALITY DESIGNATION (RQD)



$$\text{RQD}_{\text{(Equation)}} = \left(\frac{\Sigma \text{ Core with Length (L)} \geq 4"}{\text{Core Run or Interval Total Length}}\right) \times 100$$

$$\text{RQD}_{\text{(Example)}} = \left(\frac{25" + 33" + 20" + 12"}{120"}\right) \times 100 = 75\%$$

DESCRIPTORS

Arenaceous - Sandy

Argillaceous - Clayey

Brecciated - Contains angular gravel

Calcareous - Contains calcium carbonate

Carbonaceous - Contains carbon

Cherty - Contains chert

Conglomeritic - Contains rounded gravel

Crystalline - Contains crystalline structure

Dolomitic - Contains Ca/Mg carbonate

Ferriferous - Contains iron

Fissile - Thin planar partings

Fossiliferous - Contains fossils

Friable - Easily broken down

Micaceous - Contains mica

Pyritic - Contains pyrite

Siliceous - Contains silica

Stylolitic - Contains stylotites

Vuggy - Contains openings

DISCONTINUITIES IN BEDROCK

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

MODIFIED RMR DISCONTINUITY TERMS

DEGREE OF FRACTURING

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

APERTURE WIDTH

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

SURFACE ROUGHNESS

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

GSI DISCONTINUITY TERMS

ROCK MASS STRUCTURE

Intact or Massive	Intact rock with few widely spaced discontinuities
Blocky	Well interlocked undisturbed rock mass, formed by 3 intersecting discontinuity sets
Very Blocky	Interlocked, partially disturbed mass formed by 4 or more joint sets
Blocky/ Disturbed/Seamy	Angular blocks formed by many intersecting discontinuity sets, bedding planes
Disintegrated	Poorly interlocked, heavily broken rock mass
Laminated/ Sheared	Lack of blockiness due to close spacing of weak shear planes

SURFACE CONDITION

Very Good	Very rough, fresh unweathered surfaces
Good	Rough, slightly weathered, iron stained surfaces
Fair	Smooth, moderately weathered and altered surfaces
Poor	Slickensided, high weathered surface with compact coatings
Very Poor	Slickensided, highly weathered surface with soft clay coatings

S&ME JOB: 24780173

PROJECT: HAM-I-275-	DRILLING FIRM / OPERATOR: S&ME / J. BEANE	DRILL RIG: S&ME D50 TRACK	STATION / OFFSET: 437+13, 73' RT.	EXPLORATION ID B-001-0-24
TYPE:	SAMPLING FIRM / LOGGER: S&ME / S. MARAHATTA	HAMMER: CME AUTOMATIC	ALIGNMENT: I-275	
PID: 121506 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 8/29/23	ELEVATION: 633.7 (MSL) EOB: 38.8 ft.	PAGE 1 OF 2
START: 5/21/25 END: 5/24/25	SAMPLING METHOD: SPT	ENERGY RATIO (%): 87.5	LAT / LONG: 39.219255, -84.668372	

MATERIAL DESCRIPTION AND NOTES	ELEV. 633.7	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
VERY STIFF, BROWN, **CLAY**, SOME SILT, TRACE FINE TO COARSE SAND, LITTLE ROCK FRAGMENTS, FILL, MOIST		1	8 8 8	23	56	SS-1	3.3	20	3	2	32	43	41	18	23	16	A-7-6 (13)	-	
	630.7	2	4 6 7	19	33	SS-2	3.0	-	-	-	-	-	-	-	-	17	A-7-6 (V)	-	
VERY STIFF, BROWN, **SANDY SILT**, "AND" CLAY, SOME ROCK FRAGMENTS, FILL, MOIST	629.2	3 4	4 4 5	13	22	SS-3	2.5	25	5	3	26	41	32	22	10	16	A-4a (6)	-	
VERY STIFF TO HARD, BROWN, **CLAY**, "AND" SILT, TRACE FINE TO COARSE SAND, TRACE GRAVEL, FILL, MOIST		5 6	6 5 4	13	56	SS-4	3.3	-	-	-	-	-	-	-	-	20	A-7-6 (V)	-	
		7	6 8 8	23	78	SS-5	4.5	1	3	2	36	58	43	18	25	20	A-7-6 (15)	-	
@7.5'; LITTLE ROCK FRAGMENTS, FILL		8 9	8 8 12	29	67	SS-6	4.5	-	-	-	-	-	-	-	-	19	A-7-6 (V)	-	
	623.2	10	9 11 11	32	56	SS-7	4.5	-	-	-	-	-	-	-	-	27	A-7-6 (V)	-	
VERY STIFF, BROWN, **SILTY CLAY**, SOME SILT, LITTLE ROCK FRAGMENTS, LITTLE FINE TO COARSE SAND, FILL, MOIST	621.7	11	15 9 11	29	72	SS-8	4.0	17	9	5	26	43	35	17	18	16	A-6b (10)	-	
VERY STIFF, BROWN & GREENISH GRAY, **SILTY CLAY**, LITTLE FINE TO COARSE SAND, LITTLE ROCK FRAGMENTS, FILL, MOIST	620.2	12 13	7 9 10	28	50	SS-9	3.3	-	-	-	-	-	-	-	-	22	A-6b (V)	-	
		14	50/2"	-	0	SS-10	-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	-	
VERY DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, COBBLES AND BOULDERS, FILL, MOIST	617.2	15 16	50/1"	-	100	SS-11	-	-	-	-	-	-	-	-	-	13	A-2-6 (V)	-	
HARD, BROWN, **CLAY**, LITTLE FINE TO COARSE SAND, FILL, MOIST	615.7	17	50/1"	-	100	SS-12	-	-	-	-	-	-	-	-	-	18	A-7-6 (V)	-	
VERY STIFF, BROWN, **SILTY CLAY**, TRACE ROCK FRAGMENTS, TRACE FINE TO COARSE SAND, FILL, MOIST		18 19	6 4 7	16	67	SS-13	2.8	8	7	3	34	48	38	20	18	19	A-6b (11)	-	
@20.0'; COBBLE	612.7	20	5 7 5	18	33	SS-14	3.3	-	-	-	-	-	-	-	-	20	A-6b (V)	-	
HARD, BROWN, **CLAY**, TRACE FINE TO COARSE SAND, FILL, MOIST	611.2	21 22	27 9 12	31	0	SS-15	-	-	-	-	-	-	-	-	-	-	A-7-6 (V)	-	
		23	50/1"	-	0	SS-16	-	-	-	-	-	-	-	-	-	-	A-7-6 (V)	-	
HARD, BROWN & GRAY, **CLAY**, SOME SILT, TRACE FINE TO COARSE SAND, TRACE ROCK FRAGMENTS, FILL, MOIST		24 25	46 31 6	54	33	SS-17	4.5	3	2	3	35	57	43	20	23	18	A-7-6 (14)	-	
	606.7	26	7 10 10	29	44	SS-18	4.5	-	-	-	-	-	-	-	-	21	A-7-6 (V)	-	
HARD, GRAY, **CLAY**, LITTLE LIMESTONE FRAGMENTS, HIGHLY WEATHERED SHALE FRAGMENTS	604.9	27 28	50/2"	-	100	SS-19	-	-	-	-	-	-	-	-	-	5	A-7-6 (V)	-	
		TR 29	50/4"	-	100	SS-20	-	-	-	-	-	-	-	-	-	6	A-7-6 (V)	-	

S&ME JOB: 24780173

PID: 121506	SFN:	PROJECT: HAM-I-275-	STATION / OFFSET: 437+13, 73' RT.	START: 5/21/25	END: 5/24/25	PG 2 OF 2	B-001-0-24

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)	SO4 ppm	BACK FILL
INTERBEDDED SHALE (90%) AND LIMESTONE (10%), RQD 45%, REC. 68%; **SHALE**, SHALE : DARK GRAY, HIGHLY WEATHERED, VERY WEAK, MODERATELY FRACTURED, 45° FRACTURED AT 29.0 FEET QU = 137 PSI; **LIMESTONE**, LIGHT GRAY, MODERATELY WEATHERED, VERY STRONG. *(continued)*	603.7	31 32 33 34 35 36 37 38	45		68	NQ-1											CORE		
	594.9	EOB																	

NOTES: LOCATION COORDINATES AND ELEVATION WERE OBTAINED FROM STANTEC SURVEY. GROUNDWATER NOT ENCOUTERED PRIOR TO ROCK CORING.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BENTONITE AND CEMENT GROUT MIXTURE

S&ME JOB: 24780173

PROJECT: HAM-I-275-	DRILLING FIRM / OPERATOR: S&ME / J. BEANE	DRILL RIG: S&ME D50 TRACK	STATION / OFFSET: 438+51, 169' RT.
TYPE:	SAMPLING FIRM / LOGGER: S&ME / S. MARAHATTA	HAMMER: CME AUTOMATIC	ALIGNMENT: I-275
PID: 121506 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 8/29/23	ELEVATION: 639.7 (MSL) EOB: 46.0 ft.
START: 5/16/25 END: 5/19/25	SAMPLING METHOD: SPT	ENERGY RATIO (%): 87.5	LAT / LONG: 39.219631, -84.667895

EXPLORATION ID B-002-0-24

PAGE 1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
VERY STIFF, BROWN AND GRAY, **CLAY**, SOME SILT, TRACE FINE TO COARSE SAND, LITTLE ROCK FRAGEMENTS, FILL, MOIST	639.7	1	4 5 4	13	28	SS-1	4.0	-	-	-	-	-	-	-	-	17	A-7-6 (V)	-	
	636.7	2	3 3 3	9	39	SS-2	4.0	17	6	3	24	50	41	20	21	16	A-7-6 (12)	-	
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS**, COBBLES, FILL, DRY	635.2	3	46 50/1"	-	14	SS-3	-	-	-	-	-	-	-	-	-	2	A-1-a (V)	-	
VERY STIFF, GRAY-BROWN, **CLAY**, TRACE ROCK FRAGMENTS, FINE TO COARSE SAND, FILL, MOIST		4	4 4 6	15	17	SS-4	2.8	-	-	-	-	-	-	-	-	16	A-7-6 (V)	-	
	632.2	5	2 2 2	6	33	SS-5	-	-	-	-	-	-	-	-	-	20	A-7-6 (V)	-	
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS**, COBBLES, SANDSTONE, FILL, DRY	630.7	6	50/1"	-	100	SS-6	-	-	-	-	-	-	-	-	-	5	A-1-a (V)	-	
STIFF TO VERY STIFF, GRAY, **SILTY CLAY**, SOME ROCKFRAGMENTS, LITTLE FINE TO COARSE SAND, FILL, MOIST		7	7 9 20	42	56	SS-7	4.0	26	8	4	23	39	34	17	17	13	A-6b (8)	-	
	627.7	8	4 4 6	15	44	SS-8	1.3	-	-	-	-	-	-	-	-	21	A-7-6 (V)	-	
STIFF TO VERY STIFF, BROWN AND GRAY, **CLAY**, LITTLE SILT, TRACE FINE TO COARSE SAND, SOME ROCK FRAGMENTS, FILL, MOIST		9	5 6 4	15	22	SS-9	2.0	-	-	-	-	-	-	-	-	26	A-7-6 (V)	-	
		10	6 8 9	25	50	SS-10	3.0	30	4	2	19	45	43	22	21	13	A-7-6 (11)	-	
		11	12 13 25	55	33	SS-11	4.0	-	-	-	-	-	-	-	-	18	A-7-6 (V)	-	
		12	8 6 7	19	39	SS-12	3.5	-	-	-	-	-	-	-	-	19	A-7-6 (V)	-	
	620.2	13	11 15 7	32	11	SS-13	-	-	-	-	-	-	-	-	-	17	A-7-6 (V)	-	
VERY STIFF, BROWN AND GRAY, **CLAY**, SOME SILT, TRACE FINE TO COARSE SAND, TRACE ROCK FRAGEMENTS, FILL, MOIST		14	8 10 11	31	44	SS-14	3.3	9	7	3	33	48	44	23	21	17	A-7-6 (13)	-	
		15	12 14 22	53	0	SS-15	-	-	-	-	-	-	-	-	-	-	A-7-6 (V)	-	
		16	6 7 10	25	44	SS-16	3.0	-	-	-	-	-	-	-	-	14	A-7-6 (V)	-	
	614.2	17	10 10 13	34	56	SS-17	3.0	-	-	-	-	-	-	-	-	22	A-7-6 (V)	-	
VERY STIFF, GREENISH BROWN, **SILTY CLAY**, LITTLE ROCK FRAGEMENTS, LITTLE FINE TO COARSE SAND, FILL, MOIST	612.7	18	35 8 8	23	100	SS-18	2.5	19	11	4	19	47	39	18	21	16	A-6b (11)	-	
VERY STIFF TO STIFF TO VERY STIFF, GREENISH BROWN, **CLAY**, SOME SILT, TRACE FINE TO COARSE SAND, TRACE ROCK FRAGMENTS, FILL, MOIST		19	8 11 15	38	83	SS-19	3.3	-	-	-	-	-	-	-	-	17	A-7-6 (V)	-	
		20	6 8 10	26	44	SS-20	1.5	-	-	-	-	-	-	-	-	21	A-7-6 (V)	-	

S&ME JOB: 24780173

PID: 121506	SFN:	PROJECT: HAM-I-275-	STATION / OFFSET: 438+51, 169' RT.	START: 5/16/25	END: 5/19/25	PG 2 OF 2	B-002-0-24

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)	SO4 ppm	BACK FILL
	609.7																		
	608.2	31	8 8 11	28	39	SS-21	3.5	2	2	2	30	64	44	19	25	21	A-7-6 (15)	-	
HARD, BROWN AND GRAY, **CLAY**, LITTLE ROCK FRAGMENTS, TRACE FINE TO COARSE SAND, FILL, MOIST	606.7	32	32 17 50/1"	-	46	SS-22	4.5	-	-	-	-	-	-	-	-	9	A-7-6 (V)	-	
HARD, BROWN AND GRAY, **SILTY CLAY**, SOME ROCK FRAGMENTS, TRACE FINE TO COARSE SAND, FILL, MOIST	603.7	33	9 8 11	28	0	SS-23	-	-	-	-	-	-	-	-	-	-	A-7-6 (V)	-	
		34																	
		35	46 50/4"	-	90	SS-24	4.5	22	6	4	24	44	39	21	18	9	A-6b (10)	-	
		TR 36																	
INTERBEDDED SHALE (85%) AND LIMESTONE (15%), RQD 28%, REC. 93%; **SHALE**, SHALE: THINLY LAMINATED, FRACTURED TO MODERATELY FRACTURED (BREAKS ALONG CLAY SEAMS); **LIMESTONE**, LIGHT GRAY, MODERATELY WEATHERED, STRONG, FRACTURED VERTICAL, CLAY FILLED FRACTURED FROM 37.6' TO 37.9' QU = 5,826 PSI.		37				25										12	A-6b (V)		
		38																	
		39																	
		40																	
		41	28		93	NQ-1											CORE		
		42																	
		43																	
		44																	
		45																	
	593.7	EOB 46																	

NOTES: LOCATION COORDINATES AND ELEVATION WERE OBTAINED FROM STANTEC SURVEY. GROUNDWATER NOT ENCOUTERED PRIOR TO ROCK CORING.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BENTONITE AND CEMENT GROUT MIXTURE

S&ME JOB: 24780173

PROJECT: HAM-I-275-	DRILLING FIRM / OPERATOR: S&ME / J. BEANE	DRILL RIG: S&ME D50 TRACK	STATION / OFFSET: 438+72, 127' RT.
TYPE:	SAMPLING FIRM / LOGGER: S&ME / S. MARAHATTA	HAMMER: CME AUTOMATIC	ALIGNMENT: I-275
PID: 121506 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 8/29/23	ELEVATION: 614.3 (MSL) EOB: 38.67 ft.
START: 5/19/25 END: 5/21/25	SAMPLING METHOD: SPT	ENERGY RATIO (%): 87.5	LAT / LONG: 39.219671, -84.668115

EXPLORATION ID B-002-1-24

MATERIAL DESCRIPTION AND NOTES	ELEV. 614.3	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
VERY DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, FILL, DRY	612.8	1	9 50/2"	-	25	SS-1	-	-	-	-	-	-	-	-	-	6	A-2-6 (V)	-	
HARD, BROWN, **CLAY**, SOME SILT, LITTLE FINE TO COARSE SAND, TRACE ROCK FRAGMENTS, FILL, MOIST	611.3	2 3	31 15 7	32	17	SS-2	4.3	2	8	5	31	54	41	22	19	15	A-7-6 (12)	-	
BOULDERY ZONE, FILL LARGE BOULDER	606.8	4 5 6 7																	
VERY STIFF TO HARD, BROWN, **CLAY**, SOME SILT, LITTLE FINE TO COARSE SAND, TRACE ROCK FRAGMENTS, COBBLES AND BOULDERS, FILL, MOIST	602.3	8 9 10 11	7 9 11	29	56	SS-3	4.0	10	8	5	30	47	41	19	22	29	A-7-6 (13)	-	
			7 50/2"	-	50	SS-4	3.5	-	-	-	-	-	-	-	-	19	A-7-6 (V)	-	
			50/2"	-	0	SS-5	-	-	-	-	-	-	-	-	-	-	A-7-6 (V)	-	
HARD, BROWN, **CLAY**, SOME SILT, TRACE FINE TO COARSE SAND, TRACE ROCK FRAGMENTS, FILL, MOIST	600.8	12 13	7 9 5	20	56	SS-6	4.5	5	6	4	26	59	50	21	29	18	A-7-6 (18)	-	
VERY STIFF, BROWN, **CLAY**, TRACE ROCK FRAGMENTS, FILL, WET	599.3	14	5 8 9	25	33	SS-7	-	-	-	-	-	-	-	-	-	49	A-6a (V)	-	
VERY STIFF TO HARD, BROWN, **CLAY**, SOME SILT, TRACE FINE TO COARSE SAND, FILL, MOIST		15 16	5 6 8	20	44	SS-8	2.8	0	2	1	29	68	55	23	32	27	A-7-6 (19)	-	
		17	6 5 6	16	56	SS-9	4.5	-	-	-	-	-	-	-	-	21	A-7-6 (V)	-	
COBBLES AND BOULDERS, FILL	594.8	18 19	7 10 9	28	50	SS-10	4.3	-	-	-	-	-	-	-	-	22	A-7-6 (V)	-	
HARD, BROWN, **CLAY**, SOME SILT, TRACE FINE TO COARSE SAND, TRACE ROCK FRAGMENTS, COBBLES AND BOULDERS, FILL, MOIST		20	11 13 28	60	67	SS-11	4.5	1	1	1	23	74	52	20	32	18	A-7-6 (18)	-	
		21 22	26 50/2"	-	88	SS-12	4.5	-	-	-	-	-	-	-	-	20	A-7-6 (V)	-	
		23	50/1"	-	100	SS-13	-	-	-	-	-	-	-	-	-	1	A-7-6 (V)	-	
		24	50/1"	-	0	SS-14	-	-	-	-	-	-	-	-	-	-	A-7-6 (V)	-	
	588.8	25																	
VERY STIFF, BROWN AND GRAY, **CLAY**, LITTLE SILT, SOME ROCK FRAGMENTS, LITTLE FINE TO COARSE SAND, FILL, MOIST	587.3	26	11 17 50/3"	-	53	SS-15	2.8	24	10	5	16	45	41	17	24	12	A-7-6 (11)	-	
HARD, GRAY, **CLAY**, LITTLE LIMESTONE, AND SHALE, FILL, DRY	585.6	27 28	50/4"	-	100	SS-16	4.5	-	-	-	-	-	-	-	-	-	A-7-6 (V)	-	
		TR 29																	

S&ME JOB: 24780173

PID: 121506	SFN:	PROJECT: HAM-I-275-	STATION / OFFSET: 438+72, 127' RT.	START: 5/19/25	END: 5/21/25	PG 2 OF 2	B-002-1-24

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)	SO4 ppm	BACK FILL
INTERBEDDED SHALE (90%) AND LIMESTONE (10%), RQD 46%, REC. 96%; **SHALE**, SHALE: DARK GRAY, HIGHLY WEATHERED, VERY WEAK, ARGILLACEOUS, MODERATELY FRACTURED QU = 113 PSI; **LIMESTONE**, LIGHT GRAY, MODERATELY WEATHERED, STRONG, FOSSILIFEROUS. *(continued)*	584.3	31 32 33 34 35 36 37 38	46		96	NQ-1											CORE		
	575.6	EOB																	

NOTES: LOCATION COORDINATES AND ELEVATION WERE OBTAINED FROM STANTEC SURVEY. GROUNDWATER NOT ENCOUTERED PRIOR TO ROCK CORING.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BENTONITE AND CEMENT GROUT MIXTURE

S&ME JOB: 24780173

PROJECT: HAM-I-275-	DRILLING FIRM / OPERATOR: S&ME / J. BEANE	DRILL RIG: S&ME D50 TRACK	STATION / OFFSET: 439+02, 75' RT.	EXPLORATION ID B-002-2-24
TYPE:	SAMPLING FIRM / LOGGER: S&ME / S. MARAHATTA	HAMMER: CME AUTOMATIC	ALIGNMENT: I-275	
PID: 121506 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 8/29/23	ELEVATION: 598.4 (MSL) EOB: 29.2 ft.	PAGE 1 OF 1
START: 5/12/25 END: 5/12/25	SAMPLING METHOD: SPT	ENERGY RATIO (%): 87.5	LAT / LONG: 39.219720, -84.668236	

