Stantec Consulting Services Inc.
11687 Lebanon Road, Cincinnati OH 45241-2012

May 23, 2017
File: 173620049

Charlie Rowe, PE
Transportation Engineer
Ohio Department of Transportation, District 8
505 South State Route 741
Lebanon, Ohio 45036

RE: Report of Geotechnical Exploration - FINAL
HAM-71-6.86
PID 94741
Hamilton County, Ohio

Dear Mr. Rowe,

Stantec Consulting Services Inc. (Stantec) has completed the final geotechnical report for the proposed improvements near SLM 6.86 of Interstate 71 in Hamilton County, Ohio. The enclosed report contains a brief description of the site, geologic conditions encountered, the scope of work performed, and geotechnical recommendations for the proposed improvements.

Regards,

Stantec Consulting Services Inc.

Robert E. Lopina, EI
Project Engineer-in-Training
Phone: (513) 842-8247
Fax: (513) 842-8250
Robert.Lopina@stantec.com

Eric M. Kistner, PE
Project Manager
Phone: (513) 842-8213
Fax: (513) 842-8250
Eric.Kistner@stantec.com

Attachment: Report of Geotechnical Exploration – FINAL

Report of Geotechnical Exploration - FINAL
HAM-71-6.86 Improvements
PID No. 94741

Hamilton County, Ohio

Prepared for:
Ohio Department of
Transportation, District 8

Prepared by:
Stantec Consulting Services Inc.
Cincinnati, Ohio

May 23, 2017

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Executive Summary

The Ohio Department of Transportation (ODOT) is planning improvements to Interstate 71 (I-71) in Hamilton County, Ohio. The majority of the project is located within Columbia Township, with some parts of the project located within Cincinnati city limits. The alignment is approximately one mile long starting at mile marker 6.86. The proposed improvements include roadway widening of I-71 and Ridge Avenue, realignment of Ramps N and P, box culvert extension, a soil nail wall, noise barrier walls, a sidehill cut, and a sidehill fill.

Forty-one soil borings, followed by laboratory testing, were performed by Stantec to provide geotechnical data for the proposed improvements. The subsurface profile predominantly consisted of fine-grained soils that classified as sandy silt (A-4a), silt (A-4b), silt and clay (A-6a), or silty clay (A-6b) and, to a lesser degree, clay (A-7-6). Coarse-grained soils were also observed at shallow depths (typically as subgrade material) and at greater depths (typically in 5- to 10-foot layers). The coarse-grained soils classified predominantly as gravel (A-1-a), gravel with sand (A-1-b), gravel with sand and silt (A-2-4), or gravel with sand, silt, and clay (A-2-6). Perched groundwater was encountered in eight borings at various depths within coarse-grained and silt layers. Bedrock was not encountered in any of the borings.

Based on the results of the borings and laboratory testing, global subgrade stabilization is recommended for the roadway improvements. It is recommended that the subgrade soils be chemically stabilized with cement to a depth of 12 inches for Ridge Avenue and 16 inches for I-71, Ramp N, and Ramp P. A CBR value of 6 is recommended for design of the widening of Ridge Avenue, and a CBR value of 7 is recommended for the widening of I-71 and the realignment of Ramps N and P.

For the box culvert extension at approximately Station 413+50, it is assumed that the extended culvert will be supported on soil. The bearing elevations of the culvert and the footings for the headwall and wingwalls are assumed to be at or near Elevation 539.5. The nominal bearing resistance for the box culvert and headwall/wingwall spread footings at service limit state was estimated as 4 kips per foot. A nominal bearing resistance of 16 kips per square feet (factored bearing resistance of 8 kips per square foot) is recommended for design of the box culvert and headwall/wingwall spread footings at strength limit state.

A soil nail wall is planned from Station 415+70 to 417+50 of I-71 to accommodate the widening of I-71 beneath the Kennedy Avenue Overpass. Subsurface information from two borings was used in the analysis of the soil nail wall. Based on the existing bridge abutment piles, a horizontal spacing of 5.5 feet is recommended. It is recommended that one of the following configurations be used for the soil nail wall: two rows of 30-foot soil nails spaced 5.0 feet vertically or three rows of 24-foot soil nails spaced 3.5 feet vertically. The recommended nail inclination for both configurations is 15 degrees downward from horizontal.

Noise barriers are planned from approximately Station 421+31 to 440+38 of I-71. Ten borings were drilled approximately 200 feet apart to obtain subsurface information for design of the noise barrier foundations. The 2007 ODOT Bridge Design Manual (BDM), Section 802.1, presents the procedure for designing the foundations for noise barriers. Specific recommendations are included in this report based on Standard Penetration Test (SPT) N-values and soil types encountered which are to be used in conjunction with this design procedure. Rocky fill was encountered in borings B-028-0-15 and B-029-0-15. This may result in difficult drilling in the area during construction.

Stability analyses were performed on two representative sections where a sidehill cut is planned. Subsurface information from borings located at these sections was used to determine the material parameters for analysis. The factors of safety that resulted from the stability analyses were greater than the required factor of safety for embankments of 1.3.

Borings were advanced at three cross sections where sidehill fills are planned. Special benching is proposed for these areas and is shown in the geotechnical drawings in Appendix A. Slope stability analyses were performed at these three sections incorporating the special benching geometry. Material parameters were determined for these sections using laboratory data and SPT correlations. The stability analyses yielded factors of safety greater than the required factor of safety for embankments of 1.3.

1.0 INTRODUCTION

The Ohio Department of Transportation (ODOT) is planning improvements to Interstate 71 (I-71) in Hamilton County, Ohio. The majority of the project is located within Columbia Township, with some parts of the project located within Cincinnati city limits. The alignment is approximately 1.0 miles long starting at SLM 6.86. The proposed improvements include the following:

- roadway widening of I-71 and Ridge Avenue
- realignments of Ramp N and Ramp P
- box culvert extension at approximately Station 413+50 of I-71
- soil nail wall beneath the Kennedy Avenue overpass from Station 415+70 to 417+50 of I-71
- noise barrier walls from approximately Station 421+31 to 440+38 of I-71
- sidehill cut from approximately Station 418+00 to 424+00 of I-71
- sidehill fill from approximately Station 437+00 to 462+00 of I-71

Stantec Consulting Services Inc. (Stantec) was contracted by ODOT to perform the geotechnical exploration for this project. Figure 1 shows the site vicinity.

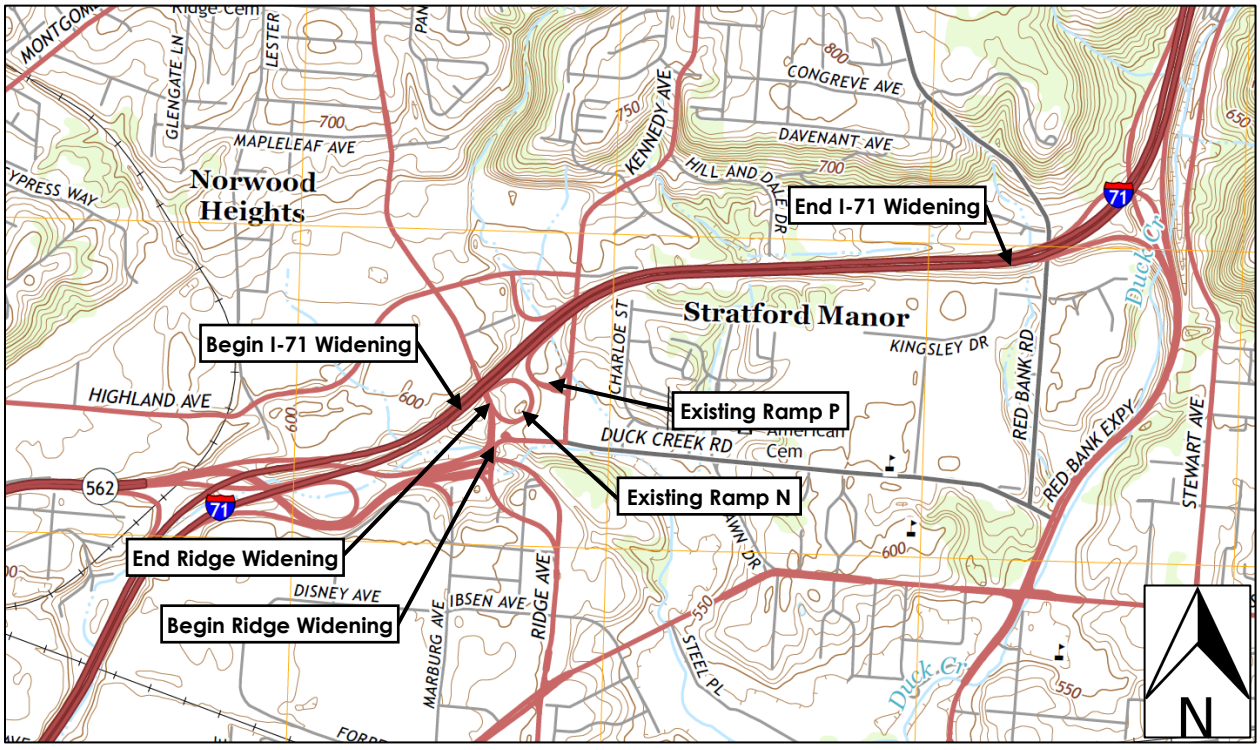


Figure 1. Site Vicinity Map
(Portion of USGS Topographic Map, Cincinnati East Quadrangle, Not To Scale)

2.0 GEOLOGY AND OBSERVATIONS OF THE PROJECT

2.1 GENERAL

The Physiographic Regions of Ohio map (Ohio Department of Natural Resources (ODNR), 1998) indicates that the project site is located in the Illinoian Till Plain. The Illinoian Till Plain is described as having rolling ground moraine of older till generally lacking ice-constructional features such as moraines, kames, and eskers. It is described as having many buried valleys and modern valleys alternating between broad floodplains and bedrock gorges. This region has moderately low relief (50 feet) with elevations of 600 to 1,100 feet.

2.2 SOIL GEOLOGY

According to the Quaternary Geology of Ohio map (ODNR, 1999), the project site is underlain predominantly by silty loam till with moderate (three to nine feet) loess cover deposited during the Illinoian Age. The loam till originates as a flat, relatively continuous ground moraine.

The soil survey (Web Soil Survey of Hamilton, Ohio, United States Department of Agriculture (USDA), 2016) indicates that the site is underlain by silt loam, predominantly of the Urban land – Udorthents complex. The site is also underlain by Bonnel silt loams and Jonesboro-Rossmoyne Silt loams. These soils consist of silt loam, silty clay, silty clay loam, and clay loam with low to moderately high capacities to transmit water.

The Drift Thickness Map of Ohio (ODNR, 2004) suggests a range of soil cover along the project site between 0 and 210 feet.

2.3 BEDROCK GEOLOGY

Bedrock mapping (Bedrock Geology of the Cincinnati East, OH Quadrangle, ODNR, 1996) and Descriptions of Geologic Map Units (ODNR, 2000) indicate that the overburden soils are underlain by sedimentary bedrock from the Kope Formation of the Ordovician System for the majority of the project site. The Kope Formation is composed of gray to bluish gray interbedded shale and limestone with an average of 75 percent shale and 25 percent limestone. Bedrock is described as planar and thin to thick bedded, with thicknesses ranging from 200 to 260 feet. Near the south end of the project near Ridge Avenue, overburden soils are underlain by sedimentary bedrock from the Point Pleasant Formation of the Ordovician System. The Point Pleasant Formation is composed of gray to bluish gray interbedded limestone and shale, with an average of 60 percent limestone and 40 percent shale. Bedrock is described as planar to lenticular and thin to medium bedded, with thicknesses ranging from 0 to 80 feet.

According to the Abandoned Underground Mine Locator (ODNR, 2015), there are no known mapped underground mines within the project footprint.

The Ohio Karst Areas map (ODNR, 2007) indicates there are no known karst areas within the project footprint. Probable karst areas are located approximately 10 to 15 miles west, northwest, and east of the project site.

2.4 SEISMIC

A review of the seismic data available in the project vicinity included the OhioSeis database developed by the ODNR, Division of Geological Survey. The review was performed using the internet mapping service (rev. 2012) at the following website: https://gis.ohiodnr.gov/website/dgs/earthquakes/.

Overall, Ohio has a relatively limited amount of seismic activity. However, within a 15-mile radius of the project, there have been ten earthquake epicenters, with magnitudes ranging between 2.5 to 3.3. The available data reviewed included events that occurred from 1804 to present day.

2.5 HYDROLOGY

Duck Creek runs north to south east of the project site. Various unnamed tributaries of Duck Creek cross I-71 along the project site, including the stream at the location of the culvert extension near Station 413+50 of I-71. Duck Creek flows into the Little Miami River approximately 4 miles south of the project site, and the Little Miami River flows into the Ohio River.

2.6 HYDROGEOLOGY

Groundwater migrates through both primary and secondary porosity at the site. Some of that water migrates through granular seams in the soil. This perched groundwater eventually intercepts the existing groundwater table in the area or travels to a stream within the tributary network. Water also may migrate along the top of bedrock, saturating the interface between the top of bedrock and unconsolidated material, until the groundwater seeps into the bedrock or into a fracture or joint. Below top of bedrock, the water migrates through the fractures, joints, bedding planes, and other voids in the bedrock. The groundwater eventually intercepts the existing groundwater table in the area or exits to the surface at a lower elevation.

2.7 RECONNAISSANCE

Stantec representatives visited the site on April 25 and May 2, 2016. The land usage around the project is primarily vegetated/wooded easement with some commercial and residential areas. Several borings were positioned on the Motel 6 property on Kennedy Avenue. One boring was located in the right-of way at the end of Charloe Street, which is a residential street. Two borings

were positioned at the north end of the Fifth Third Bank building property on Kingsley Drive. The enclosure between existing Ramp P, I-71, and Kennedy Avenue is heavily vegetated, becoming more wooded north of the existing culvert/channel. The easement for I-71 is heavily wooded from Kennedy Avenue to the start of the Fifth Third Bank building property. Due to heavy vegetation, steep slopes, and underground/overhead utilities at various locations within the project sites, some borings were relocated from the original boring plan. The drilled locations of the borings are shown in the geotechnical drawings in Appendix A. In general, the existing pavement appeared to be in good condition. The existing fill and cut slopes appear stable at the constructed 2H:1V (horizontal to vertical) slopes. The existing cut slopes are heavily vegetated. The existing fill slopes are more lightly vegetated with areas of heavier vegetation.

Interstate 71 within the project site is classified as an interstate and Ridge Avenue is classified as a minor arterial route according to the Hamilton County Functional Map (ODOT, 2004). Northbound I-71 has a daily volume between 53,929 and 58,507 vehicles and Ridge Avenue has a daily volume of 23,256 vehicles (both directions) according to the most recent traffic count (ODOT Traffic Data Management System, 2015).

3.0 EXPLORATION

3.1 HISTORIC EXPLORATION PROGRAMS

The ODOT Geotechnical Data Management System (GeoMS) indicates that several explorations were performed in the project vicinity. Geotechnical explorations were performed for the existing alignments of Ridge Avenue (HAM-71-7.45, 1965), Kennedy Avenue (HAM-71-6.14, 1965), I-71 (HAM-71-8.43, 1964 and HAM-71-7.45, 1965), and I-71 ramps (HAM-71-7.45, 1965). These explorations were used to understand the general subsurface conditions of the project area. One boring from HAM-71-6.14, four borings from HAM-71-7.45, and one boring from HAM-71-8.43 are shown in the geotechnical drawings provided in Appendix A.

A search of the ODNR Division of Oil & Gas Resources Oil & Gas Well Locator (2016) did not indicate any oil or gas wells drilled in the project vicinity. A search was also performed using the ODNR Division of Water Resources Ohio Water Wells Map (2016). According to the map, no water wells were drilled within the project footprint.

3.2 PROJECT EXPLORATION PROGRAM

Forty-one borings were advanced by Stantec to obtain geotechnical data for the design and construction of the proposed project improvements. During the site reconnaissance, some boring locations were modified due to access concerns and overhead and underground utility conflicts. A summary of the borings advanced for this project is shown in Table 1. Boring

locations are shown on the site plan in the geotechnical drawings provided in Appendix A. A complete set of boring logs are also provided in Appendix A.

Table 1 Boring Summary

Boring No.	Boring Type	Alignment	Station (feet)	Offset (feet)	Ground Surface Elevation (feet)	Bottom of Boring Elevation (feet)
B-001-0-15	Subgrade	I-71	400+20	55' RT.	567.0	559.5
X-001-1-15	Pavement Thickness	I-71	400+21	47' RT.	567.0	565.7
B-002-0-15	Subgrade	I-71	403+11	57' RT.	566.4	558.9
B-003-0-15	Subgrade	Ridge Ave.	23+81	23' RT.	560.3	552.8
B-004-0-15	Subgrade	Ridge Ave.	27+10	27' RT.	576.9	569.4
B-005-0-15	Roadway	Ramp N	407+92	2' RT.	560.4	548.9
B-006-0-15	Roadway	Ramp N	411+01	Centerline	553.2	541.7
B-007-0-15	Roadway	Ramp N	413+50	Centerline	556.6	545.1
B-008-0-15	Roadway	Ramp P	408+55	56' RT.	560.3	553.3
B-009-0-15	Roadway	Ramp P	410+00	Centerline	548.5	537.0
B-010-0-15	Roadway	Ramp P	412+50	Centerline	550.9	539.4
B-011-0-15	Subgrade	I-71	408+87	50' RT.	561.3	553.8
B-012-0-15	Subgrade	I-71	410+98	48' RT.	557.7	550.2
B-013-0-15	Culvert	I-71	412+68	157' RT.	554.1	502.6
B-014-0-15	Subgrade	Ramp P	414+87	26' LT.	558.0	550.5
B-015-0-15	Soil Nail Wall	I-71	416+51	84' RT.	560.9	529.4
B-015-1-15	Soil Nail Wall	I-71	416+68	182' RT.	586.8	545.3
B-016-0-15	Subgrade/Sidehill Cut	I-71	419+02	80' RT.	567.3	545.8
B-016-1-15	Sidehill Cut	I-71	419+21	196' RT.	595.7	554.2
B-017-0-15	Sidehill Cut/Noise Barrier	I-71	421+79	168' RT.	600.5	569.0
B-018-0-15	Subgrade/ Sidehill Cut	I-71	423+15	71' RT.	579.6	558.1
B-019-0-15	Sidehill Cut/Noise Barrier	I-71	423+44	125' RT.	600.2	568.7
B-020-0-15	Noise Barrier	I-71	425+25	74' RT.	582.9	556.4
B-021-0-15	Subgrade/Noise Barrier	I-71	426+46	59' RT.	586.5	560.0
B-022-0-15	Subgrade/Noise Barrier	I-71	428+55	61' RT.	589.0	562.5
B-024-0-15	Subgrade/Noise Barrier	I-71	430+49	76' RT.	588.8	562.3
B-025-0-15	Subgrade/Noise Barrier	I-71	432+49	74' RT.	587.2	560.7
B-027-0-15	Subgrade/Noise Barrier	I-71	434+51	72' RT.	585.2	558.7
B-028-0-15	Subgrade/Noise Barrier	I-71	437+01	61' RT.	585.7	559.2
B-029-0-15	Subgrade/Noise Barrier	I-71	438+39	60' RT.	586.9	560.4
B-030-0-15	Subgrade/Sidehill Fill	I-71	441+82	61' RT.	594.2	552.7
B-030-1-15	Sidehill Fill	I-71	441+79	139' RT.	561.3	542.5
B-030-2-15	Sidehill Fill	I-71	441+84	139' RT.	561.3	525.8
B-031-0-15	Subgrade	I-71	445+98	61' RT.	605.0	597.5
B-032-0-15	Subgrade	I-71	449+89	60' RT.	615.2	607.7
B-033-0-15	Subgrade/Sidehill Fill	I-71	454+30	60' RT.	626.8	585.3
B-033-1-15	Sidehill Fill	I-71	454+04	158' RT.	597.2	555.7
B-034-0-15	Subgrade	I-71	458+29	61' RT.	635.0	627.5
X-034-1-15	Pavement Thickness	I-71	458+29	53' RT.	635.0	633.8
B-035-0-15	Subgrade/Sidehill Fill	I-71	462+00	61' RT.	640.5	599.0
B-035-1-15	Sidehill Fill	I-71	461+86	184' RT.	601.4	559.9

Exploration
May 23, 2017

The borings were advanced in accordance with the Ohio Department of Transportation (ODOT) Specifications for Geotechnical Exploration (SGE). The borings were completed with either a CME 55 truck-mounted drill rig, a CME 55 track-mounted drill rig, or a CME 45 track-mounted drill rig, using 3¼-inch ID hollow stem augers to advance the borings through soil. Standard penetration test (SPT) sampling was performed at continuous, 2.5-foot, and 5-foot intervals to a specified depth for each boring. Undisturbed Shelby tube (ST) sampling was performed at selected depths when possible. The drill rod energy ratio (ER) is 81.3 percent for the CME 55 truck-mounted drill rig, 92.4 percent for the CME 55 track-mounted drill rig, and 91.6 percent for the CME 45 track-mounted drill rig.

The SPT is performed by advancing a split-spoon sampler, 18 inches in length, with a 140-pound automatic hammer dropping 30 inches at select depth intervals in the boring. The number of hammer blows needed to advance the sampler each 6-inch increment is recorded. The blow count from the first 6-inch increment is discarded due to ground disturbance at the bottom of the borehole. The sum of the blow counts from the last two 6-inch increments is called the N-value, which is corrected to an equivalent rod energy ratio of 60 percent (N_{60}) by multiplying the N-value by the ER of the drill rig employed, dividing the resultant by 60 percent. The locations of the SPTs with the corresponding N_{60}-values are shown on the boring logs in Appendix A.

Boreholes were checked for the presence of groundwater at the completion of soil drilling with depths to groundwater recorded. Borings where groundwater was encountered were sealed based on the soil and groundwater conditions encountered. The other borings were backfilled with auger cuttings. Borings performed in the existing roadway and shoulders were capped with asphalt cold patch.

The materials encountered were logged by a drilling inspector, with particular attention given to soil type, consistency, and moisture content. The borings were checked for the presence of groundwater during drilling and at its conclusion with the depth of water recorded.

The soil samples obtained from the borings were returned to the laboratory for visual classification and tested for water content. Engineering classification testing was performed on samples reflecting each of the main soil horizons. The engineering classification tests conducted on the samples were sieve and hydrometer analysis (ASTM D 422) and Atterberg limits (ASTM D 4318). The samples were classified according to the ODOT classification method. Seven undisturbed samples were subjected to unit weight (ASTM D 2166) and unconfined compressive strength (UC) tests (ASTM D 7012). Unconsolidated undrained (UU) triaxial compression tests (ASTM D 2850) were performed on five undisturbed samples. Three sets of consolidated undrained triaxial compression tests (ASTM D 4767) were also performed. The results of the undisturbed testing are included in the geotechnical drawings provided in Appendix A.

One sample from each roadway and subgrade boring was subjected to sulfate content testing (ODOT Supplement 1122) to identify potentially expansive soils. The results of the sulfate content tests are provided in Appendix B.

4.0 FINDINGS

4.1 ROADWAY AND SUBGRADE

Twenty borings were advanced to sample the proposed subgrade for the widening of I-71. These borings were advanced in the shoulder or just beyond the shoulder of northbound I-71. Two borings (X-001-1-15 and X-034-1-15) were advanced through the right driving lane of northbound I-71 in order to determine the existing pavement thickness of the driving lane. No sampling was performed in these two borings. The pavement encountered in these borings consisted of 0.3 to 0.4 feet of asphalt pavement and 0.9 feet of concrete. In borings drilled in the shoulder of northbound I-71 south of Ridge Avenue, the pavement consisted of 0.5 to 0.6 feet of asphalt pavement and 0.3 to 0.7 feet of granular base. The pavement consisted of 0.8 to 1.2 feet of asphalt pavement and 0.2 to 0.6 feet of granular base (where encountered) in the borings drilled in the shoulder of northbound I-71 north of Ridge Avenue.

The soils encountered below the pavement consisted of primarily fine-grained soils. The fine-grained classified primarily as silty clay (A-6b) or clay (A-7-6). Sandy silt (A-4a) and silt and clay (A-6a) were each encountered in three borings. The fine-grained materials were generally described as damp to moist and had N_{60L}-values between 3 and 25 blows per foot. Liquid limits ranged from 17 to 45 with plasticity indices between 3 and 33. Wet, non-plastic silt (A-4b) with an N_{60L}-value of 11 was encountered in one boring (B-018-0-15). Some coarse-grained materials were also encountered. The coarse-grained soils classified as gravel (A-1-a), gravel with sand and silt (A-2-4), and gravel with sand, silt, and clay (A-2-6). The coarse-grained materials were described as damp to wet with N_{60L}-values between 8 and 15 blows per foot.

Three borings (B-005-0-15, B-006-0-15, and B-007-0-15) were advanced on the proposed alignment of Ramp N. The soils encountered consisted primarily of silt and clay (A-6a) and silty clay (A-6b). These soils were described as damp to moist and medium stiff to stiff. Soft soils were encountered from 5.0 to 6.5 feet in B-005-0-15 and from 7.5 to 9.0 feet in B-006-0-15. Wet, loose coarse and fine sand (A-3a) was encountered in B-005-0-15. N_{60L}-values for these borings ranged from 2 to 6 blows per foot.

Four borings (B-008-0-15, B-009-0-15, B-010-0-15, and B-014-0-15) were advanced on the proposed alignment of Ramp P. The pavement encountered at B-014-0-15 consisted of 0.8 feet of asphalt pavement. The soils in the borings consisted of silt and clay (A-6a) and silty clay (A-6b). The soils were described as medium stiff to very stiff. Soft soils were encountered from 4.5 to 9.5 feet in B-010-015. N_{60L}-values for these borings ranged from 3 to 8 blows per foot.

Two borings (B-003-0-15 and B-004-0-15) were advanced for the Ridge Avenue widening. The pavement encountered at B-003-0-15 consisted of 0.1 feet of asphalt pavement and 0.9 feet of concrete. The soils in the borings consisted of silty clay (A-6b) and silt and clay (A-6a). The soils were described as damp to moist and stiff to hard. Medium stiff silty clay was encountered from 1.5 to 3.0 feet in B-003-0-15. N_{60L}-values for these borings ranged from 5 to 14 blows per foot.

Sulfate testing was performed on all of the roadway and subgrade borings. The samples that were tested were taken from one of the top four SPT samples. The sulfate content tests yielded sulfate concentrations that were less than 3,000 parts per million (ppm). The results of the sulfate content tests are provided in Appendix B.

Auger refusal was encountered at a depth of 7.0 feet in B-008-0-15, likely due to a boulder. Groundwater was not observed in the roadway/subgrade borings.

4.2 CULVERT EXTENSION

An extension of the box culvert at approximate Station 413+50 of I-71 is planned to accommodate the additional lane on northbound I-71. Boring B-013-0-15 was performed west of the existing culvert near the proposed extension. The boring was terminated at a depth of 51.5 feet. A boring was not performed east of the culvert due to an inability to access the location without major clearing.

The surface materials of B-013-0-15 consisted of 0.4 feet of topsoil. Beneath the topsoil, a 4.1-foot layer of silt and clay (A-6a) was encountered. This material was described as stiff to hard and damp. Following this layer, approximately 10 feet of granular material was encountered. This material classified as gravel and stone fragments with sand (A-1-b) and gravel and stone fragments with sand and silt (A-2-4). The material was described as medium dense to dense (N_{60}-values from 11 to 46) with a layer of very loose (N_{60}-value of 3) material from a depth of 7.5 to 9.0 feet. The soil was described as moist to wet and was saturated from a depth of 7.5 to 14.5 feet. Beneath the granular layer, sandy silt (A-4a) was encountered to the bottom of the boring. This material was described as very stiff to hard and damp. SPT N_{60}-values ranged from 28 to 60 blows per foot and generally increased with depth in this layer. Two Shelby tubes were attempted at 20.0 and 42.5 feet but were not subjected to testing due to low sample recoveries.

Bedrock was not encountered in B-013-0-15. A perched water table was encountered in the granular layer at a depth of 7.5 feet.

4.3 SOIL NAIL WALL

Two borings were performed to obtain subsurface information for the proposed soil nail wall beneath the Kennedy Avenue Overpass. B-015-0-15 was performed beyond the shoulder of I-71 west of the Kennedy Avenue Overpass near the base of the proposed soil nail wall, and B-015-1-

15 was performed east of Kennedy Avenue on Motel 6 property near the top of the embankment.

The surface of B-015-0-15 contained 0.3 feet of topsoil. A 6.7-foot layer of silt and clay (A-6a) was encountered below the topsoil. This layer was described as medium stiff and damp. Following the silt and clay layer, a 5.0-foot layer of gravel with sand (A-1-b) was encountered. This material was dense to very dense and damp. Sandy silt (A-4a) was encountered below the gravel with sand layer and extended to the bottom of the boring. This layer was very stiff to hard and damp to moist.

B-015-1-15 had a topsoil thickness of 0.3 feet. Below the topsoil, a 22.7-foot layer of sandy silt (A-4a) was encountered. From a depth of 0.3 to 12.0 feet, the sandy silt was described as loose to medium dense and damp to moist. From 12.0 to 23.0 feet, the sandy silt contained less gravel and was described as medium dense to dense and wet. The sandy silt was very loose to loose from 12.5 to 17.0 feet. Silt (A-4b) was encountered below the sandy silt and extended to the bottom of the boring. The silt was medium stiff from 23.0 feet to 29.0 feet and was hard from 29.0 feet to the end of the boring at 41.5 feet. The silt had moisture contents between 15 and 21 percent and described as moist to wet.

Perched groundwater was observed at a depth of 10.0 feet in B-015-1-15. Groundwater was not observed in B-015-0-15. Bedrock was not encountered in either boring.

4.4 NOISE BARRIERS

Noise barrier walls are planned from approximately Station 421+31 to 440+38 of I-71. Borings B-017-0-15, B-019-0-15, B-020-0-15, B-021-0-15, B-022-0-15, B-024-0-15, B-025-0-15, B-027-0-15, B-028-0-15, and B-029-0-15 were drilled to obtain subsurface information for the noise barrier foundations.

The surface materials consisted of 0.3 to 0.4 feet of topsoil or 1.0 to 1.1 feet of asphalt pavement when drilled through the existing pavement. Beneath the surface materials, cohesive soils were primarily encountered. These soils classified as plastic sandy silt (A-4a), plastic silt (A-4b), silt and clay (A-6a), silty clay (A-6b), and clay (A-7-6). Granular or non-cohesive soils were also encountered in several borings. These soils classified as gravel (A-1-a), gravel with sand, silt and clay (A-2-6), non-plastic sandy silt (A-4a), and non-plastic silt (A-4b). Gravel with sand and silt (A-2-4) and coarse and fine sand (A-3a) were visually classified in a few borings.

SPT N_{60}-values ranged from 3 to 61 blows per foot averaging 16 blows per foot. In general, N_{60}-values were lower for the first SPT sample in each boring (ranging from 3 to 51 blows per foot, averaging 12 blows per foot). From 4 to 12 feet, N_{60}-values ranged 6 to 61 blows per foot, averaging 20 blows per foot. From 12 feet to 25 feet, N_{60}-values ranged from 3 to 54 blows per foot, averaging 14 blows per foot.

Water contents in the noise barrier borings ranged from 5 to 29 percent. The water contents were generally higher in Borings B-017-0-15, B-019-0-15, B-022-0-15, B-024-0-15, B-025-0-15, and B-027-0-15. Perched groundwater was encountered between 12.5 and 18.0 feet in four borings (B-019-0-15, B-020-0-15, B-021-0-15, and B-027-0-15). Bedrock was not encountered in any noise barrier boring.

4.5 SIDEHILL CUT

Five borings were performed to obtain subsurface information at representative sections of the proposed sidehill cut. Three borings (B-016-1-15, B-017-0-15, and B-019-0-15) were advanced at the top and two borings (B-016-0-15 and B-018-0-15) were advanced at the bottom of the existing slope where the sidehill cut is planned.

Borings B-016-0-15 and B-016-1-15 were performed to obtain a representative section near Station 419+00. The soils in these borings consisted of gravel with sand and silt (A-2-4), coarse and fine sand (A-3a, visual), sandy silt (A-4a), non-plastic silt (A-4b), and silt and clay (A-6a). The cohesive materials were described as medium stiff to very stiff and the granular materials were described as medium dense to dense. The soils were generally damp to moist, with some wetter material observed in B-016-1-15 from 30.0 to 41.5 feet. Water contents in these borings ranged from 7 to 23 percent.

Borings B-017-0-15, B-018-0-15, and B-019-0-15 were advanced between Station 421+79 and 423+44. The soils in these borings consisted of plastic and non-plastic silt (A-4b) and silty clay (A-6b). These soils were described as medium stiff to stiff, with soft soil in B-017-0-15 from 0.0 to 1.5 feet. The soils had water contents that ranged from 15 to 25 percent and were described as damp to wet.

Perched groundwater was observed at a depth of 3.0 feet in B-016-0-15 and 12.5 feet in B-019-0-15. Groundwater was not observed in the other sidehill cut borings nor was bedrock encountered.

4.6 SIDEHILL FILL

Seven borings were performed to obtain subsurface information at representative sections of the proposed sidehill fill. Three borings (B-030-0-15, B-033-0-15, and B-035-0-15) were advanced at the top and four borings (B-030-1-15, B-030-2-15, B-033-1-15, and B-035-1-15) were advanced at the toe of the existing embankment where the sidehill fill is planned.

Borings B-030-0-15, B-030-1-15, and B-030-2-15 were advanced near Station 442+00. The embankment fill classified as gravel (A-1-a), silty clay (A-6b), and clay (A-7-6). These materials had gravel contents ranging from 28 to 59 percent. They were described as medium dense to dense or stiff to hard and damp to moist. Foundation soil classified as silty clay (A-6b), gravel (A-

1-a, visual), silt and clay (A-6a), and sandy silt (A-4a) and had low gravel contents. Cobbles and boulders were encountered in the foundation soils in these borings. These soils were described as medium stiff to hard and damp to moist.

Borings B-033-0-15 and B-033-1-15 were performed to obtain a representative section of the existing embankment at section 454+00. The fill material of the existing embankment classified as gravel with sand, silt, and clay (A-2-6) and silty clay (A-6b). Gravel contents of this material ranged from 45 to 61 percent. This soil was described as stiff to hard and damp to moist. Foundation soils encountered at this station consisted of silt (A-4b), silty clay (A-6b), and clay (A-7-6) and had low gravel contents. This material was described as stiff to hard and damp to moist.

B-035-0-15 and B-035-1-15 were advanced near Station 462+00. The embankment fill encountered at this station classified as gravel with sand, silt, and clay (A-2-6), silty clay (A-6b), and clay (A-7-6). The gravel content was 13 percent near the top of the embankment and ranged from 39 to 52 percent in the remainder of the embankment. This material was described as dense to very dense or stiff to very stiff and damp to moist. Foundation soils consisted of gravel with sand (A-1-b), sandy silt (A-4a), silt and clay (A-6a), and clay (A-7-6). These materials had higher gravel contents than the foundation soils in the other sidehill fill sections. The foundation soils were described as dense or very stiff to hard and damp to moist.

Boring B-033-0-15 contained perched groundwater at a depth of 17.0 feet. Groundwater was not observed in the other sidehill fill borings. Boring B-030-15 was terminated at a depth of 18.8 and boring B-030-2-15 was terminated at a depth of 35.5 feet due to boulders. Bedrock was not encountered in the sidehill fill borings.

5.0 ANALYSIS AND RECOMMENDATIONS

5.1 GENERAL

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

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

Applicable ODOT Geotechnical Engineering Design Checklists have been completed and are included in Appendix H.

5.2 ROADWAY AND SUBGRADE

ODOT Geotechnical Bulletin (GB) 1 outlines a procedure for estimating the method and limits of subgrade treatment that will be required to stabilize pavement subgrade prior to construction of the pavement section. The procedure is based upon the results of the borings, field testing, and laboratory testing. The subgrade treatment options provided in GB1 and specified in the ODOT Construction and Materials Specifications (CMS) are as follows:

- Undercut and Replacement (CMS Item 204) - undercutting a specified depth below subgrade, installing geotextile fabric or geogrid at the base of the undercut, and replacing with an approved granular material (ODOT Types B, C, or sometimes D) to subgrade elevation.
- Chemical Stabilization (CMS Item 206) - mixing lime or cement with the subgrade soils to a specified depth.

Based on the results of the subgrade analysis, global subgrade stabilization is recommended. Pavement design should be based on a CBR of 6 for the widening of Ridge Avenue and a CBR of 7 for the widening of I-71 and the realignment of Ramps N and P. It is not anticipated that bedrock will be encountered in cut areas along the alignment.

The following paragraphs describe the two options for subgrade stabilization. From project experience in this area and due to the shallow depth of underground utilities, the chemical stabilization option is recommended for this project. The ODOT GB1 subgrade analysis spreadsheets for I-71, Ridge Avenue, Ramp N, and Ramp P are shown in Appendix B.

5.2.1 Undercut and Replace Option (CMS Item 204)

According to the subgrade analysis, undercut and replacement to a depth of 18 inches is required with placement of geotextile at the base of the undercut or 12 inches (Ramps N and P) to 16 inches (I-71, Ridge Avenue) with the placement of a geogrid at the base of the undercut. The undercut should extend 18 inches beyond the edge of the surface of pavement and paved shoulders, including new curbs. Granular Material Type B, C, or D should be used for replacement material. Granular Material Type B should be used with geogrid. Proof rolling should be performed after the undercut and replacement is complete as outlined in CMS Item 204.

The excavation should be drained to underdrains, catch basins, or pipes. Due to difficulty with installing underdrains through Granular Material Type D and geotextile fabric, use Granular Material Type B with no geotextile fabric near underdrains. Include Plan Note G121 in the plans.

5.2.2 Chemical Stabilization Option (CMS Item 206)

Chemical stabilization is recommended for subgrade stabilization on the project. According to the GB1 spreadsheet, stabilization using cement is an option for the project due to the low to

moderate plasticity of the majority of the subgrade soils. The GB 1 subgrade analysis spreadsheet for Ramp N indicates that cement stabilization is not an option. This is due to low N_{60L}-values in B-006-0-15 at depths greater than 6 feet below the proposed subgrade. If these were not included in the spreadsheet, cement stabilization would be an option to a depth of 15 inches.

It is recommended that the subgrade soils be chemically stabilized with cement to a depth of 12 inches for Ridge Avenue and 16 inches for I-71, Ramp N, and Ramp P. The chemical stabilization should be performed throughout the entire project and should extend 18 inches beyond the edge of the pavement surface and paved shoulders, including under new curbs. Proof rolling should be performed after the global chemical stabilization is complete as outlined in the CMS Item 204.

According to GB1, chemical stabilization is not recommended in areas where sulfate contents are greater than 3,000 ppm. This condition was not observed in any of the SPT samples that were tested for sulfate content.

5.3 CULVERT EXTENSION

The existing culvert that will be extended to accommodate the widening of I-71 is located at approximate Station 413+50 of I-71. The existing culvert is a 12- by 9-foot box culvert. It is assumed that the culvert will be supported on soil. The associate headwall and wingwalls are assumed to be supported by cast-in place concrete footings. The bearing elevations of the culvert and headwall/wingwall footings are assumed to be at or near Elevation 539.5. Boring B-013-0-15 indicates that a sandy silt (A-4a) layer extends from Elevation 539.6 to the end of the boring at Elevation 502.6. This layer classifies as sandy lean clay (CL) in the Unified Soil Classification System (USCS).

The nominal bearing resistance for the box culvert and headwall/wingwall spread footings at service limit state was estimated as 4 kips per square foot according to Table C10.6.2.6.1-1 in the AASHTO LRFD Bridge Design Specifications (2014) for "medium dense to dense sandy or silty clay (CL or CH)". The nominal bearing resistance at strength limit state was calculated according to the AASHTO LRFD Bridge Design Specifications (2014) guidelines. A nominal bearing resistance of 16 kips per square foot (factored bearing resistance of 8 kips per square foot) is recommended for design of the box culvert and headwall/wingwall spread footings at strength limit state. The bearing resistance calculations are presented in Appendix C.

According to the 2007 ODOT Bridge Design Manual (BDM), backfill immediately behind the wingwall should consist of a 2-foot thick layer of porous material wrapped with geotextile fabric from 1-foot below subgrade to the top of the footing. Horizontal drains and weepholes should be designed to drain this layer behind the wall. The top foot of backfill should consist of non-granular cohesive soil. Based on the probable available soils in the project vicinity, it can be

assumed that this backfill will consist of silty clay with a wet unit weight of 125 pounds per cubic foot and an internal angle of friction of 28 degrees. The active earth pressure coefficient (K_a) for this soil can be taken as 0.36. The coefficient of friction (tan δ) between the mass concrete of spread footings against the bearing soil can be taken as 0.31 according to Table 3.11.5.3-1 of the AASHTO LRFD Bridge Design Specifications (2014).

5.4 SOIL NAIL WALL

A soil nail wall is planned from Station 415+70 to 417+50 of I-71 to accommodate the widening of I-71 beneath the Kennedy Avenue Overpass. Sections of the soil nail wall are planned with two soil nails vertically spaced, and higher wall sections planned with three soil nails.

Cross sections at Stations and 416+00 and 416+70 were analyzed. Station 416+00 contains three soil nails spaced vertically (Nos. 63, 64, and 65) and was chosen as an analysis cross section because it contains the maximum height of the existing ground surface behind the wall. The soil nail wall height at Station 416+00 is approximately 13.3 feet, which is the same height of the maximum wall height at Station 415+91.56. Station 416+70 contains two soil nails (Nos. 28 and 29) and was chosen as an analysis cross section because it contains the maximum wall height for two soil nails (approximately 10.1 feet). Analysis was performed using SNAP-2 (Soil Nail Analysis Program) software provided by the Federal Highway Administration (FHWA).

Two borings (B-015-0-15 and B-015-1-15) were drilled to obtain subsurface information for the soil nail wall analysis. Material properties were derived from lab and field data from these borings. Appendix D contains the derivation of the material properties used for the SNAP-2 analysis.

The design drawings for Bridge Number HAM-71-0853 (under Kennedy Avenue) were reviewed. The drawings indicate that the south abutment of the bridge is supported by 12-inch diameter cast-in-place reinforced concrete piles that have an estimated length of 30 feet. The design elevation of the base of the pile cap is 573 feet. As designed, two rows of piles support the rear abutment with the forward row being battered at a 1H:4V slope to provide lateral support. The forward row of piles is spaced at 5.5-feet center-to-center, leaving approximately 4.5 feet of clear space between piles. The rear row of piles was installed directly behind alternating piles of the forward row. Horizontal nail spacing of 5.5 is recommended so that nails are installed between existing abutment piles.

The cross section at Station 416+70 includes the geometry of the existing bridge abutment. For SNAP-2 analysis, however, the existing backslope was assumed to extend to the ground surface. A traffic load of 250 pounds per square foot was applied to both cross sections. Table 2 shows the summary of the inputs used for the SNAP-2 analysis for the two analyzed cross sections.

Additional inputs (including facing reinforcement and details) for each configuration can be found in the SNAP-2 Reports in Appendix D. The temporary facing contains the design and

checks for the soil nails and reinforced shotcrete. Therefore, permanent facing was not designed for this report, as it is assumed that the permanent facing will be incorporated into the final design.

Table 2. Soil Nail Wall SNAP-2 Inputs

Section	Height of Wall (feet)	Horizontal Nail Spacing (feet)	Vertical Nail Spacing (feet)		Nail Length (feet)	Nail Inclination (degrees)
Station 416+00 (3 Soil Nails)	13.3 feet	5.5	2.4	top of wall to top nail	30	15 (from horizontal)
			4.5	top nail to middle nail		
			4.4	middle nail to bottom nail		
			2.0	bottom nail to bottom of wall		
Station 416+70 (2 Soil Nails)	10.1 feet	5.5	2.4	top of wall to top nail	30	15 (from horizontal)
			5.7	top nail to bottom nail		
			2.0	bottom nail to bottom of wall		

The results of the SNAP-2 analysis are shown in Table 3. The Bishop method was used to calculate the global factory of safety. The results and checks performed by the SNAP-2 analysis are shown in the SNAP-2 reports in Appendix D.

Table 3. Soil Nail Wall SNAP-2 Results

Section	Potential Failure Mode	Required Factor of Safety	Calculated Factor of Safety
Station 416+00 (3 Soil Nails)	Sliding	1.5	2.0
	Bearing Capacity	2.5	12.3
	Global Stability	1.5	1.5
Station 416+70 (2 Soil Nails)	Sliding	1.5	2.5
	Bearing Capacity	2.5	16.1
	Global Stability	1.5	1.8

Additional global stability analysis was performed at the two analyzed cross sections using GeoStudio SLOPE/W software. The Spencer method was used in this analysis. A traffic load of 250 pounds per square foot was applied to both cross sections. Two failure conditions were considered, shallow and deep. The shallow condition contains a failure surface on the back slope above the soil nail wall, and the deep condition has failure that extends below the soil nail wall. The cross section at Station 416+70 includes the geometry of the existing bridge abutment. For the global stability analysis, however, the existing slope was assumed to extend to the ground surface for deep failure, and the existing bridge abutment was modeled for shallow

failure. The results of the stability analysis are shown in Table 4, and the outputs from this analysis are shown in Appendix D.

Table 4. Soil Nail Wall Stability Analysis

Section	Failure Condition	Calculated Factor of Safety
Station 416+00 (3 Soil Nails)	Shallow	1.5
	Deep	1.6
Station 416+70 (2 Soil Nails)	Shallow	1.6
	Deep	1.7

The resulting factors of safety from the global stability analysis using SLOPE/W software meet the requirement of 1.5 for embankments supporting a structure. The requirement of 1.5 is outlined in the ODOT Geotechnical Engineering Design Checklists, Section III.B. Embankments Checklist, Stability.

5.5 NOISE BARRIERS

A noise barrier is planned from approximately Station 421+31 to 440+38 of I-71. The noise barrier alignment begins in the northeast corner of the Motel 6 property and extends east to Charloe Street atop the proposed cut slope. From Charloe Street, the noise barrier alignment transitions closer to the shoulder of I-71. Ten borings were positioned approximately 200 feet apart to obtain subsurface information for the noise barrier foundations.

The 2007 ODOT Bridge Design Manual (BDM), Section 802.1, outlines the procedure for design of noise barrier foundations, specifically in Section 802.1.2, parts A through E. According to Section 802.1.2, the procedure to design noise barrier foundations applies only to 30-inch diameter drilled shafts. Therefore, all analyses and recommendations in this section are based on that foundation type being used. Any deviation from this requires design based on the AASHTO LRFD Bridge Design Specifications, Section 10 (2014).

SPT samples were taken at 2.5-foot intervals to a depth of 25 feet. Appendix E shows N-values that have been corrected for depth and hammer efficiency according to the ODOT BDM, Section 802.1.2, parts A and B. Design N-values are given with respect to foundation depth in Appendix E based on the average or the minimum corrected values, as explained in Section 802.1.2, Part C.

The soil type at each boring was examined to determine if it was predominantly granular or cohesive according to Section 802.1.2, Part D. A soil is considered granular if the plasticity index is less than seven. This information, summarized in Appendix E, can be used by the design engineer to complete part E of Section 802.1.2. Using the recommended soil types and

appropriate BDM figures 802.1.2-1 (granular soils) and 802.1.2-2 (cohesive soils), required shaft length can be determined based on post spacing and wall height at each boring location.

The analysis for the noise barrier on the east side of I-71 was based on the findings from 10 borings. Corrected N-values ranged from 2 to 49 blows per foot. Design N-values ranged from 2 to 20 blows per foot. The majority of the soils encountered in noise barrier borings were clays and silts; however, some layers of gravel and sand were encountered. Appendix E shows the recommended soil type, i.e. cohesive or granular, at specified depths for each boring. This information can be used to determine the required foundation depth using the appropriate BDM figures 802.1.2-1 and 802.1.2-2. Borings B-028-0-15 and B-029-0-15 revealed boulders and cobbles in the underlying soils from rocky fill. This may result in difficult drilling in these areas during construction.

5.6 SIDEHILL CUT

A sidehill cut is planned to accommodate the widening of I-71 from approximately Station 418+00 to 424+00 of I-71. The proposed slope of the cut is 2H:1V. Slope stability analyses were performed on two representative sidehill cut sections (Stations 419+00 and 422+00) where borings were performed. Two types of analyses were performed on each section: drained analysis using effective stress parameters and undrained analysis using total stress parameters. The derivation of the material parameters used for analysis is shown in Appendix F. Appendix F also contains the results of the stability analyses. A summary of the results for the sidehill fill section is shown in Table 5.

Table 5. Sidehill Cut Stability Analysis Summary

Section	Associated Borings	Condition	Calculated Factor of Safety
419+00	B-016-0-15 B-016-1-15	Drained	1.3
		Undrained	1.5
422+00	B-017-0-15 B-018-0-15	Drained	1.3
		Undrained	1.6

The resulting factors of safety from the stability analysis of the sidehill cut sections meet the required factor of safety of 1.3 for cut slopes. The requirement of 1.3 is outlined in the ODOT Geotechnical Engineering Design Checklists, Section III.B. Embankments Checklist, Stability. As stated in Section 2.7, the existing cut slopes constructed at a 2H:1V slope appear stable. The heavy vegetation observed on these slopes likely contributes to the stability. Soil that classifies as silt (A-6b) will likely be exposed on the new cut slope, which is highly erodible. In accordance with ODOT Specification SS-836, a Type III Turf Reinforcing Mat with percussion driven earth anchors should be installed on the face of the cut slope. The mat should be anchored per the

manufacturer's recommended depth and spacing. Grass seeding should be placed on the face of the cut slope below the turf reinforcing mat.

Based on the results of the borings for the sidehill cut slope, seepage out of the slope may be observed from sandier seams during construction. If these seeps are encountered during construction, subsurface drains consisting of a perforated pipe, free-draining granular material, and geotextile filter fabric should be installed to convey the seepage down to the ditch.

5.7 SIDEHILL FILL

From approximately Station 437+00 to 462+00, the widening of I-71 will include the placement of additional fill on the existing 2H:1V embankment. Special benching conforming to ODOT GB 2 is required for the sidehill fill sections. The proposed special benching is shown in the geotechnical drawings in Appendix A.

Global stability analyses were performed on three representative sidehill fill sections (Stations 442+00, 454+00, and 462+00) where borings were performed. Two types of analyses were performed on each section: drained analysis using effective stress parameters and undrained analysis using total stress parameters. Appendix G shows the derivation of the material parameters used for the analysis. Appendix G also contains the results of the stability analyses. A summary of the results for the sidehill fill analysis is shown in Table 6.

Table 6. Sidehill Fill Stability Analysis Summary

Section	Associated Borings	Condition	Calculated Factor of Safety
442+00	B-030-0-15 B-031-1-15 B-030-2-15	Drained	1.3
		Undrained	1.3
454+00	B-033-0-15 B-033-1-15	Drained	1.5
		Undrained	1.8
462+00	B-035-0-15 B-035-1-15	Drained	1.5
		Undrained	1.7

The resulting factors of safety meet the requirement of 1.3 for embankments. The requirement of 1.3 is outlined in the ODOT Geotechnical Engineering Design Checklists, Section III.B. Embankments Checklist, Stability. As stated in Section 2.7, the existing embankment slopes constructed at a 2H:1V slope appear stable. The light to heavy vegetation observed on these slopes likely contributes to the stability. It is imperative that vegetation be established on this slope as soon as possible after final grading to prevent shallow failures and erosion of the slope.

The anticipated settlements at these locations were calculated to determine if platforms would be needed to monitor consolidation. The reading of these platforms will allow construction to move forward once the consolidation has stopped or leveled off. In accordance with GB 4, "Guidelines for the use of Geotechnical Instrumentation", each platform should be a "flat 3.0' x 3.0' wood or metal plate that rest on the existing ground attached to a section of riser pipe that extends up into the air". The settlement calculated at Stations 442+00 and 454+00 was greater than three inches (3.13 and 3.35 inches, respectively) and was approximately two inches at Station 462+00 (1.94 inches). Based on the amount of settlement anticipated at each of these locations, settlement platforms are recommended.

Soil with soft to medium stiff consistency was observed in the upper 5 to 7 feet of Borings B-030-2-15, B-033-1-15, and B-035-1-15, which are located at the toe of the current embankment slope near the stream. When excavating the lower bench for the placement of the sidehill fill, soft conditions may be encountered. Over-excavation of this lower bench to expose more stable material may be necessary. As an alternative to this, geotextile filter fabric and Type C or D rock could be placed along the lower bench to bridge over soft soil.

APPENDIX A
GEOTECHNICAL DRAWINGS

PROJECT DESCRIPTION

THIS PROJECT, HAM-71-6.86, IS THE WIDENING OF I-71 FROM APPROXIMATELY 500 FEET SOUTHWEST OF RIDGE AVENUE TO APPROXIMATELY 550 FEET WEST OF RED BANK ROAD. RIDGE AVENUE IS BEING WIDENED FROM DUCK CREEK ROAD TO THE EXISTING RAMP N ENTRY TO RIDGE AVENUE. ALSO INCLUDED IN THIS PROJECT IS THE REALIGNMENT OF RAMP N AND RAMP P, A CULVERT EXTENSION, A SOIL NAIL WALL, NOISE BARRIERS, A SIDEHILL CUT, AND A SIDEHILL FILL.

HISTORIC RECORDS

HISTORICAL GEOTECHNICAL EXPLORATIONS WERE PERFORMED FOR THE EXISTING ALIGNMENTS OF RIDGE AVENUE (HAM-71-7.45, 1965), KENNEDY AVENUE (HAM-71-6.14, 1965), I-71 (HAM-71-8.43, 1964 AND HAM-71-7.45, 1965), AND I-71 RAMPS (HAM-71-7.45, 1965). THESE EXPLORATIONS WERE USED TO UNDERSTAND THE GENERAL SUBSURFACE CONDITIONS OF THE PROJECT AREA. ONE BORING FROM HAM-71-6.14, FOUR BORINGS FROM HAM-71-7.45, AND ONE BORING FROM HAM-71-8.43 ARE SHOWN IN THESE GEOTECHNICAL DRAWINGS.

GEOLOGY

THE PROJECT SITE IS LOCATED IN THE ILLINOIAN TILL PLAIN. THE ILLINOIAN TILL PLAIN IS DESCRIBED AS HAVING ROLLING GROUND MORAINE OF OLDER TILL GENERALLY LACKING ICE-CONSTRUCTIONAL FEATURES. THE PROJECT SITE IS UNDERLAIN PREDOMINANTLY BY SILTY LOAM TILL WITH MODERATE LOESS COVER DEPOSITED DURING THE ILLINOIAN AGE. THE LOAM TILL ORIGINATES AS A FLAT, RELATIVELY CONTINUOUS GROUND MORAINE. SOIL IS UNDERLAIN BY INTERBEDDED LIMESTONE AND SHALE BEDROCK OF THE KOPE FORMATION AND THE POINT PLEASANT FORMATION OF THE ORDOVICIAN SYSTEM. THE DRIFT THICKNESS MAP INDICATES THAT BEDROCK IS 0 TO 210 FEET DEEP.

RECONNAISSANCE

STANTEC REPRESENTATIVES VISITED THE SITE ON APRIL 25, 2016 AND MAY 2, 2016. THE LAND USAGE AROUND THE PROJECT IS PRIMARILY VEGETATED/WOODED EASEMENT WITH SOME COMMERCIAL AND RESIDENTIAL AREAS. SEVERAL BORINGS WERE LOCATED ON THE MOTEL 6 PROPERTY ON KENNEDY AVENUE. ONE BORING WAS POSITIONED IN THE RIGHT-OF WAY AT THE END OF CHARLOE STREET, WHICH IS A RESIDENTIAL STREET. TWO BORINGS WERE LOCATED AT THE NORTH END OF THE FIFTH THIRD BANK BUILDING PROPERTY ON KINGSLEY DRIVE. THE ENCLOSURE BETWEEN EXISTING RAMP P, I-71, AND KENNEDY AVENUE IS HEAVILY VEGETATED, BECOMING MORE WOODED NORTH OF THE EXISTING CULVERT/CHANNEL. THE EASEMENT FOR I-71 IS HEAVILY WOODED FROM KENNEDY AVENUE TO THE START OF THE FIFTH THIRD BANK BUILDING PROPERTY. DUE TO HEAVY VEGETATION, STEEP SLOPES, AND/OR UNDERGROUND/OVERHEAD UTILITIES AT VARIOUS LOCATIONS WITHIN THE PROJECT SITE, SOME BORINGS WERE RELOCATED FROM THE ORIGINAL BORING PLAN. IN GENERAL, THE EXISTING PAVEMENT APPEARED TO BE IN GOOD CONDITION.

SUBSURFACE EXPLORATION

FORTY-ONE BORINGS WERE COMPLETED AS PART OF THE EXPLORATION. THIRTY-TWO BORINGS WERE ADVANCED ALONG THE I-71 ALIGNMENT; THREE BORINGS WERE ADVANCED ALONG THE PROPOSED RAMP N ALIGNMENT; FOUR BORINGS WERE ADVANCED ALONG THE PROPOSED RAMP P ALIGNMENT; AND TWO BORINGS WERE ADVANCED ALONG THE RIDGE AVENUE ALIGNMENT. BORINGS WERE COMPLETED TO OBTAIN SUBSURFACE INFORMATION FOR THE SUBGRADE, ROADWAY, CULVERT EXTENSION, SOIL NAIL WALL, NOISE BARRIERS, SIDEHILL CUT, AND SIDEHILL FILL.

BORINGS WERE DRILLED WITH EITHER A CME 55 TRUCK-MOUNTED DRILL RIG, A CME 55 TRACK-MOUNTED DRILL RIG, OR A CME 45 TRACK-MOUNTED DRILL RIG USING 3 1/4-INCH I.D. HOLLOW-STEM AUGERS. DISTURBED SOIL SAMPLES WERE OBTAINED IN ACCORDANCE WITH THE STANDARD PENETRATION TEST (AASHTO T206) AT CONTINUOUS, 2.5-FOOT, AND 5-FOOT SAMPLING INTERVALS. THE DRILL ROD ENERGY RATIO IS 81.3 PERCENT FOR THE CME 55 TRUCK-MOUNTED RIG (CALIBRATED 02/24/16), 92.4 PERCENT FOR THE CME 55 TRACK-MOUNTED RIG (CALIBRATED 01/08/16), AND 91.6 PERCENT FOR THE CME 45 TRACK-MOUNTED RIG (CALIBRATED 06/23/16). SEVERAL UNDISTURBED SHELBY TUBE SAMPLES WERE OBTAINED FROM SELECT BORINGS AT VARIOUS DEPTHS.

EXPLORATION FINDINGS

THIRTY SUBGRADE AND ROADWAY BORINGS WERE COMPLETED. THE EXISTING PAVEMENT CONSISTED OF 0.5 TO 1.2 FEET OF ASPHALT PAVEMENT IN THE SHOULDER OF I-71, 0.3 TO 0.4 FEET OF ASPHALT PAVEMENT AND 0.9 FEET OF CONCRETE IN THE RIGHT DRIVING LANE OF I-71, AND 0.1 FEET OF ASPHALT PAVEMENT AND 0.9 FEET OF CONCRETE AT RIDGE AVENUE. BENEATH THE PAVEMENT, FINE-GRAINED SOILS CLASSIFYING AS SANDY SILT, SILT, SILT AND CLAY, SILTY CLAY AND CLAY WERE PRIMARILY ENCOUNTERED. COARSE-GRAINED SOILS CLASSIFIED AS GRAVEL, GRAVEL WITH SAND AND SILT, GRAVEL WITH SAND, SILT, AND CLAY, AND COARSE AND FINE SAND WERE ALSO ENCOUNTERED IN SOME SUBGRADE/ROADWAY BORINGS. SAMPLES THAT WERE TESTED FOR SULFATE CONTENTS DID NOT YIELD RESULTS GREATER THAN 3,000 PPM.

ONE BORING WAS ADVANCED FOR THE CULVERT EXTENSION. THE SOILS ENCOUNTERED IN THIS BORING CONSISTED OF SILT AND CLAY, GRAVEL WITH SAND, GRAVEL WITH SAND AND SILT, AND SANDY SILT. THE COHESIVE MATERIALS WERE DESCRIBED AS STIFF TO HARD AND DAMP TO MOIST. THE GRANULAR MATERIALS WERE DESCRIBED AS VERY LOOSE TO DENSE AND MOIST TO WET.

TWO BORINGS WERE COMPLETED FOR THE SOIL NAIL WALL. GRAVEL WITH SAND, SANDY SILT, SILT, AND SILT AND CLAY WERE ENCOUNTERED IN THESE BORINGS. THE COHESIVE MATERIALS WERE DESCRIBED AS MEDIUM STIFF TO HARD AND DAMP TO WET. THE GRANULAR MATERIALS WERE DESCRIBED AS VERY LOOSE TO VERY DENSE AND DAMP TO WET.

TEN NOISE BARRIER BORINGS WERE ADVANCED. COHESIVE MATERIALS COMPRISED OF SANDY SILT, SILT, SILT AND CLAY, SILTY CLAY, AND CLAY WERE PRIMARILY ENCOUNTERED. SOME NON-COHESIVE MATERIALS CONSISTING OF GRAVEL; GRAVEL WITH SAND, SILT, AND CLAY; SANDY SILT; AND SILT WERE ENCOUNTERED. SPT N60-VALUES RANGED FROM 3 TO 61 BLOWS PER FOOT, AVERAGING 16 BLOWS PER FOOT. WATER CONTENTS RANGED FROM 6 TO 29 PERCENT.

FIVE BORINGS WERE COMPLETED FOR THE PROPOSED SIDEHILL CUT. THE MATERIALS ENCOUNTERED IN THESE BORINGS CONSISTED OF GRAVEL WITH SAND AND SILT, COARSE AND FINE SAND, SANDY SILT, SILT, SILT AND CLAY, AND SILTY CLAY. THESE MATERIALS WERE DESCRIBED AS MEDIUM STIFF TO VERY STIFF OR MEDIUM DENSE TO VERY DENSE AND DAMP TO WET.

SEVEN BORINGS WERE PERFORMED FOR THE PLANNED SIDEHILL FILL. THE BORINGS REVEALED THAT THE EMBANKMENT FILL CONSISTS OF SOILS WITH HIGHER GRAVEL CONTENTS, CONSISTING OF GRAVEL; GRAVEL WITH SAND, SILT, AND CLAY; SILTY CLAY; AND CLAY. THESE SOILS WERE DESCRIBED AS MEDIUM DENSE TO VERY DENSE OR STIFF TO VERY STIFF AND DAMP TO MOIST. FOUNDATION SOILSS WERE CLASSIFIED AS GRAVEL, GRAVEL WITH SAND, SANDY SILT, SILT AND CLAY, SILTY CLAY, AND CLAY. THESE SOILS WERE DESCRIBED AS DENSE OR MEDIUM STIFF TO HARD AND DAMP TO MOIST.

EXPLORATION FINDINGS (CONTINUED)

PERCHED GROUNDWATER WAS OBSERVED IN EIGHT BORINGS WITHIN SANDY OR SILTY ZONES. THREE BORINGS WERE TERMINATED BEFORE THE PLANNED DEPTH DUE TO AUGER REFUSAL FROM BOULDERS. BEDROCK WAS NOT ENCOUNTERED IN ANY BORINGS.

SPECIFICATIONS

THIS GEOTECHNICAL EXPLORATION WAS PERFORMED IN ACCORDANCE WITH THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, OFFICE OF GEOTECHNICAL ENGINEERING, SPECIFICATIONS FOR GEOTECHNICAL EXPLORATIONS, DATED JANUARY 2016.

AVAILABLE INFORMATION

THE AVAILABLE SOIL AND BEDROCK INFORMATION THAT CAN BE CONVENIENTLY SHOWN ON THE GEOTECHNICAL EXPLORATION SHEETS HAS BEEN SO REPORTED. ADDITIONAL EXPLORATIONS MAY HAVE BEEN MADE TO STUDY SOME SPECIAL ASPECTS OF THE PROJECT. COPIES OF THIS DATA, IF ANY, MAY BE INSPECTED IN THE DISTRICT DEPUTY DIRECTOR'S OFFICE OF GEOTECHNICAL ENGINEERING AT 1980 WEST BROAD STREET.

LEGEND

DESCRIPTION	ODOT CLASS	CLASSIFIED MECH.	CLASSIFIED VISUAL
GRAVEL AND/OR STONE FRAGMENTS	A-1-a	4	5
GRAVEL AND/OR STONE FRAGMENTS WITH SAND	A-1-b	5	1
GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT	A-2-4	5	3
GRAVEL AND/OR STONE FRAGMENTS WITH SAND, SILT AND CLAY	A-2-6	8	12
COARSE AND FINE SAND	A-3a	2	2
SANDY SILT	A-4a	21	32
SILT	A-4b	21	29
SILT AND CLAY	A-6a	35	39
SILTY CLAY	A-6b	56	50
CLAY	A-7-6	14	10
	TOTAL	171	183
SOD AND/OR TOPSOIL = X = APPROXIMATE THICKNESS		VISUAL	
PAVEMENT OR BASE = X = APPROXIMATE THICKNESS		VISUAL	

BORING LOCATION - PLAN VIEW

HISTORIC BORING LOCATION - PLAN VIEW

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

N INDICATES STANDARD PENETRATION RESISTANCE.

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

X/Y/D" NUMBER OF BLOWS FOR STANDARD PENETRATION TEST (SPT): X= NUMBER OF BLOWS FOR 6 INCHES (UNCORRECTED). Y/D"= NUMBER OF BLOWS (UNCORRECTED) FOR D" OF PENETRATION AT REFUSAL.

NR NO SAMPLE RECOVERY

WS WASH SAMPLE

WC INDICATES WATER CONTENT IN PERCENT.

NP INDICATES A NON-PLASTIC SAMPLE.

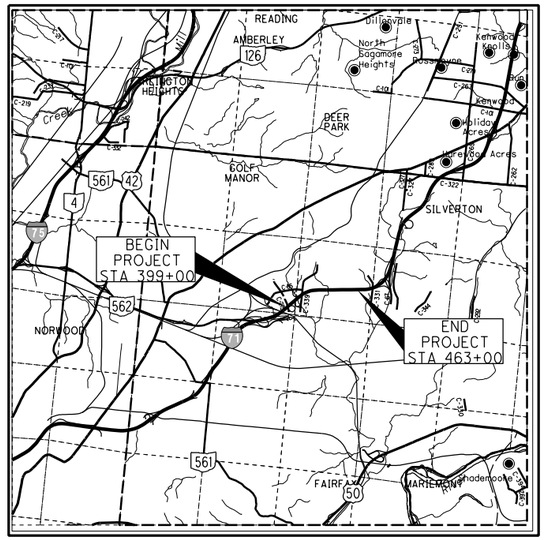
SS INDICATES A SPLIT SPOON SAMPLE, STANDARD PENETRATION TEST.

ST INDICATES A SHELBY TUBE SAMPLE.

W— INDICATES FREE WATER.

● INDICATES A PLASTIC SOIL WITH WATER CONTENT GREATER THAN LIQUID LIMIT MINUS THREE.

⊖ INDICATES A NON-PLASTIC SOIL WITH MOISTURE CONTENT GREATER THAN 19% WITH A WET APPEARANCE.



