Resource International, Inc.

BEL-7-11.04
PID NO. 110788
BELMONT COUNTY, OHIO

GEOHAZARD AND STRUCTURE FOUNDATION EXPLORATION REPORT

Prepared For:
Ohio Department of Transportation - District 11
2201 Reiser Avenue
New Philadelphia, Ohio 44663

Prepared By:
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Rii Project No. W-20-120

January 2025

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Planning

Engineering

Construction Management

Technology

January 7, 2025

Mr. Christopher (Cody) Notz, P.E.
District Geotechnical Engineer
2201 Reiser Avenue
New Philadelphia, Ohio 44663

Re: Geohazard and Structure Foundation Exploration Report
BEL-7-11.04 Slope Repairs and Rock Catchment
Belmont County, Ohio
Rii Project No. W-20-120

Mr. Notz:

Resource International, Inc. (Rii) is pleased to submit this geohazard and structure foundation exploration report for the referenced project. Engineering logs have been prepared and are attached to this report along with the results of laboratory testing. This report includes recommendations for the stabilization of multiple landslides on existing cut slopes and for the design and construction of the proposed rockfall fence/barrier along State Route 7 (SR-7) in Belmont County, Ohio.

We sincerely appreciate the opportunity to be of service to you on this project. If you have any questions regarding the Geotechnical Exploration or this report, please contact us.

Sincerely,

RESOURCE INTERNATIONAL, INC.

Ashok Gaire, P.E.
Project Engineer

Jonathan P. Sterenberg, P.E.
Vice President – Geotechnical Services

Enclosure: Geotechnical Exploration Report

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APPENDICES

EXECUTIVE SUMMARY

Resource International, Inc. (Rii) has completed the geohazard and structure foundation exploration report. This report presents the findings of two geotechnical explorations conducted to support the stabilization of an existing cut slope and the design of a proposed rockfall fence/barrier along State Route 7 (SR-7) in Belmont County, Ohio, approximately 1.5 miles south of Shadyside, Ohio. The first phase, the geohazard exploration, was completed in 2020, and the second phase, the structural foundation exploration, was completed in 2022.

It is understood that four (4) document landslides have occurred in the vicinity. Three (3) of the landslides are on the cut slope above SR-7, designed as Slide Areas 1 through 3, and one has occurred on the slope supporting SR-7 above the existing railroad and the Ohio River, designated as Slide Area 4. Based on discussions with ODOT District 11 and the Rii design team, the proposed fence/barrier will have an approximate length of 400 feet and will be constructed from Station 581+50 to Station 585+50, downslope from Slide 3, along SR-7 alignment.

Exploration and Findings

For slope stability, soil borings obtained as part of previous explorations performed by CTL Engineering (CTL) in 2019 (four borings) and 2020 (three borings) were utilized for Slide Areas 1 and 2. As part of the current exploration, Rii performed an additional two (2) borings for Slide Area 4, as well as dynamic cone penetration (DCP) tests for Slide Area 3. It should be noted that the design of the remediation for the Slide 4 will be performed by the ODOT District 11 office, and the exploration was performed by Rii to facilitate the design.

On October 13, 2020, two (2) borings, designated as B-004-0-20 and B-005-0-20, were performed to completion depths of 31.0 and 37.4 feet below the ground surface, respectively, for slope stability of Slide Area 4. As previously mentioned, a total of seven (7) borings were previously performed by CTL in 2019 and 2020. The borings were designated as B-001-0-19 and B-002-0-19, with offset borings B-001-1-19 and B-002-1-19, and B-003-0-20 through B-003-2-20. The borings were performed to completion depths of 60.0 to 140.0 feet below the existing ground surface and were utilized for Slide Areas 1 and 2. Further, Rii performed a total of six (6) dynamic cone penetration (DCP) tests for Slide Area 3 on November 23 and 24, 2020, designated as DCP-1 through DCP-6, as well as offset test locations, were performed to completion depths ranging from approximately 3 to 13 feet below the ground surface.

On December 21 and 22, 2022, a total of three (3) structure borings, designated as B-001-2-22, B-001-3-22 and B-001-4-22 were advanced for this project. The borings were advanced to depths ranging from 15.0 to 20.0 feet below the existing ground/pavement surface for the proposed fence/barrier.

At the ground surface, structure borings B-001-2-22, B-001-3-22 and B-001-4-22 encountered approximately 9 to 11 inches of hot mix asphalt (HMA) pavement over 7.0 to 9.0 inches of aggregate base materials. Beneath the surficial materials, borings B-001-2-22 encountered cohesive and granular soils layers extended to the top of bedrock surface and borings B-001-3-22 and B-001-4-22 encountered cohesive soils extended to the top of bedrock surface. The cohesive soils were described as gray to brownish gray sandy silt, silty clay, silt and clay soils (ODOT A-4a, A-6a, A-6b) with varying amount of sand and gravel. The granular soils were described as gray, medium dense, gravel with sand, silt and clay (ODOT A-2-6). Borings B-004-0-20 and B-005-0-20 encountered approximately six to seven feet of fill material consisting of stiff to hard cohesive soils and loose to medium dense granular soils. Beneath the fill or surficial materials, borings B-004-0-20 and B-005-0-20 encountered stiff to very stiff cohesive material to the bedrock surface at approximately 15.5 feet to 22.5 feet. Boings performed by CTL in 2019 and early 2020 encountered approximately 12.0 to 14.5 feet of overburden, with the exception of boring B-003-1-20, which encountered approximately 2.5 feet. The overburden material generally consisted of very soft to hard cohesive soils with isolated layers of granular soils encountered in borings B-002-0-19 and B-003-0-20. Overburden soils were encountered in the previous CTL borings at depths ranging from 5.0 feet to 20.0 feet below the existing ground surface. The results of the DCP tests indicated the existing soils were generally very loose to very dense granular soils or very soft to hard cohesive soils.

Bedrock was encountered in each boring at depths ranging from 3.5 to 9.1 feet below the existing grade corresponding to elevations ranging from 679.5 to 673.3 feet msl. Rock coring was performed in each boring upon the encounter of auger refusal and/or split-spoon refusal on bedrock. The upper auger-able rock was described as gray to dark gray shale underlain by competent sandstone. The recovered cored rock samples were described as light gray and gray, slightly weathered, weak to moderately strong sandstone.

Groundwater was not encountered in any boring during the drilling operations. At the completion of drilling groundwater was not recorded due to the influence of water added during rock coring.

Analysis and Recommendations

Slope Stability

Schematic cross sections of the existing slopes at the project location were developed based on cross section information obtained from the aerial survey provided by ODOT. The subsurface profile at each cross section was developed based on the borehole information obtained as part of the current exploration, as well as DCP data for Slide Area 3. Based upon on-site observations it is anticipated that the slope instability at each of the three slide areas is primarily contributed erosion from surface groundwater and creep under sustained loading.

Conceptual options have been considered and presented herein. These options have met or exceeded ODOT and AASHTO guidelines for minimum required factor-of-safety against slope stability of 1.3.

Slide Area 1

In order to provide an adequate factor of safety against slope instability, earthwork options have been considered and analyzed to regrade the existing slope. It is recommended that the existing slope be reconstructed at a 1.9H:1V slope with benched material in accordance with ODOT Geotechnical Bulletin No. 2, Analysis was performed for a 1.9H:1V slope with benched material at 1.5H:1V cut slopes. Results of the analysis indicated a minimum factor of safety of 1.34. In addition to benching in compacted fill, it is recommended that slope drains be constructed on the cut slopes in accordance with GB-2, in conjunction with surface drainage improvements to promote drainage away from the slope and prevent any ponding. Finally, it is recommended that a dense vegetation be established to mitigate any surface erosion.

Slide Area 2

It is anticipated that the failure mechanism for Slide Area 2 is similar to Slide Area 1. However, the slope after the failure is on the order of 2.25H:1V, and the back analysis (using similar parameters as Slide Area 1 based on similar subsurface conditions) indicated a factor of safety of 1.3. Therefore, it is recommended that the residual, or failed soil mass, be excavated and regraded. Drainage improvements should be provided to control surface water and mitigate erosion, as well as vegetation reestablished in the vicinity of the slide area and clearing that was previously performed.

Slide Area 3

It is understood that the primary concern is debris, such as cobbles and boulders, will be eroded or carried from the ledge or above and fall down the rock slope as a hazard to SR- below, as observed by the damage to the existing Type D barrier observed in the field during the reconnaissance. Therefore, it is recommended that the slope be protected using erosion control mats and a wire mesh, or slope drape. It is recommended that the existing failed material (“slough”) be excavated from the ledge and the immediate slope above. The slope drape should be anchored above the ledge in order to mitigate any fall potential from the over-steepened slope.

Barrier Wall Foundation Stability

Based on the information provided by Rii design team, the proposed rockfall barrier wall is understood to consist of flexible steel mesh ropes barrier supported on steel posts. The proposed barrier is proposed to have an exposed height of 13.5 feet above the existing pavement surface. Based on the rock fall analysis performed by Rii using the Colorado Rockfall Simulation Program (CRSP), it is calculated that the a single rockfall event will transmit a factored maximum shear-force load of 3.3 kips to a steel post.

Utilizing the soil and rock parameters and estimated load on the proposed steel fence post, Rii performed lateral load analysis to determine the embedment depths along with maximum lateral deflections of the proposed posts. An H-pile post (size HP 10x 42 and yield strength 36 ksi) was utilized for the proposed analysis. The results of the LPILE analysis are presented in Appendix VII and a summary of analysis is presented in the table below.

Summary of Lateral Load Analysis – HP 10x42 Piles

Location/ Boring Number	Calculated Maximum Moment, (kips-ft)	Allowable Maximum Moment, (kips-ft)	Calculated Maximum Shear Force, (kips)	Allowable Maximum Shear Resistance, (kips)	Maximum Pile Head Deflection, (in)	Calculated Embedment Pile Length, (ft)	Minimum Pile Length Embedment in Bedrock, (ft)
B-001-2-22	46.2	144.9	9.0	84.1	1.94	16.0	7.0
B-001-3-22	46.3	144.9	12.8	84.1	1.87	14.0	8.0
B-001-4-22	47.0	144.9	31.7	84.1	1.78	11.5	8.0

Please note that this executive summary does not contain all the information presented in the report. The unabridged Subgrade exploration report should be read in its entirety to obtain a more complete understanding of the information presented.

1.0 INTRODUCTION

This report presents the findings of two geotechnical explorations conducted to support the stabilization of an existing cut slope and the design of a proposed rockfall fence/barrier along State Route 7 (SR-7) in Belmont County, Ohio, approximately 1.5 miles south of Shadyside, Ohio. The first phase, the geohazard exploration, was completed in 2020, and the second phase, the structural foundation exploration, was completed in 2022.

It is understood that four (4) documented landslides have occurred within the project limits. Three (3) of the landslides are on the cut slope above SR-7, designed as Slide Areas 1 through 3, and one has occurred on the slope supporting SR-7 above the existing railroad and the Ohio River, designated as Slide Area 4. The existing rock cut slope adjacent to SR-7 is approximately 120 feet in height with slopes on the order of approximately 3/4(H):1(V) (horizontal: vertical), with an overall hillside height of approximately 500 feet. SR-7 primarily runs south to north in the project area. It is also understood that the project involves the design and construction of rockfall protection fence/barrier on the west side of SR-7. Based on discussions with ODOT District 11 and the Rii design team, the proposed fence/barrier will have an approximate length of 400 feet and will be constructed from Station 581+50 to Station 585+50, downslope from Slide 3, along SR-7 alignment. It is understood that the proposed barrier will be constructed immediately west of the west edge of the existing shoulder.

Soil borings obtained as part of previous explorations performed by CTL Engineering (CTL) in 2019 (four borings) and 2020 (three borings) were utilized for Slide Areas 1 and 2. As part of the current exploration, Rii performed an additional two (2) borings for Slide Area 4, as well as dynamic cone penetration (DCP) tests for Slide Area 3. It should be noted that corrections were made in the form of markups to the CTL borings logs with respect to ground surface elevations, based on information provided by ODOT, as well as location data (coordinates and project stations/offset) for each log. Corrections were not made to the content of the logs individually.

Based on the initial information provided by the Ohio Department of Transportation (ODOT) District 11 during the project development, and preliminary site visits, the failure limits and slope heights are summarized below in Table 1.

Table 1. Summary of Slope Stability Failure Sites

Slope Failure Designation	Station [1]	Supported Roadway	Slope Height [2] (feet)	Representative Borings
Slide Area 1	589+00 to 593+25	SR-7 Uphill cut slope	180	B-001-0-19, B-001-1-19, B-002-0-19, B-002-1-19
Slide Area 2	586+40 to 589+50	SR-7 Uphill cut slope	460	B-003-0-20 through B-003-1-20
Slide Area 3	582+00 to 585+50	SR-7 Uphill cut slope	240	DCP-1 through DCP-6
Slide Area 4	---[4]	SR-7	30[3]	B-004-0-20 & B-005-0-20

1. *The station limits are referenced to the existing centerline of SR-7 and are considered approximate.*
2. *Slope height provide is approximate and measured from the road surface of SR-7 to the upper limit of the slide area.*
3. *Slide Area 4 is measured from the road surface of SR-7 to the toe of the slope at the railroad bench.*
4. *Slide Area 4 is estimated to be approximately 100-feet long, with the final station limits to be determined by ODOT design.*

It should be noted that the geotechnical evaluation and the design of the remediation for the Slide 4 will be performed by the ODOT District 11 office, and the explorations herein for this area were performed by Rii to help facilitate the design.

2.0 GEOLOGY AND OBSERVATIONS OF THE PROJECT

2.1 Site Geology

Physiographically, the project site lies in the Little Switzerland Plateau physiographic region within the Appalachian Plateau Province where the rocks are relatively flat-lying and comprised of Pennsylvanian and Permian strata. The plateaus are covered with a thin to non-existent layer of colluvium over bedrock. The top of bedrock generally follows the ground surface and is typically shallower on the ridges and slopes, and deeper in the valley zones where more overburden soils or thicker colluvium has accumulated. Colluvium is the weathered rock, weathered debris, and scattered residuum that forms due primarily to gravity and erosion.

Based on the Bedrock Geology and Bedrock Topography maps, obtained from Ohio Department of Natural Resources (ODNR), the bedrock at the proposed project site consists of sandstone, siltstone, shale, limestone, and coal. The rock types within these zones can change rapidly both horizontally and vertically and commonly intertongue and intergrade. These formations, especially at the interface with the overburden soils, can also be prone to slope instability due to the soils on steep slopes becoming wet.

Within the borings performed for this project, shale, sandstone, limestone, coal seams, and claystone bedrock was encountered at the boring locations between depths of 3.5 to 60.5 feet below the ground surface.

2.2 Existing Site Conditions

Representatives of Rii performed a site reconnaissance with ODOT personnel being on site to provide guidance and insight into the past operations. At the time of the site visit on October 1, 2020, the terrain upslope was highly vegetated, with the exception of Slide Area 3, which had previously been cleared under previous work. Additionally, it is understood that paths were cleared previously in the vicinity of Slide Area 1 for access to the boring locations. During the site visit, the cleared paths were observed to be relatively saturated with soft surficial ground and ponding water in isolated areas. Bedrock outcrop was also observed toward the top (upper elevation) of Slide Area 1. The terrain was overly steepened at nearly vertical slopes in the vicinity of the west of Slide Area 1 (top) and the east end of Slide Area 2 (lower elevation/bottom).

Slide Area 3 is located toward the south end of the project and is located above a rock cut that extends approximately 100 to 120-feet above SR-7. During the site reconnaissance Rii and ODOT only access the northeast portion of the slide to overlook the slide area due to the terrain. Above the rock cut slope, the overburden appeared to have failed with slough and multiple fallen trees observed, as well as from below on SR-7. With the existing rock catchment area, multiple cobbles and boulders were observed, as well as a damaged section of fence along the Type D barrier below along the southbound travel lanes of SR-7.

As stated, Slide Area 4 is on the supporting slope of SR-7 above the bench supporting railroad. The existing scarp appeared to extend over a linear distance of approximately 100-feet in the northbound, east shoulder and outside travel lane. Pavement distress including longitudinal and transverse cracking was observed in the vicinity of the slide. The scarp did not appear to present significant vertical settlement.

Rii understands that, within the project limits rockfall is a cause of concern and ODOT District 11 desires to construct a flexible barrier fence to capture the falling rocks.

3.0 EXPLORATION

On October 13, 2020, two (2) borings, designated as B-004-0-20 and B-005-0-20, were performed to completion depths of 31.0 and 37.4 feet below the ground surface, respectively. The borings were performed in general accordance with the ODOT Specifications for Geotechnical Explorations (SGE) dated July, 2020.

As previously mentioned, a total of seven (7) borings were previously performed by CTL in 2019 and 2020. The borings were designated as B-001-0-19 and B-002-0-19, with offset borings B-001-1-19 and B-002-1-19, and B-003-0-20 through B-003-2-20. The

borings were performed to completion depths of 60.0 to 140.0 feet below the existing ground surface.

In addition to the current exploration by Rii and the previous explorations by CTL, Rii performed a total of six (6) DCP tests on November 23 and 24, 2020, designated as DCP-1 through DCP-6, were performed to completion depths ranging from approximately 3 to 13 feet below the ground surface. DCP testing was performed using the Wildcat DCP. Additional DCP tests were performed as offsets at four of the test locations, designated as DCP-1.1, DCP-2.1, DCP-3.1, and DCP-5.1. Each test was performed to a depth where refusal was encountered, designated as 50 blows per interval (10 centimeters, cm). If refusal was encountered at a shallow depth, an offset test location was performed to verify the refusal depth.

Further, on December 21 and 22, 2022, a total of three (3) structure borings, designated as B-001-2-22, B-001-3-22 and B-001-4-22 were advanced for this project. The borings were advanced to depths ranging from 15.0 to 20.0 feet below the existing ground/pavement surface.

The borings locations are illustrated on the boring plan presented in Appendix I of this report and a summary of borings and DCP information is provided in Tables 2 and 3.

Table 2. Test Boring Summary

Boring Number	Station [1]	Offset [1]	Latitude	Longitude	Ground Surface Elevation (feet msl)	Boring Depth (feet)
B-001-0-19	589+96	207' LT	39.9536310 [3]	-80.7650654 [3]	791.8 [3]	115.0
B-001-1-19	589+77	297' LT	39.9536230 [3]	-80.7647391 [3]	837.6 [3]	60.6
B-002-0-19	592+72	159' LT	39.9543399 [3]	-80.7643173 [3]	735.1 [3]	65.0
B-002-1-19	591+70	300' LT	39.9541657 [3]	-80.7649001 [3]	820.0 [3]	105.1
B-003-0-20	588+23	461' LT	39.9532700 [3]	-80.7657000 [3]	963.3 [3]	140.0
B-003-1-20	587+93	612'LT	39.9532700 [3]	-80.7663000 [3]	1013.0 [3]	60.0
B-003-2-20	587+27	752 LT	39.9532700 [3]	-80.7657000 [3]	1095.0 [3]	120.5
B-004-0-20	590+28	29' RT	39.953555 [2]	-80.7638930 [2]	679.4 [2]	31.0
B-005-0-20	591+29	40' RT	39.953815 [2]	-80.7637660 [2]	677.7 [2]	37.4
B-001-2-22	581+50	33' LT	39.9512184[2]	-80.7646902[2]	682.4[2]	20.0
B-001-3-22	583+50	33' LT	39.9517642[2]	-80.7645889[2]	683.3[2]	17.5
B-001-4-22	585+50	33' LT	39.9523078[2]	-80.7644689[2]	683.0[2]	15.0

1. Station and offsets are referenced to the centerline of SR-7.
2. Ground surface elevations were determined from survey performed by Rii
3. Ground surface elevations were approximated from topographic maps provided by ODOT aerial survey.

Table 3. DCP Test Summary

DCP Test Number	Station [1]	Offset [1]	Latitude [2,3]	Longitude [2,3]	Ground Surface Elevation (feet msl) [2,3]	Test Depth (feet)
DCP-1	584+73.8	-255.3	39.9522050	-80.7652980	869.0	6.89
DCP-1.1	584+87.9	-265.2	39.9522490	-80.7653240	880.0	3.94
DCP-2	584+77.0	-240.5	39.9522070	-80.7652440	862.0	5.35
DCP-2.1	584+60.9	-283.4	39.9521820	-80.7654050	890.0	4.59
DCP-3	584+63.1	-246.3	39.9521710	-80.7652730	865.0	2.95
DCP-3.1 [4]	584+63.1	-246.3	39.9521710	-80.7652730	865.0	2.95
DCP-4	582+68.1	-261.5	39.9516310	-80.7654390	880.0	12.63
DCP-5	583+85.1	-288.0	39.9519710	-80.7654670	900.0	2.46
DCP-5.1	583+64.6	-280.0	39.9519100	-80.7654510	900.0	9.02
DCP-6	583+59.8	-316.0	39.9519120	-80.7655810	913.0	9.35

1. *Station and offset referenced to the centerline of SR-7.*
2. *Ground surface elevations and coordinates at the boring locations were surveyed by Rii.*
3. *Ground surface elevations were approximated from topographic maps provided by ODOT aerial survey.*
4. *The location for DCP-3.1 was not recorded by GPS but was offset to DCP-3. Identical location data is provided as an approximation.*

The locations of the borings B-004-0-20, B-005-0-20, B-001-2-22, B-001-3-22 and B-001-4-22 were determined in the field by using a handheld GPS unit, and the available project information. Also, for these borings, the ground surface elevations at the boring locations were determined from survey performed by Rii. Stations and offsets at boring locations were referenced to centerline of SR-7. The boring coordinate and elevation data from the previous explorations were provided as part of the available information at the start of the project by ODOT. It should be noted that the elevations reported on the logs did not match the data provided or correspond to the topographic maps provided, and, therefore, markups are provided on the individual boring logs.

Borings B-004-0-20 and B-005-0-20 were drilled and sampled using CME 55 truck rig utilizing a 3.25-inch inside diameter, hollow-stem auger to advance the holes. In general, standard penetration test (SPT) and split spoon sampling were performed in the borings with continuous sampling performed on the borings to 10.0 feet, followed by 2.5-foot interval sampling to auger refusal on the underlying bedrock. Further, structure borings B-001-2-22, B-001-3-22 and B-001-4-22 were drilled and sampled using CME 55 truck rig utilizing 4.5-inch continuous flight augers to advance the holes. SPT and split spoon sampling were performed at 2.5-foot intervals.

The borings performed by CTL were drilled using an ATV-mounted rotary drilling machine, utilizing a 3.25-inch inside diameter, hollow-stem auger to advance the holes.

In general, standard penetration test (SPT) and split spoon sampling were performed in the borings with continuous sampling performed on all of the borings to 10.0 feet, followed by 2.5-foot interval sampling to auger refusal on the underlying bedrock.

The SPT, per the American Society for Testing and Materials (ASTM) designation D1586, was conducted using a 140 pound hammer free falling 30 inches to drive a 2.0-inch outside diameter (O.D.) split spoon sampler for 18.0 inches. Rii utilized a calibrated automatic drop hammer to generate consistent energy transfer to the sampler. Driving resistance is recorded on the boring logs in terms of blows per 6.0-inch interval of the driving distance. The second and third intervals were added to obtain the number of blows per foot (N). SPT blow counts aid in estimating soil characteristics used to calculate bearing/subgrade capacities and settlement potential. Measured blow count (N_m) values are corrected to an equivalent (60%) energy ratio, N_{60}, by the following equation.

$$N_{60} = N_m*(ER/60)$$

Where:
N_{60} = energy corrected number of blows required to drive split spoon sampler final 12 inches in 1.5-foot sampling intervals
N_m = measured N value
ER = drill rod energy ratio, expressed as a percent, for the system used

For the first and second explorations, the hammer utilized in CME 55 was calibrated on September 14, 2020 and March 21, 2022, respectively, and had an energy ratio of 84.2 percent. Upon completion of drilling, the borings were backfilled with a mixture of soil cuttings and bentonite chips. The pavement surface was patched with an equivalent thickness of asphalt cold patch.

The depth to bedrock was determined by split spoon sampler refusal and/or auger refusal on bedrock. Borings were extended into the bedrock using an NQ-2 double-tube diamond bit core barrel (utilizing wire line equipment). The rock cores obtained from the borings were logged in the field and visually classified in the laboratory. The retrieved cores were analyzed to identify the type of rock, color, mineral content, bedding planes and other geological and mechanical features of interest in this project. The Rock Quality Designation (RQD) for each rock core run was calculated according to the following equation:

$$RQD = \frac{\sum \text{segments equal to or longer than 4.0 inches}}{\text{core run length}} \text{ x } 100$$

The RQD value aids in estimating the general quality of the rock and is used in conjunction with other parameters to designate the quality of the rock mass.

Upon completion of drilling, the borings were backfilled with a mixture of bentonite chips and soil cuttings generated during the drilling process or sealed with cement-bentonite grout in accordance with ODOT standards. Where borings penetrated the existing roadway, the pavement surface was patched with an equivalent thickness of quick-set concrete.

During drilling, Rii personnel prepared field logs showing the encountered subsurface conditions. Soil samples obtained from the drilling operations were preserved and sealed in glass jars and delivered to the soil laboratory. In the laboratory, the soil samples were visually classified and select samples were tested, as noted in Table 4.

Table 4. Laboratory Test Schedule

Laboratory Test	Test Designation	Number of Tests Performed (Rii Exploration 2020)	Number of Tests Performed (Rii Exploration 2022)	Number of Tests Performed (CTL Exploration 2019 and 2020)
Natural Moisture Content	ASTM D 2216	20	6	37
Plastic and Liquid Limits	AASHTO T89, T90	8	3	14
Gradation – Sieve/Hydrometer	AASHTO T88	8	3	14
Unconfined Compressive Strength Test (Rock)	ASTM D7012	2	3	7

The tests performed are necessary to classify existing soil according to the Ohio Department of Transportation (ODOT) classification system and to estimate engineering properties of importance for pavement design and construction recommendations. Results of the laboratory testing are presented on the boring logs in Appendix III and also in Appendix VI. A description of the soil terms used throughout this report is presented in Appendix II. A summary of rock core photographs is also presented in Appendix III.

Hand penetrometer readings, which provide a rough estimate of the unconfined compressive strength of the soil, were reported on the boring logs in units of tons per square foot (tsf) and were utilized to classify the consistency of the cohesive soil in each layer. An indirect estimate of the unconfined compressive strength of the cohesive split spoon samples can also be made from a correlation with the blow counts (N_{60}). Please note that split spoon samples are considered to be disturbed and the laboratory determination of their shear strengths may vary from undisturbed conditions.

4.0 FINDINGS

Interpreted engineering logs have been prepared based on the field logs, visual examination of samples and laboratory test results. Classification follows the current version of the ODOT SGE. The following is a summary of what was found in the test borings and what is represented on the boring logs.

4.1 Surface Materials

At the ground surface, borings B-004-0-20, B-001-2-22, B-001-3-22 and B-001-4-22 encountered approximately 9 to 11 inches of asphalt over 2.0 to 9.0 inches of aggregate base materials.

All of the previous project borings performed by CTL were performed on the existing cut slope and did not record surficial materials at the ground surface. It should be noted that the borings were reportedly performed in areas that had be excavated and cleared for drill rig access.

4.2 Subsurface Soils

Beneath the surficial materials, borings B-004-0-20 and B-005-0-20 encountered approximately six to seven feet of fill material consisting of stiff to hard silt and clay, silty clay (ODOT A-6a and A-6b) containing coal fragments and loose to medium dense gravel with sand and gravel with sand, silt, and clay (ODOT A-1-b and A-2-6). Beneath the fill or surficial materials, borings B-004-0-20 and B-005-0-20 encountered stiff to very stiff sandy silt, silt and clay, silty clay, and clay (ODOT A-4a, A-6a, A-6b, and A-7-6) material to the bedrock surface at approximately 15.5 feet to 22.5 feet.

Beneath the surficial materials of structure borings, boring B-001-2-22 encountered cohesive and granular soils layers extended to the top of bedrock surface and, borings B-001-3-22 and B-001-4-22 encountered cohesive soils extended to the top of bedrock surface. The cohesive soils were described as gray to brownish gray sandy silt, silty clay, silt and clay soils (ODOT A-4a, A-6a, A-6b) with varying amount of sand and gravel. The shear strength and consistency of the cohesive soils were primarily derived from the hand penetrometer values (HP). The consistency of the encountered cohesive soils ranged from very stiff to hard. The unconfined compressive strength of the cohesive soil samples tested, obtained from the hand penetrometer, ranged from 3.0 tsf to 4.5 tsf. The granular soils were described as gray, medium dense, gravel with sand, silt and clay (ODOT A-2-6). The SPT-N_{60} values determined within these granular soils ranged from 25 blows per foot (bpf) to 29 bpf.

Boings performed by CTL in 2019 and early 2020 encountered approximately 12.0 to 14.5 feet of overburden, with the exception of boring B-003-1-20, which encountered approximately 2.5 feet. The overburden material generally consisted of very soft to hard sandy silt, silt and clay, elastic clay, and clay (ODOT A-4a, A-6a, A-7-5, and A-7-6) with isolated layers of gravel and/or stone fragments encountered in borings B-002-0-19 and B-003-0-20. Overburden soils were encountered in the previous CTL borings at depths ranging from 5.0 feet to 20.0 feet below the existing ground surface.

Natural moisture contents of the soil samples tested ranged from 2 to 46 percent. The natural moisture content of the cohesive samples tested for plasticity index, ranged from 17 percent below to 6 percent above the corresponding plastic limits.

DCP tests do not obtain physical samples that can be used to visually or mechanically classify the soils. However, based on typical correlations, the consistency or compactness of the soils is estimated based on either fine- or coarse-grained soils (cohesive or granular). The results of the DCP tests indicated the existing soils were generally very loose to very dense granular soils or very soft to hard cohesive soils. Based on the site observations and the historic borings at the site, it is anticipated the overburden soils are primarily cohesive in nature.

4.3 Bedrock

Borings performed by Rii in the two stages, B-004-0-20, B-005-0-20, B-001-2-22, B-001-3-22 and B-001-4-22, encountered bedrock at depths ranging from 3.5 to 22.4 feet below the existing grade corresponding to elevations ranging from 679.5 to 655.3 feet msl. Rock coring was performed in each boring upon the encounter of auger refusal and/or split-spoon refusal on bedrock. The upper auger-able rock was described as gray to dark gray shale underlain by competent sandstone. The recovered cored rock samples were described as light gray and gray, slightly weathered, weak to moderately strong sandstone. Borings B-004-0-20 and B-005-0-20, were located in the shoulder of the northbound travel lanes of SR-7 and encountered sampler and auger refusal on slightly weathered sandstone and limestone bedrock. Borings performed upslope of SR-7 by CTL encountered severely weathered to slightly weathered shale, siltstone, limestone, claystone, and sandstone. Coal was also encountered in isolated seams at depths ranging from 26.7 feet to 127.0 feet below the existing ground surface in multiple borings.

In general, percent recoveries of the rock cores ranged from 42 to 100 percent, with an average value of 95 percent. The RQD values determined generally ranged from 0 to 100 percent, with an average value of 68 percent. Uniaxial compressive strength testing performed on sandstone rock core samples for the structure foundation exhibited unconfined compressive strength (Q_u) values ranging from 932 to 4,721 pounds per square inch (psi). However, two (2) unconfined compressive strength tests were performed on the recovered limestone core samples from borings B-004-0-20 and B-005-020 with results ranging from 8,441 psi to 15,532 psi. Results of the unconfined compressive strength testing are provided on the boring logs in Appendix III.

A detailed description of recovered rock cores along with photographic summary of rock cores samples is provided in Appendix III. A summary of the top of bedrock elevations encountered in the borings is provided in Table 5 below.

Table 5. Top of Bedrock Elevations

Boring Number	Ground Elevation (feet msl)	Top of Bedrock		Rock Description[1]
		Depth (feet)	Elevation (feet msl)	
B-001-0-19	791.8	13.5	778.3	Siltstone
B-001-1-19	837.6	14.5	823.4	Shale
B-002-0-19	735.1	12.0	723.1	Claystone
B-002-1-19	820.0	13.1	806.9	Shale
B-003-0-20	963.3	12.5	950.8	Shale
B-003-1-20	1013.0	5.0	1008.0	Limestone
B-003-2-20	1095.0	14.0	1081.0	Sandstone
B-004-0-20	679.4	15.5	663.9	Sandstone
B-005-0-20	677.7	22.4	655.3	Limestone
B-001-2-22	682.4	9.1	673.3	Sandstone
B-001-3-22	683.3	6.0	677.3	Sandstone
B-001-4-22	683.0	3.5	679.5	Sandstone

1. Rock descriptions reflects the material encountered at the top of rock only.

4.4 Groundwater

Groundwater seepage was encountered in boring B-005-0-20 at a depth of 6-feet below the existing ground surface. Groundwater was not encountered in any boring during the drilling operations. At the completion of drilling groundwater was not recorded due to the influence of water added during rock coring.

Please note that short-term water level readings, especially in cohesive soils, are not necessarily an accurate indication of the actual groundwater level. In addition, groundwater levels or the presence of groundwater are considered to be dependent on seasonal fluctuations in precipitation.

A more comprehensive description of what was encountered during the drilling process may be found on the boring logs in Appendix III.

5.0 ANALYSES AND RECOMMENDATIONS

Data obtained from the historic soil borings, and performed drilling and testing program have been used to determine shear strength parameters and foundation support capabilities for the soils/rock encountered at the site. These parameters have been used for evaluating the stability of the existing slopes as well as the proposed slope remediation alternatives, and to provide guidelines for the design and construction of the foundation systems. The soil parameters and results of the analysis performed are presented in the following sections. This report, and the recommendations contained herein, has been written under the consideration that the construction will be performed in accordance with the latest version of the ODOT Construction and Materials Specifications (CMS). Recommendations are provided herein for Slide Areas 1 through 3. It should be noted that recommendations are provided for Slide Area 4. It is understood that the remediation design will be performed by ODOT District 11.

5.1 Slope Stability Evaluation

5.1.1 Strength Parameters Utilized in Slope Stability Analyses

The shear strength parameters utilized in the slope stability analyses for the analysis of the existing conditions and proposed slope remediations are provided in Tables 6 and 7.

Table 6. Soil Parameters Utilized in Slope Stability Analyses – Slide Area 1

Material Type	Unit Weight, γ (pcf)	Effective Friction Angle, φ' (°)	Effective Cohesion, c' (psf)
Fill	120	30	0
Stiff to Very Stiff A-6a/A-6b	120	28	100
Soft to Medium Stiff A-7-6	120	26	45
Stiff to Hard A-6a	120	30	100
Bedrock	145	28	4,000

Table 7. Soil Parameters Utilized in Slope Stability Analyses – Slide Area 2

Material Type	Unit Weight, γ (pcf)	Effective Friction Angle, φ' (°)	Effective Cohesion, c' (psf)
Fill	120	30	0
Very Stiff Elastic Clay/Clay (A-7-5/A-7-6)	120	28	100
Stiff Clay (A-7-6)	120	28	45
Bedrock	145	28	4,000

Shear strength parameters were estimated based on the results of the available boring information and DCP test results, as well as engineering judgment based on the results of analyses.

5.1.2 Slope Stability Analyses – Existing Slopes

Schematic cross sections of the existing slopes at the project location were developed based on cross section information obtained from the aerial survey provided by ODOT. The subsurface profile at each cross section was developed based on the borehole information obtained as part of the current exploration, as well as DCP data for Slide Area 3.

Based upon on-site observations it is anticipated that the slope instability at each of the three slide areas is primarily contributed erosion from surface groundwater and creep under sustained loading. It is understood that inclinometers were installed by CTL in borings B-003-0-20 and B-003-1-20. However, based on correspondence with ODOT, it is understood that the inclinometers installed were impacted by earthwork (fill placement) performed by the contractor that cleared the site and provided access, and therefore, were not able to provide reliable readings.

Rii performed a slope stability analysis to calibrate the in-situ soil parameters by adjusting factor of safety (FS) to 1.0, also known as a back-analysis. Analyses were performed using the program Slide developed by Rocscience. Analysis exhibits for the back analysis and remediation alternatives herein are presented in Appendix VIII.

It should be noted that back analysis was not performed for Slide Area 3 due to the uncertainty in the original slope geometry and the lack of subsurface data above the slide area. The geometry within the limits of Slide Area 3 creates a ledge, or shelf, where residual material has sloughed above the rock cut slope. Due to the rock cut slope at a higher elevation, the over-steepened slope above in conjunction with uncertainty in the original slope geometry, and lack of subsurface information above the ledge, calibrating the model in a back analysis is not feasible. Due to the slope configuration and the higher rock cut slope, it is understood from the field reconnaissance and coordination with ODOT, that rockfall or debris falling down the hill is the primary concern. It is understood that the existing Type D barrier was struck by a fallen cobble or boulder previously. Recommendations are provided herein for Slide Area 3.

5.1.3 Slope Remediation Recommendations

Conceptual options have been considered and presented below. These options have met or exceeded ODOT and AASHTO guidelines for minimum required factor-of-safety against slope stability of 1.3. Therefore, they are considered viable options for repairing the slope failure encountered at this site. Results of the analysis are provided in the Appendix VIII. Conceptual exhibits for remediation of Slide Areas 1 through 3 are provided in Appendix IX.

Slide Area 1

Slide Area 1 extends up to approximately 180 feet above SR-7 between approximately stations 589+00 to 593+25 (approximately a failure length of 425 feet), and appears to have experienced progressive failure. Progressive failure occurs when the adjacent soils – either up or downslope, or laterally – have been weakened by the initial failure, causing propagation of the slip to occur beyond the initial limits. Weakening can occur through the creation of surface cracks that allow water to enter the subsurface strata, softening the soils below. Based on site observations during the reconnaissance, and the results of the back analysis, it is anticipated that erosion and any cyclic variations due to groundwater through surface cracks and/or ponding, contributed to the failure.

In order to provide an adequate factor of safety against slope instability, earthwork options have been considered and analyzed to regrade the existing slope. Based on the site observations and the field survey, it appears the existing slope prior to failure was on the order of 1.9H:1V (horizontal to vertical). Due to the geometry of the overall hillside, flattening the slope to a 2H:1V, or flatter, would require an excavation on the order of 20 feet vertical at the top of the hillside, and, therefore, is not considered practical. Thus, it is recommended that the existing slope be reconstructed at a 1.9H:1V slope with benched material in accordance with ODOT Geotechnical Bulletin No. 2, Special Benching and Sidehill Embankment Fills (GB2).

Analysis was performed for a 1.9H:1V slope with benched material at 1.5H:1V cut slopes, no greater than 10-feet in vertically. Benching should be limited to phases, such as 50 linear feet, to prevent excavations from being open without new fill in place for extended periods. Results of the analysis indicated a minimum factor of safety of 1.34. In the analysis, cohesive fill material with long-term (drained) shear strengths of a 28 degree friction angle and a cohesion of 270 pounds per square foot (psf) were considered, in general accordance with ODOT GB-7. It is recommended that material meeting or exceeding these values be used as fill placement. In addition to benching in compacted fill, it is recommended that slope drains be constructed on the cut slopes in accordance with GB-2, in conjunction with surface drainage improvements to promote drainage away from the slope and prevent any ponding. Drainage improvements consisting of surface drainage systems combined with slope drains along the excavation for benching may be considered. Finally, it is recommended that vegetation be reestablished to mitigate any surface erosion.

Slide Area 2

Slide Area 2 extends up to approximately 460 feet above SR-7 between approximately stations 586+40 to 589+50 (approximately a failure length of 310 feet). However, it should be noted that the failure area appears to extend on the slope at a skew from the SR-7 centerline alignment. It is anticipated that the failure mechanism for Slide Area 2 is similar to Slide Area 1. However, the slope after the failure is on the order of 2.25H:1V, and the back analysis (using similar parameters as Slide Area 1 based on similar subsurface conditions) indicated a minimum factor of safety of 1.3. However, in areas where the existing failure resulted in over-steepened slopes, the factor of safety was on the order of 1.0 to 0.9. Over-steepened areas should be regraded to match the overall slope and be no steeper than 2H:1V.

Therefore, it is recommended that the residual, or failed soil mass, be excavated and regraded. Drainage improvements should be provided to control surface water and mitigate erosion, as well as vegetation reestablished in the vicinity of the slide area and clearing that was previously performed. In order to determine the depth of excavations, test pits inspected by the Geotechnical Engineer should be considered during construction. Excavations should be regraded to slopes no steeper than 2H:1V and blended to match the adjacent grades. Any fill material required should be benched in accordance with ODOT GB-2.

Slide Area 3

Slide Area 3 extends up to approximately 240 feet above SR-7 between approximately stations 582+00 to 585+50 (approximately a failure length of 310 feet). As previously stated, due to the uncertainties in the past slope conditions and the subsurface conditions above the failure area, a back analysis was not performed. Based on the results of the DCP testing performed, it is anticipated that the bedrock surface is on the order of 7 to 10 feet below the existing ground surface at the test locations. The test locations were generally performed in the vicinity of the failed mass on the "ledge" at approximately elevation 900, immediately above the existing rock cut slope.