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)	SO4 ppm	BACK FILL
VERY STIFF, BROWN, **CLAY**, SOME SILT, LITTLE FINE TO COARSE SAND, TRACE ROCK FRAGMENTS, FILL, MOIST	598.4		8 3 3	9	44	SS-1	4.0	-	-	-	-	-	-	-	-	15	A-7-6 (V)	-	
		1	4 7 8	22	100	SS-2	3.0	7	7	4	25	57	45	19	26	19	A-7-6 (15)	-	
	593.9	2	4 8 8	23	44	SS-3	2.5	-	-	-	-	-	-	-	-	11	A-7-6 (V)	-	
STIFF, BROWN, **SILTY CLAY**, LITTLE SILT, LITTLE FINE TO COARSE SAND, AND ROCK FRAGMENTS, FILL, MOIST	592.4	3	11 13 36	71	28	SS-4	1.5	40	13	5	15	27	37	20	17	14	A-6b (3)	-	
VERY DENSE, GRAY AND BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, FILL, DRY	590.9	4	28 38 17	80	22	SS-5	-	-	-	-	-	-	-	-	-	9	A-2-6 (V)	-	
VERY STIFF TO HARD, BROWN, **CLAY**, LITTLE SILT, SOME FINE TO COARSE SAND, SOME ROCK FRAGMENTS, FILL, MOIST	587.9	5	17 17 19	53	56	SS-6	3.5	31	14	15	11	29	37	19	18	13	A-6b (3)	-	
		6	15 22 17	57	28	SS-7	-	-	-	-	-	-	-	-	-	15	A-6b (V)	-	
HARD TO VERY STIFF, BROWN, **CLAY**, LITTLE ROCK FRAGMENTS, TRACE FINE TO COARSE SAND, FILL, MOIST	584.9	7	10 14 19	48	50	SS-8	4.5	-	-	-	-	-	-	-	-	20	A-7-6 (V)	-	
		8	19 19 23	61	61	SS-9	3.5	-	-	-	-	-	-	-	-	25	A-7-6 (V)	-	
HARD, BROWN, **CLAY**, SOME SILT, LITTLE FINE TO COARSE SAND, LITTLE ROCK FRAGMENTS, FILL, MOIST	583.4	9	12 18 50/3"	-	100	SS-10	4.5	11	4	3	27	55	46	23	23	16	A-7-6 (14)	-	
HARD, GRAY, **CLAY**, AND SHALE FRAGMENTS, LITTLE SANDSTONE FRAGMENTS, FILL, DRY	581.9	10	25 50 50/0"	-	75	SS-11	4.5	-	-	-	-	-	-	-	-	10	A-7-6 (V)	-	
HARD, BROWN AND GRAY, **CLAY**, AND SHALE FRAGMENTS, LITTLE SANDSTONE FRAGMENTS, FILL, DRY	579.2	11	50/2"	-	100	SS-12	-	-	-	-	-	-	-	-	-	14	A-7-6 (V)	-	
		TR 12																	
INTERBEDDED SHALE (80%) AND LIMESTONE (20%), RQD 38%, REC. 80%; **SHALE**, SHALE: DARK GRAY, HIGHLY WEATHERED, VERY WEAK, THINLY LAMINATED, MODERATELY FRACTURED (ALONG CLAY SEAMS) QU = 157 PSI; **LIMESTONE**, LIGHT GRAY, MODERATELY WEATHERED, VERY STRONG, THIN BEDDED, FOSSILIFEROUS.	569.2	EOB 29	38		80	NQ-1											CORE		

NOTES: LOCATION COORDINATES AND ELEVATION WERE OBTAINED FROM STANTEC SURVEY. GROUNDWATER NOT ENCOUTERED PRIOR TO ROCK CORING.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BENTONITE AND CEMENT GROUT MIXTURE

S&ME JOB: 24780173

PROJECT: HAM-I-275-	DRILLING FIRM / OPERATOR: S&ME / J. BEANE	DRILL RIG: S&ME D50 TRACK	STATION / OFFSET: 439+85, 78' RT.	EXPLORATION ID B-003-0-24
TYPE:	SAMPLING FIRM / LOGGER: S&ME / S. MARAHATTA	HAMMER: CME AUTOMATIC	ALIGNMENT: I-275	
PID: 121506 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 8/29/23	ELEVATION: 644.3 (MSL) EOB: 43.5 ft.	PAGE 1 OF 2
START: 5/14/25 END: 5/16/25	SAMPLING METHOD: SPT	ENERGY RATIO (%): 87.5	LAT / LONG: 39.219788, -84.667699	

MATERIAL DESCRIPTION AND NOTES	ELEV. 644.3	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
HARD, BROWN AND GRAY, **CLAY**, LITTLE GRAVEL, TRACE FINE TO COARSE SAND, FILL, MOIST		1	3 3 3	9	33	SS-1	4.5	-	-	-	-	-	-	-	-	19	A-7-6 (V)	-	
	641.3	2	3 5 7	18	22	SS-2	4.5	-	-	-	-	-	-	-	-	6	A-7-6 (V)	-	
VERY STIFF TO HARD, DARK GRAY AND BROWN, **CLAY**, SOME SILT, TRACE FINE TO COARSE SAND, LITTLE ROCK FRAGMENTS, FILL, MOIST		3	5 6 6	18	44	SS-3	4.0	11	4	3	32	50	42	21	21	15	A-7-6 (13)	-	
		4	5 4 6	15	22	SS-4	-	-	-	-	-	-	-	-	-	15	A-7-6 (V)	-	
		5	5 9 6	22	0	SS-5	-	-	-	-	-	-	-	-	-	-	A-7-6 (V)	-	
		6	5 5 6	16	44	SS-6	4.5	6	4	3	32	55	43	20	23	17	A-7-6 (14)	-	
		7	4 7 9	23	44	SS-7	4.0	-	-	-	-	-	-	-	-	20	A-7-6 (V)	-	
	632.3	8	4 8 11	28	33	SS-8	4.5	-	-	-	-	-	-	-	-	18	A-7-6 (V)	-	
VERY STIFF, DARK GRAY AND BROWN, **SILTY CLAY**, SOME SILT, LITTLE FINE TO COARSE SAND, LITTLE ROCK FRAGMENTS, FILL, MOIST	630.8	9	7 6 7	19	11	SS-9	-	12	7	4	34	43	39	19	20	15	A-6b (12)	-	
VERY STIFF TO HARD, GRAY, **SILTY CLAY**, LITTLE SILT, "AND" ROCK FRAGMENTS, COBBLES, LITTLE FINE TO COARSE SAND, FILL, DRY		10	8 9 8	25	0	SS-10	-	-	-	-	-	-	-	-	-	-	A-6b (V)	-	
		11	50/1"	-	100	SS-11	-	44	11	5	14	26	37	19	18	9	A-6b (3)	-	
	627.8	12																	
HARD, BROWN AND GRAY, **CLAY**, SOME ROCK FRAGMENTS, LITTLE FINE TO COARSE SAND, COBBLES, FILL, MOIST	626.3	13	46 50/1"	-	57	SS-12	4.5	-	-	-	-	-	-	-	-	13	A-7-6 (V)	-	
VERY STIFF, BROWN, **CLAY**, TRACE FINE TO COARSE SAND, FILL, MOIST	624.8	14	7 8 9	25	17	SS-13	3.5	-	-	-	-	-	-	-	-	14	A-7-6 (V)	-	
HARD, BROWN AND DARK GRAY, **CLAY**, SOME SILT, TRACE FINE TO COARSE SAND, LITTLE ROCK FRAGMENTS, FILL, MOIST	623.3	15	6 12 21	48	56	SS-14	4.5	14	5	4	29	48	46	21	25	17	A-7-6 (15)	-	
VERY STIFF, BROWN AND DARK GRAY, **CLAY**, SOME SILT, TRACE ROCK FRAGMENTS, TRACE FINE TO COARSE SAND, FILL, MOIST FILL trace woods encountered at 24.0 to 25.5 FILL soil consistency changes from very stiff to hard from 24 to 25.5 feet		16	18 12 16	41	11	SS-15	4.0	-	-	-	-	-	-	-	-	18	A-7-6 (V)	-	
		17	6 8 11	28	67	SS-16	4.0	-	-	-	-	-	-	-	-	21	A-7-6 (V)	-	
		18	9 10 13	34	61	SS-17	4.5	3	2	3	34	58	52	24	28	25	A-7-6 (18)	-	
		19	6 11 15	38	56	SS-18	4.0	-	-	-	-	-	-	-	-	16	A-7-6 (V)	-	
	615.8	20	8 9 16	36	67	SS-19	3.3	4	6	9	27	54	49	21	28	24	A-7-6 (17)	-	
		21	9 13 44	83	56	SS-20	4.5	-	-	-	-	-	-	-	-	20	A-7-6 (V)	-	

S&ME JOB: 24780173

PID: 121506	SFN:	PROJECT: HAM-I-275-	STATION / OFFSET: 439+85, 78' RT.	START: 5/14/25	END: 5/16/25	PG 2 OF 2	B-003-0-24

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)	SO4 ppm	BACK FILL
HARD, BROWN AND GRAY, **CLAY**, TRACE ROCK FRAGMENTS, TRACE FINE TO COARSE SAND, FILL, MOIST *(continued)*	614.3		50/1"	-	100	SS-21	4.5	-	-	-	-	-	-	-	-	11	A-7-6 (V)	-	
	612.8	31																	
HARD, BROWN AND GRAY, **CLAY**, AND SHALE FRAGMENTS, LITTLE LIMESTONE, FILL, MOIST			50/3"	-	100	SS-22	4.5	-	-	-	-	-	-	-	-	9	A-7-6 (V)	-	
	610.8	32 33																	
		TR																	
INTERBEDDED SHALE (90%) AND LIMESTONE (10%), RQD 48%, REC. 92%; **SHALE**, SHALE: DARK GRAY, HIGHLY WEATHERED, VERY WEAK (BECOMES WEAK AND MODERATELY WEATHERED FROM 41.1' TO 43.5'), ARGILLACEOUS FROM 34.1' TO 41.4', MODERATELY FRACTURED QU = 521 PSI; **LIMESTONE**, LIGHT GRAY, MODERATELY WEATHERED, STRONG, FOSSILIFEROUS.		34 35 36 37 38 39 40 41 42 43	48		92	NQ-1											CORE		
	600.8	EOB																	

NOTES: LOCATION COORDINATES AND ELEVATION WERE OBTAINED FROM STANTEC SURVEY. GROUNDWATER NOT ENCOUTERED PRIOR TO ROCK CORING.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED BENTONITE AND CEMENT GROUT MIXTURE

Date: 5/28/2025

Photographer: Suman Marahatta, EI

13	**Location / Orientation**	B-001-0-24
	Remarks	28.8 feet to 38.8 feet

Date: 5/28/2025

Photographer: Suman Marahatta, EI

14	**Location / Orientation**	B-002-0-24
	Remarks	36 feet to 46 feet

Date: 5/28/2025

Photographer: Suman Marahatta, EI

15	**Location / Orientation**	B-002-1-24
	Remarks	28.7 feet to 38.7 feet

Date: 5/28/2025

Photographer: Suman Marahatta, EI

16	**Location / Orientation**	B-002-2-24
	Remarks	19.2 feet to 29.4 feet

Date: 5/28/2025

Photographer: Suman Marahatta, EI

17	**Location / Orientation**	B-003-0-24
	Remarks	33.5 feet to 43.5 feet

Appendix III– Laboratory Testing

Laboratory Test Results Summary
Particle Size Distribution Charts
Uniaxial Compressive Strength of Rock
Organic Content Test Results
Summary of Laboratory Procedures

SUMMARY OF LABORATORY TEST RESULTS

BORING	SAMPLE (#)	Top Depth (ft)	MC %	LL %	PL %	PI %	AGGREGATE %	COARSE SAND %	FINE SAND %	SILT %	CLAY %	SILT/CLAY %	D / 50 m m	D / 95 m m	H R B ODOT CLASSIFICATION
B-001-0-24		0.00	16	41	18	23	20	3	2	32	43		0.0083	19.8609	A-7-6 (13)
B-001-0-24		1.50	17												A-7-6 (V)
B-001-0-24		3.00	16	32	22	10	25	5	3	26	41		0.0128	21.9568	A-4a (6)
B-001-0-24		4.50	20												A-7-6 (V)
B-001-0-24		6.00	20	43	18	25	1	3	2	36	58			0.1814	A-7-6 (15)
B-001-0-24		7.50	19												A-7-6 (V)
B-001-0-24		9.00	27												A-7-6 (V)
B-001-0-24		10.50	16	35	17	18	17	9	5	26	43		0.0105	14.3705	A-6b (10)
B-001-0-24		12.00	22												A-7-6 (V)
B-001-0-24		13.50													A-2-6 (V)
B-001-0-24		15.00	13												A-2-6 (V)
B-001-0-24		16.50	18												A-7-6 (V)
B-001-0-24		18.00	19	38	20	18	8	7	3	34	48		0.0059	4.8098	A-6b (11)
B-001-0-24		19.50	20												A-7-6 (V)
B-001-0-24		21.00													A-7-6 (V)
B-001-0-24		22.50													A-7-6 (V)
B-001-0-24		24.00	18	43	20	23	3	2	3	35	57			0.4250	A-7-6 (14)
B-001-0-24		25.50	21												A-7-6 (V)
B-001-0-24		27.00	5												A-7-6 (V)
B-001-0-24		28.50	6												A-7-6 (V)
B-002-0-24		0.00	17												A-7-6 (V)
B-002-0-24		1.50	16	41	20	21	17	6	3	24	50		0.0052	9.5000	A-7-6 (12)
B-002-0-24		3.00	2												A-1-a (V)
B-002-0-24		4.50	16												A-7-6 (V)
B-002-0-24		6.00	20												A-7-6 (V)
B-002-0-24		7.50	5												A-1-a (V)
B-002-0-24		9.00	13	34	17	17	26	8	4	23	39		0.0173	28.8426	A-6b (8)
B-002-0-24		10.50	21												A-7-6 (V)
B-002-0-24		12.00	26												A-7-6 (V)
B-002-0-24		13.50	13	43	22	21	30	4	2	19	45		0.0098	34.3572	A-7-6 (11)

PROJECT HAM-275-11.40 Landslide
LOCATION Hamilton County, Ohio
JOB NO. 24780173 **DATE** 7/10/25

SUMMARY OF LABORATORY TEST RESULTS

BORING	SAMPLE (#)	Top Depth (ft)	MC %	LL %	PL %	PI %	AGGREGATE %	COARSE SAND %	FINE SAND %	SILT %	CLAY %	SILT/CLAY %	D / 50 mm	D / 95 mm	HRB ODOT CLASSIFICATION
B-002-0-24		15.00	18												A-7-6 (V)
B-002-0-24		16.50	19												A-7-6 (V)
B-002-0-24		18.00	17												A-7-6 (V)
B-002-0-24		19.50	17	44	23	21	9	7	3	33	48		0.0057	6.7466	A-7-6 (13)
B-002-0-24		21.00													
B-002-0-24		22.50	14												A-7-6 (V)
B-002-0-24		24.00	22												A-7-6 (V)
B-002-0-24		25.50	16	39	18	21	19	11	4	19	47		0.0068	19.6903	A-6b (11)
B-002-0-24		27.00	17												A-7-6 (V)
B-002-0-24		28.50	21												A-7-6 (V)
B-002-0-24		30.00	21	44	19	25	2	2	2	30	64			0.1683	A-7-6 (15)
B-002-0-24		31.50	9												A-7-6 (V)
B-002-0-24		33.00													
B-002-0-24		34.50	9	39	21	18	22	6	4	24	44		0.0094	30.7073	A-6b (10)
B-002-0-24		36.00	12												A-7-6 (V)
B-002-1-24		0.00	6												A-2-6 (V)
B-002-1-24		1.50	15	41	22	19	2	8	5	31	54			1.1969	A-7-6 (12)
B-002-1-24		8.50	29	41	19	22	10	8	5	30	47		0.0064	7.2723	A-7-6 (13)
B-002-1-24		9.00	19												A-7-6 (V)
B-002-1-24		10.50													A-7-6 (V)
B-002-1-24		12.00	18	50	21	29	5	6	4	26	59			2.0864	A-7-6 (18)
B-002-1-24		13.50	49												A-6a (V)
B-002-1-24		15.00	27	55	23	32	0	2	1	29	68			0.0618	A-7-6 (19)
B-002-1-24		16.50	21												A-7-6 (V)
B-002-1-24		18.00	22												A-7-6 (V)
B-002-1-24		19.50	18	52	20	32	1	1	1	23	74			0.0583	A-7-6 (18)
B-002-1-24		21.00	20												A-7-6 (V)
B-002-1-24		22.50	1												A-7-6 (V)
B-002-1-24		24.00													A-7-6 (V)
B-002-1-24		25.50	12	41	17	24	24	10	5	16	45		0.0111	22.3584	A-7-6 (11)

PROJECT HAM-275-11.40 Landslide
LOCATION Hamilton County, Ohio
JOB NO. 24780173 **DATE** 7/10/25

SUMMARY OF LABORATORY TEST RESULTS

BORING	SAMPLE (#)	Top Depth (ft)	MC %	LL %	PL %	PI %	AGGREGATE %	COARSE SAND %	FINE SAND %	SILT %	CLAY %	SILT/CLAY %	D / 50 m m	D / 95 m m	H R B ODOT CLASSIFICATION
B-002-1-24		27.00													A-7-6 (V)
B-002-2-24		0.00	15												A-7-6 (V)
B-002-2-24		1.50	19	45	19	26	7	7	4	25	57			3.7836	A-7-6 (15)
B-002-2-24		3.00	11												A-7-6 (V)
B-002-2-24		4.50	14	37	20	17	40	13	5	15	27		0.7148	35.0496	A-6b (3)
B-002-2-24		6.00	9												A-2-6 (V)
B-002-2-24		7.50	13	37	19	18	31	14	15	11	29		0.1500	15.7072	A-6b (3)
B-002-2-24		9.00	15												A-7-6 (V)
B-002-2-24		10.50	20												A-7-6 (V)
B-002-2-24		12.00	25												A-7-6 (V)
B-002-2-24		13.50	16	46	23	23	11	4	3	27	55			9.5000	A-7-6 (14)
B-002-2-24		15.00	10												A-7-6 (V)
B-002-2-24		16.50	14												A-7-6 (V)
B-003-0-24		0.00	19												A-7-6 (V)
B-003-0-24		1.50	6												A-7-6 (V)
B-003-0-24		3.00	15	42	21	21	11	4	3	32	50		0.0050	4.9365	A-7-6 (13)
B-003-0-24		4.50	15												A-7-6 (V)
B-003-0-24		6.00													A-7-6 (V)
B-003-0-24		7.50	17	43	20	23	6	4	3	32	55			2.8252	A-7-6 (14)
B-003-0-24		9.00	20												A-7-6 (V)
B-003-0-24		10.50	18												A-7-6 (V)
B-003-0-24		12.00	15	39	19	20	12	7	4	34	43		0.0086	4.7364	A-6b (12)
B-003-0-24		13.50													A-1-b (V)
B-003-0-24		15.00	9	37	19	18	44	11	5	14	26		0.9712	21.7826	A-6b (3)
B-003-0-24		16.50	13												A-7-6 (V)
B-003-0-24		18.00	14												A-7-6 (V)
B-003-0-24		19.50	17	46	21	25	14	5	4	29	48		0.0057	10.6369	A-7-6 (15)
B-003-0-24		21.00	18												A-7-6 (V)
B-003-0-24		22.50	21												A-7-6 (V)
B-003-0-24		24.00	25	52	24	28	3	2	3	34	58			0.5807	A-7-6 (18)

PROJECT HAM-275-11.40 Landslide
LOCATION Hamilton County, Ohio
JOB NO. 24780173 **DATE** 7/10/25

SUMMARY OF LABORATORY TEST RESULTS

BORING	SAMPLE (#)	Top Depth (ft)	MC %	LL %	PL %	PI %	AGGREGATE %	COARSE SAND %	FINE SAND %	SILT %	CLAY %	SILT/CLAY %	D / 50 m m	D / 95 m m	H R B ODOT CLASSIFICATION
B-003-0-24		**25.50**	**16**												**A-7-5 (V)**
B-003-0-24		**27.00**	**24**	**49**	**21**	**28**	**4**	**6**	**9**	**27**	**54**			**1.6148**	**A-7-6 (17)**
B-003-0-24		**28.50**	**20**												**A-7-6 (V)**
B-003-0-24		**30.00**	**11**												**A-7-6 (V)**
B-003-0-24		**31.50**	**9**												**Rock (V)**

PROJECT HAM-275-11.40 Landslide
LOCATION Hamilton County, Ohio
JOB NO. 24780173 **DATE** 7/10/25

Form No. TR-D7012C-01
Revision No. : 1LexD
Revision Date: 06/19/25

UNIAXIAL COMPRESSIVE STRENGTH OF ROCK

ASTM D7012 Method C

Quality Assurance

S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

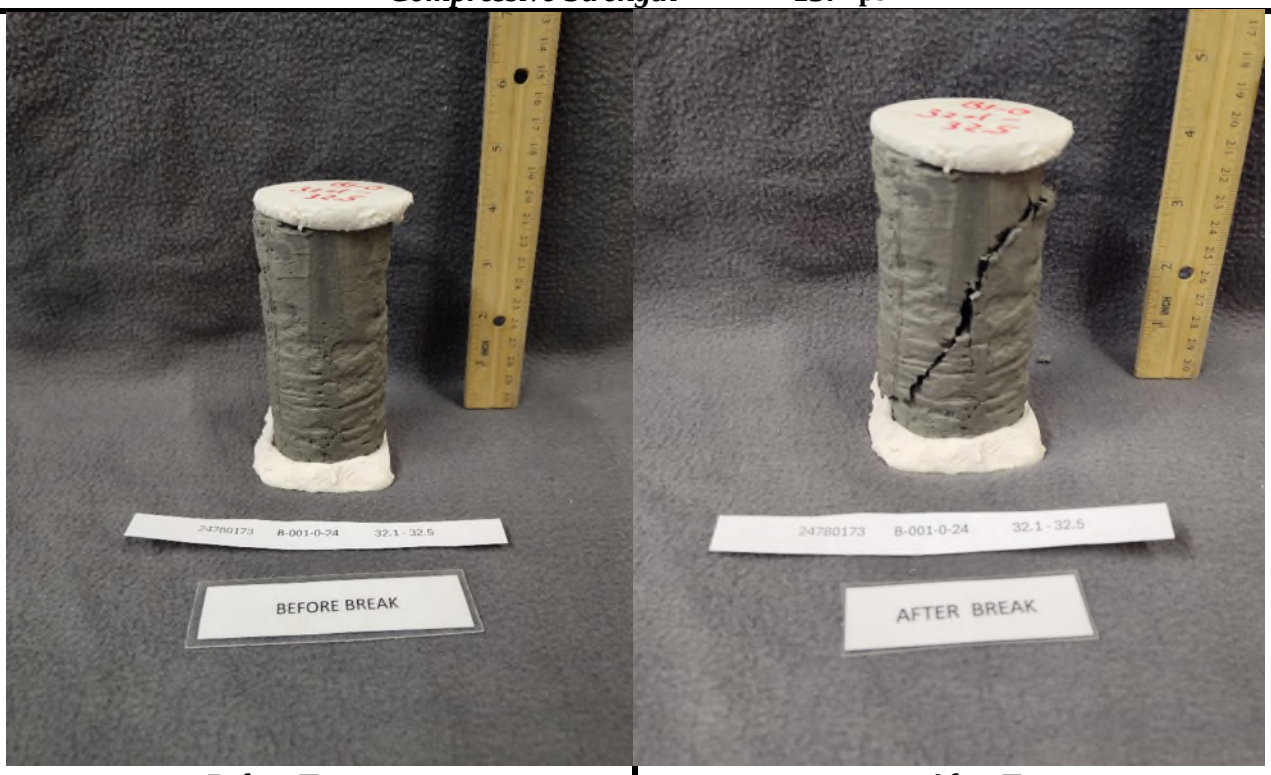
Project No.:	24780173	Report Date:	06/30/25
Project Name:	HAM-275-11.40 Landslide (PID:121506)	Test Date(s):	06/27/25
Client Name:	Stantec		
Client Address:	10200 Alliance Road, Suite 300, Cincinnati, OH 45242	Received Date:	06/09/25
Location:	B-001-0-24	Depth, ft:	32.1 - 32.5
Sample Description:	Weathered Shale		

Angle of load relative to lithology: Approximately perpendicular

Test Results

Moisture Content ***9.6*** **%** ***Dry Unit Weight*** ***130.3*** **pcf**

Compressive Strength ***137*** **psi**



Before Test **After Test**

Strain rate: 0.015 in/min.