LOCATION MAP

SCALE IN MILES

0 1 2 2.5 3

N

PARTICLE SIZE DEFINITIONS

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

LEGEND (CONTINUED)

HISTORIC BORING DESCRIPTIONS	ODOT CLASS	CLASSIFIED MECH.	CLASSIFIED VISUAL
GRAVEL AND/OR STONE FRAGMENTS WITH SAND	A-1-b	3	-
GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT	A-2-4	4	-
FINE SAND	A-3	1	-
COARSE AND FINE SAND	A-3a	3	-
SANDY SILT	A-4a	19	-
SILT	A-4b	10	-
SILT AND CLAY	A-6a	12	-
SILTY CLAY	A-6b	4	-
CLAY	A-7-6	5	-
	TOTAL	61	0

RECON. - EK & RL 04/25/16 & 05/02/16
DRILLING - RL & SB 05/10/16 TO 06/14/16
DRAWN - MJ 06/16-08/16, 05/17
REVIEWED - RL & EK 08/16, 05/17

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

PID NO. 94741

SOIL PROFILE

HAM-71-6.86

INDEX OF SHEETS							
LOCATION FROM STA. TO STA.	PLAN VIEW SHEET	PROFILE SHEET	CROSS SECTION SHEET	CUT MAX	FILL MAX	STRUCTURES INCLUDED	
						BRIDGE NO.	SFN
HAM-71-6.86							
398+00 413+00	14	14	-	2 FT.	-		
413+00 428+00	15	15	28/29/30/31	2 FT.	-		
428+00 443+50	16	16	32	2 FT.	-		
443+50 458+00	17	17	33	2 FT.	-		
458+00 463+00	18	18	34	2 FT.	-		
413+00 414+00	19	19	-	-	-	HAM-071-0868	3115275
415+60.60 417+47.44	20	20	-	-	-	SOIL NAIL WALL	N/A
421+30.74 424+94.33	21	21	-	-	-	NOISE WALL	N/A
424+94.33 430+32.50	22	22	-	-	-	NOISE WALL	N/A
430+32.50 434+96.63	23	23	-	-	-	NOISE WALL	N/A
434+96.63 440+38.26	24	24	-	-	-	NOISE WALL	N/A
RIDGE RD.							
21+00 31+00	25	25	-	2 FT.	-		
RAMP N							
405+00 414+47.72	26	26	-	2 FT.	2 FT.		
RAMP P							
407+92.33 418+00	27	27	-	1 FT.	5 FT.		
BORING LOGS, SHEETS 35-44							

SUMMARY OF PAVEMENT CORES		
BORING NO.	ASPHALT (FT.)	GRANULAR BASE (FT.)
X-001-1-15	0.4	0.9
X-034-1-15	0.3	0.9

DRAWN MSJ
CHECKED EMK

SOIL PROFILE

HAM-71-6.86

2 / 44

SUMMARY OF SOIL TEST DATA
INTERSTATE 71

EXPLORATION NO., STATION & OFFSET	FROM	TO	SAMPLE ID	N60	% REC	HP tsf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-001-0-15	01.50	03.00	SS-1	19	78	2.50	26	6	6	32	30	38	18	20	18	A-6b (9)	
STA. 400+20, 55' RT.	03.00	04.50	SS-2	43	67	2.50				SAME AS SS-1					14	A-6b (VISUAL)	644
LATITUDE = 39.166540493	04.50	06.00	SS-3	39	72	2.75	8	12	26	34	20	19	12	7	12	A-4a (4)	
LONGITUDE = -84.423907748	06.00	07.50	SS-4	37	89	-	8	12	26	34	20	19	12	7	9	A-4a (4)	
B-002-0-15	01.50	03.00	SS-1	16	94	3.50	25	13	23	26	13	17	11	6	10	A-4a (1)	
STA. 403+11, 57' RT.	03.00	04.50	SS-2	23	78	3.00				SAME AS SS-1					9	A-4a (VISUAL)	300
LATITUDE = 39.167068841	04.50	06.00	SS-3	24	100	4.00	34	13	22	20	11	17	12	5	8	A-2-4 (0)	
LONGITUDE = -84.423135336	06.00	07.50	SS-4	22	100	3.50				SAME AS SS-3					17	A-2-4 (VISUAL)	
B-011-0-15	01.50	03.00	SS-1	23	78	3.00				SAME AS SS-2					9	A-6b (VISUAL)	<100
STA. 408+87, 50' RT.	03.00	04.50	SS-2	32	61	4.50	10	6	16	34	34	33	14	19	12	A-6b (10)	
LATITUDE = 39.167958656	04.50	06.00	SS-3	31	78	3.00	10	6	16	34	34	33	14	19	18	A-6b (10)	
LONGITUDE = -84.421847415	06.00	07.50	SS-4	25	61	2.50	12	5	14	40	29	34	17	17	22	A-6b (10)	
B-012-0-15	01.50	03.00	SS-1	37	56	4.00	37	8	14	21	20	31	13	18	13	A-6b (3)	
STA. 410+98, 48' RT.	03.00	04.50	SS-2	25	89	4.00	37	8	14	21	20	31	13	18	12	A-6b (3)	
LATITUDE = 39.168352631	04.50	06.00	SS-3	37	89	3.50				SAME AS SS-2					17	A-6b (VISUAL)	<100
LONGITUDE = -84.421301374	06.00	07.50	SS-4	26	100	-	26	9	18	26	21	24	13	11	15	A-6a (3)	
B-013-0-15	00.00	01.50	SS-1	11	56	4.00	37	9	14	24	16	33	19	14	15	A-6a (2)	
STA. 412+68, 157' RT.	02.50	04.00	SS-2	50	33	4.50	37	9	14	24	16	33	19	14	16	A-6a (2)	
LATITUDE = 39.168491459	05.00	06.50	SS-3	46	72	-	48	19	11	17	5	NP	NP	NP	13	A-1-b (0)	
LONGITUDE = -84.420657605	07.50	09.00	SS-4	3	89	2.50	48	19	11	17	5	NP	NP	NP	141	A-1-b (0)	
	10.00	11.50	SS-5	25	61	1.50	44	12	14	21	9	NP	NP	NP	57	A-2-4 (0)	
	12.50	14.00	SS-6	11	39	1.50	44	12	14	21	9	NP	NP	NP	95	A-2-4 (0)	
	15.00	16.50	SS-7	28	78	3.00				SAME AS SS-9					8	A-4a (VISUAL)	
	17.50	19.00	SS-8	49	78	3.00				SAME AS SS-9					8	A-4a (VISUAL)	
	20.00	22.00	ST-1	-	29	0.50				SAME AS SS-9					12	A-4a (VISUAL)	
	22.50	24.00	SS-9	51	94	4.50	16	8	19	34	23	21	13	8	12	A-4a (4)	
	25.00	26.50	SS-10	60	78	4.50	16	8	19	34	23	21	13	8	11	A-4a (4)	
	27.50	28.42	SS-11	-	100	4.50				SAME AS SS-10					10	A-4a (VISUAL)	
	30.00	31.50	SS-12	65	89	4.50				SAME AS SS-10					13	A-4a (VISUAL)	
	35.00	36.50	SS-13	65	56	4.50				SAME AS SS-10					9	A-4a (VISUAL)	
	40.00	41.50	SS-14	94	89	4.50				SAME AS SS-10					10	A-4a (VISUAL)	
	42.50	44.50	ST-2	-	0	-				SAME AS SS-10					-	A-4a (VISUAL)	
	45.00	46.50	SS-15	91	22	3.00				SAME AS SS-10					8	A-4a (VISUAL)	
	50.00	51.50	SS-16	86	89	4.50				SAME AS SS-10					14	A-4a (VISUAL)	
B-015-0-15	02.50	04.00	SS-1	8	89	2.50	15	11	13	33	28	26	14	12	13	A-6a (6)	
STA. 416+51, 84' RT.	05.00	07.00	ST-1	-	67	4.00				SAME AS SS-1					11	A-6a (VISUAL)	
LATITUDE = 39.169311878	07.50	09.00	SS-2	69	89	1.50	49	10	16	17	8	17	13	4	10	A-1-b (0)	
LONGITUDE = -84.419815310	10.00	11.50	SS-3	31	0	-				SAME AS SS-2					-	A-1-b (VISUAL)	
	12.50	14.00	SS-4	59	89	4.50				SAME AS SS-5					13	A-4a (VISUAL)	
	15.00	16.50	SS-5	95	61	4.50	13	9	13	38	27	23	14	9	18	A-4a (6)	
	17.50	19.00	SS-6	48	100	4.50	13	9	13	38	27	23	14	9	7	A-4a (6)	
	20.00	22.00	ST-2	-	71	4.50				SAME AS SS-6					12	A-4a (VISUAL)	
	22.50	24.00	SS-7	48	72	4.50				SAME AS SS-6					11	A-4a (VISUAL)	
	25.00	26.50	SS-8	29	78	1.50				SAME AS SS-6					15	A-4a (VISUAL)	
	27.50	29.00	SS-9	40	100	4.00				SAME AS SS-6					10	A-4a (VISUAL)	
	30.00	31.50	SS-10	31	67	2.00				SAME AS SS-6					13	A-4a (VISUAL)	
B-015-1-15	00.00	01.50	SS-1	11	78	4.00	28	9	24	23	16	24	14	10	13	A-4a (1)	
STA. 416+68, 182' RT.	02.50	04.00	SS-2	17	89	4.50	28	9	24	23	16	24	14	10	13	A-4a (1)	
LATITUDE = 39.169126185	05.00	07.00	ST-1	-	71	1.00				SAME AS SS-2					16	A-4a (VISUAL)	
LONGITUDE = -84.419561843	07.50	09.00	SS-3	14	89	3.50				SAME AS SS-2					18	A-4a (VISUAL)	
	10.00	11.50	SS-4	9	89	3.00				SAME AS SS-2					20	A-4a (VISUAL)	
	12.50	14.00	SS-5	3	72	2.00				SAME AS SS-6					20	A-4a (VISUAL)	
	15.00	17.00	ST-2	-	92	1.00				SAME AS SS-6					23	A-4a (VISUAL)	
	17.50	19.00	SS-6	12	67	1.50	6	7	42	35	10	18	17	1	21	A-4a (2)	
	20.00	21.50	SS-7	31	67	4.00	6	7	42	35	10	18	17	1	19	A-4a (2)	
	22.50	24.00	SS-8	6	61	1.00				SAME AS SS-9					19	A-4b (VISUAL)	
	25.00	27.00	ST-3	-	100	2.50				SAME AS SS-9					17	A-4b (VISUAL)	
	27.50	29.00	SS-9	6	67	1.50	5	5	10	52	28	23	15	8	21	A-4b (8)	
	30.00	31.50	SS-10	31	94	2.00	5	5	10	52	28	23	15	8	15	A-4b (8)	
	32.50	34.00	SS-11	55	94	4.50				SAME AS SS-10					19	A-4b (VISUAL)	
	35.00	37.00	ST-4	-	79	4.50				SAME AS SS-10					19	A-4b (VISUAL)	
	37.50	39.00	SS-12	42	0	-				SAME AS SS-10					-	A-4b (VISUAL)	
	40.00	41.50	SS-13	63	67	4.50				SAME AS SS-10					15	A-4b (VISUAL)	

SUMMARY OF SOIL TEST DATA
INTERSTATE 71 (CONTINUED)

EXPLORATION NO., STATION & OFFSET	FROM	TO	SAMPLE ID	N60	% REC	HP tsf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-016-0-15	00.00	01.50	SS-1	32	78	1.00	30	12	27	21	10	22	15	7	13	A-2-4 (0)	
STA. 419+02, 80' RT.	01.50	03.00	SS-2	31	72	-				SAME AS SS-1					15	A-2-4 (VISUAL)	<100
LATITUDE = 39.169696078	03.00	04.50	SS-3	22	94	1.00	31	15	30	16	8	NP	NP	NP	11	A-2-4 (0)	
LONGITUDE = -84.419121478	04.50	06.00	SS-4	15	78	-				SAME AS SS-6					17	A-6a (VISUAL)	
	07.50	09.00	SS-5	6	89	1.00				SAME AS SS-6					20	A-6a (VISUAL)	
	10.00	11.50	SS-6	9	89	1.00	3	2	4	51	40	28	15	13	23	A-6a (9)	
	12.50	14.00	SS-7	23	72	1.50	3	2	4	51	40	28	15	13	21	A-6a (9)	
	15.00	16.50	SS-8	18	39	1.00				SAME AS SS-7					21	A-6a (VISUAL)	
	17.50	19.00	SS-9	25	44	1.00				SAME AS SS-7					20	A-6a (VISUAL)	
	20.00	21.50	SS-10	77	67	4.50				SAME AS SS-7					14	A-6a (VISUAL)	
B-016-1-15	01.50	03.00	SS-1	17	72	4.50				SAME AS SS-4					21	A-6a (VISUAL)	
STA. 419+21, 196' RT.	03.00	04.50	SS-2	18	39	-	-	-	-	-	-	-	-	-	7	A-3a (VISUAL)	
LATITUDE = 39.169447564	05.00	06.50	SS-3	9	78	3.50				SAME AS SS-4					22	A-6a (VISUAL)	
LONGITUDE = -84.418860814	07.50	09.00	SS-4	20	56	1.00	3	2	32	37	26	28	13	15	20	A-6a (8)	
	10.00	11.50	SS-5	20	61	2.50	3	2	32	37	26	28	13	15	17	A-6a (8)	
	12.50	14.00	SS-6	6	56	1.50				SAME AS SS-5					20	A-6a (VISUAL)	
	15.00	17.00	ST-1	-	54	0.50				SAME AS SS-5					10	A-6a (VISUAL)	
	17.50	19.00	SS-7	22	56	1.50				SAME AS SS-5					17	A-6a (VISUAL)	
	20.00	21.50	SS-8	29	61	2.50				SAME AS SS-5					18	A-6a (VISUAL)	
	22.50	24.00	SS-9	11	67	1.00				SAME AS SS-10					18	A-4b (VISUAL)	
	25.00	27.00	ST-2	-	100	1.50				SAME AS SS-10					18	A-4b (VISUAL)	
	27.50	29.00	SS-10	6	61	1.00	2	1	21	66	10	NP	NP	NP	17	A-4b (8)	
	30.00	31.50	SS-11	6	89	3.00	2	1	21	66	10	NP	NP	NP	21	A-4b (8)	
	32.50	34.00	SS-12	5	72	2.50				SAME AS SS-11					20	A-4b (VISUAL)	
	35.00	36.50	SS-13	6	72	3.00	12	4	10	47	27	21	14	7	22	A-4a (8)	
	37.50	39.00	SS-14	15	78	4.50	12	4	10	47	27	21	14	7	17	A-4a (8)	
	40.00	41.50	SS-15	40	78	4.50				SAME AS SS-15					15	A-4a (VISUAL)	
B-017-0-15	00.00	01.50	SS-1	3	72	1.50				SAME AS SS-3					21	A-6b (VISUAL)	
STA. 421+79, 168' RT.	02.50	04.00	SS-2	11	56	3.00				SAME AS SS-3					23	A-6b (VISUAL)	
LATITUDE = 39.169802165	05.00	06.50	SS-3	11	72	2.50	4	9	37	25	25	30	13	17	19	A-6b (5)	
LONGITUDE = -84.418167950	07.50	09.00	SS-4	15	56	3.00	4	9	37	25	25	30	13	17	19	A-6b (5)	
	10.00	12.00	ST-1	-	100	2.00				SAME AS SS-4					15	A-6b (VISUAL)	
	12.50	14.00	SS-5	26	61	3.50				SAME AS SS-4					18	A-6b (VISUAL)	
	15.00	16.50	SS-6	11	44	-				SAME AS SS-7					13	A-4b (VISUAL)	
	17.50	19.00	SS-7	9	78	2.00	0	0	18	69	13	26	21	5	21	A-4b (8)	
	20.00	21.50	SS-8	9	61	2.00	0	0	18	69	13	26	21	5	25	A-4b (8)	
	22.50	24.00	SS-9	6	67	1.00				SAME AS SS-8					21	A-4b (VISUAL)	
	25.00	26.50	SS-10	17	89	1.50				SAME AS SS-8					19	A-4b (VISUAL)	
	27.50	29.00	SS-11	18	94	1.00				SAME AS SS-8					23	A-4b (VISUAL)	
	30.00	31.50	SS-12	9	67	2.50				SAME AS SS-8					22	A-4b (VISUAL)	
B-018-0-15	00.00	01.50	SS-1	14	100	2.50				SAME AS SS-2					22	A-4b (VISUAL)	<100
STA. 423+15, 71' RT.	01.50	03.00	SS-2	17	78	2.50	0	0	15	74	11	NP	NP	NP	25	A-4b (8)	
LATITUDE = 39.170173054	03.00	04.50	SS-3	17	78	2.00	0	0	15	74	11	NP	NP	NP	20	A-4b (8)	
LONGITUDE = -84.417868351	04.50	06.00	SS-4	11	56	3.00	0	0	18	73	9	NP	NP	NP	24	A-4b (8)	
	07.50	09.00	SS-5	9	67	1.50	1	1	19	68	11	NP	NP	NP	20	A-4b (8)	
	10.00	11.50	SS-6	8	72	2.00	1	1	19	68	11	NP	NP	NP	19	A-4b (8)	
	12.50	14.50	ST-1	-	0	-				SAME AS SS-6					-	A-4b (VISUAL)	
	15.00	16.50	SS-7	6	56	1.50				SAME AS SS-8					19	A-4b (VISUAL)	
	17.50	19.00	SS-8	11	89	2.00	11	4	10	57	18	19	16	3	22	A-4b (8)	
	20.00	21.50	SS-9	12	72	1.50	11	4	10	57	18	19	16	3	17	A-4b (8)	
B-019-0-15	02.50	04.00	SS-1	6	94	1.75	12	3	14	44	27	33	16	17	21	A-6b (10)	
STA. 423+44, 125' RT.	05.00	06.50	SS-2	28	89	-				SAME AS SS-5					15	A-4b (VISUAL)	
LATITUDE = 39.170055757	07.50	09.00	SS-3	23	50	2.00				SAME AS SS-5					16	A-4b (VISUAL)	
LONGITUDE = -84.417715946	10.00	11.50	SS-4	22	100	-				SAME AS SS-5					17	A-4b (VISUAL)	
	12.50	14.00	SS-5	15	100	-	1	0	4	69	26	30	20	10	24	A-4b (8)	
	15.00	16.50	SS-6	15	100	-	1	0	4	69	26	30	20	10	24	A-4b (8)	
	17.50	19.00	SS-7	18	89	-				SAME AS SS-6					21	A-4b (VISUAL)	
	20.00	21.50	SS-8	22	100	-				SAME AS SS-6					18	A-4b (VISUAL)	
	22.50	24.00	SS-9	26	100	-				SAME AS SS-6					23	A-4b (VISUAL)	
	25.00	26.50	SS-10	15	78	-	2	6	23	60	9	NP	NP	NP	22	A-4b (7)	
	27.50	29.00	SS-11	8	72	-	2	6	23	60	9	NP	NP	NP	18	A-4b (7)	
	30.00	31.50	SS-12	8	100	-				SAME AS SS-11					20	A-4b (VISUAL)	

DRAWN MSJ
CHECKED EMK

SOIL PROFILE
SUMMARY OF SOIL TEST DATA

HAM-71-6.86

3 / 44

V:\1736\active\173620049\design\94741\geotechnical\sheets\94741IC002.dgn Sheet 5/15/2017 10:10:02 AM mjennings

SUMMARY OF SOIL TEST DATA
INTERSTATE 71 (CONTINUED)

EXPLORATION NO., STATION & OFFSET	FROM	TO	SAMPLE ID	N60	% REC	HP tsf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-020-0-15	02.50	04.00	SS-1	5	39	1.00	27	7	20	29	17	24	13	11	14	A-6a (3)	
STA. 425+25, 74' RT.	05.00	06.50	SS-2	20	67	4.50	27	7	20	29	17	24	13	11	15	A-6a (3)	
LATITUDE = 39.170313698	07.50	09.00	SS-3	11	61	3.00	14	3	15	44	24	30	17	13	19	A-6a (8)	
LONGITUDE = -84.417177660	10.00	11.50	SS-4	6	67	2.00	14	3	15	44	24	30	17	13	21	A-6a (8)	
	12.50	14.00	SS-5	6	78	1.00				SAME AS SS-4					21	A-6a (VISUAL)	
	15.00	16.50	SS-6	8	39	-				GRAVEL AND STONE FRAGMENTS					20	A-1-a (VISUAL)	
	17.50	19.00	SS-7	11	39	-				GRAVEL AND STONE FRAGMENTS					11	A-1-a (VISUAL)	
	20.00	21.50	SS-8	20	61	4.50				SAME AS SS-9					8	A-4a (VISUAL)	
	22.50	24.00	SS-9	5	33	3.00	30	8	13	31	18	23	14	9	14	A-4a (3)	
	25.00	26.50	SS-10	20	89	2.50	30	8	13	31	18	23	14	9	16	A-4a (3)	
B-021-0-15	01.50	03.00	SS-1	20	50	4.00				SAME AS SS-2					11	A-4a (VISUAL)	
STA. 426+46, 59' RT.	03.00	04.50	SS-2	24	72	3.50	18	7	21	43	11	21	18	3	10	A-4a (4)	
LATITUDE = 39.170409881	04.50	06.00	SS-3	37	78	3.25	24	6	15	36	19	24	15	9	11	A-4a (4)	
LONGITUDE = -84.416781348	06.00	07.50	SS-4	34	78	3.75				SAME AS SS-3					11	A-4a (VISUAL)	<100
	07.50	09.00	SS-5	27	100	4.50				SAME AS SS-3					14	A-4a (VISUAL)	
	10.00	11.50	SS-6	16	100	3.00				SAME AS SS-3					16	A-4a (VISUAL)	
	12.50	14.00	SS-7	4	56	1.25	20	7	8	35	30	40	16	24	19	A-6b (12)	
	15.00	16.50	SS-8	9	39	1.25	20	7	8	35	30	40	16	24	20	A-6b (12)	
	17.50	19.00	SS-9	4	28	1.50				SAME AS SS-8					18	A-6b (VISUAL)	
	20.00	21.50	SS-10	22	83	-	64	14	10	8	4	16	14	2	6	A-1-a (0)	
	22.50	24.00	SS-11	15	56	-	64	14	10	8	4	16	14	2	7	A-1-a (0)	
	25.00	26.50	SS-12	4	56	0.25	-	-	-	-	-	-	-	-	14	A-4b (VISUAL)	
B-022-0-15	01.50	03.00	SS-1	8	67	1.75				SAME AS SS-2					18	A-7-6 (VISUAL)	<100
STA. 428+55, 61' RT.	03.00	04.50	SS-2	12	78	2.75	5	5	11	42	37	41	15	26	17	A-7-6 (15)	
LATITUDE = 39.170470026	04.50	06.00	SS-3	16	50	2.75	10	4	13	42	31	27	16	11	23	A-6a (8)	
LONGITUDE = -84.416065222	06.00	07.50	SS-4	20	44	3.00	10	4	13	42	31	27	16	11	25	A-6a (8)	
	07.50	09.00	SS-5	14	100	3.50				SAME AS SS-7					26	A-6b (VISUAL)	
	10.00	11.50	SS-6	14	89	3.50				SAME AS SS-7					25	A-6b (VISUAL)	
	12.50	14.00	SS-7	12	100	3.00	15	2	3	34	46	40	19	21	26	A-6b (12)	
	15.00	16.50	SS-8	9	83	2.75				SAME AS SS-7					24	A-6b (VISUAL)	
	17.50	19.00	SS-9	8	100	2.00				SAME AS SS-10					24	A-4b (VISUAL)	
	20.00	21.50	SS-10	4	100	1.25	0	0	0	59	41	24	15	9	23	A-4b (8)	
	22.50	24.00	SS-11	9	100	1.50				SAME AS SS-10					23	A-4b (VISUAL)	
	25.00	26.50	SS-12	11	100	1.00				SAME AS SS-10					22	A-4b (VISUAL)	
B-024-0-15	01.50	03.00	SS-1	14	72	4.00				SAME AS SS-2					25	A-6b (VISUAL)	347
STA. 430+49, 76' RT.	03.00	04.50	SS-2	15	89	2.00	15	1	1	38	45	40	20	26	26	A-6b (12)	
LATITUDE = 39.170455846	04.50	06.00	SS-3	25	94	3.00	0	0	1	49	50	38	19	19	24	A-6b (12)	
LONGITUDE = -84.415387932	06.00	07.50	SS-4	29	89	4.50	0	0	1	49	50	38	19	19	22	A-6b (12)	
	07.50	09.00	SS-5	25	94	4.00				SAME AS SS-6					22	A-6a (VISUAL)	
	10.00	11.50	SS-6	12	89	3.00	0	0	0	57	43	29	17	12	23	A-6a (9)	
	12.50	14.00	SS-7	15	78	4.50	0	0	0	57	43	29	17	12	23	A-6a (9)	
	15.00	16.50	SS-8	14	100	3.50				SAME AS SS-7					24	A-6a (VISUAL)	
	17.50	19.00	SS-9	14	100	3.00				SAME AS SS-10					21	A-6a (VISUAL)	
	20.00	21.50	SS-10	8	67	1.50	0	0	0	59	41	27	16	11	24	A-6a (8)	
	22.50	24.00	SS-11	3	94	0.50	0	0	0	59	41	27	16	11	22	A-6a (8)	
	25.00	26.50	SS-12	5	100	2.00				SAME AS SS-11					24	A-6a (VISUAL)	
B-025-0-15	01.50	03.00	SS-1	3	67	2.00				SAME AS SS-2					23	A-6b (VISUAL)	<100
STA. 432+49, 74' RT.	03.00	04.50	SS-2	11	72	2.50	19	3	9	39	30	35	15	20	19	A-6b (11)	
LATITUDE = 39.170355837	04.50	06.00	SS-3	15	72	3.00	24	3	8	27	38	48	15	33	24	A-7-6 (15)	
LONGITUDE = -84.414681868	06.00	07.50	SS-4	17	78	3.00	24	3	8	27	38	48	15	33	24	A-7-6 (15)	
	07.50	09.00	SS-5	12	89	2.50				SAME AS SS-4					22	A-7-6 (VISUAL)	
	10.00	11.50	SS-6	11	78	3.00				SAME AS SS-4					24	A-7-6 (VISUAL)	
	12.50	14.00	SS-7	6	72	2.50				SAME AS SS-9					29	A-6a (VISUAL)	
	15.00	16.50	SS-8	12	94	2.00				SAME AS SS-9					24	A-6a (VISUAL)	
	17.50	19.00	SS-9	18	94	3.00	0	0	2	57	41	30	16	14	21	A-6a (10)	
	20.00	21.50	SS-10	12	94	4.50	0	0	2	57	41	30	16	14	20	A-6a (10)	
	22.50	24.00	SS-11	12	72	3.50				SAME AS SS-10					21	A-6a (VISUAL)	
	25.00	26.50	SS-12	12	72	1.50				SAME AS SS-10					20	A-6a (VISUAL)	

SUMMARY OF SOIL TEST DATA
INTERSTATE 71 (CONTINUED)

EXPLORATION NO., STATION & OFFSET	FROM	TO	SAMPLE ID	N60	% REC	HP tsf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-027-0-15	01.50	03.00	SS-1	8	33	-	-	-	-	-	-	-	-	-	8	A-2-4 (VISUAL)	
STA. 435+25, 66' RT.	03.00	04.50	SS-2	15	78	3.75				SAME AS SS-3					20	A-7-6 (VISUAL)	376
LATITUDE = 39.170368643	04.50	06.00	SS-3	20	89	3.25	8	3	3	39	47	43	18	25	24	A-7-6 (15)	
LONGITUDE = -84.414001908	06.00	07.50	SS-4	25	94	3.25	0	0	1	56	43	35	19	16	22	A-6b (10)	
	07.50	09.00	SS-5	23	83	4.00				SAME AS SS-4					22	A-6b (VISUAL)	
	10.00	11.50	SS-6	15	83	3.50				SAME AS SS-4					18	A-6b (VISUAL)	
	12.50	14.00	SS-7	5	28	-	-	-	-	-	-	-	-	-	24	A-3a (VISUAL)	
	15.00	16.50	SS-8	20	78	4.00	1	2	2	68	27	24	19	5	24	A-4b (8)	
	17.50	19.00	SS-9	42	33	-	1	2	2	68	27	24	19	5	24	A-4b (8)	
	20.00	21.50	SS-10	3	100	0.25				SAME AS SS-11					21	A-6a (VISUAL)	
	22.50	24.00	SS-11	5	100	0.25	0	1	3	50	46	29	16	13	24	A-6a (9)	
	25.00	26.50	SS-12	6	100	0.25				SAME AS SS-11					22	A-6a (VISUAL)	
B-028-0-15	01.50	03.00	SS-1	5	89	2.50	23	8	7	31	31	42	14	28	28	A-7-6 (13)	
STA. 437+01, 61' RT.	03.00	04.50	SS-2	15	28	1.50				SAME AS SS-1					22	A-7-6 (VISUAL)	<100
LATITUDE = 39.170547121	04.50	06.00	SS-3	14	78	-	68	8	3	10	11	33	15	18	10	A-2-6 (0)	
LONGITUDE = -84.413385779	06.00	07.50	SS-4	23	6	-	68	8	3	10	11	33	15	18	8	A-2-6 (0)	
	07.50	09.00	SS-5	9	67	-				SAME AS SS-6					17	A-6b (VISUAL)	
	09.00	10.50	SS-6	35	67	2.50	49	7	3	20	21	34	16	18	14	A-6b (3)	
	10.50	12.00	SS-7	20	67	2.50	49	7	3	20	21	34	16	18	14	A-6b (3)	
	12.50	14.00	SS-8	12	6	-				SAME AS SS-7					12	A-6b (VISUAL)	
	15.00	16.50	SS-9	20	0	-				SAME AS SS-10					-	A-6a (VISUAL)	
	17.50	19.00	SS-10	18	100	3.00	0	0	1	57	42	32	18	14	19	A-6a (10)	
	20.00	21.50	SS-11	12	100	0.50				SAME AS SS-12					19	A-4a (VISUAL)	
	22.50	24.00	SS-12	9	100	1.50	9	6	16	46	23	22	15	7	18	A-4a (7)	
	25.00	26.50	SS-13	14	100	2.50				SAME AS SS-12					23	A-4a (VISUAL)	
B-029-0-15	01.50	03.00	SS-1	51	28	3.00	47	12	5	18	18	35	15	20	20	A-6b (2)	
STA. 438+39, 60' RT.	03.00	04.50	SS-2	15	28	-	47	12	5	18	18	35	15	20	15	A-6b (2)	
LATITUDE = 39.170558853	04.50	06.00	SS-3	8	78	3.00				SAME AS SS-2					11	A-6b (VISUAL)	1078
LONGITUDE = -84.412897433	06.00	07.50	SS-4	61	61	3.50	39	9	5	24	23	35	16	19	8	A-6b (5)	
	07.50	09.00	SS-5	23	28	-				SAME AS SS-6					7	A-2-6 (VISUAL)	
	10.00	11.50	SS-6	18	72	2.50	65	8	4	12	11	27	14	13	8	A-2-6 (0)	
	12.50	14.00	SS-7	39	100	-	65	8	4	12	11	27	14	13	5	A-2-6 (0)	
	15.00	16.50	SS-8	22	39	1.50				SAME AS SS-7					10	A-2-6 (VISUAL)	
	17.50	19.00	SS-9	54	39	-				SAME AS SS-7					10	A-2-6 (VISUAL)	
	20.00	21.50	SS-10	43	33	3.50				SAME AS SS-11					10	A-6b (VISUAL)	
	22.50	24.00	SS-11	19	89	2.00	43	5	5	25	22	37	17	20	15	A-6b (5)	
	25.00	26.50	SS-12	14	0	-				SAME AS SS-11					-	A-6b (VISUAL)	
B-030-0-15	01.50	03.00	SS-1	14	33	-	59	19	7	10	5	20	14	6	9	A-1-a (0)	
STA. 441+82, 61' RT.	03.00	04.50	SS-2	26	28	-	59	19	7	10	5	20	14	6	18	A-1-a (0)	
LATITUDE = 39.170587150	04.50	06.00	SS-3	77	28	-				SAME AS SS-2					9	A-1-a (VISUAL)	373
LONGITUDE = -84.411688198	06.00	07.50	SS-4	20	22	-				SAME AS SS-2					12	A-1-a (VISUAL)	373
	07.50	09.00	SS-5	12	100	0.50	28	6	4	27	35	45	17	28	29	A-7-6 (13)	
	10.00	11.50	SS-6	24	100	4.50				SAME AS SS-8					11	A-6b (VISUAL)	
	12.50	14.00	SS-7	20	78	0.50				SAME AS SS-8					9	A-6b (VISUAL)	
	15.00	16.50	SS-8	31	44	1.50	46	8	4	20	22	33	16	17	16	A-6b (3)	
	17.50	19.00	SS-9	18	78	2.50	46	8	4	20	22	33	16	17	16	A-6b (3)	
	20.00	21.50	SS-10	12	28	-				SAME AS SS-9					11	A-6b (VISUAL)	
	22.50	24.00	SS-11	16	22	-				SAME AS SS-9					15	A-6b (VISUAL)	
	25.00	26.50	SS-12	26	44	-				SAME AS SS-9					17	A-6b (VISUAL)	
	30.00	31.50	SS-13	33	39	-				SAME AS SS-9					23	A-6b (VISUAL)	
	35.00	36.50	SS-14	9	56	2.00	8	6	9	39	38	39	16	23	23	A-6b (13)	
	40.00	41.50	SS-15	27	100	4.50	8	6	9	39	38	39	16	23	21	A-6b (13)	

DRAWN MSJ
CHECKED EMK

SOIL PROFILE
SUMMARY OF SOIL TEST DATA

HAM-71-6.86

4 / 44

V:\1736\active\173620049\design\94741\geotechnical\sheets\94741IIC003.dgn 5/15/2017 10:18:12 AM mjennings

SUMMARY OF SOIL TEST DATA
INTERSTATE 71 (CONTINUED)

EXPLORATION NO., STATION & OFFSET	FROM	TO	SAMPLE ID	N60	% REC	HP tsf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-030-1-15	02.50-04.00		SS-1	5	56	0.25	1	3	15	51	30	34	18	16	29	A-6b (10)	
STA. 441+79, 139' RT.	05.00-06.50		SS-2	5	89	0.25	1	3	15	51	30	34	18	16	22	A-6b (10)	
LATITUDE = 39.170372845	07.50-09.50		ST-1	-	100	0.75			SAME AS SS-2						14	A-6b (VISUAL)	
LONGITUDE = -84.411692208	10.00-11.50		SS-3	11	28	0.50			SAME AS SS-2						14	A-6b (VISUAL)	
	12.50-13.42		SS-4	-	82	-			GRAVEL AND STONE FRAGMENTS						7	A-1-a (VISUAL)	
	15.00-16.50		SS-5	38	50	4.50			SILT AND CLAY						16	A-6a (VISUAL)	
	17.50-17.75		SS-6	-	67	-			SILT AND CLAY						6	A-6a (VISUAL)	
B-030-2-15	20.00-21.50		SS-7	34	44	4.50	16	10	11	31	32	25	13	12	18	A-6a (6)	
STA. 441+84, 139' RT.	25.00-26.50		SS-8	21	100	4.50	16	10	11	31	32	25	13	12	10	A-6a (6)	
LATITUDE = 39.170373133	30.00-31.50		SS-9	27	78	4.50	13	11	17	37	22	21	13	8	10	A-4a (5)	
LONGITUDE = -84.411674576	32.50-34.50		ST-2	-	0	-			GRAVEL AND STONE FRAGMENTS WITH SAND, SILT AND CLAY							A-2-6 (VISUAL)	
	35.00-35.42		SS-10	-	0	-			GRAVEL AND STONE FRAGMENTS WITH SAND, SILT AND CLAY							A-2-6 (VISUAL)	
B-031-0-15	01.50-03.00		SS-1	11	100	4.50	19	4	5	34	38	36	15	21	16	A-6b (12)	
STA. 445+98, 61' RT.	03.00-04.50		SS-2	11	39	4.50	16	4	3	36	41	40	17	23	22	A-6b (13)	
LATITUDE = 39.170621389	04.50-06.00		SS-3	15	44	1.00	16	4	3	36	41	40	17	23	18	A-6b (13)	
LONGITUDE = -84.410221950	06.00-07.50		SS-4	16	72	2.00			SAME AS SS-3						26	A-6b (VISUAL)	<100
B-032-0-15	01.50-03.00		SS-1	27	33	3.00			SAME AS SS-2						18	A-7-6 (VISUAL)	<100
STA. 449+89, 60' RT.	03.00-04.50		SS-2	18	44	3.00	16	7	5	32	40	41	17	24	15	A-7-6 (13)	
LATITUDE = 39.170655972	04.50-06.00		SS-3	18	39	3.00	43	7	3	19	28	40	18	22	18	A-6b (6)	
LONGITUDE = -84.408841965	06.00-07.50		SS-4	27	28	-	43	7	3	19	28	40	18	22	7	A-6b (6)	
B-033-0-15	01.50-03.00		SS-1	11	28	-			SAME AS SS-2						8	A-2-6 (VISUAL)	2164
STA. 454+30, 60' RT.	03.00-04.50		SS-2	23	22	-	61	7	4	14	14	33	16	17	2	A-2-6 (1)	
LATITUDE = 39.170693221	04.50-06.00		SS-3	23	22	-	61	7	4	14	14	33	16	17	9	A-2-6 (1)	
LONGITUDE = -84.407288855	06.00-07.50		SS-4	27	72	-	61	7	4	14	14	33	16	17	15	A-2-6 (1)	
	07.50-09.00		SS-5	12	56	-			SAME AS SS-4						19	A-2-6 (VISUAL)	
	10.00-11.50		SS-6	16	72	3.50			SAME AS SS-4						18	A-2-6 (VISUAL)	
	12.50-14.00		SS-7	77	67	-			SAME AS SS-8						4	A-6b (VISUAL)	
	15.00-16.50		SS-8	16	78	-	52	8	3	17	20	32	16	16	5	A-6b (2)	
	17.50-19.00		SS-9	46	78	-	52	8	3	17	20	32	16	16	7	A-6b (2)	
	20.00-21.50		SS-10	43	100	2.50	45	10	4	19	22	34	15	19	10	A-6b (4)	
	22.50-24.50		ST-1	-	0	-			SAME AS SS-10						-	A-6b (VISUAL)	
	25.00-26.50		SS-11	-	67	4.50	45	10	4	19	22	34	15	19	8	A-6b (4)	
	30.00-31.50		SS-12	56	39	-			SAME AS SS-11						8	A-6b (VISUAL)	
	35.00-36.50		SS-13	38	22	-			SAME AS SS-11						7	A-6b (VISUAL)	
	40.00-41.50		SS-14	50	28	-			SAME AS SS-11						5	A-6b (VISUAL)	
B-033-1-15	00.00-01.50		SS-1	3	72	2.50			SAME AS SS-2						24	A-7-6 (VISUAL)	
STA. 454+04, 158' RT.	02.50-04.00		SS-2	17	89	1.50	1	6	17	28	48	50	14	36	22	A-7-6 (18)	
LATITUDE = 39.170422674	05.00-06.50		SS-3	14	61	2.00	1	6	17	28	48	50	14	36	22	A-7-6 (18)	
LONGITUDE = -84.407369477	07.50-09.00		SS-4	17	67	3.00	1	2	6	70	21	26	19	7	20	A-4b (8)	
	10.00-12.00		ST-1	-	83	2.50			SAME AS SS-4						22	A-4b (VISUAL)	
	12.50-14.00		SS-5	46	72	4.50			SAME AS SS-8						20	A-6b (VISUAL)	
	15.00-16.50		SS-6	23	89	4.50			SAME AS SS-8						20	A-6b (VISUAL)	
	17.50-19.00		SS-7	38	67	3.50			SAME AS SS-8						24	A-6b (VISUAL)	
	20.00-21.50		SS-8	25	78	4.00	1	0	0	40	59	37	19	18	24	A-6b (11)	
	25.00-26.50		SS-9	31	78	3.00	1	0	0	40	59	37	19	18	21	A-6b (11)	
	30.00-31.50		SS-10	51	78	4.50			SAME AS SS-9						24	A-6b (VISUAL)	
	35.00-36.50		SS-11	28	72	4.00			SAME AS SS-9						25	A-6b (VISUAL)	
	40.00-41.50		SS-12	-	-	-			SAME AS SS-9						25	A-6b (VISUAL)	
B-034-0-15	01.50-03.00		SS-1	7	67	-			SAME AS SS-2						17	A-6b (VISUAL)	
STA. 458+29, 61' RT.	03.00-04.50		SS-2	14	78	-	38	9	5	26	22	35	17	18	13	A-6b (5)	
LATITUDE = 39.170722798	04.50-06.00		SS-3	14	89	-	26	10	5	25	34	43	18	25	25	A-7-6 (11)	
LONGITUDE = -84.405881654	06.00-07.50		SS-4	11	89	-			SAME AS SS-3						11	A-7-6 (VISUAL)	653

SUMMARY OF SOIL TEST DATA
INTERSTATE 71 (CONTINUED)

EXPLORATION NO., STATION & OFFSET	FROM	TO	SAMPLE ID	N60	% REC	HP tsf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-035-0-15	01.50-03.00		SS-1	9	50	2.25				SAME AS SS-2					9	A-7-6 (VISUAL)	<100
STA. 462+00, 61' RT.	03.00-04.50		SS-2	9	56	2.25	13	11	6	27	43	45	17	28	23	A-7-6 (15)	
LATITUDE = 39.170753231	04.50-06.00		SS-3	19	67	3.50	13	11	6	27	43	45	17	28	21	A-7-6 (15)	
LONGITUDE = -84.404570805	06.00-07.50		SS-4	15	89	3.25	39	9	5	22	25	36	16	20	17	A-6b (6)	
	10.00-11.50		SS-5	16	17	-				SAME AS SS-4					13	A-6b (VISUAL)	
	12.50-14.50		ST-1	-	0	-				SAME AS SS-6					-	A-6b (VISUAL)	
	15.00-16.50		SS-6	22	33	-	48	7	3	18	24	34	16	18	10	A-6b (4)	
	17.50-19.00		SS-7	28	44	-	48	7	3	18	24	34	16	18	12	A-6b (4)	
	20.00-21.50		SS-8	15	33	-				SAME AS SS-7					14	A-6b (VISUAL)	
	22.50-24.50		ST-2	-	0	-				SAME AS SS-11					-	A-2-6 (VISUAL)	
	25.00-26.50		SS-9	35	72	-				SAME AS SS-11					7	A-2-6 (VISUAL)	
	30.00-30.42		SS-10	-	100	-				SAME AS SS-11					2	A-2-6 (VISUAL)	
	35.00-36.50		SS-11	56	89	-	52	11	6	11	20	32	15	17	9	A-2-6 (1)	
	40.00-41.50		SS-12	28	50	-				SAME AS SS-11					23	A-2-6 (VISUAL)	
B-035-1-15	00.00-01.50		SS-1	3	39	1.50				SAME AS SS-2					26	A-7-6 (VISUAL)	
STA. 461+86, 184' RT.	02.50-04.00		SS-2	18	89	4.00	1	2	8	37	52	54	17	37	25	A-7-6 (19)	
LATITUDE = 39.170419154	05.00-06.50		SS-3	23	78	3.50	1	2	8	37	52	54	17	37	21	A-7-6 (19)	
LONGITUDE = -84.404598630	07.50-09.00		SS-4	20	89	4.50				SAME AS SS-5					18	A-4a (VISUAL)	
	10.00-12.00		ST-1	-	100	2.00				SAME AS SS-5					20	A-4a (VISUAL)	
	12.50-14.00		SS-5	40	89	3.00	38	12	13	22	15	23	13	10	10	A-4a (0)	
	15.00-16.50		SS-6	79	67	2.50	38	12	13	22	15	23	13	10	11	A-4a (0)	
	17.50-19.00		SS-7	66	61	4.00	47	18	17	14	4	NP	NP	NP	14	A-1-b (0)	
	20.00-21.50		SS-8	40	78	-	47	18	17	14	4	NP	NP	NP	10	A-1-b (0)	
	25.00-27.00		ST-2	-	75	2.00				SAME AS SS-10					21	A-6a (VISUAL)	
	30.00-31.50		SS-9	46	94	4.00				SAME AS SS-10					21	A-6a (VISUAL)	
	35.00-36.50		SS-10	18	78	4.50	0	0	3	43	54	30	17	13	27	A-6a (9)	
	40.00-41.50		SS-11	18	67	3.00	0	0	3	43	54	30	17	13	17	A-6a (9)	

SUMMARY OF SOIL TEST DATA
INTERSTATE 71 HISTORIC BORINGS

EXPLORATION NO., STATION & OFFSET	FROM	TO	% GR	% CS	% FS	% SILT	% CLAY	LL	PI	% WC	SHTL. CLASS
B-001-0-65 (KENNEDY)	05.00-06.00		28	9	11	25	27	30	11	16	A-6a
STA. 19+09, 40' LT. (KENNEDY)	10.00-11.00		0	2	1	38	59	37	18	17	A-6b
STA. 416+15, 133' RT. (I-71)	15.00-16.00		0	1	1	27	71	41	20	19	A-7-6
	17.50-18.50		0	0	0	30	70	43	22	23	A-7-6
	20.00-21.00		0	1	0	27	72	40	21	22	A-6b
	22.50-23.50		0	0	0	53	47	29	11	25	A-6a
	25.00-26.00		0	0	0	53	47	29	9	17	A-4b
	27.50-28.50		0	0	1	55	44	30	9	22	A-4b
	30.00-31.00		27	25	13	25	10	NP	NP	13	A-2-4
	32.50-33.50		27	11	20	22	20	20	7	14	A-4a
	35.00-36.00		0	71	13	-16-		NP	NP	13	A-1-b
	37.50-38.50		0	68	27	-5-		NP	NP	19	A-1-b
	40.00-41.00		20	7	14	37	22	21	5	12	A-4a
	45.00-46.00		49	7	10	21	13	20	4	13	A-2-4
	50.00-51.00		GRAY SILTY SAND GRAVEL					22	9	11	VISUAL
	55.00-56.00		32	3	15	31	19	19	3	10	A-4a
	60.00-60.50		36	19	22	10	13	-	-	7	A-1-b
B-446-0-64	00.20-05.00		0	5	11	44	40	35	16	29	A-6b
STA. 446+00, 50' RT.	05.00-09.00		24	7	10	36	23	25	6	26	A-4a
	09.00-12.00		34	1	1	37	27	23	6	16	A-4a
	12.00-15.00		0	10	15	42	33	32	13	19	A-6a

DRAWN MSJ
CHECKED EMK

SOIL PROFILE
SUMMARY OF SOIL TEST DATA

HAM-71-6.86

SUMMARY OF SOIL TEST DATA
RIDGE AVENUE

EXPLORATION NO., STATION & OFFSET	FROM	TO	SAMPLE ID	N60	% REC	HP tsf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-003-0-15	01.50	03.00	SS-1	5	39	3.00				SAME AS SS-2					17	A-6b (VISUAL)	<100
STA. 23+81, 23' RT.	03.00	04.50	SS-2	17	67	4.00	21	5	9	33	32	37	15	22	26	A-6b (11)	
LATITUDE = 39.165730034	04.50	06.00	SS-3	63	67	3.50	34	5	10	25	26	34	14	20	11	A-6b (7)	
LONGITUDE = -84.422642794	06.00	07.50	SS-4	11	61	3.00	34	5	10	25	26	34	14	20	12	A-6b (7)	
B-004-0-15	01.50	03.00	SS-1	14	89	4.00	0	0	0	39	61	36	18	18	22	A-6b (11)	
STA. 27+10, 27' RT.	03.00	04.50	SS-2	28	61	4.50	0	0	0	39	61	36	18	18	23	A-6b (11)	
LATITUDE = 39.166646555	04.50	06.00	SS-3	31	89	4.00	10	0	1	42	47	32	17	15	21	A-6a (10)	
LONGITUDE = -84.422662299	06.00	07.50	SS-4	28	67	4.00				SAME AS SS-3					24	A-6a (VISUAL)	<100

SUMMARY OF SOIL TEST DATA
RIDGE AVENUE HISTORIC BORINGS

EXPLORATION NO., STATION & OFFSET	FROM	TO	% GR	% CS	% FS	% SILT	% CLAY	LL	PI	% WC	SHTL. CLASS
B-001-0-65 (RIDGE)	05.00	06.00	0	2	10	37	51	51	32	20	A-7-6
STA. 28+27, 27' LT.	10.00	11.00	21	13	16	23	27	35	15	15	A-6a
	15.00	16.00	25	8	14	30	23	25	12	10	A-6a
	20.00	21.00	21	9	17	32	21	22	7	11	A-4a
	25.00	26.00	0	2	2	41	55	35	15	23	A-6a
	30.00	31.00	17	5	13	38	27	22	7	13	A-4a
	35.00	36.00	0	6	13	59	22	NP	NP	15	A-4b
	37.50	38.50	11	4	17	44	24	19	5	11	A-4a
	40.00	41.00	0	1	2	72	25	20	5	22	A-4b
	42.50	43.50	0	1	4	72	23	NP	NP	22	A-4b
	45.00	46.00	0	1	9	78	12	NP	NP	17	A-4b
	47.50	48.50	0	2	8	70	20	NP	NP	20	A-4b
	50.00	51.00	0	8	23	43	26	NP	NP	21	A-4a
	52.50	53.50	8	1	2	66	23	NP	NP	16	A-4b
	55.00	56.00	8	2	4	47	39	25	12	23	A-6a
	57.50	58.50	16	16	16	40	12	NP	NP	16	A-4a
	60.00	61.00	0	0	36	55	9	NP	NP	20	A-4b
	65.00	65.80	0	1	64	26	9	NP	NP	13	A-3a
	70.00	71.00	21	8	21	26	24	23	10	7	A-4a
	75.00	76.00	BROWN SAND AND STONE FRAGMENTS							5	VISUAL
	80.00	81.00	GRAY SANDY SILTY CLAY & GRAVEL					23	11	9	VISUAL
	85.00	86.00	32	7	18	24	19	22	11	11	A-6a
	90.00	90.60	37	8	11	24	20	22	9	12	A-4a
B-008-0-65	05.00	06.00	17	7	15	30	31	31	16	18	A-6b
STA. 24+88, 47' LT. (RIDGE)	10.00	11.00	0	4	3	33	60	41	23	23	A-7-6
STA. 20+04, 50' RT.	12.50	13.50	0	6	9	41	44	29	14	16	A-6a
(I & O RR OPERATED BY	15.00	16.00	0	6	13	40	41	23	8	18	A-4a
(NORFOLK & SOUTHERN)	17.50	18.50	0	8	26	35	31	22	9	13	A-4a
	20.00	21.00	20	10	20	28	22	20	6	9	A-4a
	22.50	23.50	GRAY SILTY SANDY GRAVEL					25	10	15	VISUAL
	25.00	26.00	0	7	19	34	40	22	7	10	A-4a
	27.50	28.50	7	6	14	37	36	26	13	16	A-6a
	30.00	31.00	29	6	12	32	21	21	6	19	A-4a
	35.00	36.00	0	3	67	20	10	NP	NP	5	A-3a
	40.00	41.00	BROWN SAND							12	VISUAL
	45.00	46.00	0	23	63	5	9	NP	NP	17	A-3a
	50.00	50.60	0	41	53	-6-		NP	NP	18	A-3

SUMMARY OF SOIL TEST DATA
RAMP N

EXPLORATION NO., STATION & OFFSET	FROM	TO	SAMPLE ID	N60	% REC	HP tsf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-005-0-15	00.00	01.50	SS-1	11	72	2.50	25	12	16	28	19	28	14	14	14	A-6a (4)	
STA. 407+92, 2' RT.	02.50	04.00	SS-2	9	78	1.50				SAME AS SS-1					17	A-6a (VISUAL)	624
LATITUDE = 39.167730601	05.00	06.50	SS-3	2	28	2.00				SAME AS SS-1					20	A-6a (VISUAL)	
LONGITUDE = -84.422039603	07.50	09.00	SS-4	6	78	0.50	22	22	32	16	8	16	13	3	20	A-3a (0)	
	10.00	11.50	SS-5	9	72	-	22	22	32	16	8	16	13	3	16	A-3a (0)	
B-006-0-15	00.00	01.50	SS-1	9	61	4.50				SAME AS SS-3					14	A-6b (VISUAL)	2338
STA. 411+01, CL	02.50	04.00	SS-2	14	56	4.00				SAME AS SS-3					16	A-6b (VISUAL)	
LATITUDE = 39.167973117	05.00	06.50	SS-3	8	72	2.00	1	8	28	40	23	35	19	16	25	A-6b (8)	
LONGITUDE = -84.421034855	07.50	09.00	SS-4	3	78	1.00	1	8	28	40	23	35	19	16	29	A-6b (8)	
	10.00	11.50	SS-5	3	72	1.50	0	0	25	48	27	31	17	14	33	A-6a (9)	
B-007-0-15	00.00	01.50	SS-1	6	61	4.00				SAME AS SS-3					14	A-6a (VISUAL)	100
STA. 413+50, CL	02.50	04.00	SS-2	20	28	3.50				SAME AS SS-3					21	A-6a (VISUAL)	
LATITUDE = 39.167698315	05.00	06.50	SS-3	14	61	-	28	5	6	33	28	29	15	14	15	A-6a (7)	
LONGITUDE = -84.420228683	07.50	09.00	SS-4	20	67	2.50	36	4	5	29	26	31	15	16	17	A-6b (6)	
	10.00	11.50	SS-5	8	39	3.50				SAME AS SS-4					17	A-6a (VISUAL)	

SUMMARY OF SOIL TEST DATA
RAMP N HISTORIC BORINGS

EXPLORATION NO., STATION & OFFSET	FROM	TO	% GR	% CS	% FS	% SILT	% CLAY	LL	PI	% WC	SHTL. CLASS
B-181-0-66	00.40	03.00	0	1	5	68	26	31	11	35	A-6a
STA. 409+93, 50' RT.	03.00	06.00	0	5	18	57	20	42	13	35	A-7-6
(CONST. RAMP N)	06.00	12.00	35	14	23	21	7	NP	NP	20	A-2-4
STA. 7+00, BL (EX. RAMP P)	12.00	17.00	42	10	21	19	8	NP	NP	27	A-2-4
	17.00	20.00	15	5	14	45	21	NP	NP	13	A-4a

SUMMARY OF SOIL TEST DATA
RAMP P

EXPLORATION NO., STATION & OFFSET	FROM	TO	SAMPLE ID	N60	% REC	HP tsf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO4
B-008-0-15	00.00	01.50	SS-1	8	33	1.50				SAME AS SS-2					17	A-6a (VISUAL)	
STA. 408+55, 56' RT.	02.50	04.00	SS-2	20	78	3.00	22	6	13	36	23	28	16	12	13	A-6a (5)	
LATITUDE = 39.167903500	05.00	06.50	SS-3	22	72	4.50				SAME AS SS-2					12	A-6a (VISUAL)	838
LONGITUDE = -84.419973184																	
B-009-0-15	00.00	01.50	SS-1	22	67	4.50				SAME AS SS-3					12	A-6b (VISUAL)	<100
STA. 410+00, CL	02.50	04.00	SS-2	8	33	2.00				SAME AS SS-3					24	A-6b (VISUAL)	<100
LATITUDE = 39.167930011	05.00	06.50	SS-3	5	67	3.00	2	5	26	38	29	34	15	19	25	A-6b (10)	
LONGITUDE = -84.420519522	07.50	09.00	SS-4	6	72	1.50	2	5	26	38	29	34	15	19	25	A-6b (10)	
	10.00	11.50	SS-5	8	78	1.00	9	4	30	37	20	28	16	12	26	A-6a (5)	
B-010-0-15	00.00	01.50	SS-1	6	44	2.50				SAME AS SS-2					12	A-6a (VISUAL)	<100
STA. 412+50, CL	02.50	04.00	SS-2	11	67	3.50	38	7	14	24	17	25	14	11	13	A-6a (1)	
LATITUDE = 39.168497877	05.00	06.50	SS-3	6	28	2.50				SAME AS SS-5					19	A-6a (VISUAL)	
LONGITUDE = -84.420806363	07.50	09.00	SS-4	3	44	1.50				SAME AS SS-5					30	A-6a (VISUAL)	
	10.00	11.50	SS-5	17	67	2.00	2	2	2	50	44	31	17	14	21	A-6a (10)	
B-014-0-15	01.50	03.00	SS-1	6	72	3.00	39	7	14	21	19	30	14	16	15	A-6b (3)	
STA. 414+87, 26' LT.	03.00	04.50	SS-2	26	56	4.50	39	7	14	21	19	30	14	16	13	A-6b (3)	
LATITUDE = 39.169015596	04.50	06.00	SS-3	31	89	3.00				SAME AS SS-2					14	A-6b (VISUAL)	<100
LONGITUDE = -84.420288354	06.00	07.50	SS-4	28	89	4.50	25	6	13	32	24	26	14	12	12	A-6a (5)	

SUMMARY OF SOIL TEST DATA
RAMP P HISTORIC BORINGS

EXPLORATION NO., STATION & OFFSET	FROM	TO	% GR	% CS	% FS	% SILT	% CLAY	LL	PI	% WC	SHTL. CLASS
B-179-0-66	00.40	04.00	0	0	2	68	30	32	10	23	A-4b
STA. 408+42, 3' LT.	04.00	12.00	26	7	11	39	17	32	13	23	A-6a
(CONSTRUCTED RAMP P)	12.00	15.00	17	8	19	33	23	21	8	11	A-4a
STA. 2+00, BL (EX. RAMP P)											

DRAWN MSJ
CHECKED EMK

SOIL PROFILE
SUMMARY OF SOIL TEST DATA

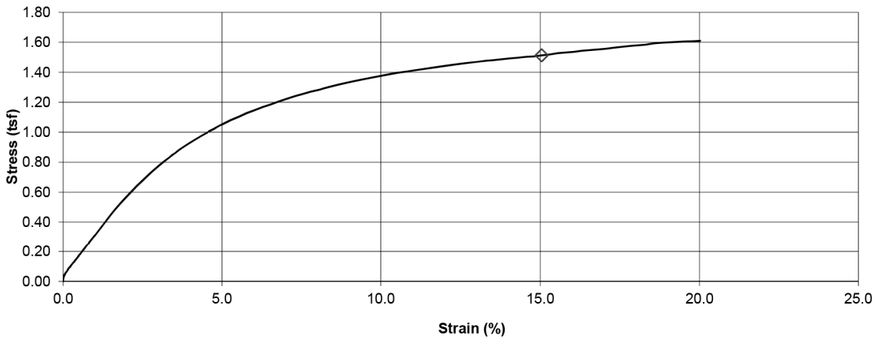
HAM-71-6.86

Unconfined Compressive Strength of Cohesive Soil

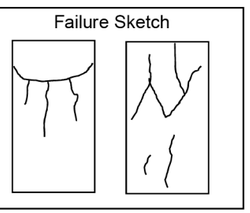
ASTM D 2166

Project Name	HAM-71-6.86					Project Number	173620049
Source	B-015-0-15, 5.0'-7.0'					Lab ID	384
Visual Description	Silt with Sand (ML), gray, moist, firm						
Classification	Silt and Clay, A-6a (6)					Recovered	0.8'
Atterberg Limits	LL 26	PL 14	PI 12			Test Interval	5.0' - 5.5'
Gradation	%GR 15	%CS 11	%FS 13				
	%SI 33	%CL 28				Date Extruded	06/06/2016
Initial Wet Density (pcf)	143.9					Date Tested	07/15/2016
Initial Moisture Content (%)	11.4	Initial MC Taken	Before Test, From Trimmings				
Initial Dry Density (pcf)	129.1						
At Test Moisture Content (%)	10.9	At Test MC Taken	After Test, From Center of Specimen				
At Test Dry Density (pcf)	129.7						
Specific Gravity	N/A						
Degree of Saturation (%)	N/A			Unconfined Compressive Strength (tsf)	1.51		
Average Height (in)	5.995			Undrained Shear Strength (tsf)	0.76		
Average Diameter (in)	2.870			Strain at Maximum Stress (%)	15.0		
Height to Diameter Ratio	2.1			Strain rate to failure (% / min.)	1.00		

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf) 4.0

Torvane Reading (kg/cm^2) N/A

Comments

3C

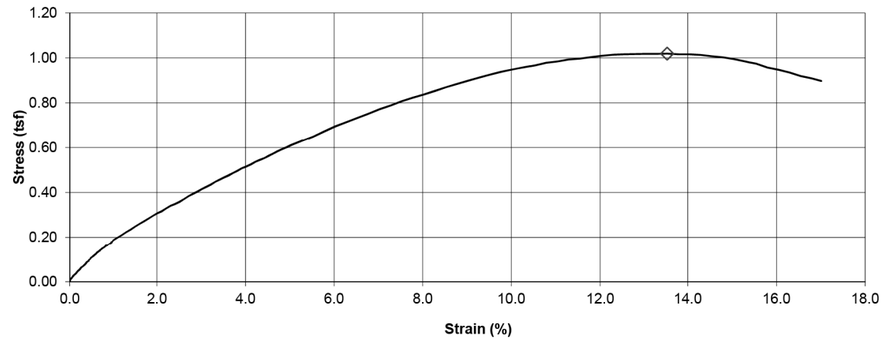
Classification data taken from SS-1 (depth 2.5' to 4.0')

Unconfined Compressive Strength of Cohesive Soil

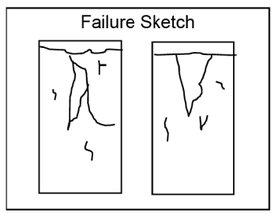
ASTM D 2166

Project Name	HAM-71-6.86					Project Number	173620049
Source	B-015-1-15, 5.0'-7.0'					Lab ID	386B
Visual Description	Silt with Sand (ML), gray brown, moist, firm						
Classification	Sandy Silt, A-4a (1)					Recovered	1.1'
Atterberg Limits	LL 24	PL 14	PI 10			Test Interval	5.5' - 6.0'
Gradation	%GR 28	%CS 9	%FS 24				
	%SI 23	%CL 16				Date Extruded	06/06/2016
Initial Wet Density (pcf)	134.1					Date Tested	06/17/2016
Initial Moisture Content (%)	N/A	Initial MC Taken	N/A				
Initial Dry Density (pcf)	N/A						
At Test Moisture Content (%)	16.2	At Test MC Taken	After Test, From Center of Specimen				
At Test Dry Density (pcf)	115.5						
Specific Gravity	N/A						
Degree of Saturation (%)	N/A			Unconfined Compressive Strength (tsf)	1.02		
Average Height (in)	6.098			Undrained Shear Strength (tsf)	0.51		
Average Diameter (in)	2.787			Strain at Maximum Stress (%)	13.5		
Height to Diameter Ratio	2.2			Strain rate to failure (% / min.)	1.00		

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf) 1.0

Torvane Reading (kg/cm^2) N/A

Comments

Classification data taken from SS-2 (depth 2.5' to 4.0')

DRAWN MSJ
CHECKED EMK

SUBSURFACE EXPLORATION
LABORATORY TEST DATA

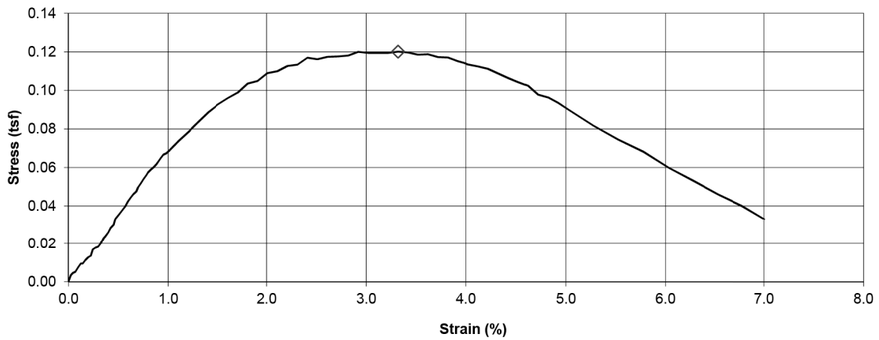
HAM-71-6.86

Unconfined Compressive Strength of Cohesive Soil

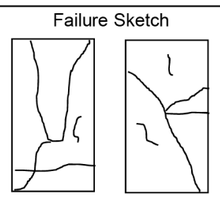
ASTM D 2166

Project Name	HAM-71-6.86					Project Number	173620049
Source	B-015-1-15, 15.0'-17.0'					Lab ID	387B
Visual Description	Poorly Graded Sand (SP), brown, wet, very soft						
Classification	Sandy Silt, A-4a (2)					Recovered	1.4'
Atterberg Limits	LL 18	PL 17	PI 1			Test Interval	15.5' - 16.0'
Gradation	%GR 6	%CS 7	%FS 42				
	%SI 35	%CL 10				Date Extruded	06/06/2016
Initial Wet Density (pcf)	125.3					Date Tested	06/17/2016
Initial Moisture Content (%)	N/A	Initial MC Taken	N/A				
Initial Dry Density (pcf)	N/A						
At Test Moisture Content (%)	22.8	At Test MC Taken	After Test, From Center of Specimen				
At Test Dry Density (pcf)	102.0						
Specific Gravity	N/A						
Degree of Saturation (%)	N/A			Unconfined Compressive Strength (tsf)	0.12		
Average Height (in)	6.067			Undrained Shear Strength (tsf)	0.06		
Average Diameter (in)	2.804			Strain at Maximum Stress (%)	3.3		
Height to Diameter Ratio	2.2			Strain rate to failure (% / min.)	1.00		

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf) 1.0

Torvane Reading (kg/cm^2) N/A

Comments

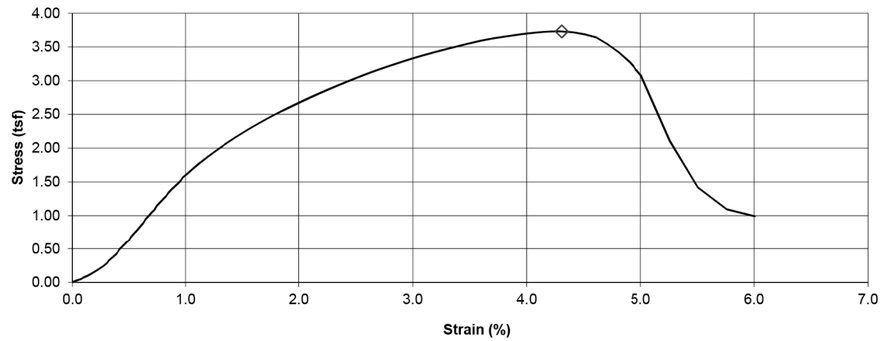
Classification data taken from SS-6 (depth 17.5' to 19.0')

Unconfined Compressive Strength of Cohesive Soil

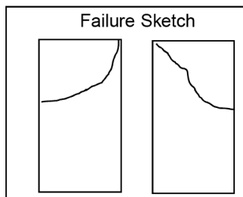
ASTM D 2166

Project Name	HAM-71-6.86					Project Number	173620049
Source	B-015-1-15, 35.0'-37.0'					Lab ID	389B
Visual Description	Silt, gray brown, moist, hard						
Classification	Silt, A-4b (8)					Recovered	1.1'
Atterberg Limits	LL 23	PL 15	PI 8			Test Interval	35.5' - 36.0'
Gradation	%GR 5	%CS 5	%FS 10				
	%SI 52	%CL 28				Date Extruded	06/06/2016
Initial Wet Density (pcf)	139.0					Date Tested	06/17/2016
Initial Moisture Content (%)	N/A	Initial MC Taken	N/A				
Initial Dry Density (pcf)	N/A						
At Test Moisture Content (%)	19.4	At Test MC Taken	After Test, From Center of Specimen				
At Test Dry Density (pcf)	116.5						
Specific Gravity	N/A						
Degree of Saturation (%)	N/A			Unconfined Compressive Strength (tsf)	3.73		
Average Height (in)	6.081			Undrained Shear Strength (tsf)	1.86		
Average Diameter (in)	2.758			Strain at Maximum Stress (%)	4.3		
Height to Diameter Ratio	2.2			Strain rate to failure (% / min.)	1.00		

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf) >4.5

Torvane Reading (kg/cm^2) N/A

Comments

Classification data taken from SS-10 (depth 30.0' to 31.5')

DRAWN MSJ

CHECKED EMK

SUBSURFACE EXPLORATION

LABORATORY TEST DATA

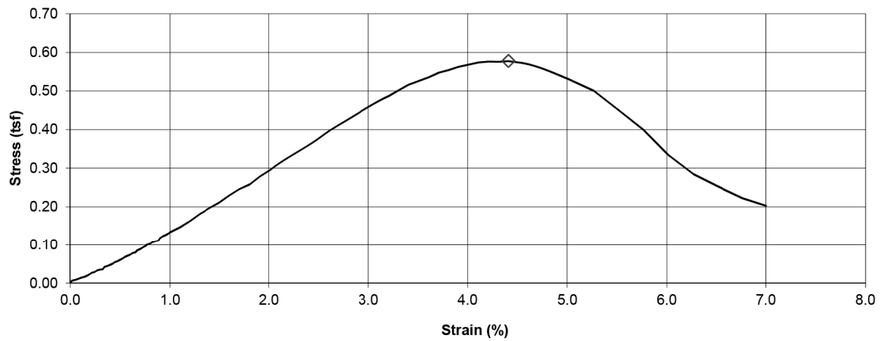
HAM-71-6.86

Unconfined Compressive Strength of Cohesive Soil

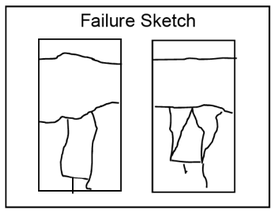
ASTM D 2166

Project Name	HAM-71-6.86						Project Number	173620049
Source	B-016-1-15, 25.0'-27.0'						Lab ID	391B
Visual Description	Poorly Graded Sand (SP), brown and gray, wet, soft							
Classification	Silt, A-4b (8)						Recovered	1.3'
Atterberg Limits	LL	NP	PL	NP	PI	NP	Test Interval	25.5' - 26.0'
Gradation	%GR	2	%CS	1	%FS	21		
	%SI	66	%CL	10			Date Extruded	06/06/2016
Initial Wet Density (pcf)	134.2						Date Tested	06/17/2016
Initial Moisture Content (%)	N/A	Initial MC Taken	N/A					
Initial Dry Density (pcf)	N/A							
At Test Moisture Content (%)	18.3	At Test MC Taken	After Test, From Center of Specimen					
At Test Dry Density (pcf)	113.5							
Specific Gravity	N/A							
Degree of Saturation (%)	N/A	Unconfined Compressive Strength (tsf)	0.58					
Average Height (in)	6.072	Undrained Shear Strength (tsf)	0.29					
Average Diameter (in)	2.802	Strain at Maximum Stress (%)	4.4					
Height to Diameter Ratio	2.2	Strain rate to failure (% / min.)	1.00					

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf) 1.5

Torvane Reading (kg/cm^2) N/A

Comments

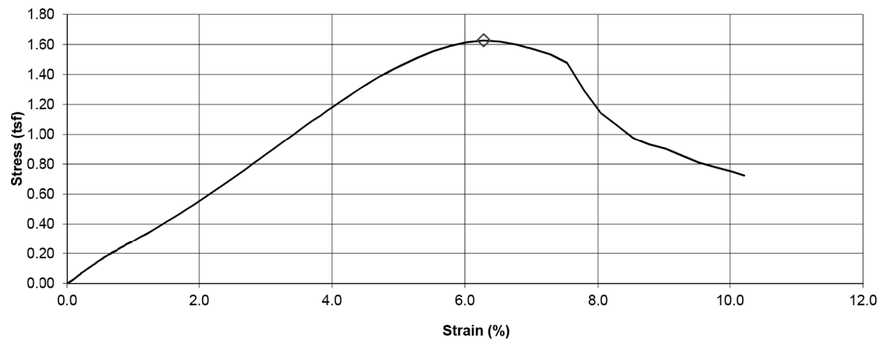
Classification data taken from SS-10 (depth 27.5' to 29.0')

Unconfined Compressive Strength of Cohesive Soil

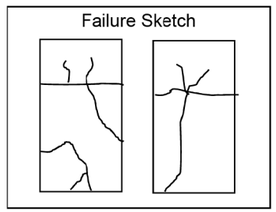
ASTM D 2166

Project Name	HAM-71-6.86						Project Number	173620049
Source	B-035-1-15, 25.0'-27.0'						Lab ID	395B
Visual Description	Lean Clay with Sand (CL), brown, moist, firm							
Classification	Silt and Clay, A-6a (9)						Recovered	1.1'
Atterberg Limits	LL	30	PL	17	PI	13	Test Interval	25.5' - 26.0'
Gradation	%GR	0	%CS	0	%FS	3		
	%SI	43	%CL	54			Date Extruded	06/06/2016
Initial Wet Density (pcf)	130.0						Date Tested	06/17/2016
Initial Moisture Content (%)	N/A	Initial MC Taken	N/A					
Initial Dry Density (pcf)	N/A							
At Test Moisture Content (%)	20.6	At Test MC Taken	After Test, From Center of Specimen					
At Test Dry Density (pcf)	107.8							
Specific Gravity	N/A							
Degree of Saturation (%)	N/A	Unconfined Compressive Strength (tsf)	1.63					
Average Height (in)	6.055	Undrained Shear Strength (tsf)	0.81					
Average Diameter (in)	2.845	Strain at Maximum Stress (%)	6.3					
Height to Diameter Ratio	2.1	Strain rate to failure (% / min.)	1.00					