As stated, it is understood that the primary concern is debris, such as cobbles and boulders, will be eroded or carried from the ledge or above and fall down the rock slope as a hazard to SR- below, as observed by the damage to the existing Type D barrier observed in the field during the reconnaissance. Therefore, it is recommended that the slope be protected using erosion control mats and a wire mesh, or slope drape. Additional analysis will be required during final design to determine the loads on the rock anchors to support the slope drape. It is recommended that the existing failed material ("slough") be excavated from the ledge and the immediate slope above. Additionally, the slope drape should be anchored above the ledge in order to mitigate any fall potential from the over-steepened slope. It is recommended that consideration be given to additional exploration be performed to determine the depth and quality of the bedrock above Slide Area 3, above the DCP test locations, in order to facilitate the design of the rock anchors for the slope drape. Erosion control mats should be provided at the slope transitions to mitigate loss of material. A conceptual exhibit for the remediation is provided in Appendix IX.

5.2 Foundation Recommendations – Rockfall Barrier

Based on the information provided by the Rii design team, the proposed rockfall barrier wall is understood to consist of flexible steel mesh ropes barrier supported on steel posts. The barrier is proposed to have an exposed height of 13.5 feet above the existing pavement surface. Based on the rock fall analysis performed by Rii using the Colorado Rockfall Simulation Program (CRSP), it is calculated that the a single rockfall event will transmit a factored maximum shear-force load of 3.3 kips to a steel post.

Utilizing the soil and rock parameters provided in Table and the estimated load on the proposed steel fence post, Rii performed a lateral load analysis to determine the required embedment depths of the foundation along with maximum lateral deflections of the proposed posts. A H-pile post (size HP 10x42 and yield strength 36 ksi) was utilized for the proposed analysis. The results of the LPILE analysis are presented in Appendix VII and a summary of analysis is presented below in Table .

Table 8. Summary of Lateral Load Analysis – HP 10x42 Piles

Location/ Boring Number	Calculated Maximum Moment, (kips-ft)	Allowable Maximum Moment, (kips-ft)	Calculated Maximum Shear Force, (kips)	Allowable Maximum Shear Resistance, (kips)	Maximum Pile Head Deflection, (in)	Calculated Embedment Pile Length, (ft)	Minimum Pile Length Embedment in Bedrock, (ft)
B-001-2-22	46.2	144.9	9.0	84.1	1.94	16.0	7.0
B-001-3-22	46.3	144.9	12.8	84.1	1.87	14.0	8.0
B-001-4-22	47.0	144.9	31.7	84.1	1.78	11.5	8.0

Table 9. Lateral Design Parameters

Boring No.	Elevation (feet msl)	Strata	Unit Weight	Strength Parameter	k (soil) k_{rm} (rock)	ε_{50} (soil) E_r (rock)
B-001-2-22	682.4-679.2	Stiff Clay w/o Free Water	125 psf	S_u = 1,875 psf	---	0.007
	679.2-673.3	Sand (Reese)	125 psf	φ = 32°	50 pci	---
	673.3-672.4	Weak Rock	135 psf	q_u = 100 psi	0.0005	18,000
	672.4-662.4	Weak Rock	140 psf	q_u = 4,721 psi	0.00005	300,000
B-001-3-22	683.3-677.3	Stiff Clay w/o Free Water	125 psf	S_u = 1,875 psf	---	0.007
	677.3-675.8	Weak Rock	135 psf	q_u = 100 psi	0.0005	18,000
	675.8-665.8	Weak Rock	140 psf	q_u = 932 psi	0.0005	100,000
B-001-4-22	683.0-679.5	Stiff Clay w/o Free Water	125 psf	S_u = 1,875 psf	---	0.007
	679.5-678.0	Weak Rock	135 psf	q_u = 100 psi	0.0005	18,000
	678.0-668.0	Weak Rock	140 psf	q_u = 3,061 psi	0.00005	300,000

5.3 Site Drainage

The project site is located along the west side of State Route 7 in Belmont County, Ohio. State Route 7 runs adjacent to the Ohio River, but the site is not within the Ohio River floodplain as the earth slips are located on the upland hillside of State Route 7. Drainage from the site drains directly to the Ohio River by way of storm sewers under State Route 7. The project site consists of several slide areas located on a steep hill slope. The overall drainage area for the hillside starts near a small residential area west of State Route 7. Sheet flow is the predominant flow throughout all project drainage areas, though over time several channels have developed in the topography. Earth slips have hastened the development of these channels. The flow characteristics in each slide area are different based on topography and the location and effect of the earth slips.

Slide Area 1

The earth slide in Area 1 is along the lower third of the hill side adjacent to State Route 7. The slide failure deposited soil alongside the shoulder of State Route 7. Further up the slide area, several small channels have developed, including some alongside access paths established during investigation of the slip. Upslope of the earth slip the flow is predominantly sheet flow on a forested slope. The primary drainage concern in this area is the concentrated flow through the small concentrated channels, some of which run obliquely along the slip area.

Slide Area 2

The earth slide in Area 2 is higher along the hill side than Slide Area 1 but does not reach the top of the hill. This area is largely overburden deposited in the middle third of the hill. A natural drainage gully has formed along the south side of the slide area. This gully runs fairly directly down the hill side with minor deviations as it flows down to the base of the hill behind the shoulder barrier of State Route 7. This drainage gully collects nearly all of the drainage from Slide Area 2.

Slide Area 3

Slide Area 3 is located predominantly along a rock face of the hill. Along the top part of the hill side, the rock has soil cover. Drainage down this slide area is generally sheet flow off of the soil and down the rock face. While this flow is not channelized and may not present a danger of erosion to the rock face, it will need to be addressed alongside any proposed improvements in Slide Area 3. The soil upslope of any work in Slide Area 3 will need to be stabilized and protected from future erosion.

5.4 Drainage Recommendations

Slide Area 1

The geotechnical improvements to Slide Area 1 involve the construction of benches under the soil to provide stabilization. The earthen surface will be graded at a slope of [x:1], restoring the sheet flow to the surface of the hillside in this area. In order to collect the sheet flow, a series of two surface benches will be proposed – one along the north side of the slide area between Stations 591+00 and 593+50 at elevation 738 and a second along the south side of the slide area between Stations 588+50 and 592+00 at elevation 790. These two benches will have shallow ditches to collect the sheet flow and carry it to the catch basins along the bench. From these basins, the flow is conveyed down the hill side in closed storm sewer systems. The proposed system will also serve to convey the collected runoff from Slide Area 2, which will enter the Slide Area 1 system at Station 591+00.

Slide Area 2

The improvements to Slide Area 2 do not propose the same extent of earthwork as Slide Area 1. The main drainage concern in Slide Area 2 is the stabilization of the existing earthen gully that conveys collected flow down the hillside. There are a range of options available for lining the gully bottom and slowing and/or collecting the drainage as it flows down the hillside.

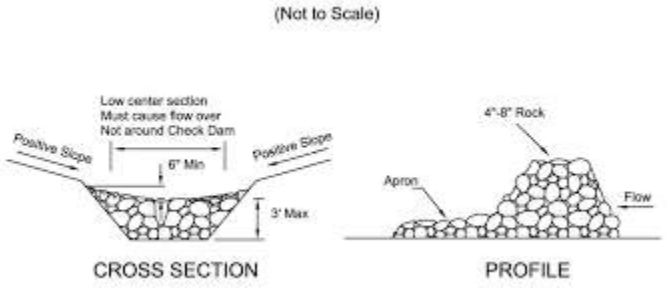
Stabilization of the gully requires lining the gully with a ditch lining capable of resisting the erosive forces of the collected flow down a steep slope. Three options are available.

The first is rock channel protection as a ditch lining. This would require placing Type B or C rock channel protection at a depth of 1.5 to 2.5 feet across the gully and up part of each side. This would slow the water and resist erosion but would require extensive excavation under the existing gully bottom elevation. The photo at left shows an example of an installation of a rock channel protection stabilized channel at a similar hillside channel at a project in Kentucky in 2019. The rock channel protection would line the gully bottom and part of the side slopes of the gully. Upslope of the rock channel protection, the gully side slopes would be seeded and mulched with temporary slope protection installed to allow the grass to take root.

The second option is the use of gabion baskets or reno mattresses. These consist of wire cages containing rock with a thickness of 6 inches to one foot with geotextile under the base. These alternatives function similar to rock channel protection in slowing the water and preventing erosion and can be installed with less excavation than rock channel protection.

The final option is the use of tied concrete block or similar surface lining. These options do not require significant excavation in and along the channel. The lining would extend along the gully bottom and up the side slopes about 18 inches. The upslope area would be seeded and mulched and protected with temporary slope protection. These linings prevent erosion of the gully bottom but do not slow the velocity of the channel flow.

The choice of channel lining will also depend on the method to slow and/or collect drainage in the gully. At the very least, one catch basin structure will be required near Station 588+50 to collect the gully flow and convey it in a closed system through Slide Area 1 to the roadside ditch. Upstream of this location there are three options. The first option slows the water as it flows down the gully but does not capture it at any point, eliminating the need for any trenching on the hill side. This option is a series of check dams, placed across the



gully at locations along the flow line of the gully. Each check dam will consist of a rock dam across the channel. The ends of the dam will be placed at or near the existing top of bank of the gully. The top of the rock dam will be an arc with the center six inches lower than the ends in order to allow for overtopping. Behind the rock check dam, there will be a short, flatter area to allow water to pond behind the dam. The entire area of the rock check dam will be underlain by geotextile fabric. The spacing between dams will depend on the local slope in the area of the dam and the accumulated flow of water reaching the dam. Rock check dams provide a flexible means to place channel impoundments to slow velocity of flow without significant excavation. The primary disadvantage of these dams is that by failing to capture and convey any water in a closed system, the dams along the lower gully channel will receive contributing flow from the entire hillside.

The second option uses periodic catch basins to capture flow and reduce the flow volume in the gully. The preferred catch basin is a CB No. 5, as the sloped grate will reduce the effects of clogging. This will reduce erosion in the gully by limiting the flow in the lower reaches of the gully and safely conveying the flow down to the base of the hill side. These catch basins would be placed sequentially down the gully and would be connected by broken back pipes. For velocity reduction in the storm sewer system, corrugated piping should be specified. The main advantage of the catch basin system is the reduction of flow volume on the hillside, reducing the erosion potential from high flow volume at a steep grade. The major disadvantage of the catch basin system is the need to trench the proposed piping down the hill side. However, use of the catch basin system reduces some of the impacts of the gabions and rock channel protection, as the backfill of the storm sewer trench could incorporate these ditch linings.

The third option is a hybrid of the two options. Periodic catch basins can be placed to bring flow into the closed storm sewer system. Rock check dams could be used on the gully to slow the flow down the hill. Because of the flow reduction, the number of dams would be reduced along the lower part of the hill. The combination of the check dams and catch basins provides for conveyance of the flow while reducing the buildup of flow in all parts of the gully.

Slide Area 3

Drainage improvements in Slide Area 3 are limited in scope. The area is located on a steep slope and is predominantly sheet flow. The proposed geotechnical improvement consists of mesh netting to control rock falls with the netting anchored upslope of the rock face. To protect against undercutting the netting, rolled erosion control matting will be used under the matting to stabilize the soil surface upslope of the rock face. This matting will be used on steep slopes under the netting. For milder sloped areas under the netting, seeding and mulching with temporary slope protection are recommended. These are less prone to eroding and the seeded slopes with a firmly rooted grass cover will safely convey the sheet flow over the ground surface.

Summary

The three slide areas addressed by this project requires a different approach. The best approach for Slide Area 1 is a benched collection system for the sheet flow with catch basins and a closed storm sewer system conveying the flow to the base of the hill side. Drainage improvements for Slide Area 2 focus on stabilizing the existing natural gully down the hillside and either using a periodic capture of the flow or a sequential series of check dams to slow the velocity of the accumulated flow. Regardless of the option selected, the system eventually ties into and uses the storm sewer system of Slide Area 1 to convey the drainage to the base of the hill. Slide Area 3 is a surface treatment of erosion control matting or seeding and mulching to stabilize the ground under the proposed mesh netting. The combination of these approaches will safely convey project drainage to the base of the hill and provide protection for the remediation of all of the earth slip areas.

5.5 Construction Considerations

All site work shall conform to local codes and to the latest ODOT CMS, including that all excavation and embankment preparation and construction should follow ODOT Item 200 (Earthwork).

5.5.1 Excavation Considerations

All excavations should be shored / braced or laid back at a safe angle in accordance to Occupational Safety and Health Administration (OSHA) guidelines. During excavation, if slopes cannot be laid back to OSHA Standards due to adjacent structures or other obstructions, temporary shoring may be required. The following table should be utilized as a general guide for implementing OSHA guidelines when estimating excavation back slopes at the various boring locations. Actual excavation back slopes must be field verified by qualified personnel at the time of excavation in strict accordance with OSHA guidelines.

Table 10. Excavation Back Slopes

Soil	Maximum Back Slope (H:V)	Notes
Soft to Medium Stiff Cohesive	1.5 : 1.0	Above Ground Water Table and No Seepage
Stiff Cohesive	1.0 : 1.0	Above Ground Water Table and No Seepage
Very Stiff to Hard Cohesive	0.75 : 1.0	Above Ground Water Table and No Seepage
All Granular & Cohesive Soil Below Ground Water Table or with Seepage	1.5 : 1.0	None
Weathered bedrock	0.75 : 1.0	Vertical excavation may be performed on competent bedrock.

5.6 Groundwater Considerations

Based on the groundwater observations made during drilling, little to no seepage of groundwater is anticipated to be encountered during construction. Based on our experience with the geology at this site, groundwater conditions affecting construction may be encountered within the trapped/perched zones. These trapped/perched zones are generally the layer(s) of granular soils that are isolated within fine-grained soil layers and may not have been encountered in the borings. If excavations encounter such layers, temporary dewatering may be accomplished by placing localized sumps and pumps within and beyond the excavation. Seepage rates from these layers are difficult to predict and flow rate could be significant. Additionally, trapped water should also be expected at the interface of bedrock and overburden soils.

Where encountered, proper groundwater control measures should be implemented to prevent disturbance to excavation bottoms consisting of cohesive soil, and to prevent the possible development of a quick or “boiling” condition if soft/loose silts and/or fine sands are encountered. It is preferable that the groundwater level, if encountered, be maintained at least 24.0 inches below the deepest excavation. Note that determining and maintaining actual groundwater levels during construction is the responsibility of the contractor.

6.0 LIMITATIONS OF STUDY

The above recommendations are predicated upon construction inspection by a qualified soil technician under the direct supervision of a professional geotechnical engineer. Adequate testing and inspection during construction are considered necessary to assure an adequate foundation system and are part of these recommendations.

The recommendations for this project were developed utilizing soil and bedrock information obtained from the test borings that were made at the proposed site for the current investigation. Resource International is not responsible for the data, conclusions, opinions or recommendations made by others during previous investigations at this site. At this time we would like to point out that soil borings only depict the soil and bedrock conditions at the specific locations and time at which they were made. The conditions at other locations on the site may differ from those occurring at the boring locations.

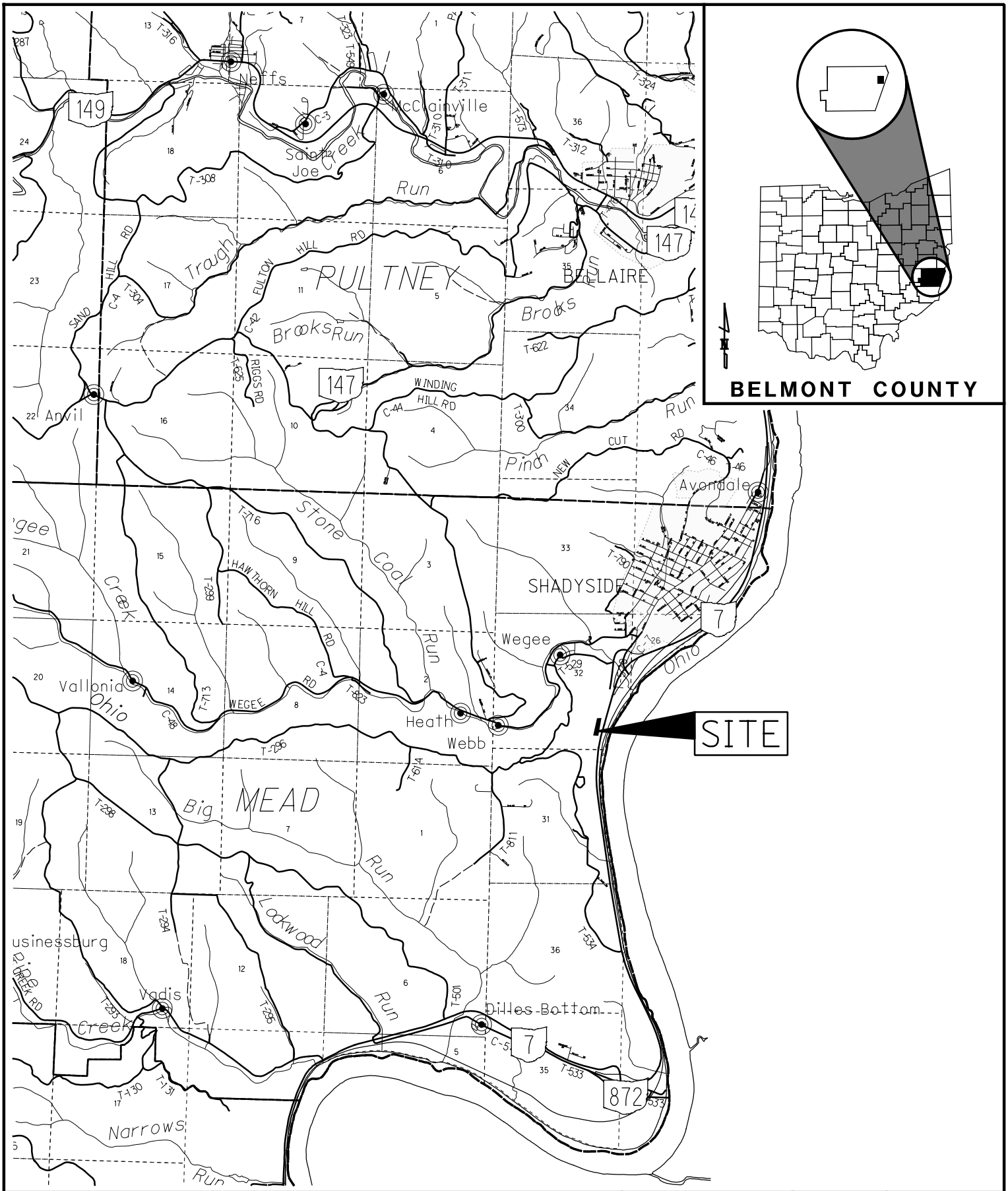
The conclusions and recommendations herein have been based upon the available soil and bedrock information and the design details furnished by a representative of the owner of the proposed project. Any revision in the plans for the proposed construction from those anticipated in this report should be brought to the attention of the geotechnical engineer to determine whether any changes in the foundation or earthwork recommendations are necessary. If deviations from the noted subsurface conditions are encountered during construction, they should also be brought to the attention of the geotechnical engineer.

The scope of our services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater or surface water within or beyond the site studied. Any statements in this report or on the test boring logs regarding odors, staining of soils or other unusual conditions observed are strictly for the information of our client.

Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with generally accepted Subgrade engineering principles and practices. Resource International is not responsible for the conclusions, opinions or recommendations made by others based upon the data included.

Appendix I

VICINITY MAP AND BORING PLAN



VICINITY MAP

BEL-7-11.04 SLOPE REPAIR

BELMONT COUNTY, OHIO

RII PROJECT NO. W-20-120	DRAWN JAS
SCALE: 1"=5000' (0, 2500, 5000)	REVIEWED MDK
	DATE 6-30-2021

RESOURCE INTERNATIONAL

B-003-2-20
B-003-1-20
B-003-0-20
SLIDE REPAIR AREA 2
WOODED AREA
DCP-6
DCP-5
DCP-4
DCP-1
DCP-3
DCP-2
SLIDE REPAIR AREA 3
Ex LA-R/W
LA-R/W
B-001-1-19
B-002-1-19
B-001-0-19
B-002-0-19
SLIDE REPAIR AREA 1
CUT ROCK SLOPE AREA
EX. CONC. BARRIER, TYPE D
EX. CONC. BARRIER, TYPE C
23.0'±
10.0'±
℄ CONST. S.R. 7
CURVE NO. 4
B-004-0-20
B-005-0-20
PT Sta. 594+02.09
SLIDE REPAIR AREA 4
OHIO RIVER
N 15° 40' 33" E

EX. SR 7 CURVE NO 4
P.I. Sta. 578+53.19
Δ = 23° 34' 18" (RT)
Dc = 0° 45' 00"
R = 7,639.44'
T = 1,593.99'
L = 3,142.89'
E = 164.52'
e_{max} =
PC Sta. 562+59.20
PT Sta. 594+02.09

HORIZONTAL SCALE IN FEET
0 30 60 120

CALCULATED JAS
CHECKED MDK

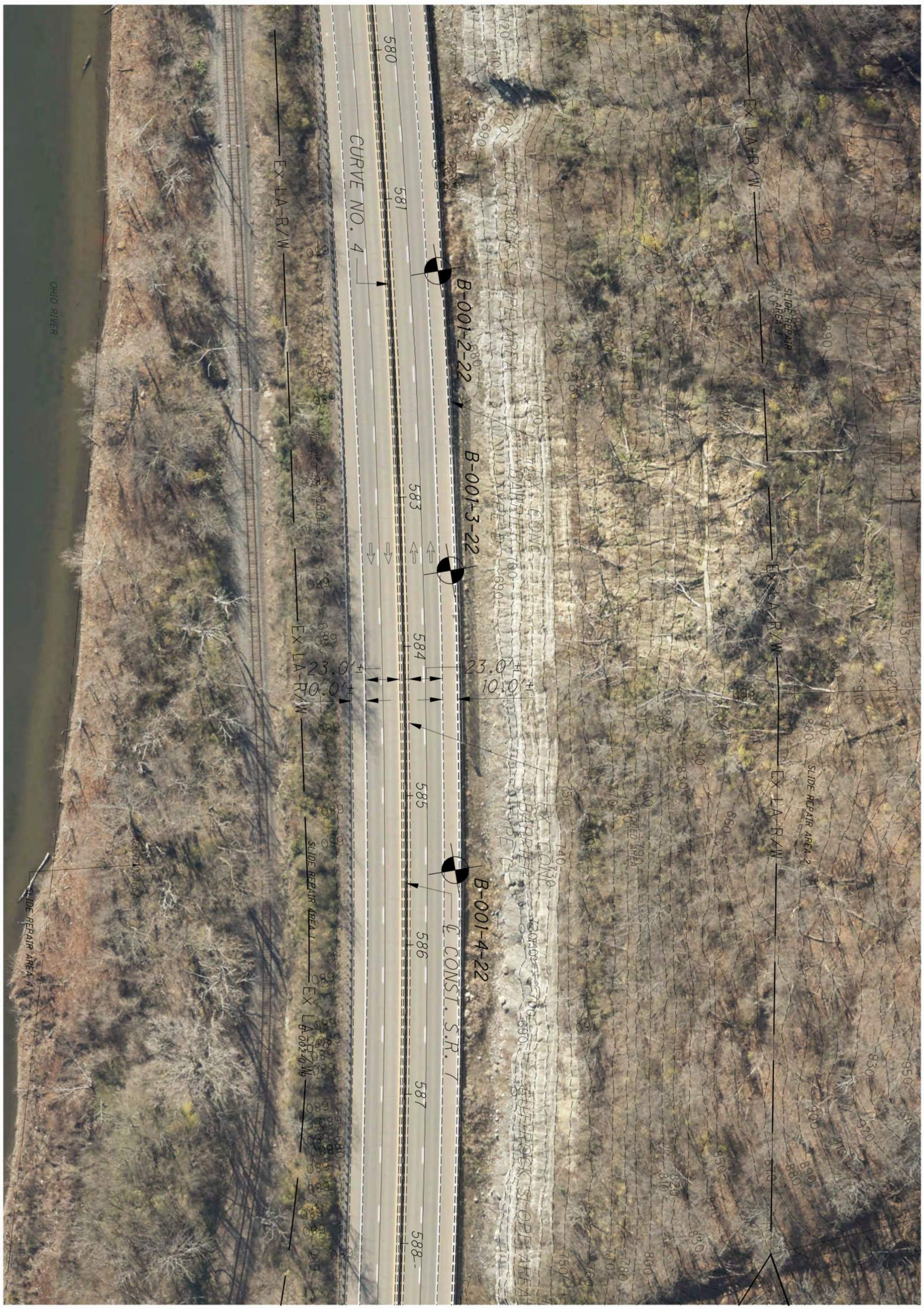
BORING LOCATION PLAN

BEL-7-11.04

1 / 1

G:\ProjectData\2020\BEL\I0788_BEL-7-11.04 W-20-120\Design\Geotechnical\Sheets\I0788_YP001.dgn Sheet 6/30/2021 9:29:56 AM juans

G:\ProjectData\2020\BEL\110788_BEL-7-11.04 W-20-120\Design\Geotechnical\Sheets\110788_YP001B.dgn Sheet 5/2/2023 3:23:12 PM adamf



BEL-7-11.04	BORING LOCATION PLAN	CALCULATED ALF / CHECKED JPS	0 100 / 50 200 HORIZONTAL SCALE IN FEET	N

Appendix II

DESCRIPTION OF SOIL TERMS

DESCRIPTION OF SOIL TERMS

The following terminology was used to describe soils throughout this report and is generally adapted from ASTM 2487/2488 and ODOT Specifications for Geotechnical Explorations.

Granular Soils - The relative compactness of granular soils is described as:
ODOT A-1, A-2, A-3, A-4 (non-plastic) or USCS GW, GP, GM, GC, SW, SP, SM, SC, ML (non-plastic)

Description	Blows per foot – SPT (N_{60})		
Very Loose	Below		5
Loose	5	-	10
Medium Dense	11	-	30
Dense	31	-	50
Very Dense	Over		50

Cohesive Soils - The relative consistency of cohesive soils is described as:
ODOT A-4, A-5, A-6, A-7, A-8 or USCS ML, CL, OL, MH, CH, OH, PT

Description	Unconfined Compression (tsf)		
Very Soft	Less than		0.25
Soft	0.25	-	0.5
Medium Stiff	0.5	-	1.0
Stiff	1.0	-	2.0
Very Stiff	2.0	-	4.0
Hard	Over		4.0

Gradation - The following size-related denominations are used to describe soils:

Soil Fraction		USCS Size	ODOT Size
Boulders		Larger than 12”	Larger than 12”
Cobbles		12” to 3”	12” to 3”
Gravel	coarse	3” to ¾”	3” to ¾“
	fine	¾” to 4.75 mm (¾” to #4 Sieve)	¾” to 2.0 mm (¾” to #10 Sieve)
Sand	coarse	4.75 mm to 2.0 mm (#4 to #10 Sieve)	2.0 mm to 0.42 mm (#10 to #40 Sieve)
	medium	2.0 mm to 0.42 mm (#10 to #40 Sieve)	-
	fine	0.42 mm to 0.074 mm (#40 to #200 Sieve)	0.42 mm to 0.074 mm (#40 to #200 Sieve)
Silt		0.074 mm to 0.005 mm (#200 to 0.005 mm)	0.074 mm to 0.005 mm (#200 to 0.005 mm)
Clay		Smaller than 0.005 mm	Smaller than 0.005 mm

Modifiers of Components - Modifiers of components are as follows:

Term	Range		
Trace	0%	-	10%
Little	10%	-	20%
Some	20%	-	35%
And	35%	-	50%

Moisture Table - The following moisture-related denominations are used to describe cohesive soils:

Term	Range - USCS	Range - ODOT
Dry	0% to 10%	Well below Plastic Limit
Damp	>2% below Plastic Limit	Below Plastic Limit
Moist	2% below to 2% above Plastic Limit	Above PL to 3% below LL
Very Moist	>2% above Plastic Limit	
Wet	≥ Liquid Limit	3% below LL to above LL

Organic Content – The following terms are used to describe organic soils:

Term	Organic Content (%)
Slightly organic	2-4
Moderately organic	4-10
Highly organic	>10

Bedrock – The following terms are used to describe the relative strength of bedrock:

Description	Field Parameter
Very Weak	Can be carved with knife and scratched by fingernail. Pieces 1 in. thick can be broken by finger pressure.
Weak	Can be grooved or gouged with knife readily. Small, thin pieces can be broken by finger pressure.
Slightly Strong	Can be grooved or gouged 0.05 in deep with knife. 1 in. size pieces from hard blows of geologist hammer.
Moderately Strong	Can be scratched with knife or pick. 1/4 in. size grooves or gouges from blows of geologist hammer.
Strong	Can be scratched with knife or pick with difficulty. Hard hammer blows to detach hand specimen.
Very Strong	Cannot be scratched by knife or pick. Hard repeated blows of geologist hammer to detach hand specimen.
Extremely Strong	Cannot be scratched by knife or pick. Hard repeated blows of geologist hammer to chip hand specimen.

DESCRIPTION OF ROCK TERMS

The following terminology was used to describe the rock throughout this report and is generally adapted from ASTM D5878 and the ODOT Specifications for Geotechnical Explorations.

Weathering – Describes the degree of weathering of the rock mass:

Description	Field Parameter
Unweathered	No evidence of any chemical or mechanical alteration of the rock mass. Mineral crystals have a right appearance with no discoloration. Fractures show little or not staining on surfaces.
Slightly Weathered	Slight discoloration of the rock surface with minor alterations along discontinuities. Less than 10% of the rock volume presents alteration.
Moderately Weathered	Portions of the rock mass are discolored as evident by a dull appearance. Surfaces may have a pitted appearance with weathering "halos" evident. Isolated zones of varying rock strengths due to alteration may be present. 10 to 15% of the rock volume presents alterations.
Highly Weathered	Entire rock mass appears discolored and dull. Some pockets of slightly to moderately weathered rock may be present and some areas of severely weathered materials may be present.
Severely Weathered	Majority of the rock mass reduced to a soil-like state with relic rock structure discernable. Zones of more resistant rock may be present but the material can generally be molded and crumbled by hand pressures.

Strength of Bedrock – The following terms are used to describe the relative strength of bedrock:

Description	Field Parameter
Very Weak	Can be carved with knife and scratched by fingernail. Pieces 1 in. thick can be broken by finger pressure.
Weak	Can be grooved or gouged with knife readily. Small, thin pieces can be broken by finger pressure.
Slightly Strong	Can be grooved or gouged 0.05 in deep with knife. 1 in. size pieces from hard blows of geologist hammer.
Moderately Strong	Can be scratched with knife or pick. 1/4 in. size grooves or gouges from blows of geologist hammer.
Strong	Can be scratched with knife or pick with difficulty. Hard hammer blows to detach hand specimen.
Very Strong	Cannot be scratched by knife or pick. Hard repeated blows of geologist hammer to detach hand specimen.
Extremely Strong	Cannot be scratched by knife or pick. Hard repeated blows of geologist hammer to chip hand specimen.

Bedding Thickness – Description of bedding thickness as the average perpendicular distances between bedding surfaces:

Description	Thickness
Very Thick	Greater than 36 inches
Thick	18 to 36 inches
Medium	10 to 18 inches
Thin	2 to 10 inches
Very Thin	0.4 to 2 inches
Laminated	0.1 to 0.4 inches
Thinly Laminated	Less than 0.1 inches

Fracturing – Describes the degree and condition of fracturing (fault, joint, or shear):

Degree of Fracturing

Description	Spacing
Unfractured	Greater than 10 feet
Intact	3 to 10 feet
Slightly Fractured	1 to 3 feet
Moderately Fractured	

Aperture Width

Description	Width
Open	Greater than 0.2 inches
Narrow	0.05 to 0.2 inches
Tight	Less than 0.05 inches

Surface Roughness

Description	Criteria
Very Rough	Near vertical steps and ridges occur on surface
Slightly Rough	Asperities on the surfaces distinguishable
Slickensided	Surface has smooth, glassy finish, evidence of Striations

RQD – Rock Quality Designation (calculation shown in report) and Rock Quality (ODOT, GB 3, January 13, 2006):

RQD %	Rock Index Property Classification (based on RQD, not slake durability index)
0 – 25%	Very Poor
26 – 50%	Poor
51 – 70%	Fair
71 – 85%	Good
86 – 100%	Very Good

CLASSIFICATION OF SOILS

Ohio Department of Transportation

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

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

MATERIAL CLASSIFIED BY VISUAL INSPECTION

 Sod and Topsoil

 Pavement or Base

 Uncontrolled Fill (Describe)

 Bouldery Zone

Peat

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

Appendix III

BORING LOGS:

B-001-2-22 through B-001-4-22, B-004-0-20 and B-005-0-20

ROCK CORE PHOTOGRAPHS

BORING LOGS

Definitions of Abbreviations

AS = Auger sample

GI = Group index as determined from the Ohio Department of Transportation classification system

HP = Unconfined compressive strength as determined by a hand penetrometer (tons per square foot)

LL_o = Oven-dried liquid limit as determined by ASTM D4318. Per ASTM D2487, if LL_o/LL is less than 75 percent, soil is classified as "organic".

LOI = Percent organic content (by weight) as determined by ASTM D2974 (loss on ignition test)

PID = Photo-ionization detector reading (parts per million)

QR = Unconfined compressive strength of intact rock core sample as determined by ASTM D2938 (pounds per square inch)

QU = Unconfined compressive strength of soil sample as determined by ASTM D2166 (pounds per square foot)

RC = Rock core sample

REC = Ratio of total length of recovered soil or rock to the total sample length, expressed as a percentage

RQD = Rock quality designation – estimate of the degree of jointing or fracture in a rock mass, expressed as a percentage:

$$\frac{\sum \text{segments equal to or longer than 4.0 inches}}{\text{core run length}} \times 100$$

S = Sulfate content (parts per million)

SPT = Standard penetration test blow counts, per ASTM D1586. Driving resistance recorded in terms of blows per 6-inch interval while letting a 140-pound hammer free fall 30 inches to drive a 2-inch outer diameter (O.D.) split spoon sampler a total of 18 inches. The second and third intervals are added to obtain the number of blows per foot (N_m).

N_{60} = Measured blow counts corrected to an equivalent (60 percent) energy ratio (ER) by the following equation: $N_{60} = N_m*(ER/60)$

SS = Split spoon sample

2S = For instances of no recovery from standard SS interval, a 2.5 inch O.D. split spoon is driven the full length of the standard SS interval plus an additional 6.0 inches to obtain a representative sample. Only the final 6.0 inches of sample is retained. Blow counts from 2S sampling are not correlated with N_{60} values.

3S = Same as 2S, but using a 3.0 inch O.D. split spoon sampler.

TR = Top of rock

W = Initial water level measured during drilling

▼ = Water level measured at completion of drilling

Classification Test Data

Gradation (as defined on Description of Soil Terms):

GR = % Gravel
SA = % Sand
SI = % Silt
CL = % Clay

Atterberg Limits:

LL = Liquid limit
PL = Plastic limit
PI = Plasticity Index

WC = Water content (%)

RESOURCE INTERNATIONAL, INC.

PROJECT: BEL SR 7 11.040	DRILLING FIRM / OPERATOR: RII / L.H.	DRILL RIG: CME 55 (386345)	STATION / OFFSET: 590+28 / 28.9'	**EXPLORATION ID B-004-0-20**
TYPE: SLOPE REPAIRS	SAMPLING FIRM / LOGGER: RII / J.K.	HAMMER: AUTOMATIC	ALIGNMENT: SR-7	
PID: NA SFN: NA	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 9/14/20	ELEVATION: 679.4 (MSL) EOB: 31.0 ft.	PAGE 1 OF 2
START: 10/13/20 END: 10/13/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 84.2	LAT / LONG: 39.953555, -80.763893	

MATERIAL DESCRIPTION AND NOTES	ELEV. 679.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
0.8' - ASPHALT (10.0")	678.6																	
0.2' - AGGREGATE BASE (2.0")	678.4																	
FILL: MEDIUM DENSE, GRAY **GRAVEL WITH SAND**, TRACE SILT, DAMP.	676.4	1	10 7 7	20	67	SS-1	-	-	-	-	-	-	-	-	-	3	A-1-b (V)	
FILL: STIFF, GRAY TO BROWNISH GRAY **SILT AND CLAY**, SOME FINE TO COARSE SAND, TRACE FINE GRAVEL, DAMP.	673.9	2 3 4 5	5 4 5	13	39	SS-2	2.00	-	-	-	-	-	-	-	-	18	A-6a (V)	
FILL: LOOSE, BROWNISH GRAY **GRAVEL WITH SAND, SILT, AND CLAY**, MOIST.	672.4	6 7 8 9 10	7 3 7	14	44	SS-3	2.00	9	17	11	32	31	32	21	11	12	A-6a (6)	
STIFF, DARK GRAY **CLAY**, SOME SILT, SOME FINE TO COARSE SAND, TRACE FINE GRAVEL, MOIST.	670.9	11 12 13 14 15	8 4 3	10	44	SS-4	-	-	-	-	-	-	-	-	-	13	A-2-6 (V)	
STIFF, DARK GRAY **SILTY CLAY**, SOME FINE TO COARSE SAND, TRACE FINE GRAVEL, MOIST.	668.9	16 17 18 19 20	2 2 2	6	44	SS-5	1.50	9	11	10	30	40	45	23	22	27	A-7-6 (13)	
STIFF TO VERY STIFF, GRAY **SANDY SILT**, SOME FINE GRAVEL, LITTLE CLAY, DAMP TO MOIST.	663.9	21 22 23 24 25	2 2 3	7	61	SS-6	2.00	7	16	15	30	32	40	23	17	31	A-6b (8)	
GRAY **SANDSTONE FRAGMENTS**.	663.4	TR	5 6 6	17	100	SS-7	3.00	-	-	-	-	-	-	-	-	15	A-6a (V)	
LIMESTONE : GRAY, SLIGHTLY WEATHERED, STRONG, THICK TO MEDIUM BEDDED, FERRIFEROUS, FOSSILIFEROUS, MODERATELY FRACTURED, NARROW, SLIGHTLY ROUGH, INTACT/MASSIVE, GOOD.	660.4	26 27 28 29 30	40 35 40	105	81	SS-8	1.50	31	9	14	34	12	29	19	10	5	A-4a (2)	
COAL : BLACK, UNWEATHERED, VERY WEAK, HIGHLY FRACTURED, NARROW, ROUGH.	657.4	31	50/5"	-	40	SS-9	-	-	-	-	-	-	-	-	-	3	Rock (V)	
LIMESTONE : LIGHT GRAY AND GRAY, SLIGHTLY WEATHERED, STRONG, THICK BEDDED, FOSSILIFEROUS, CHERTY, SLIGHTLY FRACTURED, NARROW, SMOOTH, INTACT/MASSIVE, GOOD. -QU @ 23.0' = 15,532 PSI			55		80	NQ2-1											CORE	
			74		99	NQ2-2											CORE	
			91		100	NQ2-3											CORE	

PID: NA	SFN:	PROJECT: BEL SR 7 11.040	STATION / OFFSET: 59028, 29'	START: 10/13/20	END: 10/13/20	PG 2 OF 2	B-004-0-20

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
	649.4																	
	648.4	EOB 31																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING; CAVE-IN DEPTH @ 21.3'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: COMPACTED WITH THE AUGER 100 LBS BENTONITE CHIPS AND SOIL CUTTINGS. PAVEMENT PATCHED WITH ASPHALT COLD PATCH .

RESOURCE INTERNATIONAL, INC.