Notes / Deviations / References: **Per ASTM D4543 7.6, for specimens which have physical characteristics which prevent planing the sample to within the flatness requirement it is permissible to cap them with gypsum. This specimen was too fragile for planing to within the flatness requirement and was capped with gypsum. The sides of the specimen were not sufficiently straight affecting accurate perpendicularity measurements.**

Jacob Folsom	Jacob Folsom	Laboratory Services Manger	7/3/2025
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7012C-01
Revision No. : 1LexD
Revision Date: 06/19/25

UNIAXIAL COMPRESSIVE STRENGTH OF ROCK

ASTM D7012 Method C

Quality Assurance

S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

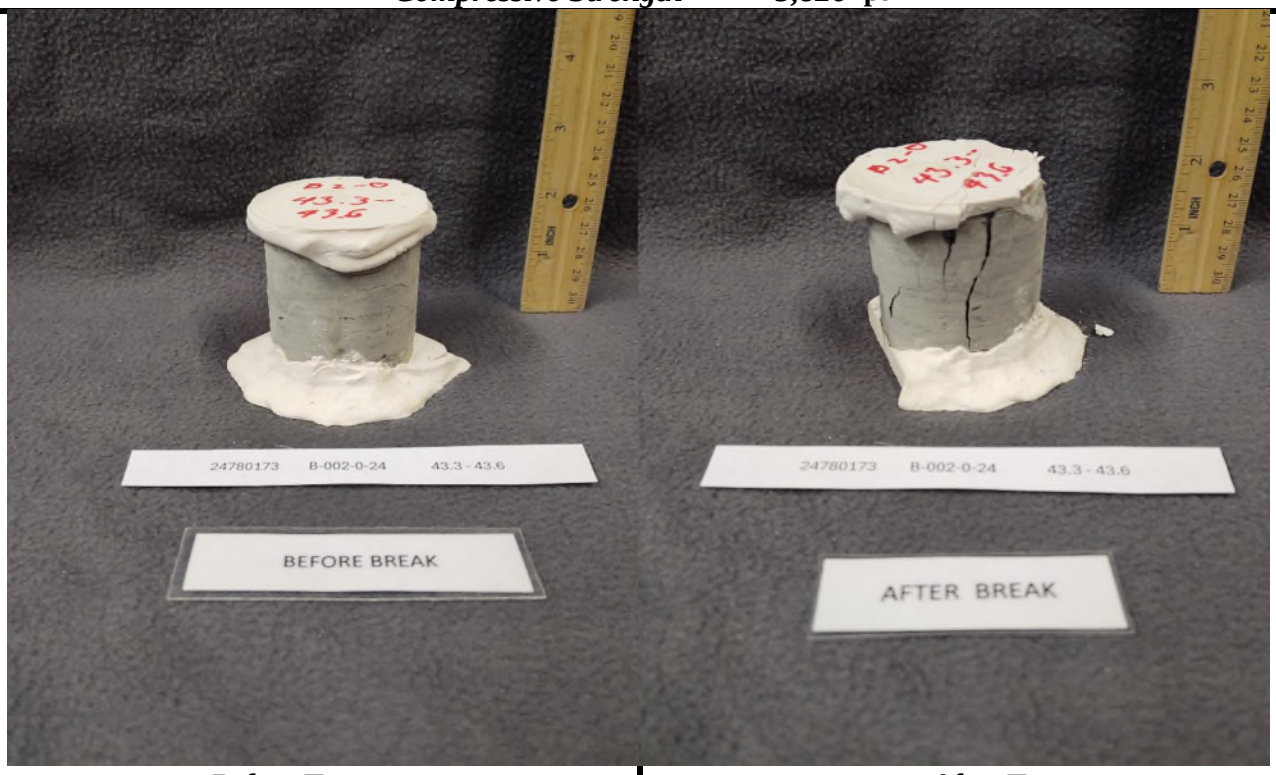
Project No.:	24780173	Report Date:	06/30/25
Project Name:	HAM-275-11.40 Landslide (PID:121506)	Test Date(s):	06/27/25
Client Name:	Stantec		
Client Address:	10200 Alliance Road, Suite 300, Cincinnati, OH 45242	Received Date:	06/09/25
Location:	B-002-0-24	Depth, ft:	43.3 - 43.6
Sample Description:	Shale		

Angle of load relative to lithology: Approximately perpendicular

Test Results

Moisture Content ***1.9*** **%** ***Dry Unit Weight*** ***155.2*** **pcf**

Compressive Strength ***5,826*** **psi**



Before Test **After Test**

Strain rate: 0.015 in/min.

Notes / Deviations / References: **Test specimen did not meet the ASTM standard specifications for height to diameter ratio and for core preparation. Test results for specimens not prepared in accordance with this method may differ from test results from specimens meeting this requirement. The sides of the specimen were not sufficiently straight. This specimen was too fragile for planing to within the flatness requirement and was capped with gypsum.**

Jacob Folsom	Jacob Folsom	Laboratory Services Manger	7/3/2025
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7012C-01
Revision No. : 1LexD
Revision Date: 06/19/25

UNIAXIAL COMPRESSIVE STRENGTH OF ROCK

ASTM D7012 Method C

Quality Assurance

S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project No.:	24780173	Report Date:	06/30/25
Project Name:	HAM-275-11.40 Landslide (PID:121506)	Test Date(s):	06/27/25
Client Name:	Stantec		
Client Address:	10200 Alliance Road, Suite 300, Cincinnati, OH 45242	Received Date:	06/09/25
Location:	B-002-1-24	Depth, ft:	37.6 - 38.0
Sample Description:	Weathered Shale		

Angle of load relative to lithology: Approximately perpendicular

Test Results

Moisture Content ***10.3*** **%** ***Dry Unit Weight*** ***132.2*** **pcf**

Compressive Strength ***113*** **psi**

Before Test

After Test

Strain rate: 0.015 in/min.

Notes / Deviations / References: **Per ASTM D4543 7.6, for specimens which have physical characteristics which prevent planing the sample to within the flatness requirement it is permissible to cap them with gypsum. This specimen was too fragile for planing to within the flatness requirement and was capped with gypsum. The sides of the specimen were not sufficiently straight affecting accurate perpendicularity measurements.**

Jacob Folsom	Jacob Folsom	Laboratory Services Manger	7/3/2025
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7012C-01
Revision No. : 1LexD
Revision Date: 06/19/25

UNIAXIAL COMPRESSIVE STRENGTH OF ROCK

ASTM D7012 Method C

Quality Assurance

S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project No.:	24780173	Report Date:	06/30/25
Project Name:	HAM-275-11.40 Landslide (PID:121506)	Test Date(s):	06/27/25
Client Name:	Stantec		
Client Address:	10200 Alliance Road, Suite 300, Cincinnati, OH 45242	Received Date:	06/09/25
Location:	B-002-2-24	Depth, ft:	21.5 - 21.9
Sample Description:	Weathered Shale		

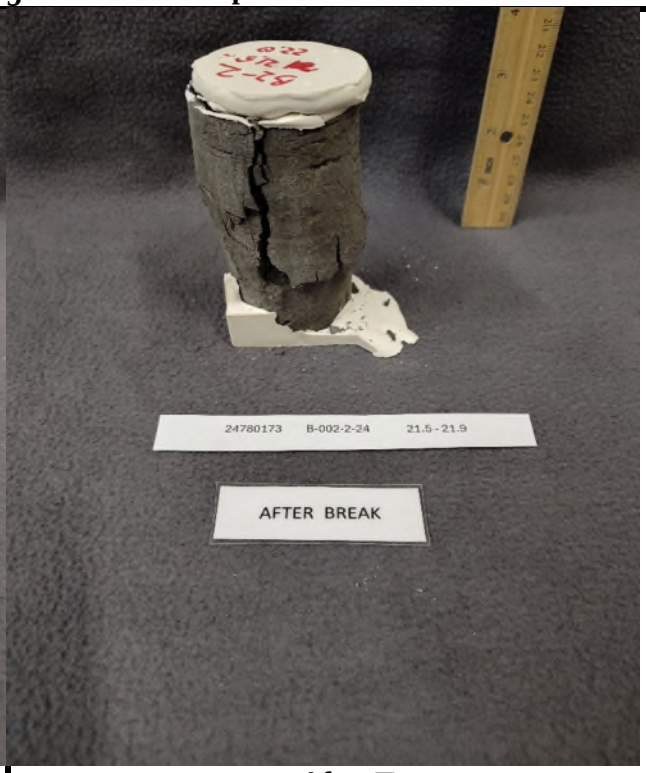
Angle of load relative to lithology: Approximately perpendicular

Test Results

Moisture Content ***11.0*** **%** ***Dry Unit Weight*** ***126.8*** **pcf**

Compressive Strength ***157*** **psi**

Before Test



After Test

Strain rate: 0.015 in/min.

Notes / Deviations / References: **Per ASTM D4543 7.6, for specimens which have physical characteristics which prevent planing the sample to within the flatness requirement it is permissible to cap them with gypsum. This specimen was too fragile for planing to within the flatness requirement and was capped with gypsum. The sides of the specimen were not sufficiently straight affecting accurate perpendicularity measurements.**

Jacob Folsom	Jacob Folsom	Laboratory Services Manger	7/3/2025
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7012C-01
Revision No. : 1LexD
Revision Date: 06/19/25

UNIAXIAL COMPRESSIVE STRENGTH OF ROCK

ASTM D7012 Method C

Quality Assurance

S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

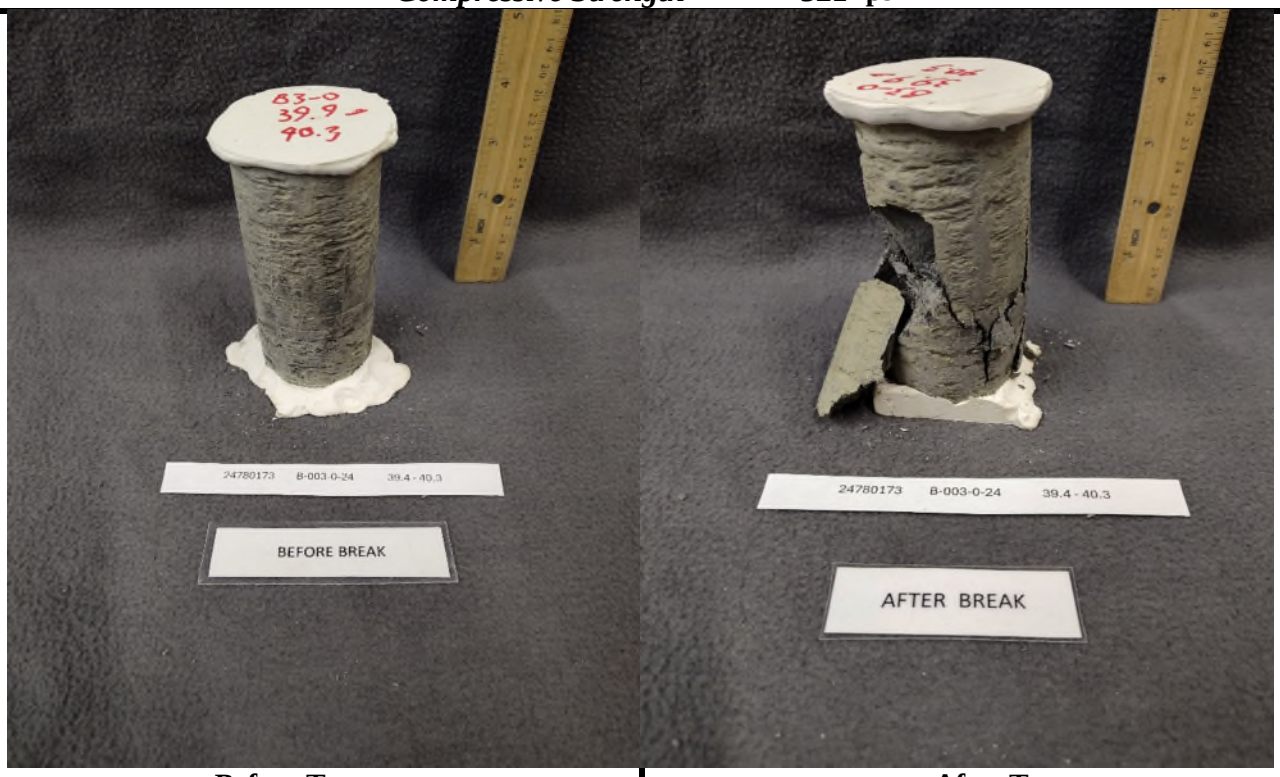
Project No.:	24780173	Report Date:	06/30/25
Project Name:	HAM-275-11.40 Landslide (PID:121506)	Test Date(s):	06/27/25
Client Name:	Stantec		
Client Address:	10200 Alliance Road, Suite 300, Cincinnati, OH 45242	Received Date:	06/09/25
Location:	B-003-0-24	Depth, ft:	39.9 - 40.3
Sample Description:	Weathered Shale		

Angle of load relative to lithology: Approximately perpendicular

Test Results

Moisture Content ***7.4*** **%** ***Dry Unit Weight*** ***138.5*** **pcf**

Compressive Strength ***521*** **psi**



Before Test **After Test**

Strain rate: 0.015 in/min.

Notes / Deviations / References: **Per ASTM D4543 7.6, for specimens which have physical characteristics which prevent planing the sample to within the flatness requirement it is permissible to cap them with gypsum. This specimen was too fragile for planing to within the flatness requirement and was capped with gypsum. The sides of the specimen were not sufficiently straight affecting accurate perpendicularity measurements.**

Jacob Folsom	Jacob Folsom	Laboratory Services Manger	7/3/2025
Technical Responsibility	*Signature*	*Position*	*Date*

Form No: TR-D2974-1
Revision No. 1
Revision Date: 08/26/17

MOISTURE, ASH, AND ORGANIC MATTER

ASTM D-2974

S&ME, Inc. Cincinnati: 862 East Crescentville Road, West Chester, OH 45246

Project #:	25780173	Report Date:	07/10/25
Project Name:	HAM-275-11.40 Landslide	Test Date(s):	6/19-6/25/25
Client Name:	Stantec		
Client Address:	10200 Alliance Road, Suite 300, Cincinnati, OH 45242		
Boring No.	B-002-0-24	Sample No. SS-2	Sample Date: 5/21/25
Location:		Sampled by:	Depth (ft.) 1.5-3.0

Equipment: *Balance: 0.01 g readability*
Balance: *S&ME ID #:* *26700* *Cal. Date:* *1/21/25* *Due:* *01/21/26*

Method A: Moisture Content Determination *Required Oven Temperature :110 ± 5 ° C*

Oven Temperature: 110 °C		*Tare #*	10
t	Tare Weight *(Dish plus Aluminum Foil Cover)*	*grams*	22.43
a	Mass of *As-Received* Specimen + Tare Wt.	*grams*	82.37
b	Mass of Oven Dry Specimen + Tare Wt.	*grams*	71.38
w	Water Weight	*(a-b)*	10.99
A	Mass of As-Received Specimen	*(a-t)*	59.94
B	Mass of Oven Dry Specimen	*(b-t)*	48.95
	% Moisture Content as a % of As Received or Total Mass	*(w/A)*100*	**18.3%**
	% Moisture Content as a % of Oven-dried Mass	*(w/B)*100*	**22.5%**

Oven *S&ME ID #:* *27008* *Cal. Date:* *12/27/24* *Due:* *12/27/25*

Method C (440 ° C) or D (750 ° C): Ash Content and Organic Matter Determination

Muffle Furnace: 440 °C		*Tare #*	C
t	Tare Weight *(Dish plus Aluminum Foil Cover)*	*grams*	88.81
b	Mass of Oven Dry Specimen + Tare Wt.	*grams*	138.51
c	Ash Weight + Tare Wt.	*grams*	137.35
C	Ash Weight	*c-t*	48.54
B	Mass of Oven Dry Specimen	*(b-t)*	49.70
D	***% Ash Content***	*(C/B)*100*	**97.7%**
	% Organic Matter	*100-D*	**2.3%**

Muffle Furnace: *S&ME ID #:* *24239* *Cal. Date:* *Due:*

Notes / Deviations / References: ASTM D2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

K. Cannady	6/23-6/24/25	on file	P5
Technician Name	*Date*	*Signature*	*Level/Certification*
K. Cannady		QAS	6/25/2025
Technical Responsibility	*Signature*	*Position*	*Date*

Form No: TR-D2974-1
Revision No. 1
Revision Date: 08/26/17

MOISTURE, ASH, AND ORGANIC MATTER

ASTM D-2974

S&ME, Inc. Cincinnati: 862 East Crescentville Road, West Chester, OH 45246

Project #:	25780173	Report Date:	07/10/25
Project Name:	HAM-275-11.40 Landslide	Test Date(s):	6/19-6/25/25
Client Name:	Stantec		
Client Address:	10200 Alliance Road, Suite 300, Cincinnati, OH 45242		
Boring No.	B-002-2-24	Sample No.	SS-2
Location:		Sampled by:	
Sample Date:	5/21/25		
Depth (ft.)	1.5-3.0		

Equipment: *Balance: 0.01 g readability*

Balance: *S&ME ID #:* *26700* *Cal. Date:* *1/21/25* *Due:* *01/21/26*

Method A: Moisture Content Determination *Required Oven Temperature :110 ± 5 ° C*

	Oven Temperature: 110 °C	*Tare #*	16
t	Tare Weight *(Dish plus Aluminum Foil Cover)*	*grams*	21.63
a	Mass of *As-Received* Specimen + Tare Wt.	*grams*	84.24
b	Mass of Oven Dry Specimen + Tare Wt.	*grams*	73.33
w	Water Weight	*(a-b)*	10.91
A	Mass of As-Received Specimen	*(a-t)*	62.61
B	Mass of Oven Dry Specimen	*(b-t)*	51.70
	% Moisture Content as a % of As Received or Total Mass	*(w/A)*100*	**17.4%**
	% Moisture Content as a % of Oven-dried Mass	*(w/B)*100*	**21.1%**

Oven *S&ME ID #:* *27008* *Cal. Date:* *12/27/24* *Due:* *12/27/25*

Method C (440 ° C) or D (750 ° C): Ash Content and Organic Matter Determination

	Muffle Furnace: 440 °C	*Tare #*	B
t	Tare Weight *(Dish plus Aluminum Foil Cover)*	*grams*	89.69
b	Mass of Oven Dry Specimen + Tare Wt.	*grams*	142.51
c	Ash Weight + Tare Wt.	*grams*	140.88
C	Ash Weight	*c-t*	51.19
B	Mass of Oven Dry Specimen	*(b-t)*	52.82
D	***% Ash Content***	*(C/B)*100*	**96.9%**
	% Organic Matter	*100-D*	**3.1%**