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf) 2.0

Torvane Reading (kg/cm^2) N/A

Comments

Classification data taken from SS-10 (depth 35.0' to 36.5')

DRAWN MSJ

CHECKED EMK

SUBSURFACE EXPLORATION

LABORATORY TEST DATA

HAM-71-6.86

Unconsolidated Undrained Triaxial Compression

ASTM D 2850

Project Name HAM-71-6.86
Source B-015-1-15, 5.0'-5.5'
Description Silt with Sand (ML), gray brown, moist, firm
Specimen Type Intact
Specific Gravity 2.65 ASTM D 854, A
Classification Sandy Silt, A-4a (1) Classification data taken from SS-2 (depth 2.5' to 4.0')

Project No. 173620049
Lab ID 386A
Test ID 386A-A
Date Received 06/02/2016
Date Tested 06/20/2016

LL	24	%GR	28
PL	14	%CS	9
PI	10	%FS	24
		%SI	23
Pocket Pen	1.0	%CL	16

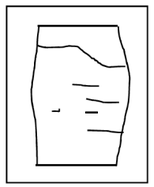
Target Test Parameters

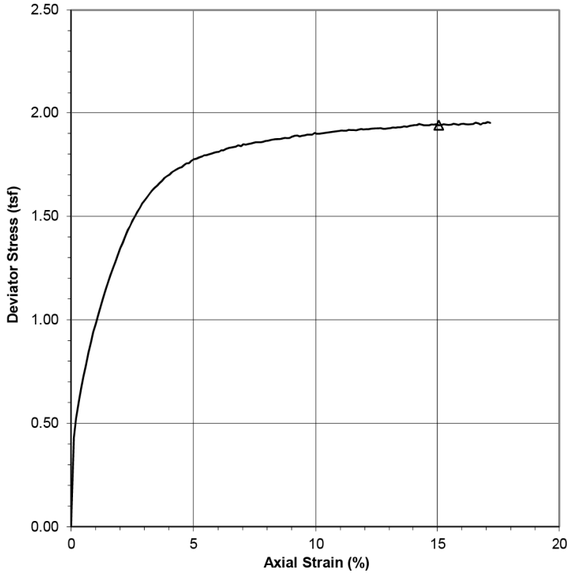
Nominal Chamber Pressure (psi) 10
Actual Axial Strain Rate of Test (%/min) 0.597

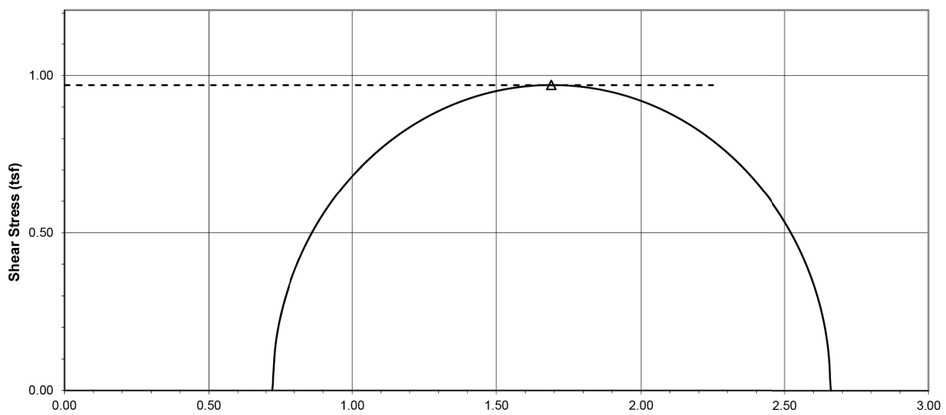
At Unconsolidated Undrained Failure

Failure Criterion: 15% Axial Strain
Axial Strain (%) 15.05
Deviator Stress (tsf) 1.939
Minor Principal Stress, σ_3 (tsf) 0.722
Major Principal Stress, σ_1 (tsf) 2.661
Undrained Shear Strength, S_u (tsf) 0.969

Failure Sketch







Unconsolidated Undrained Triaxial Compression

ASTM D 2850

Project Name HAM-71-6.86
Source B-015-1-15, 15.0'-15.5'
Description Poorly Graded Sand (SP), brown, wet, very soft
Specimen Type Intact
Specific Gravity 2.67 ASTM D 854, A
Classification Sandy Silt, A-4a (2) Classification data taken from SS-6 (depth 17.5' to 19.0')

Project No. 173620049
Lab ID 387A
Test ID 387A-A
Date Received 06/02/2016
Date Tested 06/20/2016

LL	18	%GR	6
PL	17	%CS	7
PI	1	%FS	42
		%SI	35
Pocket Pen	1.0	%CL	10

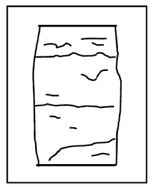
Target Test Parameters

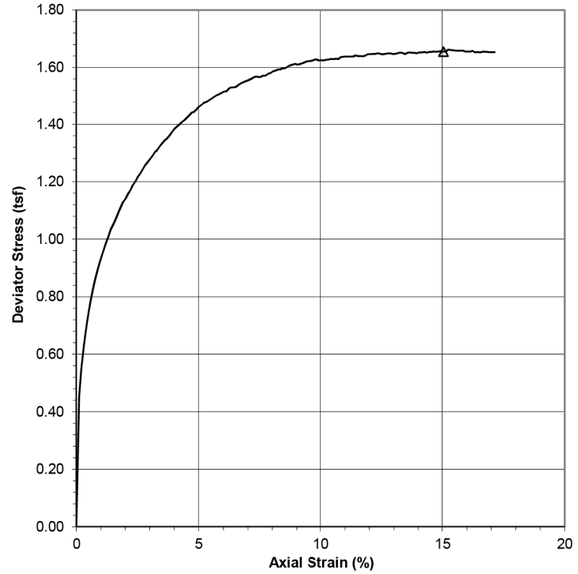
Nominal Chamber Pressure (psi) 10
Actual Axial Strain Rate of Test (%/min) 0.599

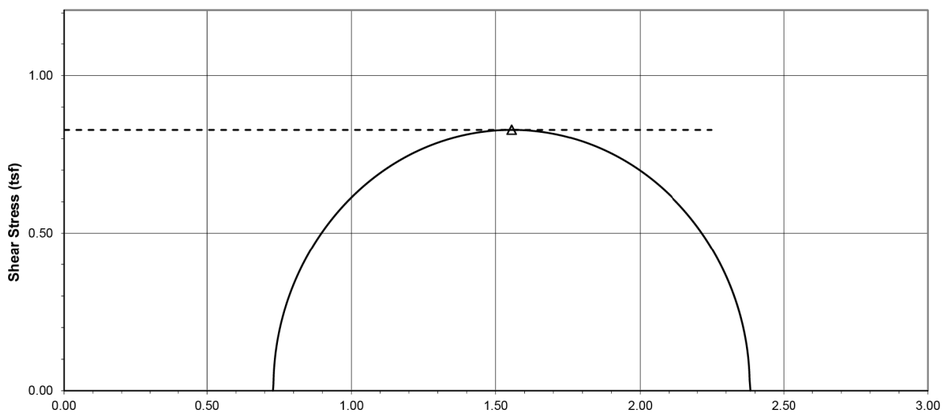
At Unconsolidated Undrained Failure

Failure Criterion: 15% Axial Strain
Axial Strain (%) 15.04
Deviator Stress (tsf) 1.655
Minor Principal Stress, σ_3 (tsf) 0.728
Major Principal Stress, σ_1 (tsf) 2.384
Undrained Shear Strength, S_u (tsf) 0.828

Failure Sketch







DRAWN MSJ
CHECKED EMK

SUBSURFACE EXPLORATION
LABORATORY TEST DATA

HAM-71-6.86

Unconsolidated Undrained Triaxial Compression

ASTM D 2850

Project Name HAM-71-6.86
Source B-016-1-15, 25.0'-25.5'
Description Poorly Graded Sand (SP), brown and gray, wet, soft
Specimen Type Intact
Specific Gravity 2.69 ASTM D 854, A
Classification Silt, A-4b (8) Classification data taken from SS-10 (depth 27.5' to 29.0')

Project No. 173620049
Lab ID 391A
Test ID 391A-A
Date Received 06/02/2016
Date Tested 06/20/2016

LL	NP	%GR	2
PL	NP	%CS	1
PI	NP	%FS	21
		%SI	66
Pocket Pen	1.5	%CL	10

Target Test Parameters

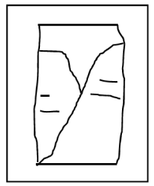
Nominal Chamber Pressure (psi)	20
Actual Axial Strain Rate of Test (%/min)	0.605

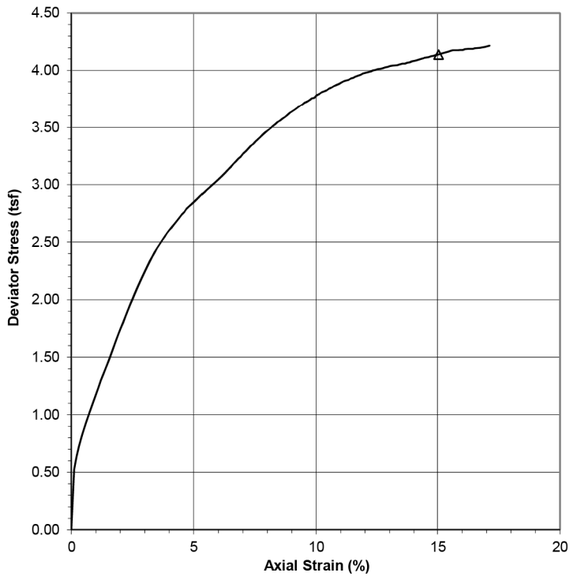
At Unconsolidated Undrained Failure

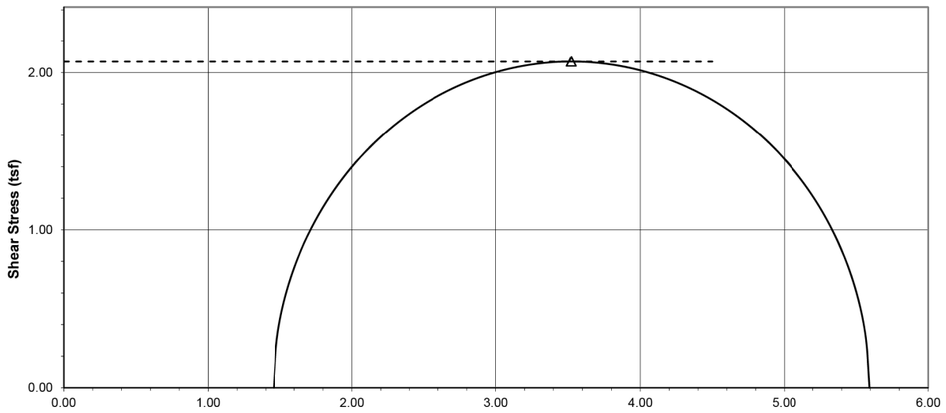
Failure Criterion: 15% Axial Strain

Axial Strain (%)	15.03
Deviator Stress (tsf)	4.138
Minor Principal Stress, σ_3 (tsf)	1.455
Major Principal Stress, σ_1 (tsf)	5.593
Undrained Shear Strength, S_u (tsf)	2.069

Failure Sketch







Unconsolidated Undrained Triaxial Compression

ASTM D 2850

Project Name HAM-71-6.86
Source B-030-1-15, 8.4'-8.9'
Description Lean Clay with Gravel (CL), gray, moist, firm
Specimen Type Intact
Specific Gravity 2.74 ASTM D 854, A
Classification Silty Clay, A-6b (10) Classification data taken from SS-2 (depth 5.0' to 6.5')

Project No. 173620049
Lab ID 399B
Test ID 399B-A
Date Received 06/15/2016
Date Tested 07/13/2016

LL	34	%GR	1
PL	18	%CS	3
PI	16	%FS	15
		%SI	51
Pocket Pen	1.0	%CL	30

Target Test Parameters

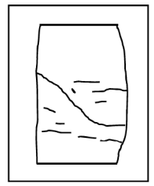
Nominal Chamber Pressure (psi)	10
Actual Axial Strain Rate of Test (%/min)	0.896

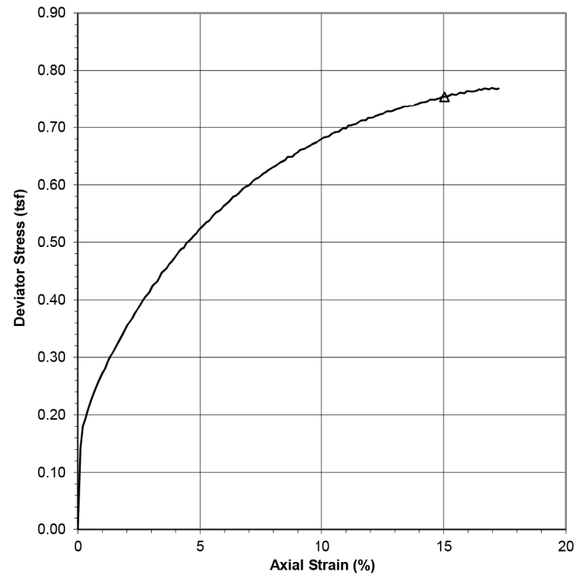
At Unconsolidated Undrained Failure

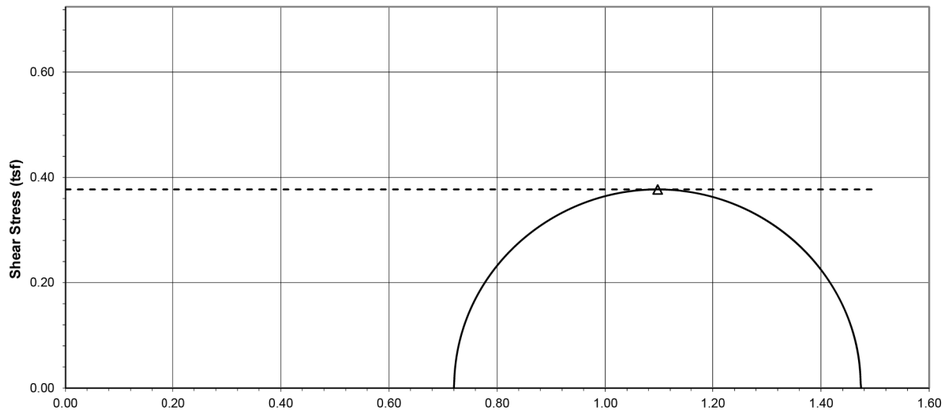
Failure Criterion: 15% Axial Strain

Axial Strain (%)	15.03
Deviator Stress (tsf)	0.754
Minor Principal Stress, σ_3 (tsf)	0.720
Major Principal Stress, σ_1 (tsf)	1.474
Undrained Shear Strength, S_u (tsf)	0.377

Failure Sketch







DRAWN MSJ
CHECKED EMK

SUBSURFACE EXPLORATION
LABORATORY TEST DATA

HAM-71-6.86

Unconsolidated Undrained Triaxial Compression

ASTM D 2850

Project Name HAM-71-6.86 | Project No. 173620049
Source B-035-1-15, 25.0'-25.5' | Lab ID 395A
Description Lean Clay with Sand (CL), brown, moist, firm | Test ID 395A-A
Specimen Type Intact
Specific Gravity 2.73 ASTM D 854, A | Date Received 06/02/2016
Classification Silt and Clay, A-6a (9) Classification data taken from SS-10 (depth 35.0' to 36.5') | Date Tested 06/20/2016

LL	30	%GR	0
PL	17	%CS	0
PI	13	%FS	3
		%SI	43
Pocket Pen	2.0	%CL	54

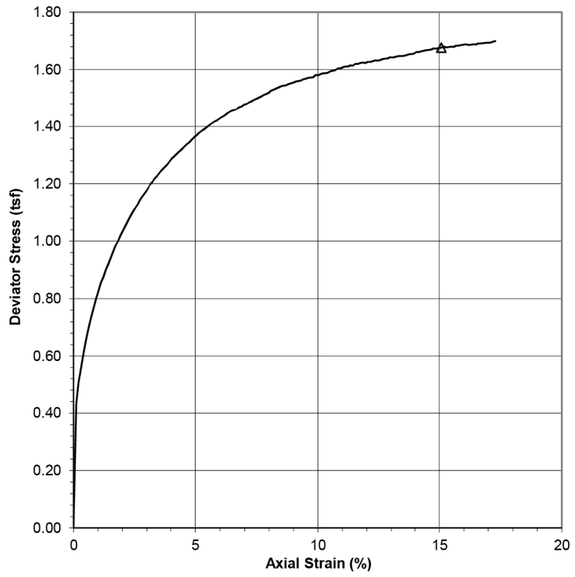
Target Test Parameters

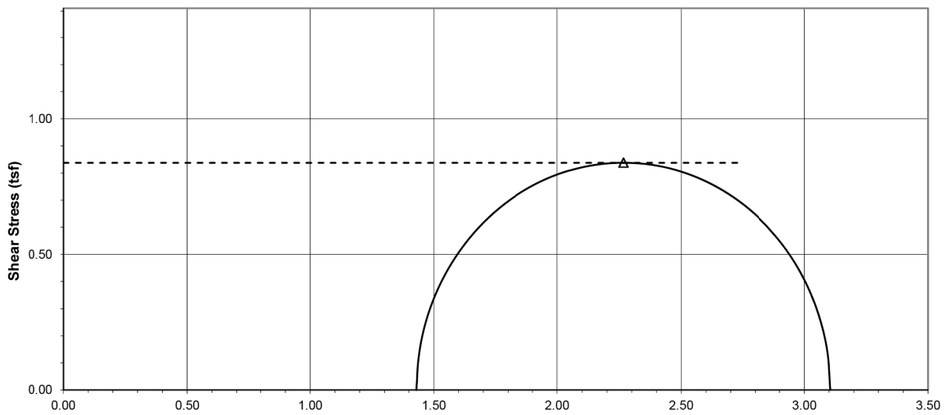
Nominal Chamber Pressure (psi) 20
Actual Axial Strain Rate of Test (%/min) 0.604

At Unconsolidated Undrained Failure

Failure Criterion: 15% Axial Strain
Axial Strain (%) 15.07
Deviator Stress (tsf) 1.676
Minor Principal Stress, σ_3 (tsf) 1.429
Major Principal Stress, σ_1 (tsf) 3.106
Undrained Shear Strength, S_u (tsf) 0.838

Failure Sketch



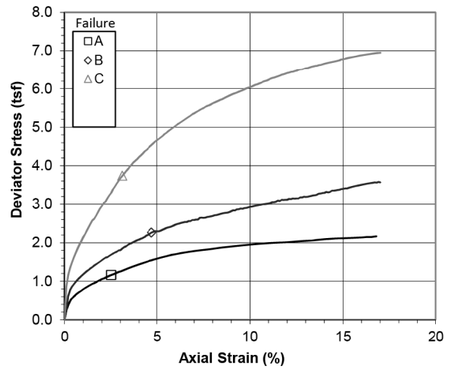


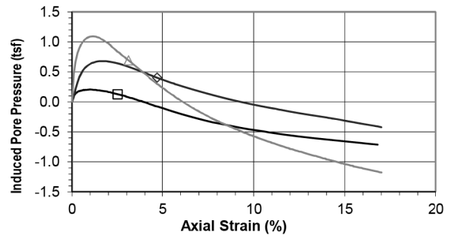
Consolidated Undrained Triaxial Compression

ASTM D 4767

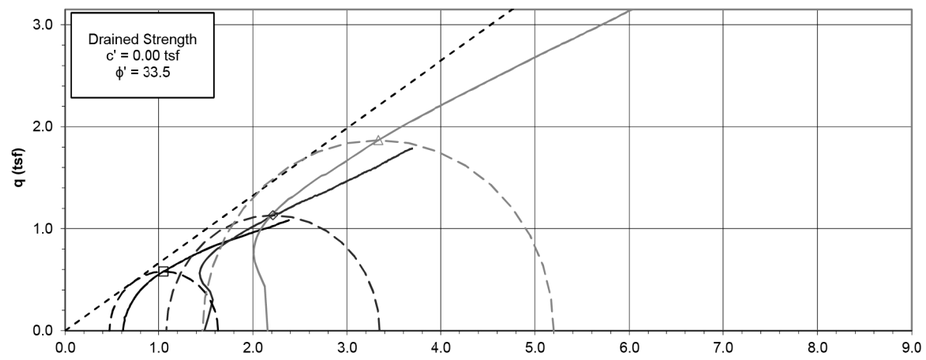
Project Name HAM-71-6.86 | Project 173620049 | Set ID 1

Test	Lab ID	Source	Description	Gs	LL	PL	PI
A	389A	B-015-1-15, 35.0'-35.5'	Fat Clay (CH), gray brown, moist, hard	2.74	23	15	8
B	385A	B-015-0-15, 20.0'-20.5'	Lean Clay w/Gravel (CL), gray brown, moist, firm	2.75	23	14	9
C	385B	B-015-0-15, 20.5'-21.0'	Lean Clay w/Gravel (CL), gray brown, moist, firm	2.75	23	14	9
Specimen A classification data from SS-10 (A-4b, GR=5, CS=5, FS=10, SI=52, CL=28)							
Specimen B and C classification data from SS-6 (A-4a, GR=13, CS=9, FS=13, SI=38, CL=27)							





Specimen	A	B	C		
	Initial Specimen Conditions				
Average Height (in)	6.080	6.058	6.095		
Average Diameter (in)	2.854	2.870	2.867		
Moist Unit Weight (pcf)	131.8	135.3	146.3		
Moisture Content (%)	18.7	14.1	10.1		
Dry Unit Weight (pcf)	111.0	118.6	132.9		
Void Ratio	0.539	0.445	0.289		
Degree of Saturation (%)	95.3	87.2	95.9		
	Consolidated Specimen Conditions				
Moist Unit Weight (pcf)	132.3	139.1	147.4		
Moisture Content (%)	20.1	15.3	10.2		
Dry Unit Weight (pcf)	110.2	120.7	133.7		
Void Ratio	0.549	0.420	0.282		
Degree of Saturation (%)	100.0	100.0	100.0		
Eff. Con. Stress, σ_3' (tsf)	0.614	1.486	2.158		
	At Drained Failure				
Failure Criterion	Max. Eff. Prin. Stress Ratio				
Axial Strain (%)	2.503	4.702	3.103		
Deviator Stress (tsf)	1.160	2.263	3.735		
Induced Pore Press. (tsf)	0.128	0.404	0.694		
Minor Eff. Stress, σ_3' (tsf)	0.471	1.082	1.465		
Major Eff. Stress, σ_1' (tsf)	1.631	3.346	5.200		
Eff. Stress Ratio, σ_1'/σ_3'	3.463	3.091	3.550		
p' (tsf)	1.051	2.214	3.332		
q (tsf)	0.580	1.132	1.868		



DRAWN MSJ
CHECKED EMK

SUBSURFACE EXPLORATION
LABORATORY TEST DATA

HAM-71-6.86

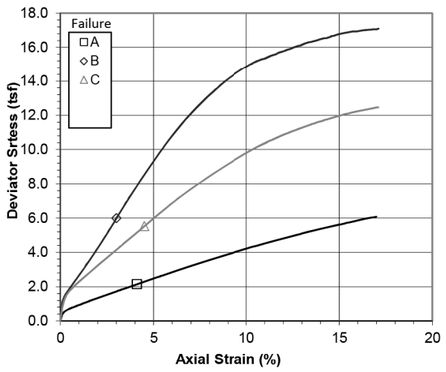
Consolidated Undrained Triaxial Compression

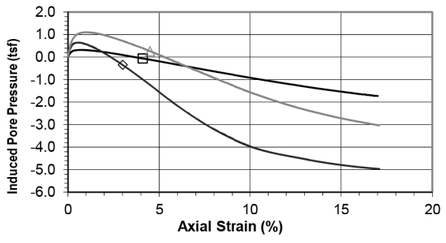
ASTM D 4767

Project Name HAM-71-6.86

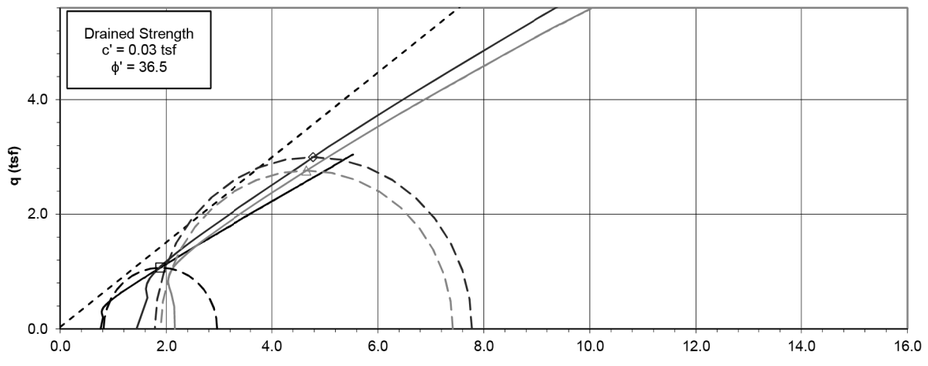
Project 173620049
Set ID 2

Test	Lab ID	Source	Description	Gs	LL	PL	PI
A	388A	B-015-1-15, 25.0'-25.5'	Poorly Graded Sand (SP), brown and gray, moist, soft	2.74	18	17	1
B	388B	B-015-1-15, 25.5'-26.0'	Silt with Sand (ML), brown and gray, wet, soft	2.74	18	17	1
C	388C	B-015-1-15, 26.1'-26.6'	Silt with Sand (ML), brown and gray, wet, soft	2.74	18	17	1
Classification data from SS-6 (A-4a, GR=6, CS=7, FS=42, SI=35, CL=10)							





Specimen	A	B	C		
	Initial Specimen Conditions				
Average Height (in)	5.890	5.923	6.012		
Average Diameter (in)	2.765	2.810	2.864		
Moist Unit Weight (pcf)	138.3	142.8	138.0		
Moisture Content (%)	18.3	16.2	16.7		
Dry Unit Weight (pcf)	116.9	122.9	118.3		
Void Ratio	0.461	0.389	0.444		
Degree of Saturation (%)	108.9	114.0	103.1		
	Consolidated Specimen Conditions				
Moist Unit Weight (pcf)	138.8	139.8	139.3		
Moisture Content (%)	15.2	14.6	14.9		
Dry Unit Weight (pcf)	120.5	121.9	121.2		
Void Ratio	0.417	0.400	0.409		
Degree of Saturation (%)	100.0	100.0	100.0		
Eff. Con. Stress, σ_3' (tsf)	0.761	1.439	2.159		
	At Drained Failure				
Failure Criterion	Max. Eff. Prin. Stress Ratio				
Axial Strain (%)	4.100	3.002	4.498		
Deviator Stress (tsf)	2.138	5.994	5.525		
Induced Pore Press. (tsf)	-0.059	-0.344	0.268		
Minor Eff. Stress, σ_3' (tsf)	0.819	1.783	1.891		
Major Eff. Stress, σ_1' (tsf)	2.957	7.776	7.415		
Eff. Stress Ratio, σ_1'/σ_3'	3.609	4.363	3.922		
p' (tsf)	1.888	4.779	4.653		
q (tsf)	1.069	2.997	2.762		



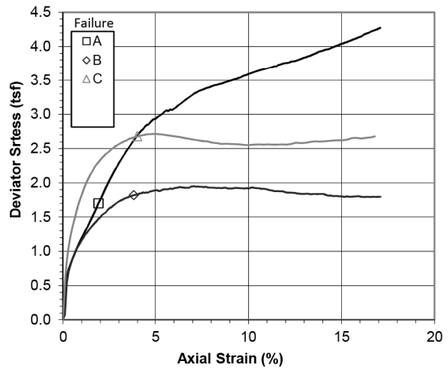
Consolidated Undrained Triaxial Compression

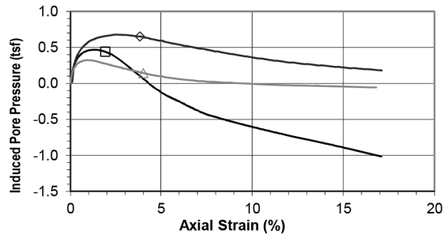
ASTM D 4767

Project Name HAM-71-6.86

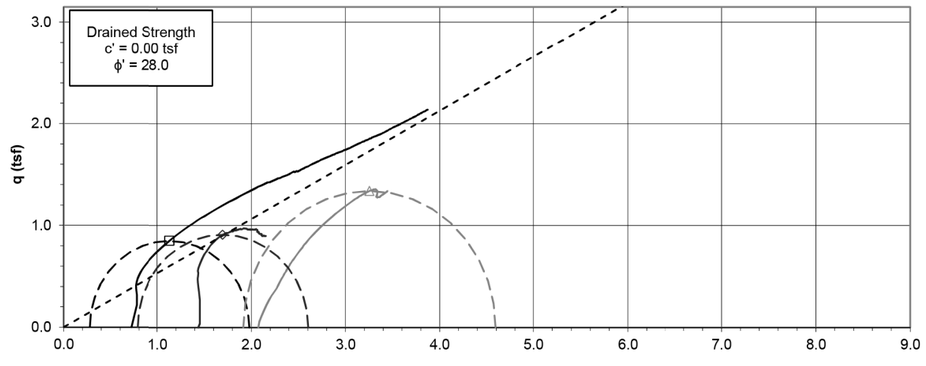
Project 173620049
Set ID 3

Test	Lab ID	Source	Description	Gs	LL	PL	PI
A	393A	B-033-1-15, 10.0'-10.5'	Silt with Sand (ML), brown, moist, firm	2.77	26	19	7
B	394A	B-035-1-15, 10.0'-10.5'	Silt with Sand (ML), brown, moist, firm	2.66	23	13	10
C	394B	B-035-1-15, 10.5'-11.0'	Silt with Sand (ML), gray and brown, moist, firm	2.66	23	13	10
Specimen A classification data from SS-4 (A-4b, GR=1, CS=2, FS=6, SI=70, CL=21)							
Specimen B and C classification data from SS-2 (A-4a, GR=38, CS=12, FS=13, SI=22, CL=15)							





Specimen	A	B	C		
	Initial Specimen Conditions				
Average Height (in)	6.010	6.035	6.064		
Average Diameter (in)	2.867	2.871	2.873		
Moist Unit Weight (pcf)	129.6	126.9	130.6		
Moisture Content (%)	21.6	21.2	18.5		
Dry Unit Weight (pcf)	106.6	104.7	110.2		
Void Ratio	0.620	0.583	0.505		
Degree of Saturation (%)	96.5	96.6	97.6		
	Consolidated Specimen Conditions				
Moist Unit Weight (pcf)	132.1	128.1	131.1		
Moisture Content (%)	21.0	21.5	18.9		
Dry Unit Weight (pcf)	109.2	105.4	110.2		
Void Ratio	0.581	0.572	0.504		
Degree of Saturation (%)	100.0	100.0	100.0		
Eff. Con. Stress, σ_3' (tsf)	0.719	1.438	2.075		
	At Drained Failure				
Failure Criterion	Max. Eff. Prin. Stress Ratio				
Axial Strain (%)	1.902	3.802	3.987		
Deviator Stress (tsf)	1.700	1.819	2.679		
Induced Pore Press. (tsf)	0.440	0.652	0.144		
Minor Eff. Stress, σ_3' (tsf)	0.279	0.786	1.915		
Major Eff. Stress, σ_1' (tsf)	1.979	2.606	4.594		
Eff. Stress Ratio, σ_1'/σ_3'	7.095	3.315	2.399		
p' (tsf)	1.129	1.696	3.255		
q (tsf)	0.850	0.910	1.340		

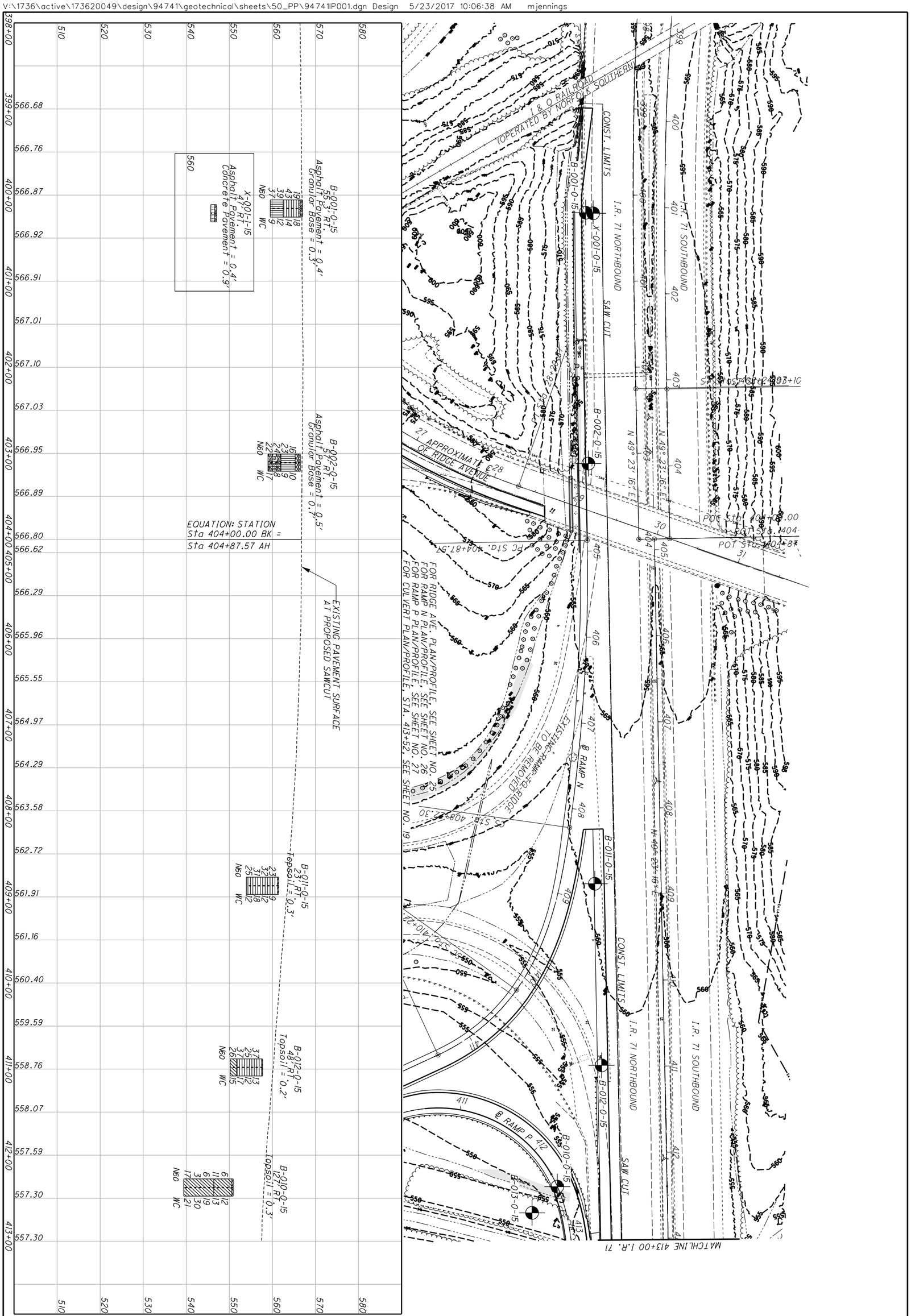


DRAWN MSJ
CHECKED EMK

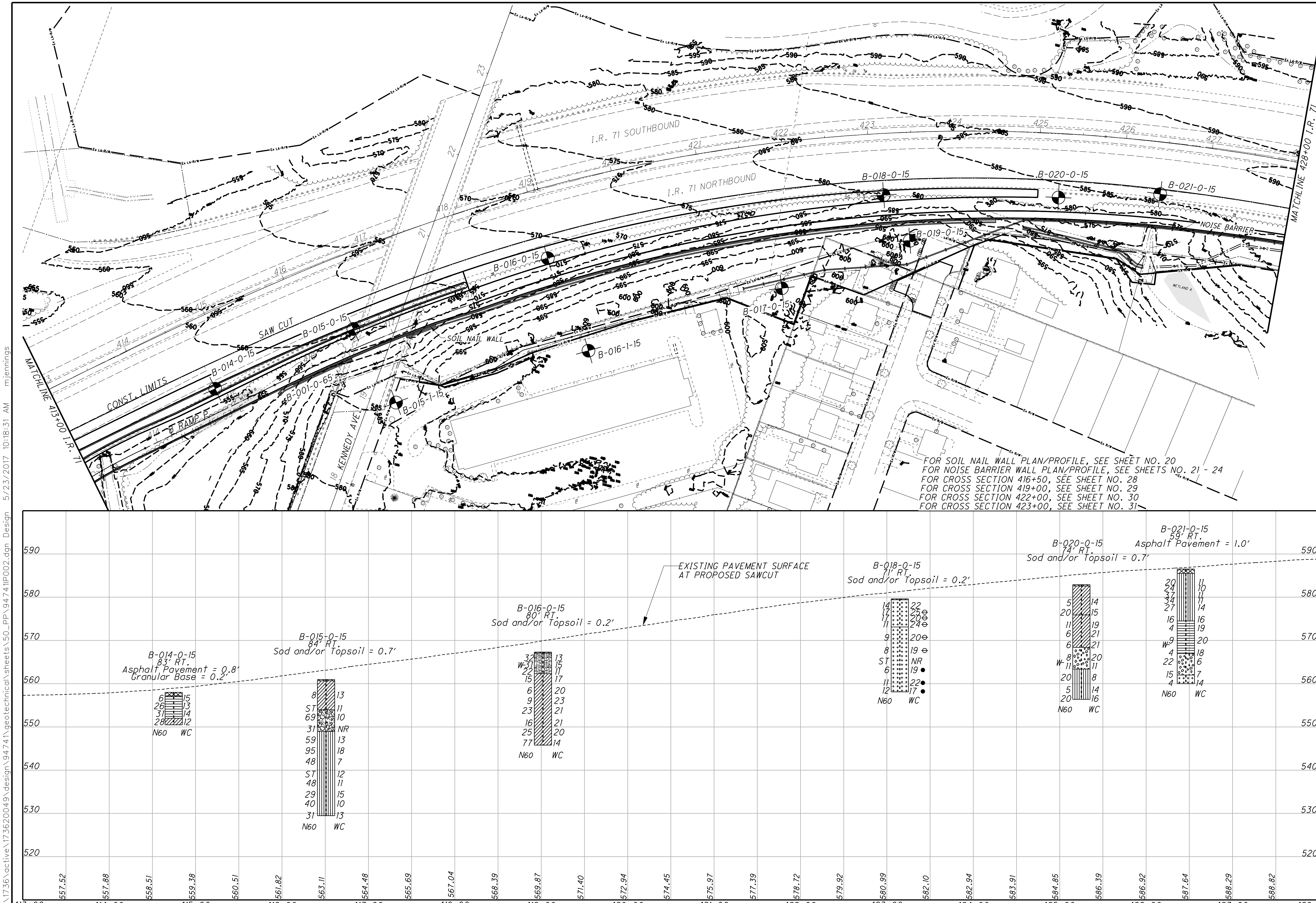
SUBSURFACE EXPLORATION
LABORATORY TEST DATA

HAM-71-6.86

V:\1736\active\173620049\design\94741\geotechnical\sheets\50_PP\94741IP001.dgn Design 5/23/2017 10:06:38 AM mjennings



1	14/44	HAM-71-6.86	SOIL PROFILE STA. 398+00.00 TO 413+00.00 - I.R. 71	DRAWN MSJ CHECKED EMK	0 50 25 100 HORIZONTAL SCALE IN FEET



HORIZONTAL SCALE IN FEET 0 25 50 100

DRAWN MSJ
CHECKED EMK

SOIL PROFILE
STA. 413+00.00 TO 428+00.00 - I.R. 71

HAM-71-6.86

15 / 44

mjennings 5/23/2017 10:18:31 AM Design V:\1736\active\173620049\design\94741\geotechnical\sheets\50_PP\94741IP002.dgn

MATCHLINE 428+00 I.R. 71

MATCHLINE 443+00 I.R. 71

I.R. 71 SOUTHBOUND

I.R. 71 NORTHBOUND

N 89° 28' 00" E

EQUATION: STATION Sta 434+25.00 BK = Sta 435+07.72 AH

B-022-0-15 CONST. LIMITS

SAW CUT

B-024-0-15

B-025-0-15

B-027-0-15

B-028-0-15

B-029-0-15

B-030-0-15

NOISE BARRIER

B-030-1-15

B-030-2-15

CONST. LIMITS

FOR CROSS SECTION 442+00, SEE SHEET NO. 32
FOR NOISE BARRIER WALL PLAN/PROFILE, SEE SHEETS NO. 21 - 24

EXISTING PAVEMENT SURFACE AT PROPOSED SAWCUT

B-022-0-15
61' RT.
Asphalt Pavement = 1.1'

B-024-0-15
76' RT.
Sod and/or Topsoil = 0.3'

B-025-0-15
74' RT.
Sod and/or Topsoil = 0.3'

B-027-0-15
66' RT.
Sod and/or Topsoil = 0.3'

B-028-0-15
61' RT.
Asphalt Pavement = 1.1'
Granular Base = 0.4'

B-029-0-15
60' RT.
Asphalt Pavement = 1.1'
Granular Base = 0.3'

B-030-0-15
61' RT.
Asphalt Pavement = 1.2'
Granular Base = 0.3'

N60 WC

620 610 600 590 580 570 560 550

589.25 589.50 589.65 589.71 589.71 589.69 589.46 589.19 588.77 588.08 587.48 586.91 586.41 586.21 586.02 586.01 586.22 586.63 587.30 588.04 588.95 589.90 590.96 592.38 593.62 594.80 596.09 597.53 598.78

428+00 429+00 430+00 431+00 432+00 433+00 434+00 435+50 436+00 437+00 438+00 439+00 440+00 441+00 442+00 443+00

N

HORIZONTAL SCALE IN FEET
0 25 50 100

DRAWN MSJ
CHECKED EMK

SOIL PROFILE
STA. 428+00.00 TO 443+50.00 - I.R. 71

HAM-71-6.86

16 / 44

1

V:\1736\active\173620049\design\94741\geotechnical\sheets\50_PP\94741IP003.dgn Design 5/23/2017 10:20:12 AM mjennings

I.R. 71 SOUTHBOUND

I.R. 71 NORTHBOUND

N 89° 28' 00" E

CONST. LIMITS

SAW CUT

CONST. LIMITS

MATCHLINE 443+00 I.R. 71

MATCHLINE 458+00 I.R. 71

B-031-0-15

B-446-0-64

B-032-0-15

B-033-0-15

B-033-1-15

FOR CROSS SECTION 454+00, SEE SHEET NO. 33

EXISTING PAVEMENT SURFACE
AT PROPOSED SAWCUT

B-031-0-15
61' RT.
Asphalt Pavement = 1.2'
Granular Base = 0.3'

B-446-0-64
50' RT.
Sod and/or Topsoil = 0.2'

B-032-0-15
60' RT.
Asphalt Pavement = 1.1'
Granular Base = 0.3'

B-033-0-15
60' RT.
Asphalt Pavement = 1.2'
Granular Base = 0.3'

N60 WC

443+00 444+00 445+00 446+00 447+00 448+00 449+00 450+00 451+00 452+00 453+00 454+00 455+00 456+00 457+00

598.78 600.13 601.46 602.69 604.04 605.34 606.68 608.05 609.32 610.53 611.81 613.22 614.46 615.76 616.99 618.43 619.82 621.07 622.42 623.72 625.02 626.31 627.52 628.74 629.82 630.92 631.98 632.94 633.82 634.77

640 630 620 610 600 590 580 570

HORIZONTAL SCALE IN FEET
0 25 50 100

DRAWN MSJ
CHECKED EMK

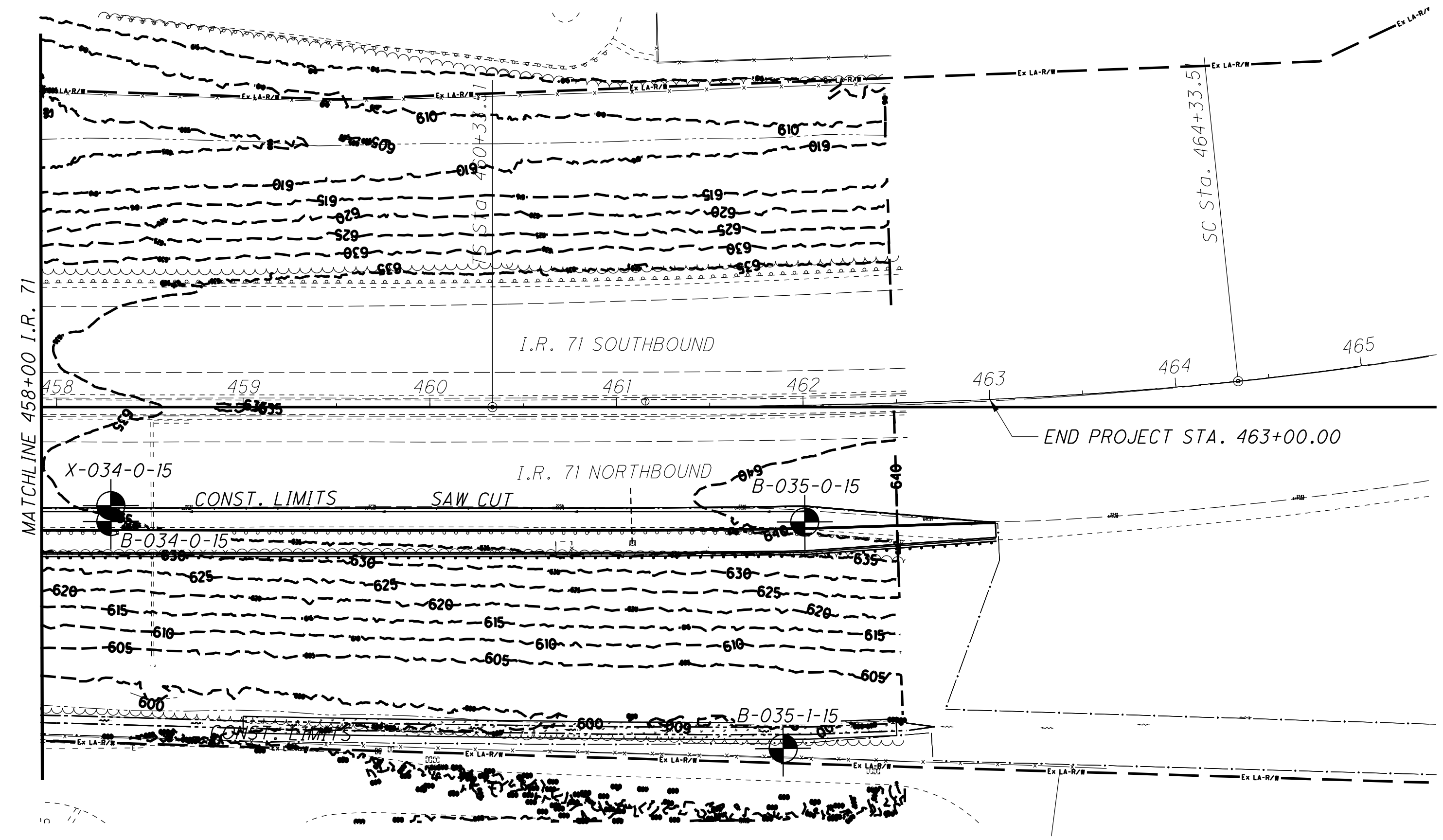
SOIL PROFILE
STA. 443+00.00 TO 458+00.00 - I.R. 71

HAM-71-6.86

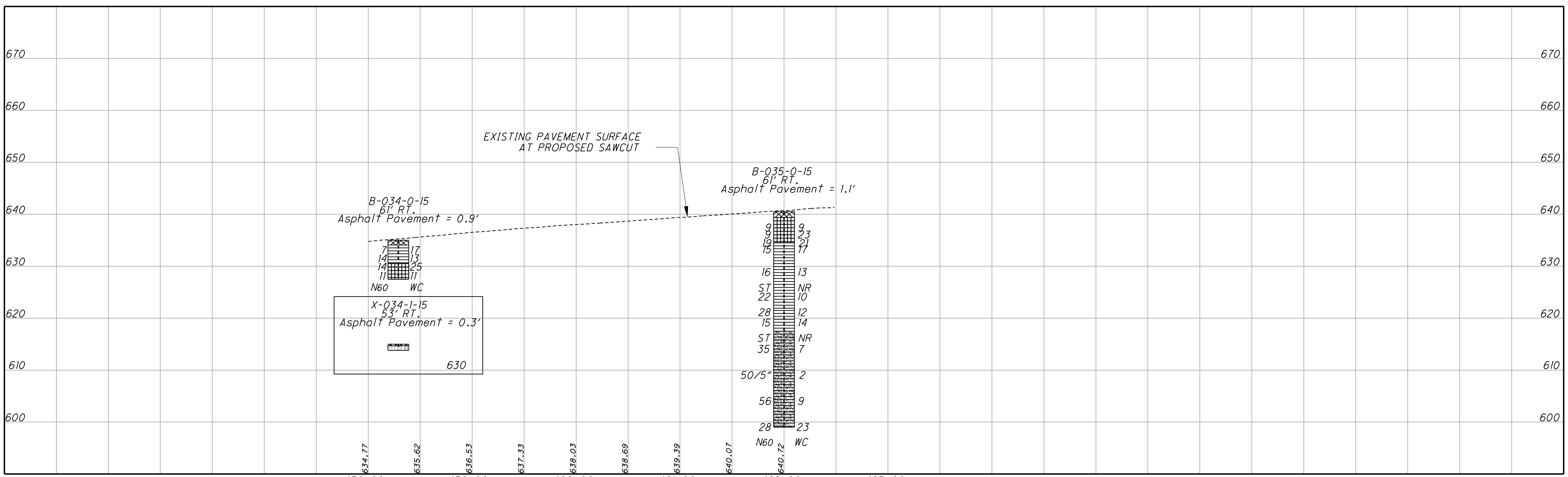
17 / 44

1

V:\1736\active\173620049\design\94741\geotechnical\sheets\50_PP\94741IP004.dgn Design 5/23/2017 10:21:38 AM mjennings



FOR CROSS SECTION 463+00, SEE SHEET NO. 34

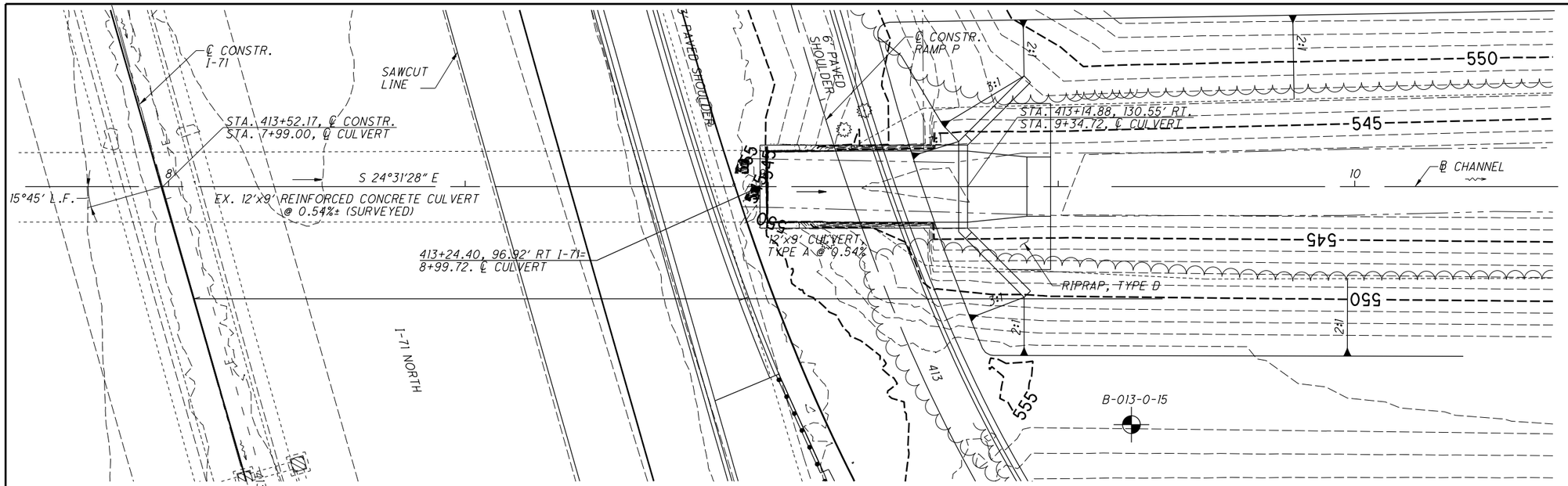


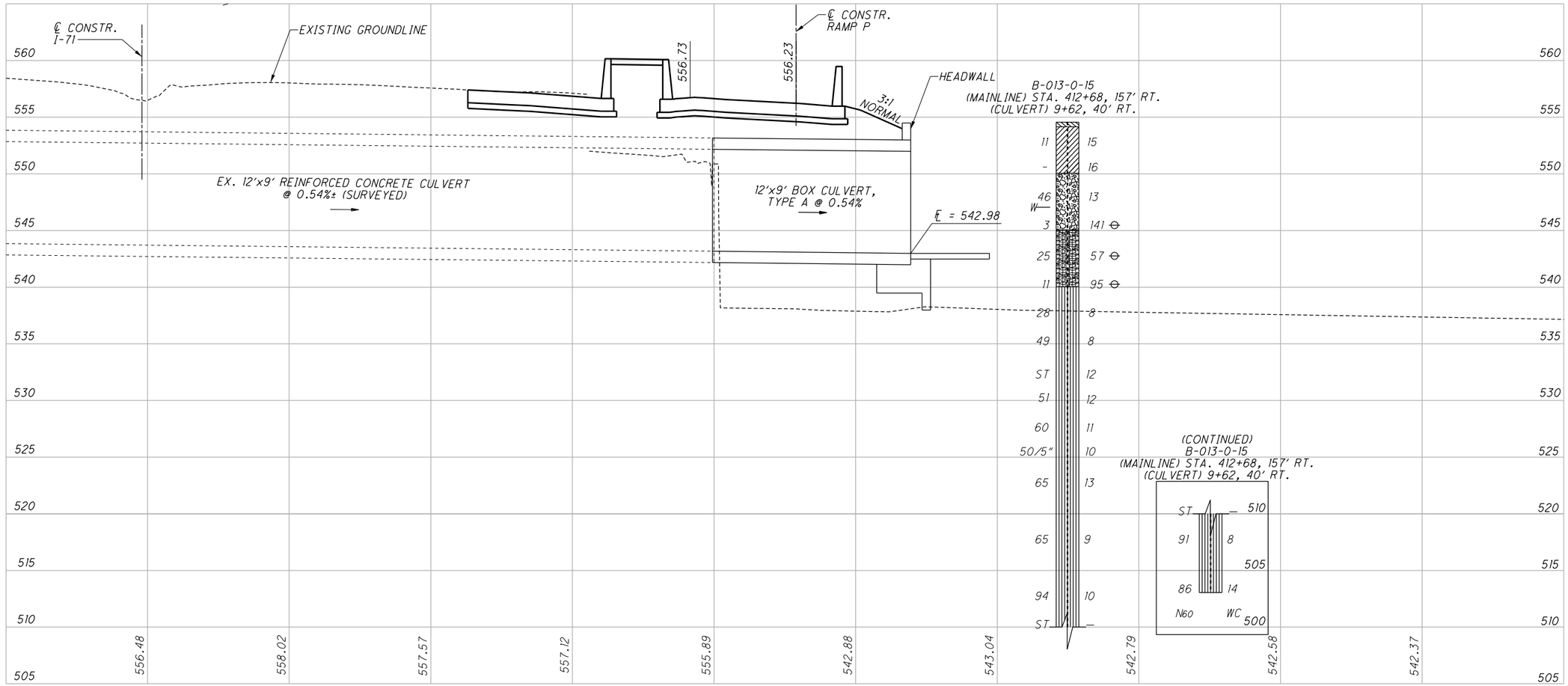
HORIZONTAL SCALE IN FEET
0 25 50 100

DRAWN MSJ
CHECKED EMK

SOIL PROFILE
STA. 458+00.00 TO 463+00.00 - I.R. 71

HAM-71-6.86





V:\1736\active\173620049\design\94741\geotechnical\sheets\94741ZP001.dgn Sheet 5/23/2017 10:30:02 AM mjennings

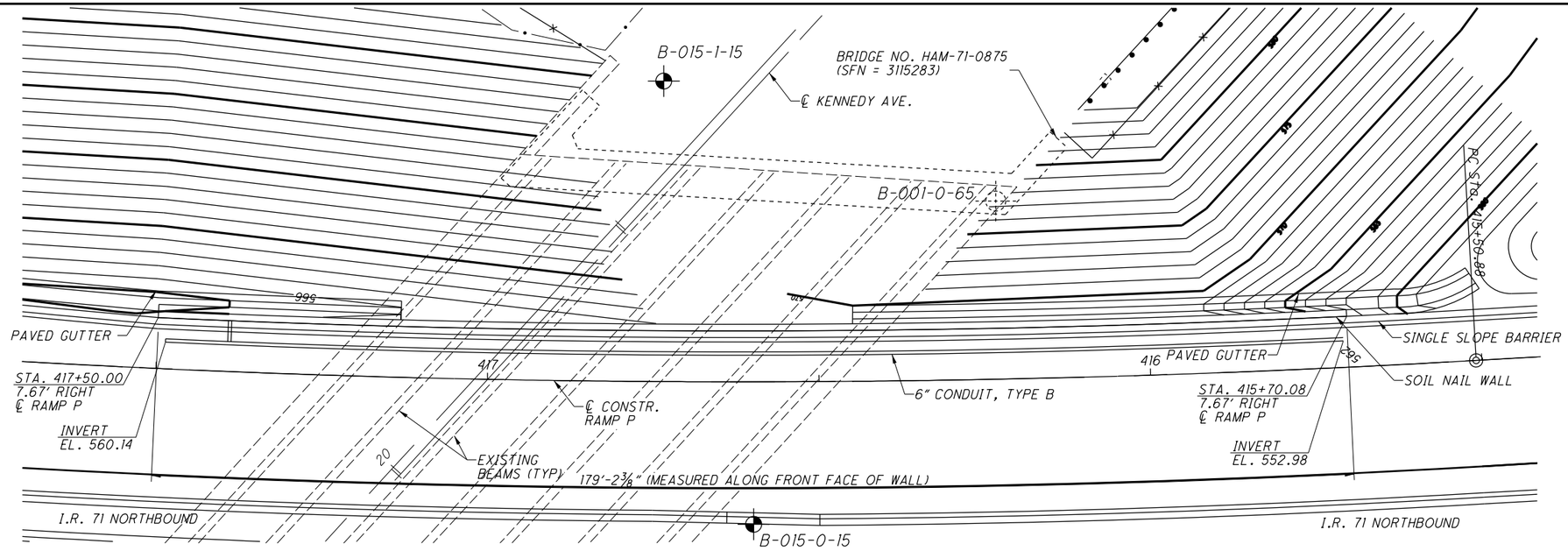
HORIZONTAL SCALE IN FEET
0 5 10 20

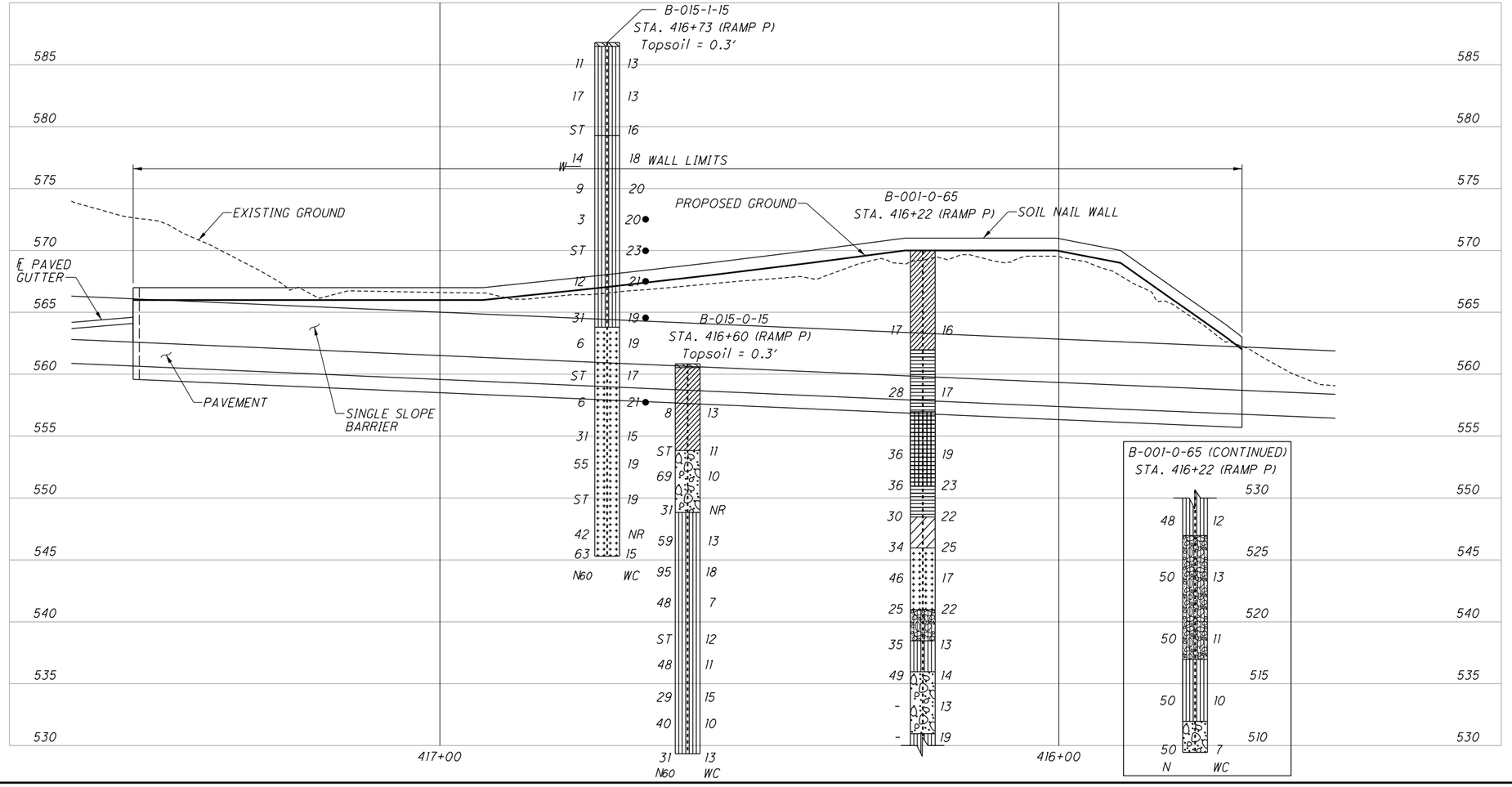
DRAWN MSJ
CHECKED EMK

STRUCTURE FOUNDATION EXPLORATION
CULVERT AT STA. 413+52.17 - I-71

HAM-71-6.86

19 / 44





STRUCTURE FOUNDATION EXPLORATION
SOIL NAIL WALL STA 415+70.08 TO 417+50.00

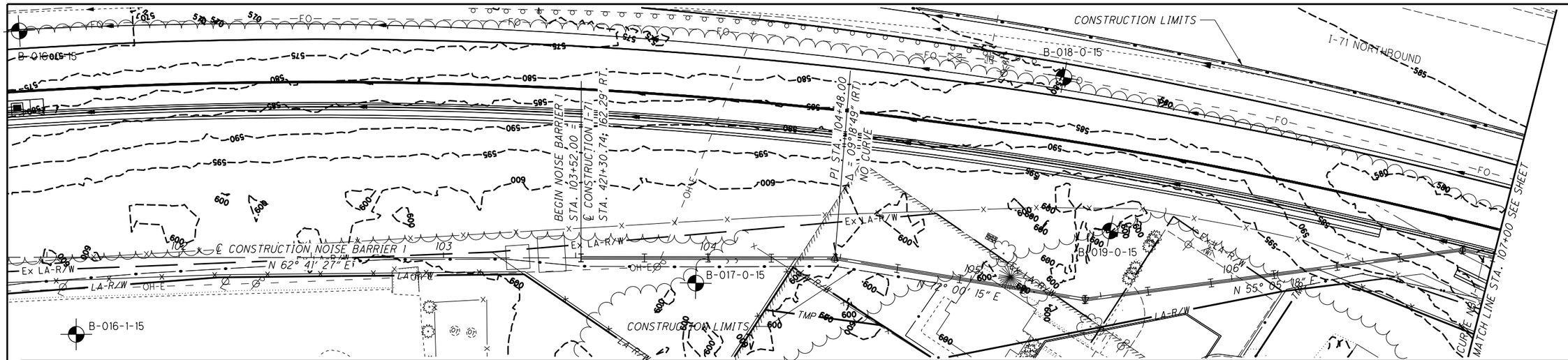
HORIZONTAL SCALE IN FEET
0 5 10 20

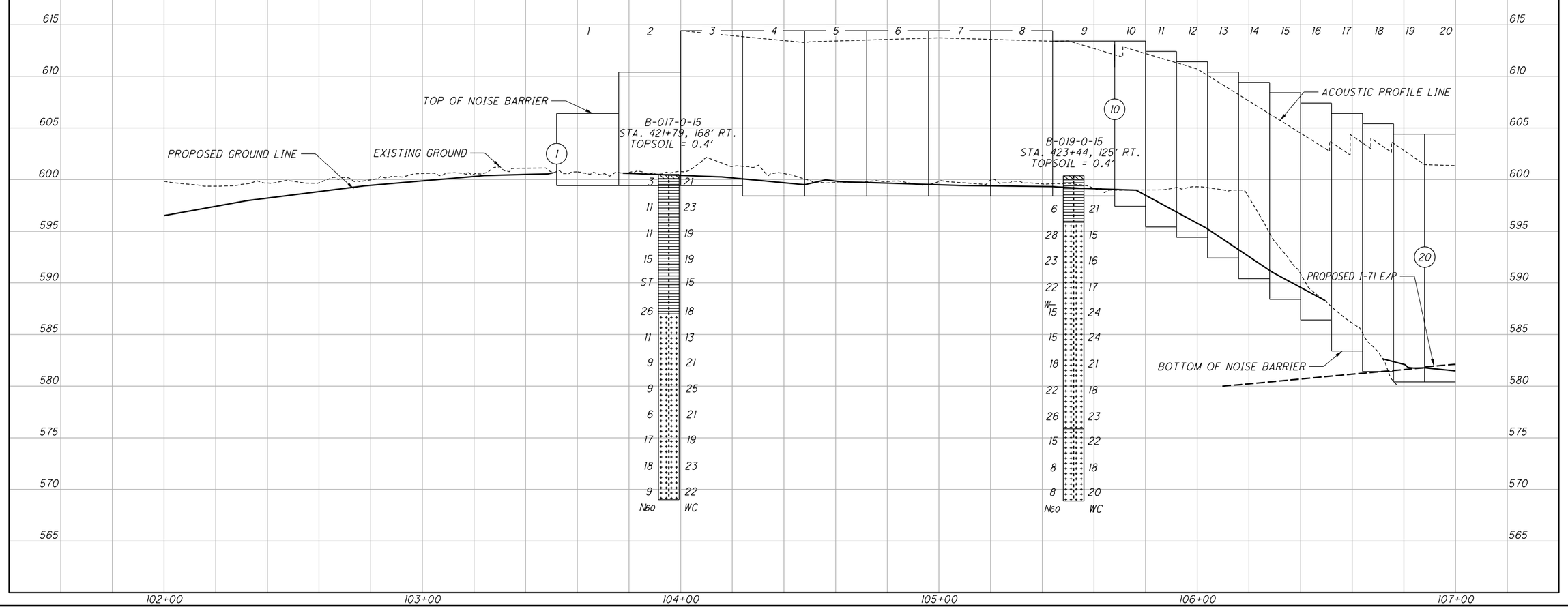
DRAWN MSJ
CHECKED EMK

HAM-71-6.86

20 / 44

1 - -





STRUCTURE FOUNDATION EXPLORATION
NOISE BARRIER STA. 103+52.00 TO STA. 107+00.00

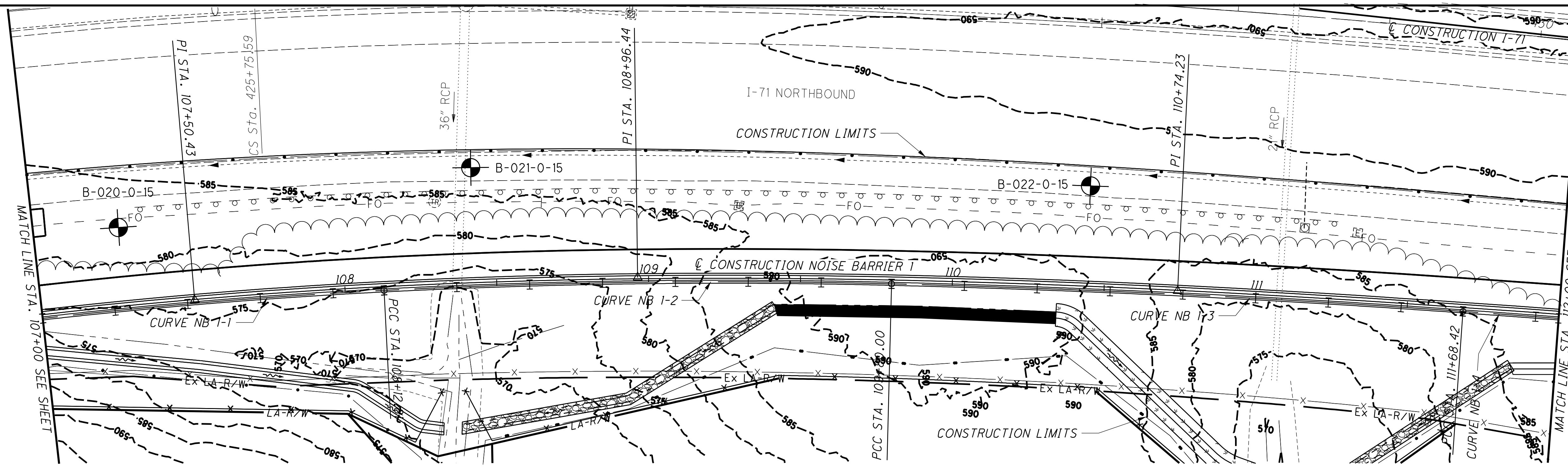
HAM-71-6.86

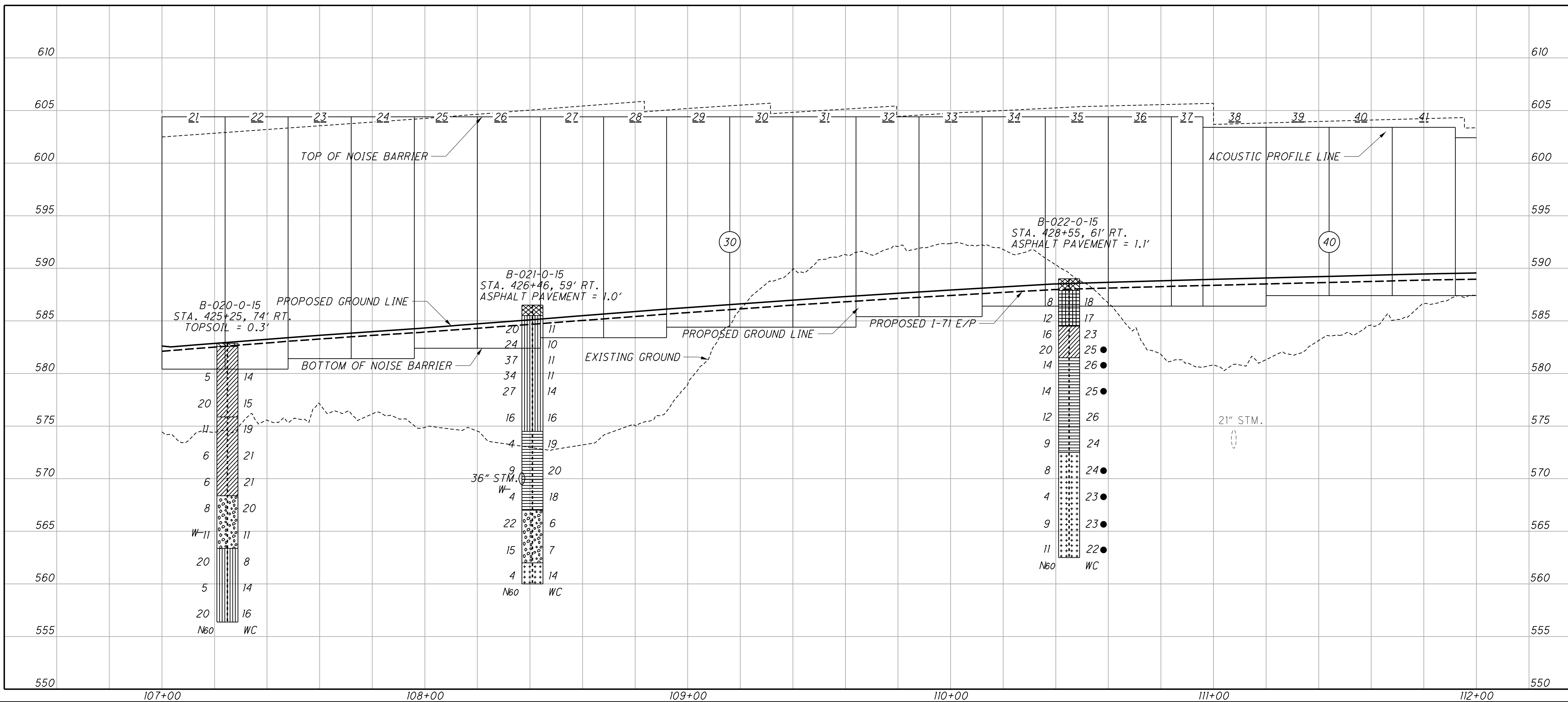
21 / 44

DRAWN MSJ
CHECKED EMK

HORIZONTAL SCALE IN FEET
0 10 20 40

V:\1736\active\173620049\design\94741\geotechnical\sheets\94741ZP003.dgn Sheet 5/23/2017 10:32:35 AM mjennings