PROJECT: BEL SR 7 11.040	DRILLING FIRM / OPERATOR: RII / L.H.	DRILL RIG: CME 55 (386345)	STATION / OFFSET: 591+29 / 40'	**EXPLORATION ID B-005-0-20**
TYPE: SLOPE REPAIRS	SAMPLING FIRM / LOGGER: RII / J.K.	HAMMER: AUTOMATIC	ALIGNMENT: SR-7	
PID: NA SFN: NA	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 9/14/20	ELEVATION: 677.7 (MSL) EOB: 37.4 ft.	PAGE 1 OF 2
START: 10/13/20 END: 10/13/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 84.2	LAT / LONG: 39.953815, -80.763766	

MATERIAL DESCRIPTION AND NOTES	ELEV. 677.7	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
FILL: VERY STIFF TO HARD, DARK GRAY TO DARK BROWN **SILTY CLAY**, SOME FINE TO COARSE SAND, TRACE FINE GRAVEL, DAMP TO MOIST.		1	3 5 4	13	58	SS-1	4.5+	-	-	-	-	-	-	-	-	14	A-6b (V)	
		2	9 8 10	25	75	SS-2	4.00	7	15	10	31	37	37	20	17	20	A-6b (9)	
-COAL FRAGMENTS @ 1.5'-6.0'		3 4	6 7 10	24	78	SS-3	4.25	-	-	-	-	-	-	-	-	14	A-6b (V)	
		5 6	7 5 7	17	75	SS-4	4.25	-	-	-	-	-	-	-	-	14	A-6b (V)	
	671.7																	
STIFF TO VERY STIFF, BROWNISH GRAY TO GRAY **CLAY**, SOME SILT, LITTLE FINE TO COARSE SAND, TRACE FINE GRAVEL, MOIST.		7	6 4 5	13	44	SS-5	1.50	-	-	-	-	-	-	-	-	14	A-7-6 (V)	
-COAL FRAGMENTS AND AND NAPHTHALENE ODOR IN SS-5		8 9			63	ST-6	2.50	1	10	9	34	46	47	23	24	24	A-7-6 (15)	
		10 11																
		12	3 4 5	13	89	SS-7	2.50	1	7	7	36	49	54	25	29	26	A-7-6 (18)	
		13 14	3 2 4	8	78	SS-8	2.50	-	-	-	-	-	-	-	-	28	A-7-6 (V)	
		15 16																
		17	4 4 6	14	0	SS-9	-	-	-	-	-	-	-	-	-	-		
		18	6	-	67	2S-SS-9A	2.50	2	6	6	33	53	54	25	29	28	A-7-6 (18)	
		19 20	4 3 5	11	39	SS-10	2.75	-	-	-	-	-	-	-	-	24	A-7-6 (V)	
	657.2																	
VERY STIFF, BROWN **SANDY SILT**, LITTLE CLAY, TRACE FINE GRAVEL, MOIST.		21																
-SANDSTONE FRAGMENTS IN SS-11		22	8 7 50/5"	-	94	SS-11	2.50	-	-	-	-	-	-	-	-	14	A-4a (V)	
	655.3	TR																
LIMESTONE : LIGHT GRAY AND GRAY, SLIGHTLY WEATHERED, STRONG, THIN BEDDED, FOSSILIFEROUS, CHERTY, SLIGHTLY FRACTURED, NARROW, SMOOTH, INTACT/MASSIVE, GOOD.		23 24 25	68		87	NQ2-1											CORE	
-QU @ 22.9' = 8,441 PSI																		
-RUBBLIZED @																		
-45° VERTICAL FRACTURE @ 27.9'-28.3'		26 27 28 29	72		97	NQ2-2											CORE	

PID: NA	SFN:	PROJECT: BEL SR 7 11.040	STATION / OFFSET: 59129, 40'	START: 10/13/20	END: 10/13/20	PG 2 OF 2	B-005-0-20

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
LIMESTONE : LIGHT GRAY AND GRAY, SLIGHTLY WEATHERED, STRONG, THIN BEDDED, FOSSILIFEROUS, CHERTY, SLIGHTLY FRACTURED, NARROW, SMOOTH, INTACT/MASSIVE, GOOD. *(continued)*	647.7	31																
		32																
		33																
-45° VERTICAL FRACTURE @ 33.6'-33.8'			92		100	NQ2-3											CORE	
		34																
		35																
		36																
-ARGILLACEOUS @ 36.5-37.4'	640.3	37 EOB	100		100	NQ2-4											CORE	

NOTES: SEEPAGE @ 6'-8'; GROUNDWATER NOT ENCOUNTERED DURING DRILLING; CAVE-IN DEPTH @ 23.2'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: COMPACTED WITH THE AUGER 100 LBS BENTONITE CHIPS AND SOIL CUTTINGS. PAVEMENT PATCHED WITH ASPHALT COLD PATCH .

RESOURCE INTERNATIONAL, INC.

PROJECT: BEL- 7-11.04	DRILLING FIRM / OPERATOR: RII / L.H.	DRILL RIG: CME 55 (386345)	STATION / OFFSET: 581+50 / 33' LT	**EXPLORATION ID**	
TYPE: STRUCTURE FOUNDATION	SAMPLING FIRM / LOGGER: RII / E.T.	HAMMER: AUTOMATIC	ALIGNMENT: SR 7	**B-001-2-22**	
PID: 110788 SFN: NA	DRILLING METHOD: 4.5" CFA / NQ	CALIBRATION DATE: 9/14/20	ELEVATION: 682.4 (MSL) EOB: 20.0 ft.	PAGE	
START: 12/21/22 END: 12/22/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 84.2	LAT / LONG: 39.951218, -80.764690	1 OF 1	

MATERIAL DESCRIPTION AND NOTES	ELEV. 682.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
0.8' - ASPHALT (9.0")	681.6																	
0.7' - AGGREGATE BASE (9.0")	680.9																	
HARD, GRAY **SILT AND CLAY**, SOME FINE GRAVEL, LITTLE FINE TO COARSE SAND, DAMP.	679.2		5 4 7	15	61	SS-1	4.50	28	12	8	28	24	33	18	15	13	A-6a (5)	
MEDIUM DENSE, GRAY **GRAVEL WITH SAND, SILT, AND CLAY**, DAMP. -COAL FRAGMENTS THROUGHOUT			11 10 11	29	61	SS-2	-	59	11	5	16	9	29	18	11	10	A-2-6 (0)	
			14 9 9	25	61	SS-3	-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
	673.3	TR	3 4 40	62	67	SS-4A	-	-	-	-	-	-	-	-	-	10	A-2-6 (V)	
DARK GRAY **SHALE FRAGMENTS**, DAMP.	672.4					SS-4B	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE : LIGHT GRAY AND GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY FINE GRAINED TO FINE GRAINED, LAMINATED TO THIN BEDDED, HIGHLY BIOTURBATED, CALCAREOUS, CARBONACEOUS, CLAYEY TO SILTY, MODERATELY FRACTURED, NARROW TO OPEN APERATURES, VERY ROUGH SURFACES, BLOCKY/DISTURBED/SEAMY, FAIR. -QU @ 10.0' = 4,721 PSI -THIN CLAY SEAM @ 13.4' -CLAYEY/SILTY ZONE FROM 13.5' TO 16.0' -MEDIUM GRAINED ZONE FROM 16.0' TO 17.0'			70		97	NQ2-1											CORE	
			88		100	NQ2-2											CORE	
	662.4	EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 50 LBS. BENTONITE CHIPS AND SOIL CUTTINGS. PAVEMENT PATCHED WITH COLD PATCH ASPHALT. .

RESOURCE INTERNATIONAL, INC.

PROJECT: BEL- 7-11.04	DRILLING FIRM / OPERATOR: RII / L.H.	DRILL RIG: CME 55 (386345)	STATION / OFFSET: 583+50 / 33' LT	**EXPLORATION ID**	
TYPE: STRUCTURE FOUNDATION	SAMPLING FIRM / LOGGER: RII / E.T.	HAMMER: AUTOMATIC	ALIGNMENT: SR 7	**B-001-3-22**	
PID: 110788 SFN: NA	DRILLING METHOD: 4.5" CFA / NQ	CALIBRATION DATE: 9/14/20	ELEVATION: 683.3 (MSL) EOB: 17.5 ft.	PAGE	
START: 12/21/22 END: 12/21/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 84.2	LAT / LONG: 39.951764, -80.764589	1 OF 1	

MATERIAL DESCRIPTION AND NOTES	ELEV. 683.3	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
0.8' - ASPHALT (10.0")	682.5	1																
0.7' - AGGREGATE BASE (8.0")	681.8																	
VERY STIFF TO HARD, GRAY TO BROWNISH GRAY **SILTY CLAY**, LITTLE COARSE AND FINE SAND, LITTLE FINE GRAVEL, MOIST.		2	6 10 14	34	72	SS-1	4.50	-	-	-	-	-	-	-	-	16	A-6b (V)	
-COAL FRAGMENTS THROUGHOUT		3																
		4	5 10 6	22	72	SS-2	4.00	17	9	9	29	36	34	18	16	17	A-6b (8)	
	677.3	5																
GRAY **SHALE FRAGMENTS**, DAMP.		TR 6																
	675.8	7	50 30 42	101	67	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE : LIGHT GRAY AND GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY FINE GRAINED TO FINE GRAINED, LAMINATED TO THIN BEDDED, BIOTURBATED, CALCAREOUS (LIMESTONE SEAMS), CARBONACEOUS, CLAYEY TO SILTY, MODERATELY FRACTURED, NARROW TO OPEN APERATURES, VERY ROUGH SURFACES, BLOCKY/DISTURBED/SEAMY, FAIR.		8																
-SHALEY ZONE FROM 9.6'-11.3'		9																
-CLAY SEAM/SOFT ZONE @ 10.3'-10.6'		10	38		88	NQ2-1											CORE	
-QU @ 12.0' = 932 PSI		11																
-WATER LOSS @ 13.5'		12																
		13																
-CARBONACEOUS NODULES IN RC-2		14																
		15	40		90	NQ2-2											CORE	
-0.25" CLAY SEAM @ 16.2'		16																
-SOFT/FRIABLE ZONE @ 16.6'-16.8'	665.8	EOB 17																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 50 LBS. BENTONITE CHIPS AND SOIL CUTTINGS. PAVEMENT PATCHED WITH COLD PATCH ASPHALT. .

00-2021 NEW STA ODOT BORING LOG (8.5X11) - OH DOT.GDT - 2/20/23 12:29 - U:\GI8\PROJECTS\2020\W-20-120.GPJ

RESOURCE INTERNATIONAL, INC.

PROJECT: BEL- 7-11.04	DRILLING FIRM / OPERATOR: RII / L.H.	DRILL RIG: CME 55 (386345)	STATION / OFFSET: 585+50 / 33' LT	**EXPLORATION ID**	
TYPE: STRUCTURE FOUNDATION	SAMPLING FIRM / LOGGER: RII / E.T.	HAMMER: AUTOMATIC	ALIGNMENT: SR 7	**B-001-4-22**	
PID: 110788 SFN: NA	DRILLING METHOD: 4.5" CFA / NQ	CALIBRATION DATE: 9/14/20	ELEVATION: 683.0 (MSL) EOB: 15.0 ft.	PAGE	
START: 12/21/22 END: 12/21/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 84.2	LAT / LONG: 39.952308, -80.764469	1 OF 1	

MATERIAL DESCRIPTION AND NOTES	ELEV. 683.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
0.9' - ASPHALT (11.0")	682.1																	
0.6' - AGGREGATE BASE (7.0")	681.5																	
VERY STIFF, GRAY **SANDY SILT**, LITTLE CLAY, TRACE FINE GRAVEL, DAMP. -COAL FRAGMENTS THROUGHOUT	679.5		4 3 8	15	39	SS-1	3.00	-	-	-	-	-	-	-	-	10	A-4a (V)	
GRAY AND DARK GRAY **SHALE FRAGMENTS**, DAMP.	678.0	TR	50/5"	-	100	SS-2	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE : LIGHT GRAY AND GRAY, SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, VERY FINE GRAINED TO FINE GRAINED, LAMINATED TO THIN BEDDED, BIOTURBATED, CALCAREOUS (LIMESTONE SEAMS), CARBONACEOUS, CLAYEY TO SILTY, MODERATELY FRACTURED, NARROW TO OPEN APERATURES, VERY ROUGH SURFACES, BLOCKY/DISTURBED/SEAMY, FAIR. -QU @ 6.0' = 3,061 PSI -SHALEY/CARBONACEOUS ZONE FROM 7.8'-10.2' -BIOTURBATED ZONE FROM 10.0'-11.5'			40		83	NQ-1											CORE	
-BECOMING COARSER GRAINED IN RC-2 -WATER LOSS @ 14.0'	668.0	EOB	83		100	NQ-2											CORE	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 50 LBS. BENTONITE CHIPS AND SOIL CUTTINGS. PAVEMENT PATCHED WITH COLD PATCH ASPHALT. .

00-2021 NEW STA ODOT BORING LOG (8.5X11) - OH DOT.GDT - 2/20/23 12:29 - U:\GI8\PROJECTS\2020\W-20-120.GPJ

Project Name: BEL-7-11.04	Location: Belmont County, Ohio	Project No.: Rii. W-20-120

Photo No.
1

Boring:
B-001-2-22

RC-1: 10.0'-15.0'
REC (%):97%
RQD (%):70%

RC-2: 15.0'-20.0'
REC (%):100%
RQD (%):88%

Project Name: BEL-7-11.04	Location: Belmont County, Ohio	Project No.: Rii. W-20-120

Photo No.
2

Boring:
B-001-3-22

RC-1: 7.5'-12.5'
REC (%):88%
RQD (%):38%

RC-2: 37.0'-42.0'
REC (%):90%
RQD (%):40%

Project Name: BEL-7-11.04	Location: Belmont County, Ohio	Project No.: Rii. W-20-120

Photo No. 3	
Boring: B-001-4-22	
RC-1: 5.0'-10.0' REC (%): 83% RQD (%): 40%	
RC-2: 10.0'-15.0' REC (%): 100% RQD (%): 83%	

Appendix IV

CTL Boring Logs (May 2019 and March 2020)

Corrections by Resource International, Inc.

PROJECT: BEL-7-11.05	DRILLING FIRM / OPERATOR: CTL / RANDY	DRILL RIG: TRACK 55	STATION / OFFSET: 589+96 / -207.2	EXPLORATION ID B-001-0-19
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / RANDY	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-7	
PID: 10176 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 10/2/17	ELEVATION: 791.8 (MSL) EOB: 115.0 ft.	PAGE 1 OF 4
START: 5/6/19 END: 5/10/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 90	COORD: 39.9536310, -80.7650654	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
STIFF, BROWN, **CLAY**, CONTAINS COBBLES, DAMP	791.8		4 3 4	11	33	SS-1	-	-	-	-	-	-	-	-	-	15	A-7-6 (V)	
@3.5'; MEDIUM STIFF, MOIST	680.0		2 2 3	8	78	SS-2	-	-	-	-	-	-	-	-	-	26	A-7-6 (V)	
@6.0'; STIFF			3 4 6	15	100	SS-3A	-	-	-	-	-	-	-	-	-	20	A-7-6 (V)	
						SS-3B	-	-	-	-	-	-	-	-	-	36	A-7-6 (V)	
@8.5'; HARD, GRAY			9 11 13	36	33	SS-4	-	-	-	-	-	-	-	-	-	2	A-7-6 (V)	
@11.0'; STIFF, BROWN			27 9 3	18	22	SS-5	1.50	-	-	-	-	-	-	-	-	28	A-7-6 (V)	
	666.5	778.3 TR																
SILTSTONE, GRAY, SEVERELY WEATHERED, VERY WEAK.	665.0	776.8	24 18 40	87	100	SS-6	-	-	-	-	-	-	-	-	-	19	Rock (V)	
SHALE, BROWN, SEVERELY WEATHERED, VERY WEAK, FRIABLE, ARGILLACEOUS, (SOIL-LIKE); RQD 0%, REC 67%.	664.5	776.3	17		42	NQ-1											CORE	
LIMESTONE, BROWN, MODERATELY WEATHERED, STRONG, CALCAREOUS, CONTAINS ARGILACEOUS SHALE INTERBEDS; RQD 57%, REC 82%. @17.5'; GRAY, UNWEATHERED, VERY STRONG.			48		95	NQ-2											CORE	
@21.0'; BROWN, SLIGHTLY WEATHERED. @21.6'; GRAY, UNWEATHERED.			65		75	NQ-3											CORE	
			69		96	NQ-4											CORE	

PID: 10176	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 5/6/19	END: 5/10/19	PG 2 OF 4	B-001-0-19

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
761.8																		
LIMESTONE, BROWN, MODERATELY WEATHERED, STRONG, CALCAREOUS, CONTAINS ARGILACEOUS SHALE INTERBEDS; RQD 57%, REC 82%. *(continued)*	650.0																	
	646.0	757.8																
SHALE, GRAY, SLIGHTLY WEATHERED, WEAK, FRIABLE, CALCAREOUS; RQD 14%, REC 85%.			23		91	NQ-5											CORE	
@35.5'; MODERATELY WEATHERED, VERY WEAK, ARGILLACEOUS.																		
@37.0'; SEVERELY WEATHERED.																		
	641.0	752.8																
LIMESTONE, GRAY, UNWEATHERED, VERY STRONG, CONTAINS CALCAREOUS SHALE INTERBEDS; RQD 85%, REC 99%.			62		91	NQ-6											CORE	
@43.0'; BROWN, HIGHLY WEATHERED, STRONG.			90		100	NQ-7											CORE	
@46.0'; GRAY, SLIGHTLY WEATHERED.																		
@47.0'; UNWEATHERED, VERY STRONG.																		
	631.0	742.8																
SHALE, GRAY, MODERATELY WEATHERED, VERY WEAK, FRIABLE, CALCAREOUS; RQD 42%, REC 71%. @49.5'; UNWEATHERED, STRONG.			55		73	NQ-8											CORE	
	626.0	737.8																
LIMESTONE, GRAY, UNWEATHERED, VERY STRONG; RQD 63%, REC 63%.			56		66	NQ-9											CORE	
	623.0	734.8																
SHALE, GRAY, SLIGHTLY WEATHERED, SLIGHTLY STRONG, FRIABLE, CALCAREOUS; RQD 97%, REC 97%.			93		96	NQ-10											CORE	
	620.0	731.8																
LIMESTONE, GRAY, SLIGHTLY WEATHERED, STRONG; RQD 85%, REC 97%.																		

PID: 10176	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 5/6/19	END: 5/10/19	PG 3 OF 4	B-001-0-19

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
729.7	~~617.9~~																	
LIMESTONE, GRAY, SLIGHTLY WEATHERED, STRONG; RQD 85%, REC 97%. *(continued)*	~~616.0~~	727.8																
SHALE, GRAY, SLIGHTLY WEATHERED, SLIGHTLY STRONG, CALCAREOUS; RQD 70%, REC 92%.			100		100	NQ-11											CORE	
			46		88	NQ-12											CORE	
	~~608.0~~	719.8																
LIMESTONE, GRAY, UNWEATHERED, VERY STRONG, CARBONACEOUS, CONTAINS CALCOREOUS CABONACEOUS SHALE INTERBEDS; RQD 83%, REC 93%.			73		100	NQ-13											CORE	
			100		100	NQ-14											CORE	
	~~595.5~~	707.3																
SHALE, GRAY AND BLACK, SLIGHTLY WEATHERED, WEAK, FRIABLE, CARBONACEOUS; RQD 78%, REC 100%.			83		88	NQ-15											CORE	
@87.0'; GRAY, SLIGHTLY WEATHERED.			55		98	NQ-16											CORE	

PID: 10176	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 5/6/19	END: 5/10/19	PG 4 OF 4	B-001-0-19

MATERIAL DESCRIPTION AND NOTES	697.5	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
SHALE, GRAY AND BLACK, SLIGHTLY WEATHERED, WEAK, FRIABLE, CARBONACEOUS; RQD 78%, REC 100%. *(continued)* @94.5'; UNWEATHERED, STRONG, CALCAREOUS.		~~585.7~~		89		98	NQ-17											CORE	
		~~583.0~~	694.8																
LIMESTONE, GRAY, UNWEATHERED, VERY STRONG; RQD 70%, REC 97%.				70		97	NQ-18											CORE	
		~~578.0~~	689.8																
SHALE, GRAY, UNWEATHERED, STRONG; RQD 65%, REC 92%.		~~576.0~~	687.8	63		94	NQ-19											CORE	
LIMESTONE, GRAY, UNWEATHERED, VERY STRONG; RQD 83%, REC 88%.		~~575.0~~	686.8																
SHALE, GRAY, UNWEATHERED, STRONG; RQD 50%, REC 100%.		~~573.0~~	684.8																
LIMESTONE, GRAY, UNWEATHERED, VERY STRONG; RQD 81%, REC 100%.				81		167	NQ-20											CORE	
		~~567.5~~	679.3																
SHALE, GRAY AND BLACK, HIGHLY WEATHERED, VERY WEAK, FRIABLE, CALCAREOUS, ARGILLACEOUS; RQD 0%, REC 53%.		~~565.0~~	676.8	0		53	NQ-21											CORE	
			EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

Corrections by Resource International, Inc.

PROJECT: BEL-7-11.05	DRILLING FIRM / OPERATOR: CTL / TOM	DRILL RIG: TRACK 55	STATION / OFFSET: 589+77 / -296.8	EXPLORATION ID B-001-1-19
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / TOM	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-7	
PID: 10176 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 10/2/17	ELEVATION: 837.6 (MSL) EOB: 60.6 ft.	PAGE 1 OF 2
START: 5/14/19 END: 5/14/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 90	COORD: 39.9536230, -80.7647391	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
837.6																		
SOFT, BROWN, **CLAY**, CONTAINS WOOD, FILL, MOIST	732.0		2 1 1	3	100	SS-1	0.50	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
	730.0	835.6																
STIFF, REDDISH BROWN, **CLAY**, AND SILT, LITTLE SAND, TRACE GRAVEL, MOIST			2 2 5	11	100	SS-2	1.50	-	-	-	-	-	-	-	-	28	A-7-6 (V)	
			3 3 4	11	67	NQ-3	1.50	10	13	7	70	-	51	29	22	28	A-7-6 (14)	
@7.5'; VERY STIFF			3 4 5	14	100	SS-4	2.50	-	-	-	-	-	-	-	-	34	A-7-6 (V)	
	723.0	828.6																
HARD, GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST			5 8 16	36	100	NQ-5	4.50	1	5	8	86	-	31	18	13	17	A-6a (9)	
@12.5'; VERY STIFF, CONTAINS ROCK FRAGMENTS, DAMP			6 8 20	42	100	SS-6	2.50	-	-	-	-	-	-	-	-	15	A-6a (V)	
	717.5	823.4 TR																
SHALE, GRAY, SLIGHTLY WEATHERED, SLIGHTLY STRONG, ARENACEOUS, CALCAREOUS; RQD 76%, REC 76%.			76		76	NQ-1											CORE	
	714.0	819.6																
SANDSTONE, GRAY, UNWEATHERED, STRONG, CONTAINS SHALE INTERBEDS; RQD 94%, REC 100%.			92		100	NQ-2											CORE	
			97		100	NQ-3											CORE	

PID: 10176	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 5/14/19	END: 5/14/19	PG 2 OF 2	B-001-1-19

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
	807.6																	
	~~702.0~~																	
	~~701.0~~	806.6	85		94	NQ-4											CORE	
SHALE, GRAY, SLIGHTLY WEATHERED, WEAK, FRIABLE; RQD 46%, REC 82%.																		
	~~695.5~~	801.1	40		85	NQ-5											CORE	
INTERBEDDED SHALE (50%) AND LIMESTONE (50%), RQD 47%, REC. 80%; **SHALE**, GRAY, SLIGHTLY WEATHERED, WEAK, FRIABLE; **LIMESTONE**, GRAY, SLIGHTLY WEATHERED, STRONG.	~~693.0~~	798.6	53		83	NQ-6											CORE	
SHALE, BLACK, SLIGHTLY WEATHERED, WEAK, FRIABLE, CALCAREOUS; RQD 57%, REC 94%.			61		96	NQ-7											CORE	
	~~681.0~~	786.6	76		100	NQ-8											CORE	
INTERBEDDED SHALE (60%) AND LIMESTONE (40%), RQD 82%, REC. 96%; **SHALE**, BLACK, SLIGHTLY WEATHERED, WEAK, FRIABLE, CALCAREOUS; **LIMESTONE**, GRAY, UNWEATHERED, VERY STRONG.			69		96	NQ-9											CORE	
@58.0'; SHALE IS ARENACEOUS.																		
	~~671.4~~	777.0 EOB	80		100	NQ-10											CORE	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

Corrections by Resource International, Inc.

PROJECT: BEL-7-11.05	DRILLING FIRM / OPERATOR: CTL / TOM	DRILL RIG: TRACK 55	STATION / OFFSET: 592+72 / -159.4	EXPLORATION ID B-002-0-19
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / TOM	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-7	
PID: 10176 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 10/2/17	ELEVATION: 735.1 (MSL) EOB: 65.0 ft.	PAGE 1 OF 3
START: 5/3/19 END: 5/3/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 90	COORD: 39.9536230, -80.7643173	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
VERY STIFF, BROWN, **CLAY**, AND SILT, LITTLE GRAVEL, LITTLE SAND, CONTAINS ROCK FRAGMENTS, DAMP	735.1 ~~638.0~~		2 6 7	20	67	NQ-1	2.00	16	9	5	- 70 -		57	26	31	-	A-7-6 (18)	
			2 3 3	9	100	SS-2	1.00	-	-	-	-	-	-	-	-	17	A-7-6 (V)	
			5 7 6	20	78	SS-3	-	-	-	-	-	-	-	-	-	-	A-7-6 (V)	
			4 8 12	30	100	SS-4	-	-	-	-	-	-	-	-	-	15	A-7-6 (V)	
	~~627.5~~	724.6																
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY	~~626.0~~	723.1	14 50/5"	-	100	NQ-5	-	36	17	17	- 30 -		25	15	10	-	A-2-4 (0)	
		TR																
CLAYSTONE, BROWN, SEVERELY WEATHERED, VERY WEAK, FRIABLE, CONGLOMERITIC; RQD 0%, REC 100%.	~~624.5~~	721.6																
LIMESTONE, GRAY, UNWEATHERED, VERY STRONG, CALCAREOUS, CONTAINS CALCAREOUS SHALE INTERBEDS; RQD 85%, REC 98%.			67		100	NQ-1											CORE	
			94		99	NQ-2											CORE	
			90		97	NQ-3											CORE	
	~~611.5~~	708.6																
SHALE, GRAY, SEVERELY WEATHERED, VERY WEAK, FRIABLE, CALCAREOUS; RQD 94%, REC 100%. @27.5'; SLIGHTLY WEATHERED, WEAK.	~~609.5~~	706.6	73		98	NQ-4											CORE	
LIMESTONE, GRAY, SLIGHTLY WEATHERED, STRONG, CALCAREOUS; RQD 98%, REC 100%.																		

PID: 10176	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 5/3/19	END: 5/3/19	PG 2 OF 3	B-002-0-19

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
LIMESTONE, GRAY, SLIGHTLY WEATHERED, STRONG, CALCAREOUS; RQD 98%, REC 100%. *(continued)*	705.1 ~~608.0~~	31	95		99	NQ-5											CORE	
@33.5'; UNWEATHERED, VERY STRONG.		32																
		33																
		34																
		35																
		36	100		100	NQ-6											CORE	
		37																
		38																
		39																
	~~598.5~~ 695.6	40																
SHALE, GRAY, SLIGHTLY WEATHERED, WEAK, FRIABLE, CALCAREOUS; RQD 77%, REC 100%.		41	90		100	NQ-7											CORE	
		42																
		43																
		44																
		45																
		46	74		98	NQ-8											CORE	
		47																
		48																
	~~589.0~~ 686.1	49																
LIMESTONE, GRAY, UNWEATHERED, VERY STRONG; RQD 92%, REC 97%.		50																
		51	88		100	NQ-9											CORE	
		52																
		53																
		54																
	~~583.0~~ 680.1	55																
SHALE, GRAY, SEVERELY WEATHERED, VERY WEAK, FRIABLE, ARENACEOUS, ARGILLACEOUS, CALCAREOUS; RQD 8%, REC 96%.		56																
		57	7		95	NQ-10											CORE	
		58																
		59																
	~~579.0~~ 676.1	60																
COAL, BLACK, UNWEATHERED, WEAK, FRIABLE; RQD 61%, REC 96%.	C	61																

PID: 10176	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 5/3/19	END: 5/3/19	PG 3 OF 3	B-002-0-19

MATERIAL DESCRIPTION AND NOTES		ELEV. 673.0 ~~575.9~~	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
COAL, BLACK, UNWEATHERED, WEAK, FRIABLE; RQD 61%, REC 96%. *(continued)*	C	~~574.5~~	671.6 63	75		98	NQ-11											CORE	
SHALE, GRAY, SLIGHTLY WEATHERED, SLIGHTLY STRONG, CALCAREOUS; RQD 67%, REC 100%.		~~573.0~~	670.1 EOB 64 65																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

Corrections by Resource International, Inc.

PROJECT: BEL-7-11.05	DRILLING FIRM / OPERATOR: CTL / TOM	DRILL RIG: TRACK 55	STATION / OFFSET: 591+70 / -300.1	EXPLORATION ID B-002-1-19
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / TOM	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-7	
PID: 10176 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 10/2/17	ELEVATION: 820.0 (MSL) EOB: 105.1 ft.	PAGE 1 OF 4
START: 5/15/19 END: 5/16/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 90	COORD: 39.9541657, -80.7649001	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
VERY SOFT, BROWN, **CLAY**, FILL, MOIST	820.0		0 0 0	0	11	SS-1	-	-	-	-	-	-	-	-	-	22	A-7-6 (V)	
@2.5'; VERY STIFF	734.0																	
STIFF, GRAY, **SILT AND CLAY**, LITTLE GRAVEL, LITTLE SAND, CONTAINS ROCK FRAGMENTS, DAMP	729.5	815.5	6 5 8	20	78	SS-2	-	-	-	-	-	-	-	-	-	33	A-7-6 (V)	
@7.5'; VERY STIFF			6 6 4	15	100	SS-3	-	-	-	-	-	-	-	-	-	17	A-6a (V)	
			4 8 18	39	100	SS-4	3.50	-	-	-	-	-	-	-	-	14	A-4a (1)	
			9 16 18	51	100	NQ-5	2.50	21	6	9	- 64 -		31	18	13	11	A-6a (7)	
	720.9	806.9 TR	36 50/1"	-	100	SS-6	-	-	-	-	-	-	-	-	-	4	A-6a (V)	
SHALE, GRAY, UNWEATHERED, STRONG; RQD 67%, REC 100%. @15.1'; WEAK, FRIABLE, CALCAREOUS.	715.9	801.9	67		100	NQ-1											CORE	
SANDSTONE, GRAY, UNWEATHERED, STRONG, CALCAREOUS, CONTAINS INTERBEDS CALCAREOUS SHALE; RQD 78%, REC 96%.			90		100	NQ-2											CORE	
			66		92	NQ-3											CORE	
	706.0	792.0																
SHALE, GRAY, UNWEATHERED, WEAK, FRIABLE; RQD 54%, REC 91%.																		

PID: 10176	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 5/15/19	END: 5/16/19	PG 2 OF 4	B-002-1-19

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
790.0																		
SHALE, GRAY, UNWEATHERED, WEAK, FRIABLE; RQD 54%, REC 91%. *(continued)*	704.0																	
	700.5	786.5	58		92	NQ-4											CORE	
LIMESTONE, GRAY, UNWEATHERED, VERY STRONG; RQD 85%, REC 88%.	698.5	784.5																
SHALE, GRAY, SLIGHTLY WEATHERED, WEAK, FRIABLE; RQD 34%, REC 93%.			45		82	NQ-5											CORE	
@41.5'; MODERATELY WEATHERED, VERY WEAK.			40		88	NQ-6											CORE	
@45.0'; LIMESTONE INTERBED. @45.5'; CALCAREOUS.	687.5	773.5	41		83	NQ-7											CORE	
LIMESTONE, GRAY, SLIGHTLY WEATHERED, STRONG, CONTAINS CALCAREOUS SHALE INTERBEDS; RQD 63%, REC 88%.			72		100	NQ-8											CORE	
	680.0	766.0																
SHALE, GRAY, HIGHLY WEATHERED, VERY WEAK, FRIABLE; RQD 0%, REC 80%.	677.5	763.5	25		97	NQ-9											CORE	
SANDSTONE, GRAY, UNWEATHERED, STRONG; RQD 57%, REC 99%.	676.0	762.0																
SHALE, GRAY, UNWEATHERED, STRONG, CALCAREOUS; RQD 99%, REC 99%.			93		96	NQ-10											CORE	
	672.5	758.5																

PID: 10176	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 5/15/19	END: 5/16/19	PG 3 OF 4	B-002-1-19

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
LIMESTONE, GRAY, UNWEATHERED, VERY STRONG, CARBONACEOUS, CONTAINS CALCEREOUS SHALE INTERBEDS; RQD 89%, REC 98%. *(continued)*	757.9 ~~671.9~~	63–68	83		100	NQ-11											CORE	
@68.0'; LOST WATER RETURN.		68–73	93		100	NQ-12											CORE	
		73–78	93		98	NQ-13											CORE	
	~~656.0~~ 742.0																	
SHALE, GRAY, MODERATELY WEATHERED, WEAK, CALCAREOUS; RQD 56%, REC 96%.		78–83	67		97	NQ-14											CORE	
	~~652.0~~ 738.0																	
LIMESTONE, GRAY, UNWEATHERED, VERY STRONG; RQD 100%, REC 100%.	~~651.0~~ 737.0																	
SHALE, GRAY, SLIGHTLY WEATHERED, SLIGHTLY STRONG, CALCAREOUS, CONTAINS LIMESTONE INTERBEDS; RQD 68%, REC 96%.		83–88	53		100	NQ-15											CORE	
@88.1'; VERY LIGHT GRAY.		88–93	70		86	NQ-16											CORE	
@93.1'; GRAY.		93–94																

PID: 10176	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 5/15/19	END: 5/16/19	PG 4 OF 4	B-002-1-19

MATERIAL DESCRIPTION AND NOTES	725.7	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
SHALE, GRAY, SLIGHTLY WEATHERED, SLIGHTLY STRONG, CALCAREOUS, CONTAINS LIMESTONE INTERBEDS; RQD 68%, REC 96%. *(continued)*		~~639.7~~	95 96 97 98	78		100	NQ-17											CORE	
		~~635.5~~	721.5																
LIMESTONE, GRAY AND BLACK, UNWEATHERED, VERY STRONG, CARBONACEOUS, CONTAINS CALCEREOUS SHALE INTERBEDS; RQD 70%, REC 97%.			99 100 101 102	82		100	NQ-18											CORE	
		~~628.9~~	103 104 714.9	46		92	NQ-19											CORE	
			EOB 105																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

Corrections by Resource International, Inc.

PROJECT: BEL-7-11.05	DRILLING FIRM / OPERATOR: CTL / TOM	DRILL RIG: CME 55 #393	STATION / OFFSET: 588+23 / -460.9	EXPLORATION ID B-003-0-20
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / TOM	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-7	
PID: 109909 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 10/8/19	ELEVATION: 963.3 (MSL) EOB: 140.0 ft.	PAGE 1 OF 5
START: 3/16/20 END: 3/18/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.5	LAT / LONG: 39.953270, -80.765700	

MATERIAL DESCRIPTION AND NOTES	963.3	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)	INCL.
VERY STIFF, BROWN, **ELASTIC CLAY**, AND SILT, TRACE SAND, CONTAINS COAL FRAGMENTS, DAMP		965.0		4 7 15	30	67	SS-1	3.75	0	3	2	47	48	51	40	11	26	A-7-5 (11)	
		960.0	958.3	14 28 50/3"	-	80	SS-2	3.50	0	10	6	56	28	53	42	11	46	A-7-5 (11)	
STIFF, BROWN, **CLAY**, AND SILT, TRACE SAND, MOIST				4 4 4	11	100	SS-3	1.50	0	0	1	51	48	47	29	18	33	A-7-6 (13)	
@8.5'; HARD				4 5 5	14	100	SS-4	4.25	0	1	1	50	48	43	26	17	32	A-7-6 (11)	
@11.0'; VERY STIFF		952.5	950.8	5 22 14	49	89	SS-5	2.50	6	2	1	47	44	41	26	15	18	A-7-6 (10)	
SHALE, GRAY, SEVERELY WEATHERED, VERY WEAK.				50/5"	-	100	SS-6	4.50	-	-	-	-	-	-	-	-	16	Rock (V)	
				50/1"	-	100	SS-7	-	-	-	-	-	-	-	-	-	6	Rock (V)	
				50/1"	-	100	SS-8	-	-	-	-	-	-	-	-	-	5	Rock (V)	
		945.0	943.3 TR																
SILTSTONE, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, THIN BEDDED, CALCAREOUS, INTACT, OPEN. SLIGHTY ROUGH, GOOD; RQD 87%, REC 90%.		942.5	940.8	87		90	NQ-1											CORE	
SHALE, GRAY, MODERATELY WEATHERED, SLIGHTLY STRONG, LAMINATED, ARGILLACEOUS, JOINTED, OPEN, MODERATELY FRACTURED, SLIGHTLY ROUGH, FAIR; RQD 88%, REC 99%.		936.8	935.1	87		98	NQ-2											CORE	
SANDSTONE, GRAY, SLIGHTLY WEATHERED, STRONG, LAMINATED TO THIN BEDDED, INTACT, NARROW, GOOD; RQD 92%, REC 98%.																			

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/11/20 08:23 - J:\DEPT5\20 PROJECTS\19530005MOR-2020.GPJ

PID: 109909	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 3/16/20	END: 3/18/20	PG 2 OF 5	B-003-0-20

MATERIAL DESCRIPTION AND NOTES	933.3 ELEV. 935.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INCL.
SANDSTONE, GRAY, SLIGHTLY WEATHERED, STRONG, LAMINATED TO THIN BEDDED, INTACT, NARROW, GOOD; RQD 92%, REC 98%. *(continued)*		31 32	93		98	NQ-3											CORE	
@34.0'; TO 36.5'; VERTICAL FRACTURES.		33 34 35 36 37	83		93	NQ-4											CORE	
@41.7'; UNWEATHERED, PYRITIC, VERY GOOD.		38 39 40 41 42	97		100	NQ-5											CORE	
	917.5	915.8 43 44 45 46 47	97		100	NQ-6											CORE	
SHALE, DARK GRAY TO BLACK, MODERATELY WEATHERED, SLIGHTLY STRONG, VERY THIN BEDDED, JOINTED, NARROW, MODERATELY FRACTURED, SLIGHTLY ROUGH, POOR; RQD 58%, REC 94%.		48 49 50 51 52	45		88	NQ-7											CORE	
		53 54 55 56 57	72		100	NQ-8											CORE	
	907.5	905.8																
SANDSTONE, GRAY AND WHITE, SLIGHTLY WEATHERED, MODERATELY STRONG, CALCAREOUS, SLIGHTLY FRACTURED, GOOD; RQD 96%, REC 99%.		58 59 60 61	97		100	NQ-9											CORE	

PID: 109909	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 3/16/20	END: 3/18/20	PG 3 OF 5	B-003-0-20

MATERIAL DESCRIPTION AND NOTES	ELEV. 901.2 ~~902.9~~	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INCL.
SANDSTONE, GRAY AND WHITE, SLIGHTLY WEATHERED, MODERATELY STRONG, CALCAREOUS, SLIGHTLY FRACTURED, GOOD; RQD 96%, REC 99%. *(continued)* @62.5'; STRONG.		63 64 65 66 67	92		98	NQ-10											CORE	
		68 69 70 71 72	98		100	NQ-11											CORE	
	~~891.4~~ 889.7	73 74 75 76 77	60		100	NQ-12											CORE	
SHALE, BLACK, GREENISH GRAY AND RED, MODERATELY WEATHERED, SLIGHTLY STRONG, LAMINATED, JOINTED, NARROW, FRACTURED, TO MODERATELY FRACTURED, SLIGHTLY ROUGH, POOR; RQD 58%, REC 97%. @78.5'; HIGHLY WEATHERED, VERY ROUGH.		78 79 80 81 82	45		93	NQ-13											CORE	
	~~880.7~~ 879.0	83 84 85 86 87	88		100	NQ-14											CORE	
LIMESTONE, LIGHT GRAY TO GRAY, SLIGHTLY WEATHERED, VERY STRONG, THIN BEDDED, CALCAREOUS, MODERATELY FRACTURED, GOOD; RQD 93%, REC 100%.	~~875.7~~ 874.0	88 89 90 91 92	95		95	NQ-15											CORE	
SHALE, DARK GRAY, UNWEATHERED, STRONG, LAMINATED, INTACT, VERY GOOD TO FAIR; RQD 81%, REC 95%.		93 94																

PID: 109909	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 3/16/20	END: 3/18/20	PG 4 OF 5	B-003-0-20

MATERIAL DESCRIPTION AND NOTES	869.0	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)	INCL.
SHALE, DARK GRAY, UNWEATHERED, STRONG, LAMINATED, INTACT, VERY GOOD TO FAIR; RQD 81%, REC 95%. *(continued)*		~~870.7~~	95	77		97	NQ-16											CORE	
@96.5'; FRACTURED.		~~868.0~~	96																
LIMESTONE, LIGHT GRAY, SLIGHTLY WEATHERED, VERY STRONG, THIN BEDDED, MODERATELY FRACTURED, GOOD; RQD 81%, REC 95%.		866.3	97																
SHALE, DARK GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, LAMINATED, JOINTED, OPEN, SLIGHTLY FRACTURED, SLIGHTLY ROUGH, GOOD; RQD 86%, REC 96%.		~~866.3~~	98																
		864.6	99																
			100	98		98	NQ-17											CORE	
			101																
			102																
			103																
			104																
			105	83		93	NQ-18											CORE	
			106																
		~~857.5~~	107																
		855.8	108																
COAL, BLACK, WEAK, THIN BEDDED, PYRITIC, FRACTURED, POOR; RQD 40%, REC 100%.	C		109																
		~~855.0~~	110	58		100	NQ-19											CORE	
		853.3	111																
SHALE, GRAY, MODERATELY WEATHERED, MODERATELY STRONG, LAMINATED, JOINTED, TIGHT, MODERATELY FRACTURED, FAIR; RQD 0%, REC 100%.		~~853.5~~	112																
		851.8	113																
SANDSTONE, GRAY, UNWEATHERED, STRONG, LAMINATED, SLIGHTLY FRACTURED, GOOD; RQD 97%, REC 98%.			114																
@112.5'; VERY STRONG, INTACT.			115	97		97	NQ-20											CORE	
			116																
			117																
			118																
			119																
			120	93		100	NQ-21											CORE	
			121																
			122																
		~~841.0~~	123																
		839.3	124																
SHALE, DARK GRAY, UNWEATHERED, STRONG, LAMINATED, PYRITIC, JOINTED, NARROW, MODERATELY FRACTURED, GOOD; RQD 81%, REC 100%.			125	87		98	NQ-22											CORE	
			126																

PID: 109909	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 3/16/20	END: 3/18/20	PG 5 OF 5	B-003-0-20

MATERIAL DESCRIPTION AND NOTES	ELEV. 836.9	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INCL.
	~~838.6~~																	
	~~838.0~~	836.3																
COAL, BLACK, WEAK, THIN BEDDED, MODERATELY FRACTURED, FAIR; RQD 0%, REC 83%.	~~837.5~~	835.8																
SHALE, BLACK, SLIGHTLY WEATHERED, STRONG, LAMINATED, SLIGHTLY FRACTURED, FAIR; RQD 71%, REC 100%.	~~836.8~~	835.1																
LIMESTONE, UNWEATHERED, STRONG, THIN BEDDED, MODERATELY FRACTURED, FAIR; RQD 89%, REC 100%.	~~834.0~~	832.3	90		100	NQ-23											CORE	
SANDSTONE, UNWEATHERED, STRONG, SLIGHTLY FRACTURED, SLIGHTLY ROUGH, GOOD; RQD 100%, REC 100%.	~~832.5~~	830.8																
INTERBEDDED SHALE (90%) AND LIMESTONE (10%), RQD 77%, REC. 100%; **SHALE**, GRAY, SLIGHTLY WEATHERED, STRONG, VERY THIN BEDDED, SHEAR MODERATELY FRACTURED, NARROW, SLICKENSIDE, FAIR; **LIMESTONE**, BLACK, UNWEATHERED, VERY STRONG, CONGLOMERITIC, CALCEREOUS, MODERATELY FRACTURED, FAIR.	~~827.5~~	825.8	77		100	NQ-24											CORE	
SANDSTONE, GRAY, UNWEATHERED, STRONG, VERY THIN BEDDED, SLIGHTLY FRACTURED, GOOD; RQD 74%, REC 89%.	~~825.9~~	824.2	83		93	NQ-25											CORE	
LIMESTONE, GRAY, SLIGHTLY WEATHERED, VERY STRONG, CONGLOMERITIC, MODERATELY FRACTURED, GOOD; RQD 100%, REC 100%.	~~825.0~~	EOB 823.3																

NOTES: INCLINOMETER INSTALLED

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

Corrections by Resource International, Inc.