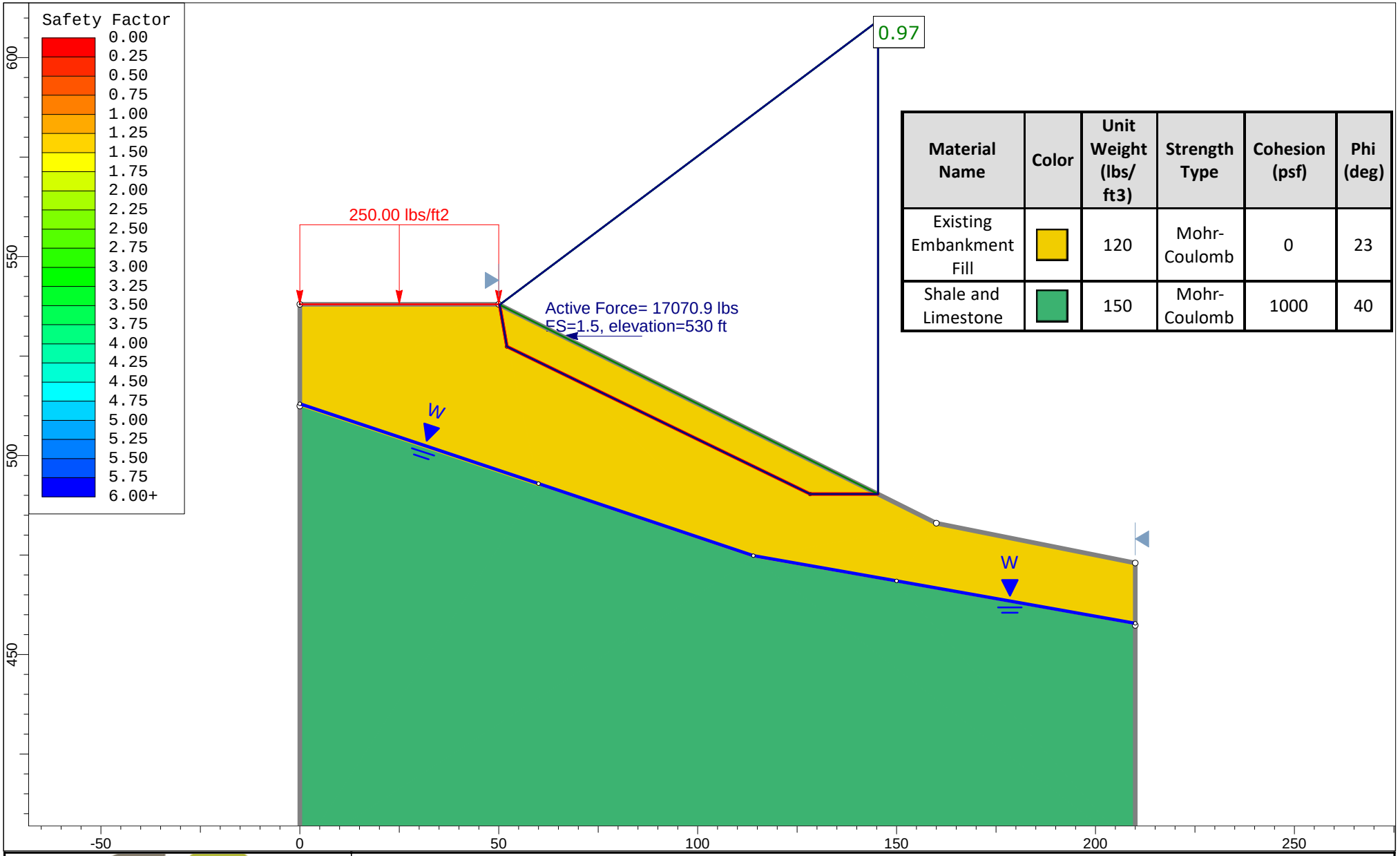
Muffle Furnace: *S&ME ID #:* *24239* *Cal. Date:* *Due:*

Notes / Deviations / References: ASTM D2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

K. Cannady	6/23-6/24/25	on file	P5
Technician Name	*Date*	*Signature*	*Level/Certification*
K. Cannady		QAS	6/25/2025
Technical Responsibility	*Signature*	*Position*	*Date*

Appendix IV– Back Analysis and Calculations

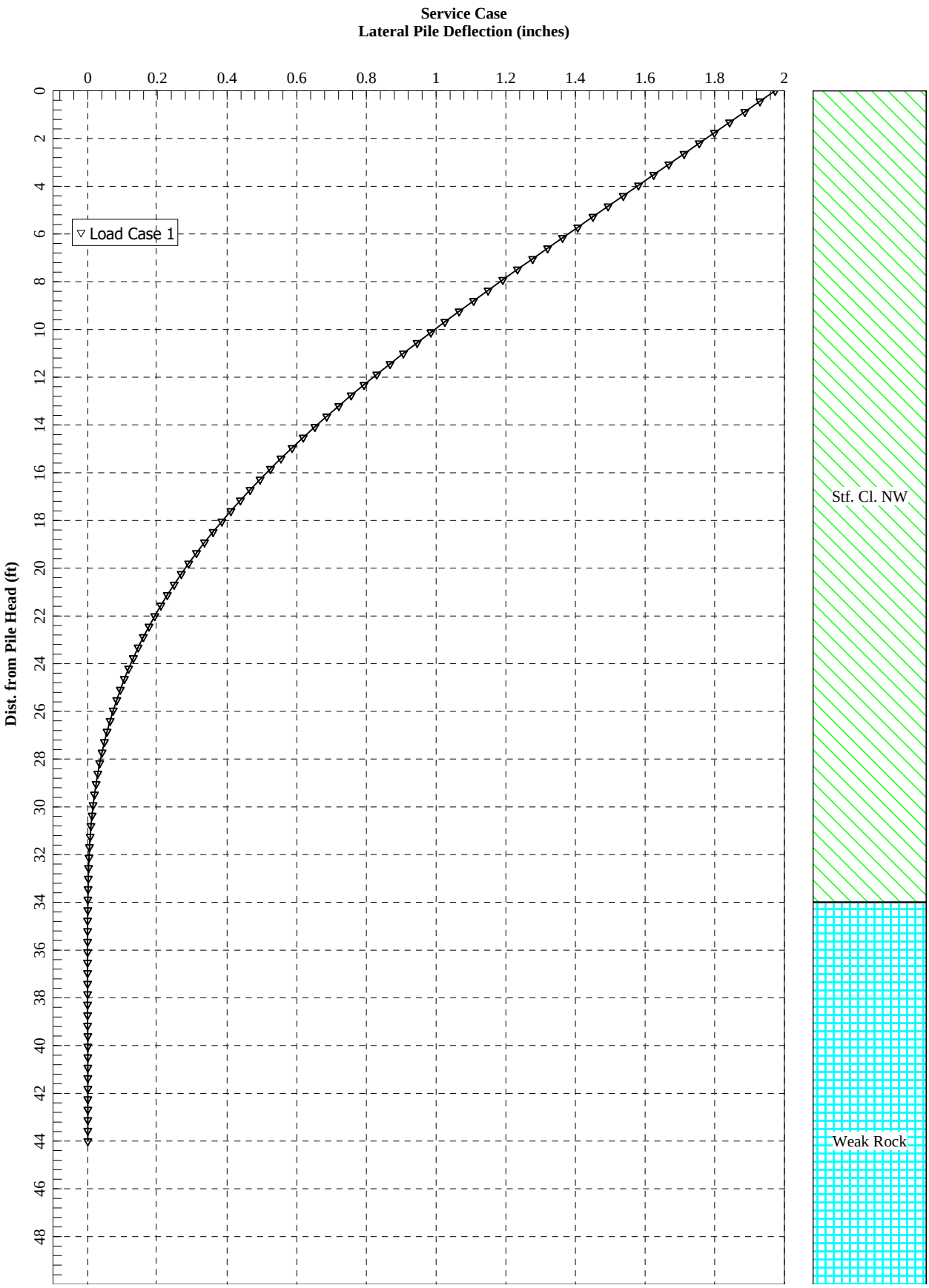
Back Analysis
LPile Analysis
Conceptual Sketch



Material Name	Color	Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Embankment Fill		120	Mohr-Coulomb	0	23
Shale and Limestone		150	Mohr-Coulomb	1000	40

SLIDEINTERPRET 9.003

Project HAM-275-11.40 Landslide	
Analysis Back Analysis	*Location* B-003-0-24
Drawn By SBK	*S&ME Project No.* 24780173


Service Case
Lateral Pile Deflection (inches)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Load Case 1
Dist. from Pile Head (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Stf. Cl. NW
Weak Rock

This model was prepared by:
Sudip Khadka

Files Used for Analysis

Path to file locations:
\Cincinnati-1178\Projects\2024\24780173_Stantec_HAM-275-11.40 Landslide_Cincinnati OH\GEO\Project Docs\Calcs\Slope Stability\

Name of input data file:
Wall Design_Service.lp12d

Name of output report file:
Wall Design_Service.lp12o

Name of plot output file:
Wall Design_Service.lp12p

Name of runtime message file:
Wall Design_Service.lp12r

Date and Time of Analysis

Date: September 8, 2025 Time: 11:05:42

Problem Title

Project Name: HAM-275-11.40 Landslide

Job Number: 24780173

Client: Stantec

Engineer: SBK

Description: Soldier Pile Cantilever Wall Design

Program Options and Settings

Computational Options:
- 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

- Analysis uses p-y modification factors for p-y curves
- 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
- p-y curves computed and reported at user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 44.000 ft
Depth of ground surface below top of pile = 0.0000 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	36.0000
2	44.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a drilled shaft with casing and AISC section core/insert
Length of section = 44.000000 ft
Section Diameter = 36.000000 in

Core/Insert AISC Section Type = W

Core/Insert AISC Section Name = W24X176

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer	=	0.0000 ft
Distance from top of pile to bottom of layer	=	34.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	750.000000 psf
Undrained cohesion at bottom of layer	=	750.000000 psf
Epsilon-50 at top of layer	=	0.010000
Epsilon-50 at bottom of layer	=	0.010000

Layer 2 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	34.000000 ft
Distance from top of pile to bottom of layer	=	54.000000 ft
Effective unit weight at top of layer	=	138.000000 pcf
Effective unit weight at bottom of layer	=	138.000000 pcf
Uniaxial compressive strength at top of layer	=	110.000000 psi
Uniaxial compressive strength at bottom of layer	=	110.000000 psi
Initial modulus of rock at top of layer	=	9900. psi
Initial modulus of rock at bottom of layer	=	9900. psi
RQD of rock at top of layer	=	26.000000 %
RQD of rock at bottom of layer	=	26.000000 %
k rm of rock at top of layer	=	0.0005000
k rm of rock at bottom of layer	=	0.0005000

(Depth of the lowest soil layer extends 10.000 ft below the pile tip)

Summary of Input Soil Properties

Layer Num.	Soil Type Name or (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Cohesion psf	Uniaxial qu psi	RQD %	E50 or krm	Rock Mass Modulus psi
1	Stiff Clay w/o Free Water	0.00	120.0000	750.0000	--	--	0.01000	--
		34.0000	120.0000	750.0000	--	--	0.01000	--
2	Weak Rock	34.0000	138.0000	--	110.0000	26.0000	5.00E-04	9900.
		54.0000	138.0000	--	110.0000	26.0000	5.00E-04	9900.

Modification Factors for p-y Curves

Distribution of p-y modifiers with depth defined using 4 points

Point No.	Depth X ft	p-mult	y-mult
1	0.000	0.8100	1.0000
2	34.000	0.8100	1.0000
3	34.010	1.0000	1.0000
4	44.000	1.0000	1.0000

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

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	55.000
2	6.000	2890.000

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	1	V = 0.0000 lbs	M = 0.0000 in-lbs	0.0000000	Yes	Yes

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.

Specified Depths for Output of p-y Curves

Lateral load-transfer (p-y) curves are computed and output at 2 depths.
(Note that load-transfer values are computeded at the specified depths and may differ from values computed at nodal points)

Depth No.	Depth Below Pile Head ft	Depth Below Ground Surface ft

1	0.000	0.000
2	44.000	44.000

Depth of ground surface below top of pile = 0.0000 ft

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 Drilled Shaft (Bored Pile) with Casing and AISC Strong Axis Core/Insert:

Length of Section	=	44.000000 ft
Outside Diameter of Casing	=	36.000000 in
Casing Wall Thickness	=	0.0000 in
Moment of Inertia of Steel Casing	=	0.0000 in^4
Width Flange of Core/Insert	=	12.900000 in
Depth of Core/Insert	=	25.200000 in
Flange Thickness of Core/Insert	=	1.340000 in
Web Thickness of Core/Insert	=	0.750000 in
Moment of Inertia of Steel Core/Insert	=	5680. in^4
Yield Stress of Casing	=	50000. psi
Elastic Modulus of Casing	=	29000000. psi
Yield Stress of Core/Insert	=	50000. psi
Elastic Modulus of Core/Insert	=	29000000. psi
Number of Reinforcing Bars	=	0 bars
Gross Area of Pile	=	1018. sq. in.
Area of Concrete	=	966.414020 sq. in.
Cross-sectional Area of Steel Casing	=	0.0000 sq. in.
Cross-sectional Area of Steel Core/Insert	=	51.700000 sq. in.
Area of All Steel (Casing, Core/Insert, and Bars)	=	51.462000 sq. in.
Area Ratio of All Steel to Gross Area	=	5.06 percent

Note that the core is assumed to be void of concrete.

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	5869.998 kips

Tensile Load for Cracking of Concrete = -574.817 kips
Nominal Axial Tensile Capacity = -2585.000 kips

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

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

Number	Axial Thrust Force kips
1	0.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318-14, Section 21.2.3.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 0.000 kips