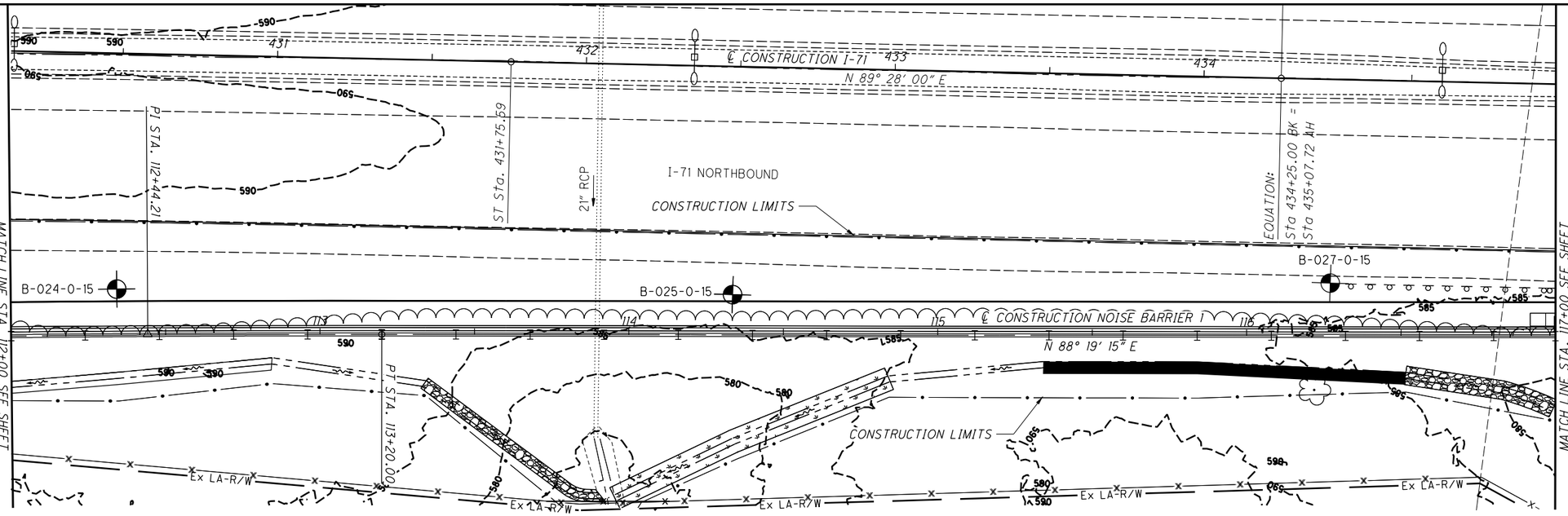


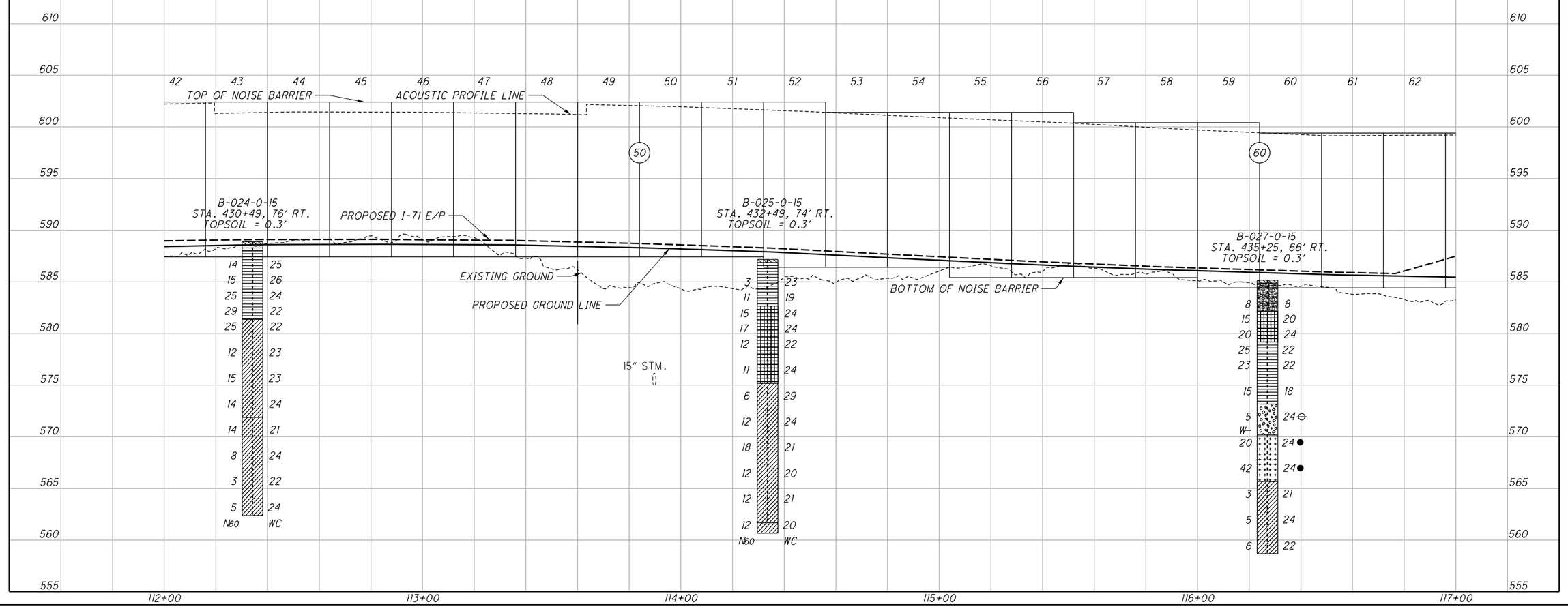
HORIZONTAL SCALE IN FEET

DRAWN MSJ
CHECKED EMK

STRUCTURE FOUNDATION EXPLORATION
NOISE BARRIER STA. 107+00.00 TO STA. 112+00.00

HAM-71-6.86





HORIZONTAL SCALE IN FEET
0 10 20 40

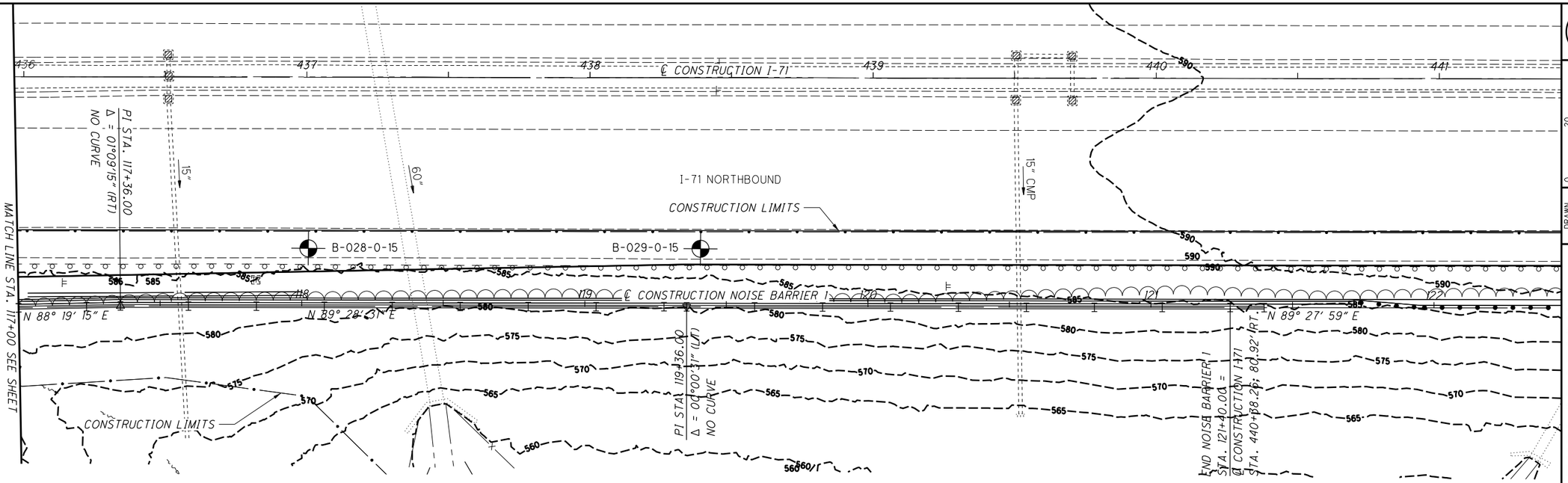
DRAWN MSJ
CHECKED EMK

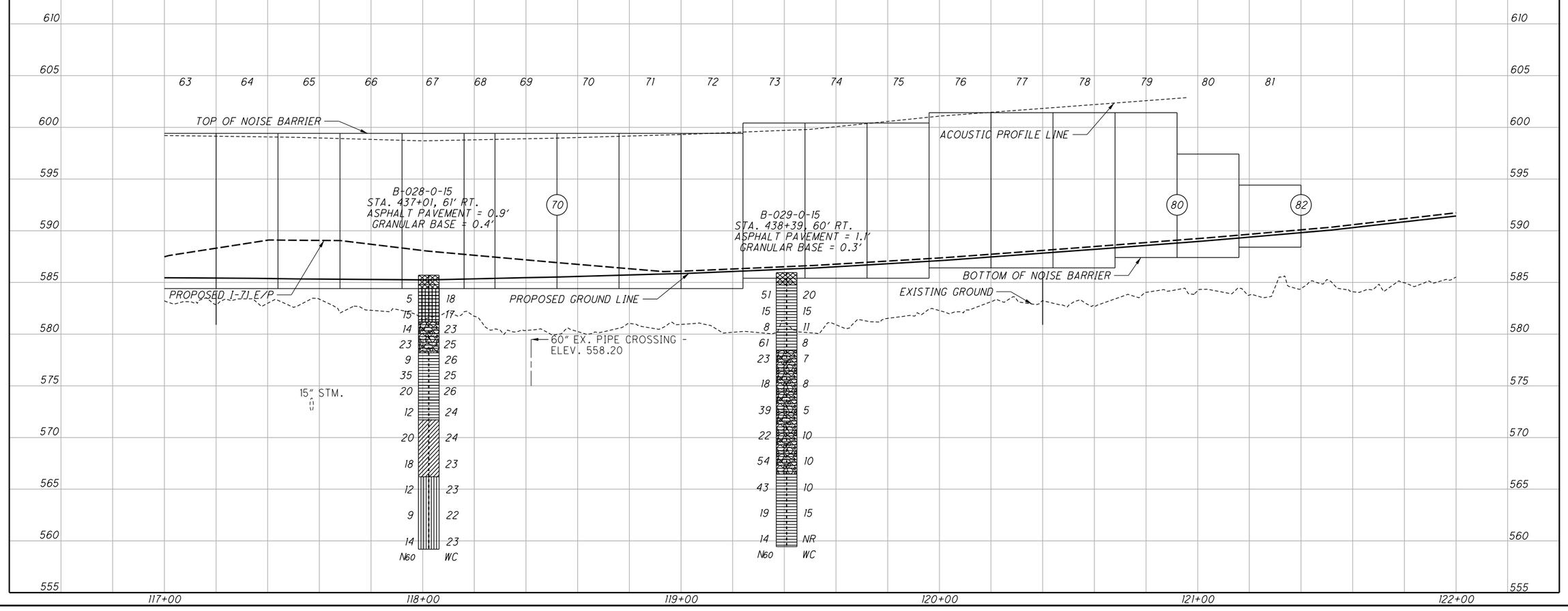
STRUCTURE FOUNDATION EXPLORATION
NOISE BARRIER STA. 112+00.00 TO STA. 117+00.00

HAM-71-6.86

23 / 44

V:\1736\active\173620049\design\94741\geotechnical\sheets\947412P005.dgn Sheet 5/23/2017 10:35:22 AM mjennings





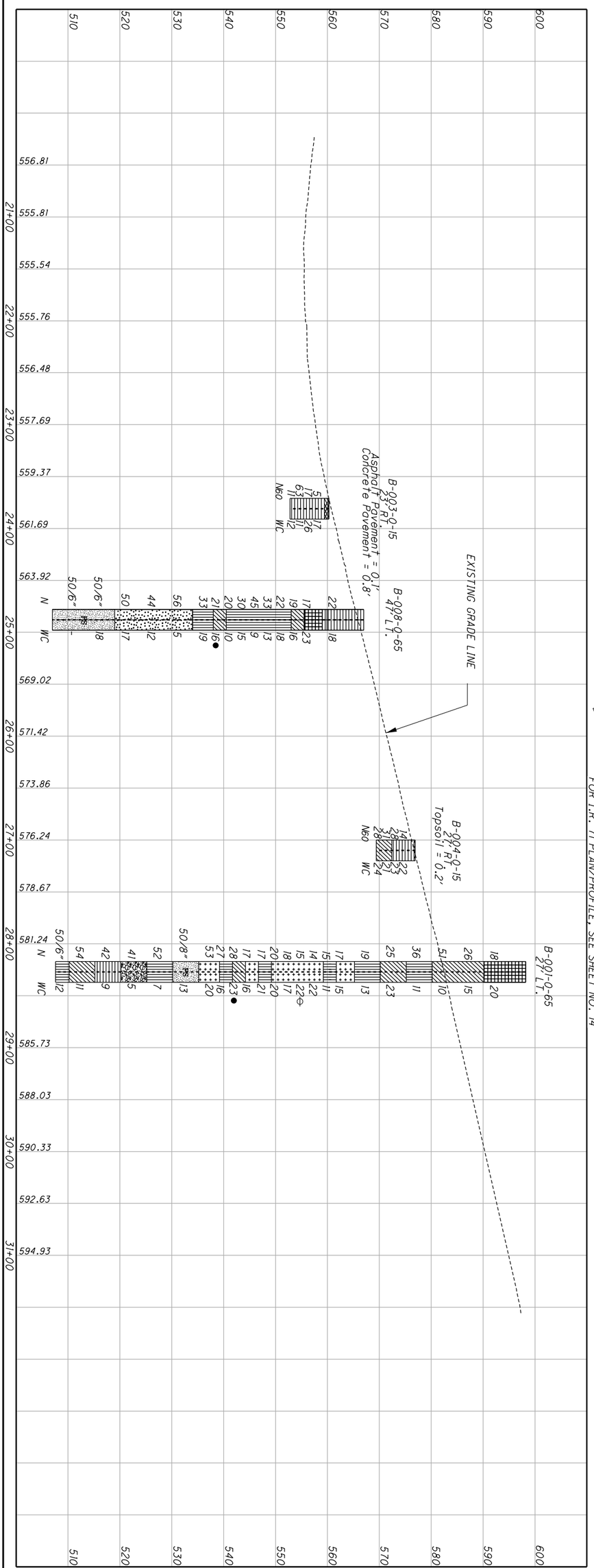
DRAWN MSJ
CHECKED EMK

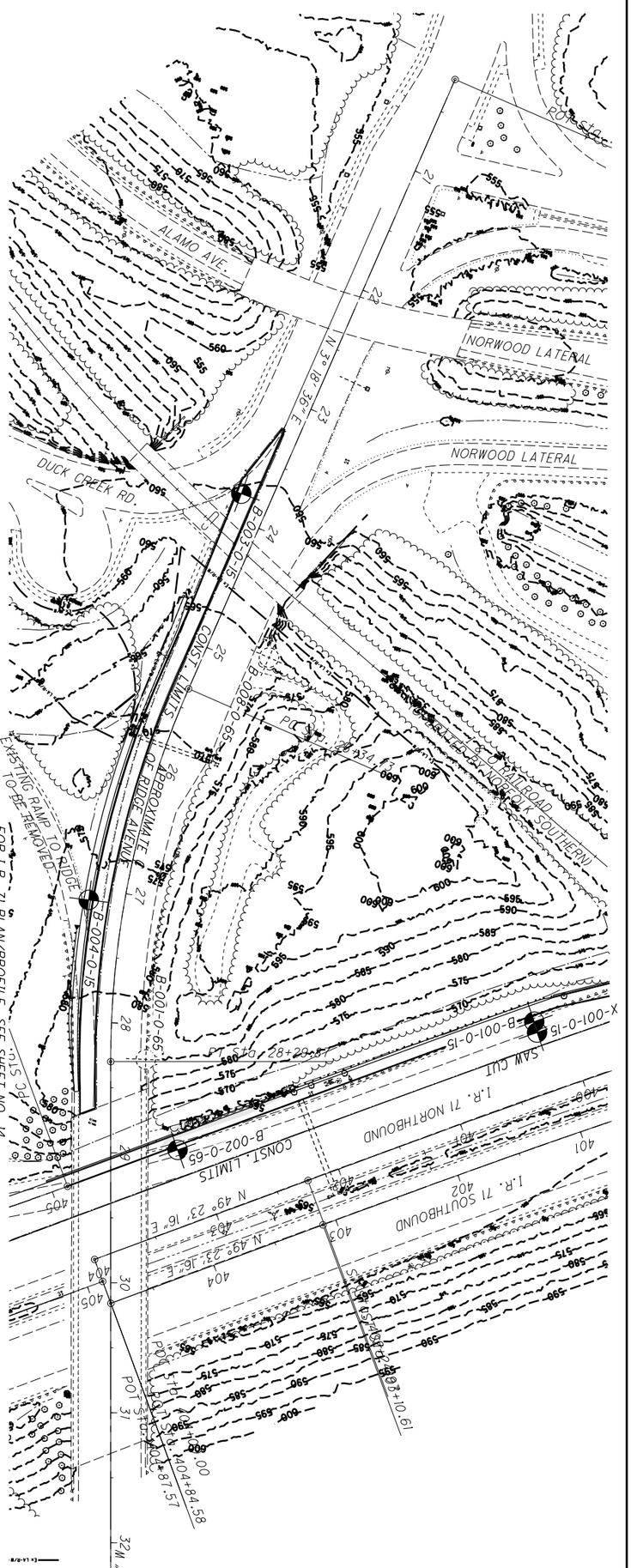
HORIZONTAL SCALE IN FEET
0 10 20 40

STRUCTURE FOUNDATION EXPLORATION
NOISE BARRIER STA. 117+00.00 TO STA. 121+40.00

HAM-71-6.86

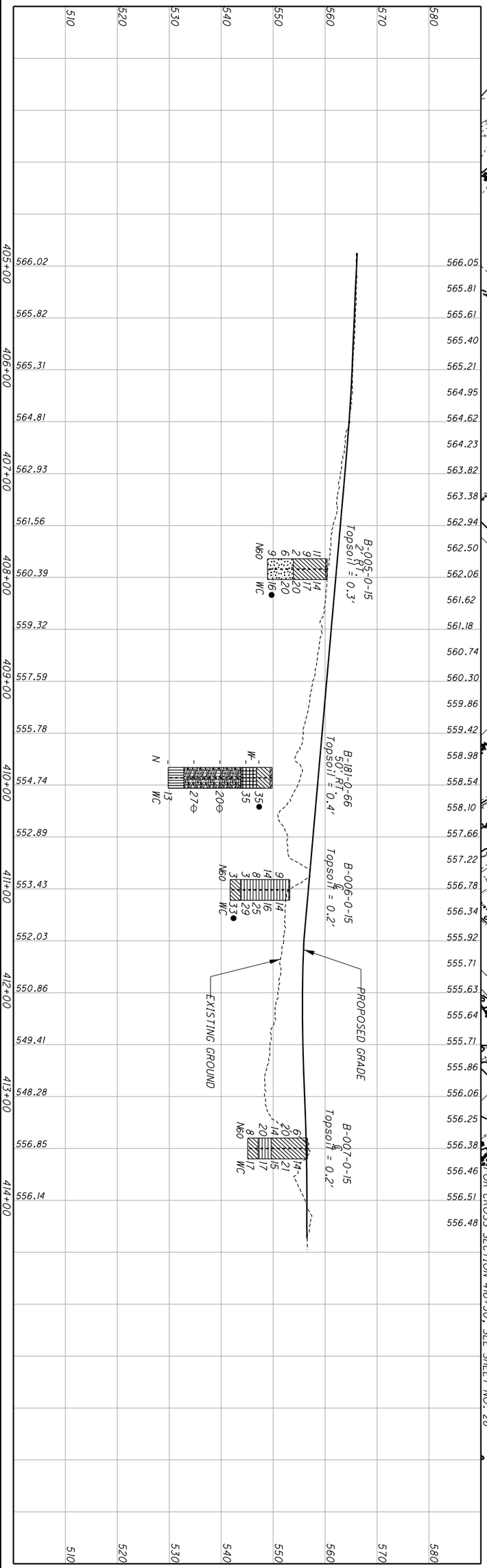
V:\1736\active\173620049\design\94741\geotechnical\sheets\50_PP\94741PP001R.dgn Design 5/23/2017 10:25:27 AM mjennings

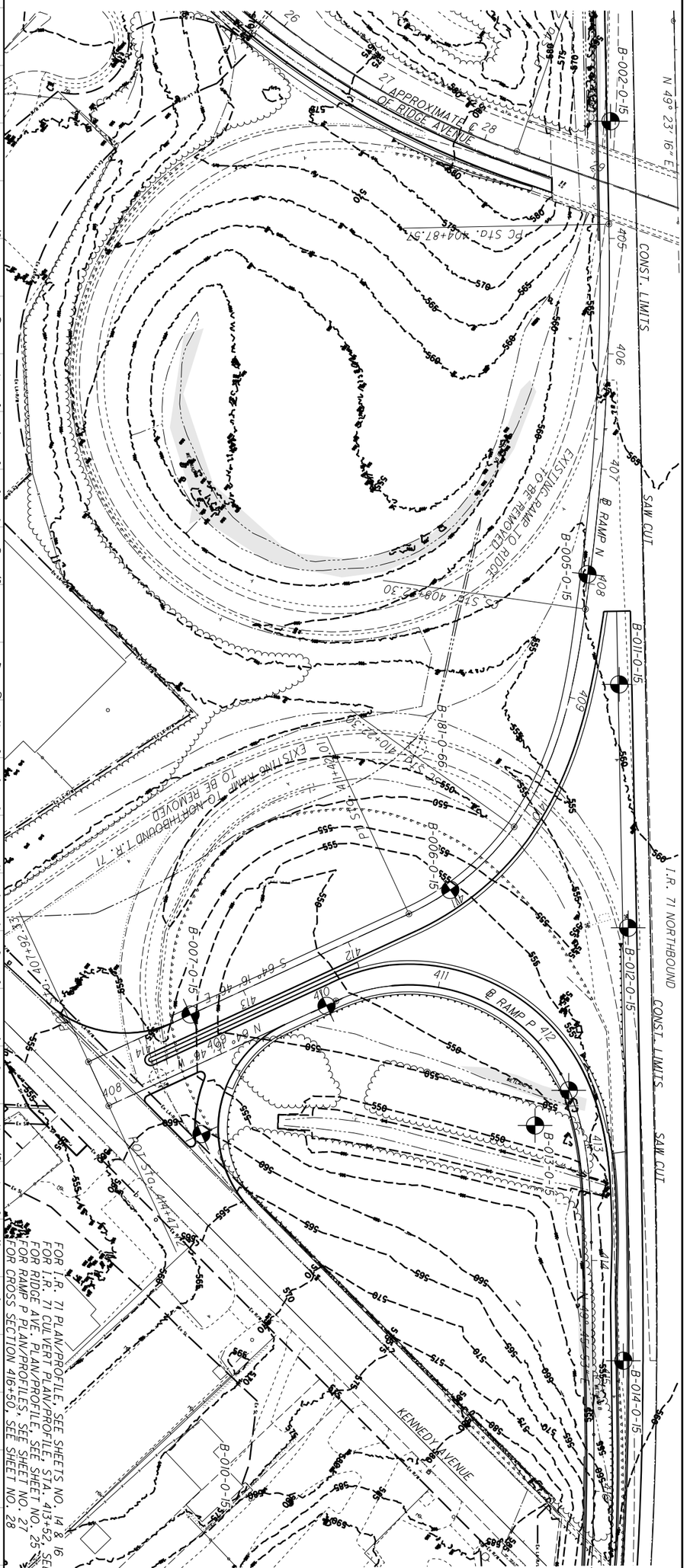




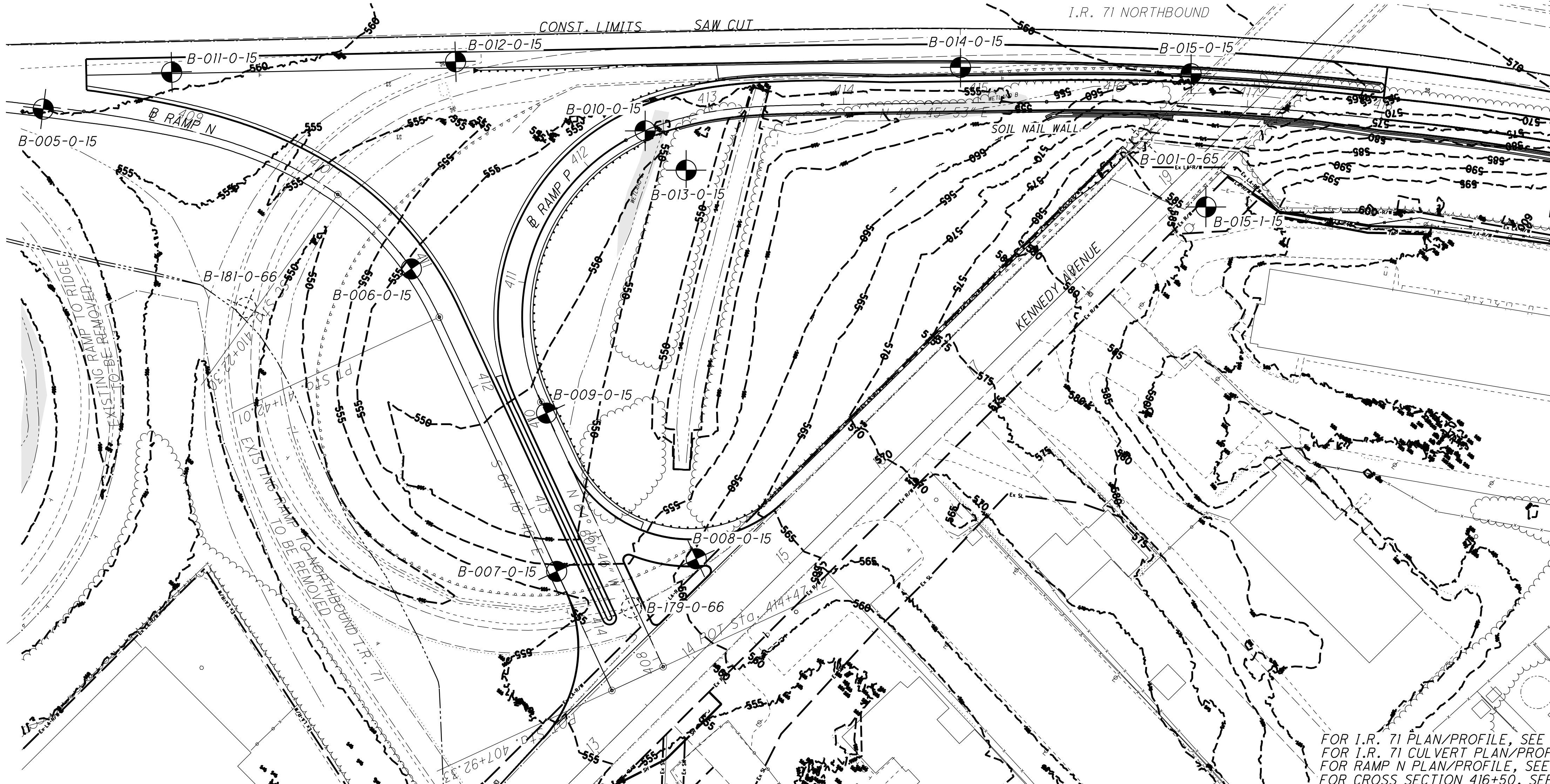
1	25/44	HAM-71-6.86	SOIL PROFILE STA. 21+00.00 TO 31+00.00 - RIDGE AVE.	DRAWN MSJ CHECKED EMK	0 50 25 100 HORIZONTAL SCALE IN FEET

V:\1736\active\173620049\design\94741\geotechnical\sheets\50_PP\94741PP006RN.dgn Design 5/23/2017 10:26:44 AM mjennings

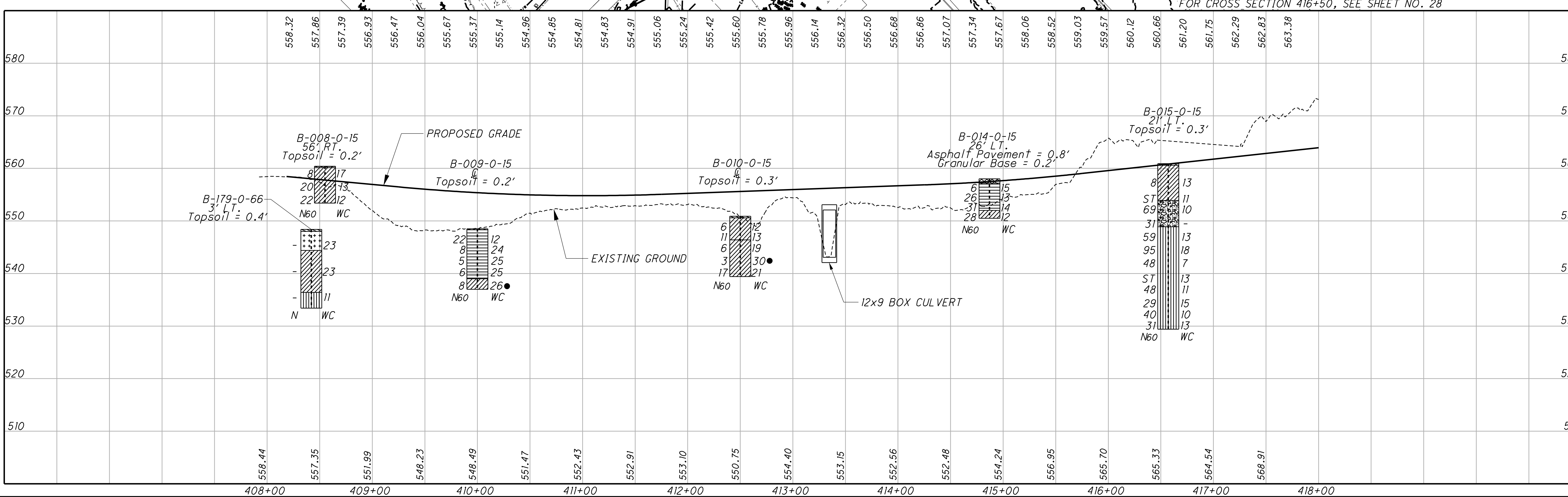




1	26/44	HAM-71-6.86	SOIL PROFILE STA. 405+00.00 TO 414+47.72 - RAMP N	DRAWN MSJ CHECKED EMK	0 50 25 100 HORIZONTAL SCALE IN FEET



FOR I.R. 71 PLAN/PROFILE, SEE SHEETS NO. 14 &15
FOR I.R. 71 CULVERT PLAN/PROFILE, STA. 413+52, SEE SHEET NO. 19
FOR RAMP N PLAN/PROFILE, SEE SHEET NO. 26
FOR CROSS SECTION 416+50, SEE SHEET NO. 28

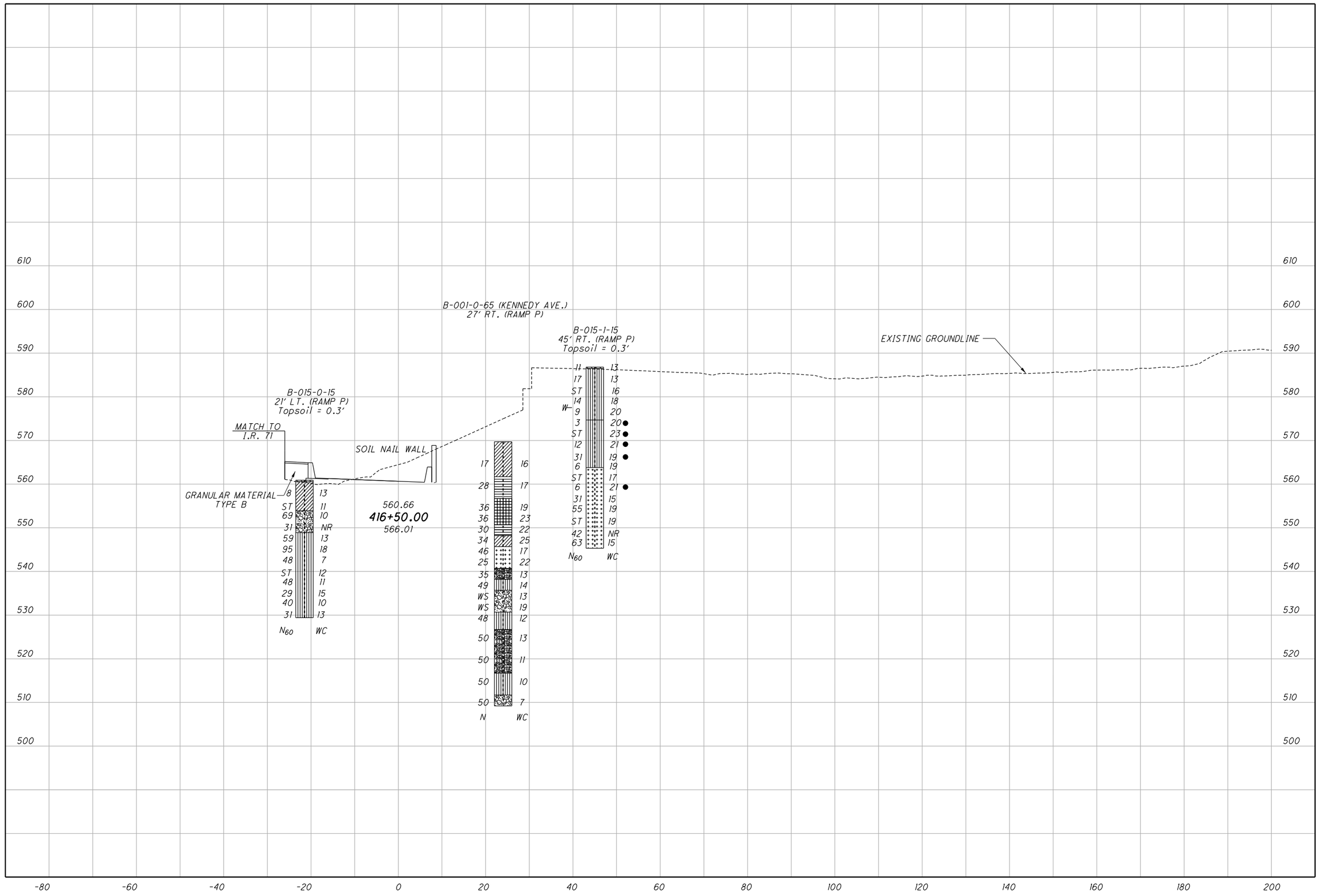


DRAWN MSJ
CHECKED EMK

HORIZONTAL SCALE IN FEET

SOIL PROFILE
STA. 407+92.33 TO 418+00.00 - RAMP P

HAM-71-6.86



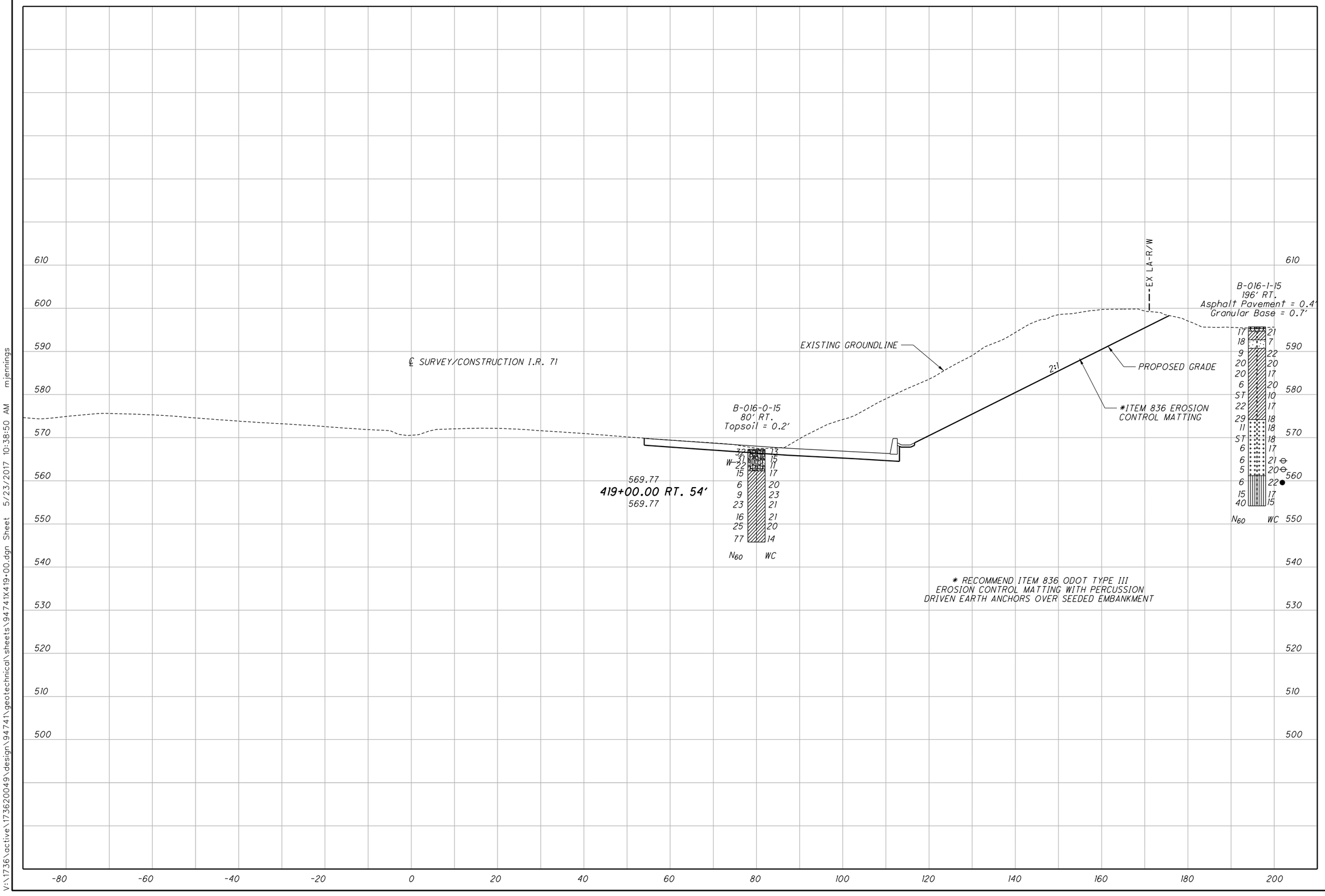
0 5 10 20
HORIZONTAL SCALE IN FEET

DRAWN MSJ
CHECKED EMK

CROSS SECTION STATION 416+50 (RAMP P)

HAM-71-6.86

28 / 44



V:\1736\active\173620049\design\94741\geotechnical\sheets\94741X419+00.dgn Sheet 5/23/2017 10:38:50 AM mjennings

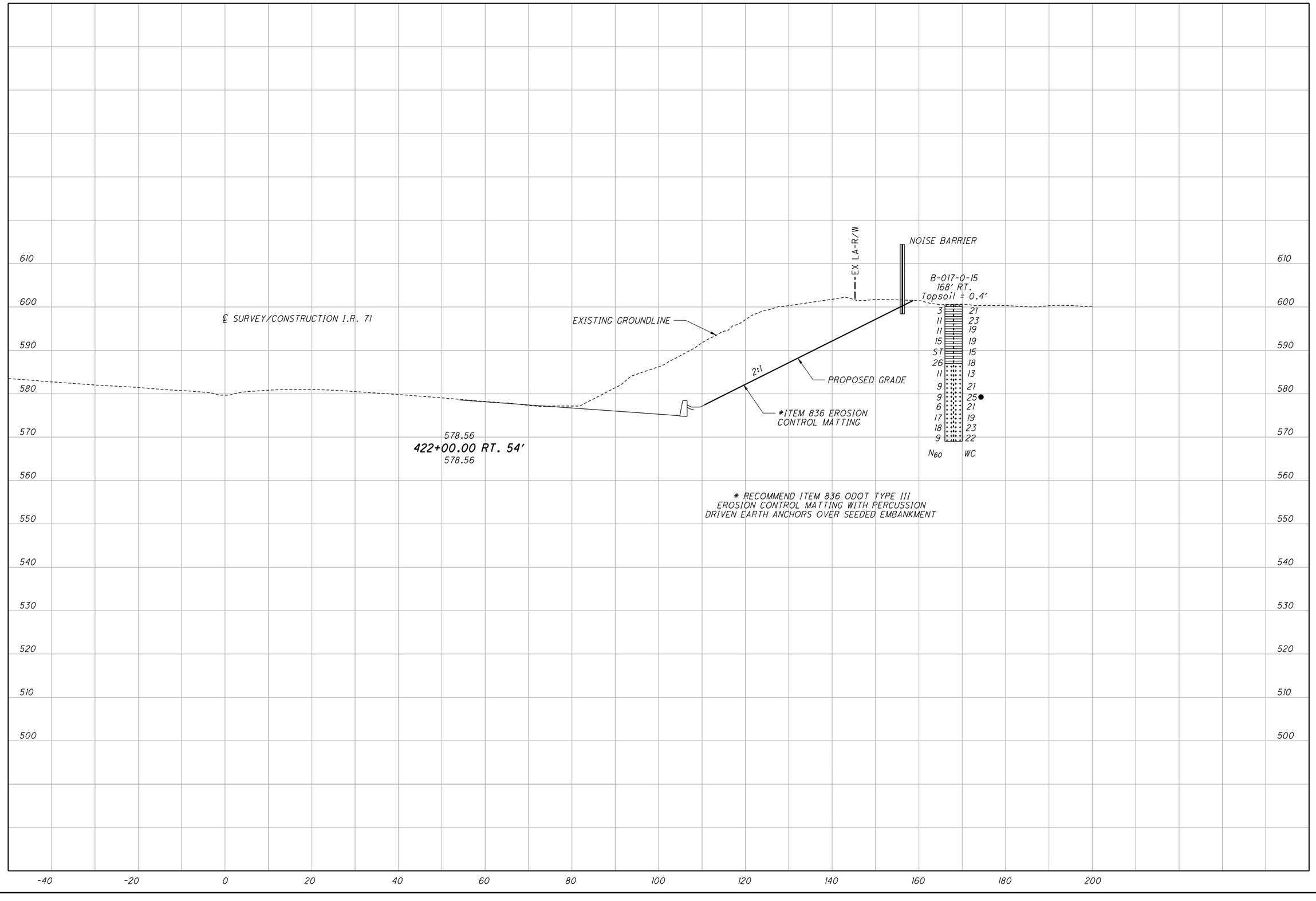
HORIZONTAL SCALE IN FEET
0 5 10 20

DRAWN MSJ
CHECKED EMK

CROSS SECTION
STATION 419+00

HAM-71-6.86

29 / 44



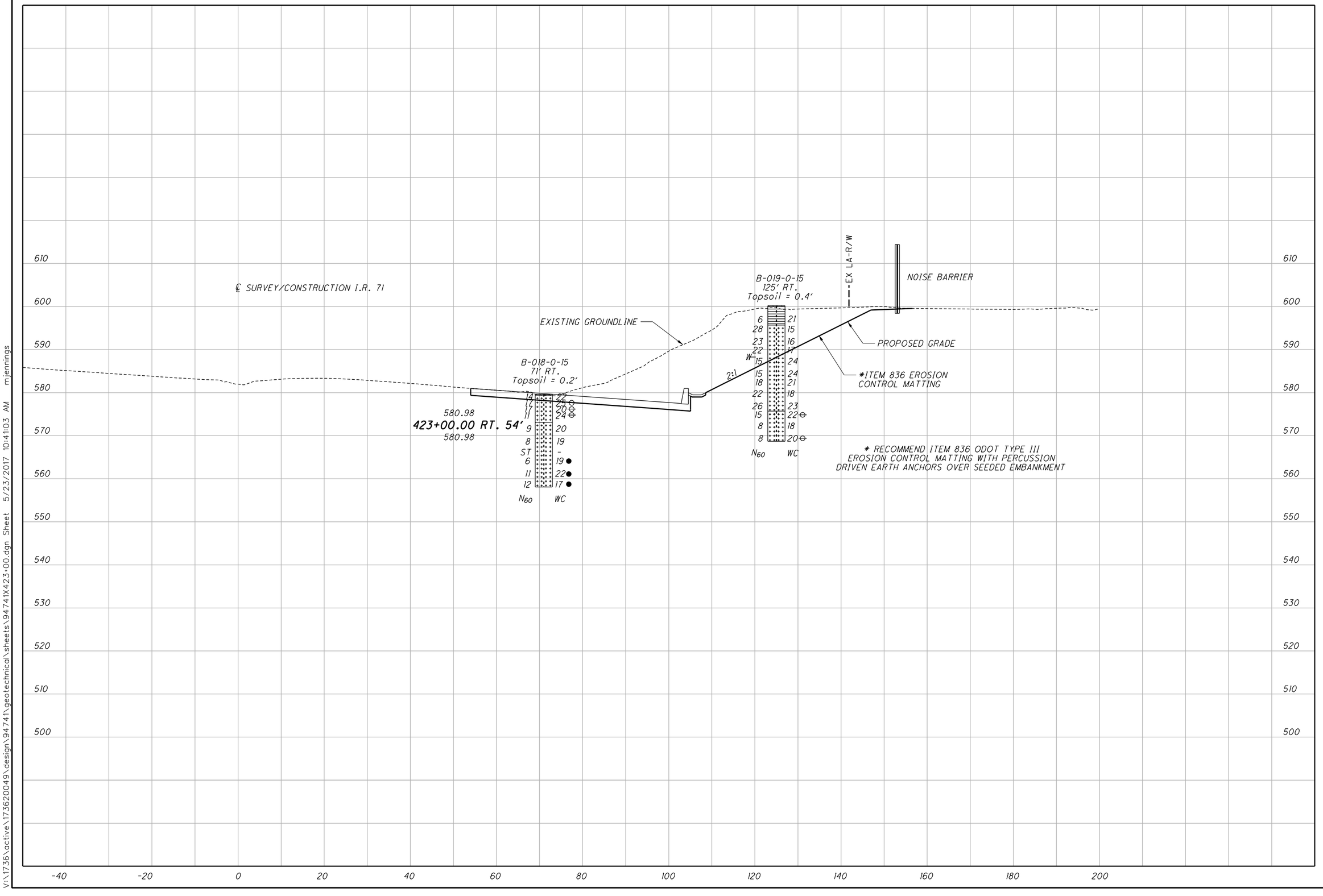
V:\1736\active\173620049\design\94741\geotechnical\sheets\94741X422+00.dgn Sheet 5/23/2017 10:39:55 AM mjennings

0 5 10 20
HORIZONTAL SCALE IN FEET

DRAWN MSJ
CHECKED EMK

CROSS SECTION STATION 422+00

HAM-71-6.86



HORIZONTAL SCALE IN FEET
0 5 10 20

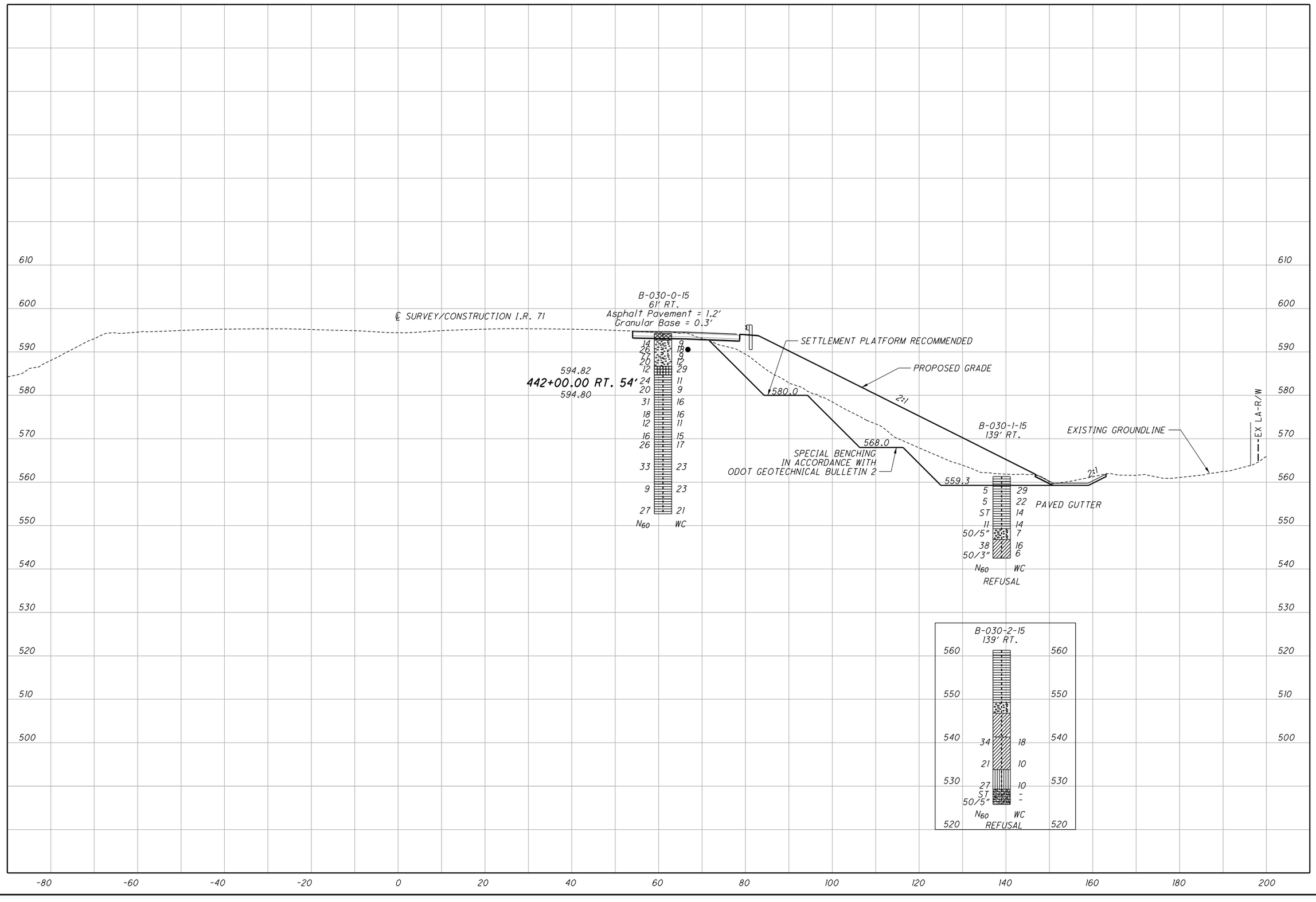
DRAWN MSJ
CHECKED EMK

CROSS SECTION
STATION 423+00

HAM-71-6.86

31 / 44

V:\1736\active\173620049\design\94741\geotechnical\sheets\94741X423+00.dgn Sheet 5/23/2017 10:41:03 AM mjennings



V:\1736\active\173620049\design\94741\geotechnical\sheets\94741X442-00.dgn Sheet 5/23/2017 10:42:19 AM mjennings

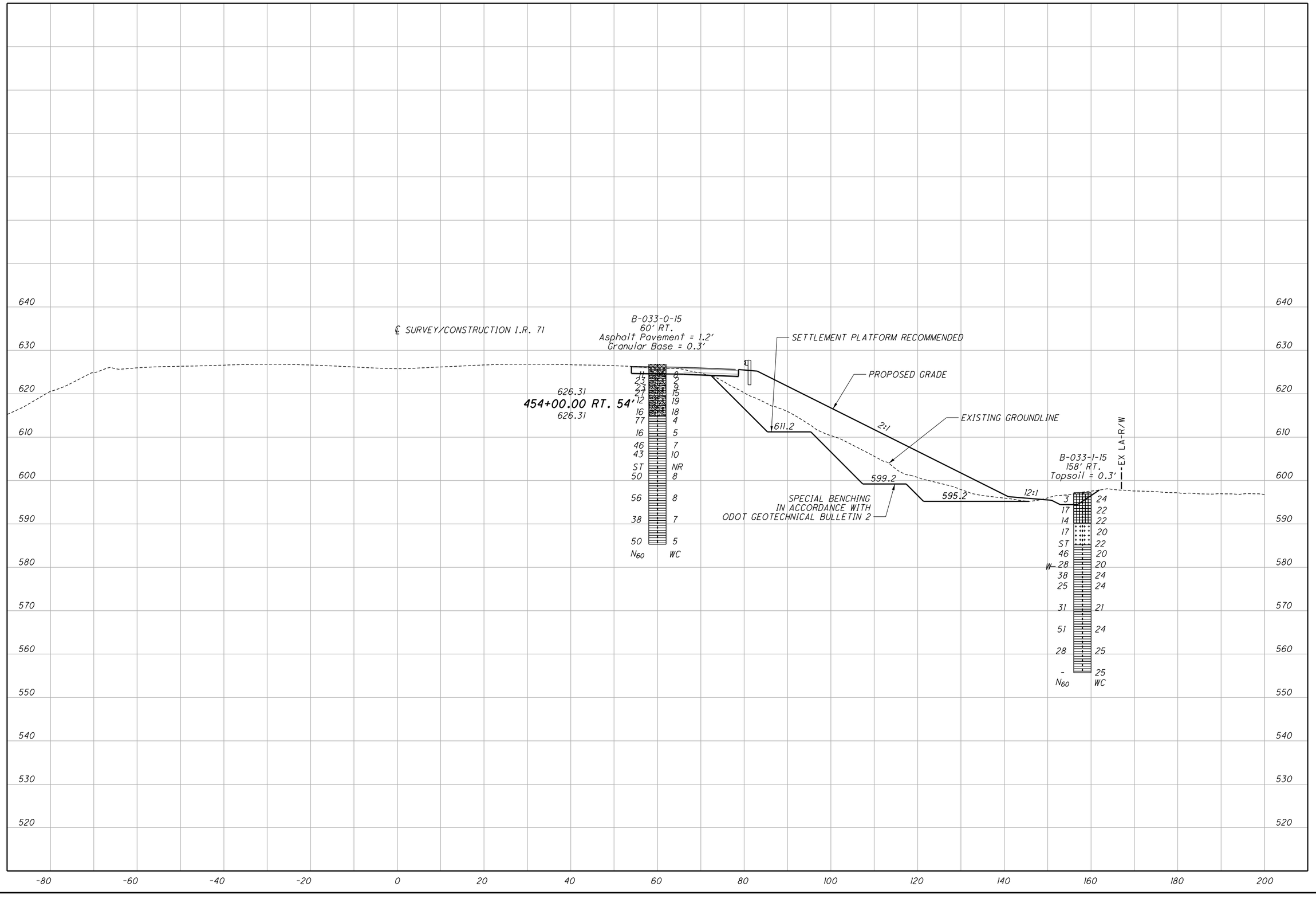
HORIZONTAL SCALE IN FEET
0 5 10 20

DRAWN MSJ
CHECKED EMK

CROSS SECTION
STATION 442+00

HAM-71-6.86

32 / 44



V:\1736\active\173620049\design\94741\geotechnical\sheets\94741X454-00.dgn Sheet 5/23/2017 10:43:28 AM mjennings

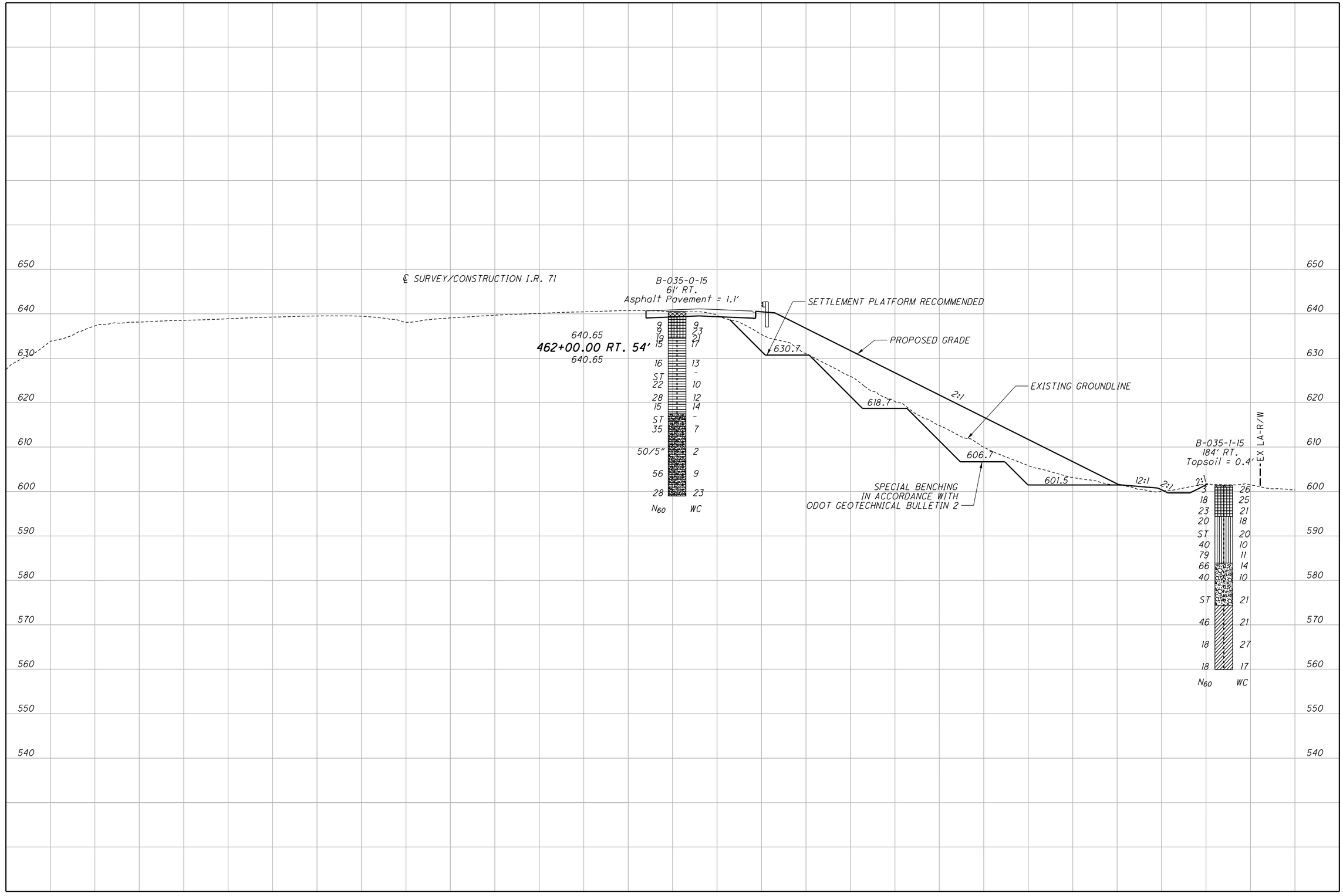
0 5 10 20
HORIZONTAL
SCALE IN FEET

DRAWN MSJ
CHECKED EMK

CROSS SECTION
STATION 454+00

HAM-71-6.86

33 / 44



V:\1736\active\17362004 9\design\94741\geotechnical\sheets\94741X462•00.dgn Sheet 5/23/2017 10:44:49 AM mjennings

0 5 10 20
HORIZONTAL
SCALE IN FEET

DRAWN MSJ
CHECKED EMK

CROSS SECTION
STATION 462+00

HAM-71-6.86

34 / 44

OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-71-6.86	DRILLING FIRM / OPERATOR: STANTEC / BRADFORD	DRILL RIG: CME 55 TRACKED	STATION / OFFSET: 412+68, 157' RT.	EXPLORATION ID B-013-0-15
TYPE: ROADWAY/CULVERT	SAMPLING FIRM / LOGGER: STANTEC / BRADFORD	HAMMER: CME AUTOMATIC	ALIGNMENT: I-71	
PID: 94741 SFN: 3115275	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 1/8/16	ELEVATION: 554.1 (MSL) EOB: 51.5 ft.	PAGE 1 OF 1
START: 5/26/16 END: 5/26/16	SAMPLING METHOD: SPT / ST	ENERGY RATIO (%): 92.4	LAT / LONG: 39.168491, -84.420658	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
TOPSOIL	554.1																	
STIFF TO HARD, BROWN, **SILT AND CLAY**, "AND" GRAVEL, SOME SAND, [FILL], DAMP	553.7	1	2 3 4	11	56	SS-1	4.00	37	9	14	24	16	33	19	14	15	A-6a (2)	
		2																
		3	50/6"	-	33	SS-2	4.50	37	9	14	24	16	33	19	14	16	A-6a (2)	
	549.6	4																
DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, [FILL], MOIST TO WET		5	16 18 12	46	72	SS-3	-	48	19	11	17	5	NP	NP	NP	13	A-1-b (0)	
		6																
		7					W											
VERY LOOSE FROM 7.5' TO 9.0'		8	5 1 1	3	89	SS-4	2.50	48	19	11	17	5	NP	NP	NP	141	A-1-b (0)	
	544.6	9																
MEDIUM DENSE, LIGHT BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, [FILL], WET		10																
		11	5 8 8	25	61	SS-5	1.50	44	12	14	21	9	NP	NP	NP	57	A-2-4 (0)	
		12																
		13	2 3 4	11	39	SS-6	1.50	44	12	14	21	9	NP	NP	NP	95	A-2-4 (0)	
	539.6	14																
VERY STIFF TO HARD, GRAY, **SANDY SILT**, LITTLE GRAVEL, SOME CLAY, DAMP TO MOIST		15																
		16	4 7 11	28	78	SS-7	3.00	-	-	-	-	-	-	-	-	8	A-4a (V)	
		17																
		18	11 15 17	49	78	SS-8	3.00	-	-	-	-	-	-	-	-	8	A-4a (V)	
		19																
		20																
		21			29	ST-1	0.50	-	-	-	-	-	-	-	-	12	A-4a (V)	
		22																
		23	7 15 18	51	94	SS-9	4.50	16	8	19	34	23	21	13	8	12	A-4a (4)	
		24																
		25																
		26	11 19 20	60	78	SS-10	4.50	16	8	19	34	23	21	13	8	11	A-4a (4)	
		27																
		28	17 50/5"	-	100	SS-11	4.50	-	-	-	-	-	-	-	-	10	A-4a (V)	
		29																
		30																
		31	9 18 24	65	89	SS-12	4.50	-	-	-	-	-	-	-	-	13	A-4a (V)	
		32																
		33																
		34																
		35																
		36	15 10 32	65	56	SS-13	4.50	-	-	-	-	-	-	-	-	9	A-4a (V)	
		37																
		38																
		39																
		40																
		41	13 27 34	94	89	SS-14	4.50	-	-	-	-	-	-	-	-	10	A-4a (V)	
		42																
		43																
		44			0	ST-2	-	-	-	-	-	-	-	-	-	-	A-4a (V)	
		45																
		46	34 33 26	91	22	SS-15	3.00	-	-	-	-	-	-	-	-	8	A-4a (V)	
		47																
		48																
		49																
		50																
	502.6	51	32 27 29	86	89	SS-16	4.50	-	-	-	-	-	-	-	-	14	A-4a (V)	
			EOB															

NOTES: PERCHED GROUNDWATER

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS; BENTONITE PELLETS

OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-71-6.86	DRILLING FIRM / OPERATOR: STANTEC / BRADFORD	DRILL RIG: CME 55 TRACKED	STATION / OFFSET: 416+51, 84' RT.	EXPLORATION ID B-015-0-15
TYPE: ROADWAY/SOIL NAIL WALL	SAMPLING FIRM / LOGGER: STANTEC / BRADFORD	HAMMER: CME AUTOMATIC	ALIGNMENT: I-71	
PID: 94741 SFN: 3115283	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 1/8/16	ELEVATION: 560.9 (MSL) EOB: 31.5 ft.	PAGE 1 OF 1
START: 5/17/16 END: 5/17/16	SAMPLING METHOD: SPT / ST	ENERGY RATIO (%): 92.4	LAT / LONG: 39.169312, -84.419815	

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
TOPSOIL	560.6																	
MEDIUM STIFF, GRAY, **SILT AND CLAY**, LITTLE GRAVEL, SOME SAND, DAMP		1																
		2	2 2 3	8	89	SS-1	2.50	15	11	13	33	28	26	14	12	13	A-6a (6)	
		3																
		4																
		5			67	ST-1	4.00	-	-	-	-	-	-	-	-	11	A-6a (V)	
	553.9	6																
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP		7																
		8	22 21 24	69	89	SS-2	1.50	49	10	16	17	8	17	13	4	10	A-1-b (0)	
		9																
		10	5 7 13	31	0	SS-3	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
	548.9	11																
VERY STIFF TO HARD, GRAY, **SANDY SILT**, LITTLE GRAVEL, SOME CLAY, DAMP TO MOIST		12																
		13	15 15 23	59	89	SS-4	4.50	-	-	-	-	-	-	-	-	13	A-4a (V)	
		14																
		15	12 23 39	95	61	SS-5	4.50	13	9	13	38	27	23	14	9	18	A-4a (6)	
		16																
		17																
		18	5 12 19	48	100	SS-6	4.50	13	9	13	38	27	23	14	9	7	A-4a (6)	
		19																
		20																
		21			71	ST-2	4.50	-	-	-	-	-	-	-	-	12	A-4a (V)	
		22																
		23	6 12 19	48	72	SS-7	4.50	-	-	-	-	-	-	-	-	11	A-4a (V)	
		24																
		25																
		26	7 12 7	29	78	SS-8	1.50	-	-	-	-	-	-	-	-	15	A-4a (V)	
		27																
		28	8 14 12	40	100	SS-9	4.00	-	-	-	-	-	-	-	-	10	A-4a (V)	
		29																
		30																
	529.4 EOB	31	7 10 10	31	67	SS-10	2.00	-	-	-	-	-	-	-	-	13	A-4a (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS

OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-71-6.86	DRILLING FIRM / OPERATOR: STANTEC / BRADFORD	DRILL RIG: CME 55 TRACKED	STATION / OFFSET: 416+68, 182' RT.	EXPLORATION ID B-015-1-15
TYPE: ROADWAY/SOIL NAIL WALL	SAMPLING FIRM / LOGGER: STANTEC / BRADFORD	HAMMER: CME AUTOMATIC	ALIGNMENT: I-71	
PID: 94741 SFN: 3115283	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 1/8/16	ELEVATION: 586.8 (MSL) EOB: 41.5 ft.	PAGE 1 OF 1
START: 5/23/16 END: 5/23/16	SAMPLING METHOD: SPT / ST	ENERGY RATIO (%): 92.4	LAT / LONG: 39.169126, -84.419562	

MATERIAL DESCRIPTION AND NOTES	ELEV. 586.8	DEPTHS	SPT/ RQD	N_m	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
TOPSOIL	586.5																	
LOOSE TO MEDIUM DENSE, BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, DAMP TO MOIST		1	1 3 4	11	78	SS-1	4.00	28	9	24	23	16	24	14	10	13	A-4a (1)	
		2																
		3	5 5 6	17	89	SS-2	4.50	28	9	24	23	16	24	14	10	13	A-4a (1)	
		4																
		5			71	ST-1	1.00	-	-	-	-	-	-	-	-	17	A-4a (V)	
		6																
		7																
		8	3 3 6	14	89	SS-3	3.50	-	-	-	-	-	-	-	-	18	A-4a (V)	
		9																
		W 10	3 3 3	9	89	SS-4	3.00	-	-	-	-	-	-	-	-	20	A-4a (V)	
	574.8	11																
MEDIUM DENSE TO DENSE, BROWN, **SANDY SILT**, TRACE GRAVEL, LITTLE CLAY, WET		12																
		13	1 1 1	3	72	SS-5	2.00	-	-	-	-	-	-	-	-	20	A-4a (V)	
		14																
VERY LOOSE TO LOOSE FROM 12.5' TO 17.0'		15																
		16			92	ST-2	1.00	-	-	-	-	-	-	-	-	22	A-4a (V)	
		17																
		18	1 3 5	12	67	SS-6	1.50	6	7	42	35	10	18	17	1	21	A-4a (2)	
		19																
		20																
		21	6 7 13	31	67	SS-7	4.00	6	7	42	35	10	18	17	1	19	A-4a (2)	
		22																
	563.8	23																
MEDIUM STIFF, GRAY, **SILT**, TRACE GRAVEL, LITTLE SAND, SOME CLAY, MOIST TO WET		24	2 1 3	6	61	SS-8	1.00	-	-	-	-	-	-	-	-	19	A-4b (V)	
		25																
		26			100	ST-3	2.50	-	-	-	-	-	-	-	-	18	A-4b (V)	
		27																
		28	1 2 2	6	67	SS-9	1.50	5	5	10	52	28	23	15	8	21	A-4b (8)	
	557.8	29																
HARD, GRAY, **SILT**, TRACE GRAVEL, LITTLE SAND, SOME CLAY, DAMP TO MOIST		30																
		31	3 9 11	31	94	SS-10	2.00	5	5	10	52	28	23	15	8	15	A-4b (8)	
		32																
		33	9 15 21	55	94	SS-11	4.50	-	-	-	-	-	-	-	-	19	A-4b (V)	
		34																
		35																
		36			79	ST-4	4.50	-	-	-	-	-	-	-	-	19	A-4b (V)	
		37																
		38	8 13 14	42	0	SS-12	-	-	-	-	-	-	-	-	-	-	A-4b (V)	
		39																
		40																
	545.3	EOB 41	5 19 22	63	67	SS-13	4.50	-	-	-	-	-	-	-	-	15	A-4b (V)	

NOTES: PERCHED GROUNDWATER

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS; BENTONITE PELLETS

OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-71-6.86	DRILLING FIRM / OPERATOR: STANTEC / BRADFORD	DRILL RIG: CME 55 TRACKED	STATION / OFFSET: 421+79, 168' RT.	EXPLORATION ID B-017-0-15
TYPE: ROADWAY/NOISEWALL	SAMPLING FIRM / LOGGER: STANTEC / BRADFORD	HAMMER: CME AUTOMATIC	ALIGNMENT: I-71	
PID: 94741 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 1/8/16	ELEVATION: 600.5 (MSL) EOB: 31.5 ft.	PAGE 1 OF 1
START: 5/25/16 END: 5/25/16	SAMPLING METHOD: SPT / ST	ENERGY RATIO (%): 92.4	LAT / LONG: 39.169802, -84.418168	

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
TOPSOIL	600.1																	
STIFF TO VERY STIFF, BROWN, **SILTY CLAY**, TRACE GRAVEL, "AND" SAND, MOIST	600.5	1	1 1	3	72	SS-1	1.50	-	-	-	-	-	-	-	-	21	A-6b (V)	
		2																
SOFT FROM 0.0' TO 1.5'		3	4 3 4	11	56	SS-2	3.00	-	-	-	-	-	-	-	-	23	A-6b (V)	
		4																
		5	2 3 4	11	72	SS-3	2.50	4	9	37	25	25	30	13	17	19	A-6b (5)	
		6																
		7	3 5 5	15	56	SS-4	3.00	4	9	37	25	25	30	13	17	19	A-6b (5)	
		8																
		9			100	ST-1	2.00	-	-	-	-	-	-	-	-	15	A-6b (V)	
		10																
		11																
	587.0	12																
STIFF TO VERY STIFF, BROWN, **SILT**, LITTLE SAND, LITTLE CLAY, DAMP TO MOIST		13	7 9 8	26	61	SS-5	3.50	-	-	-	-	-	-	-	-	18	A-6b (V)	
		14																
		15	3 3 4	11	44	SS-6	-	-	-	-	-	-	-	-	-	13	A-4b (V)	
		16																
		17	2 2 4	9	78	SS-7	2.00	0	0	18	69	13	26	21	5	21	A-4b (8)	
		18																
		19																
WET FROM 20.0' TO 21.5'		20	3 2 4	9	61	SS-8	2.00	0	0	18	69	13	26	21	5	25	A-4b (8)	
		21																
		22																
		23	1 1 3	6	67	SS-9	1.00	-	-	-	-	-	-	-	-	21	A-4b (V)	
		24																
		25	3 7 4	17	89	SS-10	1.50	-	-	-	-	-	-	-	-	19	A-4b (V)	
		26																
		27																
		28	4 7 5	18	94	SS-11	1.00	-	-	-	-	-	-	-	-	23	A-4b (V)	
		29																
		30																
	569.0	31 EOB	2 3 3	9	67	SS-12	2.50	-	-	-	-	-	-	-	-	22	A-4b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS

OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-71-6.86
TYPE: ROADWAY/NOISEWALL
PID: 94741 SFN: N/A
START: 5/27/16 END: 5/27/16

DRILLING FIRM / OPERATOR: STANTEC / BRADFORD
SAMPLING FIRM / LOGGER: STANTEC / LOPINA
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: CME 55 TRACKED
HAMMER: CME AUTOMATIC
CALIBRATION DATE: 1/8/16
ENERGY RATIO (%): 92.4

STATION / OFFSET: 423+44, 125' RT.
ALIGNMENT: I-71
ELEVATION: 600.2 (MSL) EOB: 31.5 ft.
LAT / LONG: 39.170056, -84.417716

EXPLORATION ID B-019-0-15
PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 600.2	DEPTHS	SPT/ RQD	N60	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
TOPSOIL	599.8																	
MEDIUM STIFF, BROWN, **SILTY CLAY**, LITTLE GRAVEL, LITTLE SAND, [FILL], MOIST		1																
		2	2 2 2	6	94	SS-1	1.75	12	3	14	44	27	33	16	17	21	A-6b (10)	
	595.7	3																
STIFF TO VERY STIFF, BROWN, **SILT**, TRACE GRAVEL, TRACE SAND, SOME CLAY, DAMP TO MOIST		4																
		5	11 11 7	28	89	SS-2	-	-	-	-	-	-	-	-	-	15	A-4b (V)	
		6																
		7																
		8	6 6 9	23	50	SS-3	2.00	-	-	-	-	-	-	-	-	16	A-4b (V)	
		9																
		10																
		11	5 7 7	22	100	SS-4	-	-	-	-	-	-	-	-	-	17	A-4b (V)	
		12	W															
		13	3 3 7	15	100	SS-5	-	1	0	4	69	26	30	20	10	24	A-4b (8)	
		14																
		15																
		16	2 5 5	15	100	SS-6	-	1	0	4	69	26	30	20	10	24	A-4b (8)	
		17																
		18	3 4 8	18	89	SS-7	-	-	-	-	-	-	-	-	-	21	A-4b (V)	
		19																
		20																
		21	3 6 8	22	100	SS-8	-	-	-	-	-	-	-	-	-	18	A-4b (V)	
		22																
		23	5 7 10	26	100	SS-9	-	-	-	-	-	-	-	-	-	23	A-4b (V)	
	575.7	24																
MEDIUM STIFF TO STIFF, GRAY, **SILT**, TRACE GRAVEL, SOME SAND, TRACE CLAY, MOIST TO WET		25																
		26	3 5 5	15	78	SS-10	-	2	6	23	60	9	NP	NP	NP	22	A-4b (7)	
		27																
		28	1 3 2	8	72	SS-11	-	2	6	23	60	9	NP	NP	NP	18	A-4b (7)	
		29																
		30																
	568.7 EOB	31	1 2 3	8	100	SS-12	-	-	-	-	-	-	-	-	-	20	A-4b (V)	

NOTES: PERCHED GROUNDWATER

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS

LOG OF BORING

PROJECT: HAM-71-6.86
TYPE: ROADWAY
PID: 94741 SFN: N/A
START: 5/18/16 END: 5/18/16

DRILLING FIRM / OPERATOR: STANTEC / BRADFORD
SAMPLING FIRM / LOGGER: STANTEC / BRADFORD
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: CME 55 TRACKED
HAMMER: CME AUTOMATIC
CALIBRATION DATE: 1/8/16
ENERGY RATIO (%): 92.4

STATION / OFFSET: 425+25, 74' RT.
ALIGNMENT: I-71
ELEVATION: 582.9 (MSL) EOB: 26.5 ft.
LAT / LONG: 39.170314, -84.417178

EXPLORATION ID B-020-0-15
PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 582.9	DEPTHS	SPT/ RQD	N60	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
TOPSOIL	582.6																	
MEDIUM STIFF, BROWN, **SILT AND CLAY**, SOME GRAVEL, SOME SAND, MOIST		1																
		2	1 2 1	5	39	SS-1	1.00	27	7	20	29	17	24	13	11	14	A-6a (3)	
		3																
		4																
VERY STIFF FROM 5.0' TO 6.5'		5																
		6	8 6 7	20	67	SS-2	4.50	27	7	20	29	17	24	13	11	15	A-6a (3)	
	575.9	7																
MEDIUM STIFF TO STIFF, GRAY, **SILT AND CLAY**, LITTLE GRAVEL, LITTLE SAND, MOIST		8																
		9	3 4 3	11	61	SS-3	3.00	14	3	15	44	24	30	17	13	19	A-6a (8)	
		10																
		11	2 2 2	6	67	SS-4	2.00	14	3	15	44	24	30	17	13	21	A-6a (8)	
		12																
		13	2 2 2	6	78	SS-5	1.00	-	-	-	-	-	-	-	-	21	A-6a (V)	
	568.4	14																
LOOSE TO MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS**, SOME SAND, TRACE SILT, TRACE CLAY, MOIST TO WET		15																
		16	1 3 2	8	39	SS-6	-	-	-	-	-	-	-	-	-	20	A-1-a (V)	
		17																
		18	W 4 2 5	11	39	SS-7	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	
	563.4	19																
VERY STIFF, GRAY, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, DAMP TO MOIST		20																
		21	8 6 7	20	61	SS-8	4.50	-	-	-	-	-	-	-	-	8	A-4a (V)	
		22																
MEDIUM STIFF FROM 22.5' TO 24.0'		23	1 2 1	5	33	SS-9	3.00	30	8	13	31	18	23	14	9	14	A-4a (3)	
		24																
		25																
	556.4 EOB	26	8 6 7	20	89	SS-10	2.50	30	8	13	31	18	23	14	9	16	A-4a (3)	

NOTES: PERCHED GROUNDWATER

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS; BENTONITE PELLETS

OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-71-6.86 | DRILLING FIRM / OPERATOR: STANTEC / BRADFORD | DRILL RIG: CME 55 TRUCK | STATION / OFFSET: 426+46, 59' RT. | EXPLORATION ID B-021-0-15
TYPE: ROADWAY/NOISEWALL | SAMPLING FIRM / LOGGER: STANTEC / LOPINA | HAMMER: CME AUTOMATIC | ALIGNMENT: I-71
PID: 94741 SFN: N/A | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 2/24/16 | ELEVATION: 586.5 (MSL) EOB: 26.5 ft. | PAGE 1 OF 1
START: 5/15/16 END: 5/15/16 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 81.3 | LAT / LONG: 39.170410, -84.416781

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT PAVEMENT	585.5																	
VERY STIFF TO HARD, BROWN AND GRAY, **SANDY SILT**, LITTLE TO SOME GRAVEL, LITTLE CLAY, DAMP TO MOIST		1																
		2	4 5 10	20	50	SS-1	4.00	-	-	-	-	-	-	-	-	11	A-4a (V)	
		3																
		4	8 9 9	24	72	SS-2	3.50	18	7	21	43	11	21	18	3	10	A-4a (4)	
		5	4 10 17	37	78	SS-3	3.25	24	6	15	36	19	24	15	9	11	A-4a (4)	
		6																
		7	21 11 14	34	78	SS-4	3.75	-	-	-	-	-	-	-	-	11	A-4a (V)	
		8	7 10 10	27	100	SS-5	4.50	-	-	-	-	-	-	-	-	14	A-4a (V)	
		9																
		10																
		11	5 5 7	16	100	SS-6	3.00	-	-	-	-	-	-	-	-	16	A-4a (V)	
	574.5	12																
SOFT TO MEDIUM STIFF, LIGHT BROWN, **SILTY CLAY**, SOME GRAVEL, LITTLE SAND, MOIST		13	2 1 2	4	56	SS-7	1.25	20	7	8	35	30	40	16	24	19	A-6b (12)	
		14																
		15																
		16	3 2 5	9	39	SS-8	1.25	20	7	8	35	30	40	16	24	20	A-6b (12)	
W		17																
		18	4 1 2	4	28	SS-9	1.50	-	-	-	-	-	-	-	-	18	A-6b (V)	
	567.0	19																
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS**, SOME SAND, TRACE SILT, TRACE CLAY, DAMP		20																
		21	7 8 8	22	83	SS-10	-	64	14	10	8	4	16	14	2	6	A-1-a (0)	
		22																
		23	5 6 5	15	56	SS-11	-	64	14	10	8	4	16	14	2	7	A-1-a (0)	
	562.0	24																
SOFT, GRAY, **SILT**, "AND" CLAY, DAMP		25																
		26	1 1 2	4	56	SS-12	0.25	-	-	-	-	-	-	-	-	14	A-4b (V)	
	560.0	EOB																

NOTES: PERCHED GROUNDWATER
ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; AUGER CUTTINGS; BENTONITE PELLETS

LOG OF BORING

PROJECT: HAM-71-6.86 | DRILLING FIRM / OPERATOR: STANTEC / BRADFORD | DRILL RIG: CME 55 TRUCK | STATION / OFFSET: 428+55, 61' RT. | EXPLORATION ID B-022-0-15
TYPE: ROADWAY/NOISEWALL | SAMPLING FIRM / LOGGER: STANTEC / LOPINA | HAMMER: CME AUTOMATIC | ALIGNMENT: I-71
PID: 94741 SFN: N/A | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 2/24/16 | ELEVATION: 589.0 (MSL) EOB: 26.5 ft. | PAGE 1 OF 1
START: 5/15/16 END: 5/15/16 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 81.3 | LAT / LONG: 39.170470, -84.416065

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT PAVEMENT	587.9																	
MEDIUM STIFF TO STIFF, BROWN AND GRAY, **CLAY**, TRACE GRAVEL, LITTLE SAND, "AND" SILT, MOIST		1																
		2	2 3 3	8	67	SS-1	1.75	-	-	-	-	-	-	-	-	18	A-7-6 (V)	
		3																
		4	4 4 5	12	78	SS-2	2.75	5	5	11	42	37	41	15	26	17	A-7-6 (15)	
	584.5	5																
VERY STIFF, BROWN AND GRAY, **SILT AND CLAY**, LITTLE GRAVEL, LITTLE SAND, MOIST TO WET		6	6 7 5	16	50	SS-3	2.75	10	4	13	42	31	27	16	11	23	A-6a (8)	
		7	6 8 7	20	44	SS-4	3.00	10	4	13	42	31	27	16	11	25	A-6a (8)	
	581.5	8																
STIFF, LIGHT BROWN, **SILTY CLAY**, LITTLE GRAVEL, TRACE SAND, MOIST		9	4 5 5	14	100	SS-5	3.50	-	-	-	-	-	-	-	-	26	A-6b (V)	
		10																
		11	3 4 6	14	89	SS-6	3.50	-	-	-	-	-	-	-	-	25	A-6b (V)	
		12																
		13	2 4 5	12	100	SS-7	3.00	15	2	3	34	46	40	19	21	26	A-6b (12)	
		14																
		15																
		16	10 4 3	9	83	SS-8	2.75	-	-	-	-	-	-	-	-	24	A-6b (V)	
	572.5	17																
MEDIUM STIFF TO STIFF, GRAY, **SILT**, "AND" CLAY, WET		18	1 3 3	8	100	SS-9	2.00	-	-	-	-	-	-	-	-	24	A-4b (V)	
		19																
		20																
		21	4 2 1	4	100	SS-10	1.25	0	0	0	59	41	24	15	9	23	A-4b (8)	
		22																
		23	3 4 3	9	100	SS-11	1.50	-	-	-	-	-	-	-	-	23	A-4b (V)	
		24																
		25																
		26	3 4 4	11	100	SS-12	1.00	-	-	-	-	-	-	-	-	22	A-4b (V)	
	562.5	EOB																

NOTES: NONE
ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; AUGER CUTTINGS

OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-71-6.86
TYPE: ROADWAY/NOISEWALL
PID: 94741 SFN: N/A
START: 5/18/16 END: 5/18/16

DRILLING FIRM / OPERATOR: STANTEC / BRADFORD
SAMPLING FIRM / LOGGER: STANTEC / BRADFORD
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: CME 55 TRACKED
HAMMER: CME AUTOMATIC
CALIBRATION DATE: 1/8/16
ENERGY RATIO (%): 92.4

STATION / OFFSET: 430+49, 76' RT.
ALIGNMENT: I-71
ELEVATION: 588.8 (MSL) EOB: 26.5 ft.
LAT / LONG: 39.170456, -84.415388

EXPLORATION ID B-024-0-15
PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 588.8	DEPTHS	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
TOPSOIL	588.5																	
STIFF TO VERY STIFF, BROWN, **SILTY CLAY**, LITTLE TO NO GRAVEL, TRACE SAND, [FILL], MOIST		1																
		2	1 4 5	14	72	SS-1	4.00	-	-	-	-	-	-	-	-	25	A-6b (V)	
		3																
		4	4 4 6	15	89	SS-2	2.00	15	1	1	38	45	40	20	20	26	A-6b (12)	
		5	10 7 9	25	94	SS-3	3.00	0	0	1	49	50	38	19	19	24	A-6b (12)	
		6																
	581.3	7	12 8 11	29	89	SS-4	4.50	0	0	1	49	50	38	19	19	22	A-6b (12)	
STIFF TO VERY STIFF, LIGHT BROWN, **SILT AND CLAY**, MOIST		8	4 9 7	25	94	SS-5	4.00	-	-	-	-	-	-	-	-	22	A-6a (V)	
		9																
		10																
		11	3 3 5	12	89	SS-6	3.00	0	0	0	57	43	29	17	12	23	A-6a (9)	
		12																
		13	3 5 5	15	78	SS-7	4.50	0	0	0	57	43	29	17	12	23	A-6a (9)	
		14																
		15																
		16	4 3 6	14	100	SS-8	3.50	-	-	-	-	-	-	-	-	24	A-6a (V)	
	571.8	17																
MEDIUM STIFF TO STIFF, GRAY, **SILT AND CLAY**, MOIST		18	3 3 6	14	100	SS-9	3.00	-	-	-	-	-	-	-	-	21	A-6a (V)	
		19																
		20																
		21	2 2 3	8	67	SS-10	1.50	0	0	0	59	41	27	16	11	24	A-6a (8)	
		22																
SOFT FROM 22.5' TO 24.0'		23	1 1 1	3	94	SS-11	0.50	0	0	0	59	41	27	16	11	22	A-6a (8)	
		24																
		25																
	562.3 EOB	26	1 1 2	5	100	SS-12	2.00	-	-	-	-	-	-	-	-	24	A-6a (V)	

NOTES: NONE
ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS

LOG OF BORING

PROJECT: HAM-71-6.86
TYPE: ROADWAY/NOISEWALL
PID: 94741 SFN: N/A
START: 5/18/16 END: 5/18/16

DRILLING FIRM / OPERATOR: STANTEC / BRADFORD
SAMPLING FIRM / LOGGER: STANTEC / BRADFORD
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: CME 55 TRACKED
HAMMER: CME AUTOMATIC
CALIBRATION DATE: 1/8/16
ENERGY RATIO (%): 92.4

STATION / OFFSET: 432+49, 74' RT.
ALIGNMENT: I-71
ELEVATION: 587.2 (MSL) EOB: 26.5 ft.
LAT / LONG: 39.170356, -84.414682

EXPLORATION ID B-025-0-15
PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 587.2	DEPTHS	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
TOPSOIL	586.9																	
SOFT, BROWN, **SILTY CLAY**, LITTLE GRAVEL, LITTLE SAND, [FILL], MOIST		1																
		2	1 1 1	3	67	SS-1	2.00	-	-	-	-	-	-	-	-	23	A-6b (V)	
		3																
STIFF FROM 3.0' TO 4.5'		4	3 4 3	11	72	SS-2	2.50	19	3	9	39	30	35	15	20	19	A-6b (11)	
	582.7	5																
STIFF TO VERY STIFF, BROWN, **CLAY**, SOME GRAVEL, LITTLE SAND, SOME SILT, [FILL], MOIST		6	5 5 5	15	72	SS-3	3.00	24	3	8	27	38	48	15	33	24	A-7-6 (15)	
		7	7 6 5	17	78	SS-4	3.00	24	3	8	27	38	48	15	33	24	A-7-6 (15)	
		8	1 2 6	12	89	SS-5	2.50	-	-	-	-	-	-	-	-	22	A-7-6 (V)	
		9																
		10																
		11	3 3 4	11	78	SS-6	3.00	-	-	-	-	-	-	-	-	24	A-7-6 (V)	
	575.2	12																
MEDIUM STIFF TO STIFF, BROWN, **SILT AND CLAY**, TRACE SAND, MOIST TO WET		13	1 1 3	6	72	SS-7	2.50	-	-	-	-	-	-	-	-	29	A-6a (V)	
		14																
		15																
		16	3 5 3	12	94	SS-8	2.00	-	-	-	-	-	-	-	-	24	A-6a (V)	
		17																
VERY STIFF FROM 17.5' TO 19.0'		18	3 6 6	18	94	SS-9	3.00	0	0	2	57	41	30	16	14	21	A-6a (10)	
		19																
		20																
		21	3 3 5	12	94	SS-10	4.50	0	0	2	57	41	30	16	14	20	A-6a (10)	
		22																
		23	2 3 5	12	72	SS-11	3.50	-	-	-	-	-	-	-	-	21	A-6a (V)	
		24																
	561.7	25																
STIFF, GRAY, **SILT AND CLAY**, MOIST	560.7 EOB	26	3 4 4	12	72	SS-12	1.50	-	-	-	-	-	-	-	-	20	A-6a (V)	

NOTES: NONE
ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS

OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-71-6.86 | DRILLING FIRM / OPERATOR: STANTEC / BRADFORD | DRILL RIG: CME 55 TRACKED | STATION / OFFSET: 435+25, 66' RT. | EXPLORATION ID B-027-0-15
TYPE: ROADWAY/NOISEWALL | SAMPLING FIRM / LOGGER: STANTEC / LOPINA | HAMMER: CME AUTOMATIC | ALIGNMENT: I-71
PID: 94741 SFN: N/A | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/8/16 | ELEVATION: 585.2 (MSL) EOB: 26.5 ft. | PAGE 1 OF 1
START: 5/27/16 END: 5/27/16 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 92.4 | LAT / LONG: 39.170369, -84.414002

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
TOPSOIL	585.2																	
LOOSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, [FILL], DAMP	584.9		3 2 3	8	33	SS-1	-	-	-	-	-	-	-	-	-	8	A-2-4 (V)	
STIFF TO VERY STIFF, BROWN AND GRAY, **CLAY**, TRACE GRAVEL, TRACE SAND, "AND" SILT, MOIST	582.2		2 3 7	15	78	SS-2	3.75	-	-	-	-	-	-	-	-	20	A-7-6 (V)	
STIFF TO VERY STIFF, BROWN AND GRAY, **SILTY CLAY**, TRACE SAND, MOIST	579.2		6 6 7	20	89	SS-3	3.25	8	3	3	39	47	43	18	25	24	A-7-6 (15)	
			6 8 8	25	94	SS-4	3.25	0	0	1	56	43	35	19	16	22	A-6b (10)	
			6 6 9	23	83	SS-5	4.00	-	-	-	-	-	-	-	-	22	A-6b (V)	
	573.2		3 5 5	15	83	SS-6	3.50	-	-	-	-	-	-	-	-	18	A-6b (V)	
LOOSE, BROWN, **COARSE AND FINE SAND**, WET	570.2	W	1 1 2	5	28	SS-7	-	-	-	-	-	-	-	-	-	24	A-3a (V)	
VERY STIFF TO HARD, BROWN, **SILT**, TRACE GRAVEL, TRACE SAND, SOME SAND, WET			5 6 7	20	78	SS-8	4.00	1	2	2	68	27	24	19	5	24	A-4b (8)	
	565.7		7 12 15	42	33	SS-9	-	1	2	2	68	27	24	19	5	24	A-4b (8)	
SOFT TO MEDIUM STIFF, GRAY, **SILT AND CLAY**, TRACE SAND, MOIST			1 1 1	3	100	SS-10	0.25	-	-	-	-	-	-	-	-	21	A-6a (V)	
			WOH 1 2	5	100	SS-11	0.25	0	1	3	50	46	29	16	13	24	A-6a (9)	
	558.7	EOB	1 2 2	6	100	SS-12	0.25	-	-	-	-	-	-	-	-	22	A-6a (V)	

NOTES: PERCHED GROUNDWATER
ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS; BENTONITE POWDER

LOG OF BORING

PROJECT: HAM-71-6.86 | DRILLING FIRM / OPERATOR: STANTEC / BRADFORD | DRILL RIG: CME 55 TRUCK | STATION / OFFSET: 437+01, 61' RT. | EXPLORATION ID B-028-0-15
TYPE: ROADWAY/NOISEWALL | SAMPLING FIRM / LOGGER: STANTEC / WILSON | HAMMER: CME AUTOMATIC | ALIGNMENT: I-71
PID: 94741 SFN: N/A | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 2/24/16 | ELEVATION: 585.7 (MSL) EOB: 26.5 ft. | PAGE 1 OF 1
START: 5/10/16 END: 5/10/16 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 81.3 | LAT / LONG: 39.170547, -84.413386

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT PAVEMENT	585.7																	
GRANULAR BASE	584.6																	
MEDIUM STIFF TO STIFF, GRAY, **CLAY**, SOME GRAVEL, LITTLE SAND, SOME SILT, [FILL], MOIST	584.2		5 2 2	5	89	SS-1	2.50	23	8	7	31	31	42	14	28	28	A-7-6 (13)	
			6 3 8	15	28	SS-2	1.50	-	-	-	-	-	-	-	-	22	A-7-6 (V)	
MEDIUM DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, [FILL], DAMP	581.2		3 5 5	14	78	SS-3	-	68	8	3	10	11	33	15	18	10	A-2-6 (0)	
	578.2		7 8 9	23	6	SS-4	-	68	8	3	10	11	33	15	18	8	A-2-6 (0)	
STIFF TO VERY STIFF, GRAY, **SILTY CLAY**, "AND" GRAVEL, TRACE SAND, [FILL], DAMP TO MOIST			7 4 3	9	67	SS-5	-	-	-	-	-	-	-	-	-	17	A-6b (V)	
			12 10 16	35	67	SS-6	2.50	49	7	3	20	21	34	16	18	14	A-6b (3)	
			4 6 9	20	67	SS-7	2.50	49	7	3	20	21	34	16	18	14	A-6b (3)	
	571.7		6 5 4	12	6	SS-8	-	-	-	-	-	-	-	-	-	12	A-6b (V)	
VERY STIFF, GRAY, **SILT AND CLAY**, TRACE SAND, MOIST			7 7 8	20	0		-	-	-	-	-	-	-	-	-	-	A-6a (V)	
	566.2		5 6 7	18	100	SS-9	3.00	0	0	1	57	42	32	18	14	19	A-6a (10)	
STIFF, BROWN, **SANDY SILT**, TRACE GRAVEL, SOME CLAY, MOIST			4 5 4	12	100	SS-10	0.50	-	-	-	-	-	-	-	-	19	A-4a (V)	
			3 4 3	9	100	SS-11	1.50	9	6	16	46	23	22	15	7	18	A-4a (7)	
	559.2	EOB	4 5 5	14	100	SS-12	2.50	-	-	-	-	-	-	-	-	23	A-4a (V)	

NOTES: NONE
ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; AUGER CUTTINGS

HAM-71-6.86

STRUCTURE FOUNDATION EXPLORATION
I-71 NOISE WALL
BORING LOGS B-027-0-15 & B-028-0-15

DRAWN MSJ
CHECKED EMK

OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

LOG OF BORING

PROJECT: HAM-71-6.86	DRILLING FIRM / OPERATOR: STANTEC / BRADFORD	DRILL RIG: CME 55 TRUCK	STATION / OFFSET: 438+39, 60' RT.	EXPLORATION ID B-029-0-15
TYPE: ROADWAY/NOISEWALL	SAMPLING FIRM / LOGGER: STANTEC / WILSON	HAMMER: CME AUTOMATIC	ALIGNMENT: I-71	
PID: 94741 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 2/24/16	ELEVATION: 586.9 (MSL) EOB: 26.5 ft.	PAGE 1 OF 1
START: 5/10/16 END: 5/10/16	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.3	LAT / LONG: 39.170559, -84.412897	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_m	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT PAVEMENT	586.9																	
	585.8	1																
GRANULAR BASE	585.5																	
STIFF TO HARD, BROWN, **SILTY CLAY**, "AND" GRAVEL, LITTLE SAND, [FILL], DAMP TO MOIST		2	2 32 6	51	28	SS-1	3.00	47	12	5	18	18	35	15	20	20	A-6b (2)	
		3																
		4	6 6 5	15	28	SS-2	-	47	12	5	18	18	35	15	20	15	A-6b (2)	
	582.4																	
STIFF TO HARD, GRAY, **SILTY CLAY**, "AND" GRAVEL, LITTLE SAND, [FILL], DAMP		5	4 3 3	8	78	SS-3	3.00	-	-	-	-	-	-	-	-	11	A-6b (V)	
		6																
		7	7 9 36	61	61	SS-4	3.50	39	9	5	24	23	35	16	19	8	A-6b (5)	
	579.4																	
MEDIUM DENSE TO DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, [FILL], DAMP		8	13 11 6	23	28	SS-5	-	-	-	-	-	-	-	-	-	7	A-2-6 (V)	
		9																
		10	7 7 6	18	72	SS-6	2.50	65	8	4	12	11	27	14	13	8	A-2-6 (0)	
		11																
		12																
		13	19 12 17	39	100	SS-7	-	65	8	4	12	11	27	14	13	5	A-2-6 (0)	
		14																
		15																
		16	7 8 8	22	39	SS-8	1.50	-	-	-	-	-	-	-	-	10	A-2-6 (V)	
		17																
		18	39 28 12	54	39	SS-9	-	-	-	-	-	-	-	-	-	10	A-2-6 (V)	
	567.4	19																
STIFF TO HARD, GRAY, **SILTY CLAY**, "AND" GRAVEL, LITTLE SAND, DAMP		20																
		21	13 17 15	43	33	SS-10	3.50	-	-	-	-	-	-	-	-	10	A-6b (V)	
		22																
		23	11 9 5	19	89	SS-11	2.00	43	5	5	25	22	37	17	20	15	A-6b (5)	
		24																
		25																
		26	6 5 5	14	0	SS-12	-	-	-	-	-	-	-	-	-	-	A-6b (V)	
	560.4	EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; AUGER CUTTINGS

OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF GEOTECHNICAL ENGINEERING

TYPE: ROADWAY/SOIL NAIL WALL
SFN: 3115283

LOG OF BORING (HISTORIC)
(I-71 UNDER KENNEDY AVE. REAR ABUTMENT)

LOG OF BORING

Date Started 4-28-65 | Sampler Type SS | Dia. 1 3/8" | Water Elev. ____
Date Completed 4-29-65 | Casing: Length 55' | Dia. 3 1/2" | Surface Elev. 569.7'
Boring No. B-1 | Station & Offset 19+09, 40' Lt (REAR ABUTMENT)

Elev.	Depth	Std. Pen. (N)	Rec. ft.	Loss ft.	Description	Sample No.	Physical Characteristics % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	SHTL Class.
569.7	0														
	2														
	4														
564.7	6	8/9			Brown and Gray Sandy Gravelly Clay	1	28	9	11	25	27	30	11	16	
	8														
559.7	10	9/19			Gray Silty Clay	2	0	2	1	38	59	37	18	17	
	12														
	14														
554.7	16	13/23			Gray Silty Clay	3	0	1	1	27	71	41	20	19	
552.2	18	15/21			Gray Clay	4	0	0	0	30	70	43	22	23	
549.7	20	11/19			Gray Clay	5	0	1	0	27	72	40	21	22	
547.2	22	13/21			Gray Silt and Clay	6	0	0	0	53	47	29	11	25	
544.7	24	21/25			Gray Clayey Silt	7	0	0	0	53	47	29	9	17	
542.2	26	10/15			Gray Clayey Silt	8	0	0	1	55	44	30	9	22	
539.7	28	14/21			Gray Silty Gravelly Sand	9	27	25	13	25	10	NP	NP	13	
537.2	30	21/28			Gray Gravelly Sandy Silt	10	27	11	20	22	20	20	7	14	
534.7	32				Gray Silty Sand (Wash Sample)	11	0	71	13	-16-		NP	NP	13	
532.2	34				Gray Sand (Wash Sample)	12	0	68	27	-5-		NP	NP	19	
529.7	36	20/28			Gray Gravelly Sandy Silt	13	20	7	14	37	22	21	5	12	
	38														
	40														
524.7	42	50* (0.8')			Gray Silty Sandy Gravel	14	49	7	10	21	13	20	4	13	
	44														
	46														
519.7	48	50* (0.4')			Gray Silty Sandy Gravel	15	V	I	S	U	A	L	22	9	11.3
	50														
	52														
514.7	54	50* (0.7')			Gray Sandy Gravelly Silt	16	32	3	15	31	19	19	3	10	
	56														
	58														
509.7	60	50* (0.5')			BOTTOM OF BORING Gray Silty Sandy Gravel	17	36	19	22	10	13	--	--	7	
509.2					*Refusal										

HAM-71-6.86

STRUCTURE FOUNDATION EXPLORATION
I-71 SOIL NAIL WALL
HISTORIC BORING LOG B-001-0-65

DRAWN MSJ
CHECKED EMK

APPENDIX B
SUBGRADE STABILIZATION ANALYSIS

APPENDIX B.1
RESULTS OF SULFATE TESTING

Stantec

Sulfate Content in Soils
Colormetric Method
ODOT Supplement 1122

Project Name HAM-71-6.86 Project Number 173620049

Lab ID	Source	Depth	Prep. Date	Test Date	Tech.	Reading 1 (mg/l)	Reading 2 (mg/l)	Reading 3 (mg/l)	Reading Average (mg/l)	Dilution Factor	Sulfate Concentration (ppm)
2A	B-001-0-15	3.0'-4.5'	06/06/2016	06/08/2016	DB	32	32	33	32	20	647
2B	B-001-0-15	3.0'-4.5'	06/06/2016	06/08/2016	DB	28	29	29	29	20	573
2C	B-001-0-15	3.0'-4.5'	06/06/2016	06/08/2016	DB	35	36	36	36	20	713
7A	B-002-0-15	3.0'-4.5'	06/06/2016	06/08/2016	DB	14	15	15	15	20	293
7B	B-002-0-15	3.0'-4.5'	06/06/2016	06/08/2016	DB	18	18	19	18	20	367
7C	B-002-0-15	3.0'-4.5'	06/06/2016	06/08/2016	DB	12	12	12	12	20	240
13A	B-021-0-15	6.0'-7.5'	06/06/2016	06/08/2016	DB	<5	<5	<5	<5	20	<100
13B	B-021-0-15	6.0'-7.5'	06/06/2016	06/08/2016	DB	<5	<5	<5	<5	20	<100
13C	B-021-0-15	6.0'-7.5'	06/06/2016	06/08/2016	DB	<5	<5	<5	<5	20	<100
24A	B-022-0-15	1.5'-3.0'	06/06/2016	06/08/2016	DB	<5	<5	<5	<5	20	<100
24B	B-022-0-15	1.5'-3.0'	06/06/2016	06/08/2016	DB	<5	<5	<5	<5	20	<100
24C	B-022-0-15	1.5'-3.0'	06/06/2016	06/08/2016	DB	<5	<5	<5	<5	20	<100
38A	B-028-0-15	3.0'-4.5'	06/06/2016	06/08/2016	DB	<5	<5	<5	<5	20	<100
38B	B-028-0-15	3.0'-4.5'	06/06/2016	06/08/2016	DB	<5	<5	<5	<5	20	<100
38C	B-028-0-15	3.0'-4.5'	06/06/2016	06/08/2016	DB	<5	<5	<5	<5	20	<100
54A	B-029-0-15	4.5'-6.0'	06/06/2016	06/08/2016	DB	58	59	59	59	20	1173
54B	B-029-0-15	4.5'-6.0'	06/06/2016	06/08/2016	DB	49	50	51	50	20	1000
54C	B-029-0-15	4.5'-6.0'	06/06/2016	06/08/2016	DB	52	53	54	53	20	1060
67A	B-030-0-15	4.5'-6.0', 6.0'-7.5'	06/06/2016	06/08/2016	DB	20	20	21	20	20	407
67B	B-030-0-15	4.5'-6.0', 6.0'-7.5'	06/06/2016	06/08/2016	DB	16	16	17	16	20	327
67C	B-030-0-15	4.5'-6.0', 6.0'-7.5'	06/06/2016	06/08/2016	DB	19	19	20	19	20	387
87A	B-031-0-15	6.0'-7.5'	06/06/2016	06/08/2016	DB	<5	<5	<5	<5	20	<100
87B	B-031-0-15	6.0'-7.5'	06/06/2016	06/08/2016	DB	<5	<5	<5	<5	20	<100
87C	B-031-0-15	6.0'-7.5'	06/06/2016	06/08/2016	DB	<5	<5	<5	<5	20	<100
88A	B-032-0-15	1.5'-3.0'	06/09/2016	06/13/2016	JW	<5	<5	<5	<5	20	<100
88B	B-032-0-15	1.5'-3.0'	06/09/2016	06/13/2016	JW	<5	<5	<5	<5	20	<100
88C	B-032-0-15	1.5'-3.0'	06/09/2016	06/13/2016	JW	<5	<5	<5	<5	20	<100
93A	B-033-0-15	1.5'-3.0'	06/09/2016	06/13/2016	JW	52	53	53	53	40	2107
93B	B-033-0-15	1.5'-3.0'	06/09/2016	06/13/2016	JW	55	55	56	55	40	2213
93C	B-033-0-15	1.5'-3.0'	06/09/2016	06/13/2016	JW	54	54	55	54	40	2173
113A	B-034-0-15	6.0'-7.5'	06/09/2016	06/13/2016	JW	36	36	37	36	20	727
113B	B-034-0-15	6.0'-7.5'	06/09/2016	06/13/2016	JW	30	30	31	30	20	607
113C	B-034-0-15	6.0'-7.5'	06/09/2016	06/13/2016	JW	31	31	32	31	20	627
114A	B-035-0-15	1.5'-3.0'	06/09/2016	06/13/2016	JW	<5	<5	<5	<5	20	<100
114B	B-035-0-15	1.5'-3.0'	06/09/2016	06/13/2016	JW	<5	<5	<5	<5	20	<100

Stantec

Sulfate Content in Soils
Colormetric Method
ODOT Supplement 1122

Project Name HAM-71-6.86 Project Number 173620049

Lab ID	Source	Depth	Prep. Date	Test Date	Tech.	Reading 1 (mg/l)	Reading 2 (mg/l)	Reading 3 (mg/l)	Reading Average (mg/l)	Dilution Factor	Sulfate Concentration (ppm)
114C	B-035-0-15	1.5'-3.0'	06/09/2016	06/13/2016	JW	<5	<5	<5	<5	20	<100

Stantec

Sulfate Content in Soils
Colormetric Method
ODOT Supplement 1122

Project Name HAM-71-6.86 Project Number 173620049

Lab ID	Source	Depth	Prep. Date	Test Date	Tech.	Reading 1 (mg/l)	Reading 2 (mg/l)	Reading 3 (mg/l)	Reading Average (mg/l)	Dilution Factor	Sulfate Concentration (ppm)
128A	B-003-0-15	1.5'-3.0'	06/09/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
128B	B-003-0-15	1.5'-3.0'	06/09/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
128C	B-003-0-15	1.5'-3.0'	06/09/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
137A	B-004-0-15	6.0'-7.5'	06/09/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
137B	B-004-0-15	6.0'-7.5'	06/09/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
137C	B-004-0-15	6.0'-7.5'	06/09/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
139A	B-005-0-15	2.5'-4.0'	06/09/2016	06/14/2016	JW	31	31	31	31	20	620
139B	B-005-0-15	2.5'-4.0'	06/09/2016	06/14/2016	JW	30	30	31	30	20	607
139C	B-005-0-15	2.5'-4.0'	06/09/2016	06/14/2016	JW	32	32	33	32	20	647
144A	B-006-0-15	0.0'-1.5'	06/09/2016	06/14/2016	JW	58	58	58	58	40	2320
144B	B-006-0-15	0.0'-1.5'	06/09/2016	06/14/2016	JW	59	59	60	59	40	2373
144C	B-006-0-15	0.0'-1.5'	06/09/2016	06/14/2016	JW	58	58	58	58	40	2320
150A	B-007-0-15	0.0'-1.5'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
150B	B-007-0-15	0.0'-1.5'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
150C	B-007-0-15	0.0'-1.5'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
157A	B-008-0-15	5.0'-6.5'	06/13/2016	06/14/2016	JW	41	42	42	42	20	833
157B	B-008-0-15	5.0'-6.5'	06/13/2016	06/14/2016	JW	44	44	45	44	20	887
157C	B-008-0-15	5.0'-6.5'	06/13/2016	06/14/2016	JW	39	40	40	40	20	793
158A	B-009-0-15	0.0'-1.5', 2.5'-4.0'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
158B	B-009-0-15	0.0'-1.5', 2.5'-4.0'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
158C	B-009-0-15	0.0'-1.5', 2.5'-4.0'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
165A	B-010-0-15	0.0'-1.5'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
165B	B-010-0-15	0.0'-1.5'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
165C	B-010-0-15	0.0'-1.5'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
170A	B-011-0-15	1.5'-3.0'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
170B	B-011-0-15	1.5'-3.0'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
170C	B-011-0-15	1.5'-3.0'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
178A	B-012-0-15	4.5'-6.0'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
178B	B-012-0-15	4.5'-6.0'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
178C	B-012-0-15	4.5'-6.0'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
203A	B-014-0-15	4.5'-6.0'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
203B	B-014-0-15	4.5'-6.0'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
203C	B-014-0-15	4.5'-6.0'	06/13/2016	06/14/2016	JW	<5	<5	<5	<5	20	<100
231A	B-016-0-15	1.5'-3.0'	06/15/2016	06/16/2016	JW	<5	<5	<5	<5	20	<100
231B	B-016-0-15	1.5'-3.0'	06/15/2016	06/16/2016	JW	<5	<5	<5	<5	20	<100

Stantec

Sulfate Content in Soils
Colormetric Method
ODOT Supplement 1122

Project Name HAM-71-6.86 Project Number 173620049

Lab ID	Source	Depth	Prep. Date	Test Date	Tech.	Reading 1 (mg/l)	Reading 2 (mg/l)	Reading 3 (mg/l)	Reading Average (mg/l)	Dilution Factor	Sulfate Concentration (ppm)
231C	B-016-0-15	1.5'-3.0'	06/15/2016	06/16/2016	JW	<5	<5	<5	<5	20	<100
273A	B-018-0-15	0.0'-1.5'	06/15/2016	06/16/2016	JW	<5	<5	<5	<5	20	<100
273B	B-018-0-15	0.0'-1.5'	06/15/2016	06/16/2016	JW	<5	<5	<5	<5	20	<100
273C	B-018-0-15	0.0'-1.5'	06/15/2016	06/16/2016	JW	<5	<5	<5	<5	20	<100
312A	B-024-0-15	1.5'-3.0'	06/15/2016	06/16/2016	JW	19	19	19	19	20	380
312B	B-024-0-15	1.5'-3.0'	06/15/2016	06/16/2016	JW	17	17	17	17	20	340
312C	B-024-0-15	1.5'-3.0'	06/15/2016	06/16/2016	JW	16	16	16	16	20	320
327A	B-025-0-15	1.5'-3.0'	06/15/2016	06/16/2016	JW	<5	<5	<5	<5	20	<100
327B	B-025-0-15	1.5'-3.0'	06/15/2016	06/16/2016	JW	<5	<5	<5	<5	20	<100
327C	B-025-0-15	1.5'-3.0'	06/15/2016	06/16/2016	JW	<5	<5	<5	<5	20	<100
342A	B-027-0-15	3.0'-4.5'	06/15/2016	06/16/2016	JW	17	18	19	18	20	360
342B	B-027-0-15	3.0'-4.5'	06/15/2016	06/16/2016	JW	17	19	20	19	20	373
342C	B-027-0-15	3.0'-4.5'	06/15/2016	06/16/2016	JW	19	20	20	20	20	393

Comments

Reviewed By RJ

APPENDIX B.2
SUBGRADE ANALYSIS SPREADSHEETS

Subgrade Analysis

V. 13.00 01/15/16

Design CBR 7

Global Options		
320	R&R	Option
206	CS	Option
	LS	Option
206	Depth	--

Classification Counts by Sample																	
R	1a	1b	3	3a	2-4	2-5	2-6	2-7	4a	4b	5	6a	6b	7-5	7-6	8a	8b
0	4	0	0	0	7	0	6	0	8	4	0	4	31	0	16	0	0
	5%				9%		8%		10%	5%		5%	39%		20%		
0%	21%								79%								

Surface Class		
2-5	0	
4b	1	5%
5	0	
7-5	0	
7-6	4	20%
8a	0	
8b	0	
R	0	

% Borings	
N_{60L}<= 5	10%
<=10	40%
>=20	15%
M+	75%
R	0%

% Surface	
55%	
5%	55%

UC @ Surface
Undercut
17.3
36
12

Rig	ER
A	81
B	92
C	
D	
E	
F	
G	
H	

Total Borings	20					Average					21.6	12.6			17.7		25.6		16.0	14.0		7.04					
PID	94741					Maximum					77	25	48	20	33	74	50	99	27.6	18		15					
Location	HAM-71-6.86 (I-71)					Minimum					3	3	17	11	3	10	5	15	2.2	6		0					

	Boring					Subgrade		Standard Penetration						Physical Characteristics						Moisture		Class		Sulfate		Problem		Undercuts		Analysis / Comments
#	B #	Boring Location	Depth	To	Cut Fill	Depth	To	n_2	n_3	N	Rig	N_{60}	N_{60L}	LL	PL	PI	% Silt	% Clay	P 200	M	M_{OPT}	Ohio DOT	GI			w/ Class	w/ MN	UC Class	UC MN	
1	B	I-71	1.5	3.0	-1.9	-0.4	1.1	11	3	14	A	19		38	18	20	32	30	62	18	16	6b	9							
	001-0	400+16	3.0	4.5		1.1	2.6	16	16	32		43								14	16	6b	10	644						
	15	55' RT	4.5	6.0		2.6	4.1	16	13	29		39		19	12	7	34	20	54	12	10	4a	4							
			6.0	7.5		4.1	5.6	14	13	27		37	19	19	12	7	34	20	54	9	10	4a	4							
2	B	I-71	1.5	3.0	-1.9	-0.4	1.1	8	4	12	A	16		17	11	6	26	13	39	10	10	4a	1							
	002-0	403+11	3.0	4.5		1.1	2.6	6	11	17		23								9	10	4a	5	300						
	15	57' RT	4.5	6.0		2.6	4.1	10	8	18		24		17	12	5	20	11	31	8	10	2-4	0							
			6.0	7.5		4.1	5.6	8	8	16		22	16							17	10	2-4	0		M					
3	B	I-71	1.5	3.0	-1.8	-0.3	1.2	2	13	15	B	23								9	16	6b	10	100						
	011-0	408+87	3.0	4.5		1.2	2.7	10	11	21		32		33	14	19	34	34	68	12	16	6b	10							
	15	50' RT	4.5	6.0		2.7	4.2	10	10	20		31		33	14	19	34	34	68	18	16	6b	10							
			6.0	7.5		4.2	5.7	9	7	16		25	23	34	17	17	40	29	69	22	16	6b	10		M					
4	B	I-71	1.5	3.0	-1.8	-0.3	1.2	7	17	24	B	37		31	13	18	21	20	41	13	16	6b	3							
	012-0	410+98	3.0	4.5		1.2	2.7	8	8	16		25		31	13	18	21	20	41	12	16	6b	3							
	15	48' RT	4.5	6.0		2.7	4.2	11	13	24		37								17	16	6b	10	100						
			6.0	7.5		4.2	5.7	8	9	17		26	25	24	13	11	26	21	47	15	14	6a	3							
5	B	Ramp P	1.5	3.0	-1.6	-0.1	1.4	2	2	4	B	6		30	14	16	21	19	40	15	16	6b	3		N		18			
	014-0	414+87	3.0	4.5		1.4	2.9	8	9	17		26		30	14	16	21	19	40	13	16	6b	3							
	15	26' LT	4.5	6.0		2.9	4.4	10	10	20		31								14	16	6b	10	100						
			6.0	7.5		4.4	5.9	9	9	18		28	6	26	14	12	32	24	56	12	14	6a	5							
6	B	I-71	0.0	1.5	-1.3	-1.3	0.2	11	10	21	B	32		22	15	7	21	10	31	13	10	2-4	0							
	016-0	419+02	1.5	3.0		0.2	1.7	9	11	20		31								15	10	2-4	0	100						
	15	80' RT	3.0	4.5		1.7	3.2	7	7	14		22		NP	NP	NP	16	8	24	11	10	2-4	0							
			4.5	6.0		3.2	4.7	6	4	10		15	15							17	10	2-4	0		M					
7	B	I-71	0.0	1.5	-1.3	-1.3	0.2	4	5	9	B	14								22	10	4b		100		4b	MN	36	12	
	018-0	423+15	1.5	3.0		0.2	1.7	6	5	11		17		NP	NP	NP	74	11	85	25	11	4b	8			4b	M	36		
	15	71' RT	3.0	4.5		1.7	3.2	5	6	11		17		NP	NP	NP	74	11	85	20	11	4b	8			4b	M	36		
			4.5	6.0		3.2	4.7	4	3	7		11	11	NP	NP	NP	73	9	82	24	11	4b	8			4b	N	36	12	
8	B	I-71	1.5	3.0	-1.7	-0.2	1.3	5	10	15	A	20								11	10	4a	5							
	021-0	426+46	3.0	4.5		1.3	2.8	9	9	18		24		21	18	3	43	11	54	10	13	4a	4							
	15	59' RT	4.5	6.0		2.8	4.3	10	17	27		37		24	15	9	36	19	55	11	10	4a	4							
			6.0	7.5		4.3	5.8	11	14	25		34	20							11	10	4a	5	100						
9	B	I-71	1.5	3.0	-1.7	-0.2	1.3	3	3	6	A	8								18	18	7-6	14	100			N		12	
	022-0	428+55	3.0	4.5		1.3	2.8	4	5	9		12		41	15	26	42	37	79	17	18	7-6	15							
	15	61' RT	4.5	6.0		2.8	4.3	7	5	12		16		27	16	11	42	31	73	23	14	6a	8		M					
			6.0	7.5		4.3	5.8	8	7	15		20	8	27	16	11	42	31	73	25	14	6a	8		M					
10	B	I-71	1.5	3.0	-1.3	0.2	1.7	4	5	9	B	14								25	16	6b	10	347			MN		12	
	024-0	430+49	3.0	4.5		1.7	3.2	4	6	10		15		40	20	20	38	45	83	26	16	6b	12				M			
	15	76' RT	4.5	6.0		3.2	4.7	7	9	16		25		38	19	19	49	50	99	24	16	6b	12				M			
			6.0	7.5		4.7	6.2	8	11	19		29	14	38	19	19	49	50	99	22	16	6b	12				M			
11	B	I-71	1.5	3.0	-0.3	1.2	2.7	1	1	2	B	3								23	16	6b	10	100			N		33	
	025-0	432+49	3.0	4.5		2.7	4.2	4	3	7		11		35	15	20	39	30	69	19	18	7-6	11				N		12	
	15	74' RT	4.5	6.0		4.2	5.7	5	5	10		15		48	15	33	27	38	65	24	18	7-6	15				M			
			6.0	7.5		5.7	7.2	6	5	11		17	3	48	15	33	27	38	65	24	18	7-6					M			

	Boring					Subgrade		Standard Penetration						Physical Characteristics						Moisture		Class			Sulfate		Problem		Undercuts		Analysis / Comments
#	B #	Boring Location	Depth	To	Cut Fill	Depth	To	n_2	n_3	N	Rig	N_{60}	N_{60L}	LL	PL	PI	% Silt	% Clay	P 200	M	M_{OPT}	Ohio DOT	GI				w/ Class	w/ MN	UC Class	UC MN	
12	B	I-71	1.5	3.0	-1.4	0.1	1.6	2	3	5	B	8								8	10	2-4	0					N		12	
	027-0	435+25	3.0	4.5		1.6	3.1	3	7	10		15								20	18	7-6	14		376						
	15	66' RT	4.5	6.0		3.1	4.6	6	7	13		20		43	18	25	39	47	86	24	18	7-6	15					M			
			6.0	7.5		4.6	6.1	8	8	16		25	8	35	19	16	56	43	99	22	16	6b	10					M			
13	B	I-71	1.5	3.0	-1.5	0.0	1.5	2	2	4	A	5		42	14	28	31	31	62	28	18	7-6	13					N		21	
	028-0	437+01	3.0	4.5		1.5	3.0	3	8	11		15								22	18	7-6	14		100						
	15	61' RT	4.5	6.0		3.0	4.5	5	5	10		14		33	15	18	10	11	21	10	10	2-6	0								
			6.0	7.5		4.5	6.0	8	9	17		23	5	33	15	18	10	11	21	8	10	2-6	0								
14	B	I-71	1.5	3.0	-1.6	-0.1	1.4	32	6	38	A	51		35	15	20	18	18	36	20	16	6b	2								
	029-0	438+39	3.0	4.5		1.4	2.9	6	5	11		15		35	15	20	18	18	36	15	16	6b	2								
	15	60' RT	4.5	6.0		2.9	4.4	3	3	6		8								11	16	6b	10		1078			N		12	
			6.0	7.5		4.4	5.9	9	36	45		61	8	35	16	19	24	23	47	8	16	6b	5								
15	B	I-71	1.5	3.0	-1.7	-0.2	1.3	5	5	10	A	14		20	14	6	10	5	15	9	6	1a	0								
	030-0	441+82	3.0	4.5		1.3	2.8	3	16	19		26		20	14	6	10	5	15	18	6	1a	0					M			
	15	61' RT	4.5	6.0		2.8	4.3	44	13	57		77								9	6	1a	0		373						
			6.0	7.5		4.3	5.8	7	8	15		20	14							12	6	1a	0		373			M			
16	B	I-71	1.5	3.0	-1.4	0.1	1.6	4	4	8	A	11		36	15	21	34	38	72	16	16	6b	12					N		12	
	031-0	445+98	3.0	4.5		1.6	3.1	5	3	8		11		40	17	23	36	41	77	22	16	6b	13					N		12	
	15	61' RT	4.5	6.0		3.1	4.6	6	5	11		15		40	17	23	36	41	77	18	16	6b	13								
			6.0	7.5		4.6	6.1	6	6	12		16	11							26	16	6b	10		100			M			
17	B	I-71	1.5	3.0	-1.5	0.0	1.5	15	5	20	A	27								18	18	7-6	14		100						
	032-0	449+89	3.0	4.5		1.5	3.0	7	6	13		18		41	17	24	32	40	72	15	18	7-6	13								
	15	60' RT	4.5	6.0		3.0	4.5	5	8	13		18		40	18	22	19	28	47	18	16	6b	6								
			6.0	7.5		4.5	6.0	13	7	20		27	18	40	18	22	19	28	47	7	16	6b	6								
18	B	I-71	1.5	3.0	-1.5	0.0	1.5	5	3	8	A	11								8	10	2-6	2		2164			N		12	
	033-0	454+30	3.0	4.5		1.5	3.0	10	7	17		23		33	16	17	14	14	28	2	10	2-6	1								
	15	60' RT	4.5	6.0		3.0	4.5	9	8	17		23		33	16	17	14	14	28	9	10	2-6	1								
			6.0	7.5		4.5	6.0	9	11	20		27	11	33	16	17	14	14	28	15	10	2-6	1					M			
19	B	I-71	1.5	3.0	-1.5	0.0	1.5	2	3	5	A	7								17	16	6b	10					N		15	
	034-0	458+29	3.0	4.5		1.5	3.0	5	5	10		14		35	17	18	26	22	48	13	16	6b	5								
	15	61' RT	4.5	6.0		3.0	4.5	6	4	10		14		43	18	25	25	34	59	25	18	7-6	11					MN		12	
			6.0	7.5		4.5	6.0	5	3	8		11	7							11	18	7-6	14		653			N		12	
20	B	I-71	1.5	3.0	-1.3	0.2	1.7	3	4	7	A	9								9	18	7-6	14		100			N		12	
	035-0	462+00	3.0	4.5		1.7	3.2	2	5	7		9		45	17	28	27	43	70	23	18	7-6	15					N		12	
	15	61' RT	4.5	6.0		3.2	4.7	6	8	14		19		45	17	28	27	43	70	21	18	7-6	15								
			6.0	7.5		4.7	6.2	7	4	11		15	9	36	16	20	22	25	47	17	16	6b	6								

Subgrade Analysis

V. 13.00 01/15/16

Design CBR 7

Global Options		
320	R&R	No
206	CS	No
	LS	No
206	Depth	24

Classification Counts by Sample																	
R	1a	1b	3	3a	2-4	2-5	2-6	2-7	4a	4b	5	6a	6b	7-5	7-6	8a	8b
0	0	0	0	1	0	0	0	0	0	0	0	6	5	0	0	0	0
				8%								50%	42%				
0%	8%								92%								

Surface Class	
2-5	0
4b	0
5	0
7-5	0
7-6	0
8a	0
8b	0
R	0

% Borings	
N_{60L}<= 5	67%
<=10	100%
>=20	0%
M+	100%
R	0%

% Surface		
100%		
0%	100%	

UC @ Surface
Undercut
14.0
18
12

Rig	ER
A	92
B	
C	
D	
E	
F	
G	
H	

		N_{60}	N_{60L}		PI	Clay	M	M_{OPT}	GI
Total Borings	3	Average	10.2	3.7	8.8	21.2	18.5	14.3	7.86
PID	94741	Maximum	20	6	31	16	16	40	28	63	28.8	16	10
Location	HAM-71-6.86 (Ramp N)	Minimum	2	2	16	13	3	16	8	24	13.5	8	4

	Boring				Cut	Subgrade		Standard Penetration						Physical Characteristics								Moisture		Class		Sulfate		Problem		Undercuts		Analysis /
#	B #	Boring Location	Depth	To	Fill	Depth	To	n_2	n_3	N	Rig	N_{60}	N_{60L}	LL	PL	PI	% Silt	% Clay	P 200	M	M_{OPT}	Ohio DOT	GI		w/ Class	w/ MN	UC Class	UC MN	Comments
1	B	Ramp N	0.0	1.5	0.2	0.2	1.7	3	4	7	A	11		28	14	14	28	19	47	14	14	6a	4			N		12	
	005-0	407+92	2.5	4.0		2.7	4.2	2	4	6		9								17	14	6a	8	624		N		12	
	15	2' RT	5.0	6.5		5.2	6.7	0	1	1		2								20	14	6a				N		42	
			7.5	9.0		7.7	9.2	2	2	4		6	2	16	13	3	16	8	24	20	8	3a				N		---	
2	B	Ramp N	0.0	1.5	1.6	1.6	3.1	4	2	6	A	9								14	16	6b	10	2338		N		12	
	006-0	411+00	2.5	4.0		4.1	5.6	4	5	9		14								16	16	6b	10						
	15	Centerline	5.0	6.5		6.6	8.1	3	2	5		8		19	16	3	40	23	63	25	16	6b				N		12	
			7.5	9.0		9.1	10.6	1	1	2		3	3	19	16	3	40	23	63	29	16	6b				N		33	
3	B	Ramp N	0.0	1.5	-2.2	-2.2	-0.7	1	3	4	A	6								14	14	6a	8	100		N		18	
	007-0	413+50	2.5	4.0		0.3	1.8	8	5	13		20								21	14	6a	8			M			
	15	Centerline	5.0	6.5		2.8	4.3	4	5	9		14		29	15	14	33	28	61	15	14	6a	7						
			7.5	9.0		5.3	6.8	8	5	13		20	6	31	15	16	29	26	55	17	16	6b							

Subgrade Analysis

V. 13.00 01/15/16

Design CBR 7

Global Options		
320	R&R	No
206	CS	Option
	LS	No
206	Depth	15

Classification Counts by Sample																	
R	1a	1b	3	3a	2-4	2-5	2-6	2-7	4a	4b	5	6a	6b	7-5	7-6	8a	8b
0	0	0	0	0	0	0	0	0	0	0	0	8	7	0	0	0	0
												53%	47%				
0%	0%								100%								

Surface Class	
2-5	0
4b	0
5	0
7-5	0
7-6	0
8a	0
8b	0
R	0

% Borings	
N_{60L}<= 5	50%
<=10	100%
>=20	0%
M+	50%
R	0%

% Surface	
75%	
0%	75%

UC @ Surface
Undercut
16.0
18
12

Rig	ER
A	92
B	
C	
D	
E	
F	
G	
H	

Total Borings	4
PID	94741
Location	HAM-71-6.86 (Ramp P)

	N_{60}	N_{60L}			PI		Clay		M	M_{OPT}		GI
Average	13.7	5.5			15.0		22.9		17.1	14.9		6.00
Maximum	31	8	34	16	19	38	29	67	29.7	16		8
Minimum	3	3	25	14	11	21	17	40	11.6	14		3

	Boring					Subgrade		Standard Penetration						Physical Characteristics						Moisture		Class		Sulfate		Problem		Undercuts		Analysis / Comments
#	B #	Boring Location	Depth	To	Cut Fill	Depth	To	n_2	n_3	N	Rig	N_{60}	N_{60L}	LL	PL	PI	% Silt	% Clay	P 200	M	M_{OPT}	Ohio DOT	GI			w/ Class	w/ MN	UC Class	UC MN	
1	B	Ramp P	0.0	1.5	-0.5	-0.5	1.0	2	3	5	A	8								17	14	6a	8				N		12	
	008-0	408+55	2.5	4.0		2.0	3.5	6	7	13		20		28	16	12	36	23	59	13	14	6a	6							
	15	56' RT	5.0	6.5		4.5	6.0	7	7	14		21								12	14	6a	8	838						
													8																	
2	B	Ramp P	0.0	1.5	5.1	5.1	6.6	9	5	14	A	21								12	16	6b		100						
	009-0	410+00	2.5	4.0		7.6	9.1	3	2	5		8								24	16	6b		100			N		12	
	15	Centerline	5.0	6.5		10.1	11.6	1	2	3		5		34	15	19	38	29	67	25	16	6b					N		21	
			7.5	9.0		12.6	14.1	2	2	4		6	5	34	15	19	38	29	67	25	16	6b					N		18	
3	B	Ramp P	0.0	1.5	3.1	3.1	4.6	1	3	4	A	6								12	14	6a	8	100			N		18	
	010-0	412+50	2.5	4.0		5.6	7.1	4	3	7		11		25	14	11	24	17	41	13	14	6a					N		12	
	15	Centerline	5.0	6.5		8.1	9.6	2	2	4		6								19	14	6a					N		18	
			7.5	9.0		10.6	12.1	1	1	2		3	3							30	14	6a					N		33	
4	B	Ramp P	1.5	3.0	1.7	3.2	4.7	2	2	4	A	6		30	14	16	21	19	40	15	16	6b	3				N		18	
	014-0	414+87	3.0	4.5		4.7	6.2	8	9	17		26		30	14	16	21	19	40	13	16	6b	3							
	15	26' LT	4.5	6.0		6.2	7.7	10	10	20		31								14	16	6b		100						
			6.0	7.5		7.7	9.2	9	9	18		28	6	26	14	12	32	24	56	12	14	6a								

Subgrade Analysis

V. 13.00 01/15/16

Design CBR 6

Global Options		
320	R&R	No
206	CS	Option
	LS	Option
206	Depth	12

Classification Counts by Sample																	
R	1a	1b	3	3a	2-4	2-5	2-6	2-7	4a	4b	5	6a	6b	7-5	7-6	8a	8b
0	0	0	0	0	0	0	0	0	0	0	0	2	6	0	0	0	0
												25%	75%				
0%	0%								100%								

Surface Class	
2-5	0
4b	0
5	0
7-5	0
7-6	0
8a	0
8b	0
R	0

% Borings	
N_{60L}<= 5	50%
<=10	50%
>=20	0%
M+	100%
R	0%

% Surface	
100%	
0%	100%

UC @ Surface
Undercut
16.5
21
12

Rig	ER
A	92
B	
C	
D	
E	
F	
G	
H	

		N_{60}	N_{60L}			PI		Clay			M	M_{OPT}		GI
Total Borings	2	Average		24.6	9.5		18.8		42.2		19.4	15.5		9.38
PID	94741	Maximum		63	14	37	18	22	42	61	100	25.8	16	11
Location	HAM-71-6.86 (Ridge)	Minimum		5	5	32	14	15	25	26	51	11.1	14	7

	Boring				Cut	Subgrade		Standard Penetration						Physical Characteristics						Moisture		Class		Sulfate		Problem		Undercuts		Analysis /
#	B #	Boring Location	Depth	To	Fill	Depth	To	n_2	n_3	N	Rig	N_{60}	N_{60L}	LL	PL	PI	% Silt	% Clay	P 200	M	M_{OPT}	Ohio DOT	GI			w/ Class	w/ MN	UC Class	UC MN	Comments
1	B	Ridge Avenue	1.5	3.0	-1.4	0.1	1.6	1	2	3	A	5								17	16	6b	10	100			N		21	
	003-0	23+81	3.0	4.5		1.6	3.1	5	6	11		17		37	15	22	33	32	65	26	16	6b	11				M			
	15	23' RT	4.5	6.0		3.1	4.6	32	9	41		63		34	14	20	25	26	51	11	16	6b	7							
			6.0	7.5		4.6	6.1	3	4	7		11	5	34	14	20	25	26	51	12	16	6b	7				N		12	
2	B	Ridge Avenue	1.5	3.0	-2.0	-0.5	1.0	3	6	9	A	14		36	18	18	39	61	100	22	16	6b	11				MN		12	
	004-0	27+10	3.0	4.5		1.0	2.5	10	8	18		28		36	18	18	39	61	100	23	16	6b	11				M			
	15	27' RT	4.5	6.0		2.5	4.0	10	10	20		31		32	17	15	42	47	89	21	14	6a	10				M			
			6.0	7.5		4.0	5.5	7	11	18		28	14							24	14	6a	8	100			M			

APPENDIX C
CULVERT BEARING RESISTANCE CALCULATIONS

SUMMARY OF CALCULATIONS

Elevation	Limit State	Bearing Resistance
539.6 ft and below	Strength	8 ksf
	Service	4 ksf

Service Limit State (2014 AASHTO LRFD Bridge Design Specifications):

Elevation 539.6' and below

Layer of sandy silt (A-4a) or sandy lean clay (CL), with N_{60} values between 28 and 94.