PROJECT: BEL-7-11.05	DRILLING FIRM / OPERATOR: CTL / TOM	DRILL RIG: CME 55 #393	STATION / OFFSET: 587+93 / -612.0	EXPLORATION ID B-003-1-20
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / TOM	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-7	
PID: 109909 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 10/8/19	ELEVATION: 1013.0 (MSL) EOB: 60.0 ft.	PAGE 1 OF 2
START: 3/12/20 END: 3/18/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.5	LAT / LONG: 39.953270, -80.766300	

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)	INCL.
1013.0	~~1015.0~~																	
VERY STIFF, DARK BROWN, **CLAY**, AND SILT, TRACE SAND, CONTAINS SANDSTONE FRAGMENTS, DAMP			26 36 50/1"	-	100	SS-1	3.50	0	0	1	59	40	45	26	19	17	A-7-6 (13)	
	~~1012.5~~	1010.5																
SHALE, GRAY, SEVERELY WEATHERED, VERY WEAK.			50/2"	-	100	SS-2	-	-	-	-	-	-	-	-	-	35	Rock (V)	
	~~1010.0~~	1008.0 TR																
LIMESTONE, GRAY TO DARK GRAY, MODERATELY WEATHERED, VERY STRONG, THINLY LAMINATED, VERTICAL FRACTURES, FAULTS, MODERATELY FRACTURED, OPEN, FAIR; RQD 68%, REC 95%.			61		89	NQ-1											CORE	
	~~1002.7~~	1000.7																
SHALE, GRAY, HIGHLY WEATHERED, MODERATELY STRONG, LAMINATED, FAULTS, MODERATELY FRACTURED, OPEN, SLIGHTLY ROUGH, FAIR; RQD 55%, REC 99%. @14.0'; ARGILLACEOUS, POOR.			72		100	NQ-2											CORE	
			49		100	NQ-3											CORE	
			75		98	NQ-4											CORE	
	~~988.3~~	986.3	30		100	NQ-5											CORE	
COAL, BLACK, VERY WEAK, VERY THIN BEDDED, CARBONACEOUS, HIGHLY FRACTURED, OPEN, VERY ROUGH, VERY POOR, CONTAINS SHALE SEAMS; RQD 0%, REC 100%.	~~987.3~~	985.3																

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/11/20 08:23 - J:\DEPT5\20 PROJECTS\19530005MOR-2020.GPJ

PID: 109909	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 3/12/20	END: 3/18/20	PG 2 OF 2	B-003-1-20

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)	INCL.
INTERBEDDED SHALE (54%) AND LIMESTONE (46%), RQD 55%, REC. 100%; **SHALE**, GRAY TO BLACK, HIGHLY WEATHERED, SLIGHTLY STRONG, VERY THIN TO LAMINATED, ARGILLACEOUS; **LIMESTONE**, GRAY, SLIGHTLY WEATHERED, STRONG, THIN BEDDED, MODERATELY FRACTURED, FAIR. *(continued)*	983.0 ~~985.0~~	31	57		100	NQ-6											CORE	
		32																
		33																
		34																
		35	52		100	NQ-7											CORE	
		36																
		37																
	~~976.8~~	974.8 38																
SHALE, LIGHT GRAY TO GRAY, HIGHLY WEATHERED, WEAK TO SLIGHTLY STRONG, LAMINATED, ARGILLACEOUS, JOINTED, OPEN, MODERATELY FRACTURED, SLIGHTLY ROUGH, POOR; RQD 37%, REC 90%.		39																
		40																
	~~973.4~~	971.4 41	18		93	NQ-8											CORE	
INTERBEDDED SHALE (57%) AND COAL (43%), RQD 45%, REC. 100%; **SHALE**, DARK GRAY, MODERATELY WEATHERED, SLIGHTLY STRONG, LAMINATED; **COAL**, BLACK, WEAK, CARBONACEOUS, FRACTURED, VERY ROUGH, BLOCKY, POOR.		42																
	~~969.6~~	967.6 43																
SHALE, DARK GRAY, SLIGHTLY WEATHERED, SLIGHTLY STRONG, LAMINATED, JOINTED, NARROW, MODERATELY FRACTURED, FAIR; RQD 47%, REC 100%.		44																
		45	67		100	NQ-9											CORE	
		46																
		47																
		48																
		49																
		50	48		100	NQ-10											CORE	
		51																
		52																
	~~962.0~~	960.0 53																
COAL, BLACK, WEAK, LAMINATED, PYRITIC, JOINTED, FRACTURED, BLOCKY, POOR; RQD 0%, REC 100%.	C ~~961.3~~	959.3																
SHALE, GRAY TO DARK GRAY, MODERATELY WEATHERED, SLIGHTLY STRONG, LAMINATED, MODERATELY FRACTURED, FAIR; RQD 68%, REC 95%. @55.0'; 5" COAL SEAM.		54																
		55																
		56	68		97	NQ-11											CORE	
		57																
	~~958.0~~	956.0 58																
@56.9'; 1" COAL SEAM.																		
LIMESTONE, GRAY, SLIGHTLY WEATHERED, STRONG, THIN BEDDED, CALCAREOUS, MODERATELY FRACTURED, FAIR; RQD 92%, REC 100%.		59																
	~~955.0~~	953.0 EOB 60	83		100	NQ-12											CORE	

NOTES: INCLINOMETER INSTALLED

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 5/11/20 08:23 - J:\DEPT5\20 PROJECTS\19530005MOR-2020.GPJ

Corrections by Resource International, Inc.

PROJECT: BEL-7-11.05	DRILLING FIRM / OPERATOR: CTL / TOM	DRILL RIG: CME 55 #393	STATION / OFFSET: 587+27 / -752.2	EXPLORATION ID B-003-2-20
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / TOM	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-7	
PID: 109909 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 10/8/19	ELEVATION: 1095.0 (MSL) EOB: 120.5 ft.	PAGE 1 OF 4
START: 3/10/20 END: 3/18/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.5	LAT / LONG: 39.953270, -80.765700	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
1095.0																		
VERY STIFF, BROWN, **ELASTIC CLAY**, AND SILT, LITTLE SAND, DAMP	~~1127.0~~		2 2 2	5	67	SS-1	2.75	0	1	15	38	46	49	34	15	17	A-7-5 (12)	
VERY STIFF, BROWN, **SILT AND CLAY**, TRACE SAND, TRACE GRAVEL, DAMP	~~1124.5~~	1092.5	4 5 8	18	100	SS-2	4.00	1	7	2	65	25	32	21	11	13	A-6a (8)	
@6.0'; HARD, SOME GRAVEL, CONTAINS SANDSTONE FRAGMENTS	~~1119.5~~	1087.5	13 11 17	38	100	SS-3	-	31	14	5	35	15	33	21	12	17	A-6a (4)	
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, CONTAINS SANDSTONE FRAGMENTS, DRY			5 5 7	16	33	SS-4	-	-	-	-	-	-	-	-	-	9	A-2-4 (V)	
			0 9 9	24	78	SS-5	-	-	-	-	-	-	-	-	-	5	A-2-4 (V)	
	~~1113.0~~	1081.0	50/4"	-	100	SS-6	-	-	-	-	-	-	-	-	-	5	A-2-4 (V)	
SANDSTONE, LIGHT BROWN TO GRAY, SLIGHTLY WEATHERED, STRONG, THIN LAMINATED, SLIGHTLY FRACTURED, NARROW, SLIGHTLY ROUGH FAIR; RQD 67%, REC 81%.		TR	100		100	NQ-1											CORE	
	~~1105.5~~	1073.5	50		72	NQ-2											CORE	
SHALE, LIGHT GRAY, BLUISH TO RED, SEVERELY WEATHERED, VERY WEAK, LAMINATED, ARGILLACEOUS, JOINTED, HIGHLY FRACTURED, NARROW, VERY ROUGH, VERY POOR; RQD 41%, REC 92%.			25		100	NQ-3											CORE	
			60		100	NQ-4											CORE	

PID: 109909	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 3/10/20	END: 3/18/20	PG 2 OF 4	B-003-2-20

MATERIAL DESCRIPTION AND NOTES	1065.0	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
SHALE, LIGHT GRAY, BLUISH TO RED, SEVERELY WEATHERED, VERY WEAK, LAMINATED, ARGILLACEOUS, JOINTED, HIGHLY FRACTURED, NARROW, VERY ROUGH, VERY POOR; RQD 41%, REC 92%. *(continued)*		~~1097.0~~	31																
			32																
			33																
		~~1092.7~~	1060.7 34	63		88	NQ-5											CORE	
LIMESTONE, LIGHT GRAY TO GRAY, HIGHLY WEATHERED, SLIGHTLY STRONG, LAMINATED TO THIN BEDDED, FRACTURED, VERY ROUGH, SLICKENSIDE, POOR, CONTAINS SHALE SEAMS; RQD 75%, REC 98%.			35																
			36																
			37																
			38																
			39	82		100	NQ-6											CORE	
			40																
		~~1085.7~~	1053.7 41																
SANDSTONE, DARK GRAY TO LIGHT GRAY, SLIGHTLY WEATHERED, STRONG, VERY THIN BEDDED, CARBONACEOUS, IRON STAINS, SLIGHTLY FRACTURES, VERTICAL FRACTURED, FAIR; RQD 83%, REC 99%.			42																
			43																
			44	85		97	NQ-7											CORE	
			45																
			46																
			47																
			48																
			49	70		87	NQ-8											CORE	
		~~1076.4~~	1044.4 50																
SHALE, GRAY TO RED, MODERATELY WEATHERED, MODERATELY STRONG, LAMINATED, IRON STAINS, MODERATELY FRACTURED, NARROW, SLIGHTLY ROUGH, FAIR; RQD 82%, REC 96%.			51																
			52																
			53																
			54	73		97	NQ-9											CORE	
			55																
		~~1070.5~~	1038.5 56																
LIMESTONE, GRAY TO RED, MODERATELY WEATHERED, MODERATELY STRONG, LAMINATED TO VERY THIN BEDDED, MODERATELY FRACTURED, OPEN SLIGHTLY TO VERY ROUGH, FAIR; RQD 72%, REC 100%.			57																
			58																
			59	72		100	NQ-10											CORE	
			60																
		~~1065.5~~	1033.5 61																

PID: 109909	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 3/10/20	END: 3/18/20	PG 3 OF 4	B-003-2-20

MATERIAL DESCRIPTION AND NOTES	1032.9	ELEV. ~~1064.9~~	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
SHALE, GRAY AND RED, SLIGHTLY WEATHERED, SLIGHTLY STRONG, LAMINATED TO VERY THIN BEDDED, SLICKENSIDE, SLIGHTLY FRACTURED, FAIR; RQD 77%, REC 100%. *(continued)*			63 64 65 66	77		100	NQ-11											CORE	
		~~1060.5~~	1028.5																
SANDSTONE, GRAY, SLIGHTLY WEATHERED, STRONG, VERY THIN BEDDED, CALCAREOUS, SLIGHTLY FRACTURED, GOOD, CONTAINS FEW SHALE SEAMS WITH SLICKENSIDE; RQD 69%, REC 98%.			67 68 69 70 71	92		98	NQ-12											CORE	
			72 73 74 75	82		98	NQ-13											CORE	
		~~1051.0~~	1019.0																
SHALE, GRAY, HIGHLY WEATHERED, WEAK, LAMINATED, ARGILLACEOUS, FRACTURED, OPEN, VERY ROUGH, GOOD; RQD 63%, REC 92%.		~~1049.0~~	1017.0																
SANDSTONE, GRAY AND BROWN, SLIGHTLY WEATHERED, STRONG, LAMINATED, JOINTED, TIGHT, SLIGHTLY FRACTURED TO INTACT, VERY GOOD; RQD 89%, REC 96%.			76 77 78 79 80 81	77		93	NQ-14											CORE	
			82 83 84 85 86	87		98	NQ-15											CORE	
			87 88 89 90 91	88		100	NQ-16											CORE	
		~~1035.0~~	1003.0																
SHALE, DARK GRAY, SLIGHTLY WEATHERED, STRONG, LAMINATED, INTACT, FEW ANGULAR FRACTURES, NARROW, FAIR TO POOR; RQD 90%, REC 100%.			92 93 94	97		100	NQ-17											CORE	

PID: 109909	SFN:	PROJECT: BEL-7-11.05	STATION / OFFSET:	START: 3/10/20	END: 3/18/20	PG 4 OF 4	B-003-2-20

MATERIAL DESCRIPTION AND NOTES	1000.7	ELEV. ~~1032.7~~	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
SHALE, DARK GRAY, SLIGHTLY WEATHERED, STRONG, LAMINATED, INTACT, FEW ANGULAR FRACTURES, NARROW, FAIR TO POOR; RQD 90%, REC 100%. *(continued)*			95																
			96																
			97																
			98																
			99	98		100	NQ-18											CORE	
			100																
			101																
			102																
			103																
			104	83		100	NQ-19											CORE	
			105																
			106																
			107																
			108																
		~~1017.5~~	109 985.5	60		93	NQ-20											CORE	
LIMESTONE, GRAY TO DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, VERY THIN BEDDED, MODERATELY FRACTURED, IRON STAINING, OPEN, SLIGHTLY ROUGH, FAIR TO GOOD; RQD 85%, REC 100%.			110																
			111																
			112																
			113																
			114	90		100	NQ-21											CORE	
			115																
			116																
			117																
			118																
			119	96		100	NQ-22											CORE	
		~~1006.5~~	120 974.5 EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH BENTONITE GROUT

Appendix V

Dynamic Cone Penetration Test Logs

WILDCAT DYNAMIC CONE LOG

Resource International, Inc.
6350 Presidential Gateway
Columbus, Ohio 43231

PROJECT NUMBER: W-20-120
DATE STARTED: 11-23-2020
DATE COMPLETED: 11-23-2020

HOLE #: DCP-1
STATION: STA.584+73.8 OFFSET: -255.3
SURFACE ELEVATION: 869
CREW: Justin, Steve, and Zach
WATER ON COMPLETION:
PROJECT: BEL-7-11.04 | PID 110788
HAMMER WEIGHT: 35 lbs.
ADDRESS: ODOT District 11
CONE AREA: 10 sq. cm
LOCATION: Belmont County, Ohio

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	2	8.88	••	2	VERY LOOSE	SOFT
-	2	8.88	••	2	VERY LOOSE	SOFT
- 1 ft	3	13.32	•••	3	VERY LOOSE	SOFT
-	5	22.20	•••••	6	LOOSE	MEDIUM STIFF
-	9	39.96	•••••••••	11	MEDIUM DENSE	STIFF
- 2 ft	11	48.84	••••••••••	13	MEDIUM DENSE	STIFF
-	12	53.28	••••••••••••	15	MEDIUM DENSE	STIFF
-	25	111.00	••••••••••••••••••••••••	25+	DENSE	HARD
- 3 ft	26	115.44	••••••••••••••••••••••••	25+	DENSE	HARD
- 1 m	25	111.00	••••••••••••••••••••••••	25+	DENSE	HARD
-	28	108.08	••••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
- 4 ft	30	115.80	••••••••••••••••••••••••	25+	DENSE	HARD
-	35	135.10	••••••••••••••••••••••••••••••	25+	DENSE	HARD
-	40	154.40	••••••••••••••••••••••••••••••••	25+	DENSE	HARD
- 5 ft	40	154.40	••••••••••••••••••••••••••••••••	25+	DENSE	HARD
-	19	73.34	•••••••••••••••••	20	MEDIUM DENSE	VERY STIFF
-	15	57.90	••••••••••••••	16	MEDIUM DENSE	VERY STIFF
- 6 ft	21	81.06	••••••••••••••••••	23	MEDIUM DENSE	VERY STIFF
-	22	84.92	•••••••••••••••••••	24	MEDIUM DENSE	VERY STIFF
- 2 m	13	50.18	••••••••••••	14	MEDIUM DENSE	STIFF
- 7 ft	50	171.00	••••••••••••••••••••••••••••••••••••	25+	DENSE	HARD
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

Resource International, Inc.
6350 Presidential Gateway
Columbus, Ohio 43231

PROJECT NUMBER: W-20-120
DATE STARTED: 11-23-2020
DATE COMPLETED: 11-23-2020

HOLE #: DCP-1.1
STATION: STA. 584+87.9 OFFSET: -265.2
SURFACE ELEVATION: 880
CREW: Justin, Steve, and Zach
WATER ON COMPLETION:
PROJECT: BEL-7-11.04 | PID 110788
HAMMER WEIGHT: 35 lbs.
ADDRESS: ODOT District 11
CONE AREA: 10 sq. cm
LOCATION: Belmont County, Ohio

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	5	22.20	•••••	6	LOOSE	MEDIUM STIFF
-	4	17.76	••••	5	LOOSE	MEDIUM STIFF
- 1 ft	4	17.76	••••	5	LOOSE	MEDIUM STIFF
-	8	35.52	••••••••	10	LOOSE	STIFF
-	10	44.40	••••••••••	12	MEDIUM DENSE	STIFF
- 2 ft	11	48.84	••••••••••	13	MEDIUM DENSE	STIFF
-	13	57.72	••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	16	71.04	••••••••••••••••	20	MEDIUM DENSE	VERY STIFF
- 3 ft	19	84.36	••••••••••••••••••	24	MEDIUM DENSE	VERY STIFF
- 1 m	34	150.96	••••••••••••••••••••••••••••••••••	25+	DENSE	HARD
-	60	231.60	••	25+	VERY DENSE	HARD
- 4 ft	61	235.46	••	25+	VERY DENSE	HARD
-						
-						
- 5 ft						
-						
-						
- 6 ft						
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

Resource International, Inc.
6350 Presidential Gateway
Columbus, Ohio 43231

PROJECT NUMBER: W-20-120
DATE STARTED: 11-23-2020
DATE COMPLETED: 11-23-2020

HOLE #: DCP-2
STATION: STA. 584+77.0 OFFSET: -240.5
CREW: Justin, Steve, and Zach
PROJECT: BEL-7-11.04 | PID 110788
ADDRESS: ODOT District 11
LOCATION: Belmont County, Ohio

SURFACE ELEVATION: 862
WATER ON COMPLETION:
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	2	8.88	••	2	VERY LOOSE	SOFT
-	2	8.88	••	2	VERY LOOSE	SOFT
- 1 ft	2	8.88	••	2	VERY LOOSE	SOFT
-	2	8.88	••	2	VERY LOOSE	SOFT
-	4	17.76	••••	5	LOOSE	MEDIUM STIFF
- 2 ft	3	13.32	•••	3	VERY LOOSE	SOFT
-	13	57.72	••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	28	124.32	••••••••••••••••••••••••••••	25+	DENSE	HARD
- 3 ft	16	71.04	••••••••••••••••	20	MEDIUM DENSE	VERY STIFF
- 1 m	20	88.80	••••••••••••••••••••	25	MEDIUM DENSE	VERY STIFF
-	28	108.08	••••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
- 4 ft	28	108.08	••••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
-	34	131.24	••••••••••••••••••••••••••••	25+	DENSE	HARD
-	56	216.16	••	25+	VERY DENSE	HARD
- 5 ft	65	250.90	••	25+	VERY DENSE	HARD
-	60	231.60	••	25+	VERY DENSE	HARD
-						
- 6 ft						
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

Resource International, Inc.
6350 Presidential Gateway
Columbus, Ohio 43231

PROJECT NUMBER: W-20-120
DATE STARTED: 11-23-2020
DATE COMPLETED: 11-23-2020

HOLE #: DCP-2.1
STATION: STA. 584+60.9 OFFSET: -283.4
SURFACE ELEVATION: 890
CREW: Justin, Steve, and Zach
WATER ON COMPLETION:
PROJECT: BEL-7-11.04 | PID 110788
HAMMER WEIGHT: 35 lbs.
ADDRESS: ODOT District 11
CONE AREA: 10 sq. cm
LOCATION: Belmont County, Ohio

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	1	4.44	•	1	VERY LOOSE	VERY SOFT
-	2	8.88	••	2	VERY LOOSE	SOFT
- 1 ft	2	8.88	••	2	VERY LOOSE	SOFT
-	3	13.32	•••	3	VERY LOOSE	SOFT
-	2	8.88	••	2	VERY LOOSE	SOFT
- 2 ft	3	13.32	•••	3	VERY LOOSE	SOFT
-	4	17.76	••••	5	LOOSE	MEDIUM STIFF
-	7	31.08	•••••••	8	LOOSE	MEDIUM STIFF
- 3 ft	13	57.72	••••••••••••	16	MEDIUM DENSE	VERY STIFF
- 1 m	28	124.32	••••••••••••••••••••••••••	25+	DENSE	HARD
-	32	123.52	••••••••••••••••••••••••••	25+	DENSE	HARD
- 4 ft	50	193.00	••	25+	VERY DENSE	HARD
-	55	212.30	••	25+	VERY DENSE	HARD
-	53	204.58	••	25+	VERY DENSE	HARD
- 5 ft						
-						
-						
- 6 ft						
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

Resource International, Inc.
6350 Presidential Gateway
Columbus, Ohio 43231

PROJECT NUMBER: W-20-120
DATE STARTED: 11-23-2020
DATE COMPLETED: 11-23-2020

HOLE #: DCP-3
STATION: STA. 584+63.1 OFFSET: -246.3
SURFACE ELEVATION: 865
CREW: Justin, Steve, and Zach
WATER ON COMPLETION:
PROJECT: BEL-7-11.04 | PID 110788
HAMMER WEIGHT: 35 lbs.
ADDRESS: ODOT District 11
CONE AREA: 10 sq. cm
LOCATION: Belmont County, Ohio

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	2	8.88	••	2	VERY LOOSE	SOFT
-	2	8.88	••	2	VERY LOOSE	SOFT
- 1 ft	3	13.32	•••	3	VERY LOOSE	SOFT
-	4	17.76	••••	5	LOOSE	MEDIUM STIFF
-	4	17.76	••••	5	LOOSE	MEDIUM STIFF
- 2 ft	9	39.96	•••••••••	11	MEDIUM DENSE	STIFF
-	9	39.96	•••••••••	11	MEDIUM DENSE	STIFF
-	16	71.04	••••••••••••••••	20	MEDIUM DENSE	VERY STIFF
- 3 ft	50	222.00	••	25+	VERY DENSE	HARD
- 1 m						
-						
- 4 ft						
-						
-						
- 5 ft						
-						
-						
- 6 ft						
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

Resource International, Inc.
6350 Presidential Gateway
Columbus, Ohio 43231

PROJECT NUMBER: W-20-120
DATE STARTED: 11-23-2020
DATE COMPLETED: 11-23-2020

HOLE #: DCP-3.1
STATION: STA. 584+63.1 OFFSET: -246.3
SURFACE ELEVATION: 865
CREW: Justin, Steve, and Zach
WATER ON COMPLETION:
PROJECT: BEL-7-11.04 | PID 110788
HAMMER WEIGHT: 35 lbs.
ADDRESS: ODOT District 11
CONE AREA: 10 sq. cm
LOCATION: Belmont County, Ohio

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	1	4.44	•	1	VERY LOOSE	VERY SOFT
-	1	4.44	•	1	VERY LOOSE	VERY SOFT
- 1 ft	3	13.32	•••	3	VERY LOOSE	SOFT
-	6	26.64	••••••	7	LOOSE	MEDIUM STIFF
-	5	22.20	•••••	6	LOOSE	MEDIUM STIFF
- 2 ft	12	53.28	••••••••••••	15	MEDIUM DENSE	STIFF
-	25	111.00	•••••••••••••••••••••••••	25+	DENSE	HARD
-	35	155.40	••••••••••••••••••••••••••••••••••	25+	DENSE	HARD
- 3 ft	50	222.00	••	25+	VERY DENSE	HARD
- 1 m						
-						
- 4 ft						
-						
-						
- 5 ft						
-						
-						
- 6 ft						
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

Resource International, Inc.
6350 Presidential Gateway
Columbus, Ohio 43231

PROJECT NUMBER: W-20-120
DATE STARTED: 11-24-2020
DATE COMPLETED: 11-24-2020

HOLE #: DCP-4
STATION: STA. 582+68.1 OFFSET: -261.5
CREW: Justin, Steve, and Zach
PROJECT: BEL-7-11.04 | PID 110788
ADDRESS: ODOT District 11
LOCATION: Belmont County, Ohio

SURFACE ELEVATION: 880
WATER ON COMPLETION:
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	COHESIVE
-	2	8.88	••	2	VERY LOOSE	SOFT
-	4	17.76	••••	5	LOOSE	MEDIUM STIFF
- 1 ft	3	13.32	•••	3	VERY LOOSE	SOFT
-	3	13.32	•••	3	VERY LOOSE	SOFT
-	3	13.32	•••	3	VERY LOOSE	SOFT
- 2 ft	5	22.20	•••••	6	LOOSE	MEDIUM STIFF
-	9	39.96	•••••••••	11	MEDIUM DENSE	STIFF
-	7	31.08	•••••••	8	LOOSE	MEDIUM STIFF
- 3 ft	8	35.52	••••••••	10	LOOSE	STIFF
- 1 m	8	35.52	••••••••	10	LOOSE	STIFF
-	9	34.74	••••••••	9	LOOSE	STIFF
- 4 ft	11	42.46	•••••••••	12	MEDIUM DENSE	STIFF
-	9	34.74	••••••••	9	LOOSE	STIFF
-	9	34.74	••••••••	9	LOOSE	STIFF
- 5 ft	16	61.76	••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-	35	135.10	••••••••••••••••••••••••••••••	25+	DENSE	HARD
-	20	77.20	••••••••••••••••••	22	MEDIUM DENSE	VERY STIFF
- 6 ft	11	42.46	•••••••••	12	MEDIUM DENSE	STIFF
-	11	42.46	•••••••••	12	MEDIUM DENSE	STIFF
- 2 m	9	34.74	••••••••	9	LOOSE	STIFF
- 7 ft	13	44.46	••••••••••	12	MEDIUM DENSE	STIFF
-	35	119.70	••••••••••••••••••••••••••	25+	DENSE	HARD
-	18	61.56	••••••••••••••	17	MEDIUM DENSE	VERY STIFF
- 8 ft	9	30.78	•••••••	8	LOOSE	MEDIUM STIFF
-	8	27.36	••••••	7	LOOSE	MEDIUM STIFF
-	9	30.78	•••••••	8	LOOSE	MEDIUM STIFF
- 9 ft	12	41.04	•••••••••	11	MEDIUM DENSE	STIFF
-	15	51.30	••••••••••	14	MEDIUM DENSE	STIFF
-	20	68.40	••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
- 3 m 10 ft	16	54.7	••••••••••••	15	MEDIUM DENSE	STIFF
-	24	73.4	••••••••••••••••••	20	MEDIUM DENSE	VERY STIFF
-	16	49.0	••••••••••	13	MEDIUM DENSE	STIFF
- 11 ft	16	49.0	••••••••••	13	MEDIUM DENSE	STIFF
-	18	55.1	••••••••••••	15	MEDIUM DENSE	STIFF
-	21	64.3	••••••••••••••	18	MEDIUM DENSE	VERY STIFF
- 12 ft	19	58.1	••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	17	52.0	••••••••••••	14	MEDIUM DENSE	STIFF
-	50	153.0	••••••••••••••••••••••••••••••••••	25+	DENSE	HARD
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

Resource International, Inc.
6350 Presidential Gateway
Columbus, Ohio 43231

PROJECT NUMBER: W-20-120
DATE STARTED: 11-24-2020
DATE COMPLETED: 11-24-2020

HOLE #: DCP-5
STATION: STA. 583+85.1 OFFSET: -288
CREW: Justin, Steve, and Zach
PROJECT: BEL-7-11.04 | PID 110788
ADDRESS: ODOT District 11
LOCATION: Belmont County, Ohio

SURFACE ELEVATION: 900
WATER ON COMPLETION:
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	COHESIVE
-	1	4.44	•	1	VERY LOOSE	VERY SOFT
-	3	13.32	•••	3	VERY LOOSE	SOFT
- 1 ft	3	13.32	•••	3	VERY LOOSE	SOFT
-	3	13.32	•••	3	VERY LOOSE	SOFT
-	8	35.52	••••••••	10	LOOSE	STIFF
- 2 ft	8	35.52	••••••••	10	LOOSE	STIFF
-	15	66.60	•••••••••••••••	19	MEDIUM DENSE	VERY STIFF
-	50	222.00	••	25+	VERY DENSE	HARD
- 3 ft						
- 1 m						
-						
- 4 ft						
-						
-						
- 5 ft						
-						
-						
- 6 ft						
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

Resource International, Inc.
6350 Presidential Gateway
Columbus, Ohio 43231

PROJECT NUMBER: W-20-120
DATE STARTED: 11-24-2020
DATE COMPLETED: 11-24-2020

HOLE #: DCP-5.1
STATION: STA. 583+64.6 OFFSET: -280
CREW: Justin, Steve, and Zach
PROJECT: BEL-7-11.04 | PID 110788
ADDRESS: ODOT District 11
LOCATION: Belmont County, Ohio

SURFACE ELEVATION: 900
WATER ON COMPLETION:
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	2	8.88	••	2	VERY LOOSE	SOFT
-	3	13.32	•••	3	VERY LOOSE	SOFT
- 1 ft	3	13.32	•••	3	VERY LOOSE	SOFT
-	4	17.76	••••	5	LOOSE	MEDIUM STIFF
-	3	13.32	•••	3	VERY LOOSE	SOFT
- 2 ft	5	22.20	•••••	6	LOOSE	MEDIUM STIFF
-	5	22.20	•••••	6	LOOSE	MEDIUM STIFF
-	6	26.64	••••••	7	LOOSE	MEDIUM STIFF
- 3 ft	5	22.20	•••••	6	LOOSE	MEDIUM STIFF
- 1 m	5	22.20	•••••	6	LOOSE	MEDIUM STIFF
-	6	23.16	•••••	6	LOOSE	MEDIUM STIFF
- 4 ft	7	27.02	••••••	7	LOOSE	MEDIUM STIFF
-	6	23.16	•••••	6	LOOSE	MEDIUM STIFF
-	7	27.02	••••••	7	LOOSE	MEDIUM STIFF
- 5 ft	10	38.60	••••••••	11	MEDIUM DENSE	STIFF
-	9	34.74	••••••••	9	LOOSE	STIFF
-	9	34.74	••••••••	9	LOOSE	STIFF
- 6 ft	25	96.50	••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
-	8	30.88	•••••••	8	LOOSE	MEDIUM STIFF
- 2 m	9	34.74	••••••••	9	LOOSE	STIFF
- 7 ft	7	23.94	•••••	6	LOOSE	MEDIUM STIFF
-	18	61.56	••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-	11	37.62	••••••••	10	LOOSE	STIFF
- 8 ft	9	30.78	•••••••	8	LOOSE	MEDIUM STIFF
-	8	27.36	••••••	7	LOOSE	MEDIUM STIFF
-	11	37.62	••••••••	10	LOOSE	STIFF
- 9 ft	15	51.30	••••••••••••	14	MEDIUM DENSE	STIFF
-	50	171.00	••••••••••••••••••••••••••••••••••••••	25+	DENSE	HARD
-						
- 3 m 10 ft						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

Resource International, Inc.
6350 Presidential Gateway
Columbus, Ohio 43231

PROJECT NUMBER: W-20-120
DATE STARTED: 11-24-2020
DATE COMPLETED: 11-24-2020

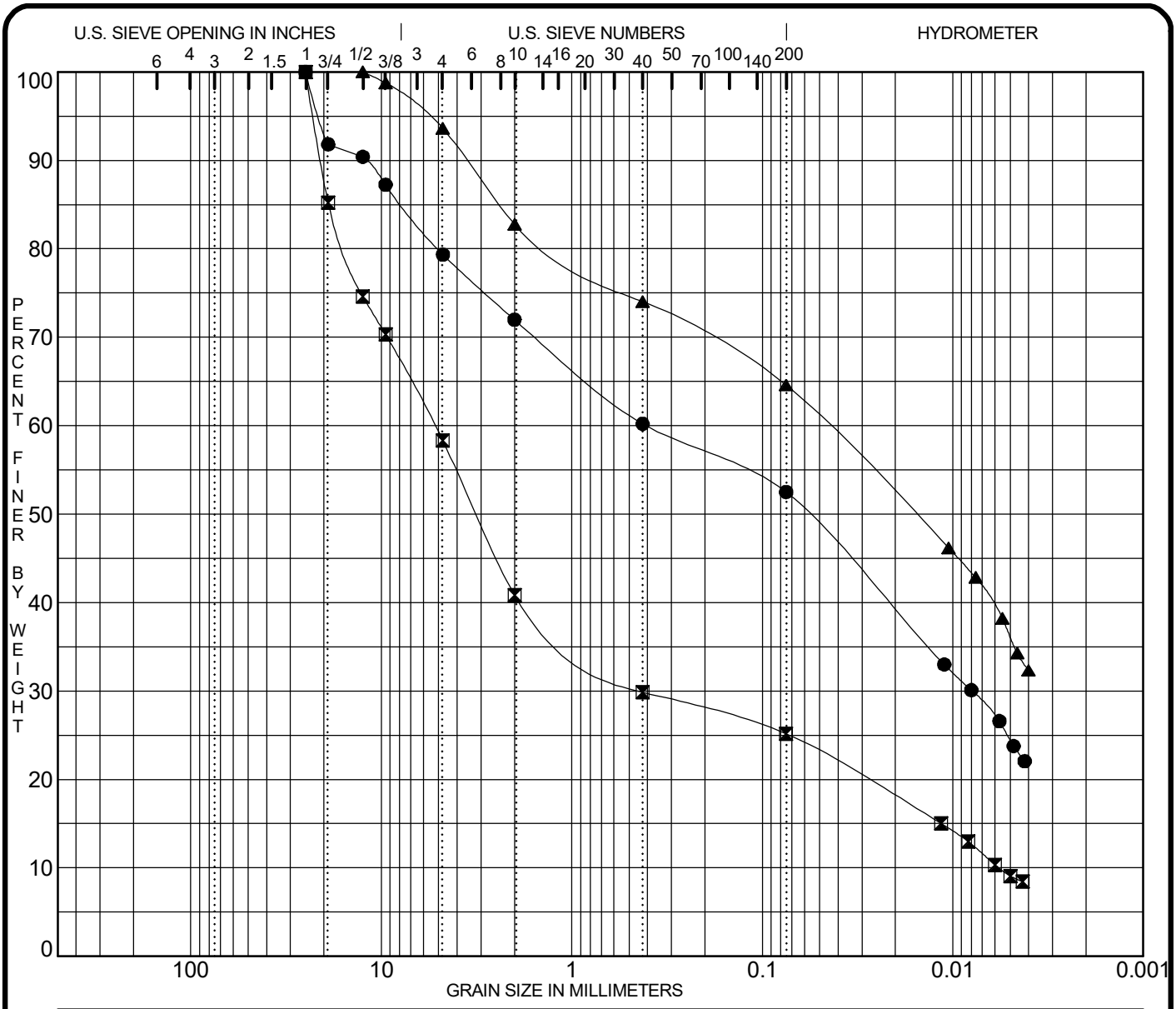
HOLE #: DCP-6
STATION: STA.583+59.8 OFFSET: -316
CREW: Justin, Steve, and Zach
PROJECT: BEL-7-11.04 | PID 110788
ADDRESS: ODOT District 11
LOCATION: Belmont County, Ohio

SURFACE ELEVATION: 913
WATER ON COMPLETION:
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	2	8.88	••	2	VERY LOOSE	SOFT
-	2	8.88	••	2	VERY LOOSE	SOFT
- 1 ft	3	13.32	•••	3	VERY LOOSE	SOFT
-	2	8.88	••	2	VERY LOOSE	SOFT
-	4	17.76	••••	5	LOOSE	MEDIUM STIFF
- 2 ft	3	13.32	•••	3	VERY LOOSE	SOFT
-	6	26.64	••••••	7	LOOSE	MEDIUM STIFF
-	33	146.52	••••••••••••••••••••••••••••••••••	25+	DENSE	HARD
- 3 ft	10	44.40	••••••••••	12	MEDIUM DENSE	STIFF
- 1 m	11	48.84	•••••••••••	13	MEDIUM DENSE	STIFF
-	10	38.60	••••••••	11	MEDIUM DENSE	STIFF
- 4 ft	9	34.74	••••••••	9	LOOSE	STIFF
-	7	27.02	••••••	7	LOOSE	MEDIUM STIFF
-	8	30.88	•••••••	8	LOOSE	MEDIUM STIFF
- 5 ft	6	23.16	•••••	6	LOOSE	MEDIUM STIFF
-	5	19.30	••••	5	LOOSE	MEDIUM STIFF
-	6	23.16	•••••	6	LOOSE	MEDIUM STIFF
- 6 ft	10	38.60	••••••••	11	MEDIUM DENSE	STIFF
-	6	23.16	•••••	6	LOOSE	MEDIUM STIFF
- 2 m	14	54.04	••••••••••••	15	MEDIUM DENSE	STIFF
- 7 ft	15	51.30	•••••••••••	14	MEDIUM DENSE	STIFF
-	12	41.04	•••••••••	11	MEDIUM DENSE	STIFF
-	4	13.68	•••	3	VERY LOOSE	SOFT
- 8 ft	7	23.94	•••••	6	LOOSE	MEDIUM STIFF
-	9	30.78	•••••••	8	LOOSE	MEDIUM STIFF
-	11	37.62	••••••••	10	LOOSE	STIFF
- 9 ft	18	61.56	••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-	14	47.88	••••••••••••	13	MEDIUM DENSE	STIFF
-	50	171.00	••••••••••••••••••••••••••••••••••••••	25+	DENSE	HARD
- 3 m 10 ft						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

Appendix VI

LABORATORY TEST RESULTS



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Specimen Identification	Depth	Classification	MC%	LL	PL	PI	Cz	Cu
●	**B-001-2-22**	**1.5**	**A-6a**	**13**	**33**	**18**	**15**		
⊠	**B-001-2-22**	**3.5**	**A-2-6**	**10**	**29**	**18**	**11**	**6.31**	**917.2**
▲	**B-001-3-22**	**3.5**	**A-6b**	**17**	**34**	**18**	**16**		

	Specimen Identification	D60	D50	D30	D10	%Gravel coarse	%Gravel fine	%Sand coarse	%Sand fine	%Silt	%Clay
●	**B-001-2-22**	**7.802**	**0.059**	**0.008**		**8.2**	**19.8**	**11.8**	**7.7**	**28.1**	**24.4**
⊠	**B-001-2-22**	**18.840**	**3.146**	**0.434**	**0.0057**	**14.8**	**44.3**	**11.0**	**4.7**	**16.1**	**9.1**
▲	**B-001-3-22**	**2.388**	**0.016**			**0.0**	**17.2**	**8.7**	**9.4**	**28.5**	**36.1**

PROJECT **BEL- 7-11.04** PROJECT NO. **W-20-120**

GRADATION CURVES

Resource International Inc.