Bending Max Conc Curvature Stress rad/in. ksi	Bending Max Steel Moment Stress in-kip ksi	Bending Max Casing Stiffness Stress kip-in2 ksi	Depth to Max Core N Axis Stress in ksi	Run Msg	Max Comp Strain in/in	Max Tens Strain in/in

```
------------ ------------ ------------ ------------ ---
 6.25000E-07  305.3064333   488490293.   18.0000000   0.00001125  -0.00001125
  0.0470966      0.00000      0.00000    -0.231637
  0.00000125  609.7844438   487827555.   18.0000000   0.00002250  -0.00002250
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  0.00000188  913.4340317   487164817.   18.0000000   0.00003375  -0.00003375
  0.1404531      0.00000      0.00000    -0.694912
  0.00000250       1216.    486502079.   18.0000000   0.00004500  -0.00004500
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  0.00000313       1518.    485839341.   18.0000000   0.00005625  -0.00005625
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  0.4686532      0.00000      0.00000    -4.460425 C
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  0.5334844      0.00000      0.00000    -5.095691 C
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2.1503649 0.00000 0.00000 -22.983384 C
0.00004688 11611. 247711260. 13.4169092 0.0006289 -0.001059
2.1987429 0.00000 0.00000 -23.602951 C
0.00004813 11912. 247522928. 13.4243784 0.0006460 -0.001086
2.2465359 0.00000 0.00000 -24.221939 C
0.00004938 12212. 247333968. 13.4318767 0.0006632 -0.001114
2.2937420 0.00000 0.00000 -24.840344 C
0.00005063 12512. 247144375. 13.4394043 0.0006804 -0.001142
2.3403592 0.00000 0.00000 -25.458162 C
0.00005188 12811. 246954144. 13.4469615 0.0006976 -0.001170
2.3863856 0.00000 0.00000 -26.075390 C
0.00005313 13109. 246763271. 13.4545484 0.0007148 -0.001198
2.4318191 0.00000 0.00000 -26.692024 C
0.00005438 13407. 246571751. 13.4621474 0.0007320 -0.001225
2.4766578 0.00000 0.00000 -27.308060 C
0.00005563 13705. 246379579. 13.4697211 0.0007493 -0.001253
2.5208995 0.00000 0.00000 -27.923496 C
0.00005688 14002. 246186750. 13.4773250 0.0007665 -0.001281
2.5645423 0.00000 0.00000 -28.538327 C
0.00005813 14298. 245993259. 13.4849594 0.0007838 -0.001309
2.6075841 0.00000 0.00000 -29.152549 C
0.00005938 14594. 245799101. 13.4926246 0.0008011 -0.001336
2.6500227 0.00000 0.00000 -29.766159 C
0.00006063 14890. 245604284. 13.5006954 0.0008185 -0.001364
2.6918540 0.00000 0.00000 -30.379177 C
0.00006188 15185. 245408935. 13.5079646 0.0008358 -0.001392
2.7330573 0.00000 0.00000 -30.991827 C
0.00006313 15479. 245212918. 13.5156462 0.0008532 -0.001419
2.7736507 0.00000 0.00000 -31.603866 C
0.00006438 15773. 245016227. 13.5233589 0.0008706 -0.001447
2.8136322 0.00000 0.00000 -32.215291 C
0.00006563 16066. 244818859. 13.5311031 0.0008880 -0.001475
2.8529994 0.00000 0.00000 -32.826097 C
0.00006688 16359. 244620806. 13.5388788 0.0009054 -0.001502
2.8917503 0.00000 0.00000 -33.436282 C
0.00006813 16651. 244422065. 13.5466864 0.0009229 -0.001530
2.9298827 0.00000 0.00000 -34.045840 C
0.00006938 16943. 244222630. 13.5545262 0.0009403 -0.001557

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2.9673943       0.00000       0.00000    -34.654769 C
0.00007063        17234.    244022495.     13.5623984     0.0009578     -0.001585
3.0042829       0.00000       0.00000    -35.263063 C
0.00007188        17525.    243821654.     13.5703032     0.0009754     -0.001612
3.0405463       0.00000       0.00000    -35.870720 C
0.00007313        17815.    243620104.     13.5782410     0.0009929     -0.001640
3.0761822       0.00000       0.00000    -36.477734 C
0.00007438        18104.    243417837.     13.5862120     0.0010105     -0.001667
3.1111883       0.00000       0.00000    -37.084102 C
0.00007938        19256.    242601492.     13.6184337     0.0010810     -0.001777
3.2448675       0.00000       0.00000    -39.503027 C
0.00008438        20400.    241773218.     13.6515139     0.0011518     -0.001886
3.3682797       0.00000       0.00000    -41.911265 C
0.00008938        21533.    240932623.     13.6848374     0.0012231     -0.001994
3.4812663       0.00000       0.00000    -44.308525 C
0.00009438        22657.    240079289.     13.7187524     0.0012947     -0.002103
3.5836620       0.00000       0.00000    -46.694502 C
0.00009938        23772.    239212774.     13.7532810     0.0013667     -0.002211
3.6752947       0.00000       0.00000    -49.068876 C
 0.0001044        24849.    238077026.     13.7818931     0.0014385     -0.002319
3.7552674       0.00000       0.00000    -50.000000 CY
 0.0001094        25579.    233867998.     13.7302623     0.0015017     -0.002436
3.8163176       0.00000       0.00000    -50.000000 CY
 0.0001144        25950.    226882748.     13.6008637     0.0015556     -0.002562
3.8612898       0.00000       0.00000    -50.000000 CY
 0.0001194        26260.    219977498.     13.4695783     0.0016079     -0.002690
3.8989363       0.00000       0.00000    -50.000000 CY
 0.0001244        26541.    213392170.     13.3415166     0.0016594     -0.002818
3.9301251       0.00000       0.00000    -50.000000 CY
 0.0001294        26798.    207131194.     13.2193323     0.0017103     -0.002947
3.9553422       0.00000       0.00000    -50.000000 CY
 0.0001344        27033.    201177100.     13.1018021     0.0017606     -0.003077
3.9747376       0.00000       0.00000    -50.000000 CY
 0.0001394        27249.    195511496.     12.9876859     0.0018102     -0.003207
3.9884865       0.00000       0.00000    -50.000000 CY
 0.0001444        27448.    190116838.     12.8782452     0.0018593     -0.003338
3.9968522       0.00000       0.00000    -50.000000 CY
 0.0001494        27633.    184992928.     12.7746948     0.0019082     -0.003469
3.9999726       0.00000       0.00000    -50.000000 CY
 0.0001544        27802.    180092641.     12.6723644     0.0019563     -0.003601
3.9998000       0.00000       0.00000    -50.000000 CY
 0.0001594        27959.    175426189.     12.5748270     0.0020041     -0.003733
3.9992640       0.00000       0.00000    -50.000000 CY
 0.0001644        28105.    170979667.     12.4819144     0.0020517     -0.003866
3.9980485       0.00000       0.00000    -50.000000 CY
 0.0001694        28241.    166734946.     12.3923005     0.0020989     -0.003999
3.9999994       0.00000       0.00000    -50.000000 CY
 0.0001744        28366.    162672833.     12.3046526     0.0021456     -0.004132
3.9993984       0.00000       0.00000    -50.000000 CY
 0.0001794        28483.    158792794.     12.2207239     0.0021921     -0.004265
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  3.9972632       0.00000       0.00000    -50.000000 CY
   0.0001844        28594.    155083806.     12.1402859     0.0022384     -0.004399
  3.9998112       0.00000       0.00000    -50.000000 CY
   0.0001894        28697.    151535964.     12.0632969     0.0022845     -0.004533
  3.9977318       0.00000       0.00000    -50.000000 CY
   0.0001944        28793.    148130485.     11.9867891     0.0023299     -0.004668
  3.9998597       0.00000       0.00000    -50.000000 CY
   0.0001994        28883.    144868570.     11.9132969     0.0023752     -0.004802
  3.9972601       0.00000       0.00000    -50.000000 CY
   0.0002044        28969.    141744000.     11.8427098     0.0024204     -0.004937
  3.9996467       0.00000       0.00000    -50.000000 CY
   0.0002094        29050.    138746786.     11.7747974     0.0024653     -0.005072
  3.9957327       0.00000       0.00000    -50.000000 CY
   0.0002144        29126.    135866799.     11.7091855     0.0025102     -0.005207
  3.9988421       0.00000       0.00000    -50.000000 CY
   0.0002194        29198.    133096527.     11.6440162     0.0025544     -0.005343
  3.9999888       0.00000       0.00000    -50.000000 CY
   0.0002244        29266.    130434852.     11.5811083     0.0025985     -0.005479
  3.9965841       0.00000       0.00000    -50.000000 CY
   0.0002294        29330.    127869616.     11.5198618     0.0026424     -0.005615
  3.9990955       0.00000       0.00000    -50.000000 CY
   0.0002344        29392.    125405748.     11.4609493     0.0026862     -0.005751
  3.9999969       0.00000       0.00000    -50.000000 CY
   0.0002394        29451.    123032132.     11.4041377     0.0027299     -0.005888
  3.9957835       0.00000       0.00000    -50.000000 CY
   0.0002444        29507.    120744389.     11.3490277     0.0027734     -0.006024
  3.9984949       0.00000       0.00000    -50.000000 CY
   0.0002494        29560.    118536663.     11.2940620     0.0028165     -0.006161
  3.9998257       0.00000       0.00000    -50.000000 CY
   0.0002544        29610.    116401196.     11.2401046     0.0028592     -0.006298
  3.9964279       0.00000       0.00000    -50.000000 CY
   0.0002594        29658.    114344993.     11.1883189     0.0029020     -0.006436
  3.9962034       0.00000       0.00000    -50.000000 CY
   0.0002644        29704.    112354466.     11.1372332     0.0029444     -0.006573
  3.9985196       0.00000       0.00000    -50.000000 CY
   0.0002694        29749.    110436332.     11.0887608     0.0029870     -0.006710
  3.9997653       0.00000       0.00000    -50.000000 CY
   0.0002744        29791.    108577957.     11.0410263     0.0030294     -0.006848
  3.9977431       0.00000       0.00000    -50.000000 CY
   0.0003044        30012.     98600632.     10.7740284     0.0032793     -0.007678
  3.9926677       0.00000       0.00000    -50.000000 CY
   0.0003344        30188.     90283063.     10.5404889     0.0035245     -0.008513
  3.9958795       0.00000       0.00000    -50.000000 CY
   0.0003644        30329.     83234314.     10.3353748     0.0037660     -0.009352
  3.9994381       0.00000       0.00000     50.0000000 CY
   0.0003944        30329.     76902703.     10.2312251     0.0040349     -0.010163
  3.9969666       0.00000       0.00000     50.0000000 CY
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Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	0.000	29761.735	0.00300000	-0.00675261

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	0.0000	29762.	0.0000	19345.	242537270.
1	0.75	0.0000	29762.	0.0000	22321.	240334487.
1	0.90	0.0000	29762.	0.0000	26786.	207424499.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	588755.
2	34.0000	34.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

p-y Curves Reported for Specified Depths

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	1
Depth of p-y curve below pile head	=	0.000 ft
Depth of p-y curve below ground surface	=	0.000 ft
Depth of top of layer 1 below pile head	=	0.000 ft
Equiv. depth of p-y curve below ground surface	=	0.000 ft
Pile diameter	=	36.000 in
Undrained cohesion	=	5.208 psi
Undrained cohesion	=	750.000 psf
Average effective unit weight	=	0.06944 pci
Average effective unit weight	=	120.000 pcf
Epsilon-50	=	0.01000
Pct	=	562.500 lb/in
Pcd	=	1687.500 lb/in
Pu	=	562.500 lb/in
y50	=	0.90000 in
p-multiplier	=	0.81000
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00028444	30.37500

0.00455	60.75000
0.02304	91.12500
0.07282	121.50000
0.17778	151.87500
0.36864	182.25000
0.68295	212.62500
1.16508	243.00000
1.86624	273.37500
2.84444	303.75000
4.16455	334.12500
5.89824	364.50000
8.12402	394.87500
10.92722	425.25000
14.40000	455.62500
18.00000	455.62500

p-y Curve Computed Using Weak Rock Criteria

Soil Layer Number	=	2
Depth of top of Layer 2 below pile head	=	34.000 ft
Depth of p-y curve below pile head	=	44.000 ft
Depth of p-y curve below ground surface	=	44.000 ft
Pile diameter	=	36.000 in
Average effective unit weight	=	124.091 pcf
Unconfined compressive strength	=	110.000 psi
Eir	=	9900. psi
RQD	=	26.000 %
k_rm	=	0.00050
Alpha_r	=	0.827
Xr	=	120.000 in
kir	=	500.
Mir	=	4.95000E+06 psi
Yu	=	1.35000 in
Yrm	=	0.01800 in
Y_A	=	7.87427E-04 in
Pu	=	17022.720 lb/in
p-multiplier	=	1.00000
y-multiplier	=	1.00000

y, inches	p, lbs/in
0.00000	0.00000
0.00078743	3892.54296
0.00653	6605.97664
0.01228	7734.71711
0.01802	8513.74471

0.02376	9123.52565
0.02951	9630.93153
0.05823	11414.77676
0.08695	12618.26743
0.11567	13551.52976
0.14439	14324.11850
0.17311	14988.71806
0.20184	15575.09177
0.23056	16101.84495
0.25928	16581.45214
0.28800	17022.72000
0.36000	17022.72000

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	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*H	Soil Spr. p	Distrib. Lat. Load
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	lb/inch	lb/inch	lb/inch
0.00	1.9735	-1.32E-04	-7.37E-07	-0.00826	0.00	4.88E+11	-277.221	370.8512	106.9750
0.4400	1.9298	-2373.	-518.044	-0.00826	0.00	4.88E+11	-288.883	790.3829	262.9000
0.8800	1.8862	-5471.	-136.701	-0.00827	0.00	4.88E+11	-300.369	840.8204	470.8000
1.3200	1.8425	-3817.	1282.	-0.00827	0.00	4.88E+11	-311.672	893.1254	678.7000
1.7600	1.7989	8069.	3740.	-0.00827	0.00	4.88E+11	-322.788	947.4182	886.6000
2.2000	1.7553	35674.	7237.	-0.00826	0.00	4.88E+11	-333.711	1004.	1095.
2.6400	1.7116	84487.	11774.	-0.00826	0.00	4.88E+11			

-344.435	1063.	1302.				
3.0800	1.6680	160008.	17353.	-0.00826	0.00	4.88E+11
-354.954	1124.	1510.				
3.5200	1.6244	267737.	23975.	-0.00826	0.00	4.88E+11
-365.261	1187.	1718.				
3.9600	1.5808	413185.	31641.	-0.00826	0.00	4.88E+11
-375.349	1254.	1926.				
4.4000	1.5372	601864.	40352.	-0.00825	0.00	4.88E+11
-385.213	1323.	2134.				
4.8400	1.4936	839298.	50109.	-0.00824	0.00	4.87E+11
-394.843	1396.	2342.				
5.2800	1.4501	1131012.	60913.	-0.00823	0.00	4.87E+11
-404.234	1472.	2550.				
5.7200	1.4067	1482541.	72766.	-0.00822	0.00	4.86E+11
-413.376	1552.	2758.				
6.1600	1.3633	1899426.	78876.	-0.00820	0.00	4.85E+11
-422.263	1635.	392.1580				
6.6000	1.3201	2315471.	77659.	-0.00818	0.00	4.84E+11
-430.886	1723.	0.00				
7.0400	1.2770	2719505.	75362.	-0.00815	0.00	4.83E+11
-439.236	1816.	0.00				
7.4800	1.2340	3111293.	73021.	-0.00810	0.00	2.53E+11
-447.306	1914.	0.00				
7.9200	1.1914	3490611.	70639.	-0.00803	0.00	2.52E+11
-455.102	2017.	0.00				
8.3600	1.1492	3857241.	68216.	-0.00796	0.00	2.52E+11
-462.617	2125.	0.00				
8.8000	1.1074	4210974.	65755.	-0.00787	0.00	2.52E+11
-469.848	2240.	0.00				
9.2400	1.0661	4551609.	63255.	-0.00778	0.00	2.52E+11
-476.788	2361.	0.00				
9.6800	1.0252	4878952.	60720.	-0.00768	0.00	2.52E+11
-483.432	2490.	0.00				
10.1200	0.9850	5192817.	58151.	-0.00758	0.00	2.52E+11
-489.775	2626.	0.00				
10.5600	0.9452	5493028.	55549.	-0.00746	0.00	2.51E+11
-495.811	2770.	0.00				
11.0000	0.9061	5779417.	52916.	-0.00735	0.00	2.51E+11
-501.535	2922.	0.00				
11.4400	0.8677	6051824.	50254.	-0.00722	0.00	2.51E+11
-506.942	3085.	0.00				
11.8800	0.8299	6310098.	47564.	-0.00709	0.00	2.51E+11
-512.025	3258.	0.00				
12.3200	0.7928	6554098.	44848.	-0.00696	0.00	2.51E+11
-516.780	3442.	0.00				
12.7600	0.7564	6783690.	42107.	-0.00681	0.00	2.51E+11
-521.201	3638.	0.00				
13.2000	0.7208	6998753.	39345.	-0.00667	0.00	2.50E+11
-525.282	3848.	0.00				
13.6400	0.6860	7199171.	36561.	-0.00652	0.00	2.50E+11

-529.018	4072.	0.00				
14.0800	0.6520	7384841.	33759.	-0.00637	0.00	2.50E+11
-532.402	4312.	0.00				
14.5200	0.6188	7555669.	30940.	-0.00621	0.00	2.50E+11
-535.430	4569.	0.00				
14.9600	0.5864	7711570.	28106.	-0.00605	0.00	2.50E+11
-538.094	4845.	0.00				
15.4000	0.5549	7852469.	25259.	-0.00588	0.00	2.50E+11
-540.390	5142.	0.00				
15.8400	0.5243	7978303.	22401.	-0.00572	0.00	2.50E+11
-542.310	5461.	0.00				
16.2800	0.4946	8089019.	19533.	-0.00555	0.00	2.50E+11
-543.849	5806.	0.00				
16.7200	0.4657	8184573.	16659.	-0.00537	0.00	2.50E+11
-545.001	6179.	0.00				
17.1600	0.4378	8264933.	13779.	-0.00520	0.00	2.50E+11
-545.758	6582.	0.00				
17.6000	0.4108	8330079.	10896.	-0.00502	0.00	2.50E+11
-546.115	7019.	0.00				
18.0400	0.3847	8379999.	8013.	-0.00485	0.00	2.50E+11
-546.064	7494.	0.00				
18.4800	0.3596	8414696.	5137.	-0.00467	0.00	2.50E+11
-543.376	7978.	0.00				
18.9200	0.3354	8434245.	2293.	-0.00449	0.00	2.50E+11
-533.998	8406.	0.00				
19.3600	0.3122	8438907.	-501.760	-0.00431	0.00	2.50E+11
-524.494	8871.	0.00				
19.8000	0.2899	8428947.	-3246.	-0.00414	0.00	2.50E+11
-514.862	9378.	0.00				
20.2400	0.2685	8404633.	-5938.	-0.00396	0.00	2.50E+11
-505.101	9933.	0.00				
20.6800	0.2481	8366237.	-8579.	-0.00378	0.00	2.50E+11
-495.208	10540.	0.00				
21.1200	0.2286	8314037.	-11167.	-0.00360	0.00	2.50E+11
-485.179	11207.	0.00				
21.5600	0.2100	8248310.	-13702.	-0.00343	0.00	2.50E+11
-475.013	11942.	0.00				
22.0000	0.1924	8169340.	-16183.	-0.00326	0.00	2.50E+11
-464.706	12755.	0.00				
22.4400	0.1756	8077415.	-18609.	-0.00308	0.00	2.50E+11
-454.254	13655.	0.00				
22.8800	0.1598	7972827.	-20980.	-0.00291	0.00	2.50E+11
-443.653	14658.	0.00				
23.3200	0.1449	7855870.	-23294.	-0.00275	0.00	2.50E+11
-432.899	15778.	0.00				
23.7600	0.1308	7726844.	-25551.	-0.00258	0.00	2.50E+11
-421.985	17034.	0.00				
24.2000	0.1176	7586055.	-27750.	-0.00242	0.00	2.50E+11
-410.907	18449.	0.00				
24.6400	0.1052	7433809.	-29889.	-0.00226	0.00	2.50E+11

```
-399.658     20051.       0.00
   25.0800    0.09371   7270422.    -31969.   -0.00211       0.00   2.50E+11
-388.231     21874.       0.00
   25.5200    0.08299   7096212.    -33989.   -0.00196       0.00   2.50E+11
-376.616     23961.       0.00
   25.9600    0.07306   6911502.    -35946.   -0.00181       0.00   2.51E+11
-364.806     26364.       0.00
   26.4000    0.06390   6716622.    -37840.   -0.00166       0.00   2.51E+11
-352.788     29152.       0.00
   26.8400    0.05548   6511907.    -39671.   -0.00153       0.00   2.51E+11
-340.552     32408.       0.00
   27.2800    0.04779   6297698.    -41436.   -0.00139       0.00   2.51E+11
-328.082     36246.       0.00
   27.7200    0.04080   6074342.    -43135.   -0.00126       0.00   2.51E+11
-315.364     40811.       0.00
   28.1600    0.03448   5842195.    -44766.   -0.00113       0.00   2.51E+11
-302.379     46298.       0.00
   28.6000    0.02882   5601618.    -46327.   -0.00101       0.00   2.51E+11
-289.105     52972.       0.00
   29.0400    0.02377   5352981.    -47818.  -9.00E-04       0.00   2.51E+11
-275.521     61200.       0.00
   29.4800    0.01932   5096663.    -49236.  -7.90E-04       0.00   2.52E+11
-261.597     71502.       0.00
   29.9200    0.01543   4833052.    -50579.  -6.86E-04       0.00   2.52E+11
-247.305     84630.       0.00
   30.3600    0.01208   4562546.    -51846.  -5.87E-04       0.00   2.52E+11
-232.611    101703.       0.00
   30.8000    0.00923   4285556.    -53034.  -4.94E-04       0.00   2.52E+11
-217.485    124434.       0.00
   31.2400    0.00685   4002502.    -54142.  -4.08E-04       0.00   2.52E+11
-201.903    155527.       0.00
   31.6800    0.00492   3713820.    -55165.  -3.27E-04       0.00   2.52E+11
-185.870    199350.       0.00
   32.1200    0.00340   3419956.    -56103.  -2.52E-04       0.00   2.53E+11
-169.466    263032.       0.00
   32.5600    0.00226   3121368.    -56955.  -1.84E-04       0.00   2.53E+11
-152.967    357663.       0.00
   33.0000    0.00146   2818515.    -57721.  -1.36E-04       0.00   4.83E+11
-137.134    496431.       0.00
   33.4400   8.22E-04   2511839.    -58396.  -1.07E-04       0.00   4.84E+11
-118.807    763504.       0.00
   33.8800   3.29E-04   2201851.    -58849.  -8.12E-05       0.00   4.84E+11
-52.596    842894.       0.00
   34.3200  -3.59E-05   1890397.    -58880.  -5.89E-05       0.00   4.85E+11
40.6315   5970624.       0.00
   34.7600  -2.93E-04   1580075.    -57750.  -4.00E-05       0.00   4.86E+11
387.6097   6992832.       0.00
   35.2000  -4.59E-04   1280560.    -54888.  -2.45E-05       0.00   4.86E+11
696.3182   8015040.       0.00
   35.6400  -5.51E-04   1000456.    -50559.  -1.21E-05       0.00   4.87E+11
```

```
943.6752   9037248.       0.00
   36.0800  -5.87E-04    746661.    -45116.  -2.65E-06       0.00   4.87E+11
1118.   1.01E+07       0.00
   36.5200  -5.79E-04    524027.    -38955.   4.23E-06       0.00   4.88E+11
1216.   1.11E+07       0.00
   36.9600  -5.42E-04    335292.    -32465.   8.87E-06       0.00   4.88E+11
1243.   1.21E+07       0.00
   37.4000  -4.86E-04    181199.    -25997.   1.17E-05       0.00   4.88E+11
1207.   1.31E+07       0.00
   37.8400  -4.19E-04     60762.    -19847.   1.30E-05       0.00   4.88E+11
1122.   1.41E+07       0.00
   38.2800  -3.49E-04    -28384.    -14239.   1.31E-05       0.00   4.88E+11
1002.   1.52E+07       0.00
   38.7200  -2.80E-04    -89605.     -9328.   1.25E-05       0.00   4.88E+11
858.7223   1.62E+07       0.00
   39.1600  -2.17E-04   -126886.     -5197.   1.13E-05       0.00   4.88E+11
705.8842   1.72E+07       0.00
   39.6000  -1.60E-04   -144489.     -1873.   9.87E-06       0.00   4.88E+11
553.4697   1.82E+07       0.00
   40.0400  -1.12E-04   -146662.   669.1781   8.30E-06       0.00   4.88E+11
409.3488   1.93E+07       0.00
   40.4800  -7.26E-05   -137423.      2486.   6.77E-06       0.00   4.88E+11
278.7871   2.03E+07       0.00
   40.9200  -4.08E-05   -120411.      3656.   5.37E-06       0.00   4.88E+11
164.5186   2.13E+07       0.00
   41.3600  -1.58E-05    -98813.      4267.   4.19E-06       0.00   4.88E+11
66.9931   2.23E+07       0.00
   41.8000   3.45E-06    -75348.      4404.   3.25E-06       0.00   4.88E+11
-15.249   2.33E+07       0.00
   42.2400   1.84E-05    -52307.      4139.   2.56E-06       0.00   4.88E+11
-85.113   2.44E+07       0.00
   42.6800   3.04E-05    -31640.      3528.   2.10E-06       0.00   4.88E+11
-146.425   2.54E+07       0.00
   43.1200   4.06E-05    -15054.      2610.   1.85E-06       0.00   4.88E+11
-201.207   2.61E+07       0.00
   43.5600   5.00E-05     -4078.      1426.   1.75E-06       0.00   4.88E+11
-247.449   2.61E+07       0.00
   44.0000   5.91E-05       0.00       0.00   1.73E-06       0.00   4.88E+11
-292.539   1.31E+07       0.00

* This analysis computed pile response using nonlinear moment-curvature rela-
  tionships. Values of total stress due to combined axial and bending stresses
  are computed only for elastic sections only and do not equal the actual
  stresses in concrete and steel. Stresses in concrete and steel may be inter-
  polated from the output for nonlinear bending properties relative to the
  magnitude of bending moment developed in the pile.


Output Summary for Load Case No. 1:
```

```
Pile-head deflection             =     1.97346738 inches
Computed slope at pile head      =     -0.0082650 radians
Maximum bending moment           =       8438907. inch-lbs
Maximum shear force              =         78876. lbs
Depth of maximum bending moment  =    19.36000000 feet below pile head
Depth of maximum shear force     =     6.16000000 feet below pile head
Number of iterations             =             42
Number of zero deflection points =              2
```

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

```
Shear      =              0. lbs
Moment     =              0. in-lbs
Axial Load =              0. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
44.00000	1.97346738	8438907.	78876.
41.80000	1.97337727	8438089.	79352.
39.60000	1.97120160	8437860.	79023.
37.40000	1.98909201	8398626.	78840.
35.20000	2.27813488	7938839.	77938.
33.00000	4.12896270	6432344.	73772.
30.80000	5.44564280	5836481.	72220.
28.60000	7.42736202	5203096.	68615.
26.40000	10.46515616	4556062.	66038.
24.20000	15.18624641	3902673.	62422.
22.00000	28.81765305	3471728.	61045.