Undrained ($\Phi_f = 0$)

Hand penetrometer values were recorded as q_u = 6.0 to 9.0 ksf.
From ODOT SGE Table 600-2: For N_{60} = 28 → q_u = 7.43 ksf
Use q_u = 6.0 ksf, more conservative

Nominal bearing resistance equation:

$$q_n = c\, N_{cm} + \gamma\, D_f\, N_{qm}\, C_{wq} + 0.5\, \gamma\, B\, N_{\gamma m}\, C_{w\gamma} \qquad (10.6.3.1.2a\text{-}1)$$

Where:

c = cohesion, taken as undrained shear strength (s_u) $s_u = 0.5\, q_u$ for $\Phi_f = 0$
$c = 0.5\, q_u = 0.5$ (6.0 ksf) = 3.0 ksf
$N_{cm} = N_c\, s_c\, i_c = 5.14$ (1) (1) = 5.14
$N_{qm} = N_q\, s_q\, d_q\, i_q = 1.0$ (1) (1) (1) = 1.0
$N_{\gamma m} = N_\gamma\, s_\gamma\, i_\gamma = 0$
C_{wq}, $C_{w\gamma}$ = correction factors to account for groundwater = 1.0
D_f = Depth of footing, say 10 ft
γ = Unit weight of soil = 120 pcf = 0.120 kcf

q_n = 3.0 ksf (5.14) + 0.120 kcf (10 ft) (1) (1) + 0
q_n = 15.42 ksf + 1.20 ksf
q_n = 16.62 ksf

Performed by:	Robert Lopina	**Date:**	7/13/2016
Checked by:	Eric Kistner	**Date:**	7/13/2016

Drained ($\Phi_f > 0$)

From ODOT GB 7: For $N_{60} = 28 \rightarrow \Phi_f = 26°$, c = 190 psf = 0.190 ksf

Nominal bearing resistance equation:

$$q_n = c\, N_{cm} + \gamma\, D_f\, N_{qm}\, C_{wq} + 0.5\, \gamma\, B\, N_{\gamma m}\, C_{w\gamma} \qquad (10.6.3.1.2a\text{-}1)$$

$N_{cm} = N_c\, s_c\, i_c$ = 18.1 (1) (1) = 22.3
$N_{qm} = N_q\, s_q\, d_q\, i_q$ = 8.7 (1) (1) (1) = 11.9
$N_{\gamma m} = N_\gamma\, s_\gamma\, i_\gamma$ = 8.2 (1) (1) = 12.5
C_{wq}, $C_{w\gamma}$ = correction factors to account for groundwater = 1.0
D_f = Depth of footing, say 10 ft
γ = Unit weight of soil = 120 pcf = 0.120 kcf
B = Width of footing, say 3 ft

q_n = 0.190 ksf (22.3) + 0.120 kcf (10 ft) (11.9) (1) + 0.5 (0.120 kcf) (3 ft) (12.5) (1)
q_n = 4.24 ksf + 14.28 ksf + 2.25 ksf
q_n = 20.77 ksf

Undrained controls, q_n = 16.62 ksf

Factored Resistance:

$$q_R = \varphi_b\, q_n \qquad (10.6.3.1.1\text{-}1)$$

Where:
q_R = allowable bearing resistance (ksf)
φ_b = resistance factor = 0.50 for shallow foundations in clay (Table 10.5.5.2.2-1)
q_n = nominal bearing resistance (ksf)

q_R = 0.5 (16.62 ksf) = 8.31 ksf, say **8 ksf**

Performed by:	Robert Lopina	**Date:**	7/13/2016
Checked by:	Eric Kistner	**Date:**	7/13/2016

Service Limit State (2014 AASHTO LRFD Bridge Design Specifications):

The Presumptive Bearing Resistance for Spread Footing Foundations at the Service Limit State (Table C10.6.2.6.1-1) is used. Soil is classified as sandy lean clay (CL) in the USCS. From table, for "medium dense to dense sandy or silty clay (CL or CH)":

Service Limit State = **4 ksf**

Performed by:	Robert Lopina	**Date:**	7/13/2016
Checked by:	Eric Kistner	**Date:**	7/13/2016

AASHTO LRFD Bridge Design Specifications (2014)

Table C10.6.2.6.1-1—Presumptive Bearing Resistance for Spread Footing Foundations at the Service Limit State Modified after U.S. Department of the Navy (1982)

Type of Bearing Material	Consistency in Place	Bearing Resistance (ksf)	
		Ordinary Range	Recommended Value of Use
Massive crystalline igneous and metamorphic rock: granite, diorite, basalt, gneiss, thoroughly cemented conglomerate (sound condition allows minor cracks)	Very hard, sound rock	120–200	160
Foliated metamorphic rock: slate, schist (sound condition allows minor cracks)	Hard sound rock	60–80	70
Sedimentary rock: hard cemented shales, siltstone, sandstone, limestone without cavities	Hard sound rock	30–50	40
Weathered or broken bedrock of any kind, except highly argillaceous rock (shale)	Medium hard rock	16–24	20
Compaction shale or other highly argillaceous rock in sound condition	Medium hard rock	16–24	20
Well-graded mixture of fine- and coarse-grained soil: glacial till, hardpan, boulder clay (GW-GC, GC, SC)	Very dense	16–24	20
Gravel, gravel-sand mixture, boulder-gravel mixtures (GW, GP, SW, SP)	Very dense Medium dense to dense Loose	12–20 8–14 4–12	14 10 6
Coarse to medium sand, and with little gravel (SW, SP)	Very dense Medium dense to dense Loose	8–12 4–8 2–6	8 6 3
Fine to medium sand, silty or clayey medium to coarse sand (SW, SM, SC)	Very dense Medium dense to dense Loose	6–10 4–8 2–4	6 5 3
Fine sand, silty or clayey medium to fine sand (SP, SM, SC)	Very dense Medium dense to dense Loose	6–10 4–8 2–4	6 5 3
Homogeneous inorganic clay, sandy or silty clay (CL, CH)	Very dense Medium dense to dense Loose	6–12 2–6 1–2	8 4 1
Inorganic silt, sandy or clayey silt, varved silt-clay-fine sand (ML, MH)	Very stiff to hard Medium stiff to stiff Soft	4–8 2–6 1–2	6 3 1

Table 10.5.5.2.2-1—Resistance Factors for Geotechnical Resistance of Shallow Foundations at the Strength Limit State

Method/Soil/Condition			Resistance Factor
Bearing Resistance	φ_b	Theoretical method (Munfakh et al., 2001), in clay	0.50
		Theoretical method (Munfakh et al., 2001), in sand, using *CPT*	0.50
		Theoretical method (Munfakh et al., 2001), in sand, using *SPT*	0.45
		Semi-empirical methods (Meyerhof, 1957), all soils	0.45
		Footings on rock	0.45
		Plate Load Test	0.55
Sliding	φ_τ	Precast concrete placed on sand	0.90
		Cast-in-Place Concrete on sand	0.80
		Cast-in-Place or precast Concrete on Clay	0.85
		Soil on soil	0.90
	φ_{ep}	Passive earth pressure component of sliding resistance	0.50

Performed by: Robert Lopina **Date:** 7/13/2016

Checked by: Eric Kistner **Date:** 7/13/2016

ODOT Specifications for Geotechnical Explorations (2015)

Table 600-2. Relative Consistency of Cohesive Soils

Description	Unconfined Compressive Strength*, tsf (kPa)	Standard Penetration Blows Per Foot (0.30 m), N_{60}	Hand Manipulation
Very Soft	Less than 0.25 (24)	Less than 2	Easily penetrated 2 in. (50 mm) by fist
Soft	0.25 – 0.5 (24 – 48)	2 – 4	Easily penetrated 2 in. (50 mm) by thumb
Medium Stiff	0.5 – 1.0 (48 – 96)	5 – 8	Penetrated by thumb with moderate effort
Stiff	1.0 – 2.0 (96 – 192)	9 – 15	Readily indented by thumb but not penetrated
Very Stiff	2.0 – 4.0 (192 – 383)	16 – 30	Readily indented by thumbnail
Hard	Greater than 4.0 (383)	Greater than 30	Indented with difficulty by thumbnail

*As determined by hand penetrometer or torvane tests.

ODOT Geotechnical Bulletin 7 (2014)

TABLE 2 – Typical Strength Values for Various Soils

Properties for Cohesive Soils			"Typical" Long-Term Strength Values	
Consistency	Blow Counts N		Friction Angle (ϕ')	Cohesion (c')
Very Soft	<	2	12-18°	0-25 psf
Soft	2 -	4	18-20°	25-50 psf
Medium Stiff	4 -	8	20-22°	50-100 psf
Stiff	8 -	15	22-24°	100-150 psf
Very Stiff	15 -	30	24-26°	150-200 psf
Hard	>	30	26-28°	200-250 psf

APPENDIX D
SOIL NAIL WALL ANALYSIS

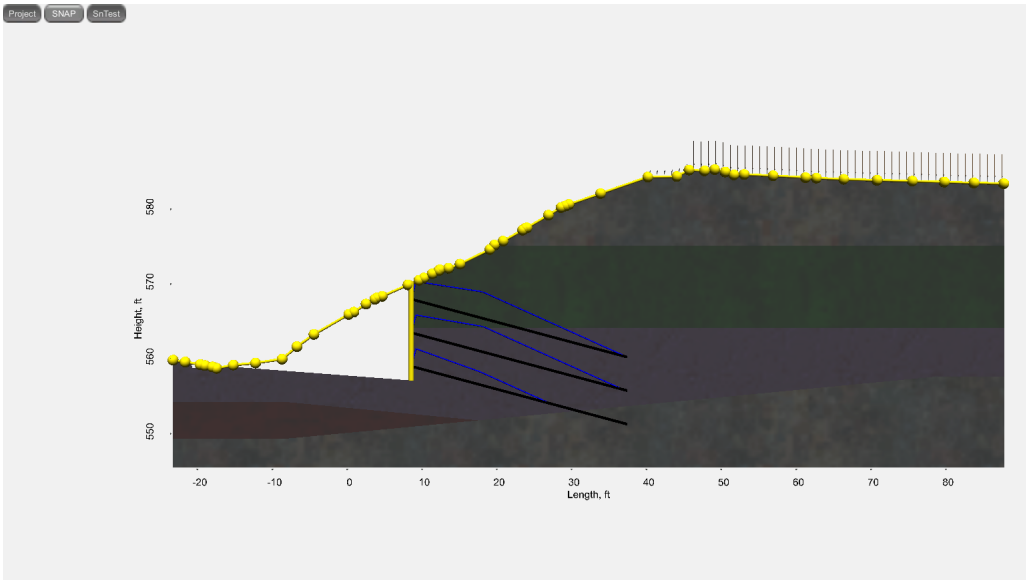
APPENDIX D.1
SNAP-2 ANALYSIS REPORTS

SNAP_2 Report

Name	Station	Designer	Date
HAM-71-6.86	416+00	R. Lopina	3/24/17

Name: Name of project.
Station: Roadway station number
Designer: Name of person performing design.
Date: Date of project

Existing Slope



Existing Slope Points

#	X, ft	Y, ft
1	-23.8	559.5
2	-22.1	559.2
3	-20.1	558.9
4	-19.5	558.7
5	-18.5	558.6
6	-17.9	558.4
7	-15.7	558.8
8	-12.7	559.1
9	-9.1	559.6
10	-7.1	561.3
11	-4.9	562.9
12	-0.2	565.6
13	0.5	565.9
14	2.1	567.0

15	3.3	567.6
16	3.5	567.8
17	4.3	568.0
18	7.8	569.6
19	9.2	570.2
20	9.9	570.5
21	11.0	571.1
22	11.9	571.5
23	12.0	571.6
24	13.2	571.8
25	14.7	572.4
26	18.7	574.3
27	19.4	574.9
28	20.5	575.4
29	23.1	576.9
30	23.5	577.1
31	23.7	577.2
32	26.6	578.9
33	28.3	579.9
34	28.8	580.1
35	28.9	580.2
36	29.4	580.3
37	33.6	581.8
38	39.9	584.0
39	43.8	584.1
40	45.5	585.0
41	47.5	584.9
42	48.9	585.0
43	50.3	584.7
44	51.5	584.3
45	52.9	584.4
46	56.8	584.2
47	61.1	584.0
48	62.5	583.9
49	66.2	583.7
50	70.7	583.6
51	75.4	583.5
52	79.7	583.4
53	83.7	583.2
54	87.7	583.1

X: Horizontal coordinates
Y: Vertical coordinates

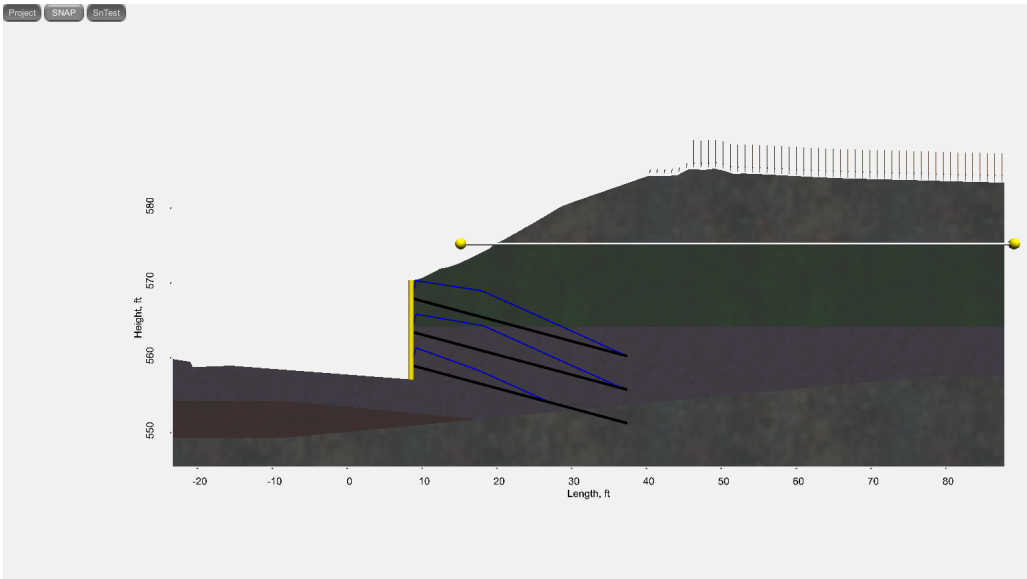
Soils

Soil Properties

#	Name	Texture	γ'_s, pcf	ϕ', ^{o}	δ_s, ^{o}	c', psf	q_u, psi	N_c	N_q	N_γ
1	Sandy Silt (1)	silt	135	28	18.7	100.0	8.7	25.8	14.7	16.7
2	Sandy Silt (2)	silt	125	28	18.7	100.0	8.7	25.8	14.7	16.7
3	Silt and Clay	clay	140	28	18.7	100.0	8.7	25.8	14.7	16.7
4	Gravel with Sand	gravel	130	34	22.7	0.0	14.5	42.2	29.4	41.1
5	Silt	silt	135	34	22.7	0.0	8.7	42.2	29.4	41.1

Name: Name of soil
Texture: Soil/rock Type
γ'_s: Effective unit weight of soil
ϕ': Effective soil friction angle / angle of internal friction
δ_s: Wall-soil interface friction angle, $\delta = 2/3\phi$
c': Effective cohesion of soil
q_u: Ultimate bond strength
N_c: N_c bearing capacity factor
N_q: N_q bearing capacity factor
N_γ: N_γ bearing capacity factor

Sandy Silt (2): Points at top of Sandy Silt (2)

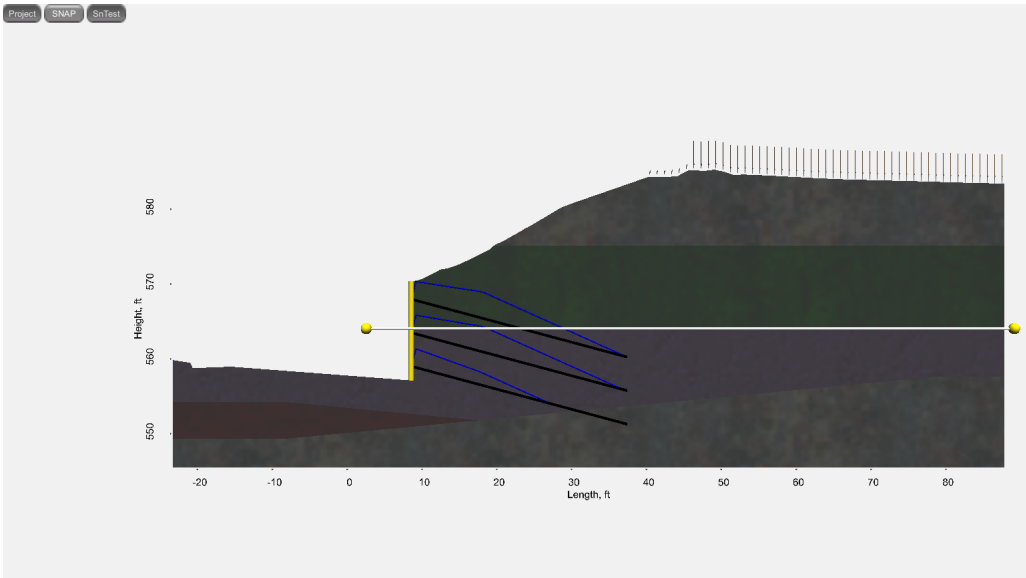


Points at top of Sandy Silt (2)

#	X, ft	Y, ft
1	15.0	574.8
2	87.6	574.8

X: Horizontal coordinates
Y: Vertical coordinates

Silt and Clay: Points at top of Silt and Clay

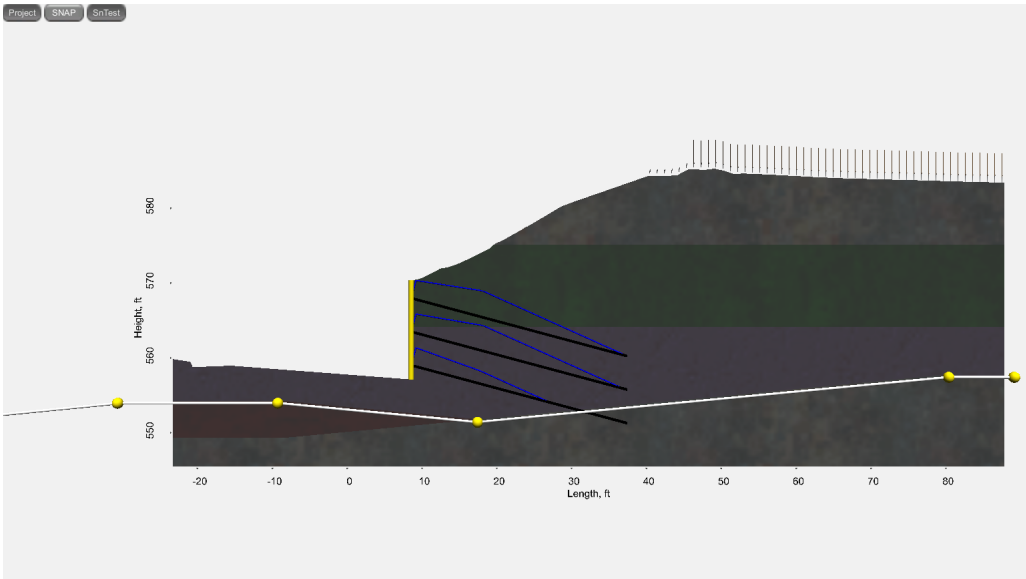


Points at top of Silt and Clay

#	X, ft	Y, ft
1	2.6	563.8
2	87.6	563.8

X: Horizontal coordinates
Y: Vertical coordinates

Gravel with Sand: Points at top of Gravel with Sand

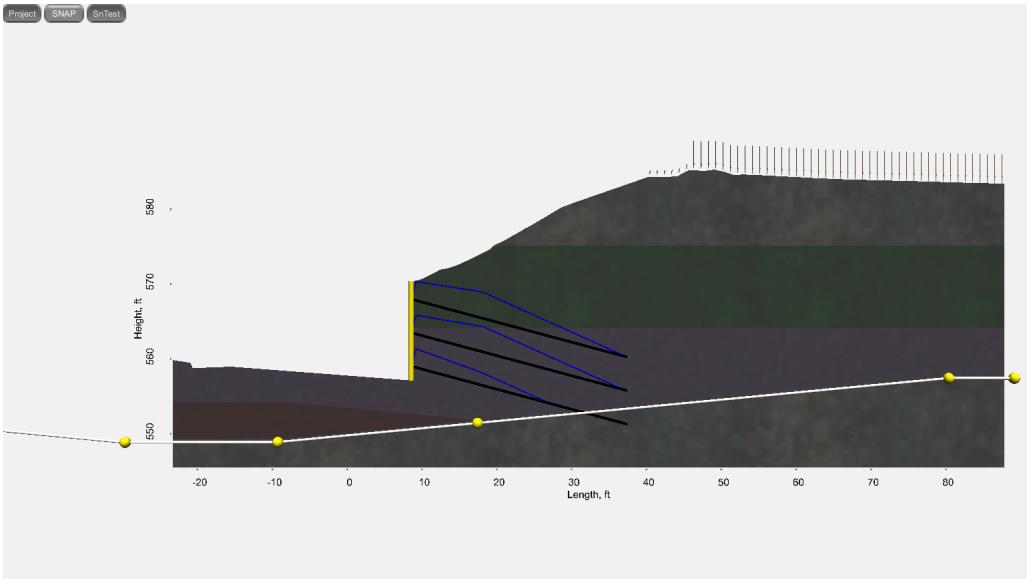


Points at top of Gravel with Sand

#	X, ft	Y, ft
1	-87.0	551.4
2	-55.2	551.4
3	-30.0	553.9
4	-9.0	553.9
5	17.2	551.4
6	79.0	557.3
7	87.6	557.3

X: Horizontal coordinates
Y: Vertical coordinates

Silt: Points at top of Silt

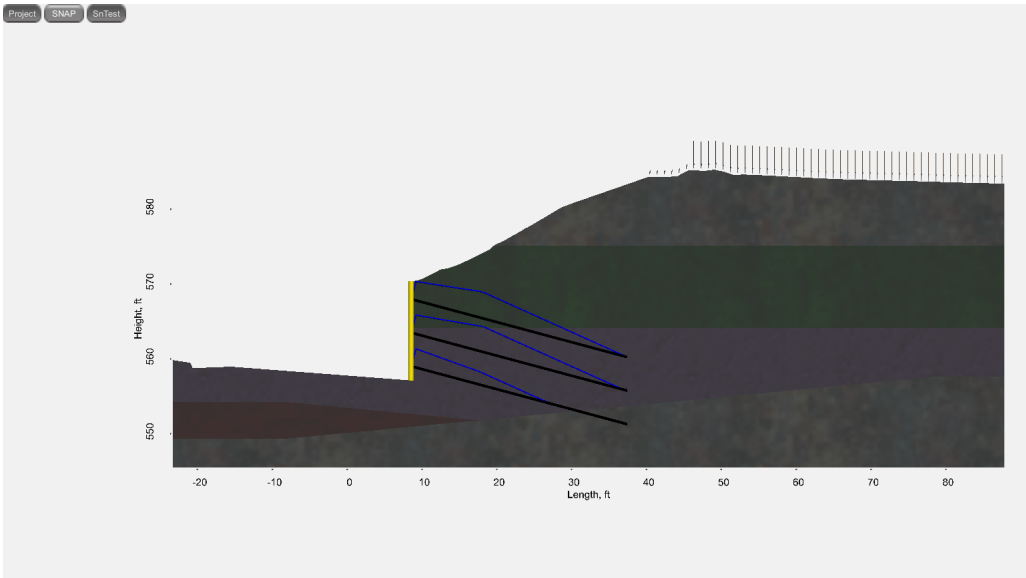


Points at top of Silt

#	X, ft	Y, ft
1	-87.0	551.4
2	-55.2	551.4
3	-29.0	548.9
4	-9.0	548.9
5	17.2	551.4
6	79.0	557.3
7	87.6	557.3

X: Horizontal coordinates
Y: Vertical coordinates

Ground Water



Nails

Default Factors of Safety

U	F_y FoS	F_{ys} FoS	F_p FoS	F_{ps} FoS
true	1.80	1.35	2.00	1.50

U: Use same factors of safety for each bar
F_y FoS: Factor of safety for yield strength
F_{ys} FoS: Seismic factor of safety for yield strength
F_p FoS: Factor of safety for pullout
F_{ps} FoS: Seismic factor of safety for pullout

Bar Properties

Name	D, in	D_{out}, in	D_{in}, in	Bar No, Bar #	F_y, ksi
Bar 1	6.0	1.000	0.000	8.0	60.0

Name: Name of bar set
D: Drill hole diameter
D_{out}: Outside diameter of bar
D_{in}: Inside diameter of bar
Bar No: Nail size 3-18
F_y: Steel yield strength of bar

Facings

Facing Properties

Type	Name	Description
Temp SNW	Temp SNW 1	-

Type: Facing type
Name: Name of facing
Description: Facing description

Temp SNW 1:

Mesh	Bars
true	true

Mesh: true if temporary facing has mesh reinforcement
Bars: true if temporary facing has bar reinforcement

Mesh: Temporary facing mesh

S_{vw}, in	S_{hw}, in	A_{wire}, in^2	$Mesh_{F_y}$, ksi
6.0	6.0	0.040	60.0

S_{vw}: Vertical mesh spacing of wires
S_{hw}: Horizontal mesh spacing of wires
A_{wire}: Mesh area of wire
$Mesh_{F_y}$: Wire mesh yield strength

Bars: Temporary facing bars

H_{Bars}	hr, in	H, Bar #	d_W, in	H_{F_y}, ksi	V_{Bars}	vr, in	V, Bar #	d_B, in	$L_{c_{vb}}$, ft	V_{F_y}, ksi
2	12	4	0.354	60.0	2	12	4	0.354	6.0	60.0

H_{Bars}: Number of horizontal waler bars
hr: Horizontal reinforcement spacing
H: Horizontal waler bar size, 3-10
d_W: Horizontal bar diameter
H_{F_y}: Horizontal bar yield strength
V_{Bars}: Number of vertical bearing bars
vr: Vertical reinforcement spacing
V: Vertical bearing bar size, 3-10
d_B: Vertical bearing bar diameter
$L_{c_{vb}}$: Vertical bearing bar length
V_{F_y}: Bearing bar yield strength

Shotcrete: Temporary shotcrete facing

$f_{c'}$, psi	h_c, in	C_F	C_S	TF FoS	TF_s FoS
4000	4.0	1	1	1.35	1.10

$f_{c'}$: Shotcrete facing compressive strength
h_c: Shotcrete facing thickness
C_F: Flexure pressure factor (Accounts for non-uniformity of pressure at back of facing)
C_S: Shear pressure factor
TF FoS: Factor of safety for flexure and punching
TF_s FoS: Seismic factor of safety for flexure and punching

Plate: Temporary facing plate

b_{PL}, in	b_d, in	F_F
10.0	1.0	0.5

b_{PL}: Bearing plate side length
b_d: Bearing plate thickness
F_F: Nail head service load factor

Wall types

Name	Description

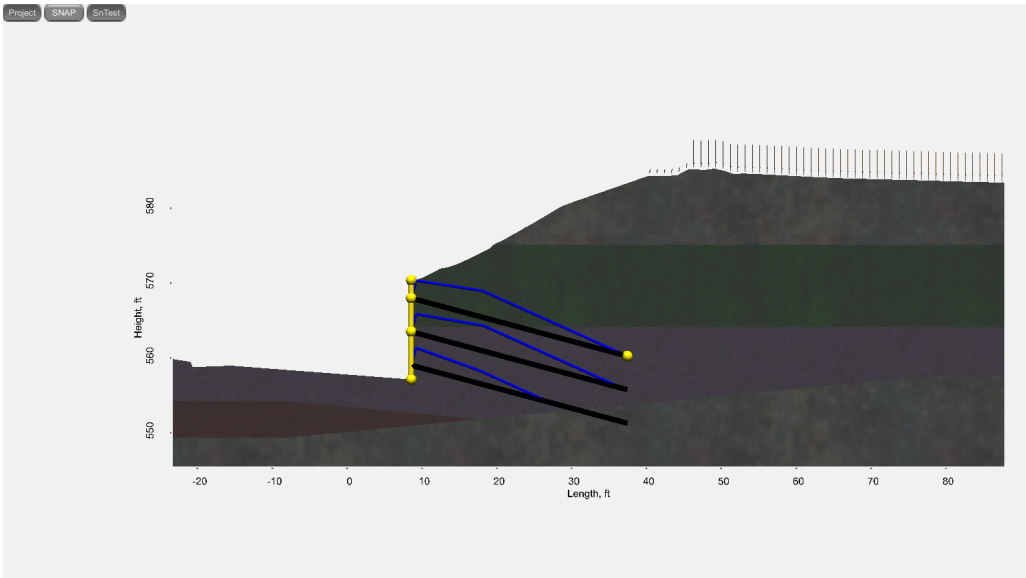
SN Wall 1	-

Name: Name of wall
Description: Wall Description

SN Wall 1:

Static Case

Wall: Soil nail wall geometry



.

Construction: Construction specification

Construction #	Con_{seq}
20	1

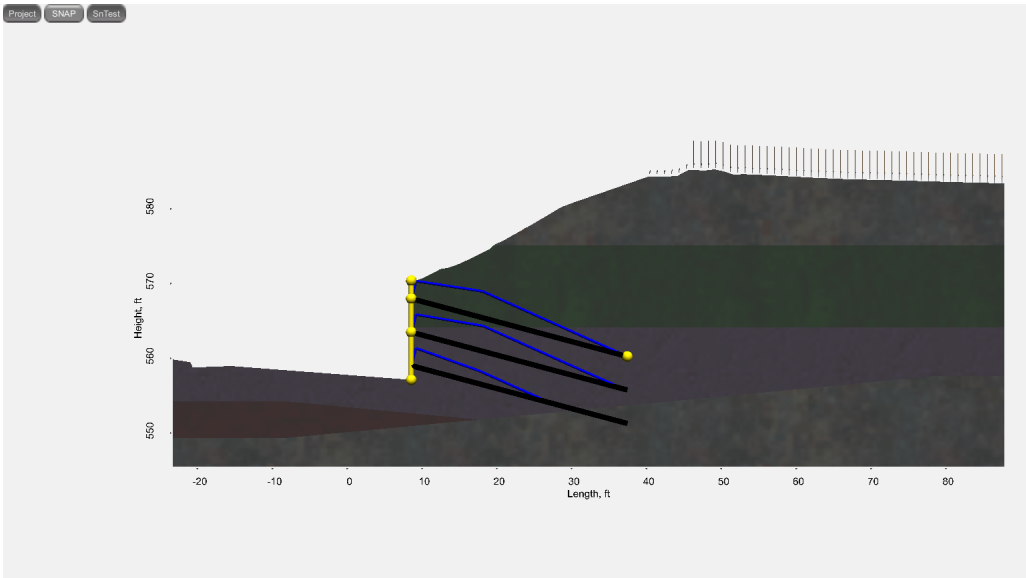
Construction #: Construction number, adds stage cuts and nails according to assigned construction sequences
Con_{seq}: Construction (stage cut) sequence when wall construction begins ie. "1" or "2,4-6"

Wall: Soil nail wall size and location

Facing	Base, ft	Top, ft	H, ft	θ, º	Emb, ft	Width, ft
Temp SNW 1	8.2,556.8	8.2,570.1	13.3	0.0	0.0	50

Facing: Wall facing
Base: Base of wall
Top: Top of wall
H: Wall height
θ: Wall batter angle, degrees from vertical
Emb: Embedment, depth below ground surface at toe
Width: Width of wall, extending along Z-Axis

Nails: Soil nail wall nail geometry



Shorten T_F
true

Shorten T_F: Shorten T-Forces on lower nails due to deformation during construction

Nails: Soil nail sizes and locations

Nail	L, ft	S_V, ft	S_H, ft	δ, °	C_d, ft	O	U
Bar 1	30.00	4.50	5.50	15.0	2.40	false	true

Nail: Bar used for this nail
L: Nail length
S_V: Vertical nail spacing
S_H: Horizontal nail spacing
δ: Nail inclination, degrees from horizontal
C_d: Cantilever distance, vertical distance from top of wall to top nail
O: Offset pattern, true if nails in even rows are offset to midspan, otherwise nails are in a square pattern
U: Use uniform nails
Nail List: Nail properties

Nail[1]

C_{dH}, ft	Failure	L_{fail}, ft	T_{Force}, kip
2.40	-	0.00	0.0

C_{dH}: Cantilever distance, vertical distance from top of wall to this nail
Failure: Failure mode for wall slip surface
L_{fail}: Distance from nail head to failure surface
T_{Force}: Nail T-force

T-Forces: Nail T-forces

#	Dist, ft	T-Force, kip	Soil	Failure
1	0.00	16.4	Sandy Silt (1)	Punching/Flexure Failure
2	9.00	22.9	Sandy Silt (1)	Pullout
3	30.00	0.0	Sandy Silt (1)	Pullout

Dist: Horizontal distance of T-force from nail head
T-Force: Nail T-force

Soil: Soil layer at T-force location
Failure: Failure mode at T-force location

Nail[2]

C_{dH}, ft	Failure	L_{fail}, ft	T_{Force}, kip
6.90	-	0.00	0.0

C_{dH}: Cantilever distance, vertical distance from top of wall to this nail
Failure: Failure mode for wall slip surface
L_{fail}: Distance from nail head to failure surface
T_{Force}: Nail T-force

T-Forces: Nail T-forces

#	Dist, ft	T-Force, kip	Soil	Failure
1	0.00	16.4	Sandy Silt (1)	Punching/Flexure Failure
2	9.13	22.0	Sandy Silt (1)	Pullout
3	29.44	0.0	Sandy Silt (1)	Pullout

Dist: Horizontal distance of T-force from nail head
T-Force: Nail T-force
Soil: Soil layer at T-force location
Failure: Failure mode at T-force location

Nail[3]

C_{dH}, ft	Failure	L_{fail}, ft	T_{Force}, kip
11.40	-	0.00	0.0

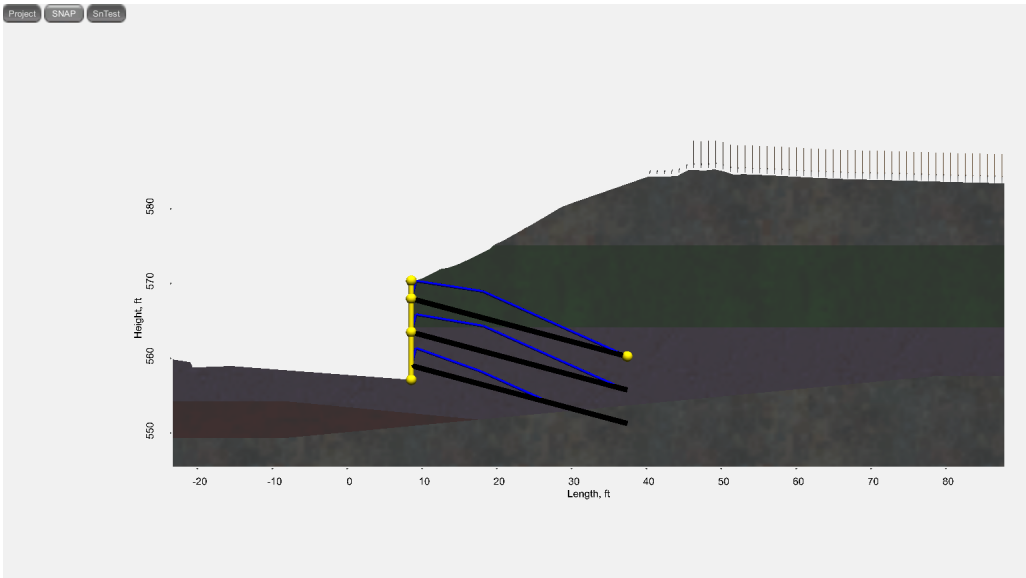
C_{dH}: Cantilever distance, vertical distance from top of wall to this nail
Failure: Failure mode for wall slip surface
L_{fail}: Distance from nail head to failure surface
T_{Force}: Nail T-force

T-Forces: Nail T-forces

#	Dist, ft	T-Force, kip	Soil	Failure
1	0.00	16.3	Sandy Silt (1)	Punching/Flexure Failure
2	9.09	11.2	Sandy Silt (1)	Pullout
3	19.34	0.0	Sandy Silt (1)	Pullout

Dist: Horizontal distance of T-force from nail head
T-Force: Nail T-force
Soil: Soil layer at T-force location
Failure: Failure mode at T-force location

Slope: Backslope and downslope cuts

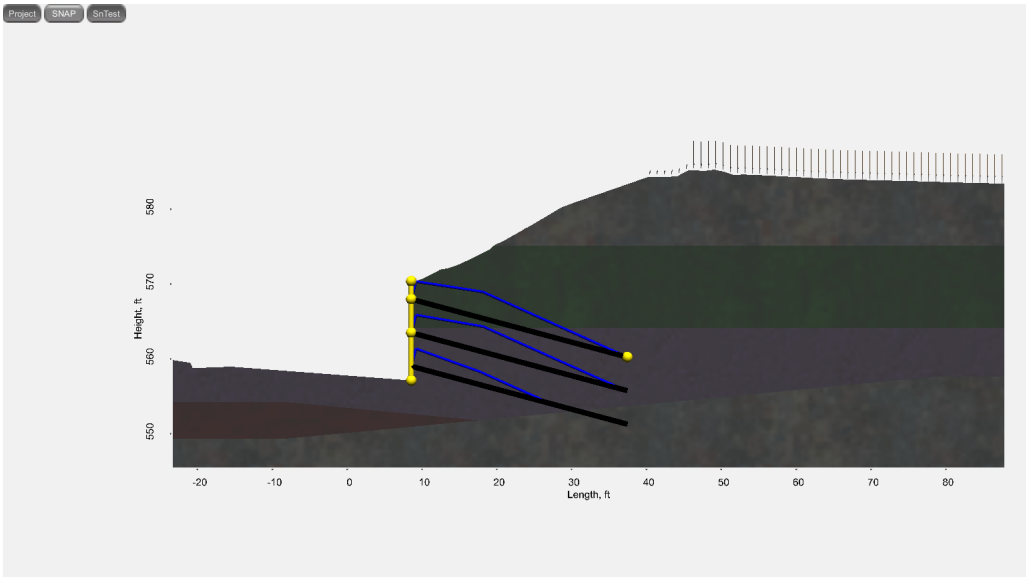


Downslope: Final downslope cut

#	XY, ft
1	-21.2,558.4
2	-16.0,558.6

XY: Horizontal X and Y coordinates

Checks: Soil nail wall design checks



Checks: Facing design checks

T_F, lbf	t_F, lbf	V, lbf/ft	M, ft-lbf/ft	L_{VB}, ft	L_S, in	ecc, ft	FS_{SL}	FS_{BC}	FoS_{GS}

16064	12219	2247.8	1067.8	2.0	12.9	-1.0	2.0	12.3	1.49

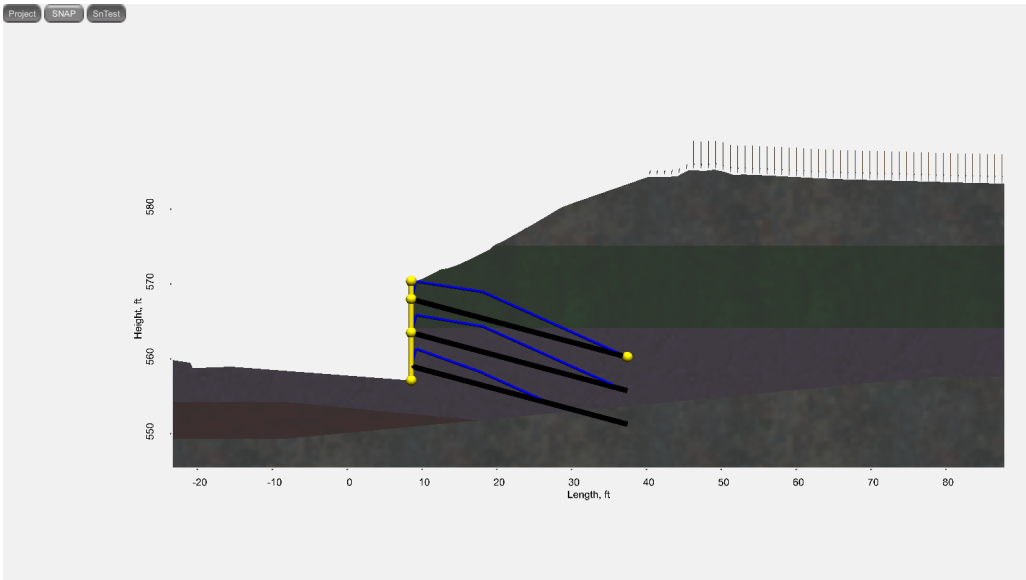
T_F: Allowable nail head strength - minimum of temporary facing T_{FF} and T_{FP}, T_F: Nail Head Load Ok: $t_F < T_F$: 12219 < 16064
t_F: Estimated nail head service load, Nail Head Load Ok: $t_F < T_F$: 12219 < 16064
V: Allowable one-way unit shear strength, One-way Unit Shear in Upper Cantilever OK: v < 0.67 V
M: Allowable one-way unit moment, Design for Flexure in Upper Cantilever OK: mS < 0.67 M
L_{VB}: Minimum total length of vertical bearing bars, Bearing bar embedment length OK
L_S: Minimum waler splice length, AASHTO 8.32, Waler splice length must be greater of 12 in. or LDwb, Ok
ecc: Eccentricity check for overturning, Ok: ecc < B / 4
FS_{SL}: Factor of safety with respect to base sliding, Ok: FS_{SL} >= 1.3
FS_{BC}: Factor of safety with respect to bearing capacity $FS_{BC} = q_{ult}/\sigma_v$, Ok: FS_{BC} >= 2.5
FoS_{GS}: Factor of safety of global stability slip surface, Ok: FoS_{GS} >= 1.35

Displacement: Long-term wall deformation and displacement parameters

$\delta_{h\,/\,H}$	κ	δ, in	λ, ft
0.002	1.25	0.3	16.6

$\delta_{h\,/\,H}$: Displacement ratio: (weathered rock/stiff soil: 0.001) (sandy soil: 0.002) (fine-grained soil: 0.003)
κ: Damping coefficient used to estimate wall displacement: (weathered rock/stiff soil: 0.8) (sandy soil: 1.25) (fine-grained soil: 1.5)
δ: Estimated displacement at the top of soil nail wall, L/H ratio outside 0.7 - 1.0, Estimation may not be accurate
λ: Horizontal distance behind soil nail wall where ground deformation can be significant

Vars: Soil nail internal variables



SC Facing Vars: Shotctrete facing design intermediate variables

$A_{S_{NEG}}$, in^2	$A_{S_{POS}}$, in^2	$m_{V_{NEG}}$, ft-lbf/ft	$m_{V_{POS}}$, ft-lbf/ft	D'_C, in	D_C, in	V_N, lbf	A_C, in^2	A_{GC}, in^2
0.840	0.440	1442	776	14.0	18.0	44507	254	28

$A_{S_{NEG}}$: Cross sectional area of steel near the nail head
$A_{S_{POS}}$: Cross sectional area of steel near the nail mid-point
$m_{V_{NEG}}$: NEG average nominal unit moment resistance
$m_{V_{POS}}$: POS average nominal unit moment resistance
D'_C: Effective diameter of punching cone
D_C: Base diameter of punching cone
V_N: Nominal internal punching shear strength of the shotcrete facing
A_C: Cross-sectional area at base of punching cone
A_{GC}: Cross-sectional area of grout column

SC Facing Vars 2: More shotctrete facing design intermediate variables

T_{FN_F}, lbf	T_{F_F}, lbf	T_{FN_P}, lbf	T_{F_P}, lbf	MaxDevLen, in	%CVB, %	L_{DBwb}, in	L_{Dwb}, in	L_D, in	MaxDevLenMesh, in
21687	16064	47549	35221	5.3	47.6	7.6	12.9	2.571	8.0

T_{FN_F}: Nominal nail head strength - flexure
T_{F_F}: Allowable nail head strength - flexure
T_{FN_P}: Nominal nail head strength - punching
T_{F_P}: Allowable nail head strength - punching
MaxDevLen: Maximum of (L_{cvb}/20), (15*d_B), and (h_c/2)
%CVB: Percent coverage from vertical bars
L_{DBwb}: Basic development length of waler bars, AASHTO 8.25.1
L_{Dwb}: Development length of waler bars, AASHTO 8.25
L_D: Basic development length of wire mesh, AASHTO 8.30
MaxDevLenMesh: Minimum wire mesh splice length

SC Facing Vars 3: More shotctrete facing design intermediate variables

K_A	A_N, in^2	T_{NN}, lbf	T_N, lbf	$K_{A_{LC}}$	v, lbf/ft	V_{NS}, lbf/ft	m_S, ft-lbf/ft
0.550	0.79	47124.4	26180.2	0.521	202.6	3034.5	160.4

K_A: Coulomb active earth pressure coefficient
A_N: Nail tendon area
T_{NN}: Nominal nail tendon tensile load
T_N: Allowable nail tendon tensile load
$K_{A_{LC}}$: Active earth pressure coefficient for load component normal to wall
v: One-way unit service shear force
V_{NS}: Nominal one-way unit shear strength
m_S: One-way unit service moment

Ex Vars: External stability intermediate variables

θ, °	β, °	q_s, psf	ϕ, °	ϕ_f, °	γ_1, pcf	γ_2, pcf	c, psf	δ, °
0.0	24.6	0	28.0	28.0	135.0	135.0	100.0	18.7

θ: Inclination of back wall measured CCW from vertical plane
β: Inclination of ground slope behind wall measured CCW from horiz. plane
q_s: Surcharge load behind wall
ϕ: Internal friction angle of weakest retained soil
ϕ_f: Internal friction angle of weakest foundation soil
γ_1: Unit weight of weakest retained soil
γ_2: Unit weight of weakest foundation soil
c: Cohesion - weakest foundation soil
δ: Wall/soil interface friction angle

Ex Vars 2: More external stability intermediate variables

B, ft	h, ft	Nγ	N_c	N_q	H2, ft	K_a	S, °
29.0	26.6	16.7	25.8	14.7	17.3	0.550	0.974

B: Effective width of wall at the base
h: Effective total height of soil at back of reinforced soil mass
Nγ: See Fig 4.4.7.1.1.4B and Table 4.4.7.1A AASHTO
N_c: Bearing capacity coefficient - weakest foundation soil
N_q: Bearing capacity coefficient - weakest foundation soil
H2: A height near the back of wall for calculating PIR and PAE
K_a: Active earth pressure coefficient - no seismic forces
S: Angle relating the horizontal and vertical seismic coefficients

Ex Vars 3: More external stability intermediate variables

F_T, lbf/ft	F_H, lbf/ft	F_V, lbf/ft	V_2, lbf/ft	V_1, lbf/ft	F_2, lbf/ft

26221.2	23838.0	10922.5	25970.9	52029.4	0.0

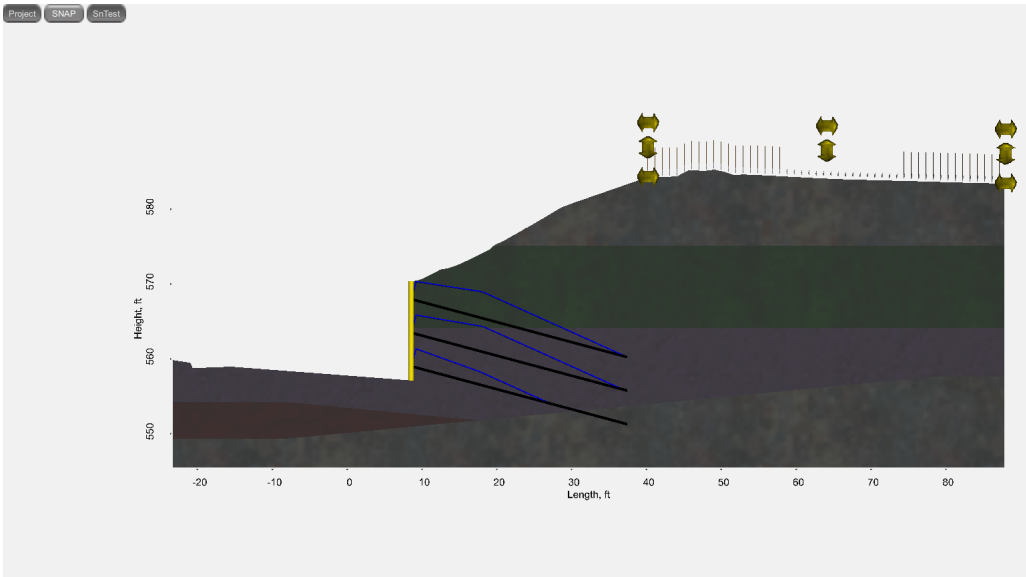
F_T: Lateral earth pressure
F_H: Horizontal lateral earth pressure
F_V: Vertical lateral earth pressure
V_2: Weight of soil above wall
V_1: Weight of soil above wall
F_2: Surcharge load

Ex Vars 4: More external stability intermediate variables

P_{IR}, lbf/ft	Y_{IR}, ft	σ_v, psf	q_{ult}, psf	q_{allow}, psf
997.4	7.7	2879.6	35278	14111

P_{IR}: Horizontal inertial force
Y_{IR}: Y-coordinate of centroid of mass for inertial force
σ_v: Vertical effective stress at base of footing
q_{ult}: Terzaghi bearing capacity
q_{allow}: Terzaghi bearing capacity $q_{allow} = q_{ult}/FOS$

Surcharge



Con_{seq}	X1, ft	X2, ft	q_s, psf	q_{sH}, psf
1-20	39.9	87.7	250	0

Con_{seq}: Construction sequence for applying surcharge, ie. "1-5" or "2,4-6"
X1: Surcharge X range start
X2: Surcharge X range end
q_s: Vertical surcharge load on slope segment as a number (250) or a linearly interpolated range (100~250)
q_{sH}: Horizontal surcharge load on slope segment as a number (250) or a linearly interpolated range (100~250)

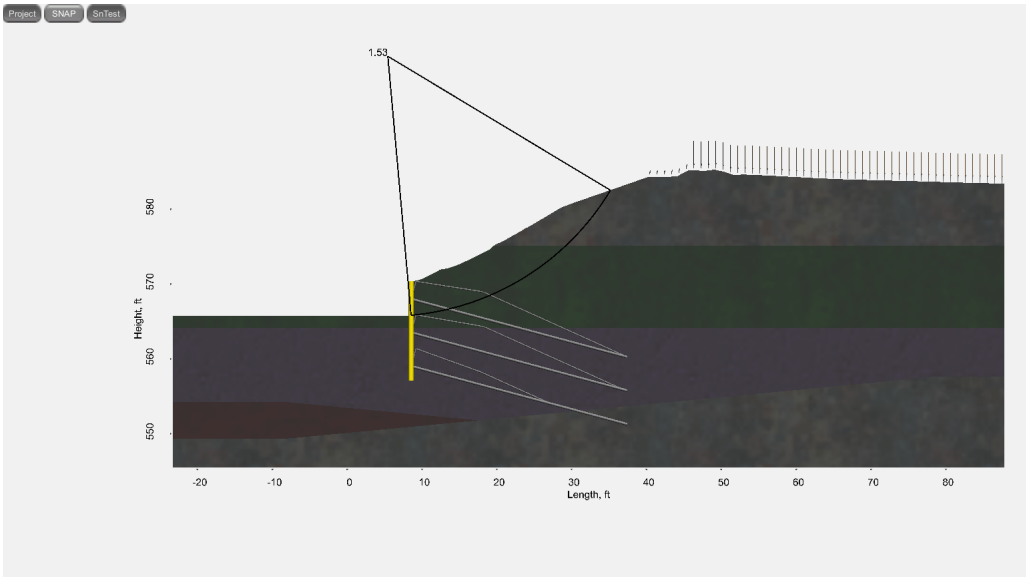
Seismic

Seismic	d, in	A	A_m	Calc K_h	K_h	K_v
false	3.000	0.040	0.056	false	0.017	0.000

Seismic: Use seismic loading for external and global stability analysis
d: Tolerable seismically induced wall lateral movement
A: Peak ground acceleration coefficient as a fraction of gravity

A_m: Normalized horizontal acceleration, $A_m = A (1.45 - A)$
Calc K_h: Automatically calculate K_h from A, if d is between 25 and 203, $K_h = 0.74 A_m (A_m/d)^{0.25}$, else $K_h = A/2$
K_h: Horizontal seismic coefficient
K_v: Vertical seismic coefficient

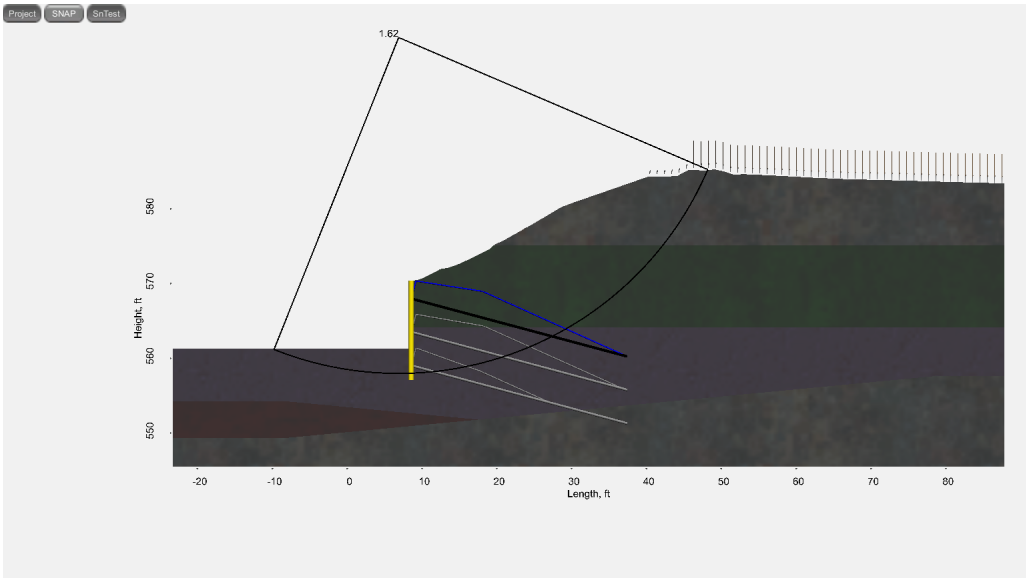
Static global stability for construction sequence 1



Construction #	Min_{Depth}, ft	Seismics	Center, ft	Radius, ft	FoS
1	2.0	false	5.1,600.1	34.7	1.53

Construction #: Construction number, adds stage cuts and nails according to assigned construction sequences
Min_{Depth}: Minimum height of failure circle arc. Use this to remove small failure circles.
Seismics: Select to use seismic case, unselect for static case
Center: Center of minimum factor of safety failure circle
Radius: Radius of minimum factor of safety failure circle
FoS: Minimum factor of safety

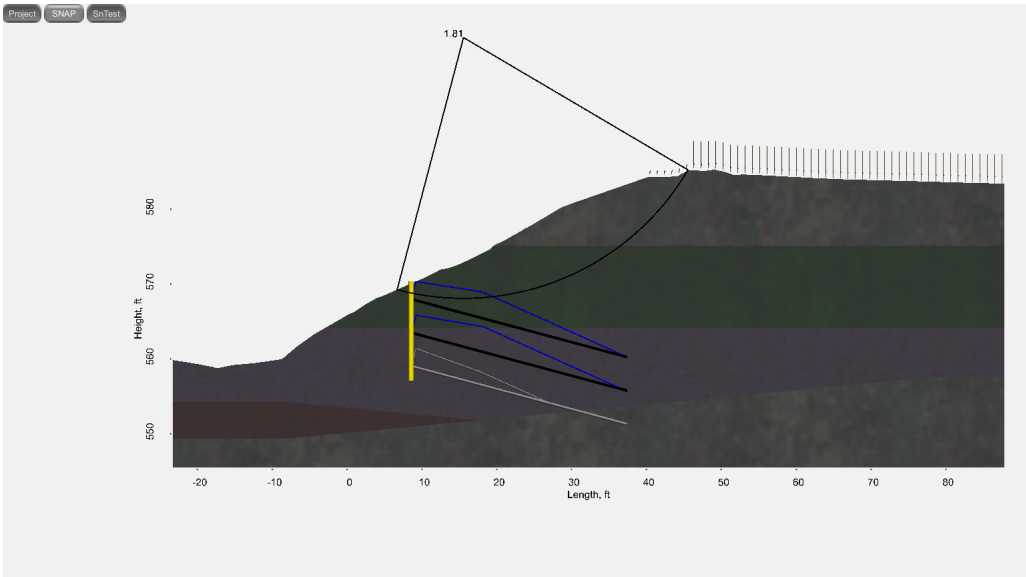
Static global stability for construction sequence 2



Construction #	Min_{Depth}, ft	Seismics	Center, ft	Radius, ft	FoS
2	2.0	false	6.6,602.6	44.9	1.62

Construction #: Construction number, adds stage cuts and nails according to assigned construction sequences
Min_{Depth}: Minimum height of failure circle arc. Use this to remove small failure circles.
Seismics: Select to use seismic case, unselect for static case
Center: Center of minimum factor of safety failure circle
Radius: Radius of minimum factor of safety failure circle
FoS: Minimum factor of safety

Static global stability for construction sequence 3

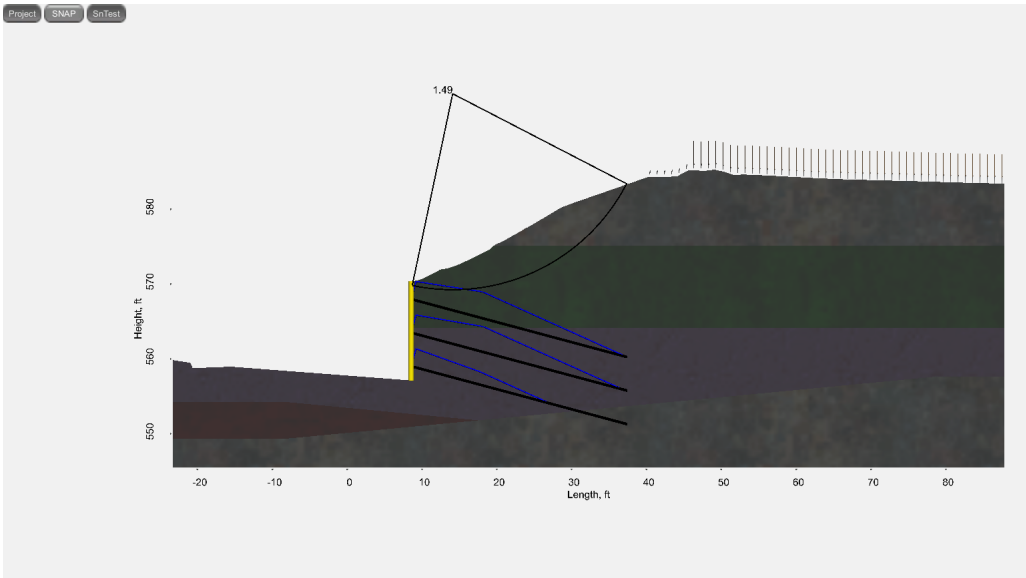


Construction #	Min_{Depth}, ft	Seismics	Center, ft	Radius, ft	FoS
3	2.0	false	15.2,602.6	34.8	1.81

Construction #: Construction number, adds stage cuts and nails according to assigned construction sequences
Min_{Depth}: Minimum height of failure circle arc. Use this to remove small failure circles.
Seismics: Select to use seismic case, unselect for static case
Center: Center of minimum factor of safety failure circle

Radius: Radius of minimum factor of safety failure circle
FoS: Minimum factor of safety

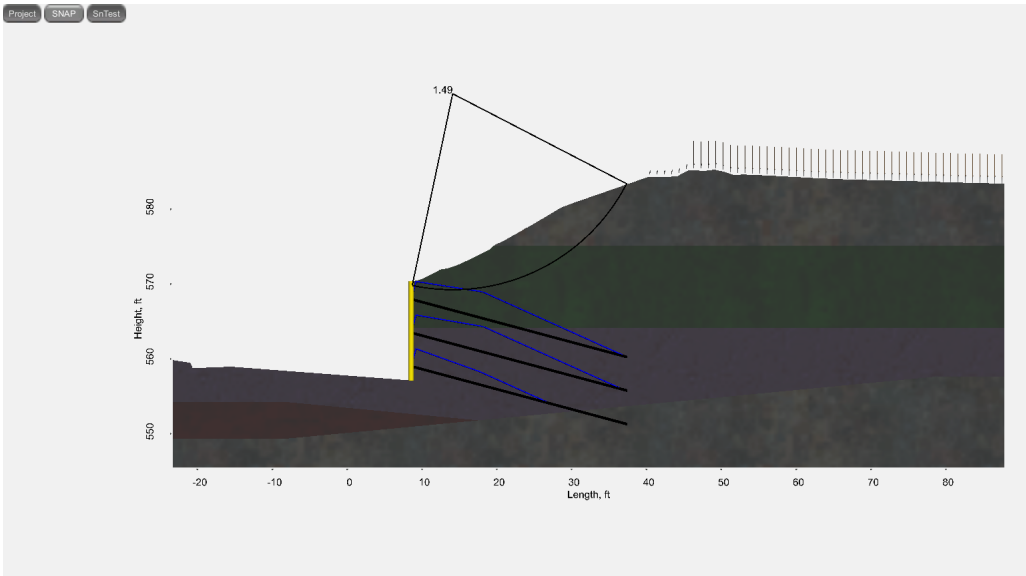
Static global stability for construction sequence 4



Construction #	Min_{Depth}, ft	Seismics	Center, ft	Radius, ft	FoS
4	2.0	false	13.8,595.1	26.2	1.49

Construction #: Construction number, adds stage cuts and nails according to assigned construction sequences
Min_{Depth}: Minimum height of failure circle arc. Use this to remove small failure circles.
Seismics: Select to use seismic case, unselect for static case
Center: Center of minimum factor of safety failure circle
Radius: Radius of minimum factor of safety failure circle
FoS: Minimum factor of safety

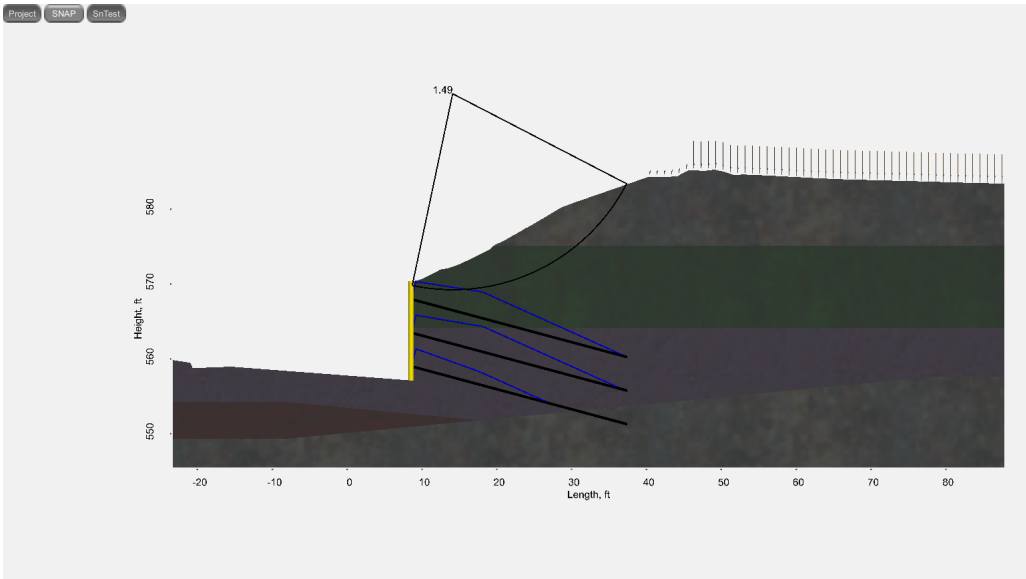
Static global stability for construction sequence 5



Construction #	Min_{Depth}, ft	Seismics	Center, ft	Radius, ft	FoS
5	2.0	false	13.8,595.1	26.2	1.49

Construction #: Construction number, adds stage cuts and nails according to assigned construction sequences
Min_{Depth}: Minimum height of failure circle arc. Use this to remove small failure circles.
Seismics: Select to use seismic case, unselect for static case
Center: Center of minimum factor of safety failure circle
Radius: Radius of minimum factor of safety failure circle
FoS: Minimum factor of safety

Static global stability for construction sequence 6



Construction #	Min_{Depth}, ft	Seismics	Center, ft	Radius, ft	FoS
6	2.0	false	13.8,595.1	26.2	1.49

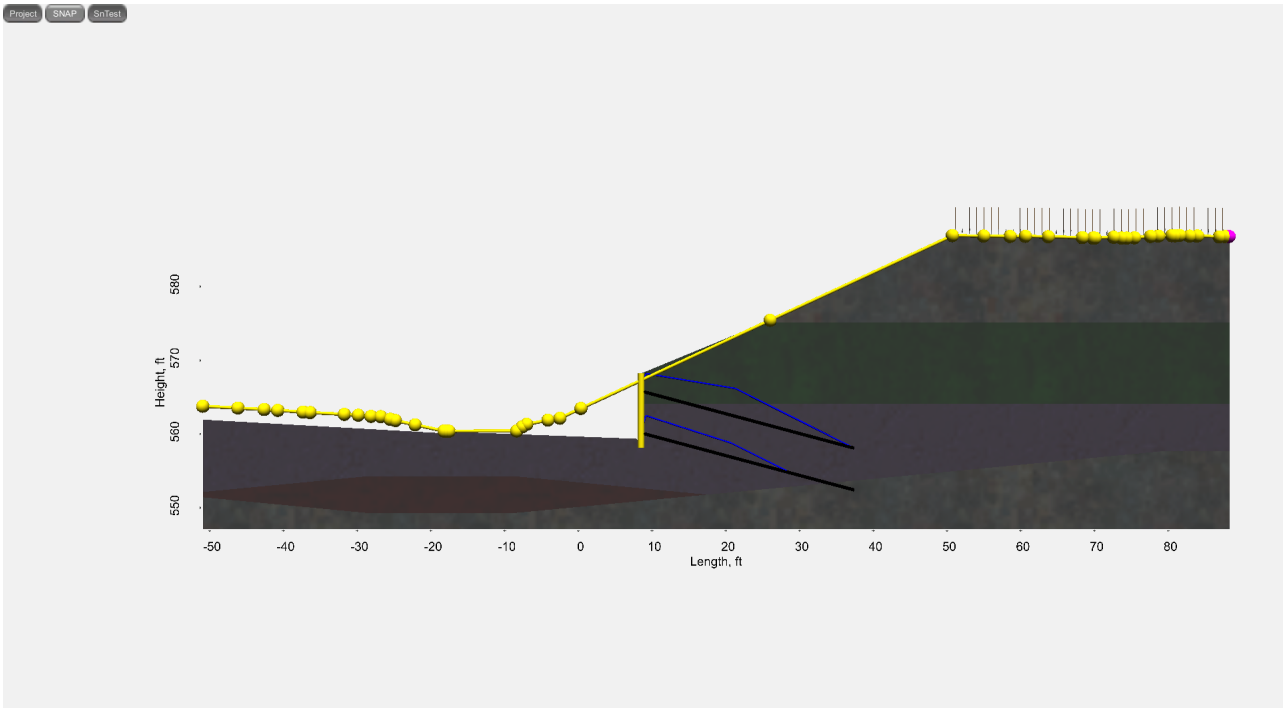
Construction #: Construction number, adds stage cuts and nails according to assigned construction sequences
Min_{Depth}: Minimum height of failure circle arc. Use this to remove small failure circles.
Seismics: Select to use seismic case, unselect for static case
Center: Center of minimum factor of safety failure circle
Radius: Radius of minimum factor of safety failure circle
FoS: Minimum factor of safety

SNAP_2 Report

Name	Station	Designer	Date
HAM-71-6.86	416+70	R. Lopina	3/24/17

Name: Name of project.
Station: Roadway station number
Designer: Name of person performing design.
Date: Date of project

Existing Slope



Existing Slope Points

#	X, ft	Y, ft
1	-51.4	563.4
2	-46.7	563.2
3	-43.1	563.0
4	-41.2	562.9
5	-37.8	562.6
6	-36.8	562.6
7	-32.2	562.3
8	-30.3	562.2
9	-28.6	562.1
10	-27.2	562.0
11	-25.9	561.7

12	-25.2	561.5
13	-22.6	560.9
14	-18.6	560.1
15	-18.3	560.0
16	-17.9	560.0
17	-8.7	560.1
18	-8.0	560.6
19	-7.4	561.0
20	-4.5	561.5
21	-2.9	561.8
22	0.0	563.1
23	25.8	575.1
24	50.5	586.7
25	54.8	586.6
26	58.4	586.6
27	60.5	586.6
28	63.6	586.5
29	68.2	586.4
30	69.7	586.3
31	69.9	586.3
32	72.5	586.4
33	73.6	586.3
34	74.3	586.3
35	75.3	586.4
36	77.5	586.6
37	78.6	586.6
38	80.4	586.7
39	80.9	586.6
40	81.4	586.7
41	82.8	586.6
42	83.8	586.6
43	83.9	586.6
44	86.9	586.5
45	87.6	586.5
46	88.2	586.5

X: Horizontal coordinates
Y: Vertical coordinates

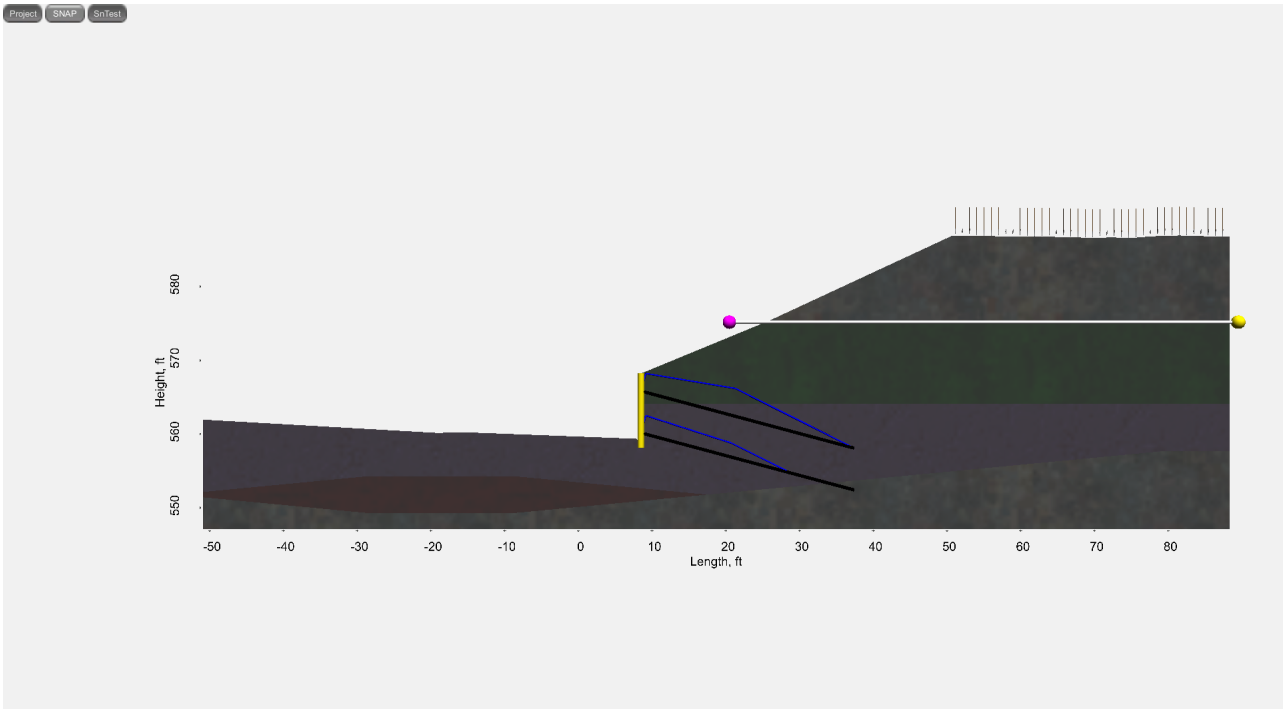
Soils

Soil Properties

#	Name	Texture	γ'_s, pcf	ϕ', °	δ_s, °	c', psf	q_u, psi	N_c	N_q	N_γ
1	Sandy Silt (1)	silt	135	28	18.7	100.0	8.7	25.8	14.7	16.7
2	Sandy Silt (2)	silt	125	28	18.7	100.0	8.7	25.8	14.7	16.7
3	Silt and Clay	clay	140	28	18.7	100.0	8.7	25.8	14.7	16.7
4	Gravel with Sand	gravel	130	34	22.7	0.0	14.5	42.2	29.4	41.1
5	Silt	silt	135	34	22.7	0.0	8.7	42.2	29.4	41.1