RESOURCE INTERNATIONAL, INC.
Engineering Consultants

6350 Presidential Gatew.
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Phone (513) 769-6998

Unconfined Compressive Strength of Intact Rock Core Specimens

(ASTM D 7012-14)

Project: BEL SR 7 11.040
Project No.: W-20-120
Date of Testing: 11/2/2020
Test Performed by: KL/EM

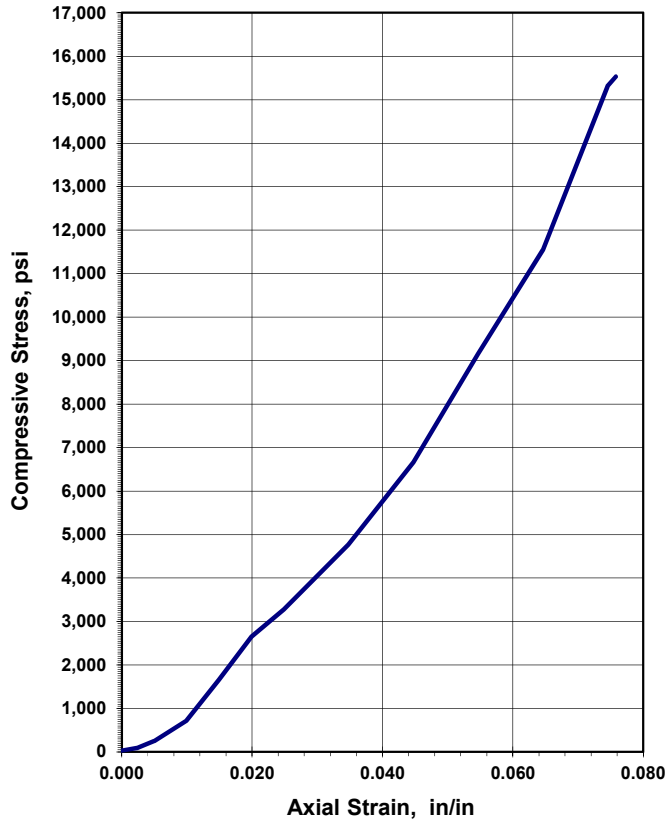
Rock Description: Gray LIMESTONE
Rock Formation:

Boring No.:	B-004-0-20		Average Length:	4.025	in
Sample No:	NQ-2		Average Diameter:	1.981	in
Depth (ft):	23.0	feet	Length to diameter ratio:	2.032	
Moisture condition:			Cross Sectional Area:	3.082	in^2
Sample Mass:	528.19	grams	Volume:	0.0072	ft^3
Testing Temperature:	21	°C	Unit Weight (sample specimen)*:	162.19	lbs/ft3
Rate of Loading:	117.3	lbs/sec	Failure Load:	47,872	lbs
Testing Time:	408	sec	Axial Strain at Failure:	0.0758	in/in
(Rate 2-15 minutes to failure)			Compressive Strength:	15,532	psi

Sample Preparation: Per ASTM D4543

**Actual test sample used for unit weight prior to testing.*

Unconfined Compression Test



Before Testing

After Failure

REMARKS:

RESOURCE INTERNATIONAL, INC.
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Columbus, OH 43231
Phone (614) 823-4949

9885 Rockside Road
Cleveland, OH 44125
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4480 Lake Forest Drive
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Phone (513) 769-6998

Unconfined Compressive Strength of Intact Rock Core Specimens

(ASTM D 7012-14)

Project: BEL SR 7 11.040
Project No.: W-20-120
Date of Testing: 11/2/2020
Test Performed by: KL/EM

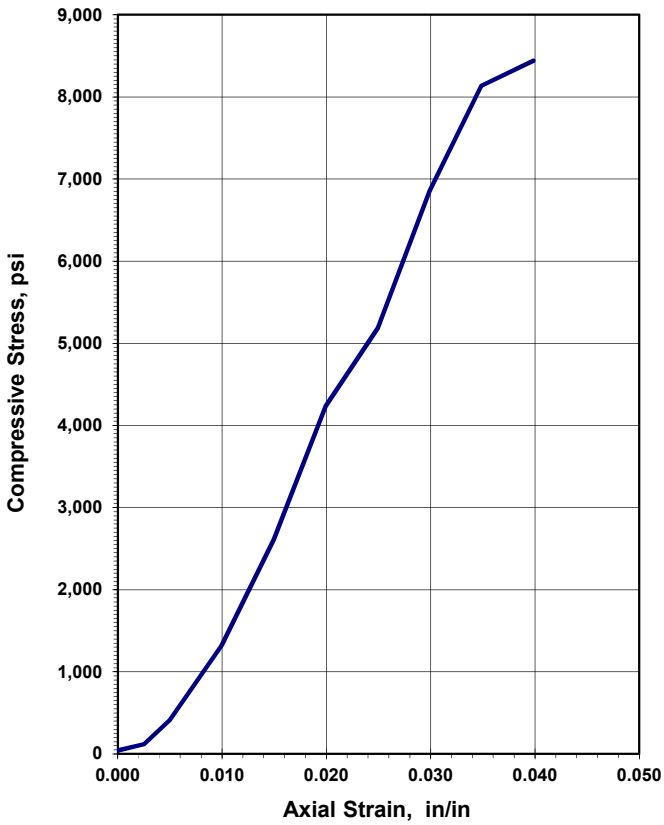
Rock Description: Gray LIMESTONE
Rock Formation:

Boring No.:	B-005-0-20		Average Length:	4.016	in
Sample No:	NQ-2		Average Diameter:	1.983	in
Depth (ft):	22.9	feet	Length to diameter ratio:	2.025	
Moisture condition:			Cross Sectional Area:	3.088	in^2
Sample Mass:	535.00	grams	Volume:	0.0072	ft^3
Testing Temperature:	21	°C	Unit Weight (sample specimen)*:	164.32	lbs/ft3
Rate of Loading:	91.5	lbs/sec	Failure Load:	26,068	lbs
Testing Time:	285	sec	Axial Strain at Failure:	0.0398	in/in
(Rate 2-15 minutes to failure)			Compressive Strength:	8,441	psi

Sample Preparation: Per ASTM D4543

**Actual test sample used for unit weight prior to testing.*

Unconfined Compression Test



Before Testing

After Failure

REMARKS:

RESOURCE INTERNATIONAL, INC.
Engineering Consultants

6350 Presidential Gatew.
Columbus, OH 43231
Phone (614) 823-4949

9885 Rockside Road
Cleveland, OH 44125
Phone (216) 573-0955

4480 Lake Forest Drive
Cincinnati, Ohio 45242
Phone (513) 769-6998

Unconfined Compressive Strength of Intact Rock Core Specimens

(ASTM D 7012-14)

Project: BEL SR 7 11.40
Project No.: W-20-120
Date of Testing: 12/28/2022
Test Performed by: KL/EM

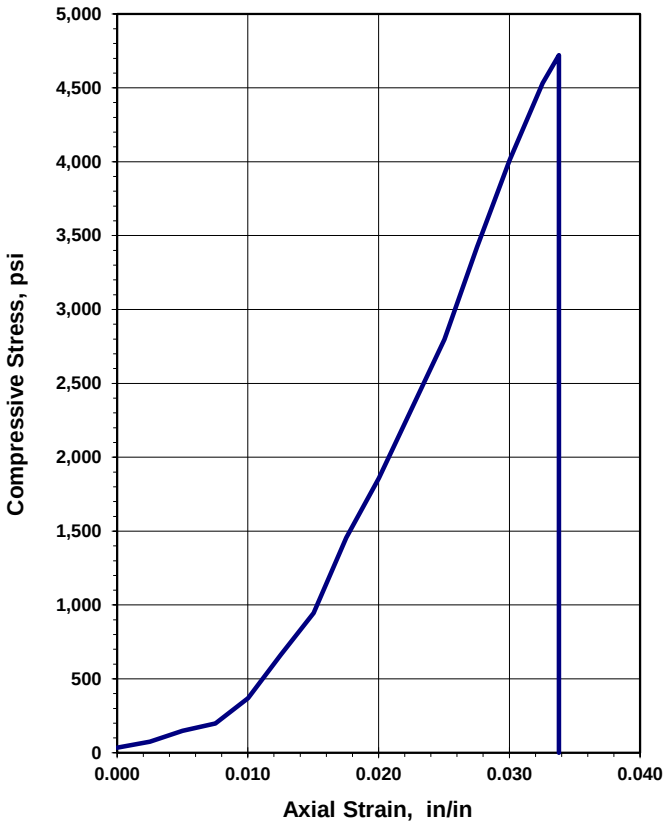
Rock Description: Gray SHALE
Rock Formation:

Boring No.:	B-001-2-22		Average Length:	3.995	in
Sample No:	RC-1		Average Diameter:	1.971	in
Depth (ft):	10.0	feet	Length to diameter ratio:	2.027	
Moisture condition:	As received		Cross Sectional Area:	3.051	in^2
Sample Mass:	519.50	grams	Volume:	0.0071	ft^3
Testing Temperature:	23	^oC	Unit Weight (sample specimen)*:	162.36	lbs/ft3
Rate of Loading:	39.1	lbs/sec	Failure Load:	14,405	lbs
Testing Time:	368	sec	Axial Strain at Failure:	0.0338	in/in
(Rate 2-15 mir			Compressive Strength:	4,721	psi

Sample Preparation: Per ASTM D4543

**Actual test sample used for unit weight prior to testing.*

Unconfined Compression Test



Before Testing

After Failure

REMARKS:

RESOURCE INTERNATIONAL, INC.
Engineering Consultants

6350 Presidential Gatew.
Columbus, OH 43231
Phone (614) 823-4949

9885 Rockside Road
Cleveland, OH 44125
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4480 Lake Forest Drive
Cincinnati, Ohio 45242
Phone (513) 769-6998

Unconfined Compressive Strength of Intact Rock Core Specimens

(ASTM D 7012-14)

Project: BEL SR 7 11.40
Project No.: W-20-120
Date of Testing: 12/28/2022
Test Performed by: KL/EM

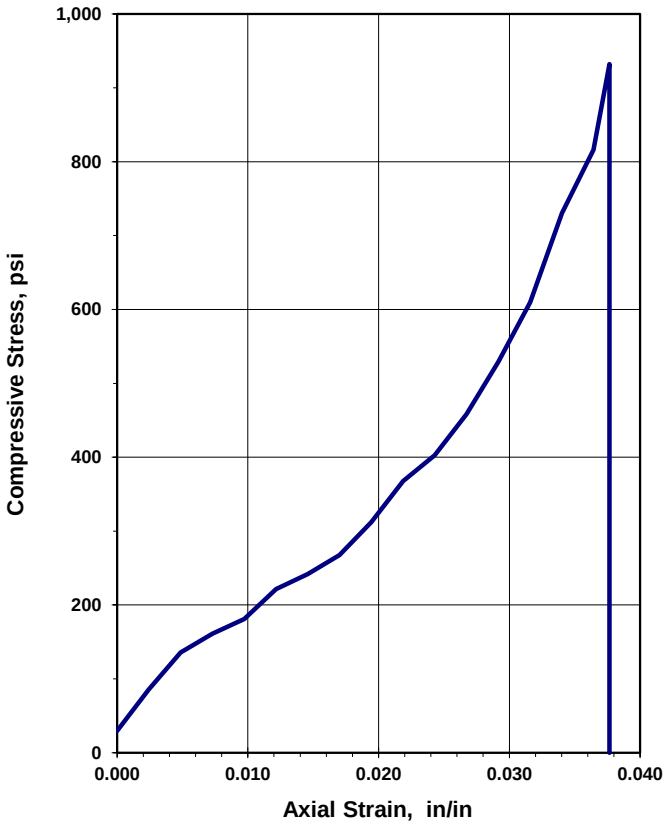
Rock Description: Gray SHALE
Rock Formation:

Boring No.:	B-001-3-22		Average Length:	4.116	in
Sample No:	RC-1		Average Diameter:	1.89	in
Depth (ft):	12.0	feet	Length to diameter ratio:	2.178	
Moisture condition:	As received		Cross Sectional Area:	2.806	in^2
Sample Mass:	507.41	grams	Volume:	0.0067	ft^3
Testing Temperature:	23	^oC	Unit Weight (sample specimen)*:	167.39	lbs/ft3
Rate of Loading:	7.1	lbs/sec	Failure Load:	2,615	lbs
Testing Time:	368	sec	Axial Strain at Failure:	0.0377	in/in
(Rate 2-15 mir			Compressive Strength:	932	psi

Sample Preparation: Per ASTM D4543

**Actual test sample used for unit weight prior to testing.*

Unconfined Compression Test



Before Testing

After Failure

REMARKS:

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Unconfined Compressive Strength of Intact Rock Core Specimens

(ASTM D 7012-14)

Project: BEL SR 7 11.40
Project No.: W-20-120
Date of Testing: 12/28/2022
Test Performed by: KL/EM

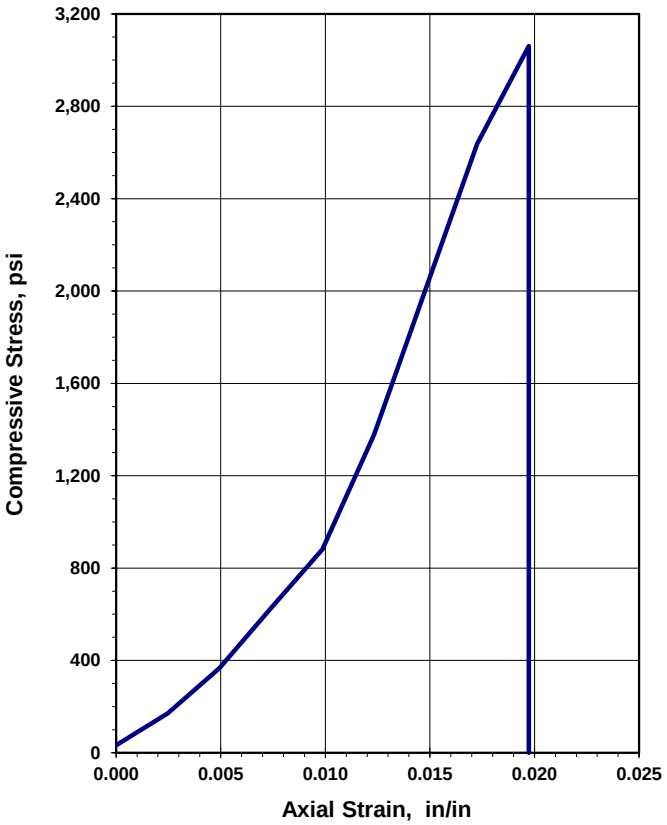
Rock Description: Gray SHALE
Rock Formation:

Boring No.:	B-001-3-22		Average Length:	4.055	in
Sample No:	RC-1		Average Diameter:	1.976	in
Depth (ft):	6.0	feet	Length to diameter ratio:	2.052	
Moisture condition:	As received		Cross Sectional Area:	3.067	in^2
Sample Mass:	518.98	grams	Volume:	0.0072	ft^3
Testing Temperature:	23	^oC	Unit Weight (sample specimen)*:	158.99	lbs/ft3
Rate of Loading:	30.8	lbs/sec	Failure Load:	9,387	lbs
Testing Time:	305	sec	Axial Strain at Failure:	0.0197	in/in
(Rate 2-15 mir			Compressive Strength:	3,061	psi

Sample Preparation: Per ASTM D4543

**Actual test sample used for unit weight prior to testing.*

Unconfined Compression Test



Before Testing

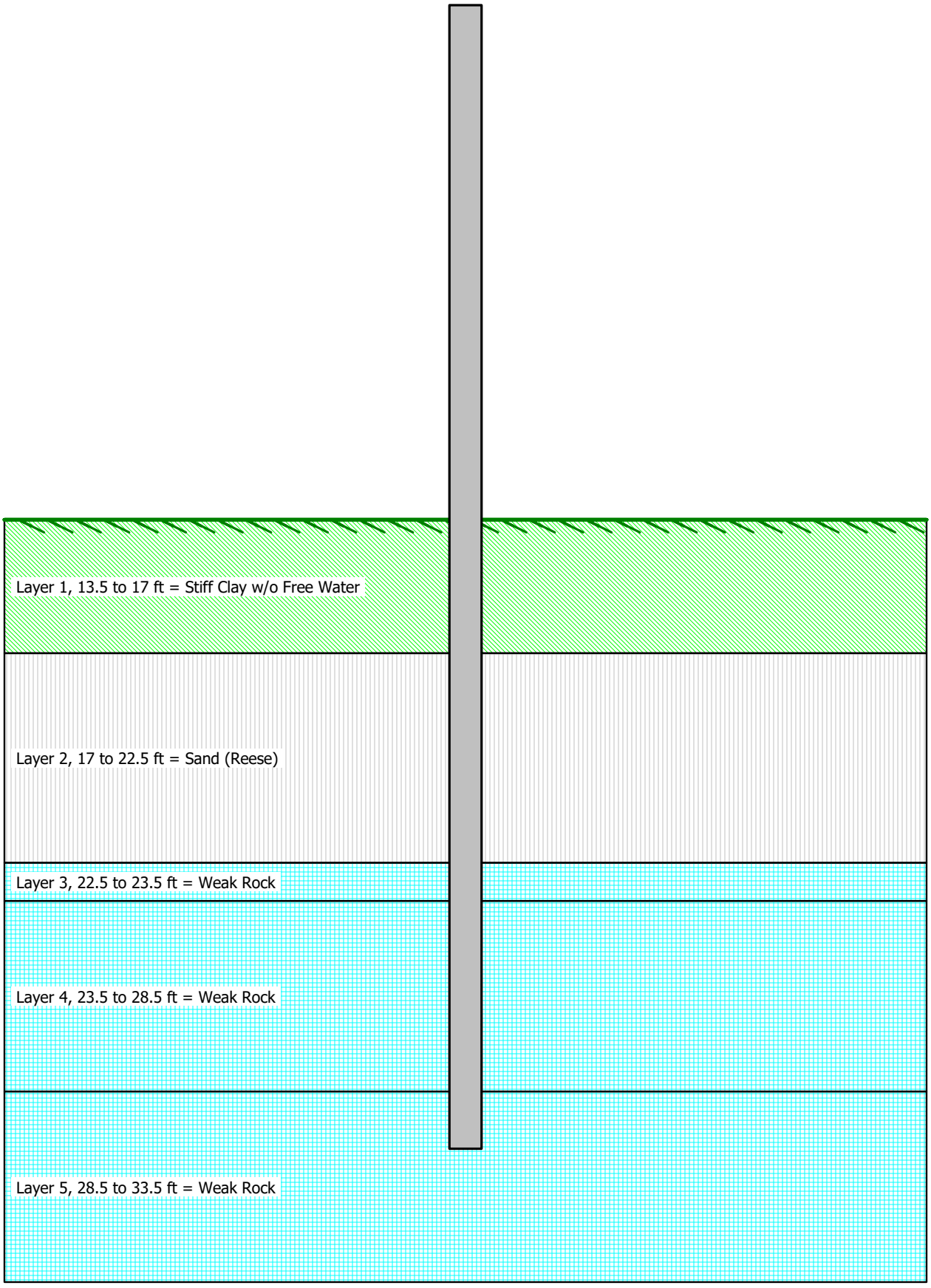
After Failure

REMARKS:

Appendix VII

LATERAL LOAD ANALYSIS

HP 10x42
Boring B-001-2-22



```
================================================================================

                  LPile for Windows(Beta), Version 2018-10.009

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

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--------------------------------------------------------------------------------
                             Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\GEOTECH\PROJECTS\2020\W-20-120 BEL-7-11.04\Analysis\2.17.2023 LPile Analysis\Lpile\

Name of input data file:
HP 10x42_B-001-2-22.lp10

Name of output report file:
HP 10x42_B-001-2-22.lp10

Name of plot output file:
HP 10x42_B-001-2-22.lp10

Name of runtime message file:
HP 10x42_B-001-2-22.lp10



--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  February 20, 2023          Time:  15:58:02
```

Problem Title

Project Name: BEL-7-11.04

Job Number: W-20-120

Client:

Engineer: AG/JPS

Description: 10 x 42 HP - Boring B-001-2-22

Program Options and Settings

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

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

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

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1

- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 30.000 ft
Depth of ground surface below top of pile = 13.5000 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	10.1000
2	30.000	10.1000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a H strong axis steel pile
Length of section = 30.000000 ft
Pile width = 10.100000 in
Shear capacity of section = 84100. lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer	=	13.500000 ft
Distance from top of pile to bottom of layer	=	17.000000 ft
Effective unit weight at top of layer	=	125.000000 pcf
Effective unit weight at bottom of layer	=	125.000000 pcf
Undrained cohesion at top of layer	=	1875. psf
Undrained cohesion at bottom of layer	=	1875. psf
Epsilon-50 at top of layer	=	0.007000
Epsilon-50 at bottom of layer	=	0.007000

Layer 2 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	17.000000 ft
Distance from top of pile to bottom of layer	=	22.500000 ft
Effective unit weight at top of layer	=	125.000000 pcf
Effective unit weight at bottom of layer	=	125.000000 pcf
Friction angle at top of layer	=	32.000000 deg.
Friction angle at bottom of layer	=	32.000000 deg.
Subgrade k at top of layer	=	50.000000 pci
Subgrade k at bottom of layer	=	50.000000 pci

Layer 3 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	22.500000 ft
Distance from top of pile to bottom of layer	=	23.500000 ft
Effective unit weight at top of layer	=	135.000000 pcf
Effective unit weight at bottom of layer	=	135.000000 pcf
Uniaxial compressive strength at top of layer	=	100.000000 psi
Uniaxial compressive strength at bottom of layer	=	100.000000 psi
Initial modulus of rock at top of layer	=	18000. psi
Initial modulus of rock at bottom of layer	=	18000. psi
RQD of rock at top of layer	=	0.0000 %
RQD of rock at bottom of layer	=	0.0000 %
k rm of rock at top of layer	=	0.0005000
k rm of rock at bottom of layer	=	0.0005000

Layer 4 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	23.500000 ft
Distance from top of pile to bottom of layer	=	28.500000 ft
Effective unit weight at top of layer	=	140.000000 pcf
Effective unit weight at bottom of layer	=	140.000000 pcf
Uniaxial compressive strength at top of layer	=	4721. psi

```
   Uniaxial compressive strength at bottom of layer    =        4721. psi
   Initial modulus of rock at top of layer             =      300000. psi
   Initial modulus of rock at bottom of layer          =      300000. psi
   RQD of rock at top of layer                         =    70.000000 %
   RQD of rock at bottom of layer                      =    70.000000 %
   k rm of rock at top of layer                        =    0.0000500
   k rm of rock at bottom of layer                     =    0.0000500


Layer 5 is weak rock, p-y criteria by Reese, 1997

   Distance from top of pile to top of layer           =    28.500000 ft
   Distance from top of pile to bottom of layer        =    33.500000 ft
   Effective unit weight at top of layer               =   140.000000 pcf
   Effective unit weight at bottom of layer            =   140.000000 pcf
   Uniaxial compressive strength at top of layer       =        4721. psi
   Uniaxial compressive strength at bottom of layer    =        4721. psi
   Initial modulus of rock at top of layer             =      300000. psi
   Initial modulus of rock at bottom of layer          =      300000. psi
   RQD of rock at top of layer                         =    88.000000 %
   RQD of rock at bottom of layer                      =    88.000000 %
   k rm of rock at top of layer                        =    0.0000500
   k rm of rock at bottom of layer                     =    0.0000500


 (Depth of the lowest soil layer extends 3.500 ft below the pile tip)
```

Summary of Input Soil Properties

Layer Num.	Soil Type / Layer Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Angle of Friction deg.	Uniaxial qu psi	RQD %	E50 or krm	kpy pci	Rock Mass Modulus psi
1	Stiff Clay	13.5000	125.0000	1875.	--	--	--	0.00700	--	--
	w/o Free Water	17.0000	125.0000	1875.	--	--	--	0.00700	--	--
2	Sand	17.0000	125.0000	--	32.0000	--	--	--	50.0000	--
	(Reese, et al.)	22.5000	125.0000	--	32.0000	--	--	--	50.0000	--
3	Weak	22.5000	135.0000	--	--	100.0000	0.00	5.00E-04	--	18000.
	Rock	23.5000	135.0000	--	--	100.0000	0.00	5.00E-04	--	18000.

4	Weak	23.5000	140.0000	--	--	4721.	70.0000	5.00E-05	--	300000.
	Rock	28.5000	140.0000	--	--	4721.	70.0000	5.00E-05	--	300000.
5	Weak	28.5000	140.0000	--	--	4721.	88.0000	5.00E-05	--	300000.
	Rock	33.5000	140.0000	--	--	4721.	88.0000	5.00E-05	--	300000.

Static Loading Type

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

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
1	1	V = 3300. lbs	M = 0.0000 in-lbs	0.0000000	No

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

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

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

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel H Strong Axis:

Length of Section = 30.000000 ft
Flange Width = 10.100000 in
Section Depth = 9.700000 in
Flange Thickness = 0.420000 in
Web Thickness = 0.415000 in
Yield Stress of Pipe = 36.000000 ksi
Elastic Modulus = 29000. ksi
Cross-sectional Area = 12.160900 sq. in.
Moment of Inertia = 206.834773 in^4
Elastic Bending Stiffness = 5998208. kip-in^2
Plastic Modulus, Z = 47.510093in^3
Plastic Moment Capacity = Fy Z = 1710.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As = 437.792 kips
Nominal Axial Tensile Capacity = -437.792 kips

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

Number	Axial Thrust Force kips
1	0.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 0.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000522	31.3039815	5992769.	4.8500000	0.7273560	
0.00001045	62.6079629	5992769.	4.8500000	1.4547119	
0.00001567	93.9119444	5992769.	4.8500000	2.1820679	
0.00002089	125.2159259	5992769.	4.8500000	2.9094238	
0.00002612	156.5199073	5992769.	4.8500000	3.6367798	
0.00003134	187.8238888	5992769.	4.8500000	4.3641357	
0.00003657	219.1278703	5992769.	4.8500000	5.0914917	
0.00004179	250.4318517	5992769.	4.8500000	5.8188476	
0.00004701	281.7358332	5992769.	4.8500000	6.5462036	

0.00005224	313.0398146	5992769.	4.8500000	7.2735596	
0.00005746	344.3437961	5992769.	4.8500000	8.0009155	
0.00006268	375.6477776	5992769.	4.8500000	8.7282715	
0.00006791	406.9517590	5992769.	4.8500000	9.4556274	
0.00007313	438.2557405	5992769.	4.8500000	10.1829834	
0.00007835	469.5597220	5992769.	4.8500000	10.9103393	
0.00008358	500.8637034	5992769.	4.8500000	11.6376953	
0.00008880	532.1676849	5992769.	4.8500000	12.3650512	
0.00009403	563.4716664	5992769.	4.8500000	13.0924072	
0.00009925	594.7756478	5992769.	4.8500000	13.8197632	
0.0001045	626.0796293	5992769.	4.8500000	14.5471191	
0.0001097	657.3836108	5992769.	4.8500000	15.2744751	
0.0001149	688.6875922	5992769.	4.8500000	16.0018310	
0.0001201	719.9915737	5992769.	4.8500000	16.7291870	
0.0001254	751.2955551	5992769.	4.8500000	17.4565429	
0.0001306	782.5995366	5992769.	4.8500000	18.1838989	
0.0001358	813.9035181	5992769.	4.8500000	18.9112548	
0.0001410	845.2074995	5992769.	4.8500000	19.6386108	
0.0001463	876.5114810	5992769.	4.8500000	20.3659668	
0.0001515	907.8154625	5992769.	4.8500000	21.0933227	
0.0001567	939.1194439	5992769.	4.8500000	21.8206787	
0.0001619	970.4234254	5992769.	4.8500000	22.5480346	
0.0001672	1002.	5992769.	4.8500000	23.2753906	
0.0001724	1033.	5992769.	4.8500000	24.0027465	
0.0001776	1064.	5992769.	4.8500000	24.7301025	
0.0001828	1096.	5992769.	4.8500000	25.4574585	
0.0001881	1127.	5992769.	4.8500000	26.1848144	
0.0001933	1158.	5992769.	4.8500000	26.9121704	
0.0001985	1190.	5992769.	4.8500000	27.6395263	
0.0002037	1221.	5992769.	4.8500000	28.3668823	
0.0002142	1283.	5992769.	4.8500000	29.8215942	
0.0002246	1346.	5992769.	4.8500000	31.2763061	
0.0002351	1409.	5992769.	4.8500000	32.7310180	
0.0002455	1471.	5992769.	4.8500000	34.1857299	
0.0002560	1534.	5992769.	4.8500000	35.6404418	
0.0002664	1583.	5942130.	4.8500000	36.0000000	Y
0.0002769	1608.	5807975.	4.8500000	36.0000000	Y
0.0002873	1617.	5627120.	4.8500000	36.0000000	Y
0.0002977	1623.	5451108.	4.8500000	36.0000000	Y
0.0003082	1629.	5285148.	4.8500000	36.0000000	Y
0.0003186	1634.	5128131.	4.8500000	36.0000000	Y
0.0003291	1639.	4979678.	4.8500000	36.0000000	Y
0.0003395	1643.	4839137.	4.8500000	36.0000000	Y
0.0003500	1647.	4705909.	4.8500000	36.0000000	Y
0.0003604	1651.	4579458.	4.8500000	36.0000000	Y
0.0003709	1654.	4459307.	4.8500000	36.0000000	Y
0.0003813	1657.	4345022.	4.8500000	36.0000000	Y
0.0003918	1660.	4236215.	4.8500000	36.0000000	Y
0.0004022	1662.	4132530.	4.8500000	36.0000000	Y
0.0004127	1665.	4033644.	4.8500000	36.0000000	Y
0.0004231	1667.	3939263.	4.8500000	36.0000000	Y
0.0004336	1669.	3849104.	4.8500000	36.0000000	Y

0.0004440	1671.	3762749.	4.8500000	36.0000000	Y
0.0004545	1672.	3680141.	4.8500000	36.0000000	Y
0.0004649	1674.	3601052.	4.8500000	36.0000000	Y
0.0004753	1676.	3525092.	4.8500000	36.0000000	Y
0.0004858	1677.	3452291.	4.8500000	36.0000000	Y
0.0004962	1678.	3382319.	4.8500000	36.0000000	Y
0.0005067	1680.	3315098.	4.8500000	36.0000000	Y
0.0005171	1681.	3250437.	4.8500000	36.0000000	Y
0.0005276	1682.	3188206.	4.8500000	36.0000000	Y
0.0005380	1683.	3128263.	4.8500000	36.0000000	Y
0.0005485	1684.	3070519.	4.8500000	36.0000000	Y
0.0005589	1685.	3014790.	4.8500000	36.0000000	Y
0.0005694	1686.	2961096.	4.8500000	36.0000000	Y
0.0005798	1687.	2909147.	4.8500000	36.0000000	Y
0.0005903	1688.	2859037.	4.8500000	36.0000000	Y
0.0006007	1688.	2810577.	4.8500000	36.0000000	Y
0.0006112	1689.	2763692.	4.8500000	36.0000000	Y
0.0006216	1690.	2718382.	4.8500000	36.0000000	Y
0.0006634	1692.	2550781.	4.8500000	36.0000000	Y
0.0007052	1694.	2402455.	4.8500000	36.0000000	Y
0.0007470	1696.	2270298.	4.8500000	36.0000000	Y
0.0007888	1697.	2151822.	4.8500000	36.0000000	Y
0.0008306	1699.	2045031.	4.8500000	36.0000000	Y
0.0008723	1700.	1948248.	4.8500000	36.0000000	Y
0.0009141	1700.	1860154.	4.8500000	36.0000000	Y
0.0009559	1701.	1779680.	4.8500000	36.0000000	Y
0.0009977	1702.	1705811.	4.8500000	36.0000000	Y
0.0010395	1703.	1637830.	4.8500000	36.0000000	Y
0.0010813	1703.	1575020.	4.8500000	36.0000000	Y
0.0011231	1704.	1516858.	4.8500000	36.0000000	Y
0.0011649	1704.	1462791.	4.8500000	36.0000000	Y
0.0012067	1704.	1412468.	4.8500000	36.0000000	Y
0.0012484	1705.	1365457.	4.8500000	36.0000000	Y
0.0012902	1705.	1321468.	4.8500000	36.0000000	Y

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

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	0.00000000	1705.

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

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

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

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	13.5000	0.00	N.A.	No	0.00	22957.
2	17.0000	5.8515	No	No	22957.	113304.
3	22.5000	9.0000	No	Yes	N.A.	N.A.
4	23.5000	10.0000	No	Yes	N.A.	N.A.
5	28.5000	15.0000	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.

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 = 3300.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	1.9444	-5.75E-06	3300.	-0.01315	1.40E-07	5.99E+09	0.00	0.00	0.00
0.3000	1.8970	11880.	3300.	-0.01314	290.0576	5.99E+09	0.00	0.00	0.00
0.6000	1.8497	23760.	3300.	-0.01313	580.1152	5.99E+09	0.00	0.00	0.00

0.9000	1.8025	35640.	3300.	-0.01312	870.1728	5.99E+09	0.00	0.00	0.00
1.2000	1.7553	47520.	3300.	-0.01309	1160.	5.99E+09	0.00	0.00	0.00
1.5000	1.7082	59400.	3300.	-0.01306	1450.	5.99E+09	0.00	0.00	0.00
1.8000	1.6613	71280.	3300.	-0.01302	1740.	5.99E+09	0.00	0.00	0.00
2.1000	1.6145	83160.	3300.	-0.01297	2030.	5.99E+09	0.00	0.00	0.00
2.4000	1.5678	95040.	3300.	-0.01292	2320.	5.99E+09	0.00	0.00	0.00
2.7000	1.5214	106920.	3300.	-0.01286	2611.	5.99E+09	0.00	0.00	0.00
3.0000	1.4753	118800.	3300.	-0.01279	2901.	5.99E+09	0.00	0.00	0.00
3.3000	1.4293	130680.	3300.	-0.01272	3191.	5.99E+09	0.00	0.00	0.00
3.6000	1.3837	142560.	3300.	-0.01263	3481.	5.99E+09	0.00	0.00	0.00
3.9000	1.3384	154440.	3300.	-0.01255	3771.	5.99E+09	0.00	0.00	0.00
4.2000	1.2934	166320.	3300.	-0.01245	4061.	5.99E+09	0.00	0.00	0.00
4.5000	1.2487	178200.	3300.	-0.01235	4351.	5.99E+09	0.00	0.00	0.00
4.8000	1.2045	190080.	3300.	-0.01224	4641.	5.99E+09	0.00	0.00	0.00
5.1000	1.1606	201960.	3300.	-0.01212	4931.	5.99E+09	0.00	0.00	0.00
5.4000	1.1172	213840.	3300.	-0.01199	5221.	5.99E+09	0.00	0.00	0.00
5.7000	1.0743	225720.	3300.	-0.01186	5511.	5.99E+09	0.00	0.00	0.00
6.0000	1.0318	237600.	3300.	-0.01172	5801.	5.99E+09	0.00	0.00	0.00
6.3000	0.9899	249480.	3300.	-0.01157	6091.	5.99E+09	0.00	0.00	0.00
6.6000	0.9485	261360.	3300.	-0.01142	6381.	5.99E+09	0.00	0.00	0.00
6.9000	0.9077	273240.	3300.	-0.01126	6671.	5.99E+09	0.00	0.00	0.00
7.2000	0.8674	285120.	3300.	-0.01109	6961.	5.99E+09	0.00	0.00	0.00
7.5000	0.8278	297000.	3300.	-0.01092	7251.	5.99E+09	0.00	0.00	0.00
7.8000	0.7888	308880.	3300.	-0.01074	7541.	5.99E+09	0.00	0.00	0.00
8.1000	0.7505	320760.	3300.	-0.01055	7832.	5.99E+09	0.00	0.00	0.00
8.4000	0.7129	332640.	3300.	-0.01035	8122.	5.99E+09	0.00	0.00	0.00
8.7000	0.6760	344520.	3300.	-0.01015	8412.	5.99E+09	0.00	0.00	0.00
9.0000	0.6398	356400.	3300.	-0.00994	8702.	5.99E+09	0.00	0.00	0.00
9.3000	0.6044	368280.	3300.	-0.00972	8992.	5.99E+09	0.00	0.00	0.00
9.6000	0.5698	380160.	3300.	-0.00949	9282.	5.99E+09	0.00	0.00	0.00
9.9000	0.5361	392040.	3300.	-0.00926	9572.	5.99E+09	0.00	0.00	0.00
10.2000	0.5031	403920.	3300.	-0.00902	9862.	5.99E+09	0.00	0.00	0.00
10.5000	0.4711	415800.	3300.	-0.00878	10152.	5.99E+09	0.00	0.00	0.00
10.8000	0.4399	427680.	3300.	-0.00852	10442.	5.99E+09	0.00	0.00	0.00
11.1000	0.4097	439560.	3300.	-0.00826	10732.	5.99E+09	0.00	0.00	0.00
11.4000	0.3804	451440.	3300.	-0.00800	11022.	5.99E+09	0.00	0.00	0.00
11.7000	0.3521	463320.	3300.	-0.00772	11312.	5.99E+09	0.00	0.00	0.00
12.0000	0.3249	475200.	3300.	-0.00744	11602.	5.99E+09	0.00	0.00	0.00
12.3000	0.2986	487080.	3300.	-0.00715	11892.	5.99E+09	0.00	0.00	0.00
12.6000	0.2734	498960.	3300.	-0.00685	12182.	5.99E+09	0.00	0.00	0.00
12.9000	0.2492	510840.	3300.	-0.00655	12472.	5.99E+09	0.00	0.00	0.00
13.2000	0.2262	522720.	3300.	-0.00624	12763.	5.99E+09	0.00	0.00	0.00
13.5000	0.2043	534600.	2932.	-0.00592	13053.	5.99E+09	-204.5438	3604.	0.00
13.8000	0.1836	543829.	2182.	-0.00560	13278.	5.99E+09	-212.2995	4164.	0.00
14.1000	0.1640	550307.	1405.	-0.00527	13436.	5.99E+09	-219.1927	4812.	0.00
14.4000	0.1456	553944.	604.9222	-0.00494	13525.	5.99E+09	-225.1935	5567.	0.00
14.7000	0.1284	554662.	-214.9120	-0.00461	13542.	5.99E+09	-230.2700	6454.	0.00
15.0000	0.1125	552396.	-1051.	-0.00427	13487.	5.99E+09	-234.3879	7503.	0.00
15.3000	0.09767	547093.	-1901.	-0.00394	13358.	5.99E+09	-237.5101	8754.	0.00
15.6000	0.08407	538711.	-2760.	-0.00362	13153.	5.99E+09	-239.5949	10260.	0.00
15.9000	0.07163	527225.	-3624.	-0.00330	12873.	5.99E+09	-240.5947	12091.	0.00
16.2000	0.06034	512620.	-4490.	-0.00298	12516.	5.99E+09	-240.4531	14347.	0.00