Summary of Pile-head Responses for Conventional Analyses

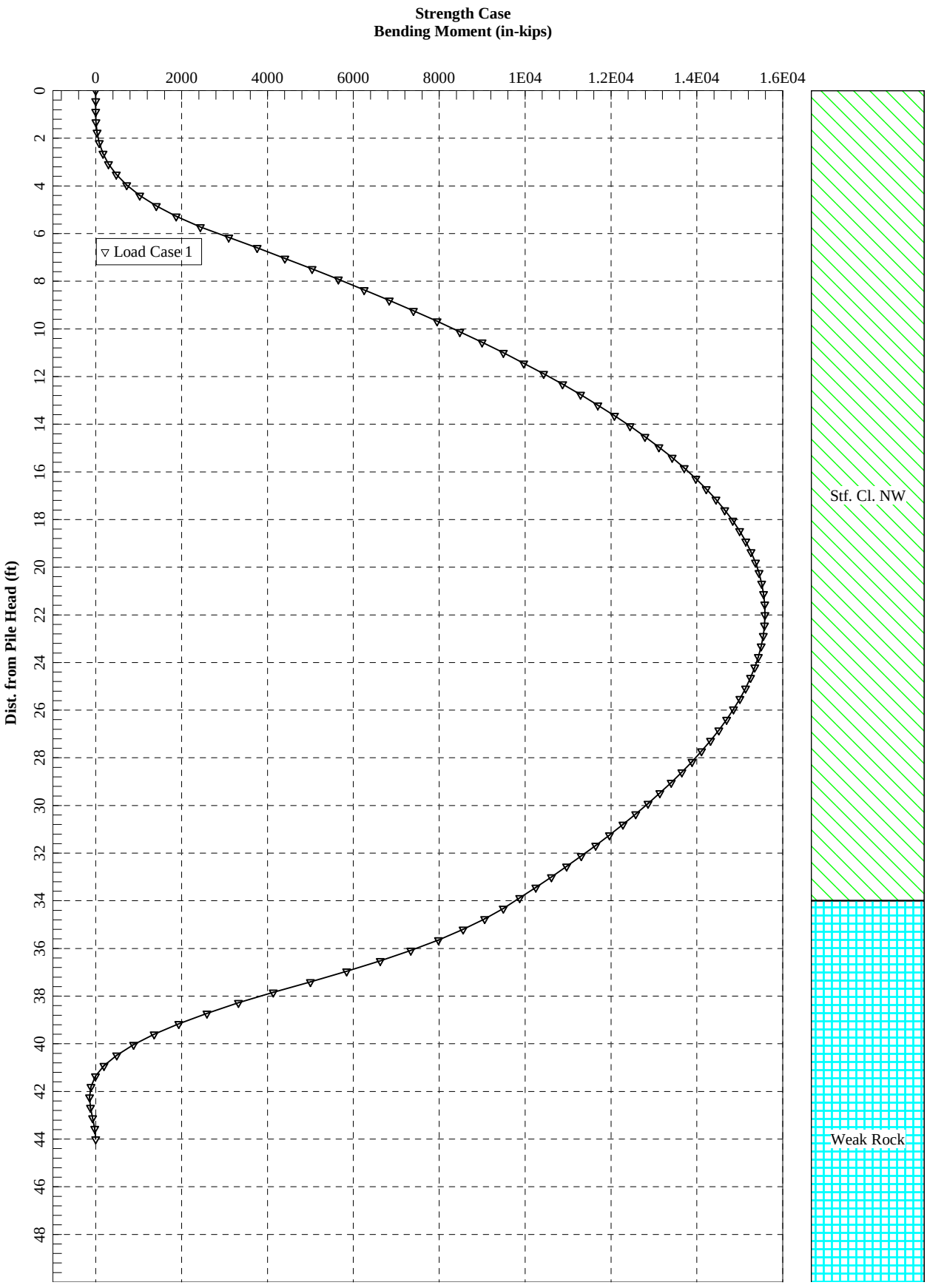
Definitions of Pile-head Loading Conditions:

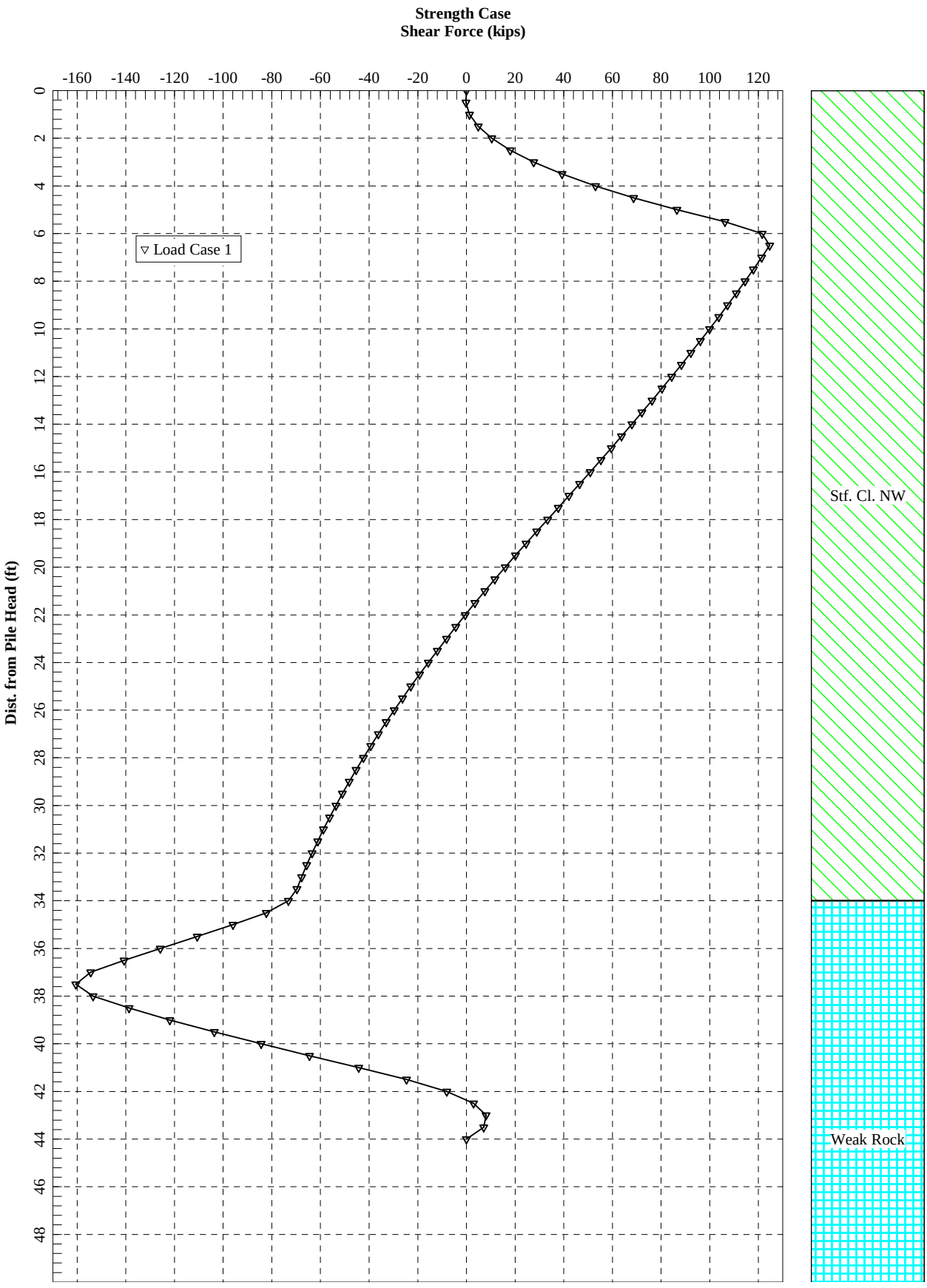
```
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs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

Load Case	Load Type	Pile-head Load 1	Load Type	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	0.00	M, in-lb	0.00	0.00	1.9735	-0.00826	78876.	8438907.

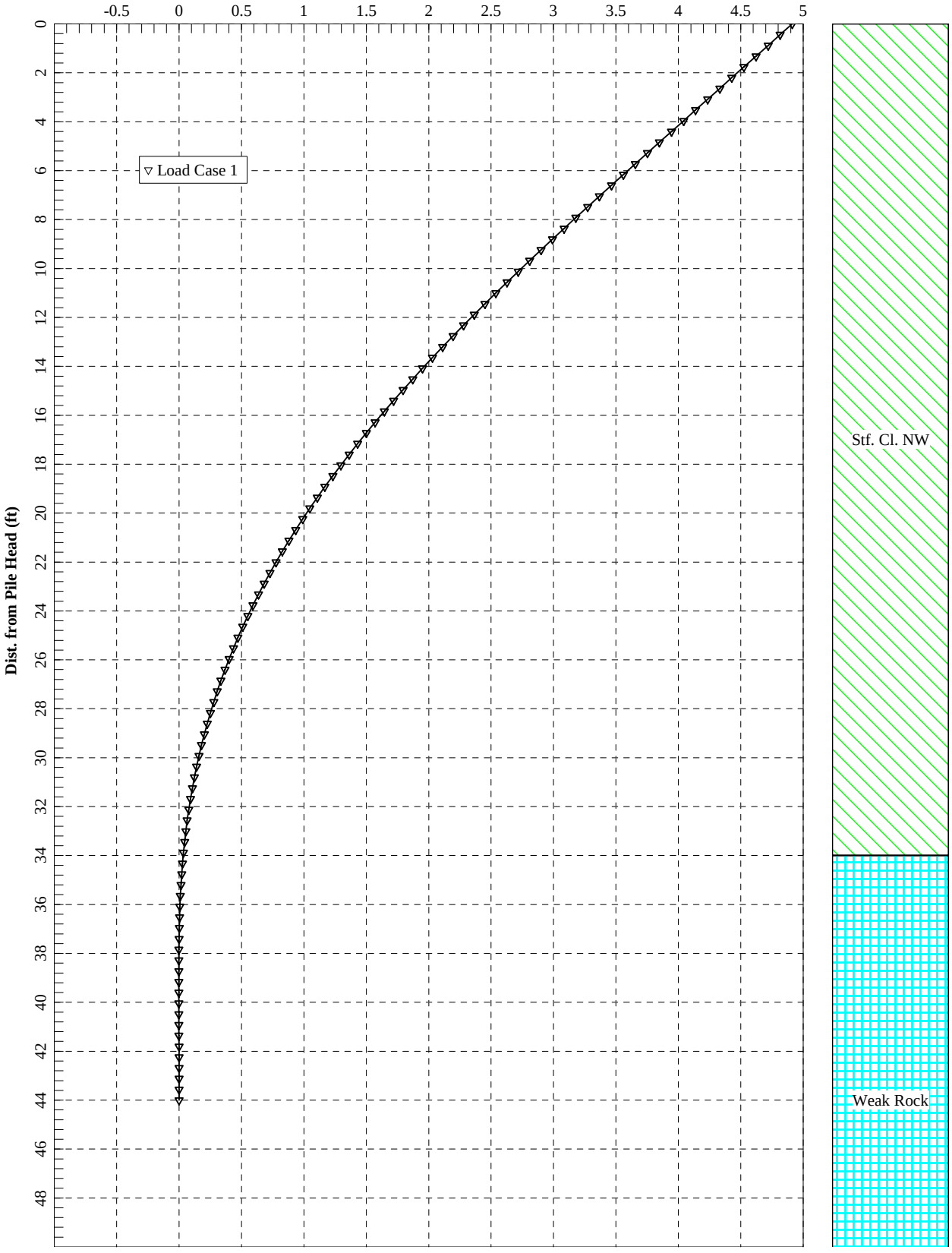
Maximum pile-head deflection = 1.9734673761 inches
Maximum pile-head rotation = -0.0082649591 radians = -0.473547 deg.

The analysis ended normally.


Strength Case
Bending Moment (in-kips)
0
2000
4000
6000
8000
1E04
1.2E04
1.4E04
1.6E04
Dist. from Pile Head (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Load Case 1
Stf. Cl. NW
Weak Rock


Strength Case
Shear Force (kips)
-160 -140 -120 -100 -80 -60 -40 -20 0 20 40 60 80 100 120
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Dist. from Pile Head (ft)
Load Case 1
Stf. Cl. NW
Weak Rock

Geotechnical Overturning Resistance_Strength Case
Lateral Pile Deflection (inches)



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LPile for Version 2022-12.012

License ID : 357343918
License Type : (Single User License)

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

This software is licensed for exclusive use by:
S&ME, Inc. (OH)
Cincinnati, OH, USA

==========

This model was prepared by:
Sudip Khadka

Files Used for Analysis

Path to file locations:
\Cincinnati-1178\Projects\2024\24780173_Stantec_HAM-275-11.40 Landslide_Cincinnati OH\GEO\Project Docs\Calcs\Slope Stability\

Name of input data file:
Wall Design_Strength.lp12d

Name of output report file:
Wall Design_Strength.lp12o

Name of plot output file:
Wall Design_Strength.lp12p

Name of runtime message file:
Wall Design_Strength.lp12r

Date and Time of Analysis

Date: September 8, 2025 Time: 11:21:50

Problem Title

Project Name: HAM-275-11.40 Landslide

Job Number: 24780173

Client: Stantec

Engineer: SBK

Description: Soldier Pile Cantilever Wall Design

Program Options and Settings

Computational Options:
- 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

- Analysis uses p-y modification factors for p-y curves
- 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
- p-y curves computed and reported at user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 44.000 ft
Depth of ground surface below top of pile = 0.0000 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	36.0000
2	44.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a drilled shaft with casing and AISC section core/insert
Length of section = 44.000000 ft
Section Diameter = 36.000000 in

Core/Insert AISC Section Type = W

Core/Insert AISC Section Name = W24X176

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer	=	0.0000 ft
Distance from top of pile to bottom of layer	=	34.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Undrained cohesion at top of layer	=	750.000000 psf
Undrained cohesion at bottom of layer	=	750.000000 psf
Epsilon-50 at top of layer	=	0.010000
Epsilon-50 at bottom of layer	=	0.010000

Layer 2 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	34.000000 ft
Distance from top of pile to bottom of layer	=	54.000000 ft
Effective unit weight at top of layer	=	138.000000 pcf
Effective unit weight at bottom of layer	=	138.000000 pcf
Uniaxial compressive strength at top of layer	=	110.000000 psi
Uniaxial compressive strength at bottom of layer	=	110.000000 psi
Initial modulus of rock at top of layer	=	9900. psi
Initial modulus of rock at bottom of layer	=	9900. psi
RQD of rock at top of layer	=	26.000000 %
RQD of rock at bottom of layer	=	26.000000 %
k rm of rock at top of layer	=	0.0005000
k rm of rock at bottom of layer	=	0.0005000

(Depth of the lowest soil layer extends 10.000 ft below the pile tip)

Summary of Input Soil Properties

Layer Num.	Soil Type Name or (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Cohesion psf	Uniaxial qu psi	RQD %	E50 or krm	Rock Mass Modulus psi
1	Stiff Clay w/o Free Water	0.00	120.0000	750.0000	--	--	0.01000	--
		34.0000	120.0000	750.0000	--	--	0.01000	--
2	Weak Rock	34.0000	138.0000	--	110.0000	26.0000	5.00E-04	9900.
		54.0000	138.0000	--	110.0000	26.0000	5.00E-04	9900.

Modification Factors for p-y Curves

Distribution of p-y modifiers with depth defined using 4 points

Point No.	Depth X ft	p-mult	y-mult
1	0.000	0.8100	1.0000
2	34.000	0.8100	1.0000
3	34.010	1.0000	1.0000
4	44.000	1.0000	1.0000

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

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	95.000
2	6.000	4345.000

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	1	V = 0.0000 lbs	M = 0.0000 in-lbs	0.0000000	Yes	Yes

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.

Specified Depths for Output of p-y Curves

Lateral load-transfer (p-y) curves are computed and output at 2 depths.
(Note that load-transfer values are computeded at the specified depths and may differ from values computed at nodal points)

Depth No.	Depth Below Pile Head ft	Depth Below Ground Surface ft

1	0.000	0.000
2	44.000	44.000

Depth of ground surface below top of pile = 0.0000 ft

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 Drilled Shaft (Bored Pile) with Casing and AISC Strong Axis Core/Insert:

Length of Section	=	44.000000 ft
Outside Diameter of Casing	=	36.000000 in
Casing Wall Thickness	=	0.0000 in
Moment of Inertia of Steel Casing	=	0.0000 in^4
Width Flange of Core/Insert	=	12.900000 in
Depth of Core/Insert	=	25.200000 in
Flange Thickness of Core/Insert	=	1.340000 in
Web Thickness of Core/Insert	=	0.750000 in
Moment of Inertia of Steel Core/Insert	=	5680. in^4
Yield Stress of Casing	=	50000. psi
Elastic Modulus of Casing	=	29000000. psi
Yield Stress of Core/Insert	=	50000. psi
Elastic Modulus of Core/Insert	=	29000000. psi
Number of Reinforcing Bars	=	0 bars
Gross Area of Pile	=	1018. sq. in.
Area of Concrete	=	966.414020 sq. in.
Cross-sectional Area of Steel Casing	=	0.0000 sq. in.
Cross-sectional Area of Steel Core/Insert	=	51.700000 sq. in.
Area of All Steel (Casing, Core/Insert, and Bars)	=	51.462000 sq. in.
Area Ratio of All Steel to Gross Area	=	5.06 percent

Note that the core is assumed to be void of concrete.

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	5869.998 kips

Tensile Load for Cracking of Concrete = -574.817 kips
Nominal Axial Tensile Capacity = -2585.000 kips

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.34165 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

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

Number	Axial Thrust Force kips
1	0.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318-14, Section 21.2.3.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 0.000 kips

Bending Max Conc Curvature Stress rad/in. ksi	Bending Max Steel Moment Stress in-kip ksi	Bending Max Casing Stiffness Stress kip-in2 ksi	Depth to Max Core N Axis Stress in ksi	Run Msg	Max Comp Strain in/in	Max Tens Strain in/in

```
------------ ------------ ------------ ------------ ---
 6.25000E-07  305.3064333   488490293.   18.0000000   0.00001125  -0.00001125
  0.0470966      0.00000      0.00000    -0.231637
  0.00000125  609.7844438   487827555.   18.0000000   0.00002250  -0.00002250
  0.0939143      0.00000      0.00000    -0.463275
  0.00000188  913.4340317   487164817.   18.0000000   0.00003375  -0.00003375
  0.1404531      0.00000      0.00000    -0.694912
  0.00000250       1216.    486502079.   18.0000000   0.00004500  -0.00004500
  0.1867130      0.00000      0.00000    -0.926550
  0.00000313       1518.    485839341.   18.0000000   0.00005625  -0.00005625
  0.2326940      0.00000      0.00000    -1.158187
  0.00000375       1819.    485176602.   18.0000000   0.00006750  -0.00006750
  0.2783960      0.00000      0.00000    -1.389825
  0.00000438       2120.    484513864.   18.0000000   0.00007875  -0.00007875
  0.3238192      0.00000      0.00000    -1.621462
  0.00000500       2419.    483851126.   18.0000000   0.00009000  -0.00009000
  0.3689635      0.00000      0.00000    -1.853100
  0.00000563       2718.    483188388.   18.0000000    0.0001012    -0.000101
  0.4138288      0.00000      0.00000    -2.084737
  0.00000625       3016.    482525650.   18.0000000    0.0001125    -0.000113
  0.4584153      0.00000      0.00000    -2.316375
  0.00000688       3016.    438659682.   13.1919941   0.00009069    -0.000157
  0.3704078      0.00000      0.00000    -3.506609 C
  0.00000750       3016.    402104708.   13.1953144   0.00009896    -0.000171
  0.4032891      0.00000      0.00000    -3.824669 C
  0.00000813       3016.    371173577.   13.1986404    0.0001072    -0.000185
  0.4360376      0.00000      0.00000    -4.142608 C
  0.00000875       3016.    344661179.   13.2019722    0.0001155    -0.000199
  0.4686532      0.00000      0.00000    -4.460425 C
  0.00000938       3016.    321683767.   13.2053097    0.0001238    -0.000214
  0.5011355      0.00000      0.00000    -4.778119 C
  0.00001000       3016.    301578531.   13.2086530    0.0001321    -0.000228
  0.5334844      0.00000      0.00000    -5.095691 C
  0.00001063       3016.    283838618.   13.2120020    0.0001404    -0.000242
  0.5656998      0.00000      0.00000    -5.413139 C
  0.00001125       3016.    268069806.   13.2153569    0.0001487    -0.000256
  0.5977814      0.00000      0.00000    -5.730465 C
  0.00001188       3016.    253960868.   13.2187176    0.0001570    -0.000271
  0.6297291      0.00000      0.00000    -6.047667 C
  0.00001250       3158.    252660641.   13.2220841    0.0001653    -0.000285
  0.6615426      0.00000      0.00000    -6.364744 C
  0.00001313       3315.    252574361.   13.2254565    0.0001736    -0.000299
  0.6932218      0.00000      0.00000    -6.681698 C
  0.00001375       3472.    252487952.   13.2288349    0.0001819    -0.000313
  0.7247664      0.00000      0.00000    -6.998527 C
  0.00001438       3628.    252401414.   13.2322191    0.0001902    -0.000327
  0.7561763      0.00000      0.00000    -7.315231 C
  0.00001500       3785.    252314745.   13.2356092    0.0001985    -0.000341
  0.7874513      0.00000      0.00000    -7.631810 C
  0.00001563       3941.    252227946.   13.2390053    0.0002069    -0.000356
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0.8185912       0.00000       0.00000     -7.948263 C
0.00001625         4097.    252141016.     13.2424074     0.0002152     -0.000370
0.8495957       0.00000       0.00000     -8.264590 C
0.00001688         4253.    252053954.     13.2458155     0.0002235     -0.000384
0.8804648       0.00000       0.00000     -8.580792 C
0.00001750         4409.    251966760.     13.2492296     0.0002319     -0.000398
0.9111981       0.00000       0.00000     -8.896866 C
0.00001813         4565.    251879434.     13.2526497     0.0002402     -0.000412
0.9417956       0.00000       0.00000     -9.212813 C
0.00001875         4721.    251791975.     13.2560759     0.0002486     -0.000426
0.9722569       0.00000       0.00000     -9.528634 C
0.00001938         4877.    251704383.     13.2595082     0.0002569     -0.000441
1.0025819       0.00000       0.00000     -9.844326 C
0.00002000         5032.    251616658.     13.2629466     0.0002653     -0.000455
1.0327704       0.00000       0.00000    -10.159891 C
0.00002063         5188.    251528798.     13.2663911     0.0002736     -0.000469
1.0628222       0.00000       0.00000    -10.475327 C
0.00002125         5343.    251440803.     13.2698418     0.0002820     -0.000483
1.0927370       0.00000       0.00000    -10.790635 C
0.00002188         5498.    251352674.     13.2732986     0.0002904     -0.000497
1.1225148       0.00000       0.00000    -11.105814 C
0.00002250         5653.    251264409.     13.2767617     0.0002987     -0.000511
1.1521552       0.00000       0.00000    -11.420863 C
0.00002313         5808.    251176008.     13.2802309     0.0003071     -0.000525
1.1816581       0.00000       0.00000    -11.735783 C
0.00002375         5963.    251087471.     13.2837064     0.0003155     -0.000540
1.2110233       0.00000       0.00000    -12.050572 C
0.00002438         6118.    250998797.     13.2871882     0.0003239     -0.000554
1.2402505       0.00000       0.00000    -12.365231 C
0.00002563         6427.    250821036.     13.2941706     0.0003407     -0.000582
1.2982903       0.00000       0.00000    -12.994157 C
0.00002688         6736.    250642723.     13.3011784     0.0003575     -0.000610
1.3557758       0.00000       0.00000    -13.622557 C
0.00002813         7044.    250463852.     13.3082117     0.0003743     -0.000638
1.4127053       0.00000       0.00000    -14.250427 C
0.00002938         7352.    250284421.     13.3152707     0.0003911     -0.000666
1.4690772       0.00000       0.00000    -14.877766 C
0.00003063         7659.    250104425.     13.3223556     0.0004080     -0.000695
1.5248897       0.00000       0.00000    -15.504570 C
0.00003188         7966.    249923861.     13.3294666     0.0004249     -0.000723
1.5801412       0.00000       0.00000    -16.130837 C
0.00003313         8273.    249742724.     13.3366039     0.0004418     -0.000751
1.6348297       0.00000       0.00000    -16.756562 C
0.00003438         8579.    249561011.     13.3437677     0.0004587     -0.000779
1.6889537       0.00000       0.00000    -17.381744 C
0.00003563         8884.    249378717.     13.3509583     0.0004756     -0.000807
1.7425113       0.00000       0.00000    -18.006379 C
0.00003688         9189.    249195839.     13.3581757     0.0004926     -0.000835
1.7955007       0.00000       0.00000    -18.630463 C
0.00003813         9494.    249012372.     13.3654203     0.0005096     -0.000863
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1.8479202 0.00000 0.00000 -19.253995 C
0.00003938 9798. 248828312. 13.3726922 0.0005265 -0.000891
1.8997679 0.00000 0.00000 -19.876970 C
0.00004063 10101. 248643655. 13.3799916 0.0005436 -0.000919
1.9510420 0.00000 0.00000 -20.499385 C
0.00004188 10404. 248458396. 13.3873187 0.0005606 -0.000947
2.0017406 0.00000 0.00000 -21.121237 C
0.00004313 10707. 248272532. 13.3946739 0.0005776 -0.000975
2.0518619 0.00000 0.00000 -21.742523 C
0.00004438 11009. 248086057. 13.4020572 0.0005947 -0.001003
2.1014040 0.00000 0.00000 -22.363240 C
0.00004563 11310. 247898968. 13.4094689 0.0006118 -0.001031
2.1503649 0.00000 0.00000 -22.983384 C
0.00004688 11611. 247711260. 13.4169092 0.0006289 -0.001059
2.1987429 0.00000 0.00000 -23.602951 C
0.00004813 11912. 247522928. 13.4243784 0.0006460 -0.001086
2.2465359 0.00000 0.00000 -24.221939 C
0.00004938 12212. 247333968. 13.4318767 0.0006632 -0.001114
2.2937420 0.00000 0.00000 -24.840344 C
0.00005063 12512. 247144375. 13.4394043 0.0006804 -0.001142
2.3403592 0.00000 0.00000 -25.458162 C
0.00005188 12811. 246954144. 13.4469615 0.0006976 -0.001170
2.3863856 0.00000 0.00000 -26.075390 C
0.00005313 13109. 246763271. 13.4545484 0.0007148 -0.001198
2.4318191 0.00000 0.00000 -26.692024 C
0.00005438 13407. 246571751. 13.4621474 0.0007320 -0.001225
2.4766578 0.00000 0.00000 -27.308060 C
0.00005563 13705. 246379579. 13.4697211 0.0007493 -0.001253
2.5208995 0.00000 0.00000 -27.923496 C
0.00005688 14002. 246186750. 13.4773250 0.0007665 -0.001281
2.5645423 0.00000 0.00000 -28.538327 C
0.00005813 14298. 245993259. 13.4849594 0.0007838 -0.001309
2.6075841 0.00000 0.00000 -29.152549 C
0.00005938 14594. 245799101. 13.4926246 0.0008011 -0.001336
2.6500227 0.00000 0.00000 -29.766159 C
0.00006063 14890. 245604284. 13.5006954 0.0008185 -0.001364
2.6918540 0.00000 0.00000 -30.379177 C
0.00006188 15185. 245408935. 13.5079646 0.0008358 -0.001392
2.7330573 0.00000 0.00000 -30.991827 C
0.00006313 15479. 245212918. 13.5156462 0.0008532 -0.001419
2.7736507 0.00000 0.00000 -31.603866 C
0.00006438 15773. 245016227. 13.5233589 0.0008706 -0.001447
2.8136322 0.00000 0.00000 -32.215291 C
0.00006563 16066. 244818859. 13.5311031 0.0008880 -0.001475
2.8529994 0.00000 0.00000 -32.826097 C
0.00006688 16359. 244620806. 13.5388788 0.0009054 -0.001502
2.8917503 0.00000 0.00000 -33.436282 C
0.00006813 16651. 244422065. 13.5466864 0.0009229 -0.001530
2.9298827 0.00000 0.00000 -34.045840 C
0.00006938 16943. 244222630. 13.5545262 0.0009403 -0.001557