Name: Name of soil
Texture: Soil/rock Type
γ'_s: Effective unit weight of soil
ϕ': Effective soil friction angle / angle of internal friction
δ_s: Wall-soil interface friction angle, $\delta = 2/3\phi$
c': Effective cohesion of soil
q_u: Ultimate bond strength
N_c: N_c bearing capacity factor
N_q: N_q bearing capacity factor
N_γ: N_γ bearing capacity factor

Sandy Silt (2): Points at top of Sandy Silt (2)

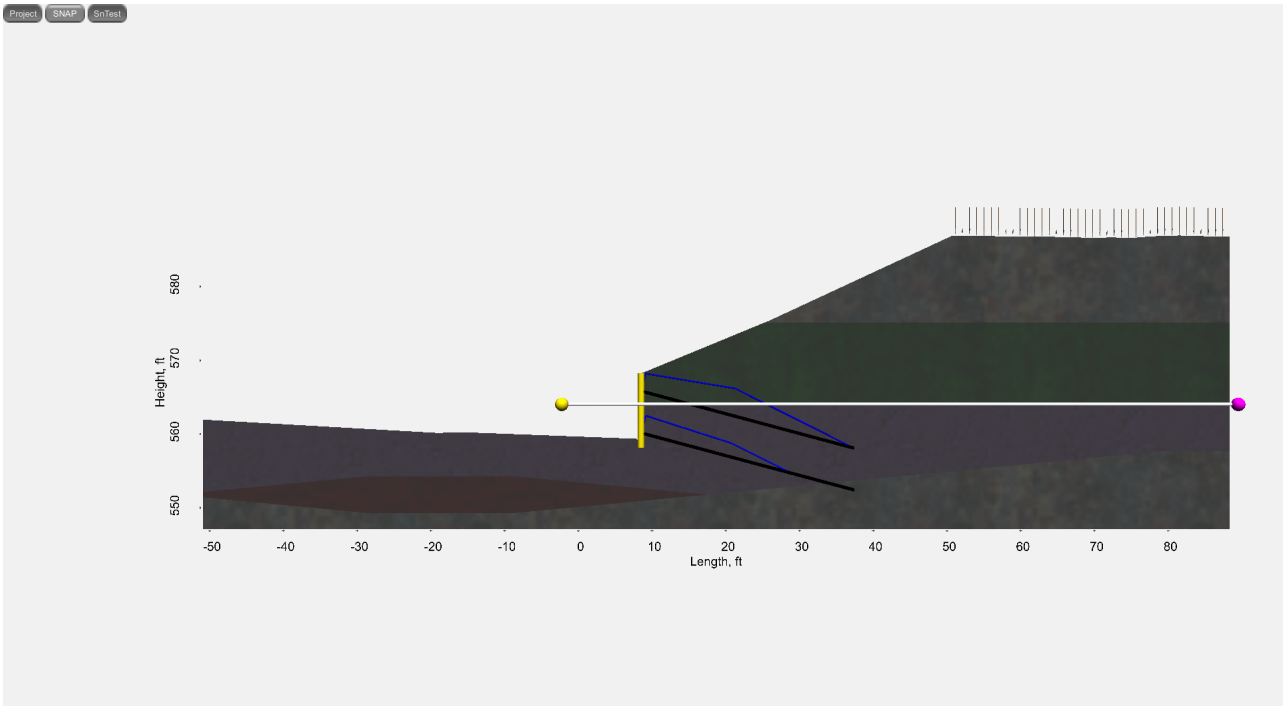


Points at top of Sandy Silt (2)

#	X, ft	Y, ft
1	20.0	574.8
2	88.0	574.8

X: Horizontal coordinates
Y: Vertical coordinates

Silt and Clay: Points at top of Silt and Clay

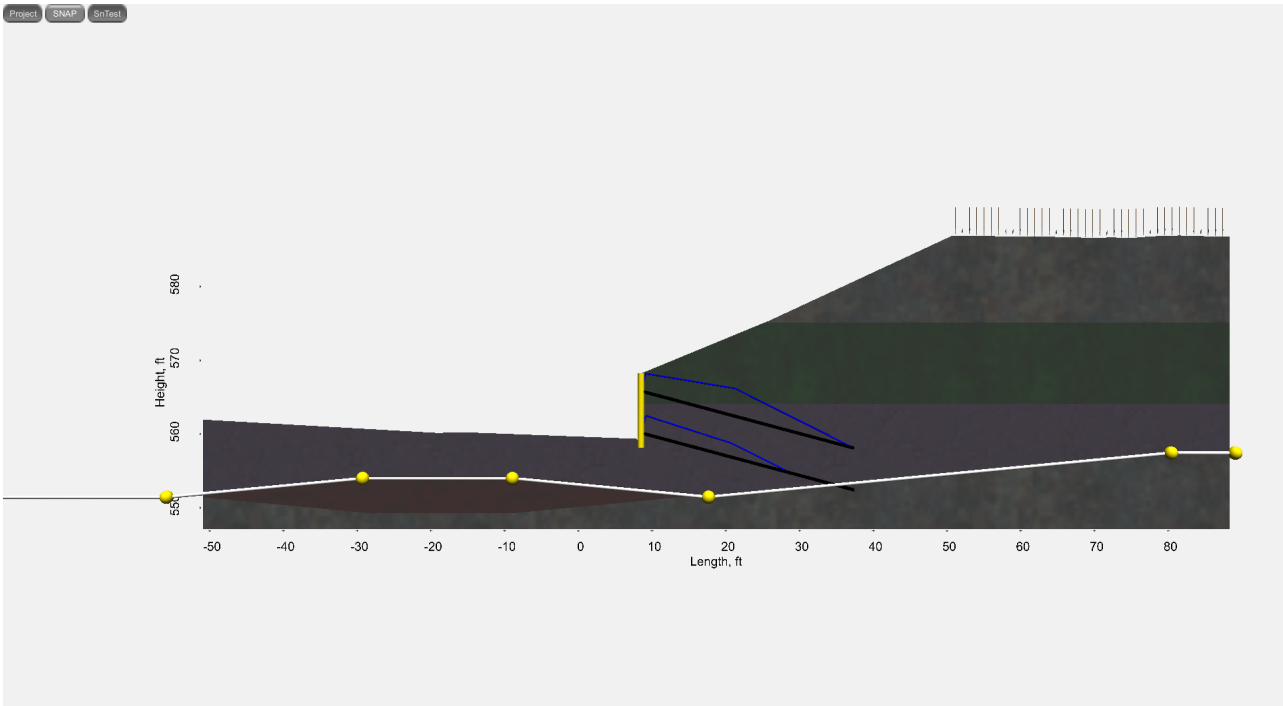


Points at top of Silt and Clay

#	X, ft	Y, ft
1	-2.4	563.8
2	88.0	563.8

X: Horizontal coordinates
Y: Vertical coordinates

Gravel with Sand: Points at top of Gravel with Sand

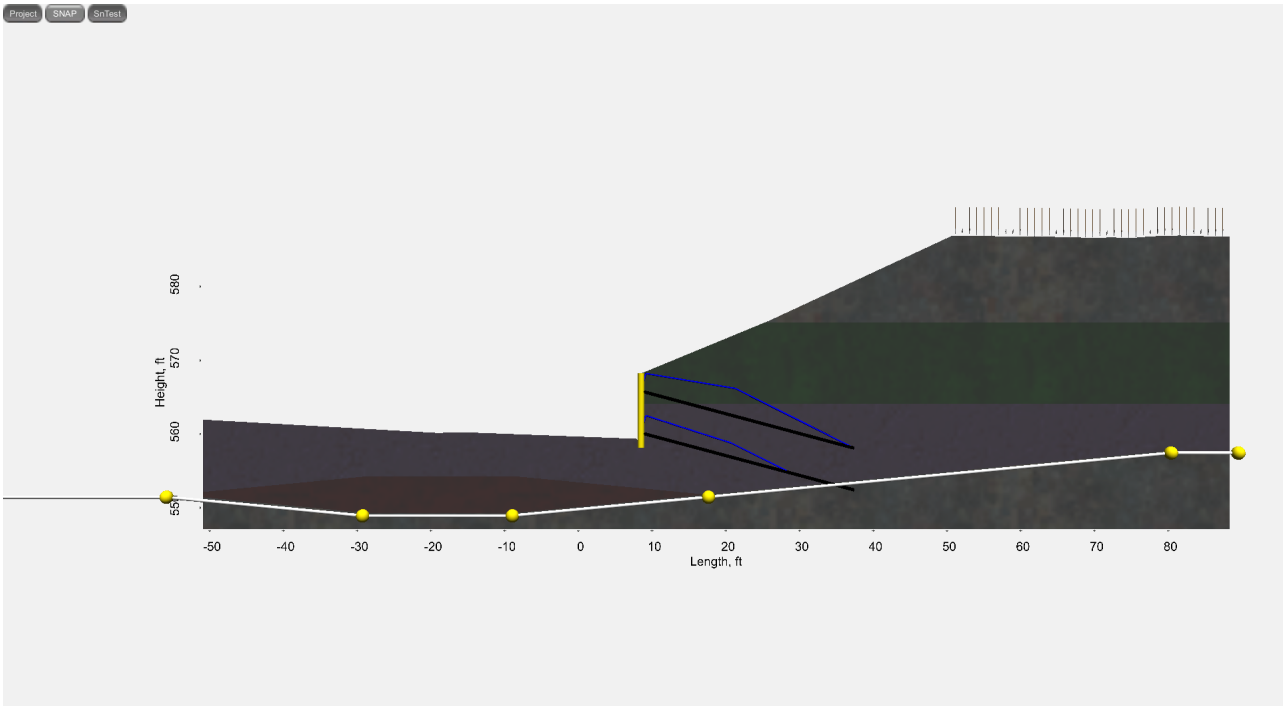


Points at top of Gravel with Sand

#	X, ft	Y, ft
1	-87.0	551.4
2	-55.2	551.4
3	-29.0	553.9
4	-9.0	553.9
5	17.2	551.4
6	79.0	557.3
7	87.6	557.3

X: Horizontal coordinates
Y: Vertical coordinates

Silt: Points at top of Silt

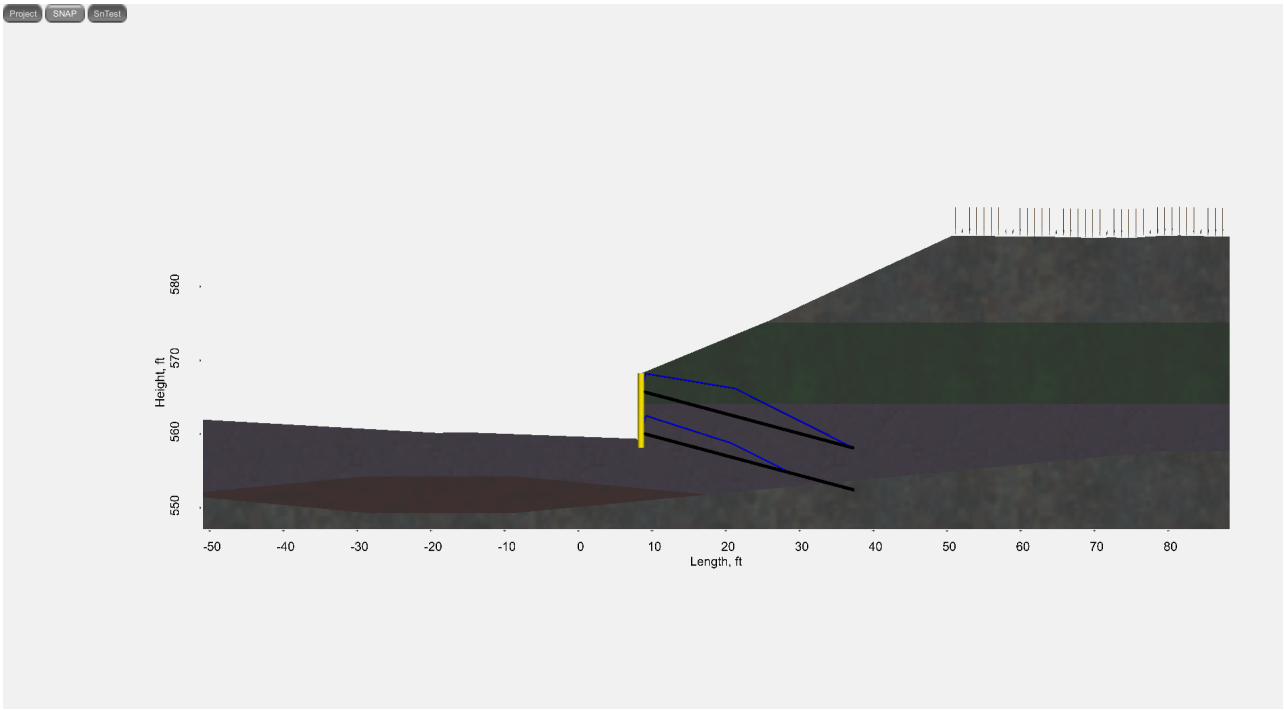


Points at top of Silt

#	X, ft	Y, ft
1	-87.0	551.4
2	-55.2	551.4
3	-29.0	548.9
4	-9.0	548.9
5	17.2	551.4
6	79.0	557.3
7	88.0	557.3

X: Horizontal coordinates
Y: Vertical coordinates

Ground Water



Nails

Default Factors of Safety

U	F_y FoS	F_{ys} FoS	F_p FoS	F_{ps} FoS
true	1.80	1.35	2.00	1.50

U: Use same factors of safety for each bar
F_y FoS: Factor of safety for yield strength
F_{ys} FoS: Seismic factor of safety for yield strength
F_p FoS: Factor of safety for pullout
F_{ps} FoS: Seismic factor of safety for pullout

Bar Properties

Name	D, in	D_{out}, in	D_{in}, in	Bar No, Bar #	F_y, ksi
Bar 1	6.0	1.000	0.000	8.0	60.0

Name: Name of bar set
D: Drill hole diameter
D_{out}: Outside diameter of bar
D_{in}: Inside diameter of bar
Bar No: Nail size 3-18
F_y: Steel yield strength of bar

Facings

Facing Properties

Type	Name	Description
Temp SNW	Temp SNW 1	-

Type: Facing type
Name: Name of facing
Description: Facing description

Temp SNW 1:

Mesh	Bars
true	true

Mesh: true if temporary facing has mesh reinforcement
Bars: true if temporary facing has bar reinforcement

Mesh: Temporary facing mesh

S_{vw}, in	S_{hw}, in	A_{wire}, in^2	$Mesh_{F_y}$, ksi
6.0	6.0	0.040	60.0

S_{vw}: Vertical mesh spacing of wires
S_{hw}: Horizontal mesh spacing of wires
A_{wire}: Mesh area of wire
$Mesh_{F_y}$: Wire mesh yield strength

Bars: Temporary facing bars

H_{Bars}	hr, in	H, Bar #	d_W, in	H_{F_y}, ksi	V_{Bars}	vr, in	V, Bar #	d_B, in	$L_{c_{vb}}$, ft	V_{F_y}, ksi
2	12	4	0.354	60.0	2	12	4	0.354	6.0	60.0

H_{Bars}: Number of horizontal waler bars
hr: Horizontal reinforcement spacing
H: Horizontal waler bar size, 3-10
d_W: Horizontal bar diameter
H_{F_y}: Horizontal bar yield strength
V_{Bars}: Number of vertical bearing bars
vr: Vertical reinforcement spacing
V: Vertical bearing bar size, 3-10
d_B: Vertical bearing bar diameter
$L_{c_{vb}}$: Vertical bearing bar length
V_{F_y}: Bearing bar yield strength

Shotcrete: Temporary shotcrete facing

$f_{c'}$, psi	h_c, in	C_F	C_S	TF FoS	TF_s FoS
4000	4.0	1	1	1.35	1.10

$f_{c'}$: Shotcrete facing compressive strength
h_c: Shotcrete facing thickness
C_F: Flexure pressure factor (Accounts for non-uniformity of pressure at back of facing)
C_S: Shear pressure factor
TF FoS: Factor of safety for flexure and punching
TF_s FoS: Seismic factor of safety for flexure and punching

Plate: Temporary facing plate

b_{PL}, in	b_d, in	F_F
10.0	1.0	0.5

b_{PL}: Bearing plate side length
b_d: Bearing plate thickness
F_F: Nail head service load factor

Wall types

Name	Description

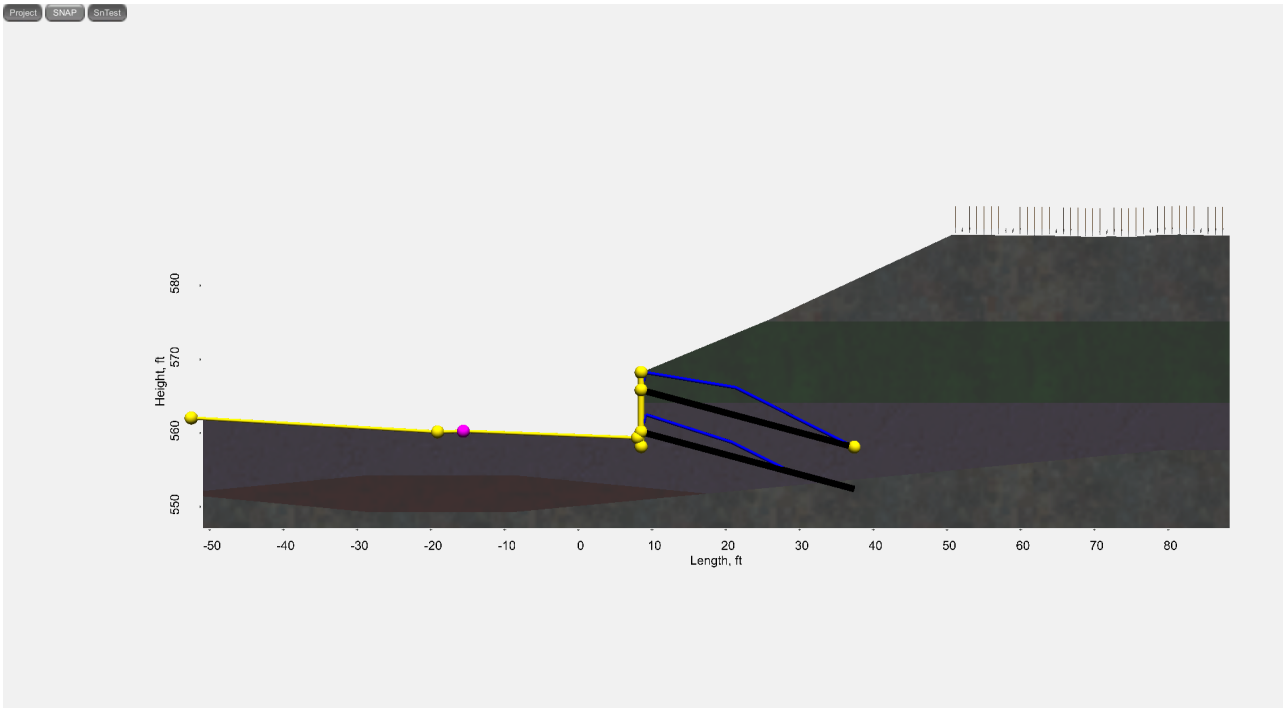
SN Wall 1	-

Name: Name of wall
Description: Wall Description

SN Wall 1:

Static Case

Wall: Soil nail wall geometry



Construction: Construction specification

Construction #	Con_{seq}
20	1

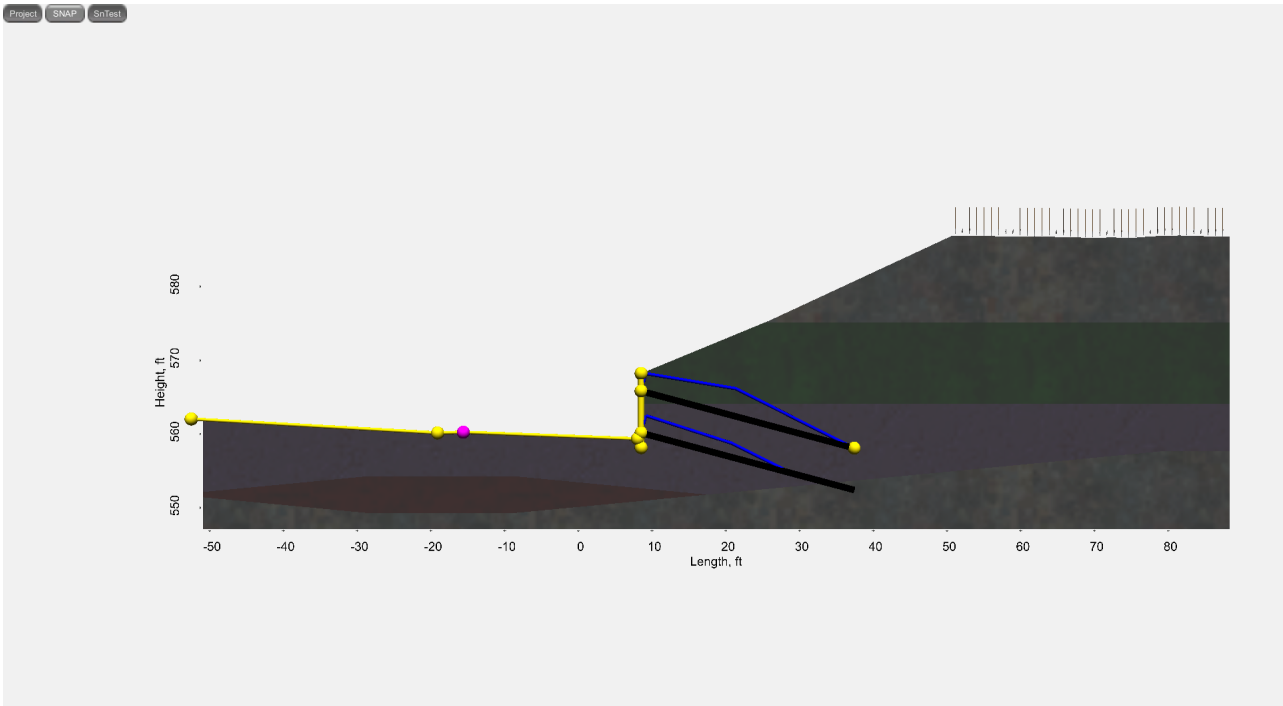
Construction #: Construction number, adds stage cuts and nails according to assigned construction sequences
Con_{seq}: Construction (stage cut) sequence when wall construction begins ie. "1" or "2,4-6"

Wall: Soil nail wall size and location

Facing	Base, ft	Top, ft	H, ft	θ, °	Emb, ft	Width, ft
Temp SNW 1	8.2,557.8	8.2,567.9	10.1	0.0	0.0	50

Facing: Wall facing
Base: Base of wall
Top: Top of wall
H: Wall height
θ: Wall batter angle, degrees from vertical
Emb: Embedment, depth below ground surface at toe
Width: Width of wall, extending along Z-Axis

Nails: Soil nail wall nail geometry



Shorten T_F
true

Shorten T_F: Shorten T-Forces on lower nails due to deformation during construction

Nails: Soil nail sizes and locations

Nail	L, ft	S_V, ft	S_H, ft	δ, °	C_d, ft	O	U
Bar 1	30.00	5.70	5.50	15.0	2.40	false	true

Nail: Bar used for this nail
L: Nail length
S_V: Vertical nail spacing
S_H: Horizontal nail spacing
δ: Nail inclination, degrees from horizontal
C_d: Cantilever distance, vertical distance from top of wall to top nail
O: Offset pattern, true if nails in even rows are offset to midspan, otherwise nails are in a square pattern
U: Use uniform nails
Nail List: Nail properties

Nail[1]

C_{dH}, ft	Failure	L_{fail}, ft	T_{Force}, kip
2.40	-	0.00	0.0

C_{dH}: Cantilever distance, vertical distance from top of wall to this nail
Failure: Failure mode for wall slip surface
L_{fail}: Distance from nail head to failure surface
T_{Force}: Nail T-force

T-Forces: Nail T-forces

#	Dist, ft	T-Force, kip	Soil	Failure
1	0.00	13.0	Sandy Silt (1)	Punching/Flexure Failure
2	12.30	19.3	Sandy Silt (1)	Pullout
3	30.00	0.0	Sandy Silt (1)	Pullout

Dist: Horizontal distance of T-force from nail head
T-Force: Nail T-force
Soil: Soil layer at T-force location
Failure: Failure mode at T-force location

Nail[2]

C_{dH}, ft	Failure	L_{fail}, ft	T_{Force}, kip
8.10	-	0.00	0.0

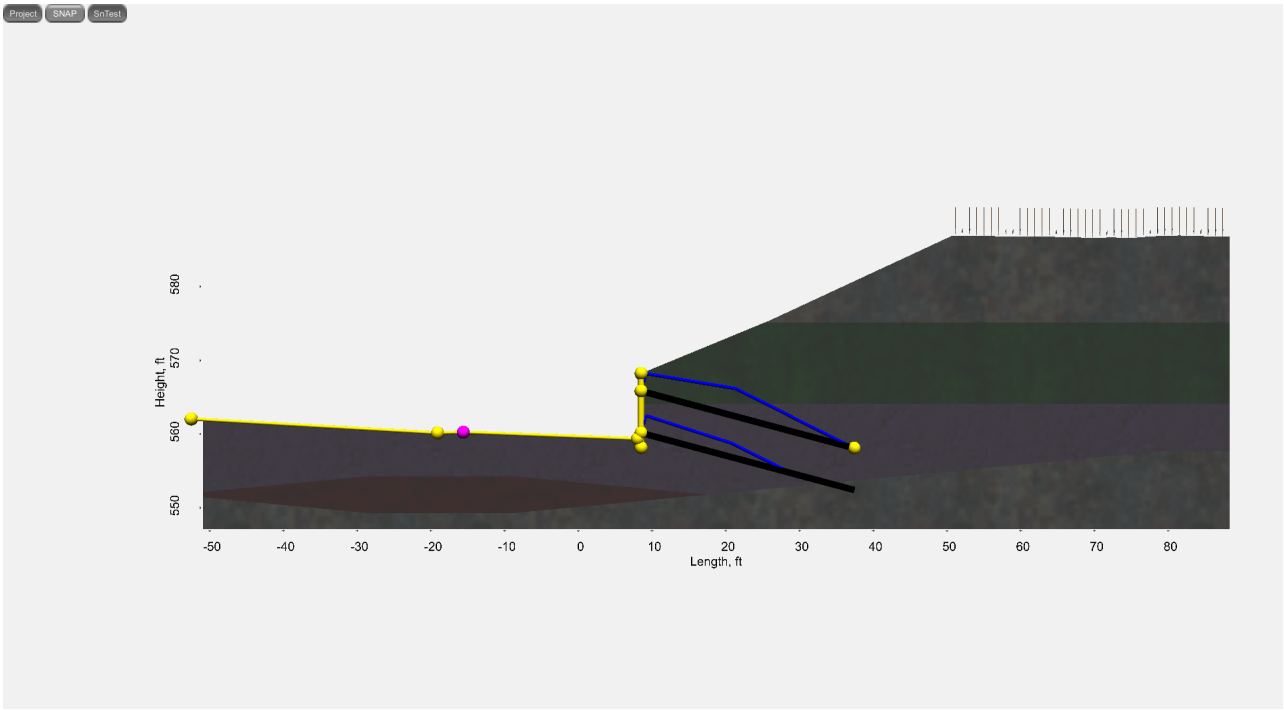
C_{dH}: Cantilever distance, vertical distance from top of wall to this nail
Failure: Failure mode for wall slip surface
L_{fail}: Distance from nail head to failure surface
T_{Force}: Nail T-force

T-Forces: Nail T-forces

#	Dist, ft	T-Force, kip	Soil	Failure
1	0.00	12.9	Sandy Silt (1)	Punching/Flexure Failure
2	12.26	9.7	Sandy Silt (1)	Pullout
3	21.14	0.0	Sandy Silt (1)	Pullout

Dist: Horizontal distance of T-force from nail head
T-Force: Nail T-force
Soil: Soil layer at T-force location
Failure: Failure mode at T-force location

Slope: Backslope and downslope cuts

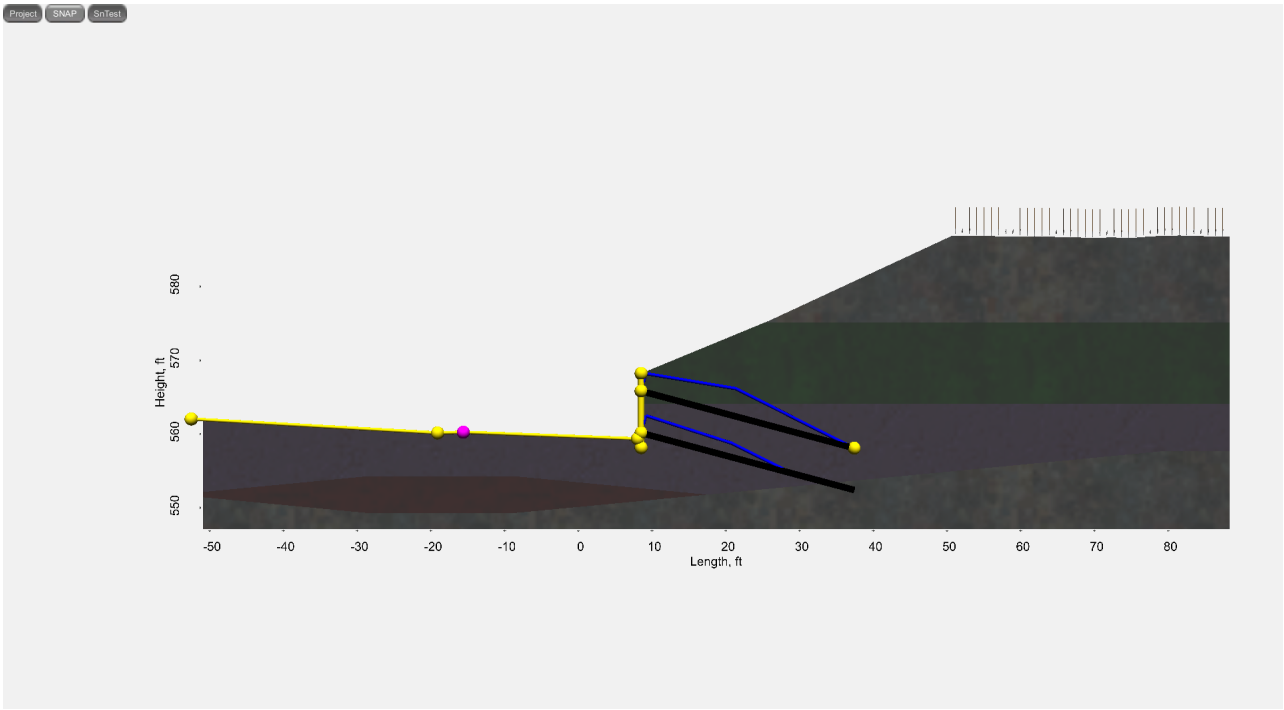


Downslope: Final downslope cut

#	XY, ft
1	-53.0,561.7
2	-19.5,559.8
3	-16.0,559.9
4	7.7,559.0

XY: Horizontal X and Y coordinates

Checks: Soil nail wall design checks



Checks: Facing design checks

T_F, lbf	t_F, lbf	V, lbf/ft	M, ft-lbf/ft	L_{VB}, ft	L_S, in	ecc, ft	FS_{SL}	FS_{BC}	FoS_{GS}
12682	10802	2247.8	1067.8	2.0	12.9	-1.5	2.5	16.1	1.78

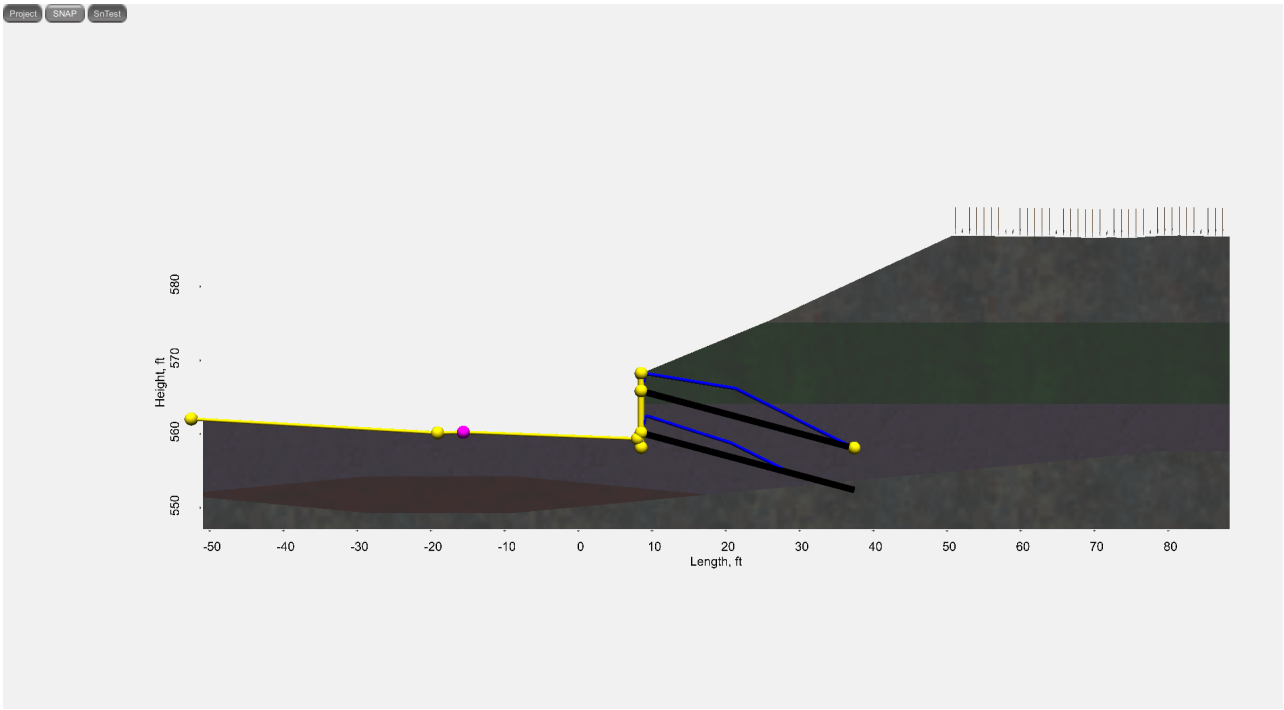
T_F: Allowable nail head strength - minimum of temporary facing T_{FF} and T_{FP}, T_F: Nail Head Load Ok: $t_F < T_F$: 10802 < 12682
t_F: Estimated nail head service load, Nail Head Load Ok: $t_F < T_F$: 10802 < 12682
V: Allowable one-way unit shear strength, One-way Unit Shear in Upper Cantilever OK: v < 0.67 V
M: Allowable one-way unit moment, Design for Flexure in Upper Cantilever OK: mS < 0.67 M
L_{VB}: Minimum total length of vertical bearing bars, Bearing bar embedment length OK
L_S: Minimum waler splice length, AASHTO 8.32, Waler splice length must be greater of 12 in. or LDwb, Ok
ecc: Eccentricity check for overturning, Ok: ecc < B / 4
FS_{SL}: Factor of safety with respect to base sliding, Ok: FS_{SL} >= 1.3
FS_{BC}: Factor of safety with respect to bearing capacity $FS_{BC} = q_{ult}/\sigma_v$, Ok: FS_{BC} >= 2.5
FoS_{GS}: Factor of safety of global stability slip surface, Ok: FoS_{GS} >= 1.35

Displacement: Long-term wall deformation and displacement parameters

$\delta_{h/H}$	κ	δ, in	λ, ft
0.002	1.25	0.2	12.6

$\delta_{h/H}$: Displacement ratio: (weathered rock/stiff soil: 0.001) (sandy soil: 0.002) (fine-grained soil: 0.003)
κ: Damping coefficient used to estimate wall displacement: (weathered rock/stiff soil: 0.8) (sandy soil: 1.25) (fine-grained soil: 1.5)
δ: Estimated displacement at the top of soil nail wall, L/H ratio outside 0.7 - 1.0, Estimation may not be accurate
λ: Horizontal distance behind soil nail wall where ground deformation can be significant

Vars: Soil nail internal variables



SC Facing Vars: Shotctrete facing design intermediate variables

$A_{S_{NEG}}$, in^2	$A_{S_{POS}}$, in^2	$m_{V_{NEG}}$, ft-lbf/ft	$m_{V_{POS}}$, ft-lbf/ft	D'$_C$, in	D_C, in	V_N, lbf	A_C, in^2	A_{GC}, in^2
0.840	0.440	1442	776	14.0	18.0	44507	254	28

$A_{S_{NEG}}$: Cross sectional area of steel near the nail head
$A_{S_{POS}}$: Cross sectional area of steel near the nail mid-point
$m_{V_{NEG}}$: NEG average nominal unit moment resistance
$m_{V_{POS}}$: POS average nominal unit moment resistance
D'$_C$: Effective diameter of punching cone
D_C: Base diameter of punching cone
V_N: Nominal internal punching shear strength of the shotcrete facing
A_C: Cross-sectional area at base of punching cone
A_{GC}: Cross-sectional area of grout column

SC Facing Vars 2: More shotctrete facing design intermediate variables

T_{FN_F}, lbf	T_{F_F}, lbf	T_{FN_P}, lbf	T_{F_P}, lbf	MaxDevLen, in	%CVB, %	L_{DBwb}, in	L_{Dwb}, in	L_D, in	MaxDevLenMesh, in
17121	12682	46870	34719	5.3	47.6	7.6	12.9	2.571	8.0

T_{FN_F}: Nominal nail head strength - flexure
T_{F_F}: Allowable nail head strength - flexure
T_{FN_P}: Nominal nail head strength - punching
T_{F_P}: Allowable nail head strength - punching
MaxDevLen: Maximum of (L_{cvb}/20), (15*d_B), and (h_c/2)
%CVB: Percent coverage from vertical bars
L_{DBwb}: Basic development length of waler bars, AASHTO 8.25.1
L_{Dwb}: Development length of waler bars, AASHTO 8.25
L_D: Basic development length of wire mesh, AASHTO 8.30
MaxDevLenMesh: Minimum wire mesh splice length

SC Facing Vars 3: More shotctrete facing design intermediate variables

K_A	A_N, in^2	T_{NN}, lbf	T_N, lbf	$K_{A_{LC}}$	v, lbf/ft	V_{NS}, lbf/ft	m_S, ft-lbf/ft
0.505	0.79	47124.4	26180.2	0.479	186.2	3034.5	147.4

K_A: Coulomb active earth pressure coefficient
A_N: Nail tendon area
T_{NN}: Nominal nail tendon tensile load
T_N: Allowable nail tendon tensile load
$K_{A_{LC}}$: Active earth pressure coefficient for load component normal to wall
v: One-way unit service shear force
V_{NS}: Nominal one-way unit shear strength
m_S: One-way unit service moment

Ex Vars: External stability intermediate variables

θ, °	β, °	q_s, psf	ϕ, °	ϕ_f, °	γ_1, pcf	γ_2, pcf	c, psf	δ, °
0.0	22.8	0	28.0	28.0	135.0	135.0	100.0	18.7

θ: Inclination of back wall measured CCW from vertical plane
β: Inclination of ground slope behind wall measured CCW from horiz. plane
q_s: Surcharge load behind wall
ϕ: Internal friction angle of weakest retained soil
ϕ_f: Internal friction angle of weakest foundation soil
γ_1: Unit weight of weakest retained soil
γ_2: Unit weight of weakest foundation soil
c: Cohesion - weakest foundation soil
δ: Wall/soil interface friction angle

Ex Vars 2: More external stability intermediate variables

B, ft	h, ft	Nγ	N_c	N_q	H2, ft	K_a	S, °
29.0	22.3	16.7	25.8	14.7	12.8	0.505	0.974

B: Effective width of wall at the base
h: Effective total height of soil at back of reinforced soil mass
Nγ: See Fig 4.4.7.1.1.4B and Table 4.4.7.1A AASHTO
N_c: Bearing capacity coefficient - weakest foundation soil
N_q: Bearing capacity coefficient - weakest foundation soil
H2: A height near the back of wall for calculating PIR and PAE
K_a: Active earth pressure coefficient - no seismic forces
S: Angle relating the horizontal and vertical seismic coefficients

Ex Vars 3: More external stability intermediate variables

F_T, lbf/ft	F_H, lbf/ft	F_V, lbf/ft	V_2, lbf/ft	V_1, lbf/ft	F_2, lbf/ft
16893.3	15578.9	6533.2	23769.8	39511.2	0.0

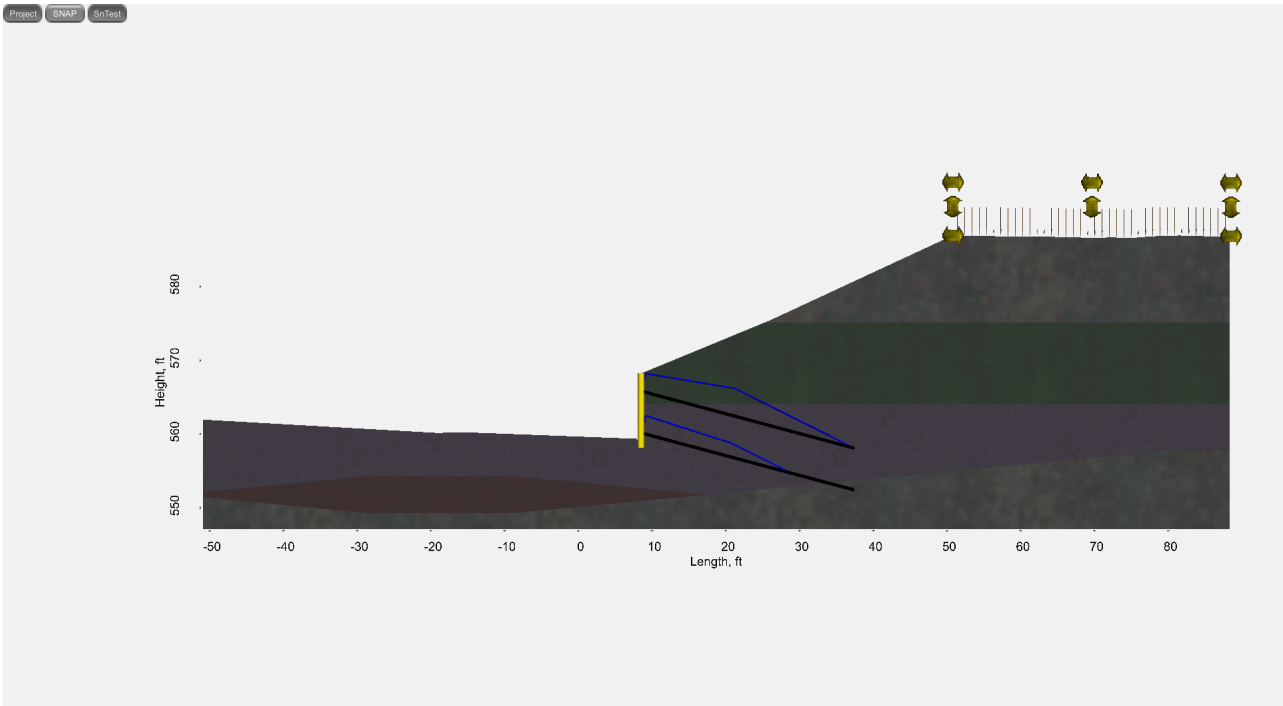
F_T: Lateral earth pressure
F_H: Horizontal lateral earth pressure
F_V: Vertical lateral earth pressure
V_2: Weight of soil above wall
V_1: Weight of soil above wall
F_2: Surcharge load

Ex Vars 4: More external stability intermediate variables

P_{IR}, lbf/ft	Y_{IR}, ft	σ_v, psf	q_{ult}, psf	q_{allow}, psf
553.3	5.7	2185.7	35278	14111

P_{IR}: Horizontal inertial force
Y_{IR}: Y-coordinate of centroid of mass for inertial force
σ_v: Vertical effective stress at base of footing
q_{ult}: Terzaghi bearing capacity
q_{allow}: Terzaghi bearing capacity $q_{allow} = q_{ult}/FOS$

Surcharge



Con_{seq}	X1, ft	X2, ft	q_s, psf	q_{sH}, psf
1-20	50.5	88.2	250	0

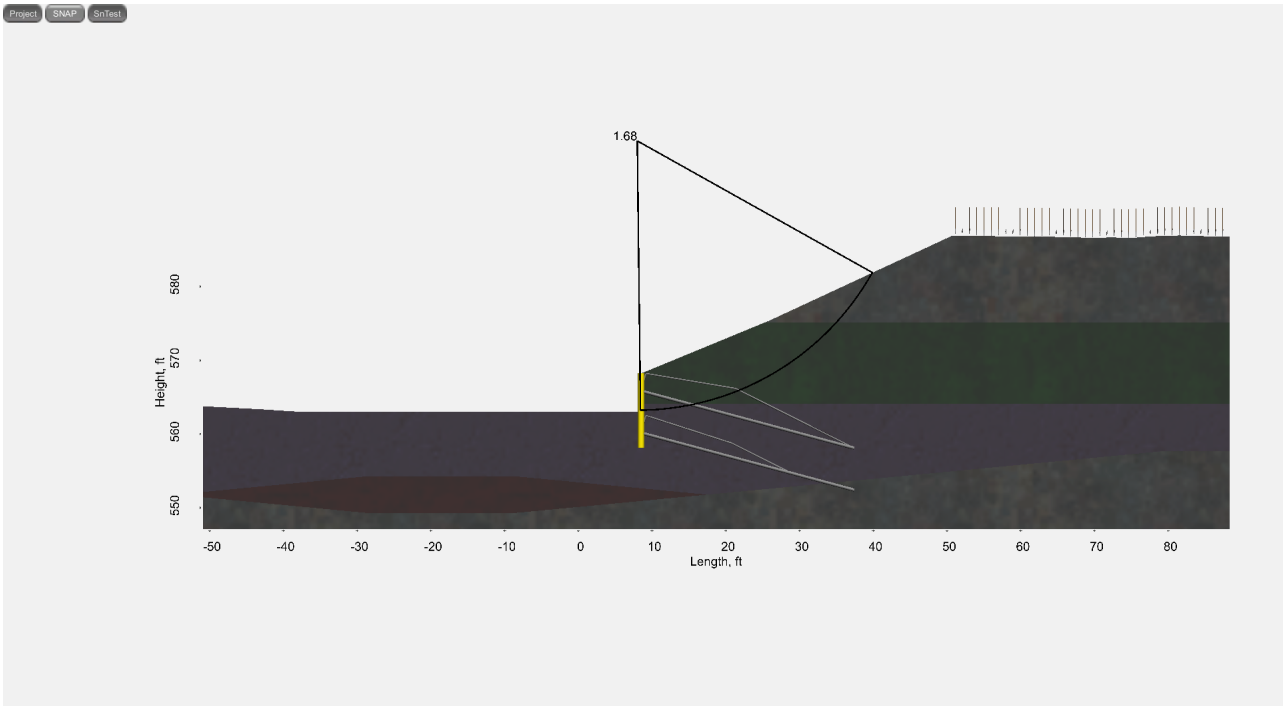
Con_{seq}: Construction sequence for applying surcharge, ie. "1-5" or "2,4-6"
X1: Surcharge X range start
X2: Surcharge X range end
q_s: Vertical surcharge load on slope segment as a number (250) or a linearly interpolated range (100~250)
q_{sH}: Horizontal surcharge load on slope segment as a number (250) or a linearly interpolated range (100~250)

Seismic

Seismic	d, in	A	A_m	Calc K_h	K_h	K_v
false	3.000	0.040	0.056	false	0.017	0.000

Seismic: Use seismic loading for external and global stability analysis
d: Tolerable seismically induced wall lateral movement
A: Peak ground acceleration coefficient as a fraction of gravity
A_m: Normalized horizontal acceleration, $A_m = A\ (1.45 - A)$
Calc K_h: Automatically calculate K_h from A, if d is between 25 and 203, $K_h = 0.74\ A_m\ (A_m/d)^{0.25}$, else $K_h = A/2$
K_h: Horizontal seismic coefficient
K_v: Vertical seismic coefficient

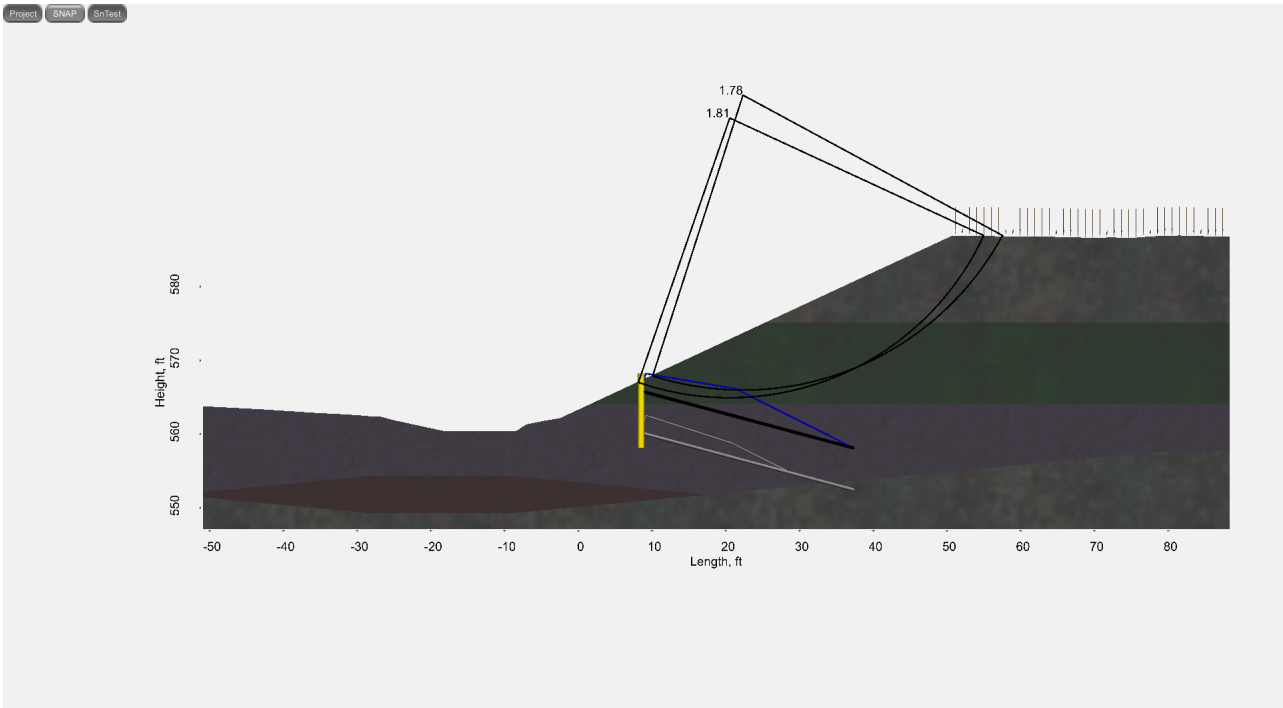
Static global stability for construction sequence 1



Construction #	Min_{Depth}, ft	Seismics	Center, ft	Radius, ft	FoS
1	2.0	false	7.7,599.5	36.5	1.68

Construction #: Construction number, adds stage cuts and nails according to assigned construction sequences
Min_{Depth}: Minimum height of failure circle arc. Use this to remove small failure circles.
Seismics: Select to use seismic case, unselect for static case
Center: Center of minimum factor of safety failure circle
Radius: Radius of minimum factor of safety failure circle
FoS: Minimum factor of safety

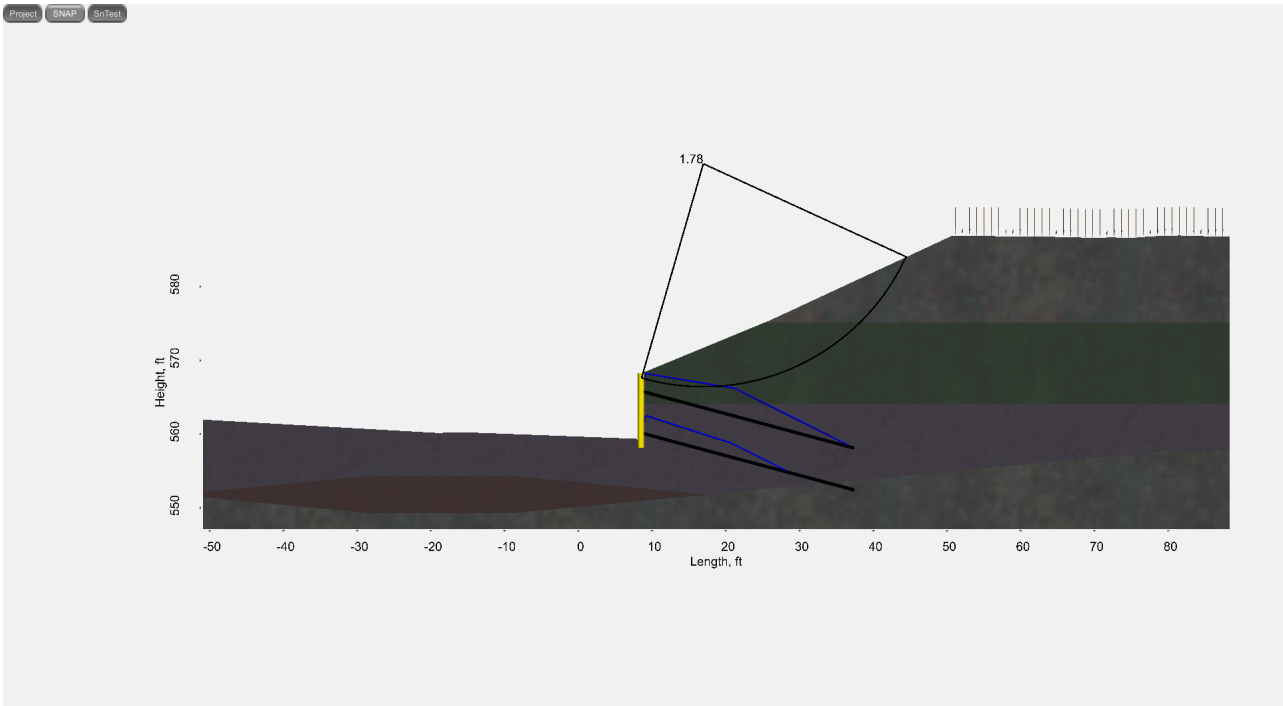
Static global stability for construction sequence 2



Construction #	Min_{Depth}, ft	Seismics	Center, ft	Radius, ft	FoS
2	2.0	false	22.0,605.7	40.0	1.78

Construction #: Construction number, adds stage cuts and nails according to assigned construction sequences
Min_{Depth}: Minimum height of failure circle arc. Use this to remove small failure circles.
Seismics: Select to use seismic case, unselect for static case
Center: Center of minimum factor of safety failure circle
Radius: Radius of minimum factor of safety failure circle
FoS: Minimum factor of safety

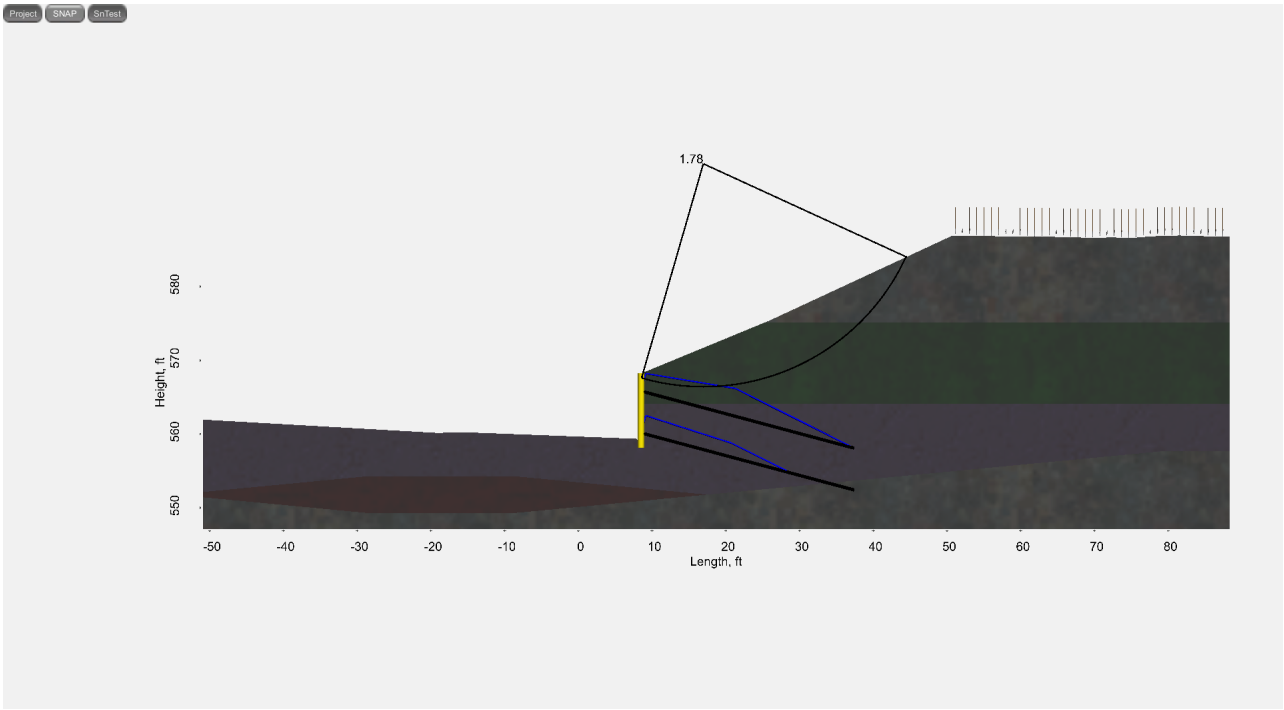
Static global stability for construction sequence 3



Construction #	Min_{Depth}, ft	Seismics	Center, ft	Radius, ft	FoS
3	2.0	false	16.6,596.4	30.3	1.78

Construction #: Construction number, adds stage cuts and nails according to assigned construction sequences
Min_{Depth}: Minimum height of failure circle arc. Use this to remove small failure circles.
Seismics: Select to use seismic case, unselect for static case
Center: Center of minimum factor of safety failure circle
Radius: Radius of minimum factor of safety failure circle
FoS: Minimum factor of safety

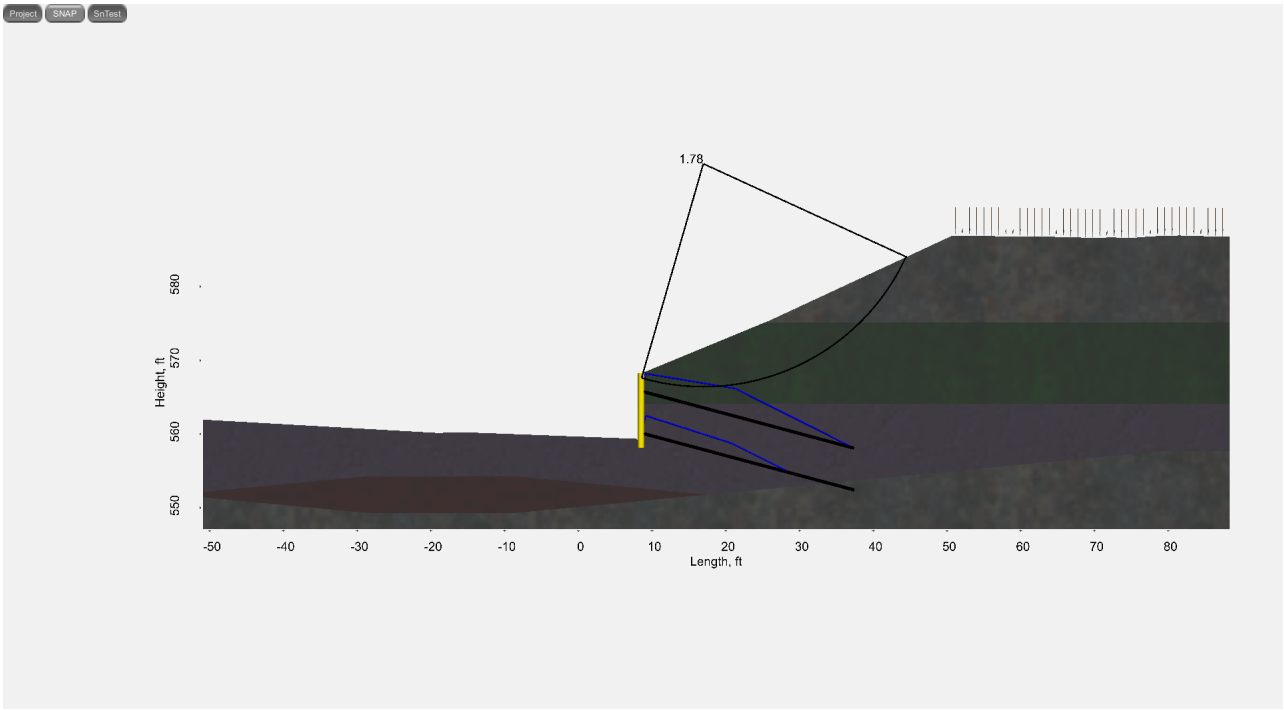
Static global stability for construction sequence 4



Construction #	Min_{Depth}, ft	Seismics	Center, ft	Radius, ft	FoS
4	2.0	false	16.6,596.4	30.3	1.78

Construction #: Construction number, adds stage cuts and nails according to assigned construction sequences
Min_{Depth}: Minimum height of failure circle arc. Use this to remove small failure circles.
Seismics: Select to use seismic case, unselect for static case
Center: Center of minimum factor of safety failure circle
Radius: Radius of minimum factor of safety failure circle
FoS: Minimum factor of safety

Static global stability for construction sequence 5



Construction #	Min_{Depth}, ft	Seismics	Center, ft	Radius, ft	FoS
5	2.0	false	16.6,596.4	30.3	1.78

Construction #: Construction number, adds stage cuts and nails according to assigned construction sequences
Min_{Depth}: Minimum height of failure circle arc. Use this to remove small failure circles.
Seismics: Select to use seismic case, unselect for static case
Center: Center of minimum factor of safety failure circle
Radius: Radius of minimum factor of safety failure circle
FoS: Minimum factor of safety

APPENDIX D.2
GLOBAL STABILITY ANALYSIS OUTPUTS

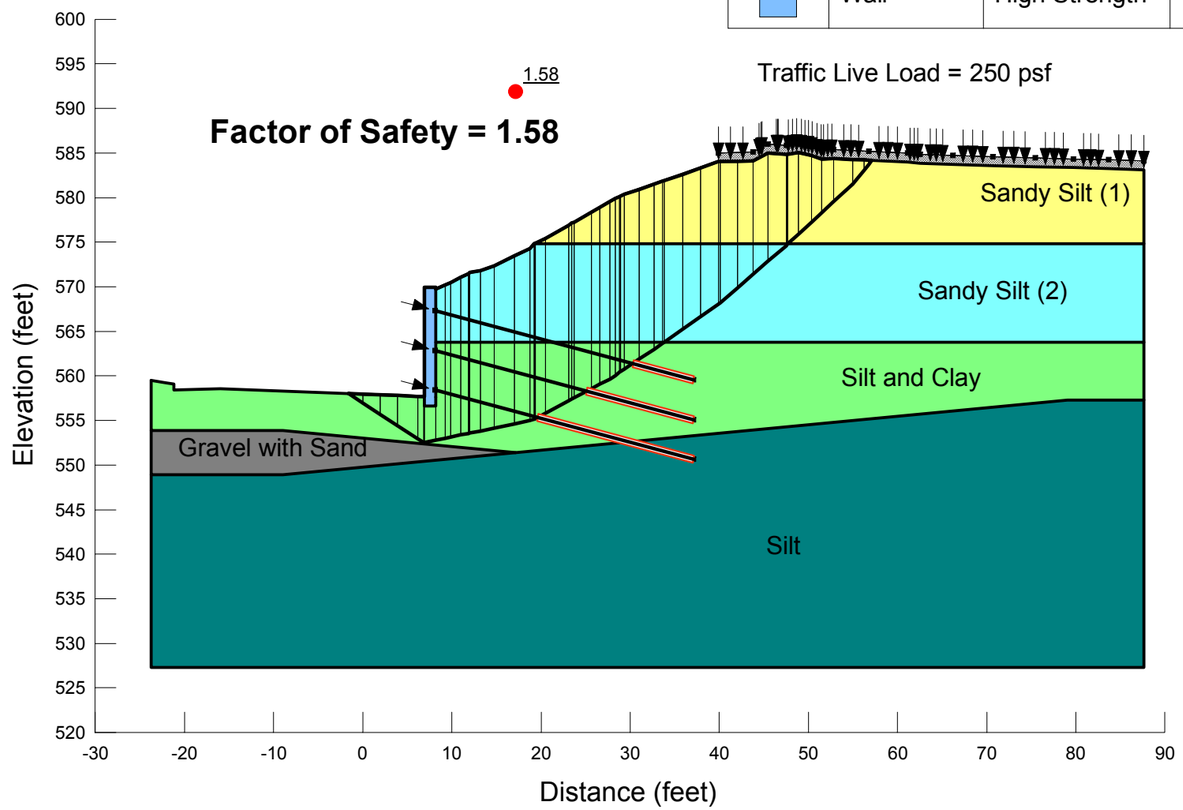
Ohio Department of Transportation
HAM-71-6.86
PID No. 94741
Soil Nail Wall Analysis
STA 416+00

Static Slope Stabilty Analysis

Global Stability
Three Soil Nail Rows, Deep Failure
5.5 Foot Horizontal Spacing
30 Foot Length

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Gravel with Sand	Mohr-Coulomb	130	0	34
	Sandy Silt (1)	Mohr-Coulomb	135	100	28
	Sandy Silt (2)	Mohr-Coulomb	125	0	30
	Silt	Mohr-Coulomb	135	0	34
	Silt and Clay	Mohr-Coulomb	140	100	28
	Wall	High Strength	150		



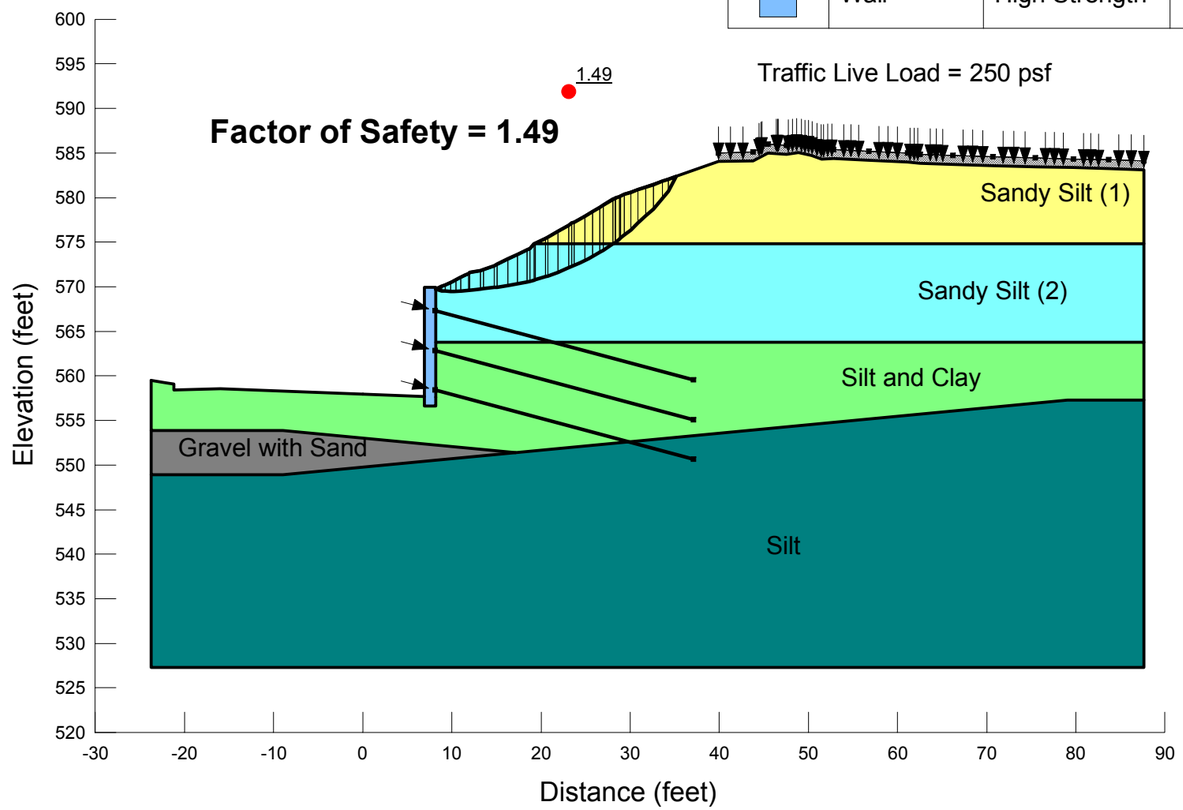
Ohio Department of Transportation
HAM-71-6.86
PID No. 94741
Soil Nail Wall Analysis
STA 416+00

Static Slope Stabilty Analysis

Global Stability
Three Soil Nail Rows, Shallow Failure
5.5 Foot Horizontal Spacing
30 Foot Length

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Gravel with Sand	Mohr-Coulomb	130	0	34
	Sandy Silt (1)	Mohr-Coulomb	135	100	28
	Sandy Silt (2)	Mohr-Coulomb	125	0	30
	Silt	Mohr-Coulomb	135	0	34
	Silt and Clay	Mohr-Coulomb	140	100	28
	Wall	High Strength	150		



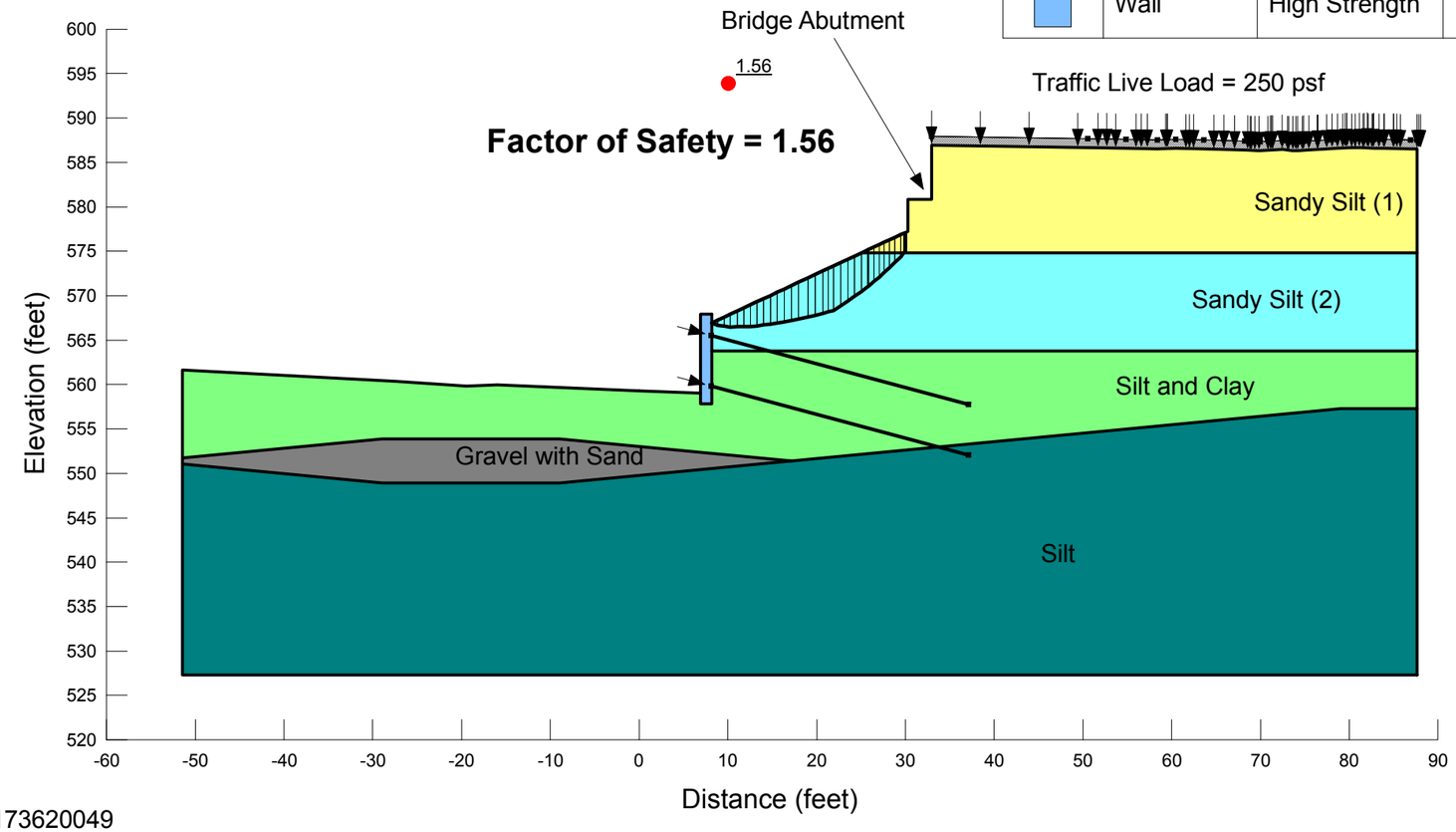
Ohio Department of Transportation
HAM-71-6.86
PID No. 94741
Soil Nail Wall Analysis
STA 416+70 (with bridge abutment modeled)

Static Slope Stabilty Analysis

Global Stability
Three Soil Nail Rows, Shallow Failure
5.5 Foot Horizontal Spacing
30 Foot Length

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Gravel with Sand	Mohr-Coulomb	130	0	34
	Sandy Silt (1)	Mohr-Coulomb	135	100	28
	Sandy Silt (2)	Mohr-Coulomb	125	0	30
	Silt	Mohr-Coulomb	135	0	34
	Silt and Clay	Mohr-Coulomb	140	100	28
	Wall	High Strength	150		



Project No. 173620049

3/27/2017 9:00:20 AM

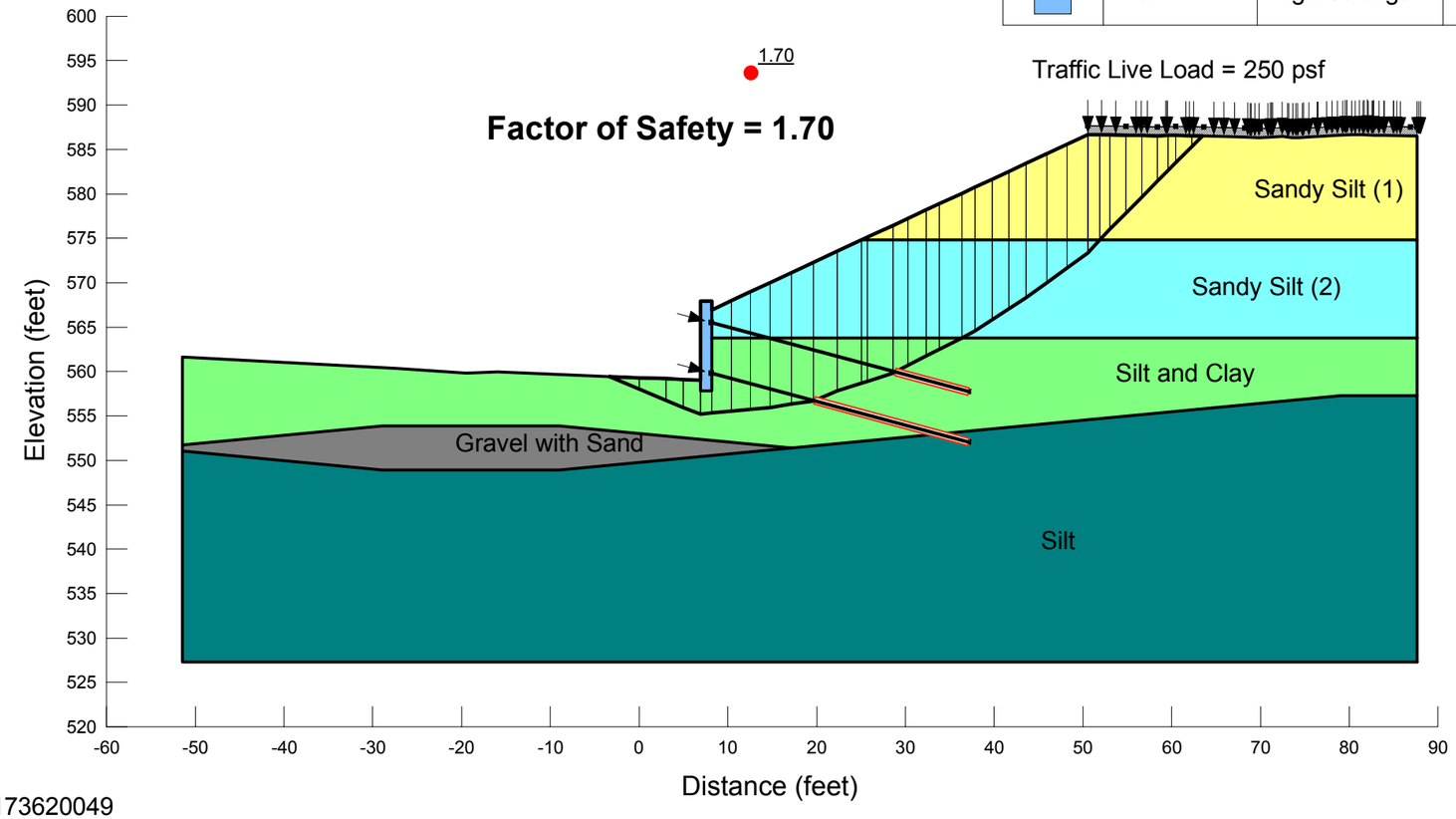
Ohio Department of Transportation
HAM-71-6.86
PID No. 94741
Soil Nail Wall Analysis
STA 416+70 (with bridge abutment not modeled)

Static Slope Stabilty Analysis

Global Stability
Three Soil Nail Rows, Deep Failure
5.5 Foot Horizontal Spacing
30 Foot Length

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Gravel with Sand	Mohr-Coulomb	130	0	34
	Sandy Silt (1)	Mohr-Coulomb	135	100	28
	Sandy Silt (2)	Mohr-Coulomb	125	0	30
	Silt	Mohr-Coulomb	135	0	34
	Silt and Clay	Mohr-Coulomb	140	100	28
	Wall	High Strength	150		



APPENDIX D.3
DERIVATION OF MATERIAL PARAMETERS

Stantec

Performed: Robert Lopina, 7/12/16 Checked: Eric Kistner, 7/12/16

Reference: HAM-71-6.86 Soil Nail Wall Material Properties

SUMMARY

The table below gives the recommended material properties for the HAM-71-6.86 soil nail wall analysis. Material properties were determined using laboratory data from samples taken from B-015-0-15 and B-015-1-15, Table 3.10 in FHWA Geotechnical Engineering Circular No. 7 (FHWA0-IF-03-017), and Tables 1 and 2 in ODOT Geotechnical Bulletin 7 (ODOT GB 7). Boring B-015-0-15 was advanced in the shoulder of I-71 underneath the Kennedy Avenue overpass. Boring B-015-1-15 was positioned off the shoulder of Kennedy Avenue east of the overpass. The process of determining each material property is discussed in more detail in the following sections. See the attached section for the recommended soil profile at the soil nail wall.