16.5000	0.05015	494898.	-5353.	-0.00268	12083.	5.99E+09	-239.1010	17165.	0.00
16.8000	0.04103	474079.	-6209.	-0.00239	11575.	5.99E+09	-236.4490	20747.	0.00
17.1000	0.03294	450194.	-6763.	-0.00211	10992.	5.99E+09	-71.1412	7776.	0.00
17.4000	0.02582	425388.	-6999.	-0.00185	10386.	5.99E+09	-60.4105	8424.	0.00
17.7000	0.01962	399799.	-7197.	-0.00160	9761.	5.99E+09	-49.4351	9072.	0.00
18.0000	0.01428	373569.	-7355.	-0.00137	9121.	5.99E+09	-38.5623	9720.	0.00
18.3000	0.00976	346839.	-7475.	-0.00115	8468.	5.99E+09	-28.0957	10368.	0.00
18.6000	0.00598	319746.	-7559.	-9.53E-04	7807.	5.99E+09	-18.2947	11016.	0.00
18.9000	0.00289	292415.	-7609.	-7.69E-04	7139.	5.99E+09	-9.3745	11664.	0.00
19.2000	4.40E-04	264962.	-7628.	-6.02E-04	6469.	5.99E+09	-1.5062	12312.	0.00
19.5000	-0.00144	237490.	-7622.	-4.51E-04	5798.	5.99E+09	5.1822	12960.	0.00
19.8000	-0.00281	210086.	-7593.	-3.16E-04	5129.	5.99E+09	10.6060	13608.	0.00
20.1000	-0.00372	182818.	-7548.	-1.98E-04	4464.	5.99E+09	14.7226	14256.	0.00
20.4000	-0.00423	155742.	-7490.	-9.67E-05	3803.	5.99E+09	17.5306	14904.	0.00
20.7000	-0.00441	128893.	-7424.	-1.12E-05	3147.	5.99E+09	19.0696	15552.	0.00
21.0000	-0.00432	102291.	-7355.	5.82E-05	2497.	5.99E+09	19.4190	16200.	0.00
21.3000	-0.00400	75940.	-7286.	1.12E-04	1854.	5.99E+09	18.6975	16848.	0.00
21.6000	-0.00351	49832.	-7222.	1.50E-04	1217.	5.99E+09	17.0627	17496.	0.00
21.9000	-0.00292	23945.	-7164.	1.72E-04	584.6335	5.99E+09	14.7102	18144.	0.00
22.2000	-0.00227	-1751.	-7117.	1.78E-04	42.7589	5.99E+09	11.8744	18792.	0.00
22.5000	-0.00163	-27294.	-6410.	1.70E-04	666.3940	5.99E+09	380.9013	838862.	0.00
22.8000	-0.00105	-47900.	-4803.	1.47E-04	1170.	5.99E+09	511.5922	1748132.	0.00
23.1000	-5.76E-04	-61875.	-2827.	1.14E-04	1511.	5.99E+09	586.3626	3664605.	0.00
23.4000	-2.32E-04	-68252.	-720.0743	7.50E-05	1666.	5.99E+09	583.9839	9049332.	0.00
23.7000	-3.62E-05	-67060.	6005.	3.43E-05	1637.	5.99E+09	3152.	3.13E+08	0.00
24.0000	1.49E-05	-25019.	8969.	6.67E-06	610.8473	5.99E+09	-1505.	3.65E+08	0.00
24.3000	1.18E-05	-2486.	3798.	-1.59E-06	60.7001	5.99E+09	-1367.	4.16E+08	0.00
24.6000	3.43E-06	2324.	534.4760	-1.64E-06	56.7488	5.99E+09	-445.4143	4.67E+08	0.00
24.9000	5.46E-08	1362.	-281.4362	-5.29E-07	33.2568	5.99E+09	-7.8702	5.19E+08	0.00
25.2000	-3.77E-07	297.9407	-193.9426	-3.03E-08	7.2744	5.99E+09	56.4778	5.40E+08	0.00
25.5000	-1.63E-07	-34.2768	-48.1807	4.89E-08	0.8369	5.99E+09	24.5011	5.40E+08	0.00
25.8000	-2.43E-08	-48.9602	2.4795	2.39E-08	1.1954	5.99E+09	3.6434	5.40E+08	0.00
26.1000	8.88E-09	-16.4247	6.6402	4.28E-09	0.4010	5.99E+09	-1.3319	5.40E+08	0.00
26.4000	6.53E-09	-1.1509	2.4800	-9.99E-10	0.02810	5.99E+09	-0.9793	5.40E+08	0.00
26.7000	1.69E-09	1.4314	0.2613	-9.14E-10	0.03495	5.99E+09	-0.2533	5.40E+08	0.00
27.0000	-5.56E-11	0.7307	-0.1796	-2.65E-10	0.01784	5.99E+09	0.00834	5.40E+08	0.00
27.3000	-2.20E-10	0.1381	-0.1053	-4.10E-12	0.00337	5.99E+09	0.03295	5.40E+08	0.00
27.6000	-8.51E-11	-0.02745	-0.02300	2.91E-11	6.70E-04	5.99E+09	0.01277	5.40E+08	0.00
27.9000	-9.93E-12	-0.02751	0.00266	1.26E-11	6.72E-04	5.99E+09	0.00149	5.40E+08	0.00
28.2000	5.77E-12	-0.00828	0.00379	1.87E-12	2.02E-04	5.99E+09	-8.65E-04	5.40E+08	0.00
28.5000	3.56E-12	-2.50E-04	0.00127	0.00	6.10E-06	5.99E+09	-5.34E-04	5.40E+08	0.00
28.8000	0.00	8.59E-04	8.84E-05	0.00	2.10E-05	5.99E+09	-1.22E-04	5.40E+08	0.00
29.1000	0.00	3.87E-04	-1.11E-04	0.00	9.45E-06	5.99E+09	1.14E-05	5.40E+08	0.00
29.4000	0.00	6.28E-05	-5.54E-05	0.00	1.53E-06	5.99E+09	1.92E-05	5.40E+08	0.00
29.7000	0.00	-1.21E-05	-8.72E-06	0.00	2.96E-07	5.99E+09	6.71E-06	5.40E+08	0.00
30.0000	0.00	0.00	0.00	0.00	0.00	5.99E+09	-1.87E-06	2.70E+08	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. 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 interpolated 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             =     1.94436171 inches
Computed slope at pile head      =    -0.01314850 radians
Maximum bending moment           =        554662. inch-lbs
Maximum shear force              =          8969. lbs
Depth of maximum bending moment  =    14.70000000 feet below pile head
Depth of maximum shear force     =    24.00000000 feet below pile head
Number of iterations             =             23
Number of zero deflection points =              8
```

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

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

Load Case No.	Load Type	Pile-head Load 1	Load Type 2	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	3300.	M, in-lb	0.00	0.00	1.9444	-0.01315	8969.	554662.

Maximum pile-head deflection = 1.9443617146 inches
Maximum pile-head rotation = -0.0131485037 radians = -0.753354 deg.

Summary of Warning Messages

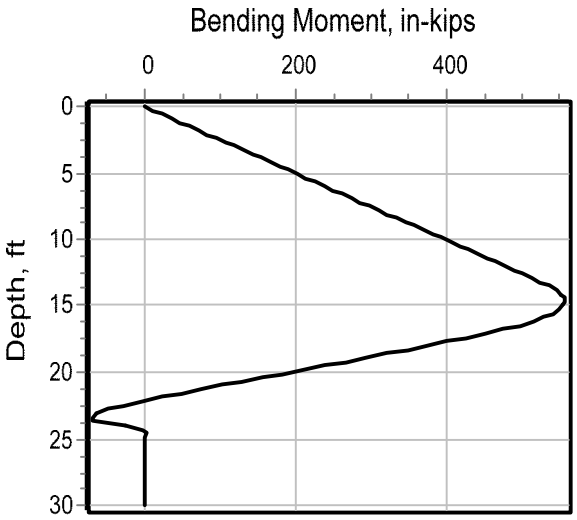
The following warning was reported 483 times

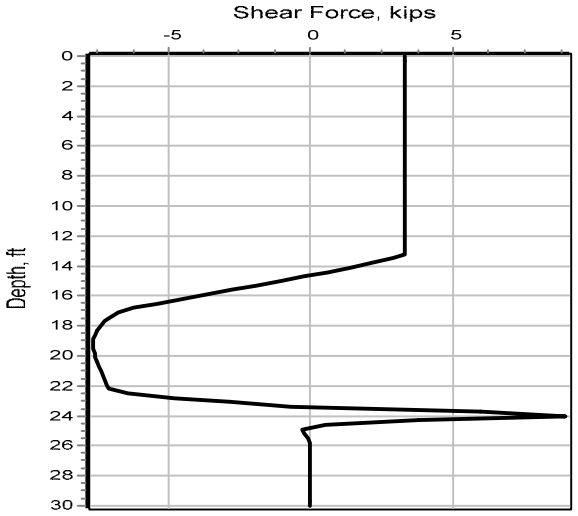
**** Warning ****

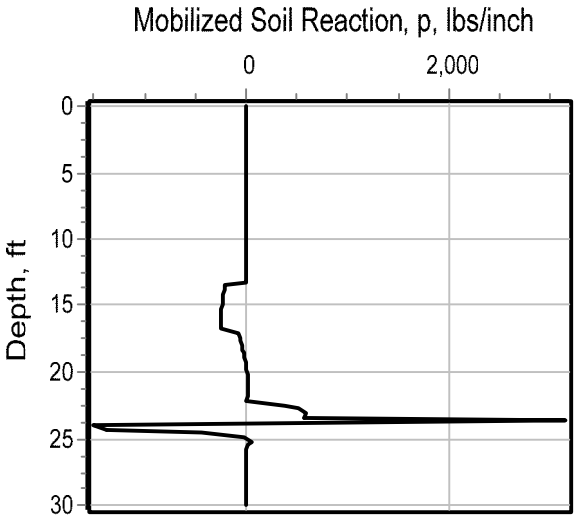
An unreasonable input value for unconfined compressive strength has been
specified for a soil defined using the weak rock criteria. The input value
is greater than 500 psi. Please check your input data for correctness.

```
The analysis ended normally.
```


Deflection, inches
0
0.5
1
1.5
Depth, ft
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30


Bending Moment, in-kips
0
200
400
Depth, ft
0
5
10
15
20
25
30


Shear Force, kips
-5
0
5
Depth, ft
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30


Mobilized Soil Reaction, p, lbs/inch
0
2,000
Depth, ft
0
5
10
15
20
25
30

RESOURCE INTERNATIONAL, INC.
6350 PRESIDENTIAL GATEWAY
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FAX: (614) 823-4990
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JOB	BEL-7-11.04	NO.	
SHEET NO.	1	OF	1
CALCULATED BY	AG	DATE	2/20/2023
CHECKED BY	JPS	DATE	2/20/2023

Wall - Steel post with fence (B-001-2-22)

Structural Element Properties

Section Type: HP 10x42

E =	29,000	ksi	d =	9.7	in	I_x =	210	in^4	Nom. Wt., W_{steel} =	42	lb/ft
A_s =	12.4	in^2	b_f =	10.1	in	r_s =	4.13	in	Z_x =	48.3	in^3
F_y =	36	ksi	t_w =	0.415	in	r_y =	2.41	in	T =	7.6	in
F_{yr} =	25	ksi	t_f =	0.420	in	r_t =	2.77	in	S =	43.4	in^3

Check Shear Resistance (AASHTO 6.10.9.2)

φ_v = **1.00**

Check: $V_u < \varphi_v V_n$ ⟶ 9.0 kips < 1.00(84.1 kips) ⟶ 9.0 kips < 84.1 kips **OK**

V_u = **9.0** kips (Determined from LPile)

$V_n = V_{cr} = CV_p$ = 84.1 kips

$V_p = 0.58F_{yw}Dt_W$ = 84.1 kips

C = 1.00

If $D/t_w \le 1.12\sqrt{Ek/F_{yw}}$ ⟶ $C = 1.0$

If $1.12\sqrt{Ek/F_{yw}} < D/t_w \le 1.40\sqrt{Ek/F_{yw}}$ ⟶ $C = \frac{1.12}{(D/t_w)}\sqrt{Ek/F_{yw}}$

If $D/t_w > 1.40\sqrt{Ek/F_{yw}}$ ⟶ $C = \frac{1.57}{(D/t_w)^2}\left(EK/F_{yw}\right)$

D/t_w = 23.4 $\quad 1.12\sqrt{Ek/F_{yw}}$ = 71.1 $\quad 1.40\sqrt{Ek/F_{yw}}$ = 88.9

k = **5.0** (AASHTO 6.10.9.2)

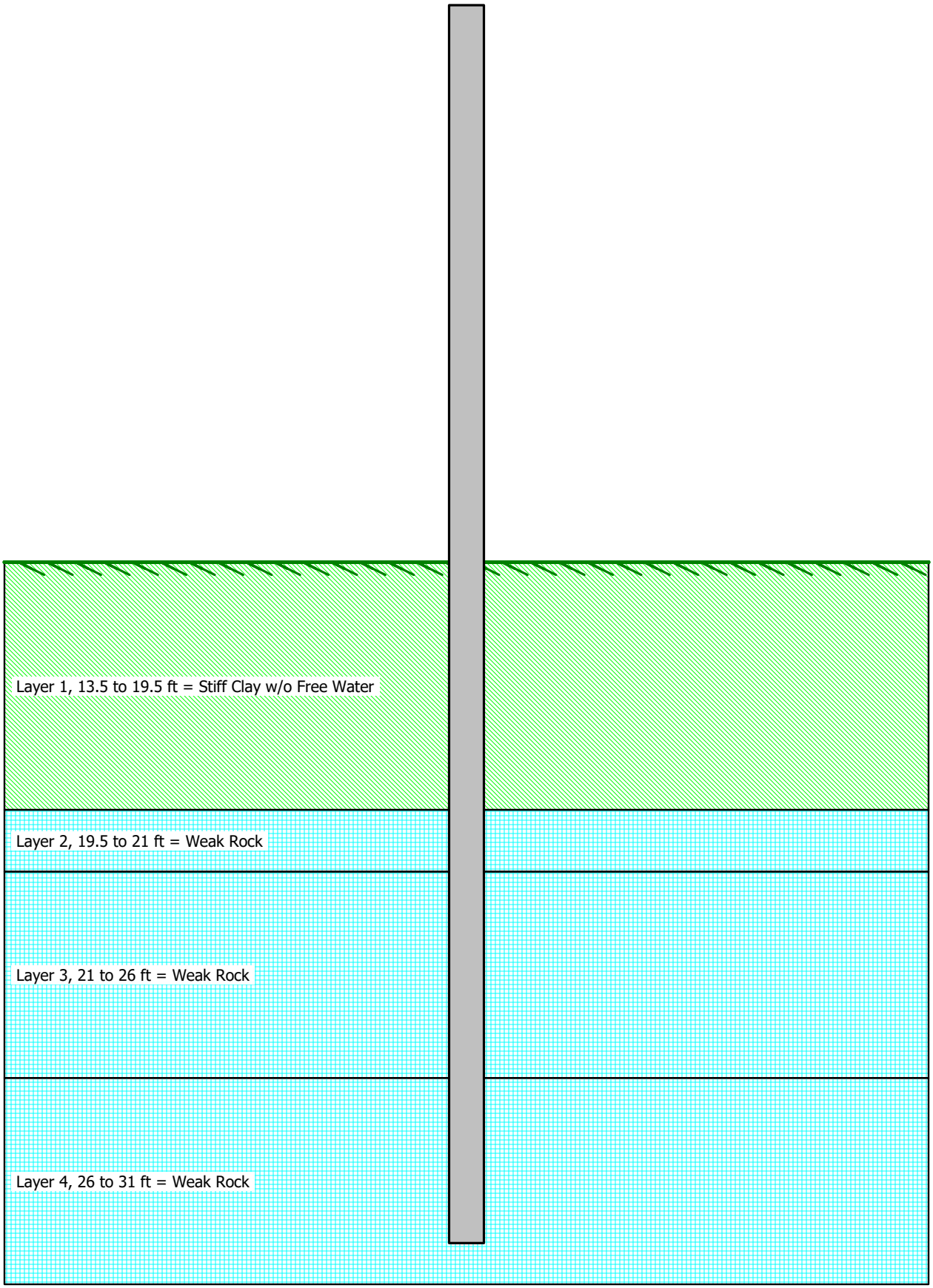
Check Flexural Resistance at Maximum Moment (AASHTO 6.10.8)

φ_f = **1.00**

Check: $M_u < \varphi_f M_n$ ⟶ 46.2 kip-ft < 1.00(144.9 kip-ft) ⟶ 46.2 kip-ft < 144.9 kip-ft **OK**

M_u = **46.2** kip-ft (Determined from LPile) $\quad M_n = F_y Z_x$ = 144.9 kip-ft

HP 10x42
Boring B-001-3-22



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================================================================================

                  LPile for Windows(Beta), Version 2018-10.009

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

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--------------------------------------------------------------------------------
                             Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\GEOTECH\PROJECTS\2020\W-20-120 BEL-7-11.04\Analysis\2.17.2023 LPile Analysis\Lpile\

Name of input data file:
HP 10x42_B-001-3-22.lp10

Name of output report file:
HP 10x42_B-001-3-22.lp10

Name of plot output file:
HP 10x42_B-001-3-22.lp10

Name of runtime message file:
HP 10x42_B-001-3-22.lp10



--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  February 20, 2023          Time:  16:01:09
```

Problem Title

Project Name: BEL-7-11.04

Job Number: W-20-120

Client:

Engineer: AG/JPS

Description: 10 x 42 HP - Boring B-001-3-22

Program Options and Settings

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

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

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

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1

- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 30.000 ft
Depth of ground surface below top of pile = 13.5000 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	10.1000
2	30.000	10.1000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a H strong axis steel pile
Length of section = 30.000000 ft
Pile width = 10.100000 in
Shear capacity of section = 84100. lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer	=	13.500000 ft
Distance from top of pile to bottom of layer	=	19.500000 ft
Effective unit weight at top of layer	=	125.000000 pcf
Effective unit weight at bottom of layer	=	125.000000 pcf
Undrained cohesion at top of layer	=	1875. psf
Undrained cohesion at bottom of layer	=	1875. psf
Epsilon-50 at top of layer	=	0.007000
Epsilon-50 at bottom of layer	=	0.007000

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

Distance from top of pile to top of layer	=	19.500000 ft
Distance from top of pile to bottom of layer	=	21.000000 ft
Effective unit weight at top of layer	=	135.000000 pcf
Effective unit weight at bottom of layer	=	135.000000 pcf
Uniaxial compressive strength at top of layer	=	100.000000 psi
Uniaxial compressive strength at bottom of layer	=	100.000000 psi
Initial modulus of rock at top of layer	=	18000. psi
Initial modulus of rock at bottom of layer	=	18000. psi
RQD of rock at top of layer	=	0.0000 %
RQD of rock at bottom of layer	=	0.0000 %
k rm of rock at top of layer	=	0.0005000
k rm of rock at bottom of layer	=	0.0005000

Layer 3 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	21.000000 ft
Distance from top of pile to bottom of layer	=	26.000000 ft
Effective unit weight at top of layer	=	140.000000 pcf
Effective unit weight at bottom of layer	=	140.000000 pcf
Uniaxial compressive strength at top of layer	=	932.000000 psi
Uniaxial compressive strength at bottom of layer	=	932.000000 psi
Initial modulus of rock at top of layer	=	100000. psi
Initial modulus of rock at bottom of layer	=	100000. psi
RQD of rock at top of layer	=	38.000000 %
RQD of rock at bottom of layer	=	38.000000 %
k rm of rock at top of layer	=	0.0005000
k rm of rock at bottom of layer	=	0.0005000

Layer 4 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	26.000000 ft

```
   Distance from top of pile to bottom of layer        =    31.000000 ft
   Effective unit weight at top of layer               =   140.000000 pcf
   Effective unit weight at bottom of layer            =   140.000000 pcf
   Uniaxial compressive strength at top of layer       =   932.000000 psi
   Uniaxial compressive strength at bottom of layer    =   932.000000 psi
   Initial modulus of rock at top of layer             =      100000. psi
   Initial modulus of rock at bottom of layer          =      100000. psi
   RQD of rock at top of layer                         =    40.000000 %
   RQD of rock at bottom of layer                      =    40.000000 %
   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 1.000 ft below the pile tip)
```

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Uniaxial qu psi	RQD %	E50 or krm	Rock Mass Modulus psi
1	Stiff Clay	13.5000	125.0000	1875.	--	--	0.00700	--
	w/o Free Water	19.5000	125.0000	1875.	--	--	0.00700	--
2	Weak	19.5000	135.0000	--	100.0000	0.00	5.00E-04	18000.
	Rock	21.0000	135.0000	--	100.0000	0.00	5.00E-04	18000.
3	Weak	21.0000	140.0000	--	932.0000	38.0000	5.00E-04	100000.
	Rock	26.0000	140.0000	--	932.0000	38.0000	5.00E-04	100000.
4	Weak	26.0000	140.0000	--	932.0000	40.0000	5.00E-04	100000.
	Rock	31.0000	140.0000	--	932.0000	40.0000	5.00E-04	100000.

Static Loading Type

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

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

```
   1     1     V =        3300. lbs   M =       0.0000 in-lbs         0.0000000          No

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



--------------------------------------------------------------------------------
     Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
--------------------------------------------------------------------------------

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

Number of Pile Sections Analyzed = 1

Pile Section No. 1:
-------------------

Dimensions and Properties of Steel H Strong Axis:
-------------------------------------------------

Length of Section                                  =    30.000000 ft
Flange Width                                       =    10.100000 in
Section Depth                                      =     9.700000 in
Flange Thickness                                   =     0.420000 in
Web Thickness                                      =     0.415000 in
Yield Stress of Pipe                               =    36.000000 ksi
Elastic Modulus                                    =       29000. ksi
Cross-sectional Area                               =    12.160900 sq. in.
Moment of Inertia                                  =   206.834773 in^4
Elastic Bending Stiffness                          =     5998208. kip-in^2
Plastic Modulus, Z                                 =    47.510093in^3
Plastic Moment Capacity = Fy Z                     =        1710.in-kip

Axial Structural Capacities:
----------------------------

Nom. Axial Structural Capacity = Fy As             =      437.792 kips
Nominal Axial Tensile Capacity                     =     -437.792 kips



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

   Number     Axial Thrust Force
```

	kips
1	0.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 0.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000522	31.3039815	5992769.	4.8500000	0.7273560	
0.00001045	62.6079629	5992769.	4.8500000	1.4547119	
0.00001567	93.9119444	5992769.	4.8500000	2.1820679	
0.00002089	125.2159259	5992769.	4.8500000	2.9094238	
0.00002612	156.5199073	5992769.	4.8500000	3.6367798	
0.00003134	187.8238888	5992769.	4.8500000	4.3641357	
0.00003657	219.1278703	5992769.	4.8500000	5.0914917	
0.00004179	250.4318517	5992769.	4.8500000	5.8188476	
0.00004701	281.7358332	5992769.	4.8500000	6.5462036	
0.00005224	313.0398146	5992769.	4.8500000	7.2735596	
0.00005746	344.3437961	5992769.	4.8500000	8.0009155	
0.00006268	375.6477776	5992769.	4.8500000	8.7282715	
0.00006791	406.9517590	5992769.	4.8500000	9.4556274	
0.00007313	438.2557405	5992769.	4.8500000	10.1829834	
0.00007835	469.5597220	5992769.	4.8500000	10.9103393	
0.00008358	500.8637034	5992769.	4.8500000	11.6376953	
0.00008880	532.1676849	5992769.	4.8500000	12.3650512	
0.00009403	563.4716664	5992769.	4.8500000	13.0924072	
0.00009925	594.7756478	5992769.	4.8500000	13.8197632	
0.0001045	626.0796293	5992769.	4.8500000	14.5471191	
0.0001097	657.3836108	5992769.	4.8500000	15.2744751	
0.0001149	688.6875922	5992769.	4.8500000	16.0018310	
0.0001201	719.9915737	5992769.	4.8500000	16.7291870	
0.0001254	751.2955551	5992769.	4.8500000	17.4565429	
0.0001306	782.5995366	5992769.	4.8500000	18.1838989	
0.0001358	813.9035181	5992769.	4.8500000	18.9112548	
0.0001410	845.2074995	5992769.	4.8500000	19.6386108	
0.0001463	876.5114810	5992769.	4.8500000	20.3659668	
0.0001515	907.8154625	5992769.	4.8500000	21.0933227	
0.0001567	939.1194439	5992769.	4.8500000	21.8206787	
0.0001619	970.4234254	5992769.	4.8500000	22.5480346	
0.0001672	1002.	5992769.	4.8500000	23.2753906	
0.0001724	1033.	5992769.	4.8500000	24.0027465	
0.0001776	1064.	5992769.	4.8500000	24.7301025	
0.0001828	1096.	5992769.	4.8500000	25.4574585	
0.0001881	1127.	5992769.	4.8500000	26.1848144	
0.0001933	1158.	5992769.	4.8500000	26.9121704	

0.0001985	1190.	5992769.	4.8500000	27.6395263	
0.0002037	1221.	5992769.	4.8500000	28.3668823	
0.0002142	1283.	5992769.	4.8500000	29.8215942	
0.0002246	1346.	5992769.	4.8500000	31.2763061	
0.0002351	1409.	5992769.	4.8500000	32.7310180	
0.0002455	1471.	5992769.	4.8500000	34.1857299	
0.0002560	1534.	5992769.	4.8500000	35.6404418	
0.0002664	1583.	5942130.	4.8500000	36.0000000	Y
0.0002769	1608.	5807975.	4.8500000	36.0000000	Y
0.0002873	1617.	5627120.	4.8500000	36.0000000	Y
0.0002977	1623.	5451108.	4.8500000	36.0000000	Y
0.0003082	1629.	5285148.	4.8500000	36.0000000	Y
0.0003186	1634.	5128131.	4.8500000	36.0000000	Y
0.0003291	1639.	4979678.	4.8500000	36.0000000	Y
0.0003395	1643.	4839137.	4.8500000	36.0000000	Y
0.0003500	1647.	4705909.	4.8500000	36.0000000	Y
0.0003604	1651.	4579458.	4.8500000	36.0000000	Y
0.0003709	1654.	4459307.	4.8500000	36.0000000	Y
0.0003813	1657.	4345022.	4.8500000	36.0000000	Y
0.0003918	1660.	4236215.	4.8500000	36.0000000	Y
0.0004022	1662.	4132530.	4.8500000	36.0000000	Y
0.0004127	1665.	4033644.	4.8500000	36.0000000	Y
0.0004231	1667.	3939263.	4.8500000	36.0000000	Y
0.0004336	1669.	3849104.	4.8500000	36.0000000	Y
0.0004440	1671.	3762749.	4.8500000	36.0000000	Y
0.0004545	1672.	3680141.	4.8500000	36.0000000	Y
0.0004649	1674.	3601052.	4.8500000	36.0000000	Y
0.0004753	1676.	3525092.	4.8500000	36.0000000	Y
0.0004858	1677.	3452291.	4.8500000	36.0000000	Y
0.0004962	1678.	3382319.	4.8500000	36.0000000	Y
0.0005067	1680.	3315098.	4.8500000	36.0000000	Y
0.0005171	1681.	3250437.	4.8500000	36.0000000	Y
0.0005276	1682.	3188206.	4.8500000	36.0000000	Y
0.0005380	1683.	3128263.	4.8500000	36.0000000	Y
0.0005485	1684.	3070519.	4.8500000	36.0000000	Y
0.0005589	1685.	3014790.	4.8500000	36.0000000	Y
0.0005694	1686.	2961096.	4.8500000	36.0000000	Y
0.0005798	1687.	2909147.	4.8500000	36.0000000	Y
0.0005903	1688.	2859037.	4.8500000	36.0000000	Y
0.0006007	1688.	2810577.	4.8500000	36.0000000	Y
0.0006112	1689.	2763692.	4.8500000	36.0000000	Y
0.0006216	1690.	2718382.	4.8500000	36.0000000	Y
0.0006634	1692.	2550781.	4.8500000	36.0000000	Y
0.0007052	1694.	2402455.	4.8500000	36.0000000	Y
0.0007470	1696.	2270298.	4.8500000	36.0000000	Y
0.0007888	1697.	2151822.	4.8500000	36.0000000	Y
0.0008306	1699.	2045031.	4.8500000	36.0000000	Y
0.0008723	1700.	1948248.	4.8500000	36.0000000	Y
0.0009141	1700.	1860154.	4.8500000	36.0000000	Y
0.0009559	1701.	1779680.	4.8500000	36.0000000	Y
0.0009977	1702.	1705811.	4.8500000	36.0000000	Y
0.0010395	1703.	1637830.	4.8500000	36.0000000	Y

0.0010813	1703.	1575020.	4.8500000	36.0000000	Y
0.0011231	1704.	1516858.	4.8500000	36.0000000	Y
0.0011649	1704.	1462791.	4.8500000	36.0000000	Y
0.0012067	1704.	1412468.	4.8500000	36.0000000	Y
0.0012484	1705.	1365457.	4.8500000	36.0000000	Y
0.0012902	1705.	1321468.	4.8500000	36.0000000	Y

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

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	0.00000000	1705.

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

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

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

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	13.5000	0.00	N.A.	No	0.00	47971.
2	19.5000	6.0000	No	Yes	N.A.	N.A.
3	21.0000	7.5000	No	Yes	N.A.	N.A.
4	26.0000	12.5000	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.

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 = 3300.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	1.8781	1.54E-06	3300.	-0.01286	3.76E-08	5.99E+09	0.00	0.00	0.00
0.3000	1.8318	11880.	3300.	-0.01285	290.0576	5.99E+09	0.00	0.00	0.00
0.6000	1.7856	23760.	3300.	-0.01284	580.1152	5.99E+09	0.00	0.00	0.00
0.9000	1.7394	35640.	3300.	-0.01283	870.1728	5.99E+09	0.00	0.00	0.00
1.2000	1.6932	47520.	3300.	-0.01280	1160.	5.99E+09	0.00	0.00	0.00
1.5000	1.6472	59400.	3300.	-0.01277	1450.	5.99E+09	0.00	0.00	0.00
1.8000	1.6013	71280.	3300.	-0.01273	1740.	5.99E+09	0.00	0.00	0.00
2.1000	1.5555	83160.	3300.	-0.01268	2030.	5.99E+09	0.00	0.00	0.00
2.4000	1.5100	95040.	3300.	-0.01263	2320.	5.99E+09	0.00	0.00	0.00
2.7000	1.4646	106920.	3300.	-0.01257	2611.	5.99E+09	0.00	0.00	0.00
3.0000	1.4195	118800.	3300.	-0.01250	2901.	5.99E+09	0.00	0.00	0.00
3.3000	1.3746	130680.	3300.	-0.01243	3191.	5.99E+09	0.00	0.00	0.00
3.6000	1.3300	142560.	3300.	-0.01234	3481.	5.99E+09	0.00	0.00	0.00
3.9000	1.2857	154440.	3300.	-0.01226	3771.	5.99E+09	0.00	0.00	0.00
4.2000	1.2418	166320.	3300.	-0.01216	4061.	5.99E+09	0.00	0.00	0.00
4.5000	1.1982	178200.	3300.	-0.01206	4351.	5.99E+09	0.00	0.00	0.00
4.8000	1.1550	190080.	3300.	-0.01195	4641.	5.99E+09	0.00	0.00	0.00
5.1000	1.1122	201960.	3300.	-0.01183	4931.	5.99E+09	0.00	0.00	0.00
5.4000	1.0698	213840.	3300.	-0.01170	5221.	5.99E+09	0.00	0.00	0.00
5.7000	1.0279	225720.	3300.	-0.01157	5511.	5.99E+09	0.00	0.00	0.00
6.0000	0.9865	237600.	3300.	-0.01143	5801.	5.99E+09	0.00	0.00	0.00
6.3000	0.9456	249480.	3300.	-0.01128	6091.	5.99E+09	0.00	0.00	0.00
6.6000	0.9052	261360.	3300.	-0.01113	6381.	5.99E+09	0.00	0.00	0.00
6.9000	0.8655	273240.	3300.	-0.01097	6671.	5.99E+09	0.00	0.00	0.00
7.2000	0.8263	285120.	3300.	-0.01080	6961.	5.99E+09	0.00	0.00	0.00
7.5000	0.7877	297000.	3300.	-0.01063	7251.	5.99E+09	0.00	0.00	0.00
7.8000	0.7497	308880.	3300.	-0.01045	7541.	5.99E+09	0.00	0.00	0.00
8.1000	0.7125	320760.	3300.	-0.01026	7832.	5.99E+09	0.00	0.00	0.00
8.4000	0.6759	332640.	3300.	-0.01006	8122.	5.99E+09	0.00	0.00	0.00
8.7000	0.6400	344520.	3300.	-0.00986	8412.	5.99E+09	0.00	0.00	0.00
9.0000	0.6049	356400.	3300.	-0.00965	8702.	5.99E+09	0.00	0.00	0.00
9.3000	0.5706	368280.	3300.	-0.00943	8992.	5.99E+09	0.00	0.00	0.00

9.6000	0.5370	380160.	3300.	-0.00920	9282.	5.99E+09	0.00	0.00	0.00
9.9000	0.5043	392040.	3300.	-0.00897	9572.	5.99E+09	0.00	0.00	0.00
10.2000	0.4724	403920.	3300.	-0.00873	9862.	5.99E+09	0.00	0.00	0.00
10.5000	0.4414	415800.	3300.	-0.00849	10152.	5.99E+09	0.00	0.00	0.00
10.8000	0.4113	427680.	3300.	-0.00823	10442.	5.99E+09	0.00	0.00	0.00
11.1000	0.3821	439560.	3300.	-0.00797	10732.	5.99E+09	0.00	0.00	0.00
11.4000	0.3539	451440.	3300.	-0.00771	11022.	5.99E+09	0.00	0.00	0.00
11.7000	0.3266	463320.	3300.	-0.00743	11312.	5.99E+09	0.00	0.00	0.00
12.0000	0.3004	475200.	3300.	-0.00715	11602.	5.99E+09	0.00	0.00	0.00
12.3000	0.2752	487080.	3300.	-0.00686	11892.	5.99E+09	0.00	0.00	0.00
12.6000	0.2510	498960.	3300.	-0.00656	12182.	5.99E+09	0.00	0.00	0.00
12.9000	0.2279	510840.	3300.	-0.00626	12472.	5.99E+09	0.00	0.00	0.00
13.2000	0.2059	522720.	3300.	-0.00595	12763.	5.99E+09	0.00	0.00	0.00
13.5000	0.1851	534600.	2941.	-0.00563	13053.	5.99E+09	-199.5456	3882.	0.00
13.8000	0.1654	543894.	2209.	-0.00531	13280.	5.99E+09	-206.8277	4503.	0.00
14.1000	0.1468	550507.	1453.	-0.00498	13441.	5.99E+09	-213.2187	5228.	0.00
14.4000	0.1295	554357.	675.8341	-0.00465	13535.	5.99E+09	-218.6860	6079.	0.00
14.7000	0.1134	555373.	-119.5532	-0.00431	13560.	5.99E+09	-223.1958	7088.	0.00
15.0000	0.09844	553497.	-929.3873	-0.00398	13514.	5.99E+09	-226.7121	8291.	0.00
15.3000	0.08470	548682.	-1750.	-0.00365	13396.	5.99E+09	-229.1966	9742.	0.00
15.6000	0.07215	540896.	-2578.	-0.00332	13206.	5.99E+09	-230.6085	11506.	0.00
15.9000	0.06077	530122.	-3408.	-0.00300	12943.	5.99E+09	-230.9032	13678.	0.00
16.2000	0.05054	516356.	-4238.	-0.00269	12607.	5.99E+09	-230.0322	16386.	0.00
16.5000	0.04142	499608.	-5062.	-0.00238	12198.	5.99E+09	-227.9412	19811.	0.00
16.8000	0.03339	479907.	-5877.	-0.00209	11717.	5.99E+09	-224.5693	24216.	0.00
17.1000	0.02639	457294.	-6677.	-0.00181	11165.	5.99E+09	-219.8457	29993.	0.00
17.4000	0.02038	431833.	-7457.	-0.00154	10543.	5.99E+09	-213.6872	37750.	0.00
17.7000	0.01530	403602.	-8213.	-0.00129	9854.	5.99E+09	-205.9917	48460.	0.00
18.0000	0.01110	372702.	-8937.	-0.00106	9100.	5.99E+09	-196.6295	63770.	0.00
18.3000	0.00770	339253.	-9625.	-8.42E-04	8283.	5.99E+09	-185.4265	86649.	0.00
18.6000	0.00504	303401.	-10269.	-6.49E-04	7408.	5.99E+09	-172.1303	122924.	0.00
18.9000	0.00303	265318.	-10860.	-4.78E-04	6478.	5.99E+09	-156.3355	185477.	0.00
19.2000	0.00160	225209.	-11388.	-3.30E-04	5499.	5.99E+09	-137.2749	308585.	0.00
19.5000	6.56E-04	183321.	-11979.	-2.08E-04	4476.	5.99E+09	-191.0572	1049125.	0.00
19.8000	1.06E-04	138957.	-12831.	-1.11E-04	3393.	5.99E+09	-281.9654	9559604.	0.00
20.1000	-1.43E-04	90939.	-12594.	-4.18E-05	2220.	5.99E+09	413.6208	1.04E+07	0.00
20.4000	-1.95E-04	48281.	-10843.	-9.22E-09	1179.	5.99E+09	558.9145	1.03E+07	0.00
20.7000	-1.43E-04	12867.	-8721.	1.84E-05	314.1610	5.99E+09	620.3969	1.56E+07	0.00
21.0000	-6.28E-05	-14507.	-3788.	1.79E-05	354.1893	5.99E+09	2120.	1.22E+08	0.00
21.3000	-1.42E-05	-14407.	1009.	9.18E-06	351.7575	5.99E+09	545.3565	1.39E+08	0.00
21.6000	3.31E-06	-7240.	1733.	2.68E-06	176.7606	5.99E+09	-143.2903	1.56E+08	0.00
21.9000	5.13E-06	-1929.	1032.	-7.53E-08	47.1045	5.99E+09	-246.1792	1.73E+08	0.00
22.2000	2.77E-06	190.6173	339.6283	-5.98E-07	4.6540	5.99E+09	-138.4615	1.80E+08	0.00
22.5000	8.24E-07	516.0489	16.2313	-3.85E-07	12.5997	5.99E+09	-41.2036	1.80E+08	0.00
22.8000	-5.08E-09	307.4825	-57.4782	-1.38E-07	7.5074	5.99E+09	0.2538	1.80E+08	0.00
23.1000	-1.69E-07	102.2059	-41.7878	-1.49E-08	2.4954	5.99E+09	8.4631	1.80E+08	0.00
23.4000	-1.12E-07	6.6105	-16.4370	1.78E-08	0.1614	5.99E+09	5.6207	1.80E+08	0.00
23.7000	-4.13E-08	-16.1405	-2.6053	1.49E-08	0.3941	5.99E+09	2.0636	1.80E+08	0.00
24.0000	-5.03E-09	-12.1476	1.5622	6.42E-09	0.2966	5.99E+09	0.2517	1.80E+08	0.00
24.3000	4.93E-09	-4.8925	1.5713	1.30E-09	0.1195	5.99E+09	-0.2466	1.80E+08	0.00
24.6000	4.32E-09	-0.8340	0.7387	-4.21E-10	0.02036	5.99E+09	-0.2160	1.80E+08	0.00
24.9000	1.90E-09	0.4258	0.1788	-5.44E-10	0.01040	5.99E+09	-0.09509	1.80E+08	0.00

25.2000	4.05E-10	0.4532	-0.02885	-2.80E-10	0.01107	5.99E+09	-0.02026	1.80E+08	0.00
25.5000	-1.11E-10	0.2180	-0.05532	-7.80E-11	0.00532	5.99E+09	0.00556	1.80E+08	0.00
25.8000	-1.56E-10	0.05491	-0.03127	4.02E-12	0.00134	5.99E+09	0.00780	1.80E+08	0.00
26.1000	-8.22E-11	-0.00708	-0.00982	1.84E-11	1.73E-04	5.99E+09	0.00411	1.80E+08	0.00
26.4000	-2.37E-11	-0.01580	-2.89E-04	1.15E-11	3.86E-04	5.99E+09	0.00118	1.80E+08	0.00
26.7000	0.00	-0.00916	0.00178	4.02E-12	2.24E-04	5.99E+09	-3.36E-05	1.80E+08	0.00
27.0000	5.22E-12	-0.00296	0.00125	0.00	7.23E-05	5.99E+09	-2.61E-04	1.80E+08	0.00
27.3000	3.36E-12	-1.40E-04	4.81E-04	0.00	3.42E-06	5.99E+09	-1.68E-04	1.80E+08	0.00
27.6000	1.20E-12	5.02E-04	7.01E-05	0.00	1.23E-05	5.99E+09	-6.01E-05	1.80E+08	0.00
27.9000	0.00	3.65E-04	-4.98E-05	0.00	8.90E-06	5.99E+09	-6.48E-06	1.80E+08	0.00
28.2000	0.00	1.43E-04	-4.75E-05	0.00	3.50E-06	5.99E+09	7.77E-06	1.80E+08	0.00
28.5000	0.00	2.27E-05	-2.18E-05	0.00	5.53E-07	5.99E+09	6.51E-06	1.80E+08	0.00
28.8000	0.00	-1.36E-05	-5.04E-06	0.00	3.33E-07	5.99E+09	2.80E-06	1.80E+08	0.00
29.1000	0.00	-1.36E-05	1.02E-06	0.00	3.33E-07	5.99E+09	5.68E-07	1.80E+08	0.00
29.4000	0.00	-6.26E-06	1.70E-06	0.00	1.53E-07	5.99E+09	-1.91E-07	1.80E+08	0.00
29.7000	0.00	-1.36E-06	8.69E-07	0.00	3.31E-08	5.99E+09	-2.73E-07	1.80E+08	0.00
30.0000	0.00	0.00	0.00	0.00	0.00	5.99E+09	-2.09E-07	9.00E+07	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. 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 interpolated 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 = 1.87813295 inches
Computed slope at pile head = -0.01285849 radians
Maximum bending moment = 555373. inch-lbs
Maximum shear force = -12831. lbs
Depth of maximum bending moment = 14.70000000 feet below pile head
Depth of maximum shear force = 19.80000000 feet below pile head
Number of iterations = 22
Number of zero deflection points = 8

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	Load	Load	Axial	Pile-head	Pile-head	Max Shear	Max Moment

Case No.	Type 1	Pile-head Load 1	Type 2	Pile-head Load 2	Loading lbs	Deflection inches	Rotation radians	in Pile lbs	in Pile in-lbs
1	V, lb	3300.	M, in-lb	0.00	0.00	1.8781	-0.01286	-12831.	555373.