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2.9673943       0.00000       0.00000    -34.654769 C
0.00007063        17234.    244022495.     13.5623984     0.0009578     -0.001585
3.0042829       0.00000       0.00000    -35.263063 C
0.00007188        17525.    243821654.     13.5703032     0.0009754     -0.001612
3.0405463       0.00000       0.00000    -35.870720 C
0.00007313        17815.    243620104.     13.5782410     0.0009929     -0.001640
3.0761822       0.00000       0.00000    -36.477734 C
0.00007438        18104.    243417837.     13.5862120     0.0010105     -0.001667
3.1111883       0.00000       0.00000    -37.084102 C
0.00007938        19256.    242601492.     13.6184337     0.0010810     -0.001777
3.2448675       0.00000       0.00000    -39.503027 C
0.00008438        20400.    241773218.     13.6515139     0.0011518     -0.001886
3.3682797       0.00000       0.00000    -41.911265 C
0.00008938        21533.    240932623.     13.6848374     0.0012231     -0.001994
3.4812663       0.00000       0.00000    -44.308525 C
0.00009438        22657.    240079289.     13.7187524     0.0012947     -0.002103
3.5836620       0.00000       0.00000    -46.694502 C
0.00009938        23772.    239212774.     13.7532810     0.0013667     -0.002211
3.6752947       0.00000       0.00000    -49.068876 C
 0.0001044        24849.    238077026.     13.7818931     0.0014385     -0.002319
3.7552674       0.00000       0.00000    -50.000000 CY
 0.0001094        25579.    233867998.     13.7302623     0.0015017     -0.002436
3.8163176       0.00000       0.00000    -50.000000 CY
 0.0001144        25950.    226882748.     13.6008637     0.0015556     -0.002562
3.8612898       0.00000       0.00000    -50.000000 CY
 0.0001194        26260.    219977498.     13.4695783     0.0016079     -0.002690
3.8989363       0.00000       0.00000    -50.000000 CY
 0.0001244        26541.    213392170.     13.3415166     0.0016594     -0.002818
3.9301251       0.00000       0.00000    -50.000000 CY
 0.0001294        26798.    207131194.     13.2193323     0.0017103     -0.002947
3.9553422       0.00000       0.00000    -50.000000 CY
 0.0001344        27033.    201177100.     13.1018021     0.0017606     -0.003077
3.9747376       0.00000       0.00000    -50.000000 CY
 0.0001394        27249.    195511496.     12.9876859     0.0018102     -0.003207
3.9884865       0.00000       0.00000    -50.000000 CY
 0.0001444        27448.    190116838.     12.8782452     0.0018593     -0.003338
3.9968522       0.00000       0.00000    -50.000000 CY
 0.0001494        27633.    184992928.     12.7746948     0.0019082     -0.003469
3.9999726       0.00000       0.00000    -50.000000 CY
 0.0001544        27802.    180092641.     12.6723644     0.0019563     -0.003601
3.9998000       0.00000       0.00000    -50.000000 CY
 0.0001594        27959.    175426189.     12.5748270     0.0020041     -0.003733
3.9992640       0.00000       0.00000    -50.000000 CY
 0.0001644        28105.    170979667.     12.4819144     0.0020517     -0.003866
3.9980485       0.00000       0.00000    -50.000000 CY
 0.0001694        28241.    166734946.     12.3923005     0.0020989     -0.003999
3.9999994       0.00000       0.00000    -50.000000 CY
 0.0001744        28366.    162672833.     12.3046526     0.0021456     -0.004132
3.9993984       0.00000       0.00000    -50.000000 CY
 0.0001794        28483.    158792794.     12.2207239     0.0021921     -0.004265
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  3.9972632       0.00000       0.00000    -50.000000 CY
   0.0001844        28594.    155083806.     12.1402859     0.0022384     -0.004399
  3.9998112       0.00000       0.00000    -50.000000 CY
   0.0001894        28697.    151535964.     12.0632969     0.0022845     -0.004533
  3.9977318       0.00000       0.00000    -50.000000 CY
   0.0001944        28793.    148130485.     11.9867891     0.0023299     -0.004668
  3.9998597       0.00000       0.00000    -50.000000 CY
   0.0001994        28883.    144868570.     11.9132969     0.0023752     -0.004802
  3.9972601       0.00000       0.00000    -50.000000 CY
   0.0002044        28969.    141744000.     11.8427098     0.0024204     -0.004937
  3.9996467       0.00000       0.00000    -50.000000 CY
   0.0002094        29050.    138746786.     11.7747974     0.0024653     -0.005072
  3.9957327       0.00000       0.00000    -50.000000 CY
   0.0002144        29126.    135866799.     11.7091855     0.0025102     -0.005207
  3.9988421       0.00000       0.00000    -50.000000 CY
   0.0002194        29198.    133096527.     11.6440162     0.0025544     -0.005343
  3.9999888       0.00000       0.00000    -50.000000 CY
   0.0002244        29266.    130434852.     11.5811083     0.0025985     -0.005479
  3.9965841       0.00000       0.00000    -50.000000 CY
   0.0002294        29330.    127869616.     11.5198618     0.0026424     -0.005615
  3.9990955       0.00000       0.00000    -50.000000 CY
   0.0002344        29392.    125405748.     11.4609493     0.0026862     -0.005751
  3.9999969       0.00000       0.00000    -50.000000 CY
   0.0002394        29451.    123032132.     11.4041377     0.0027299     -0.005888
  3.9957835       0.00000       0.00000    -50.000000 CY
   0.0002444        29507.    120744389.     11.3490277     0.0027734     -0.006024
  3.9984949       0.00000       0.00000    -50.000000 CY
   0.0002494        29560.    118536663.     11.2940620     0.0028165     -0.006161
  3.9998257       0.00000       0.00000    -50.000000 CY
   0.0002544        29610.    116401196.     11.2401046     0.0028592     -0.006298
  3.9964279       0.00000       0.00000    -50.000000 CY
   0.0002594        29658.    114344993.     11.1883189     0.0029020     -0.006436
  3.9962034       0.00000       0.00000    -50.000000 CY
   0.0002644        29704.    112354466.     11.1372332     0.0029444     -0.006573
  3.9985196       0.00000       0.00000    -50.000000 CY
   0.0002694        29749.    110436332.     11.0887608     0.0029870     -0.006710
  3.9997653       0.00000       0.00000    -50.000000 CY
   0.0002744        29791.    108577957.     11.0410263     0.0030294     -0.006848
  3.9977431       0.00000       0.00000    -50.000000 CY
   0.0003044        30012.     98600632.     10.7740284     0.0032793     -0.007678
  3.9926677       0.00000       0.00000    -50.000000 CY
   0.0003344        30188.     90283063.     10.5404889     0.0035245     -0.008513
  3.9958795       0.00000       0.00000    -50.000000 CY
   0.0003644        30329.     83234314.     10.3353748     0.0037660     -0.009352
  3.9994381       0.00000       0.00000     50.0000000 CY
   0.0003944        30329.     76902703.     10.2312251     0.0040349     -0.010163
  3.9969666       0.00000       0.00000     50.0000000 CY
```

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain	Max. Tens. Strain
1	0.000	29761.735	0.00300000	-0.00675261

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.75).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318,
or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor	Nominal Ax. Thrust kips	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	0.0000	29762.	0.0000	19345.	242537270.
1	0.75	0.0000	29762.	0.0000	22321.	240334487.
1	0.90	0.0000	29762.	0.0000	26786.	207424499.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	588755.
2	34.0000	34.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

p-y Curves Reported for Specified Depths

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	1
Depth of p-y curve below pile head	=	0.000 ft
Depth of p-y curve below ground surface	=	0.000 ft
Depth of top of layer 1 below pile head	=	0.000 ft
Equiv. depth of p-y curve below ground surface	=	0.000 ft
Pile diameter	=	36.000 in
Undrained cohesion	=	5.208 psi
Undrained cohesion	=	750.000 psf
Average effective unit weight	=	0.06944 pci
Average effective unit weight	=	120.000 pcf
Epsilon-50	=	0.01000
Pct	=	562.500 lb/in
Pcd	=	1687.500 lb/in
Pu	=	562.500 lb/in
y50	=	0.90000 in
p-multiplier	=	0.81000
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00028444	30.37500

0.00455	60.75000
0.02304	91.12500
0.07282	121.50000
0.17778	151.87500
0.36864	182.25000
0.68295	212.62500
1.16508	243.00000
1.86624	273.37500
2.84444	303.75000
4.16455	334.12500
5.89824	364.50000
8.12402	394.87500
10.92722	425.25000
14.40000	455.62500
18.00000	455.62500

p-y Curve Computed Using Weak Rock Criteria

Soil Layer Number	=	2
Depth of top of Layer 2 below pile head	=	34.000 ft
Depth of p-y curve below pile head	=	44.000 ft
Depth of p-y curve below ground surface	=	44.000 ft
Pile diameter	=	36.000 in
Average effective unit weight	=	124.091 pcf
Unconfined compressive strength	=	110.000 psi
Eir	=	9900. psi
RQD	=	26.000 %
k_rm	=	0.00050
Alpha_r	=	0.827
Xr	=	120.000 in
kir	=	500.
Mir	=	4.95000E+06 psi
Yu	=	1.35000 in
Yrm	=	0.01800 in
Y_A	=	7.87427E-04 in
Pu	=	17022.720 lb/in
p-multiplier	=	1.00000
y-multiplier	=	1.00000

y, inches	p, lbs/in
0.00000	0.00000
0.00078743	3892.54296
0.00653	6605.97664
0.01228	7734.71711
0.01802	8513.74471

0.02376	9123.52565
0.02951	9630.93153
0.05823	11414.77676
0.08695	12618.26743
0.11567	13551.52976
0.14439	14324.11850
0.17311	14988.71806
0.20184	15575.09177
0.23056	16101.84495
0.25928	16581.45214
0.28800	17022.72000
0.36000	17022.72000

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	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*H	Soil Spr. p	Distrib. Lat. Load
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	lb/inch	lb/inch	lb/inch
0.00	4.9123	-7.78E-05	0.00	-0.01832	0.00	4.88E+11	-348.208	187.1355	172.9167
0.4400	4.8156	-2443.	-347.704	-0.01832	0.00	4.88E+11	-363.081	398.0970	406.6667
0.8800	4.7188	-3672.	666.4732	-0.01832	0.00	4.88E+11	-377.760	422.6826	718.3333
1.3200	4.6221	4595.	3249.	-0.01832	0.00	4.88E+11	-392.240	448.0699	1030.
1.7600	4.5254	30641.	7402.	-0.01832	0.00	4.88E+11	-406.516	474.3043	1342.
2.2000	4.4286	82757.	13125.	-0.01832	0.00	4.88E+11	-420.582	501.4349	1653.
2.6400	4.3319	169241.	20420.	-0.01832	0.00	4.88E+11			

-434.433 529.5145 1965.
  3.0800 4.2352 298394. 29288. -0.01832 0.00 4.88E+11
-448.064 558.6000 2277.
  3.5200 4.1385 478526. 39731. -0.01831 0.00 4.88E+11
-461.467 588.7531 2588.
  3.9600 4.0418 717952. 51749. -0.01831 0.00 4.88E+11
-474.637 620.0403 2900.
  4.4000 3.9452 1024992. 65343. -0.01830 0.00 4.87E+11
-487.567 652.5333 3212.
  4.8400 3.8486 1407977. 80516. -0.01828 0.00 4.86E+11
-500.251 686.3095 3523.
  5.2800 3.7521 1875240. 97268. -0.01827 0.00 4.85E+11
-512.682 721.4525 3835.
  5.7200 3.6557 2435124. 115600. -0.01824 0.00 4.84E+11
-524.852 758.0525 4147.
  6.1600 3.5595 3095978. 125301. -0.01820 0.00 2.53E+11
-536.755 796.2067 589.6023
  6.6000 3.4636 3758306. 123993. -0.01812 0.00 2.52E+11
-548.390 835.9904 0.00
  7.0400 3.3681 4405345. 121068. -0.01804 0.00 2.52E+11
-559.751 877.5034 0.00
  7.4800 3.2731 5036780. 118083. -0.01794 0.00 2.52E+11
-570.834 920.8527 0.00
  7.9200 3.1786 5652300. 115040. -0.01783 0.00 2.51E+11
-581.634 966.1532 0.00
  8.3600 3.0848 6251605. 111942. -0.01770 0.00 2.51E+11
-592.145 1014. 0.00
  8.8000 2.9917 6834403. 108788. -0.01757 0.00 2.51E+11
-602.362 1063. 0.00
  9.2400 2.8993 7400407. 105581. -0.01742 0.00 2.50E+11
-612.281 1115. 0.00
  9.6800 2.8078 7949342. 102323. -0.01725 0.00 2.50E+11
-621.895 1169. 0.00
 10.1200 2.7171 8480940. 99015. -0.01708 0.00 2.50E+11
-631.201 1227. 0.00
 10.5600 2.6274 8994941. 95659. -0.01689 0.00 2.49E+11
-640.193 1287. 0.00
 11.0000 2.5387 9491094. 92255. -0.01670 0.00 2.49E+11
-648.865 1350. 0.00
 11.4400 2.4511 9969158. 88807. -0.01649 0.00 2.49E+11
-657.212 1416. 0.00
 11.8800 2.3645 1.04E+07 85316. -0.01628 0.00 2.48E+11
-665.230 1485. 0.00
 12.3200 2.2792 1.09E+07 81783. -0.01605 0.00 2.48E+11
-672.913 1559. 0.00
 12.7600 2.1951 1.13E+07 78211. -0.01581 0.00 2.48E+11
-680.256 1636. 0.00
 13.2000 2.1122 1.17E+07 74601. -0.01557 0.00 2.48E+11
-687.253 1718. 0.00
 13.6400 2.0307 1.21E+07 70955. -0.01531 0.00 2.47E+11

-693.899	1804.	0.00				
14.0800	1.9505	1.24E+07	67274.	-0.01505	0.00	2.47E+11
-700.189	1895.	0.00				
14.5200	1.8717	1.28E+07	63562.	-0.01478	0.00	2.47E+11
-706.116	1992.	0.00				
14.9600	1.7944	1.31E+07	59819.	-0.01451	0.00	2.47E+11
-711.677	2094.	0.00				
15.4000	1.7185	1.34E+07	56047.	-0.01422	0.00	2.47E+11
-716.864	2202.	0.00				
15.8400	1.6442	1.37E+07	52250.	-0.01393	0.00	2.46E+11
-721.672	2318.	0.00				
16.2800	1.5714	1.40E+07	48427.	-0.01363	0.00	2.46E+11
-726.096	2440.	0.00				
16.7200	1.5002	1.42E+07	44583.	-0.01333	0.00	2.46E+11
-730.130	2570.	0.00				
17.1600	1.4306	1.44E+07	40718.	-0.01302	0.00	2.46E+11
-733.767	2708.	0.00				
17.6000	1.3627	1.46E+07	36835.	-0.01271	0.00	2.46E+11
-737.002	2856.	0.00				
18.0400	1.2964	1.48E+07	32937.	-0.01240	0.00	2.46E+11
-739.827	3013.	0.00				
18.4800	1.2318	1.50E+07	29032.	-0.01207	0.00	2.46E+11
-739.215	3169.	0.00				
18.9200	1.1689	1.51E+07	25154.	-0.01175	0.00	2.45E+11
-729.592	3296.	0.00				
19.3600	1.1077	1.53E+07	21328.	-0.01142	0.00	2.45E+11
-719.851	3431.	0.00				
19.8000	1.0482	1.54E+07	17553.	-0.01109	0.00	2.45E+11
-709.991	3576.	0.00				
20.2400	0.9905	1.54E+07	13831.	-0.01076	0.00	2.45E+11
-700.012	3731.	0.00				
20.6800	0.9346	1.55E+07	10161.	-0.01043	0.00	2.45E+11
-689.911	3898.	0.00				
21.1200	0.8804	1.56E+07	6545.	-0.01009	0.00	2.45E+11
-679.686	4076.	0.00				
21.5600	0.8280	1.56E+07	2984.	-0.00976	0.00	2.45E+11
-669.336	4268.	0.00				
22.0000	0.7773	1.56E+07	-522.419	-0.00942	0.00	2.45E+11
-658.858	4475.	0.00				
22.4400	0.7285	1.56E+07	-3973.	-0.00909	0.00	2.45E+11
-648.249	4699.	0.00				
22.8800	0.6814	1.55E+07	-7368.	-0.00875	0.00	2.45E+11
-637.507	4940.	0.00				
23.3200	0.6360	1.55E+07	-10705.	-0.00842	0.00	2.45E+11
-626.629	5202.	0.00				
23.7600	0.5925	1.54E+07	-13984.	-0.00809	0.00	2.45E+11
-615.611	5486.	0.00				
24.2000	0.5507	1.53E+07	-17205.	-0.00775	0.00	2.45E+11
-604.449	5796.	0.00				
24.6400	0.5106	1.53E+07	-20367.	-0.00742	0.00	2.45E+11