Maximum pile-head deflection = 1.8781329485 inches
Maximum pile-head rotation = -0.0128584889 radians = -0.736737 deg.

Summary of Warning Messages

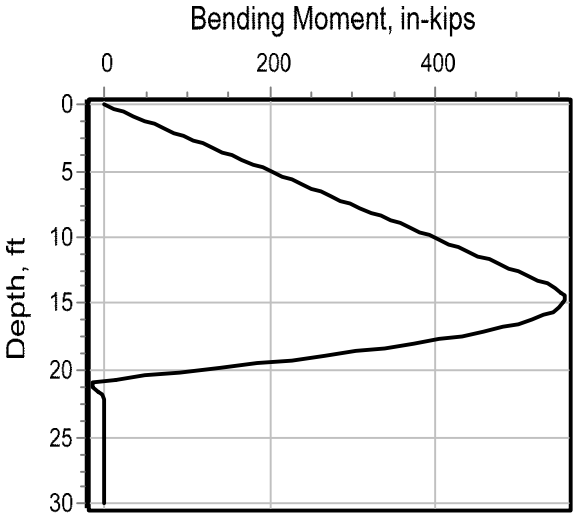
The following warning was reported 660 times

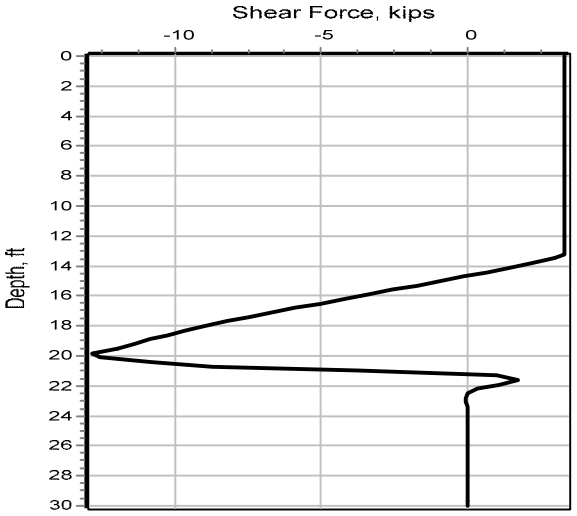
**** Warning ****

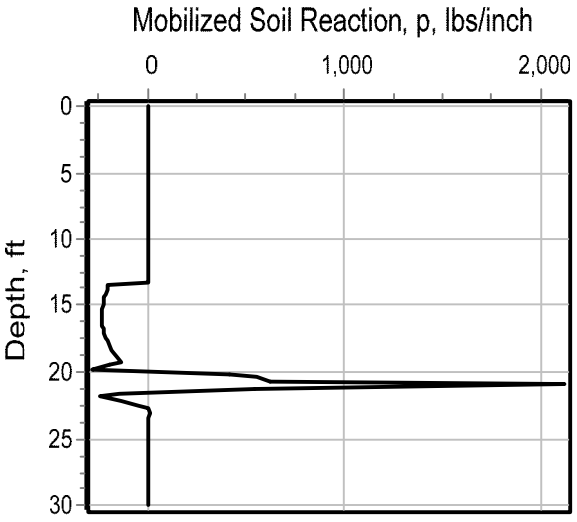
An unreasonable input value for unconfined compressive strength has been
specified for a soil defined using the weak rock criteria. The input value
is greater than 500 psi. Please check your input data for correctness.

The analysis ended normally.


Deflection, inches
0
0.5
1
1.5
Depth, ft
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30


Bending Moment, in-kips
0
200
400
Depth, ft
0
5
10
15
20
25
30


Shear Force, kips
-10
-5
0
Depth, ft
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30


Mobilized Soil Reaction, p, lbs/inch
0
1,000
2,000
Depth, ft
0
5
10
15
20
25
30

RESOURCE INTERNATIONAL, INC.
6350 PRESIDENTIAL GATEWAY
COLUMBUS, OHIO 43231
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FAX: (614) 823-4990
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JOB	BEL-7-11.04	NO.	
SHEET NO.	1	OF	1
CALCULATED BY	AG	DATE	2/20/2023
CHECKED BY	JPS	DATE	2/20/2023

Wall - Steel post with fence (B-001-3-22)

Structural Element Properties

Section Type: HP 10x42

E =	29,000	ksi	d =	9.7	in	I_x =	210	in^4	Nom. Wt., W_{steel} =	42	lb/ft
A_s =	12.4	in^2	b_f =	10.1	in	r_s =	4.13	in	Z_x =	48.3	in^3
F_y =	36	ksi	t_w =	0.415	in	r_y =	2.41	in	T =	7.6	in
F_{yr} =	25	ksi	t_f =	0.420	in	r_t =	2.77	in	S =	43.4	in^3

Check Shear Resistance (AASHTO 6.10.9.2)

φ_v = **1.00**

Check: $V_u < \varphi_v V_n$ ⟶ 12.8 kips < 1.00(84.1 kips) ⟶ 12.8 kips < 84.1 kips **OK**

V_u = **12.8** kips (Determined from LPile)

$V_n = V_{cr} = CV_p$ = 84.1 kips

$V_p = 0.58F_{yw}Dt_W$ = 84.1 kips

C = 1.00

If $D/t_w \le 1.12\sqrt{Ek/F_{yw}}$ ⟶ $C = 1.0$

If $1.12\sqrt{Ek/F_{yw}} < D/t_w \le 1.40\sqrt{Ek/F_{yw}}$ ⟶ $C = \frac{1.12}{(D/t_w)}\sqrt{Ek/F_{yw}}$

If $D/t_w > 1.40\sqrt{Ek/F_{yw}}$ ⟶ $C = \frac{1.57}{(D/t_w)^2}\left(EK/F_{yw}\right)$

D/t_w = 23.4 $\quad 1.12\sqrt{Ek/F_{yw}}$ = 71.1 $\quad 1.40\sqrt{Ek/F_{yw}}$ = 88.9

k = **5.0** (AASHTO 6.10.9.2)

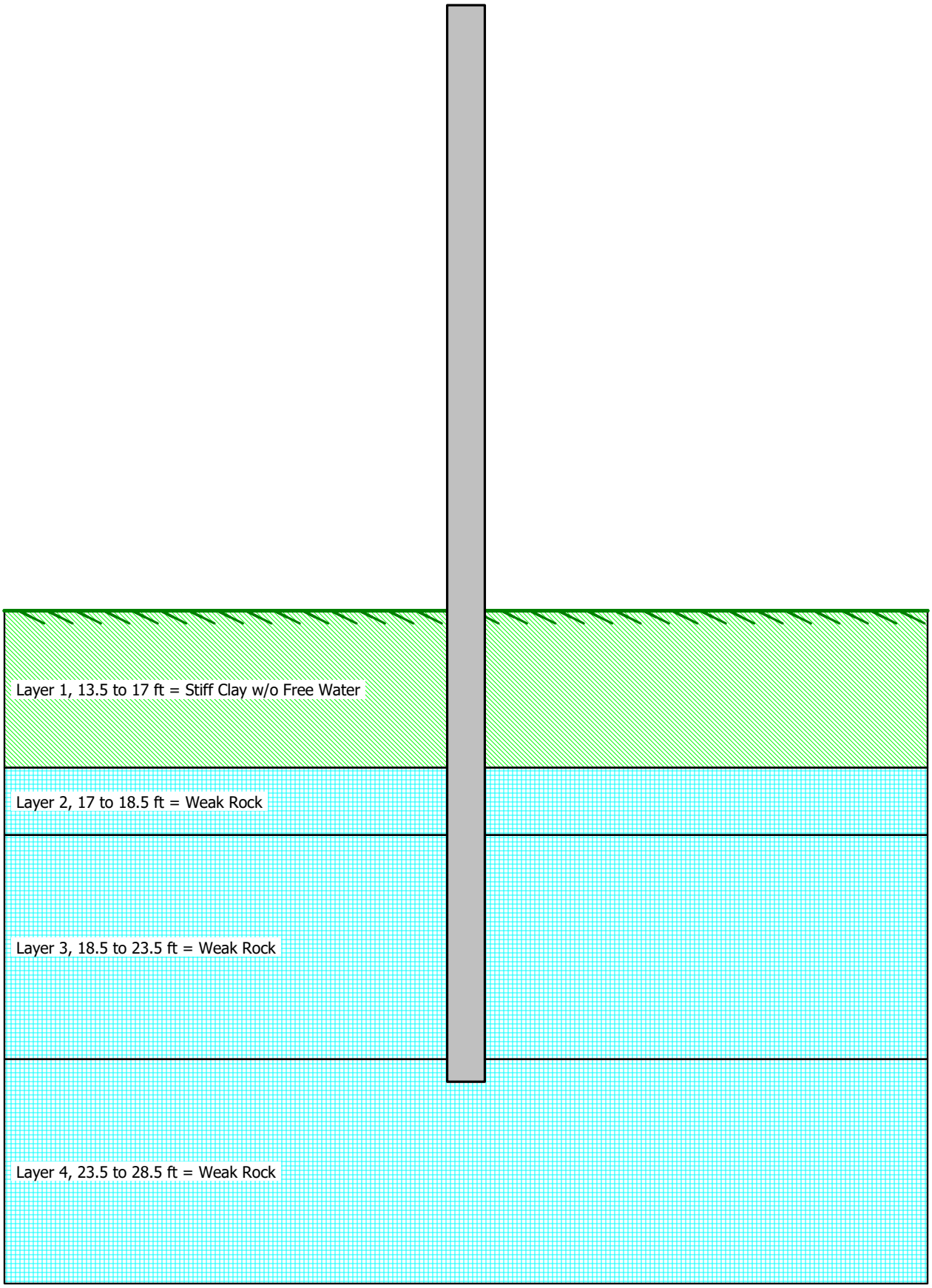
Check Flexural Resistance at Maximum Moment (AASHTO 6.10.8)

φ_f = **1.00**

Check: $M_u < \varphi_f M_n$ ⟶ 46.3 kip-ft < 1.00(144.9 kip-ft) ⟶ 46.3 kip-ft < 144.9 kip-ft **OK**

M_u = **46.3** kip-ft (Determined from LPile) $\quad M_n = F_y Z_x$ = 144.9 kip-ft

HP 10x42
Boring B-001-4-22



```
================================================================================

                  LPile for Windows(Beta), Version 2018-10.009

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

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--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\GEOTECH\PROJECTS\2020\W-20-120 BEL-7-11.04\Analysis\2.17.2023 LPile Analysis\Lpile\

Name of input data file:
HP 10x42_B-001-4-22.lp10

Name of output report file:
HP 10x42_B-001-4-22.lp10

Name of plot output file:
HP 10x42_B-001-4-22.lp10

Name of runtime message file:
HP 10x42_B-001-4-22.lp10



--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  February 20, 2023          Time:  16:02:00
```

Problem Title

Project Name: BEL-7-11.04

Job Number: W-20-120

Client:

Engineer: AG/JPS

Description: 10 x 42 HP - Boring B-001-3-22

Program Options and Settings

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

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

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

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1

 - No p-y curves to be computed and reported for user-specified depths
 - Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 24.000 ft
Depth of ground surface below top of pile = 13.5000 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	10.1000
2	24.000	10.1000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a H strong axis steel pile
Length of section = 24.000000 ft
Pile width = 10.100000 in
Shear capacity of section = 84100. lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer	=	13.500000 ft
Distance from top of pile to bottom of layer	=	17.000000 ft
Effective unit weight at top of layer	=	125.000000 pcf
Effective unit weight at bottom of layer	=	125.000000 pcf
Undrained cohesion at top of layer	=	1875. psf
Undrained cohesion at bottom of layer	=	1875. psf
Epsilon-50 at top of layer	=	0.007000
Epsilon-50 at bottom of layer	=	0.007000

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

Distance from top of pile to top of layer	=	17.000000 ft
Distance from top of pile to bottom of layer	=	18.500000 ft
Effective unit weight at top of layer	=	135.000000 pcf
Effective unit weight at bottom of layer	=	135.000000 pcf
Uniaxial compressive strength at top of layer	=	100.000000 psi
Uniaxial compressive strength at bottom of layer	=	100.000000 psi
Initial modulus of rock at top of layer	=	18000. psi
Initial modulus of rock at bottom of layer	=	18000. psi
RQD of rock at top of layer	=	0.0000 %
RQD of rock at bottom of layer	=	0.0000 %
k rm of rock at top of layer	=	0.0005000
k rm of rock at bottom of layer	=	0.0005000

Layer 3 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	18.500000 ft
Distance from top of pile to bottom of layer	=	23.500000 ft
Effective unit weight at top of layer	=	140.000000 pcf
Effective unit weight at bottom of layer	=	140.000000 pcf
Uniaxial compressive strength at top of layer	=	3061. psi
Uniaxial compressive strength at bottom of layer	=	3061. psi
Initial modulus of rock at top of layer	=	300000. psi
Initial modulus of rock at bottom of layer	=	300000. psi
RQD of rock at top of layer	=	40.000000 %
RQD of rock at bottom of layer	=	40.000000 %
k rm of rock at top of layer	=	0.0000500
k rm of rock at bottom of layer	=	0.0000500

Layer 4 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	23.500000 ft

```
   Distance from top of pile to bottom of layer        =    28.500000 ft
   Effective unit weight at top of layer               =   140.000000 pcf
   Effective unit weight at bottom of layer            =   140.000000 pcf
   Uniaxial compressive strength at top of layer       =        3061. psi
   Uniaxial compressive strength at bottom of layer    =        3061. psi
   Initial modulus of rock at top of layer             =      300000. psi
   Initial modulus of rock at bottom of layer          =      300000. psi
   RQD of rock at top of layer                         =    83.000000 %
   RQD of rock at bottom of layer                      =    83.000000 %
   k rm of rock at top of layer                        =    0.0000500
   k rm of rock at bottom of layer                     =    0.0000500


 (Depth of the lowest soil layer extends 4.500 ft below the pile tip)
```

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Uniaxial qu psi	RQD %	E50 or krm	Rock Mass Modulus psi
1	Stiff Clay	13.5000	125.0000	1875.	--	--	0.00700	--
	w/o Free Water	17.0000	125.0000	1875.	--	--	0.00700	--
2	Weak	17.0000	135.0000	--	100.0000	0.00	5.00E-04	18000.
	Rock	18.5000	135.0000	--	100.0000	0.00	5.00E-04	18000.
3	Weak	18.5000	140.0000	--	3061.	40.0000	5.00E-05	300000.
	Rock	23.5000	140.0000	--	3061.	40.0000	5.00E-05	300000.
4	Weak	23.5000	140.0000	--	3061.	83.0000	5.00E-05	300000.
	Rock	28.5000	140.0000	--	3061.	83.0000	5.00E-05	300000.

Static Loading Type

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

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

```
   1     1     V =        3300. lbs   M =       0.0000 in-lbs         0.0000000          No

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



--------------------------------------------------------------------------------
     Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
--------------------------------------------------------------------------------

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

Number of Pile Sections Analyzed = 1

Pile Section No. 1:
-------------------

Dimensions and Properties of Steel H Strong Axis:
-------------------------------------------------

Length of Section                                  =    24.000000 ft
Flange Width                                       =    10.100000 in
Section Depth                                      =     9.700000 in
Flange Thickness                                   =     0.420000 in
Web Thickness                                      =     0.415000 in
Yield Stress of Pipe                               =    36.000000 ksi
Elastic Modulus                                    =       29000. ksi
Cross-sectional Area                               =    12.160900 sq. in.
Moment of Inertia                                  =   206.834773 in^4
Elastic Bending Stiffness                          =     5998208. kip-in^2
Plastic Modulus, Z                                 =    47.510093in^3
Plastic Moment Capacity = Fy Z                     =        1710.in-kip

Axial Structural Capacities:
----------------------------

Nom. Axial Structural Capacity = Fy As             =      437.792 kips
Nominal Axial Tensile Capacity                     =     -437.792 kips



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

   Number     Axial Thrust Force
```

	kips
1	0.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 0.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000522	31.3039815	5992769.	4.8500000	0.7273560	
0.00001045	62.6079629	5992769.	4.8500000	1.4547119	
0.00001567	93.9119444	5992769.	4.8500000	2.1820679	
0.00002089	125.2159259	5992769.	4.8500000	2.9094238	
0.00002612	156.5199073	5992769.	4.8500000	3.6367798	
0.00003134	187.8238888	5992769.	4.8500000	4.3641357	
0.00003657	219.1278703	5992769.	4.8500000	5.0914917	
0.00004179	250.4318517	5992769.	4.8500000	5.8188476	
0.00004701	281.7358332	5992769.	4.8500000	6.5462036	
0.00005224	313.0398146	5992769.	4.8500000	7.2735596	
0.00005746	344.3437961	5992769.	4.8500000	8.0009155	
0.00006268	375.6477776	5992769.	4.8500000	8.7282715	
0.00006791	406.9517590	5992769.	4.8500000	9.4556274	
0.00007313	438.2557405	5992769.	4.8500000	10.1829834	
0.00007835	469.5597220	5992769.	4.8500000	10.9103393	
0.00008358	500.8637034	5992769.	4.8500000	11.6376953	
0.00008880	532.1676849	5992769.	4.8500000	12.3650512	
0.00009403	563.4716664	5992769.	4.8500000	13.0924072	
0.00009925	594.7756478	5992769.	4.8500000	13.8197632	
0.0001045	626.0796293	5992769.	4.8500000	14.5471191	
0.0001097	657.3836108	5992769.	4.8500000	15.2744751	
0.0001149	688.6875922	5992769.	4.8500000	16.0018310	
0.0001201	719.9915737	5992769.	4.8500000	16.7291870	
0.0001254	751.2955551	5992769.	4.8500000	17.4565429	
0.0001306	782.5995366	5992769.	4.8500000	18.1838989	
0.0001358	813.9035181	5992769.	4.8500000	18.9112548	
0.0001410	845.2074995	5992769.	4.8500000	19.6386108	
0.0001463	876.5114810	5992769.	4.8500000	20.3659668	
0.0001515	907.8154625	5992769.	4.8500000	21.0933227	
0.0001567	939.1194439	5992769.	4.8500000	21.8206787	
0.0001619	970.4234254	5992769.	4.8500000	22.5480346	
0.0001672	1002.	5992769.	4.8500000	23.2753906	
0.0001724	1033.	5992769.	4.8500000	24.0027465	
0.0001776	1064.	5992769.	4.8500000	24.7301025	
0.0001828	1096.	5992769.	4.8500000	25.4574585	
0.0001881	1127.	5992769.	4.8500000	26.1848144	
0.0001933	1158.	5992769.	4.8500000	26.9121704	

0.0001985	1190.	5992769.	4.8500000	27.6395263	
0.0002037	1221.	5992769.	4.8500000	28.3668823	
0.0002142	1283.	5992769.	4.8500000	29.8215942	
0.0002246	1346.	5992769.	4.8500000	31.2763061	
0.0002351	1409.	5992769.	4.8500000	32.7310180	
0.0002455	1471.	5992769.	4.8500000	34.1857299	
0.0002560	1534.	5992769.	4.8500000	35.6404418	
0.0002664	1583.	5942130.	4.8500000	36.0000000	Y
0.0002769	1608.	5807975.	4.8500000	36.0000000	Y
0.0002873	1617.	5627120.	4.8500000	36.0000000	Y
0.0002977	1623.	5451108.	4.8500000	36.0000000	Y
0.0003082	1629.	5285148.	4.8500000	36.0000000	Y
0.0003186	1634.	5128131.	4.8500000	36.0000000	Y
0.0003291	1639.	4979678.	4.8500000	36.0000000	Y
0.0003395	1643.	4839137.	4.8500000	36.0000000	Y
0.0003500	1647.	4705909.	4.8500000	36.0000000	Y
0.0003604	1651.	4579458.	4.8500000	36.0000000	Y
0.0003709	1654.	4459307.	4.8500000	36.0000000	Y
0.0003813	1657.	4345022.	4.8500000	36.0000000	Y
0.0003918	1660.	4236215.	4.8500000	36.0000000	Y
0.0004022	1662.	4132530.	4.8500000	36.0000000	Y
0.0004127	1665.	4033644.	4.8500000	36.0000000	Y
0.0004231	1667.	3939263.	4.8500000	36.0000000	Y
0.0004336	1669.	3849104.	4.8500000	36.0000000	Y
0.0004440	1671.	3762749.	4.8500000	36.0000000	Y
0.0004545	1672.	3680141.	4.8500000	36.0000000	Y
0.0004649	1674.	3601052.	4.8500000	36.0000000	Y
0.0004753	1676.	3525092.	4.8500000	36.0000000	Y
0.0004858	1677.	3452291.	4.8500000	36.0000000	Y
0.0004962	1678.	3382319.	4.8500000	36.0000000	Y
0.0005067	1680.	3315098.	4.8500000	36.0000000	Y
0.0005171	1681.	3250437.	4.8500000	36.0000000	Y
0.0005276	1682.	3188206.	4.8500000	36.0000000	Y
0.0005380	1683.	3128263.	4.8500000	36.0000000	Y
0.0005485	1684.	3070519.	4.8500000	36.0000000	Y
0.0005589	1685.	3014790.	4.8500000	36.0000000	Y
0.0005694	1686.	2961096.	4.8500000	36.0000000	Y
0.0005798	1687.	2909147.	4.8500000	36.0000000	Y
0.0005903	1688.	2859037.	4.8500000	36.0000000	Y
0.0006007	1688.	2810577.	4.8500000	36.0000000	Y
0.0006112	1689.	2763692.	4.8500000	36.0000000	Y
0.0006216	1690.	2718382.	4.8500000	36.0000000	Y
0.0006634	1692.	2550781.	4.8500000	36.0000000	Y
0.0007052	1694.	2402455.	4.8500000	36.0000000	Y
0.0007470	1696.	2270298.	4.8500000	36.0000000	Y
0.0007888	1697.	2151822.	4.8500000	36.0000000	Y
0.0008306	1699.	2045031.	4.8500000	36.0000000	Y
0.0008723	1700.	1948248.	4.8500000	36.0000000	Y
0.0009141	1700.	1860154.	4.8500000	36.0000000	Y
0.0009559	1701.	1779680.	4.8500000	36.0000000	Y
0.0009977	1702.	1705811.	4.8500000	36.0000000	Y
0.0010395	1703.	1637830.	4.8500000	36.0000000	Y

0.0010813	1703.	1575020.	4.8500000	36.0000000	Y
0.0011231	1704.	1516858.	4.8500000	36.0000000	Y
0.0011649	1704.	1462791.	4.8500000	36.0000000	Y
0.0012067	1704.	1412468.	4.8500000	36.0000000	Y
0.0012484	1705.	1365457.	4.8500000	36.0000000	Y
0.0012902	1705.	1321468.	4.8500000	36.0000000	Y

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

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	0.00000000	1705.

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

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

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

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	13.5000	0.00	N.A.	No	0.00	23316.
2	17.0000	3.5000	No	Yes	N.A.	N.A.
3	18.5000	5.0000	No	Yes	N.A.	N.A.
4	23.5000	10.0000	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.

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 = 3300.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	1.7777	-4.17E-06	3300.	-0.01245	1.02E-07	5.99E+09	0.00	0.00	0.00
0.2400	1.7418	9504.	3300.	-0.01245	232.0461	5.99E+09	0.00	0.00	0.00
0.4800	1.7060	19008.	3300.	-0.01244	464.0922	5.99E+09	0.00	0.00	0.00
0.7200	1.6702	28512.	3300.	-0.01243	696.1383	5.99E+09	0.00	0.00	0.00
0.9600	1.6344	38016.	3300.	-0.01241	928.1844	5.99E+09	0.00	0.00	0.00
1.2000	1.5987	47520.	3300.	-0.01239	1160.	5.99E+09	0.00	0.00	0.00
1.4400	1.5630	57024.	3300.	-0.01237	1392.	5.99E+09	0.00	0.00	0.00
1.6800	1.5275	66528.	3300.	-0.01234	1624.	5.99E+09	0.00	0.00	0.00
1.9200	1.4920	76032.	3300.	-0.01230	1856.	5.99E+09	0.00	0.00	0.00
2.1600	1.4566	85536.	3300.	-0.01226	2088.	5.99E+09	0.00	0.00	0.00
2.4000	1.4213	95040.	3300.	-0.01222	2320.	5.99E+09	0.00	0.00	0.00
2.6400	1.3862	104544.	3300.	-0.01217	2553.	5.99E+09	0.00	0.00	0.00
2.8800	1.3512	114048.	3300.	-0.01212	2785.	5.99E+09	0.00	0.00	0.00
3.1200	1.3164	123552.	3300.	-0.01206	3017.	5.99E+09	0.00	0.00	0.00
3.3600	1.2818	133056.	3300.	-0.01200	3249.	5.99E+09	0.00	0.00	0.00
3.6000	1.2473	142560.	3300.	-0.01193	3481.	5.99E+09	0.00	0.00	0.00
3.8400	1.2130	152064.	3300.	-0.01186	3713.	5.99E+09	0.00	0.00	0.00
4.0800	1.1789	161568.	3300.	-0.01179	3945.	5.99E+09	0.00	0.00	0.00
4.3200	1.1451	171072.	3300.	-0.01171	4177.	5.99E+09	0.00	0.00	0.00
4.5600	1.1115	180576.	3300.	-0.01162	4409.	5.99E+09	0.00	0.00	0.00
4.8000	1.0782	190080.	3300.	-0.01153	4641.	5.99E+09	0.00	0.00	0.00
5.0400	1.0451	199584.	3300.	-0.01144	4873.	5.99E+09	0.00	0.00	0.00
5.2800	1.0123	209088.	3300.	-0.01134	5105.	5.99E+09	0.00	0.00	0.00
5.5200	0.9797	218592.	3300.	-0.01124	5337.	5.99E+09	0.00	0.00	0.00
5.7600	0.9475	228096.	3300.	-0.01113	5569.	5.99E+09	0.00	0.00	0.00
6.0000	0.9156	237600.	3300.	-0.01102	5801.	5.99E+09	0.00	0.00	0.00
6.2400	0.8840	247104.	3300.	-0.01090	6033.	5.99E+09	0.00	0.00	0.00
6.4800	0.8528	256608.	3300.	-0.01078	6265.	5.99E+09	0.00	0.00	0.00
6.7200	0.8219	266112.	3300.	-0.01066	6497.	5.99E+09	0.00	0.00	0.00
6.9600	0.7914	275616.	3300.	-0.01053	6729.	5.99E+09	0.00	0.00	0.00
7.2000	0.7613	285120.	3300.	-0.01039	6961.	5.99E+09	0.00	0.00	0.00
7.4400	0.7315	294624.	3300.	-0.01025	7193.	5.99E+09	0.00	0.00	0.00

7.6800	0.7022	304128.	3300.	-0.01011	7425.	5.99E+09	0.00	0.00	0.00
7.9200	0.6733	313632.	3300.	-0.00996	7658.	5.99E+09	0.00	0.00	0.00
8.1600	0.6448	323136.	3300.	-0.00981	7890.	5.99E+09	0.00	0.00	0.00
8.4000	0.6168	332640.	3300.	-0.00965	8122.	5.99E+09	0.00	0.00	0.00
8.6400	0.5893	342144.	3300.	-0.00949	8354.	5.99E+09	0.00	0.00	0.00
8.8800	0.5622	351648.	3300.	-0.00932	8586.	5.99E+09	0.00	0.00	0.00
9.1200	0.5356	361152.	3300.	-0.00915	8818.	5.99E+09	0.00	0.00	0.00
9.3600	0.5095	370656.	3300.	-0.00897	9050.	5.99E+09	0.00	0.00	0.00
9.6000	0.4839	380160.	3300.	-0.00879	9282.	5.99E+09	0.00	0.00	0.00
9.8400	0.4588	389664.	3300.	-0.00861	9514.	5.99E+09	0.00	0.00	0.00
10.0800	0.4343	399168.	3300.	-0.00842	9746.	5.99E+09	0.00	0.00	0.00
10.3200	0.4103	408672.	3300.	-0.00823	9978.	5.99E+09	0.00	0.00	0.00
10.5600	0.3869	418176.	3300.	-0.00803	10210.	5.99E+09	0.00	0.00	0.00
10.8000	0.3641	427680.	3300.	-0.00782	10442.	5.99E+09	0.00	0.00	0.00
11.0400	0.3418	437184.	3300.	-0.00762	10674.	5.99E+09	0.00	0.00	0.00
11.2800	0.3202	446688.	3300.	-0.00740	10906.	5.99E+09	0.00	0.00	0.00
11.5200	0.2992	456192.	3300.	-0.00719	11138.	5.99E+09	0.00	0.00	0.00
11.7600	0.2788	465696.	3300.	-0.00697	11370.	5.99E+09	0.00	0.00	0.00
12.0000	0.2591	475200.	3300.	-0.00674	11602.	5.99E+09	0.00	0.00	0.00
12.2400	0.2400	484704.	3300.	-0.00651	11834.	5.99E+09	0.00	0.00	0.00
12.4800	0.2216	494208.	3300.	-0.00627	12066.	5.99E+09	0.00	0.00	0.00
12.7200	0.2039	503712.	3300.	-0.00603	12298.	5.99E+09	0.00	0.00	0.00
12.9600	0.1868	513216.	3300.	-0.00579	12530.	5.99E+09	0.00	0.00	0.00
13.2000	0.1705	522720.	3300.	-0.00554	12763.	5.99E+09	0.00	0.00	0.00
13.4400	0.1549	532224.	3300.	-0.00529	12995.	5.99E+09	0.00	0.00	0.00
13.6800	0.1401	541728.	3021.	-0.00503	13227.	5.99E+09	-193.5002	3979.	0.00
13.9200	0.1260	549627.	2458.	-0.00477	13419.	5.99E+09	-198.0128	4527.	0.00
14.1600	0.1126	555884.	1882.	-0.00450	13572.	5.99E+09	-201.8612	5162.	0.00
14.4000	0.1000	560466.	1296.	-0.00423	13684.	5.99E+09	-205.0165	5902.	0.00
14.6400	0.08823	563348.	701.9108	-0.00396	13754.	5.99E+09	-207.4473	6771.	0.00
14.8800	0.07721	564509.	102.0557	-0.00369	13783.	5.99E+09	-209.1188	7800.	0.00
15.1200	0.06697	563936.	-501.4640	-0.00342	13769.	5.99E+09	-209.9921	9030.	0.00
15.3600	0.05751	561621.	-1106.	-0.00315	13712.	5.99E+09	-210.0238	10517.	0.00
15.6000	0.04883	557563.	-1710.	-0.00288	13613.	5.99E+09	-209.1644	12336.	0.00
15.8400	0.04092	551771.	-2310.	-0.00261	13472.	5.99E+09	-207.3569	14594.	0.00
16.0800	0.03377	544260.	-2903.	-0.00235	13288.	5.99E+09	-204.5355	17441.	0.00
16.3200	0.02738	535051.	-3486.	-0.00209	13064.	5.99E+09	-200.6227	21103.	0.00
16.5600	0.02173	524179.	-4057.	-0.00184	12798.	5.99E+09	-195.5270	25918.	0.00
16.8000	0.01680	511684.	-4611.	-0.00159	12493.	5.99E+09	-189.1398	32425.	0.00
17.0400	0.01258	497621.	-5857.	-0.00135	12150.	5.99E+09	-676.6612	154910.	0.00
17.2800	0.00905	477946.	-8065.	-0.00111	11669.	5.99E+09	-856.4265	272557.	0.00
17.5200	0.00618	451167.	-10725.	-8.88E-04	11016.	5.99E+09	-990.6019	461607.	0.00
17.7600	0.00394	416171.	-13698.	-6.79E-04	10161.	5.99E+09	-1074.	786146.	0.00
18.0000	0.00227	372265.	-16831.	-4.90E-04	9089.	5.99E+09	-1101.	1398593.	0.00
18.2400	0.00111	319226.	-19942.	-3.24E-04	7794.	5.99E+09	-1060.	2740721.	0.00
18.4800	4.02E-04	257396.	-22806.	-1.85E-04	6284.	5.99E+09	-928.7535	6650286.	0.00
18.7200	4.69E-05	187863.	-31690.	-7.82E-05	4587.	5.99E+09	-5241.	3.22E+08	0.00
18.9600	-4.84E-05	74860.	-30655.	-1.51E-05	1828.	5.99E+09	5960.	3.55E+08	0.00
19.2000	-4.01E-05	11288.	-14309.	5.60E-06	275.6005	5.99E+09	5392.	3.88E+08	0.00
19.4400	-1.61E-05	-7558.	-3152.	6.50E-06	184.5290	5.99E+09	2355.	4.20E+08	0.00
19.6800	-2.66E-06	-6869.	812.5144	3.03E-06	167.7225	5.99E+09	398.2662	4.32E+08	0.00
19.9200	1.32E-06	-2878.	1102.	6.88E-07	70.2619	5.99E+09	-197.5633	4.32E+08	0.00

20.1600	1.31E-06	-524.6791	534.8757	-1.30E-07	12.8104	5.99E+09	-195.9443	4.32E+08	0.00
20.4000	5.69E-07	203.1426	129.7448	-2.07E-07	4.9599	5.99E+09	-85.3966	4.32E+08	0.00
20.6400	1.13E-07	222.6509	-17.7399	-1.05E-07	5.4362	5.99E+09	-17.0234	4.32E+08	0.00
20.8800	-3.42E-08	100.9606	-34.8731	-2.70E-08	2.4650	5.99E+09	5.1253	4.32E+08	0.00
21.1200	-4.21E-08	21.7816	-18.4013	2.48E-09	0.5318	5.99E+09	6.3135	4.32E+08	0.00
21.3600	-1.99E-08	-5.0309	-5.0193	6.51E-09	0.1228	5.99E+09	2.9796	4.32E+08	0.00
21.6000	-4.60E-09	-7.1297	0.2651	3.59E-09	0.1741	5.99E+09	0.6902	4.32E+08	0.00
21.8400	7.94E-10	-3.5039	1.0875	1.03E-09	0.08555	5.99E+09	-0.1191	4.32E+08	0.00
22.0800	1.34E-09	-0.8658	0.6268	-1.87E-11	0.02114	5.99E+09	-0.2009	4.32E+08	0.00
22.3200	6.86E-10	0.1063	0.1894	-2.01E-10	0.00260	5.99E+09	-0.1029	4.32E+08	0.00
22.5600	1.80E-10	0.2252	0.00243	-1.22E-10	0.00550	5.99E+09	-0.02698	4.32E+08	0.00
22.8000	-1.44E-11	0.1203	-0.03332	-3.85E-11	0.00294	5.99E+09	0.00216	4.32E+08	0.00
23.0400	-4.21E-11	0.03333	-0.02111	-1.61E-12	8.14E-04	5.99E+09	0.00632	4.32E+08	0.00
23.2800	-2.37E-11	-0.00129	-0.00690	6.08E-12	3.15E-05	5.99E+09	0.00355	4.32E+08	0.00
23.5200	-7.06E-12	-0.00644	-2.63E-04	4.23E-12	1.57E-04	5.99E+09	0.00106	4.32E+08	0.00
23.7600	0.00	-0.00280	0.00112	2.01E-12	6.85E-05	5.99E+09	-9.99E-05	4.32E+08	0.00
24.0000	4.51E-12	0.00	0.00	1.33E-12	0.00	5.99E+09	-6.76E-04	2.16E+08	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 = 1.77767856 inches
Computed slope at pile head = -0.01244821 radians
Maximum bending moment = 564509. inch-lbs
Maximum shear force = -31690. lbs
Depth of maximum bending moment = 14.88000000 feet below pile head
Depth of maximum shear force = 18.72000000 feet below pile head
Number of iterations = 17
Number of zero deflection points = 6

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	Load	Load	Axial	Pile-head	Pile-head	Max Shear	Max Moment

Case No.	Type 1	Pile-head Load 1	Type 2	Pile-head Load 2	Loading lbs	Deflection inches	Rotation radians	in Pile lbs	in Pile in-lbs
1	V, lb	3300.	M, in-lb	0.00	0.00	1.7777	-0.01245	-31690.	564509.

Maximum pile-head deflection = 1.7776785582 inches
Maximum pile-head rotation = -0.0124482103 radians = -0.713230 deg.

Summary of Warning Messages

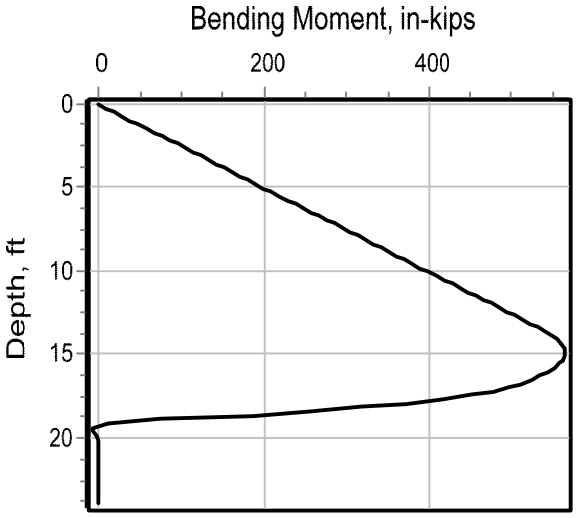
The following warning was reported 391 times

**** Warning ****

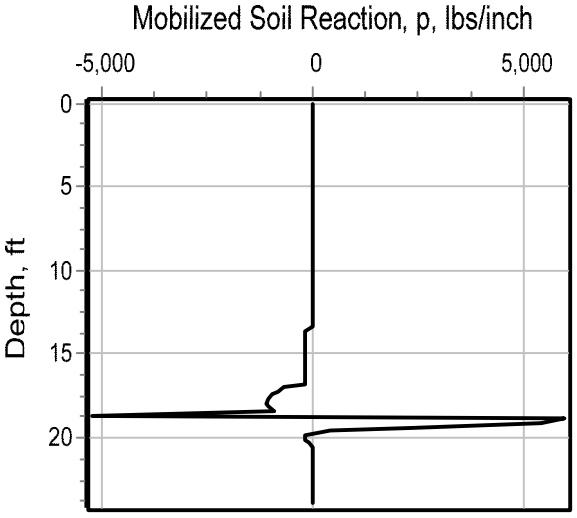
An unreasonable input value for unconfined compressive strength has been
specified for a soil defined using the weak rock criteria. The input value
is greater than 500 psi. Please check your input data for correctness.

The analysis ended normally.