```
-593.140      6134.       0.00
   25.0800     0.4723   1.51E+07    -23469.   -0.00710       0.00   2.45E+11
-581.678      6503.       0.00
   25.5200     0.4356   1.50E+07    -26509.   -0.00677       0.00   2.46E+11
-570.059      6909.       0.00
   25.9600     0.4007   1.49E+07    -29488.   -0.00645       0.00   2.46E+11
-558.277      7356.       0.00
   26.4000     0.3675   1.47E+07    -32404.   -0.00614       0.00   2.46E+11
-546.325      7849.       0.00
   26.8400     0.3359   1.45E+07    -35257.   -0.00582       0.00   2.46E+11
-534.197      8396.       0.00
   27.2800     0.3060   1.43E+07    -38045.   -0.00551       0.00   2.46E+11
-521.885      9005.       0.00
   27.7200     0.2777   1.41E+07    -40767.   -0.00521       0.00   2.46E+11
-509.379      9684.       0.00
   28.1600     0.2510   1.39E+07    -43423.   -0.00491       0.00   2.46E+11
-496.671     10447.       0.00
   28.6000     0.2259   1.37E+07    -46012.   -0.00461       0.00   2.46E+11
-483.749     11307.       0.00
   29.0400     0.2023   1.34E+07    -48531.   -0.00432       0.00   2.47E+11
-470.600     12281.       0.00
   29.4800     0.1803   1.31E+07    -50980.   -0.00404       0.00   2.47E+11
-457.211     13392.       0.00
   29.9200     0.1597   1.29E+07    -53358.   -0.00376       0.00   2.47E+11
-443.563     14666.       0.00
   30.3600     0.1406   1.26E+07    -55664.   -0.00349       0.00   2.47E+11
-429.640     16139.       0.00
   30.8000     0.1229   1.23E+07    -57895.   -0.00322       0.00   2.47E+11
-415.419     17854.       0.00
   31.2400     0.1065   1.20E+07    -60050.   -0.00296       0.00   2.47E+11
-400.875     19869.       0.00
   31.6800    0.09156   1.16E+07    -62127.   -0.00271       0.00   2.48E+11
-385.977     22259.       0.00
   32.1200    0.07789   1.13E+07    -64125.   -0.00247       0.00   2.48E+11
-370.691     25128.       0.00
   32.5600    0.06550   1.10E+07    -66040.   -0.00223       0.00   2.48E+11
-354.976     28615.       0.00
   33.0000    0.05434   1.06E+07    -67872.   -0.00200       0.00   2.48E+11
-338.780     32918.       0.00
   33.4400    0.04437   1.02E+07    -69616.   -0.00178       0.00   2.49E+11
-322.041     38323.       0.00
   33.8800    0.03555   9876509.    -71271.   -0.00157       0.00   2.49E+11
-304.684     45253.       0.00
   34.3200    0.02784   9495951.    -77614.   -0.00136       0.00   2.49E+11
-2098.    397915.       0.00
   34.7600    0.02119   9056907.    -89249.   -0.00116       0.00   2.49E+11
-2310.    575557.       0.00
   35.2000    0.01555   8553477.   -101846.  -9.77E-04       0.00   2.50E+11
-2462.    835854.       0.00
   35.6400    0.01087   7981417.   -115069.  -8.02E-04       0.00   2.50E+11
```

```
-2547.   1237362.       0.00
   36.0800    0.00708   7338347.   -128537.  -6.41E-04       0.00   2.50E+11
-2554.   1905444.       0.00
   36.5200    0.00410   6624068.   -141778.  -4.93E-04       0.00   2.51E+11
-2461.   3166276.       0.00
   36.9600    0.00187   5841174.   -154115.  -3.62E-04       0.00   2.51E+11
-2212.   6255421.       0.00
   37.4000   2.78E-04   4996611.   -161782.  -2.48E-04       0.00   2.52E+11
-692.052   1.31E+07       0.00
   37.8400  -7.57E-04   4132755.   -158255.  -1.53E-04       0.00   2.52E+11
2028.   1.41E+07       0.00
   38.2800   -0.00134   3325435.   -146143.  -7.47E-05       0.00   2.53E+11
2560.   1.01E+07       0.00
   38.7200   -0.00155   2589489.   -131891.  -2.58E-05       0.00   4.83E+11
2838.   9691379.       0.00
   39.1600   -0.00161   1932661.   -116348.  -1.19E-06       0.00   4.85E+11
3050.   1.00E+07       0.00
   39.6000   -0.00156   1360851.    -99827.   1.67E-05       0.00   4.86E+11
3208.   1.09E+07       0.00
   40.0400   -0.00143    878483.    -82595.   2.89E-05       0.00   4.87E+11
3319.   1.22E+07       0.00
   40.4800   -0.00125    488647.    -64900.   3.63E-05       0.00   4.88E+11
3384.   1.43E+07       0.00
   40.9200   -0.00105    193142.    -46989.   4.00E-05       0.00   4.88E+11
3401.   1.71E+07       0.00
   41.3600  -8.32E-04     -7559.    -29127.   4.10E-05       0.00   4.88E+11
3365.   2.14E+07       0.00
   41.8000  -6.16E-04   -114440.    -13057.   4.03E-05       0.00   4.88E+11
2722.   2.33E+07       0.00
   42.2400  -4.06E-04   -145437.   -923.897   3.89E-05       0.00   4.88E+11
1874.   2.44E+07       0.00
   42.6800  -2.05E-04   -124196.      6622.   3.74E-05       0.00   4.88E+11
984.3961   2.54E+07       0.00
   43.1200  -1.05E-05    -75512.      9358.   3.64E-05       0.00   4.88E+11
51.9718   2.61E+07       0.00
   43.5600   1.79E-04    -25379.      7151.   3.58E-05       0.00   4.88E+11
-887.941   2.61E+07       0.00
   44.0000   3.68E-04       0.00       0.00   3.57E-05       0.00   4.88E+11
-1821.   1.31E+07       0.00

* This analysis computed pile response using nonlinear moment-curvature rela-
  tionships. Values of total stress due to combined axial and bending stresses
  are computed only for elastic sections only and do not equal the actual
  stresses in concrete and steel. Stresses in concrete and steel may be inter-
  polated from the output for nonlinear bending properties relative to the
  magnitude of bending moment developed in the pile.


Output Summary for Load Case No. 1:
```

```
Pile-head deflection             =     4.91232163 inches
Computed slope at pile head      =     -0.0183214 radians
Maximum bending moment           =      15587345. inch-lbs
Maximum shear force              =       -161782. lbs
Depth of maximum bending moment  =    22.00000000 feet below pile head
Depth of maximum shear force     =    37.40000000 feet below pile head
Number of iterations             =             36
Number of zero deflection points =              2
```

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

```
Shear      =              0. lbs
Moment     =              0. in-lbs
Axial Load =              0. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
44.00000	4.91232163	15587345.	-161782.
41.80000	4.91067008	15586275.	-162276.
39.60000	5.24536763	15154450.	-178925.
37.40000	6.50266344	13987777.	-137730.
35.20000	10.20087046	12158744.	118632.
33.00000	21.69034014	10052165.	113856.
30.80000	47.23593431	9835894.	114865.

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	Load Type	Load Pile-head	Axial Loading	Pile-head Deflection	Pile-head Rotation	Max Shear in
Max Moment						

```
Pile    in Pile
 No.  1      Load 1       2        Load 2       lbs      inches     radians      lbs
     in-lbs
---- ----- ---------- ---------- ---------- ---------- ---------- ----------
---------- ----------
  1  V, lb       0.00  M, in-lb        0.00       0.00     4.9123   -0.01832
-161782.   1.56E+07


Maximum pile-head deflection = 4.9123216314 inches
Maximum pile-head rotation   = -0.0183213850 radians = -1.049738 deg.

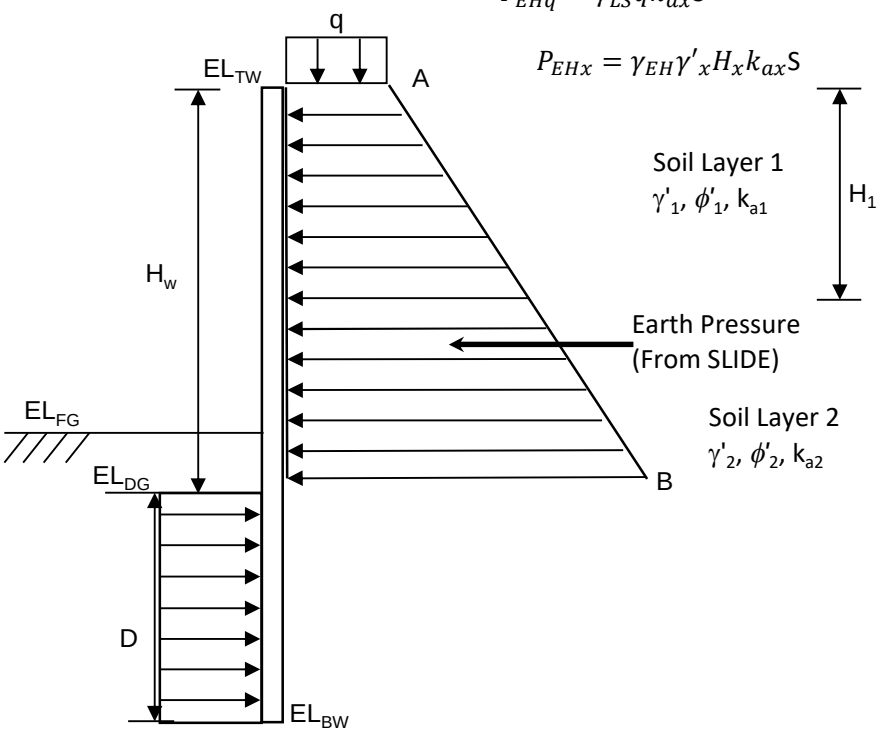
The analysis ended normally.
```

S&ME Project No.	24780173	**Calc. By**	SBK
Client	Stantec	**Calc. Date**	9/8/2025
Project	HAM-275-11.40	**Check By**	BCD
Wall Location	B-003-0-24	**Check Date**	9/5/2025

Lateral Earth Pressure Diagram

$$P_{EHq} = \gamma_{LS} q k_{ax} S$$

$$P_{EHx} = \gamma_{EH} \gamma'_x H_x k_{ax} S$$



Retaining Wall Information

EL_{TW}	=	533	MSL
EL_{FG}	=	527	MSL
EL_{DG}	=	527	MSL
EL_{BW}	=	489	MSL
$L_{T\ WALL}$	=	420	ft
	=	*Length of Wall*	
S	=	6	ft
	=	*Spacing between supports*	

General Information

EL_{WS}	=	450	MSL
γ_W	=	62.4	pcf

Boring(s): B-003-0-24

q	=	250	psf
	=	*Traffic Surcharge*	

Active Earth Pressure Coefficient

$$K_a = \frac{\sin(\theta+\phi')^2}{\left[1+\sqrt{\frac{\sin(\phi'+\delta)\sin(\phi'-\beta)}{\sin(\theta-\delta)\sin(\theta+\beta)}}\right]^2 (sin^2\theta \sin(\theta-\delta)}$$

where:
θ = Angle of the back face of the wall.
δ = Friction Angle for Dissimilar Materials (back face of wall and retained soil) from Table 3.11.5.3-1.
β = Backslope angle.

NOTE:
Cells Highlighted Green Require User Input

Wall/Site Constant Parameters

Backslope	=	0	:1
θ	=	90	deg
δ	=	0	deg
β'	=	0	deg

Soil Layer and Shear Zone Information

	Soil Layer 1		*Soil Layer 2*		*Soil Layer 3*	
Top El. (EL_{TW}) =	533	MSL	Top El. =	499	MSL	Top El. =		MSL
Bottom El. =	499	MSL	Bottom El. =	479	MSL	Bottom El. =		MSL
$\gamma_{soil\ 1}$ =	120	pcf	$\gamma_{soil\ 2}$ =	135	pcf	$\gamma_{soil\ 3}$ =		pcf
$\gamma'_{soil\ 1}$ =	120	pcf	$\gamma'_{soil\ 2}$ =	135	pcf	$\gamma'_{soil\ 3}$ =		pcf
$\phi'_{soil\ 1}$ =	24	deg	$\phi'_{soil\ 2}$ =	40	deg	$\phi'_{soil\ 3}$ =		deg
$c'_{soil\ 1}$ =	25	psf	$c'_{soil\ 2}$ =	10000	psf	$c'_{soil\ 3}$ =		psf
$\phi_{soil\ 1}$ =	0	deg	$\phi_{soil\ 2}$ =		deg	$\phi_{soil\ 3}$ =		deg
$c_{soil\ 1}$ =	0	psf	$c_{soil\ 2}$ =		psf	$c_{soil\ 3}$ =		psf
K_a =	0.422	dim	K_a =	0.217	dim	K_a =		dim

Project HAM-275-11.40 **Wall Location** B-003-0-24

Resistance and Load Factors (Tables 3.4.1-1, 3.4.1-2, & 11.5.7-1)

γ_{EH}	=	1.0		γ_{EHa}	=	1.5	
γ_{EV}	=	1.0	*SER I*	γ_{EHp}	=	0.9	*STR I*
γ_{LS}	=	1.0		γ_{LS}	=	1.75	

Determining LPILE Inputs

Earth Pressure (plf) = 17,000 from SLIDE with FS = 1.5

Earth Pressure (psf) = 944.4

Depth			*SER I Case* *Lateral Earth Pressure Calculations*			*STR I Case* *Lateral Earth Pressure Calculations*	
@ A =	0	ft	@ A =	633	plf	@ A =	1108	plf
@ B =	6.0	ft	@ B =	34633	plf	@ B =	52108	plf

Depth			*Lateral Earth Pressure Calculations*			*Lateral Earth Pressure Calculations*	
@ A =	0.00	in	@ A =	53	pli	@ A =	92	pli
@ B =	72.00	in	@ B =	2886	pli	@ B =	4342	pli

Determine p-y Modification Factor

$$\beta_a = 0.64(S/D)^{0.34}$$ *GB7, pg 27*

where:
β_a = p-multiplier, where $0.5 \leq \beta_a \leq 1.0$.
S = Spacing of Drilled Shaft Supports.
D = Diameter of Drilled Shaft Supports.

S = 6 ft

D = 3 ft

β_a = 0.81

Project HAM-275-11.40 **Wall Location** B-003-0-24

Verify PYWall Output and Pile Structural Capacity

Pile Size = W24x176 Pile Area = 51.7 in^2 Ix = 5680 in^4

Pile-Head Deflection

Per GB7, must be less than 1% of the drilled shaft length above bedrock or less than 2 inches if drilled shafts will be installed within 10 feet of the edge of the pavement, whichever is less.

Length above rock = 34 ft
1% of Length = 4.08 in
Max. Allow Deflection = 2 in

Within 10' of EOP? Yes
Pile-Head Deflection (SER I) = 1.9734674 in
GB7 Max Deflection = 2 in
Criteria Satisfied? YES

Pile Structural Capacity

Flexure

$Verify: M_{REQ} < \phi M_N$ per 6.10.8.1.3

M_{REQ} = 15,587,345 in-lbs
M_{REQ} = 15,587 in-kips

M_{REQ} = Maximum Bending Moment from PYWall Analysis (STR I Case)
ϕ = LRFD Resistance Factor = 1.0 per GB7 & 6.3.4.2

$M_N = S_x F_y$

S_x = Elastic Section Modulus about X-axis
F_y = Yield Strength of Steel = 50 ksi

ϕ = 1.0
S_x = 450 in^3
F_y = 50 ksi
ϕM_N = 22,500 in-kips

is $M_{REQ} < \phi M_N$? YES

Shear

per 6.10.9

V_{REQ} = 161,782 lbs
V_{REQ} = 162 kips

$Verify: V_{REQ} < \phi V_N$

V_{REQ} = Maximum Shear Force from PYWall Analysis (STR I Case)
ϕ = LRFD Resistance Factor = 1.0 per GB7 & 6.3.4.2

$V_N = 0.58 F_y A_W$

F_y = Yield Strength of Steel = 50 ksi

$A_W = T t_w$

T = Clear distance between flanges
t_w = Thickness of Web

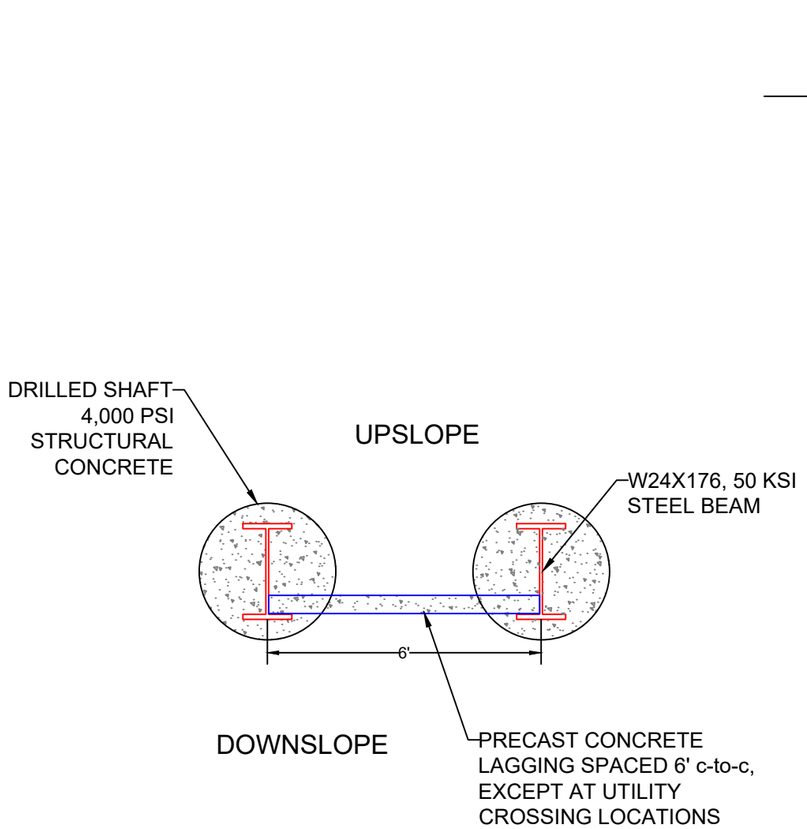
ϕ = 1.0
F_y = 50 ksi
T = 20.75 in
t_w = 0.75 in

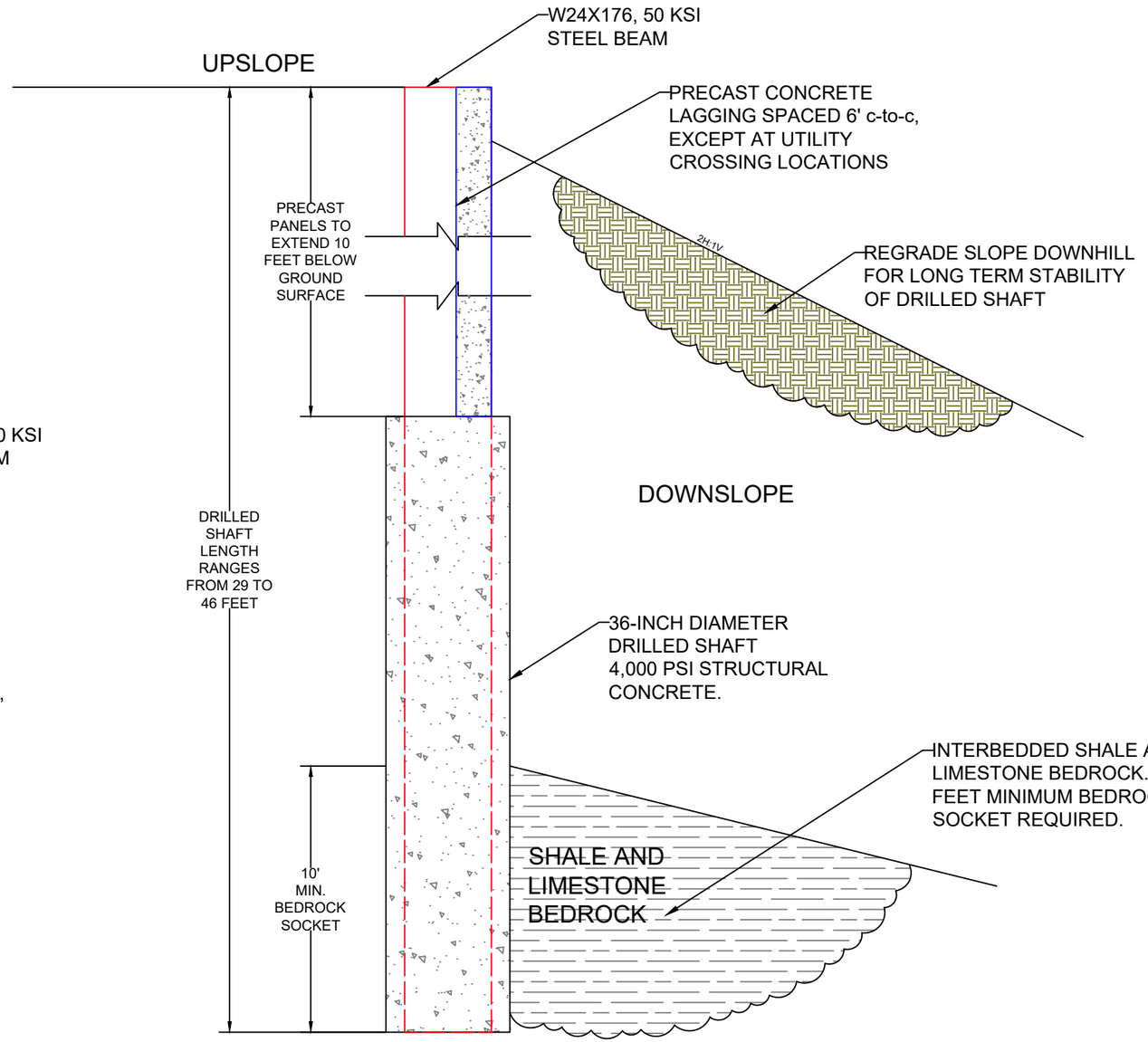
T/t_w = 27.67
Is T/t_w < 60.3? YES

Check that T/t_w < 60.3 [1.12xSQRT(Ek/F_y) = 60.3]
per 6.10.9.3.2-4

A_w = 15.56 in^2
ϕV_N = 451 kips

is $V_{REQ} < \phi V_N$? YES





DRILLED SHAFT WALL SKETCH

HAM-275-11.40 LANDSLIDE (PID: 121506)
CINCINNATI, HAMILTON COUNTY, OHIO

SCALE:	FIGURE NO.
NOT TO SCALE	18
DATE:	
09/08/2025	
PROJECT NUMBER	
24780173	