Deflection, inches
0
0.5
1
1.5
Depth, ft
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24


Bending Moment, in-kips
0
200
400
Depth, ft
0
5
10
15
20


Shear Force, kips
-30
-20
-10
0
Depth, ft
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24


Mobilized Soil Reaction, p, lbs/inch
-5,000
0
5,000
Depth, ft
0
5
10
15
20

RESOURCE INTERNATIONAL, INC.
6350 PRESIDENTIAL GATEWAY
COLUMBUS, OHIO 43231
PHONE: (614) 823-4949
FAX: (614) 823-4990
WWW.RESOURCEINTERATIONAL.COM

JOB	BEL-7-11.04	NO.	
SHEET NO.	1	OF	1
CALCULATED BY	AG	DATE	2/20/2023
CHECKED BY	JPS	DATE	2/20/2023

Wall - Steel post with fence (B-001-4-22)

Structural Element Properties

Section Type: HP 10x42

E =	29,000	ksi	d =	9.7	in	I_x =	210	in^4	Nom. Wt., W_{steel} =	42	lb/ft
A_s =	12.4	in^2	b_f =	10.1	in	r_s =	4.13	in	Z_x =	48.3	in^3
F_y =	36	ksi	t_w =	0.415	in	r_y =	2.41	in	T =	7.6	in
F_{yr} =	25	ksi	t_f =	0.420	in	r_t =	2.77	in	S =	43.4	in^3

Check Shear Resistance (AASHTO 6.10.9.2)

φ_v = **1.00**

Check: $V_u < \varphi_v V_n$ ⟶ 31.7 kips < 1.00(84.1 kips) ⟶ 31.7 kips < 84.1 kips **OK**

V_u = **31.7** kips (Determined from LPile)

$V_n = V_{cr} = CV_p$ = 84.1 kips

$V_p = 0.58F_{yw}Dt_W$ = 84.1 kips

C = 1.00

If $D/t_w \le 1.12\sqrt{Ek/F_{yw}}$ ⟶ $C = 1.0$

If $1.12\sqrt{Ek/F_{yw}} < D/t_w \le 1.40\sqrt{Ek/F_{yw}}$ ⟶ $C = \frac{1.12}{(D/t_w)}\sqrt{Ek/F_{yw}}$

If $D/t_w > 1.40\sqrt{Ek/F_{yw}}$ ⟶ $C = \frac{1.57}{(D/t_w)^2}\left(EK/F_{yw}\right)$

D/t_w = 23.4 $1.12\sqrt{Ek/F_{yw}}$ = 71.1 $1.40\sqrt{Ek/F_{yw}}$ = 88.9

k = **5.0** (AASHTO 6.10.9.2)

Check Flexural Resistance at Maximum Moment (AASHTO 6.10.8)

φ_f = **1.00**

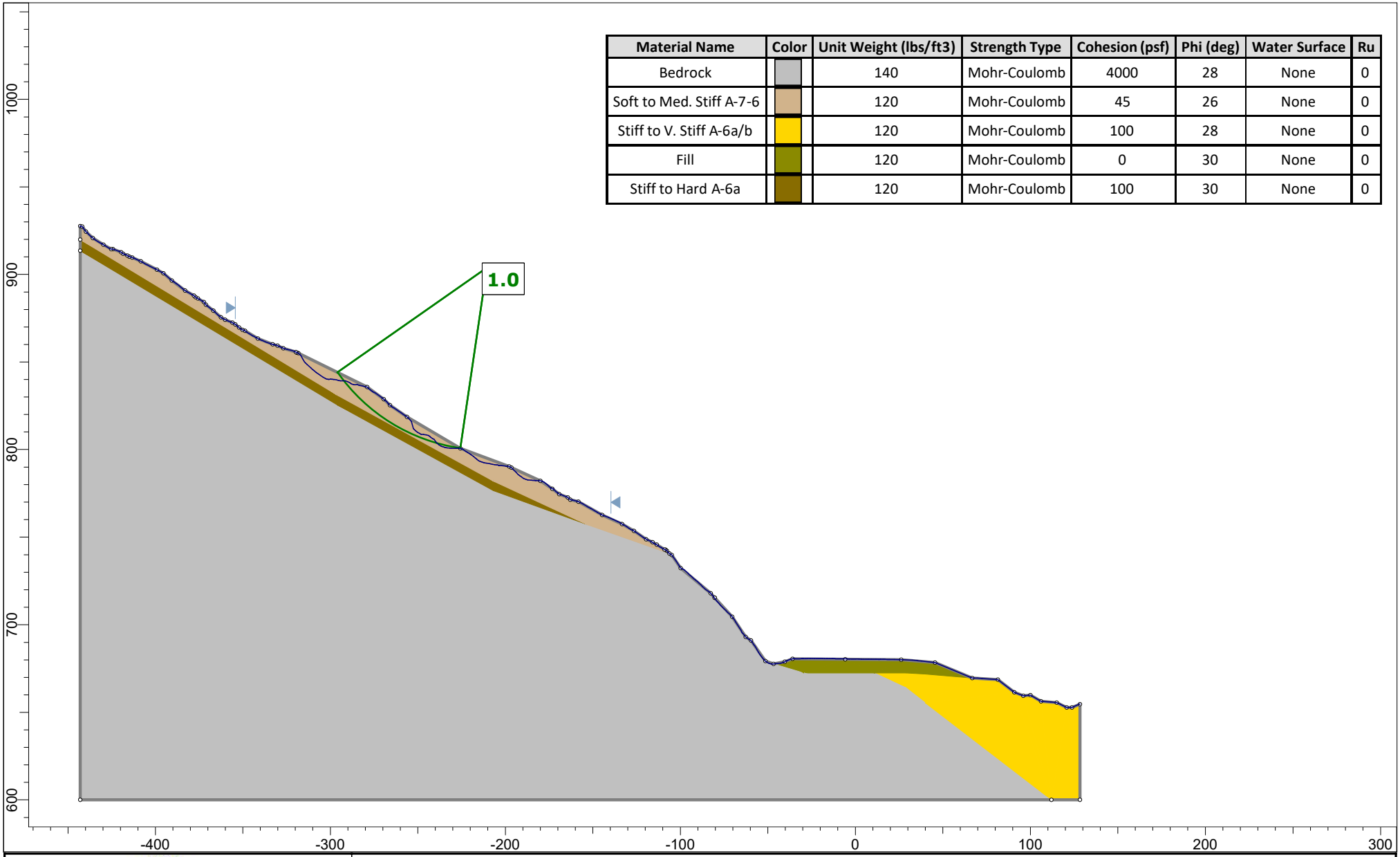
Check: $M_u < \varphi_f M_n$ ⟶ 47.0 kip-ft < 1.00(144.9 kip-ft) ⟶ 47.0 kip-ft < 144.9 kip-ft **OK**

M_u = **47.0** kip-ft (Determined from LPile) $M_n = F_y Z_x$ = 144.9 kip-ft

Appendix VIII

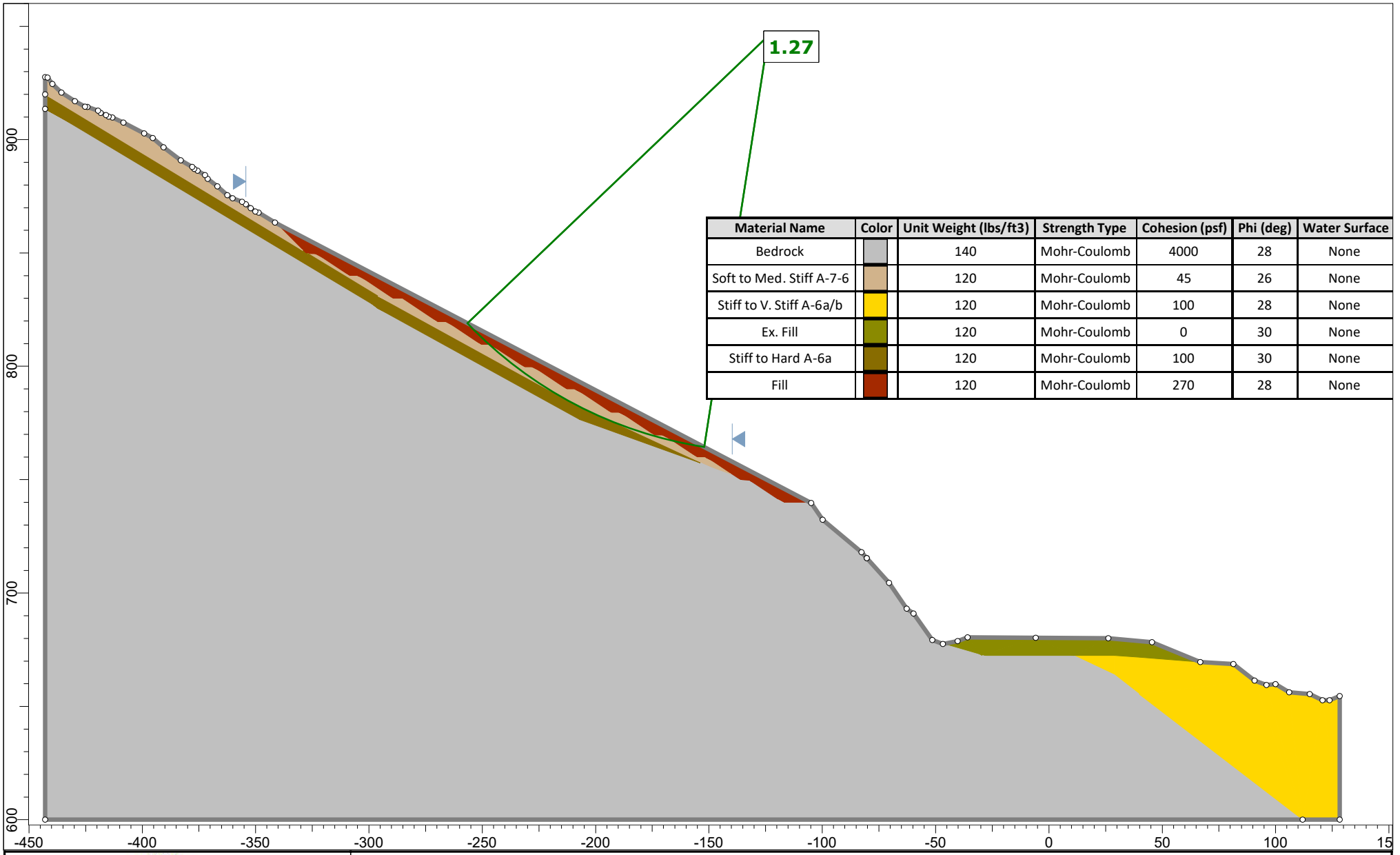
Slope Stability Analysis Outputs

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Bedrock		140	Mohr-Coulomb	4000	28	None	0
Soft to Med. Stiff A-7-6		120	Mohr-Coulomb	45	26	None	0
Stiff to V. Stiff A-6a/b		120	Mohr-Coulomb	100	28	None	0
Fill		120	Mohr-Coulomb	0	30	None	0
Stiff to Hard A-6a		120	Mohr-Coulomb	100	30	None	0



SLIDEINTERPRET 9.009

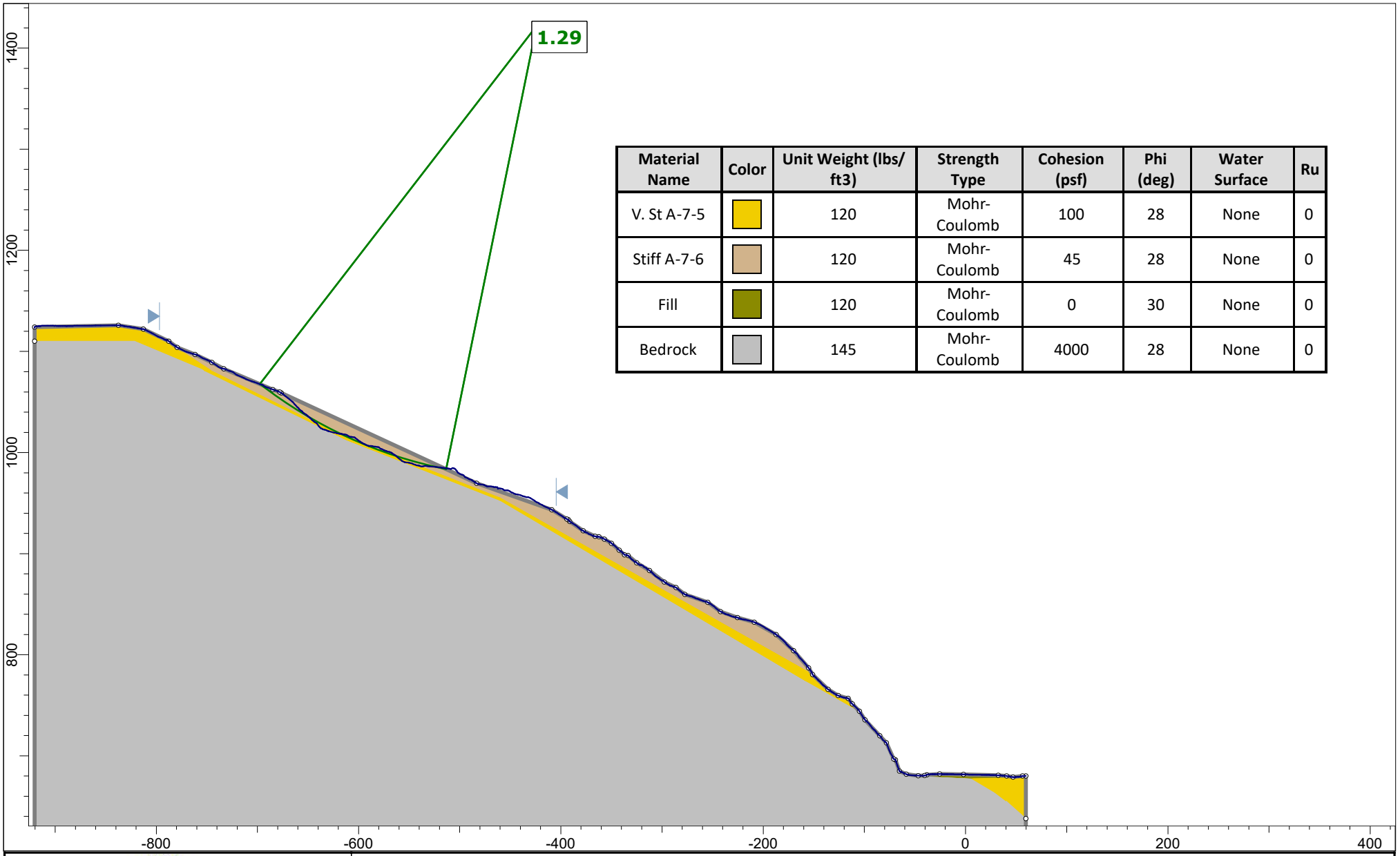
Project	SLIDE - An Interactive Slope Stability Program		
Analysis	Sta. 589+95	Scenario	Master Scenario
Drawn By	MDK	Company	Resource International, Inc.
Date	5/24/2021, 4:29:45 PM	File Name	BEL-7-11.04 Slide Area 1_back analysis.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Bedrock		140	Mohr-Coulomb	4000	28	None
Soft to Med. Stiff A-7-6		120	Mohr-Coulomb	45	26	None
Stiff to V. Stiff A-6a/b		120	Mohr-Coulomb	100	28	None
Ex. Fill		120	Mohr-Coulomb	0	30	None
Stiff to Hard A-6a		120	Mohr-Coulomb	100	30	None
Fill		120	Mohr-Coulomb	270	28	None

SLIDEINTERPRET 9.009

Project	SLIDE - An Interactive Slope Stability Program		
Analysis	Sta. 589+95	Scenario	Master Scenario
Drawn By	MDK	Company	Resource International, Inc.
Date	5/24/2021, 4:29:45 PM	File Name	BEL-7-11.04 Slide Area 1_remediation alt2.slmd



Material Name	Color	Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
V. St A-7-5		120	Mohr-Coulomb	100	28	None	0
Stiff A-7-6		120	Mohr-Coulomb	45	28	None	0
Fill		120	Mohr-Coulomb	0	30	None	0
Bedrock		145	Mohr-Coulomb	4000	28	None	0

SLIDEINTERPRET 9.009

Project	SLIDE - An Interactive Slope Stability Program		
Analysis	Sta. 588+05	Scenario	Original Conditions - Back Analysis
Drawn By	MDK	Company	Resource International, Inc.
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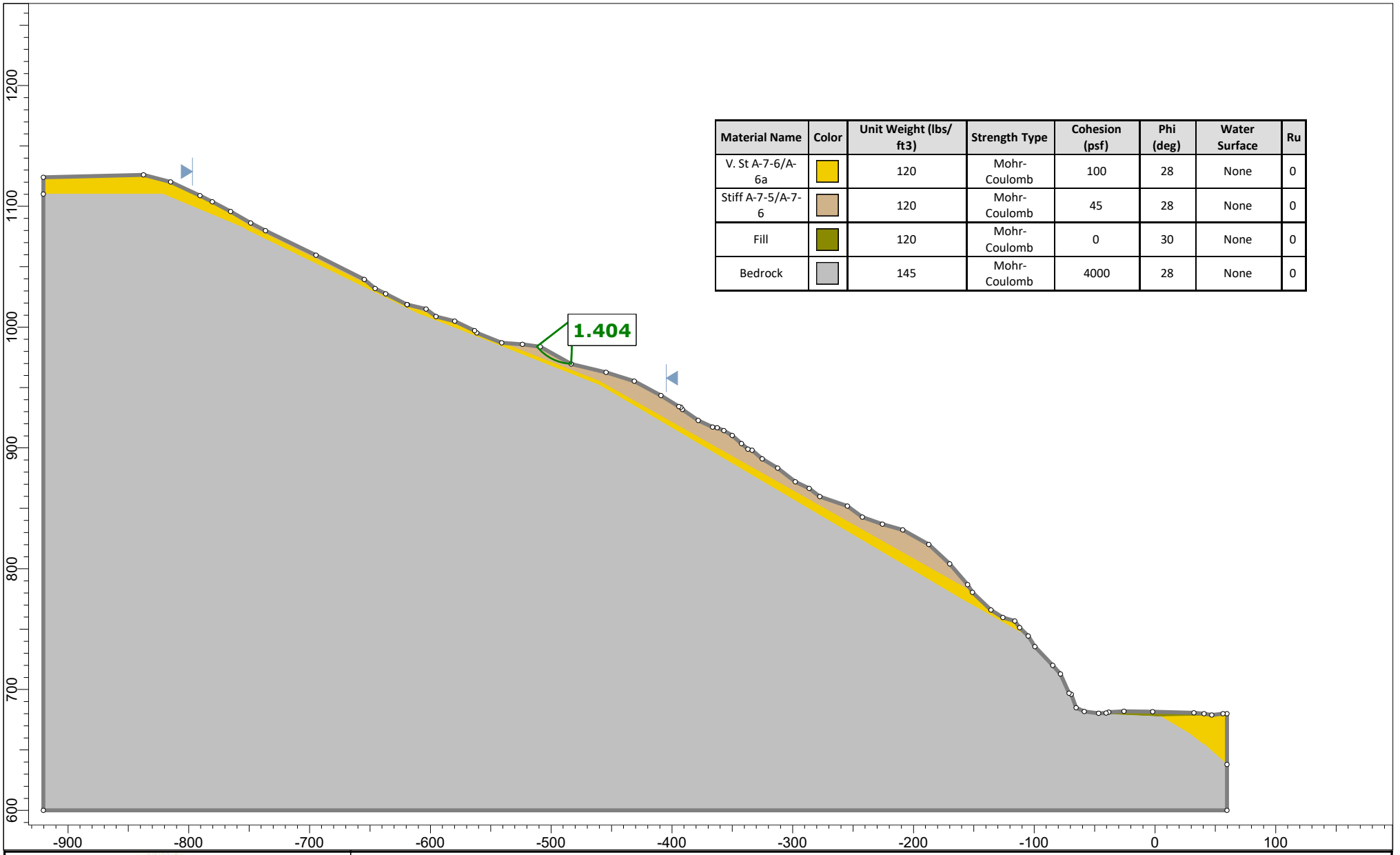

Material Name	Color	Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
V. St A-7-6/A-6a		120	Mohr-Coulomb	100	28	None	0
Stiff A-7-5/A-7-6		120	Mohr-Coulomb	45	28	None	0
Fill		120	Mohr-Coulomb	0	30	None	0
Bedrock		145	Mohr-Coulomb	4000	28	None	0

SLIDEINTERPRET 9.009

Project	SLIDE - An Interactive Slope Stability Program		
Analysis	Sta. 588+05	Scenario	Back Analysis
Drawn By	MDK	Company	Resource International, Inc.
Date	6/14/2021, 4:43:05 PM	File Name	BEL-7-11.04 Slide Area 2_remediation.slmd

Appendix IX

Site Remediation Exhibits

G:\ProjectData\2020\BEL\110788_BEL-7-11.04 W-20-120\Design\Geotechnical\Sheets\110788_SITE PLAN KEY.dgn Sheet 7/1/2021 3:51:48 PM colinr

	BEL-7-11.04	S.R. 7 SLIDE REPAIR AREAS - SITE KEY PLAN STA. 580+00.00 TO STA. 595+00.00	CALCULATED CFR CHECKED	0 60 30 120 HORIZONTAL SCALE IN FEET

950
900
850
800
750
700
650
600
400
350
300
250
200
150
100
50
0
50
100

14'
1:1
LA-R/W
1.5:1
1.9:1
1.5:1
10' (TYP.)
1.5:1
4' (TYP.)
1
1.5:1
15" TYPE C
1.5:1
4' (TYP.)
1.5:1
1.9:1
1.5:1
1.5:1
10' (TYP.)
12'
EX LA-R/W
℄ CONST. S.R. 7
36.0'±
36.0'±
EX LA-R/W

TYPICAL SECTION - SLIDE REPAIR AREA 1
STA. 588+00.00 TO STA. 594+50.00

LEGEND
(1) ITEM 203 EXCAVATION, AS PER PLAN

TYPICAL SECTIONS - SLIDE REPAIR AREA 1

BEL-7-11.04

1

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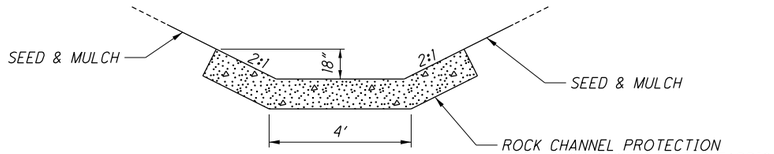
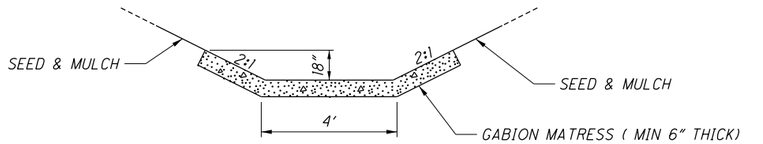
GULLY LINNING OPTIONS

ROCK CHANNEL PROTECTION

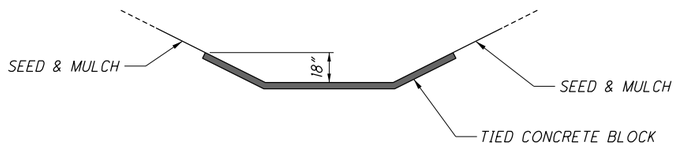


RCP THICKNESS: TYPE B = 2'-6"
TYPE C = 1'-6"

GABION MATRESS



TIED CONCRETE BLOCK



N

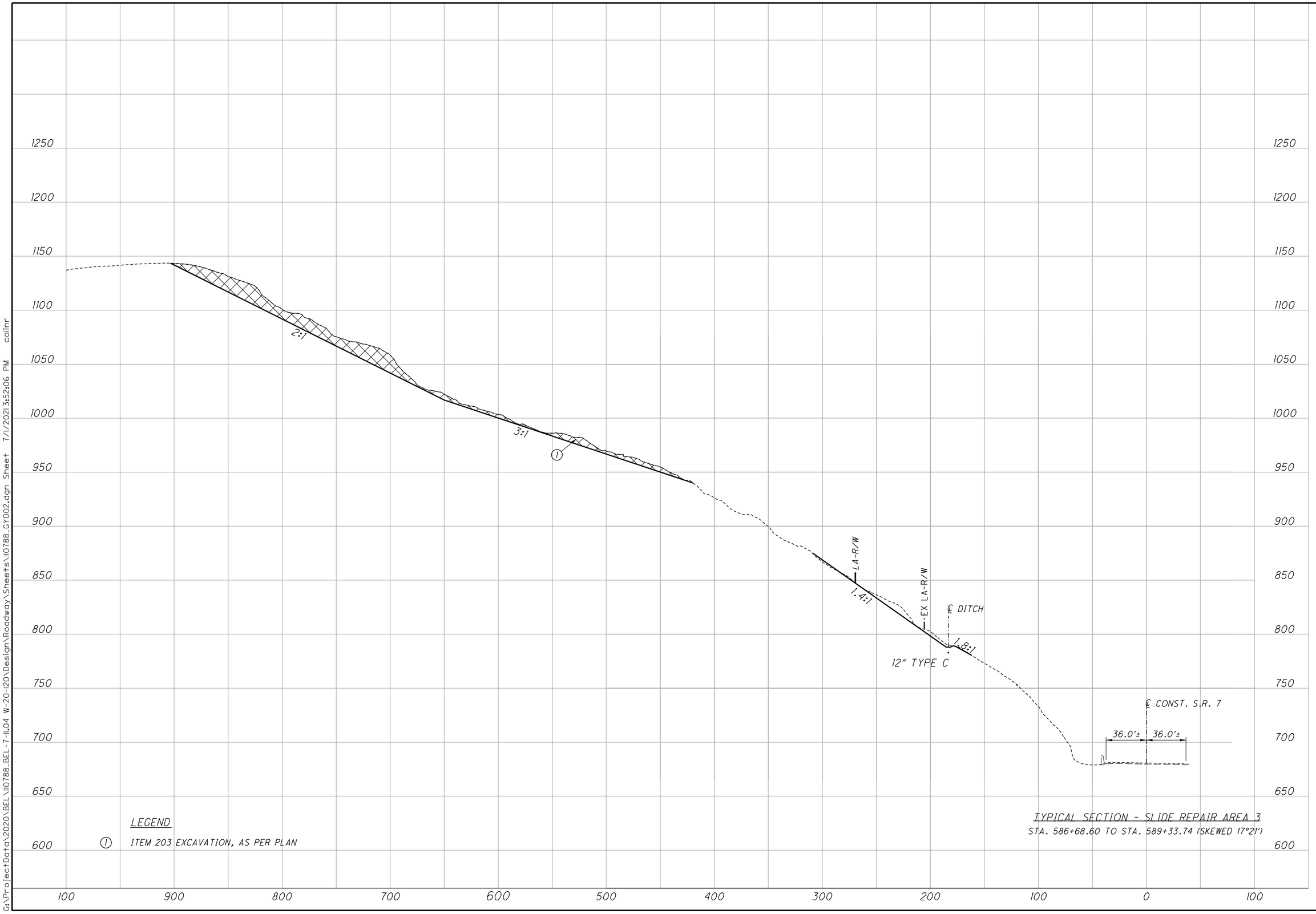
0 30 60 120
HORIZONTAL SCALE IN FEET

CALCULATED JAS
CHECKED MDK

SLIDE REPAIR AREA 2 - GULLY PLAN

BEL-7-11.04

1



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TYPICAL SECTIONS - SLIDE REPAIR AREA 2

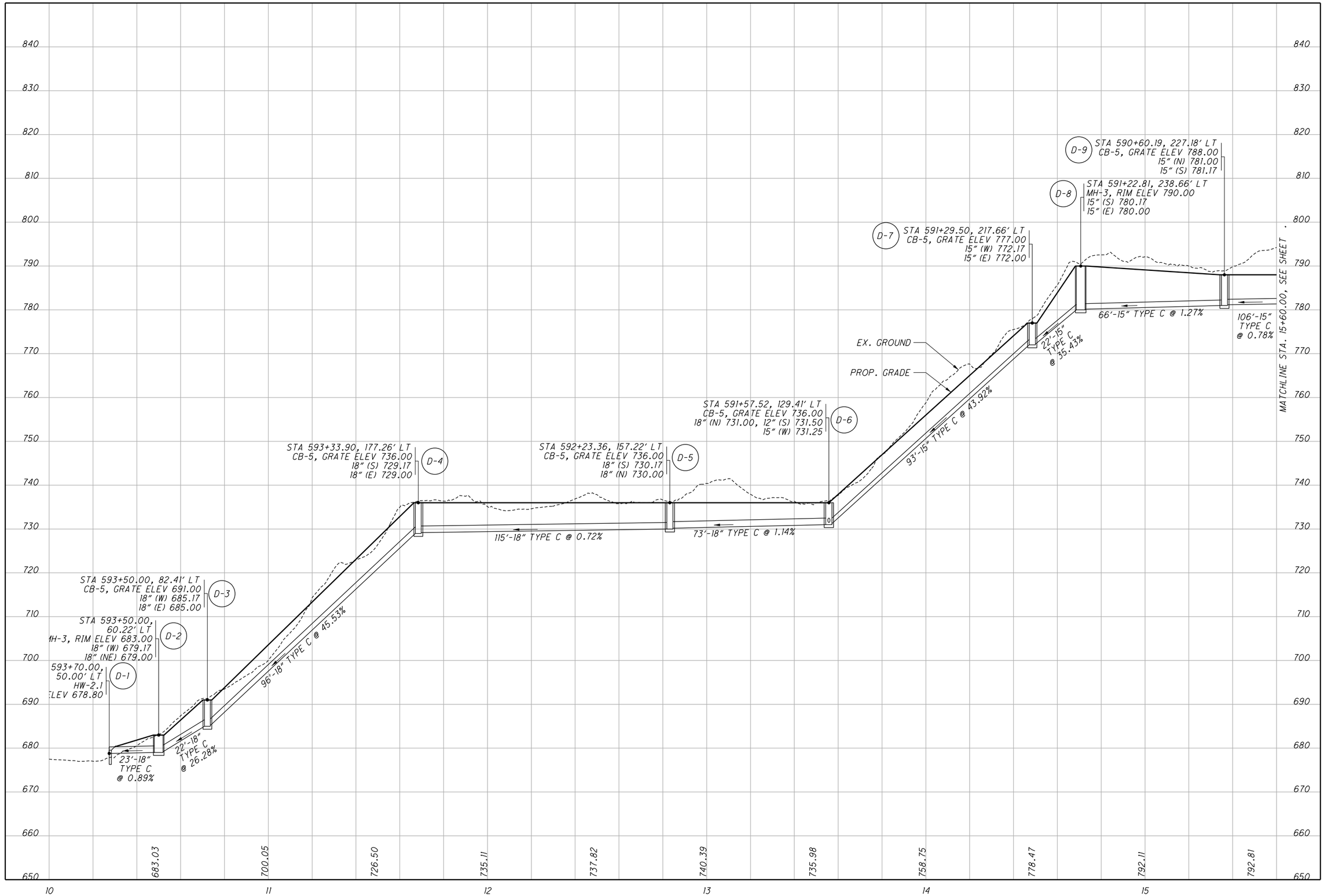
BEL-7-11.04

1

CALCULATED CFR
CHECKED NCK

SLIDE REPAIR AREA 2 - STORM PROFILE - S.R. 7

BEL-7-11.04



D-14 STA 587+51.47, 452.21' LT
CB-5, GRATE ELEV 963.00
12" (E) 958.00
12" (W) 958.17

78'-12" TYPE C @ 29.39%

MATCHLINE STA. 20+80.00, SEE BELOW

D-13 STA 587+88.98, 360.36' LT
CB-5, GRATE ELEV 913.00
12" (E) 908.00, 12" (W) 908.17
12" (S) 908.17

100'-12" TYPE C @ 49.84%

MATCHLINE STA. 15+60.00, SEE SHEET .

98'-12" TYPE C @ 64.05%

D-15 STA 587+50.14, 529.86' LT
CB-5, GRATE ELEV 986.00
12" (E) 981.00

MATCHLINE STA. 20+80.00, SEE ABOVE

78'-12" TYPE C @ 29.39%

D-12 STA 588+11.98, 265.24' LT
CB-5, GRATE ELEV 850.00
12" (E) 845.00
12" (W) 845.17

EX. GROUND

PROP. GRADE

100'-12" TYPE C @ 62.13%

D-10 STA 589+63.62, 189.32' LT
CB-5, GRATE ELEV 788.00
15" (N) 782.00
12" (S) 782.25

D-11 STA 588+42.74, 170.89' LT
CB-5, GRATE ELEV 788.00
12" (W) 783.17
12" (N) 783.00

106'-15" TYPE C @ 0.78%

125'-12" TYPE C @ 0.6%

960 950 940 930 920 910 900 890 880 870 860 850 840 830 820 810 800 790 780 770

1,000 990 980 970 960

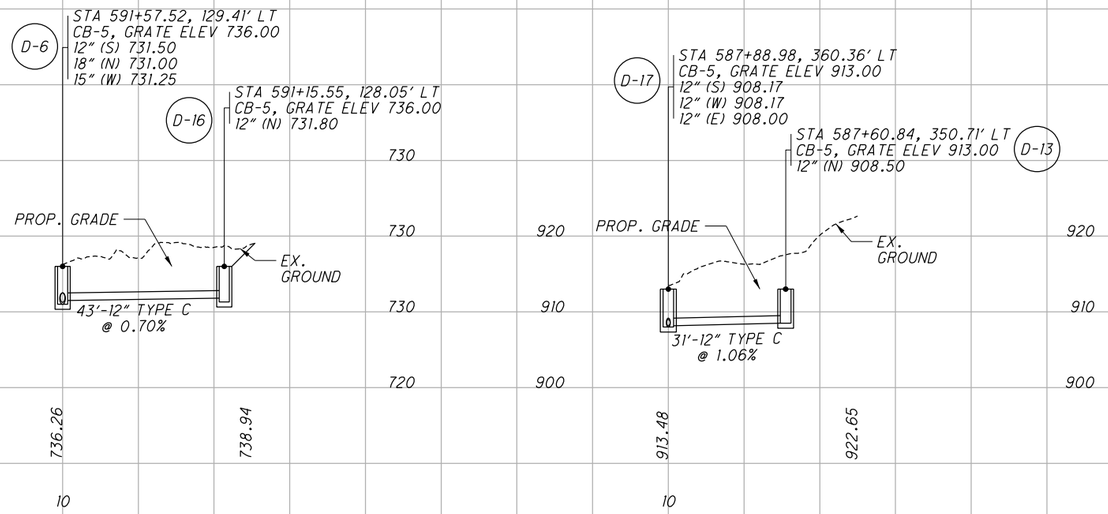
791.96 786.37 789.58 793.78 810.24 841.40 871.72 912.57 937.73 975.67 961.55 987.54

16 17 18 19 20 21

CALCULATED CFR
CHECKED NCK

SLIDE REPAIR AREA 2 - STORM PROFILE - S.R. 7

BEL-7-11.04

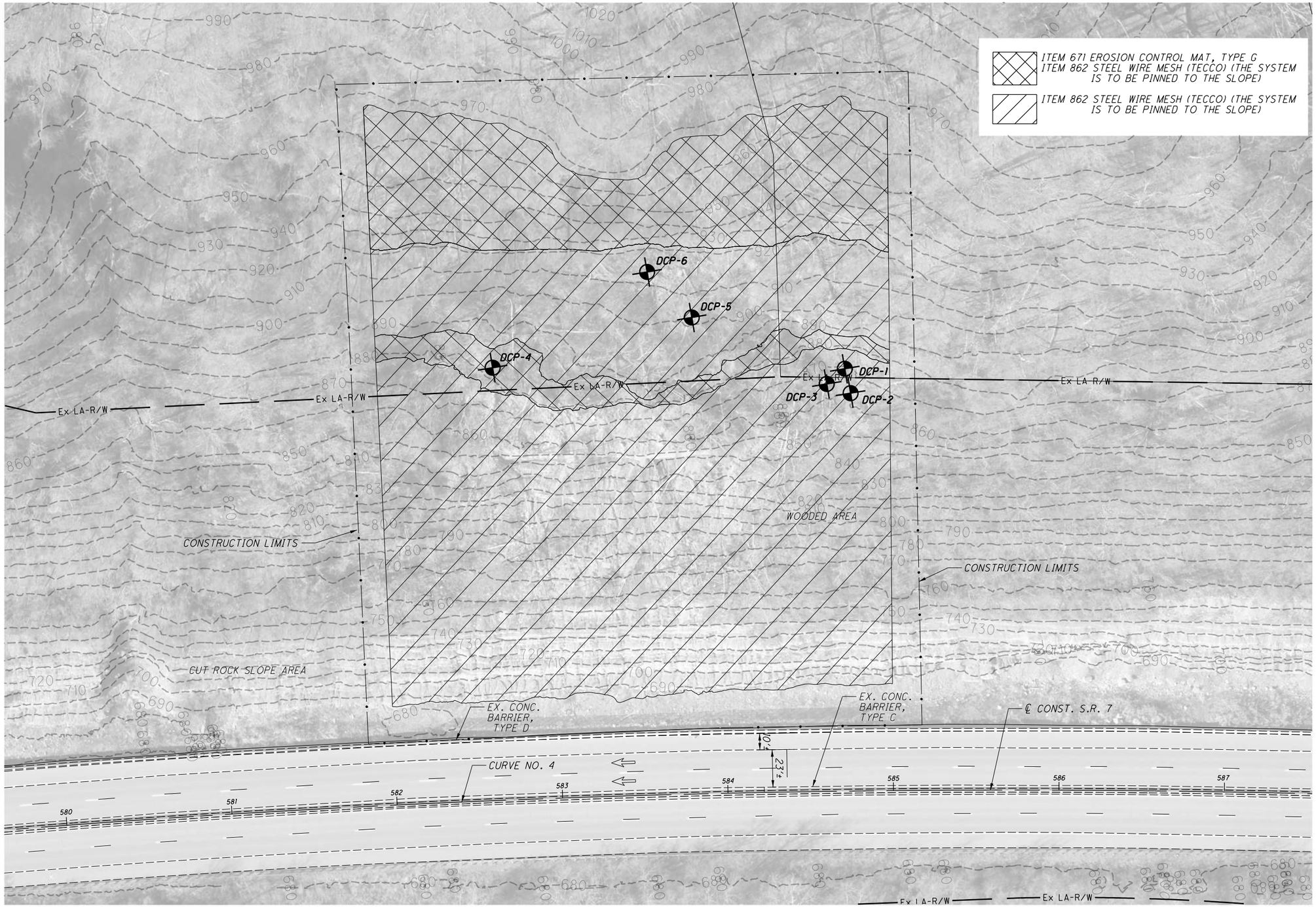


16 17 18 19 20 21

CALCULATED CFR
CHECKED NCK

SLIDE REPAIR AREA 2 - STORM PROFILE - S.R. 7

BEL-7-11.04

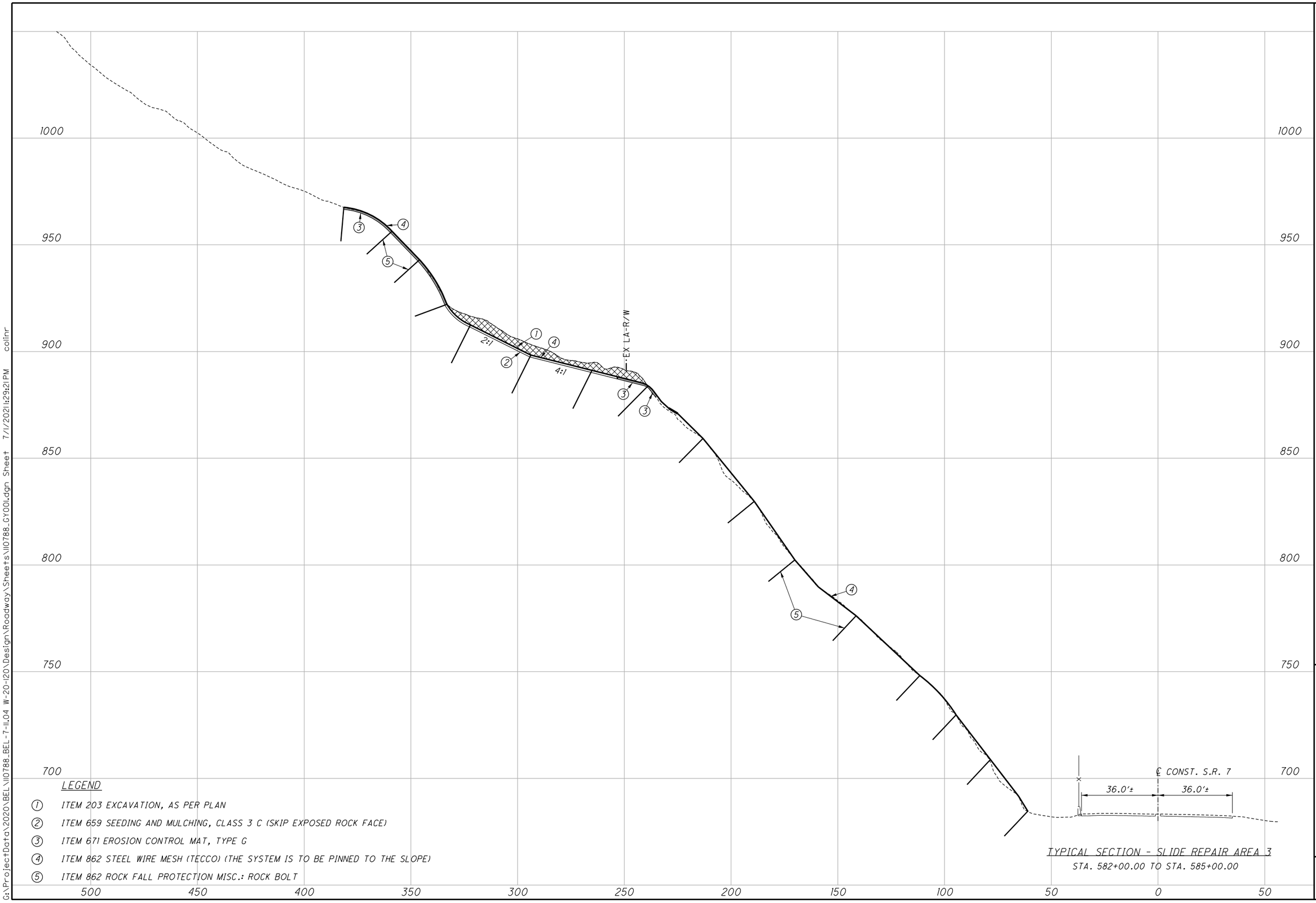


HORIZONTAL SCALE IN FEET
0 15 30 60

CALCULATED JAS
CHECKED MDK

SLIDE REPAIR AREA 3 PLAN

BEL-7-11.04



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TYPICAL SECTIONS - SLIDE REPAIR AREA 3

BEL-7-11.04

1