Material	Unit Weight, γ (pcf)	Cohesion, c (psf)	Friction Angle, ϕ (degrees)	Ultimate Bond Strength, q_u (psi)
Sandy Silt (1)	135	100	28	8.7
Sandy Silt (2)	125	0	30	8.7
Silt and Clay	140	100	28	8.7
Gravel with Sand	130	0	34	14.5
Silt	135	0	34	8.7

SANDY SILT (1)

Sandy silt (A-4a) was encountered beneath the ground surface to a depth of 12.0 feet in B-015-1-15. This layer was assumed to be from elevation 574.8 feet to the ground surface throughout the entire cross-section.

This material has a plasticity index of 10, which indicates that some cohesion exists in this soil. Unit weights, N_{60}-values, and Atterberg limits results were similar to those found in the silt and clay layer described below. Therefore, the recommended cohesion and friction angle of 100 pounds per square foot and 28 degrees for the silt and clay layer is recommended for this layer.

A wet density of 134.1 pounds per cubic foot was reported from the unconfined compression testing on the Shelby tube from 5.0 to 7.0 feet in B-015-1-15. The recommended unit weight for this soil is 135 pounds per cubic foot.

Table 3.10 of FHWA0-IF-03-017 indicates that soil nails constructed in silt using a rotary drilled method have ultimate bond strengths between 8.7 and 10.9 pounds per square inch. Soil nails constructed in silty clayey sand using an augered method have ultimate bond strengths between 8.7 and 20.3 pounds per square inch. An ultimate bond strength of 8.7 pounds per square inch is recommended for this material.

Reference: HAM-71-6.86 Soil Nail Wall Material Properties

SANDY SILT (2)

Another layer of sandy silt (A-4a) was encountered at a depth of 12.0 to 23.0 feet in B-015-1-15. This layer was assumed to be from elevation 563.8 to 574.8 feet throughout the entire cross-section.

This layer has a higher sand content than the layer above it and has a plasticity index of 1, indicating the soil is practically cohesionless. A low value of unconfined compressive strength was reported from unconfined compression testing on the Shelby tube sample from 15.0 to 17.0 feet in B-015-1-15. Therefore, the recommended value of cohesion is 0 pounds per square foot.

A wet density of 125.3 pounds per cubic foot was reported from the unconfined compression testing on the Shelby tube sample from 15.0 to 17.0 feet in B-015-1-15. Therefore, the recommended unit weight for this soil is 125 pounds per cubic foot.

SPT N_{60}-values for this layer ranged from 3 to 31 blows per foot. Table 2 of ODOT GB 7 indicates that for loose soils, the friction angle typically ranges from 28 to 30 degrees and for medium dense soils, the friction angle typically ranges from 30 to 34 degrees. A friction angle of 30 degrees is recommended for this soil.

Table 3.10 of FHWA0-IF-03-017 indicates that soil nails constructed in silt using a rotary drilled method have ultimate bond strengths between 8.7 and 10.9 pounds per square inch. Soil nails constructed in silty clayey sand using an augered method have ultimate bond strengths between 8.7 and 20.3 pounds per square inch. An ultimate bond strength of 8.7 pounds per square inch is recommended for this material.

SILT AND CLAY

A layer of silt and clay (A-6a) was encountered below the ground surface to a depth of 7.0 feet in B-015-0-15. N_{60}-values and Atterberg limits in this material matched well with the N_{60}-values and Atterberg limits results in the soil from 23.0 to 29.0 feet in B-015-1-15. Therefore, this layer is assumed to extend through the entire cross-section.

This material has a plasticity index of 12, which indicates that some cohesion exists in this soil. Consolidated-undrained triaxial compression testing on the Shelby Tube from 25.0 to 27.0 feet indicates that the drained cohesion is 120 pounds per square foot. The recommended value of cohesion is 100 pounds per square foot for this soil.

The triaxial compression testing reported a friction angle of 35.3 degrees. However, N_{60}-values of 6 were encountered in the split spoon samples above and below the Shelby tube in B-015-1-15. Therefore, the recommended value for the friction angle in this soil was reduced significantly to 28 degrees.

Wet densities ranged from 138.3 to 143.9 pounds per cubic foot from undisturbed testing for this soil layer. The recommended value for unit weight is 140 pounds per cubic foot for this soil.

Table 3.10 of FHWA0-IF-03-017 indicates that soil nails constructed in silt using a rotary drilled method have ultimate bond strengths between 8.7 and 10.9 pounds per square inch. Soil nails constructed in silty clayey sand using an augered method have ultimate bond strengths between 8.7 and 20.3

pounds per square inch. An ultimate bond strength of 8.7 pounds per square inch is recommended for this material.

GRAVEL WITH SAND

A 5-foot layer of gravel and stone fragments with sand (A-1-b) was encountered at a depth of 7 feet in B-015-0-15. This material was not encountered in B-015-1-15. Therefore, this layer is shown in the stratigraphy for B-015-0-15 but not for B-015-1-15.

This soil is considered cohesionless because the plasticity index of 4 is less than 7. SPT N_{60}-values indicate this material is dense to very dense.

Table 1 of ODOT GB 7 provides an approximate wet unit weight for dense, cohesionless soils at a depth of 5 to 10 feet of 130 pounds per cubic foot. Therefore, the recommended value for unit weight is 130 pounds per cubic foot for this soil.

Table 2 of ODOT GB 7 provides a range of typical friction angles for dense, cohesionless soils of 34 to 36 degrees. A friction angle of 34 degrees is recommended for this layer.

Table 3.10 of FHWA0-IF-03-017 provides ultimate bond strengths between 14.5 and 26.1 pounds per square inch for soil nails constructed in sand/gravel using a rotary drilled method. Other construction methods in similar materials have ultimate bond strengths greater than 14.5 pounds per square inch. An ultimate bond strength of 14.5 pounds per square inch is recommended for this material.

SILT

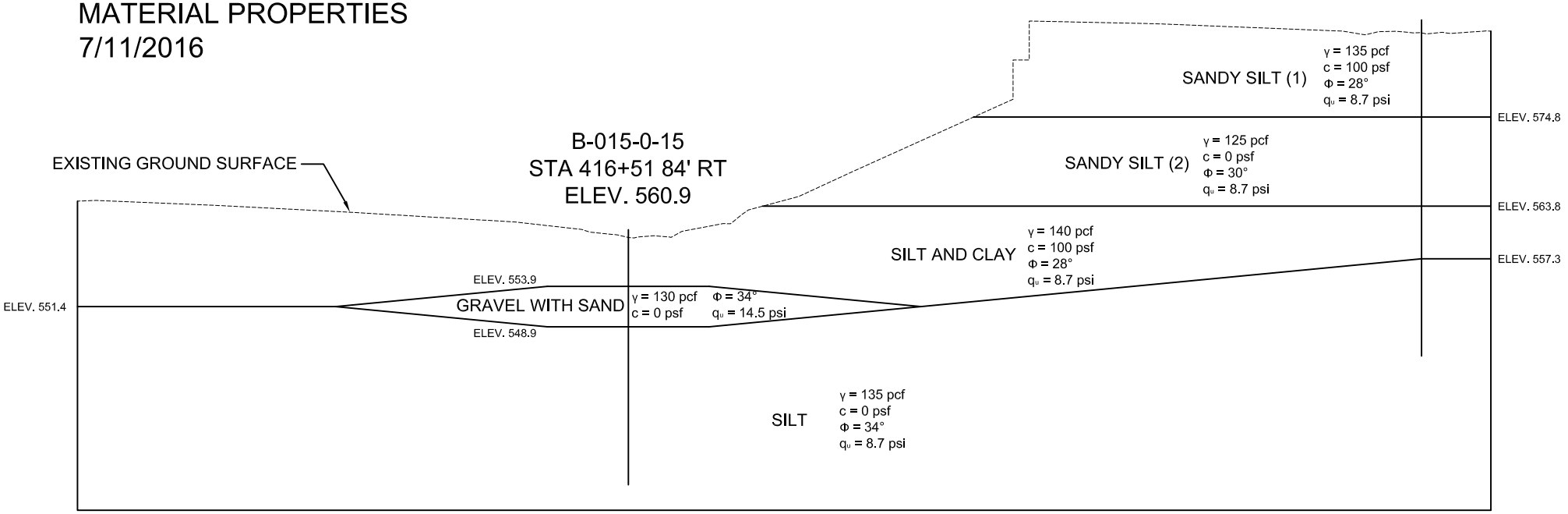
A layer of hard silt (A-4b) was encountered from 29.0 to 41.5 feet in B-015-1-15. N_{60}-values and Atterberg limits in this material matched well with the N_{60}-values and Atterberg limits results in the soil from 12.0 to 41.5 feet in B-015-0-15. Therefore, this layer is assumed to extend through the entire cross-section.

SPT N_{60}-values ranged from 29 to over 50 in this layer. Consolidated-undrained triaxial compression testing was performed using Shelby tubes from both borings in this soil layer. The results of the testing indicate the soil is cohesionless and has a friction angle of 34.3 degrees. Therefore, a friction angle of 34 degrees is recommended for this soil.

Wet densities ranged from 131.8 to 139.1 pounds per cubic foot from undisturbed testing for this soil layer. The recommended value for unit weight is 135 pounds per cubic foot for this soil.

Table 3.10 of FHWA0-IF-03-017 indicates that soil nails constructed in silt using a rotary drilled method have ultimate bond strengths between 8.7 and 10.9 pounds per square inch. Soil nails constructed in silty clayey sand using an augered method have ultimate bond strengths between 8.7 and 20.3 pounds per square inch. An ultimate bond strength of 8.7 pounds per square inch is recommended for this material.

HAM-71-6.86
SECTION 416+50
SOIL NAIL WALL
MATERIAL PROPERTIES
7/11/2016



APPENDIX E
NOISE BARRIER ANALYSIS

Stantec

HAM-71-6.86
Noise Wall Analysis
Summary Table

Boring	Station	Offset	Design N-Value	Condition	Cohesive Zones	Granular Zones
B-017-0-15	421+79	168' RT.	9 5 3	D < 15' 15' ≤ D < 22.5' D ≥ 22.5'	0.0' to 13.5'	13.5' to 26.5'
B-019-0-15	423+44	125' RT.	6	For any foundation depth	0.0' to 24.5'	24.5' to 26.5'
B-020-0-15	425+25	74' RT.	4 2	D < 22.5' D ≥ 22.5'	0.0' to 14.5' 19.5' to 26.5'	14.5' to 19.5'
B-021-0-15	426+46	59' RT.	20 11 2	D < 10' 10' ≤ D < 12.5' D ≥ 12.5'	4.5' to 19.5' 24.5' to 26.5'	0.0' to 4.5' 19.5' to 24.5'
B-022-0-15	428+55	61' RT.	12 5 2	D ≤ 7.5' 7.5' < D < 20' D ≥ 20'	Entire Boring	None
B-024-0-15	430+49	76' RT.	17 13 4 2	D ≤ 7.5' 7.5' < D < 10' 10' ≤ D < 22.5' D ≥ 22.5'	Entire Boring	None
B-025-0-15*	432+49	74' RT.	9 4	D < 10' D ≥ 10'	Entire Boring	None
B-027-0-15	435+25	66' RT.	7 3	D < 12.5' D ≥ 12.5'	3.0' to 12.0' 19.5' to 26.5'	0.0' to 3.0' 12.0' to 19.5'
B-028-0-15	437+01	61' RT.	5	For any foundation depth	1.5' to 4.5' 7.5' to 26.5'	4.5' to 7.5'
B-029-0-15	438+39	60' RT.	7	For any foundation depth	1.5' to 7.5' 19.5' to 26.5'	7.5' to 19.5'

D = Foundation Depth (ft)

**1.5' - 3.0' sample ignored; when included Design N-value = 3 for any foundation depth*

Boring	Depth	Cohesive or Granular	N-Value	Corrected N-Value	Design N-Value
B-017-0-15	2.5-4.0	Cohesive	7	10	9
Track Rig	5.0-6.5	Cohesive	7	9	if D < 15'
	7.5-9.0	Cohesive	10	11	
	12.5-14.0	Cohesive	17	17	5
	15.0-16.5	Granular	7	6	if 15' ≤ D < 22.5'
	17.5-19.0	Granular	6	5	
	20.0-21.5	Granular	6	5	3
	22.5-24.0	Granular	4	3	if D ≥ 22.5'
	25.0-26.5	Granular	11	9	
B-019-0-15	2.5-4.0	Cohesive	4	6	6
Track Rig	5.0-6.5	Cohesive	18	23	
	7.5-9.0	Cohesive	15	17	
	10.0-11.5	Cohesive	14	14	
	12.5-14.0	Cohesive	10	10	
	15.0-16.5	Cohesive	10	9	
	17.5-19.0	Cohesive	12	11	
	20.0-21.5	Cohesive	14	12	
	22.5-24.0	Cohesive	17	14	
	25.0-26.5	Granular	10	8	
B-020-0-15	2.5-4.0	Cohesive	3	4	4
Track Rig	5.0-6.5	Cohesive	13	17	if D < 22.5'
	7.5-9.0	Cohesive	7	8	
	10.0-11.5	Cohesive	4	4	2
	12.5-14.0	Cohesive	4	4	if D ≥ 22.5'
	15.0-16.5	Granular	5	5	
	17.5-19.0	Granular	7	6	
	20.0-21.5	Cohesive	13	11	
	22.5-24.0	Cohesive	3	2	
	25.0-26.5	Cohesive	13	10	
B-021-0-15	1.5-3.0	Granular	15	20	20
Truck Rig	3.0-4.5	Granular	18	22	if D < 10'
	4.5-6.0	Cohesive	27	31	
	6.0-7.5	Cohesive	35	34	11
	7.5-9.0	Cohesive	20	20	if 10' ≤ D < 12.5'
	10.0-11.5	Cohesive	12	11	
	12.5-14.0	Cohesive	3	3	2
	15.0-16.5	Cohesive	7	6	if D ≥ 12.5'
	17.5-19.0	Cohesive	3	2	
	20.0-21.5	Granular	16	12	
	22.5-24.0	Granular	11	8	
	25.0-26.5	Cohesive	3	2	
B-022-0-15	1.5-3.0	Cohesive	6	8	12
Truck Rig	3.0-4.5	Cohesive	9	11	if D ≤ 7.5'
	4.5-6.0	Cohesive	12	14	
	6.0-7.5	Cohesive	15	15	5
	7.5-9.0	Cohesive	10	10	if 7.5' < D < 20'
	10.0-11.5	Cohesive	10	9	
	12.5-14.0	Cohesive	9	8	2
	15.0-16.5	Cohesive	7	6	if D ≥ 20'
	17.5-19.0	Cohesive	6	5	
	20.0-21.5	Cohesive	3	2	
	22.5-24.0	Cohesive	7	5	
	25.0-26.5	Cohesive	8	5	

Stantec

HAM-71-6.86
Noise Wall Analysis
Data

Boring	Depth	Cohesive or Granular	N-Value	Corrected N-Value	Design N-Value
B-024-0-15	1.5-3.0	Cohesive	9	13	17
Track Rig	3.0-4.5	Cohesive	10	14	if D ≤ 7.5'
	4.5-6.0	Cohesive	16	21	
	6.0-7.5	Cohesive	19	21	13
	7.5-9.0	Cohesive	16	18	if 7.5' < D < 10'
	10.0-11.5	Cohesive	8	8	
	12.5-14.0	Cohesive	10	10	4
	15.0-16.5	Cohesive	9	8	if 10' ≤ D < 22.5'
	17.5-19.0	Cohesive	9	8	
	20.0-21.5	Cohesive	5	4	2
	22.5-24.0	Cohesive	2	2	if D ≥ 22.5'
	25.0-26.5	Cohesive	3	2	
B-025-0-15	1.5-3.0	Cohesive	2	3	3
Track Rig	3.0-4.5	Cohesive	7	10	
	4.5-6.0	Cohesive	10	13	OR
	6.0-7.5	Cohesive	11	12	
	7.5-9.0	Cohesive	8	9	if 1.5-3.0 ignored
	10.0-11.5	Cohesive	7	7	9
	12.5-14.0	Cohesive	4	4	if D < 10'
	15.0-16.5	Cohesive	8	7	
	17.5-19.0	Cohesive	12	11	4
	20.0-21.5	Cohesive	8	7	if D ≥ 10'
	22.5-24.0	Cohesive	8	7	
	25.0-26.5	Cohesive	8	6	
B-027-0-15	1.5-3.0	Granular	5	7	7
Track Rig	3.0-4.5	Cohesive	10	14	if D < 12.5'
	4.5-6.0	Cohesive	13	17	
	6.0-7.5	Cohesive	16	18	3
	7.5-9.0	Cohesive	15	17	if D ≥ 12.5'
	10.0-11.5	Cohesive	10	10	
	12.5-14.0	Granular	3	3	
	15.0-16.5	Granular	13	12	
	17.5-19.0	Granular	27	24	
	20.0-21.5	Cohesive	2	2	
	22.5-24.0	Cohesive	3	2	
	25.0-26.5	Cohesive	4	3	
B-028-0-15	1.5-3.0	Cohesive	4	5	5
Truck Rig	3.0-4.5	Cohesive	11	13	
	4.5-6.0	Granular*	10	11	
	6.0-7.5	Granular*	17	17	
	7.5-9.0	Cohesive	7	7	
	9.0-10.5	Cohesive	26	23	
	10.5-12.0	Cohesive	15	13	
	12.5-14.0	Cohesive	9	8	
	15.0-16.5	Cohesive	15	12	
	17.5-19.0	Cohesive	13	10	
	20.0-21.5	Cohesive	9	7	
	22.5-24.0	Cohesive	7	5	
	25.0-26.5	Cohesive	10	7	
B-029-0-15	1.5-3.0	Cohesive	38	49	7
Truck Rig	3.0-4.5	Cohesive	11	13	
	4.5-6.0	Cohesive	6	7	
	6.0-7.5	Cohesive	45	44	
	7.5-9.0	Granular*	17	17	
	10.0-11.5	Granular*	13	12	
	12.5-14.0	Granular*	29	26	
	15.0-16.5	Granular*	16	13	
	17.5-19.0	Granular*	40	31	
	20.0-21.5	Cohesive	32	24	
	22.5-24.0	Cohesive	14	10	
	25.0-26.5	Cohesive	10	7	

*Soil has PI > 7 but is classified as A-2-6

Stantec

HAM-71-6.86
Noise Wall Analysis
References

Depth (ft)	Correction Factor
2.5	1.6
5.0	1.4
7.5	1.2
10.0	1.1
12.5	1.1
15.0	1.0
17.5	0.96
20.0	0.91
22.5	0.88
25.0	0.84

From Ohio Department of Transportation
2007 Bridge Design Manual

Hammer Rod Efficiency	
Truck Rig	81.3%
Track Rig	92.4%

APPENDIX F
SIDEHILL CUT STABILITY ANALYSIS

APPENDIX F.1
STABILITY ANALYSIS OUTPUTS

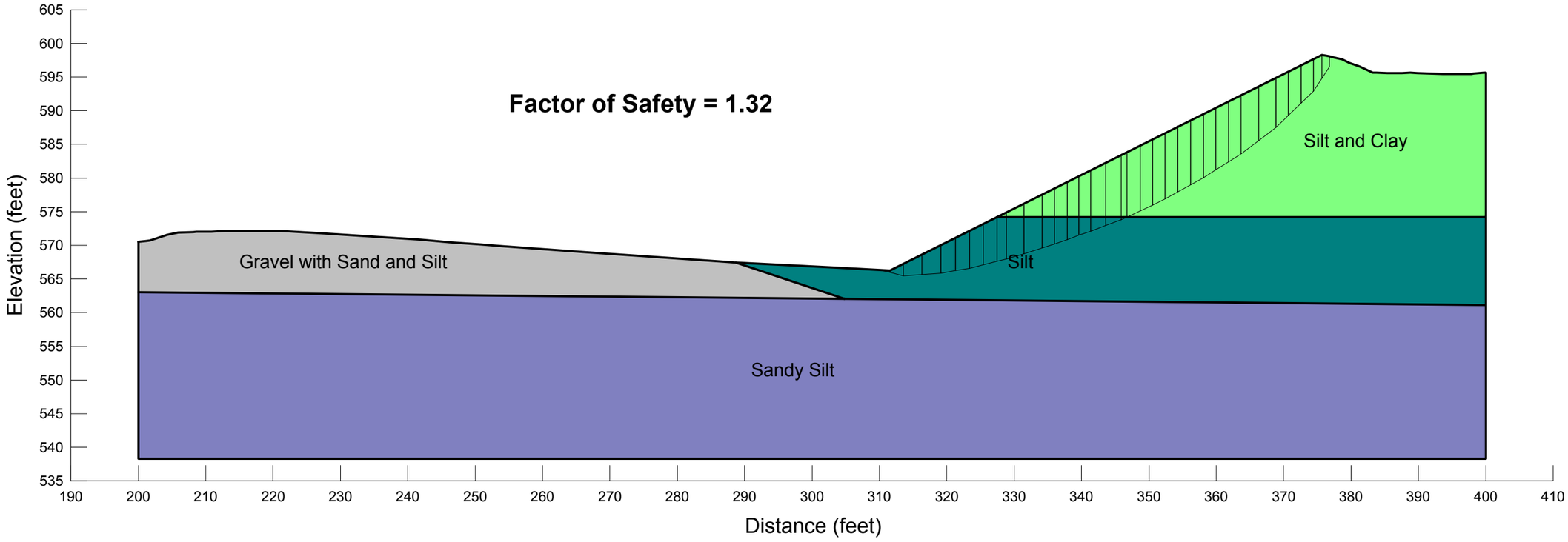
Ohio Department of Transportation
HAM-71-6.86
PID No. 94741
Cut Section Analysis
STA 419+00

Static Slope Stabilty Analysis

Cut Section
Drained Conditions

Material	Unit Weight	Friction Angle	Cohesion
Silt and Clay (Drained)	125 pcf	24 °	150 psf
Silt (Drained)	130 pcf	28 °	0 psf
Gravel with Sand and Silt (Drained)	120 pcf	33 °	0 psf
Sandy Silt (Drained)	130 pcf	24 °	150 psf

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Project No. 173620049

7/18/2016 9:25:32 AM

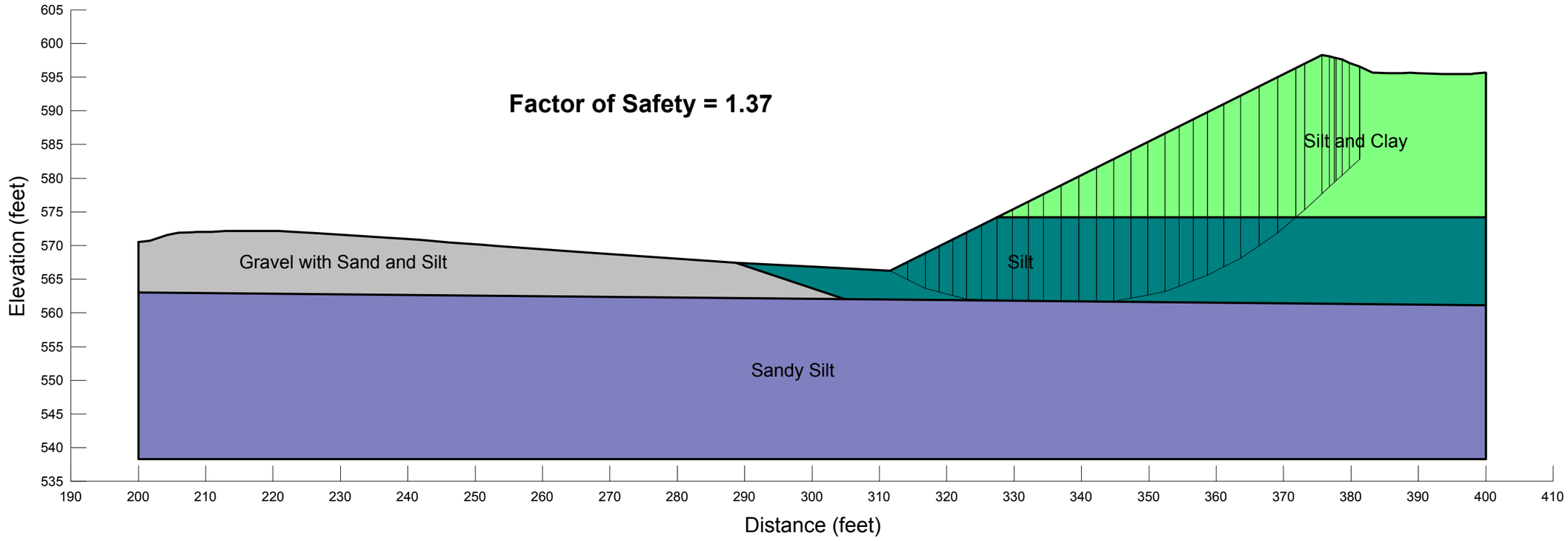
Ohio Department of Transportation
HAM-71-6.86
PID No. 94741
Cut Section Analysis
STA 419+00

Static Slope Stabilty Analysis

Cut Section
Undrained Conditions

Material	Unit Weight	Friction Angle	Cohesion
Silt and Clay (Undrained)	125 pcf	0 °	1000 psf
Silt (Undrained)	130 pcf	0 °	750 psf
Gravel with Sand and Silt (Undrained)	120 pcf	33 °	0 psf
Sandy Silt (Undrained)	130 pcf	0 °	1000 psf

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Project No. 173620049

8/18/2016 12:03:47 PM

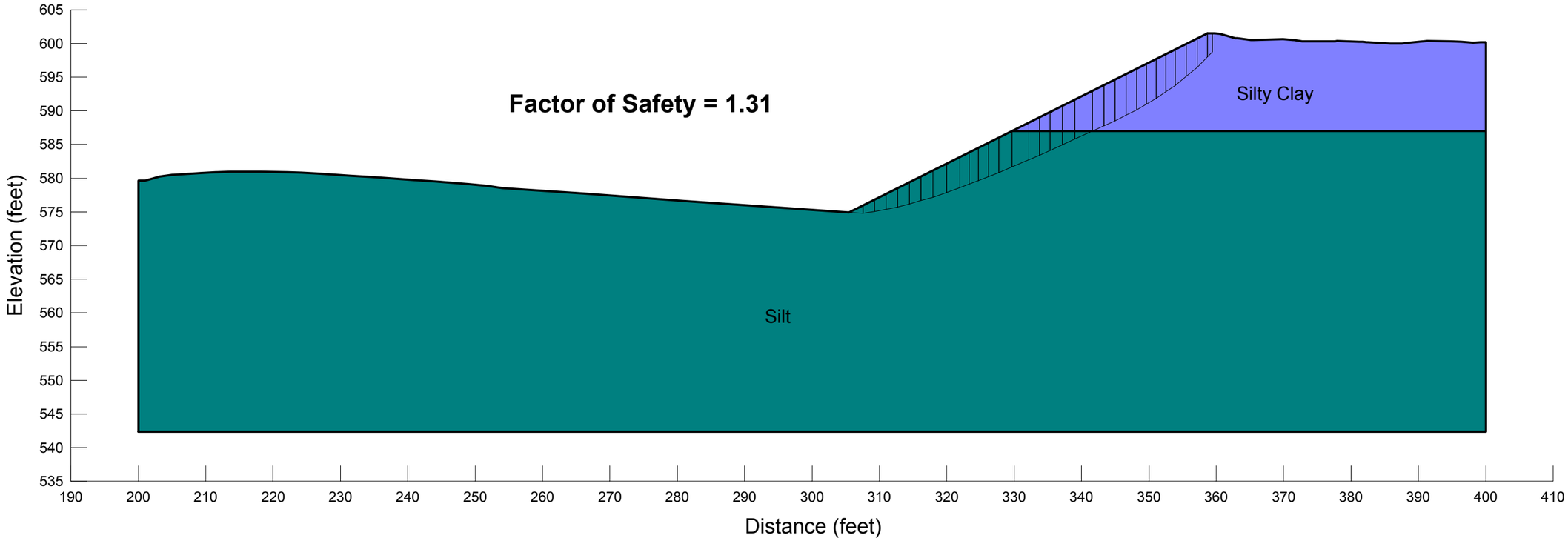
Ohio Department of Transportation
HAM-71-6.86
PID No. 94741
Cut Section Analysis
STA 422+00

Static Slope Stabilty Analysis

Cut Section
Drained Conditions

Material	Unit Weight	Friction Angle	Cohesion
Silty Clay (Drained)	120 pcf	22 °	110 psf
Silt (Drained)	125 pcf	30 °	0 psf

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Project No. 173620049

7/18/2016 9:40:20 AM

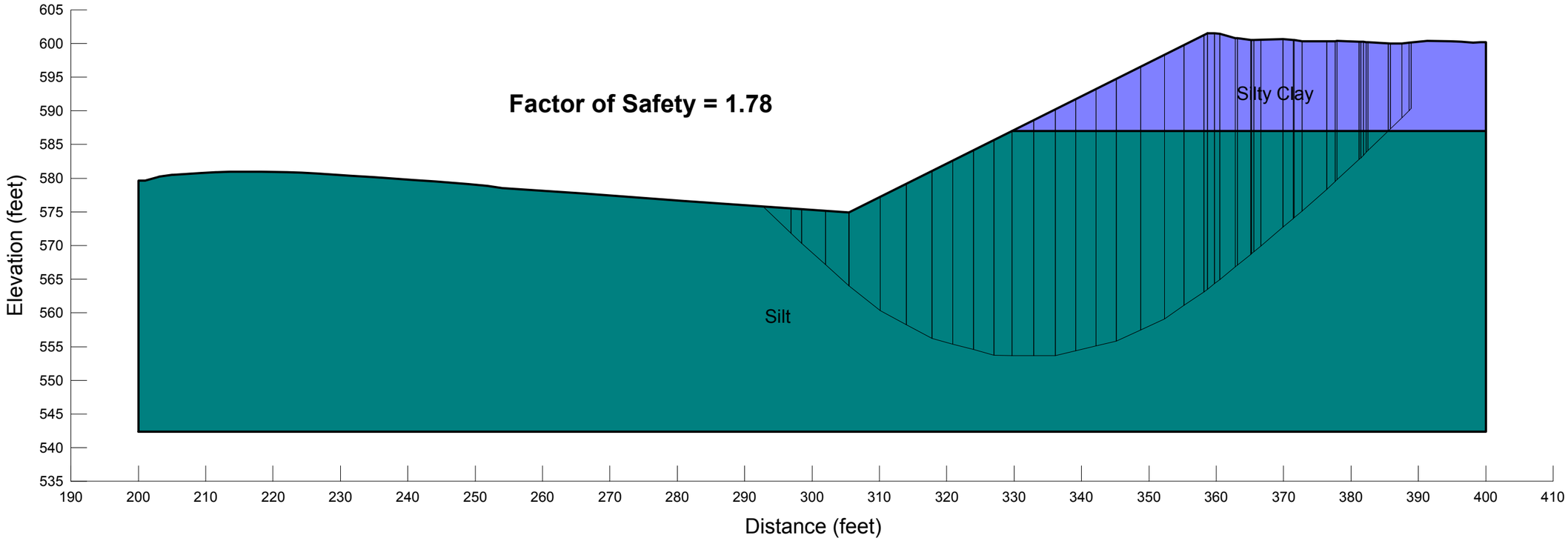
Ohio Department of Transportation
HAM-71-6.86
PID No. 94741
Cut Section Analysis
STA 422+00

Static Slope Stabilty Analysis

Cut Section
Undrained Conditions

Material	Unit Weight	Friction Angle	Cohesion
Silty Clay (Undrained)	120 pcf	0 °	750 psf
Silt (Undrained)	125 pcf	0 °	1000 psf

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Project No. 173620049

8/18/2016 12:08:35 PM

APPENDIX F.2
DERIVATION OF MATERIAL PARAMETERS

PARAMETER DERIVATION, SIDEHILL CUT ANALYSES

Three cut sections stations with boring information:

- STA 419+00 (B-016-0-15 and B-016-1-15)
- STA 422+00 (B-017-0-15)
- STA 423+00 (B-018-0-15 and B-019-0-15)

Height of embankments:

- STA 419+00 height = 34.0'
- STA 422+00 height = 28.5'
- STA 423+00 height = 24.0'

Sections analyzed:

- STA 419+00 analyzed, tallest slope
- STA 422+00 analyzed with boring information from B-017-0-15 and B-018-0-15 (B-019-0-15 had higher blow counts, so B-018-0-15 considered more conservative).

STA 419+00 (B-016-0-15 and B-016-1-15)

Ground surface (embankment) to El. 574.2: layer of A-6a

- N60 from 6 to 29, average of 17
- Cohesion (PI =15)
- GB 7, ϕ'=24°, c'=150 psf, UW=125 pcf
- SGE, say N60 of 9 (about 2/3 greater), Qu=2000 psf: ϕ =0°, c=1000 psf

Ground surface (I-71) to El. 562.3 (B-016-0-15): A-2-4

- N60 from 22 to 32, average of 28
- Cohesionless (PI = 7 to NP)
- GB 7, ϕ'=33°, c'=0 psf, UW=120 pcf
- ϕ =33°, c=0 psf

El. 574.2 to El. 561.2 (B-016-1-15)/562.3 (B-016-0-15): A-4b

- N60 from 6 to 11, average of 7
- Cohesionless (Limits NP)
- UW from ST samples = 129.6 pcf, 134.2 pcf, say 130 pcf
- Su = 4138 psf (UU)
- Qu = 1160 psf, Su = 580 psf (UC)
- GB 7, ϕ'=28°, c'=0 psf
- SGE, N60 of 7, Qu=1500 psf: ϕ =0°, c=750 psf

Below El. 561.2 (B-016-1-15)/562.3 (B-016-0-15): A-4a

- A-6a in B-016-0-15 determined to be similar to A-4a in B-016-1-15
- Cohesion (PI=7 to 13)
- N60 from 6 to 40, average of 17
- GB 7, ϕ'=24°, c'=150 psf, UW=130 pcf
- SGE, say N60 of 9 (about 2/3 greater), Qu=2000 psf: ϕ =0°, c=1000 psf

Performed by:	Robert Lopina	**Date:**	7/15/2016
Checked by:	Eric Kistner	**Date:**	7/15/2016

STA 422+00 (B-017-0-15 and B-018-0-15)

El. 587.0 and above: A-6b

- N60 from 3 to 15, average of 10
- Cohesion (PI =17)
- GB 7, ϕ'=22°, c'=110 psf, UW=120 pcf
- SGE, say N60 of 6-7 (about 2/3 greater), Qu=1500 psf: ϕ =0°, c=750 psf

El. 587.0 and below: A-4b

- N60 from 6 to 18, average of 11
- Cohesionless (PI = 5 to NP)
- GB 7, ϕ'=30°, c'=0 psf, UW=125 pcf
- SGE, N60 of 11, Qu=2500 psf: ϕ =0°, say c=1000 psf

APPENDIX G
SIDEHILL FILL STABILITY ANALYSIS

APPENDIX G.1
STABILITY ANALYSIS OUTPUTS

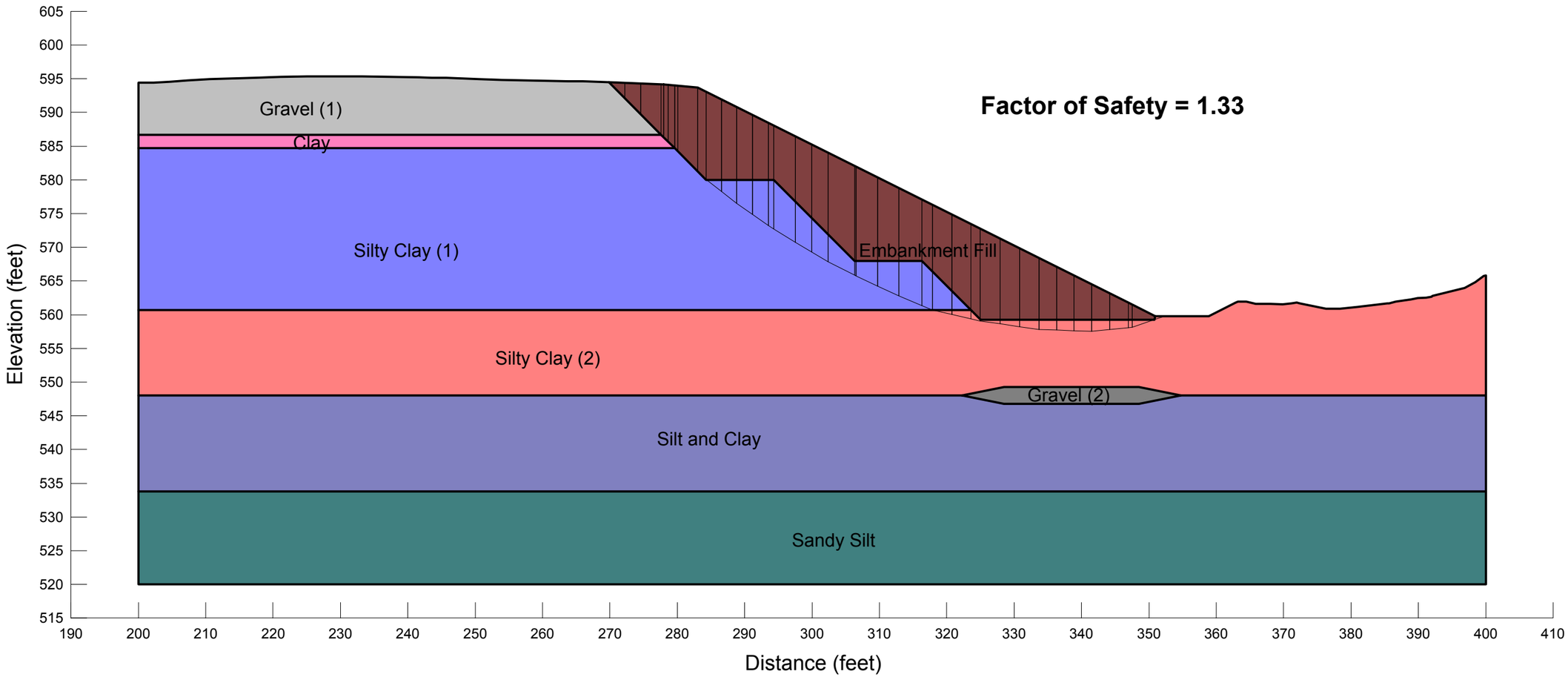
Ohio Department of Transportation
HAM-71-6.86
PID No. 94741
Fill Section Analysis
STA 442+00

Fill Section
Drained Conditions

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Static Slope Stabilty Analysis

Material	Unit Weight	Friction Angle	Cohesion
Gravel (1) (Drained)	120 pcf	32 °	0 psf
Clay (Drained)	125 pcf	23 °	100 psf
Silty Clay (1) (Drained)	130 pcf	24 °	150 psf
Silty Clay (2) (Drained)	140 pcf	22 °	100 psf
Gravel (2) (Drained)	135 pcf	35 °	0 psf
Silt and Clay (Drained)	130 pcf	25 °	150 psf
Sandy Silt (Drained)	135 pcf	26 °	200 psf
Embankment Fill (Drained)	125 pcf	28 °	300 psf



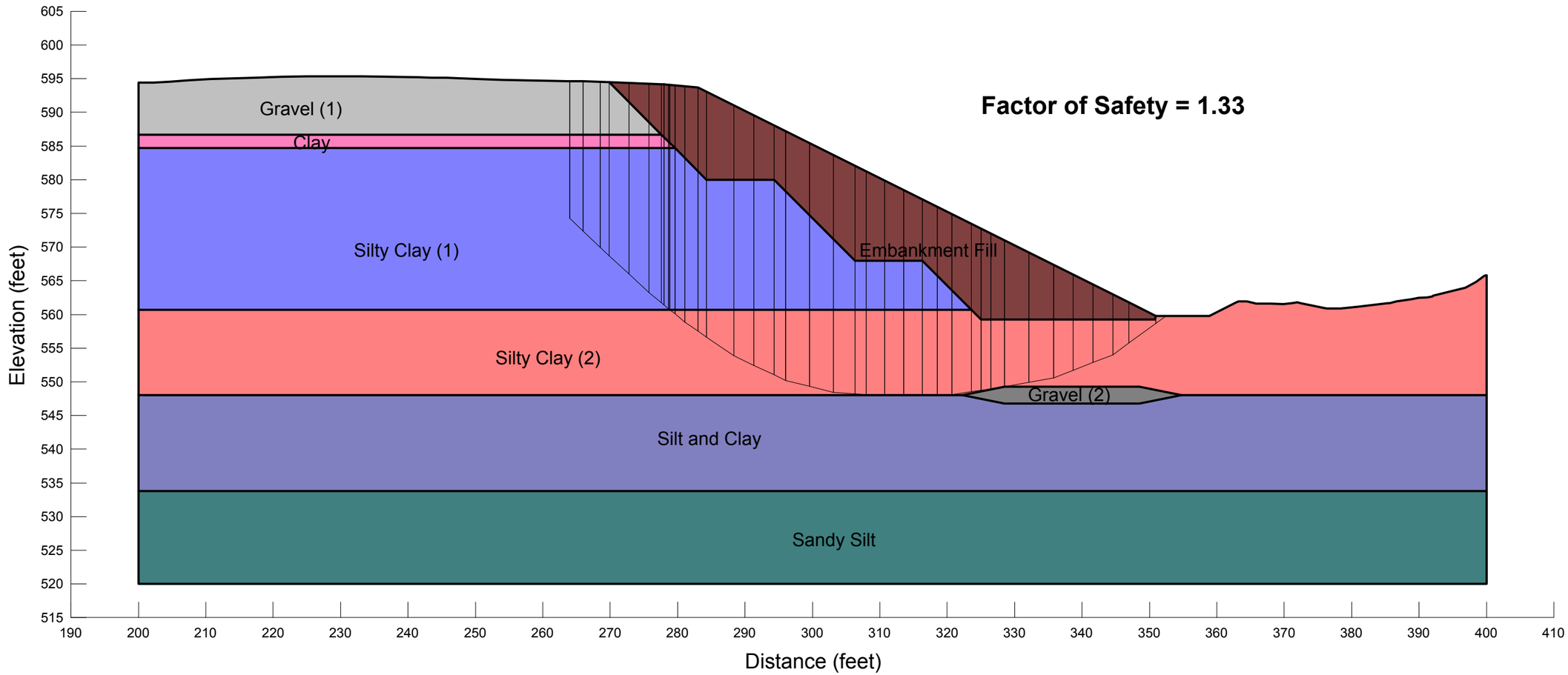
Ohio Department of Transportation
HAM-71-6.86
PID No. 94741
Fill Section Analysis
STA 442+00

Fill Section
Undrained Conditions

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Static Slope Stabilty Analysis

Material	Unit Weight	Friction Angle	Cohesion
Gravel (1) (Undrained)	120 pcf	32 °	0 psf
Clay (Undrained)	125 pcf	0 °	1000 psf
Silty Clay (1) (Undrained)	130 pcf	0 °	1750 psf
Silty Clay (2) (Undrained)	140 pcf	0 °	750 psf
Gravel (2) (Undrained)	135 pcf	35 °	0 psf
Silt and Clay (Undrained)	130 pcf	0 °	1500 psf
Sandy Silt (Undrained)	135 pcf	0 °	2000 psf
Embankment Fill (Undrained)	125 pcf	0 °	1700 psf



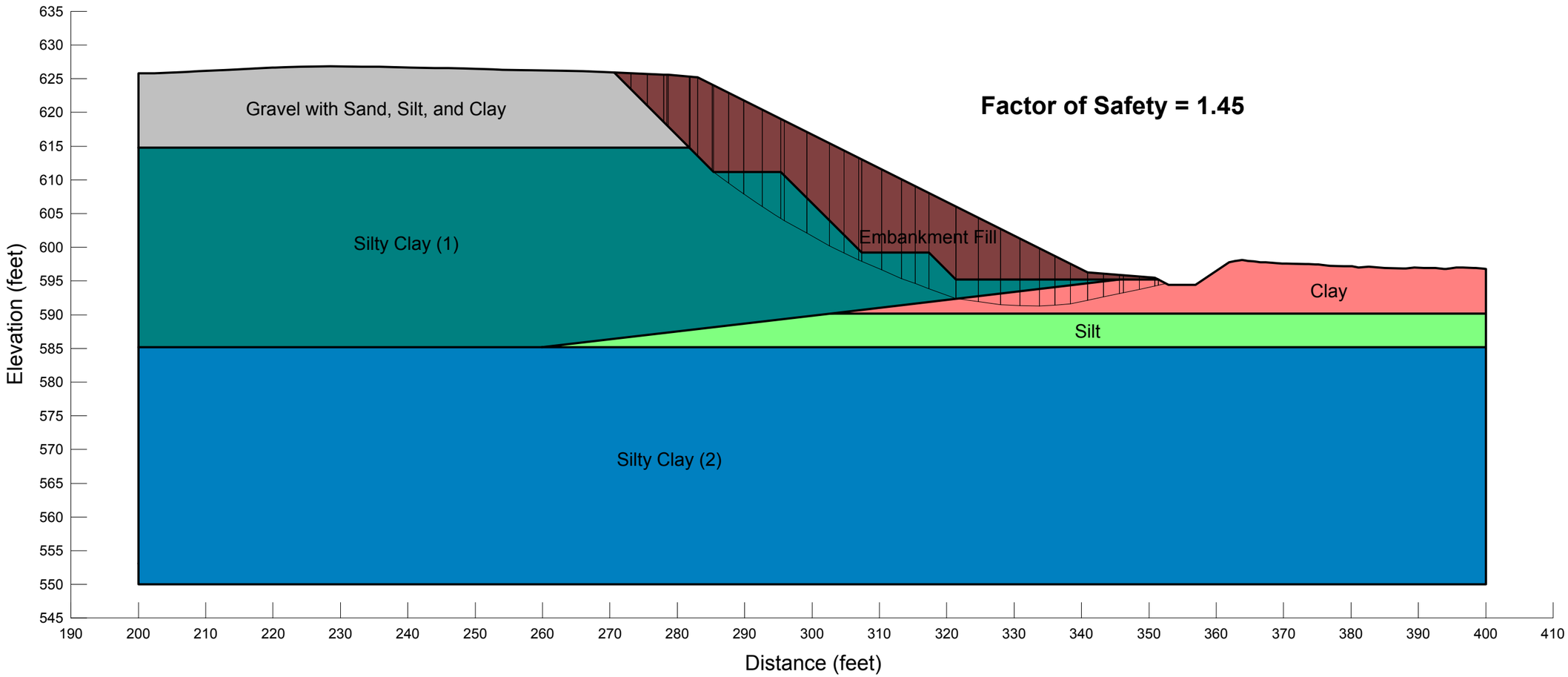
Ohio Department of Transportation
HAM-71-6.86
PID No. 94741
Fill Section Analysis
STA 454+00

Fill Section
Drained Conditions

Static Slope Stabilty Analysis

Material	Unit Weight	Friction Angle	Cohesion
Gravel with Sand, Silt, and Clay (Drained)	125 pcf	30 °	0 psf
Silty Clay (1) (Drained)	130 pcf	25 °	150 psf
Clay (Drained)	120 pcf	22 °	100 psf
Silt (Drained)	130 pcf	24 °	150 psf
Silty Clay (2) (Drained)	130 pcf	25 °	150 psf
Embankment Fill (Drained)	125 pcf	28 °	300 psf

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions between the borings.



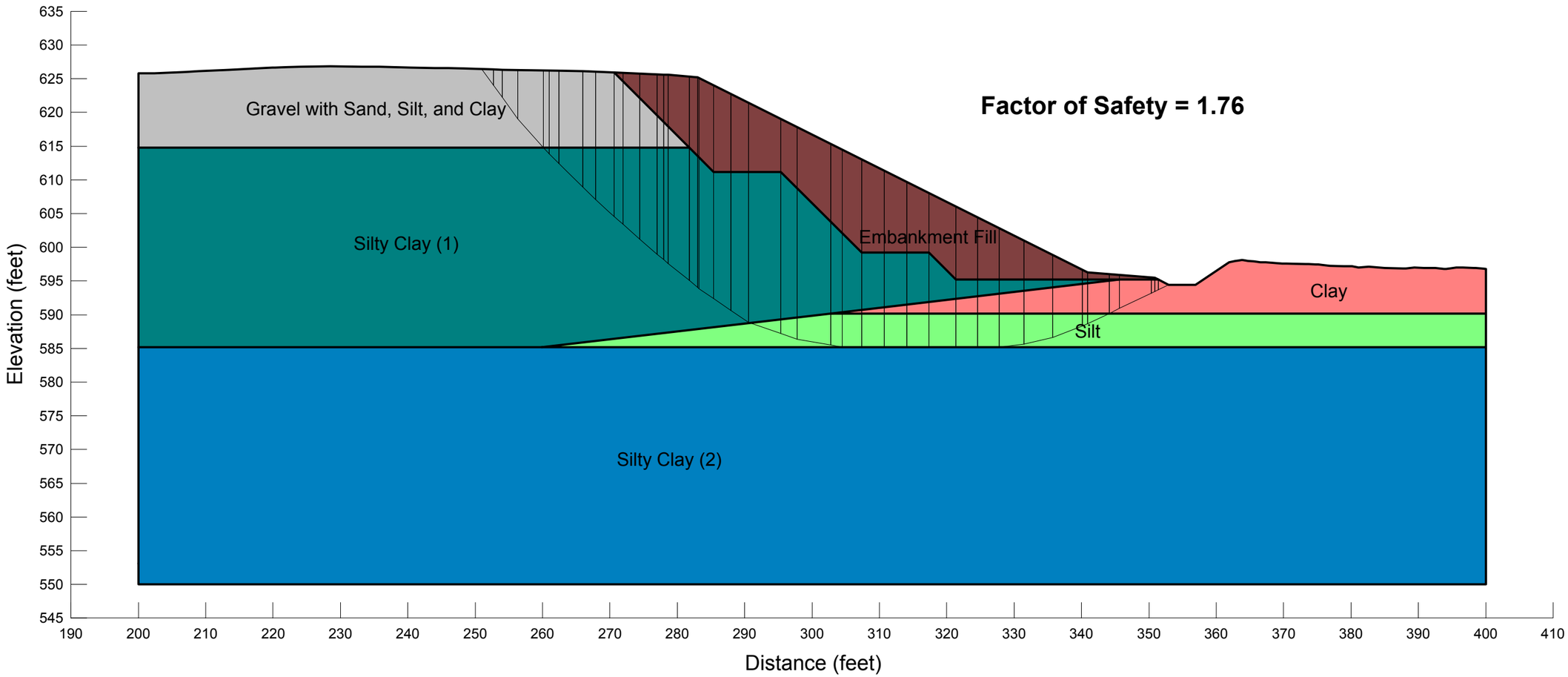
Ohio Department of Transportation
HAM-71-6.86
PID No. 94741
Fill Section Analysis
STA 454+00

Fill Section
Undrained Conditions

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Static Slope Stabilty Analysis

Material	Unit Weight	Friction Angle	Cohesion
Gravel with Sand, Silt, and Clay (Undrained)	125 pcf	30 °	0 psf
Silty Clay (1) (Undrained)	130 pcf	0 °	1500 psf
Clay (Undrained)	120 pcf	0 °	750 psf
Silt (Undrained)	130 pcf	0 °	1000 psf
Silty Clay (2) (Undrained)	130 pcf	0 °	1500 psf
Embankment Fill (Undrained)	125 pcf	0 °	1700 psf



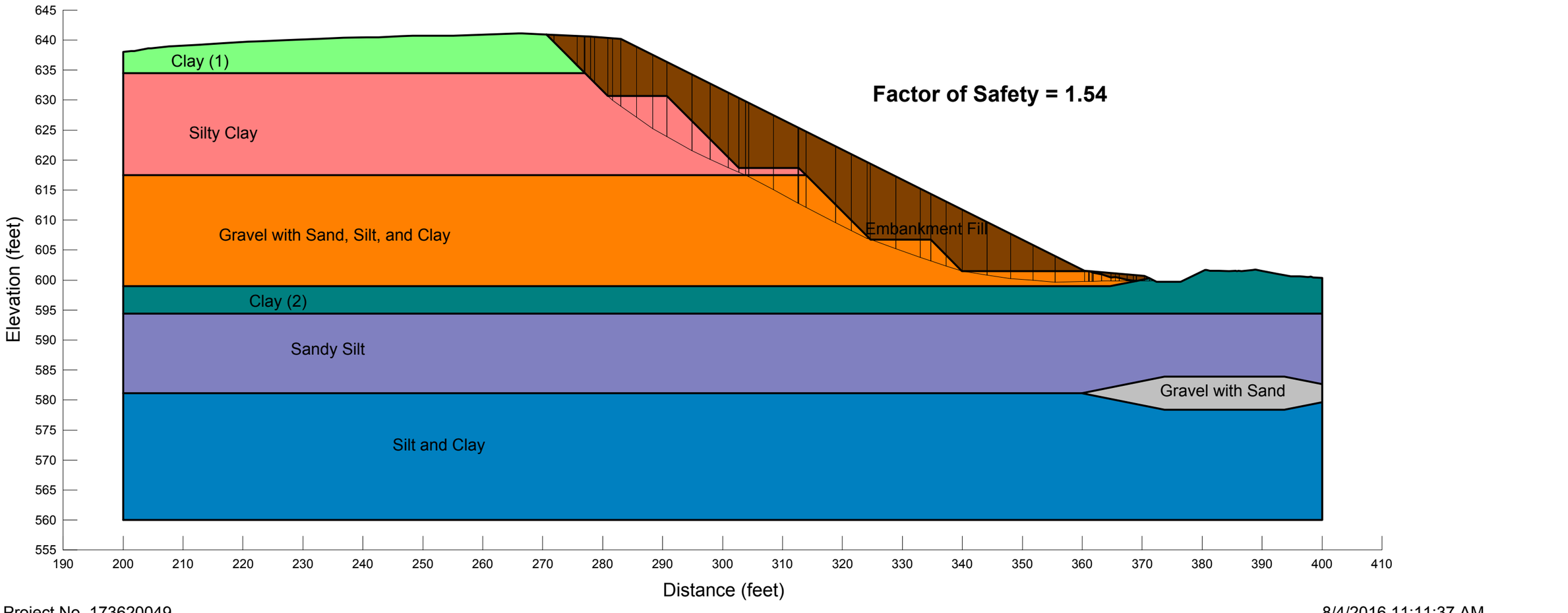
Ohio Department of Transportation
HAM-71-6.86
PID No. 94741
Fill Section Analysis
STA 462+00

Static Slope Stabilty Analysis

Fill Section
Drained Conditions

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Material	Unit Weight	Friction Angle	Cohesion
Clay (1) (Drained)	120 pcf	22 °	100 psf
Silty Clay (Drained)	125 pcf	24 °	150 psf
Gravel with Sand, Silt, and Clay (Drained)	130 pcf	34 °	0 psf
Clay (2) (Drained)	125 pcf	24 °	150 psf
Sandy Silt (Drained)	125 pcf	28 °	0 psf
Gravel with Sand (Drained)	135 pcf	35 °	0 psf
Silt and Clay (Drained)	130 pcf	24 °	150 psf
Embankment Fill (Drained)	125 pcf	28 °	300 psf



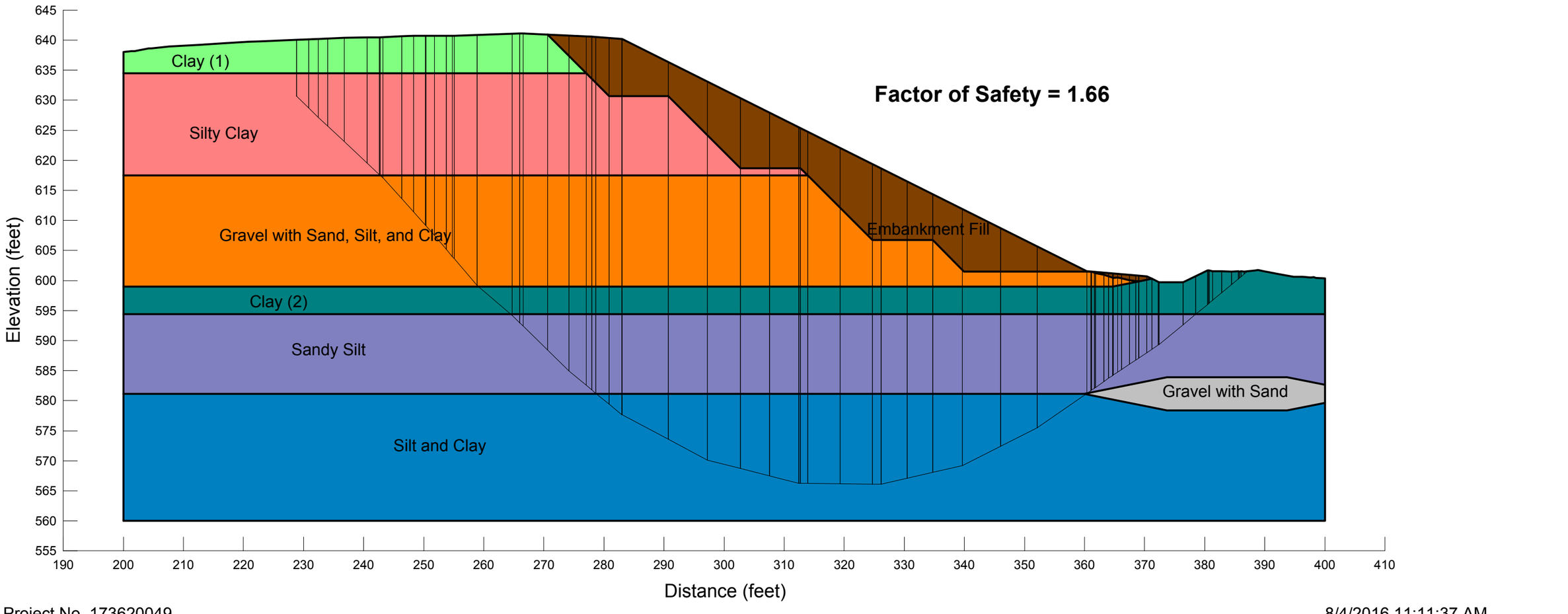
Ohio Department of Transportation
HAM-71-6.86
PID No. 94741
Fill Section Analysis
STA 462+00

Static Slope Stabilty Analysis

Fill Section
Undrained Conditions

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Material	Unit Weight	Friction Angle	Cohesion
Clay (1) (Undrained)	120 pcf	0 °	750 psf
Silty Clay (Undrained)	125 pcf	0 °	1000 psf
Gravel with Sand, Silt, and Clay (Undrained)	130 pcf	34 °	0 psf
Clay (2) (Undrained)	125 pcf	0 °	1000 psf
Sandy Silt (Undrained)	125 pcf	22 °	175 psf
Gravel with Sand (Undrained)	135 pcf	35 °	0 psf
Silt and Clay (Undrained)	125 pcf	0 °	1500 psf
Embankment Fill (Undrained)	125 pcf	0 °	1700 psf



APPENDIX G.2
DERIVATION OF MATERIAL PARAMETERS

PARAMETER DERIVATION, SIDEHILL FILL ANALYSES

Three fill sections with boring information:

- STA 442+00 (B-030-0-15, B-031-1-15, and B-030-2-15)
- STA 454+00 (B-033-0-15 and B-033-1-15)
- STA 462+00 (B-035-0-15 and B-035-1-15)

STA 442+00 (B-030-0-15, B-031-1-15, and B-030-2-15)

El. 586.7 and above: A-1-a (fill)

- N60 from 14 to 77, use 20
- Cohesionless
- GB 7, ϕ'=32°, c'=0 psf, UW=120 pcf
- ϕ =32°, c=0 psf

El. 584.7 to 586.7: A-7-6 (fill)

- N60 =12
- Cohesion (PI=28)
- GB 7, ϕ'=23°, c'=100 psf, UW=125 pcf
- SGE, Qu=3000 psf: ϕ =0°, c=1500 psf (say 1000 psf)

El. 560.7 to 584.7: A-6b (fill)

- N60 from 12 to 33, use 15
- Cohesion (PI=17)
- GB 7, ϕ'=24°, c'=150 psf, UW=130 pcf
- SGE, Qu=4000 psf: ϕ =0°, c=2000 psf (say 1750 psf)

El. 548.1 to 560.7: A-6b

- N60 from 5 to 27, use 9
- Cohesion (PI=16 to 23)
- GB 7, ϕ'=22°, c'=100 psf
- From UU in this layer, Su = 754 psf, UW=142.2 pcf, say 140 pcf: ϕ =0°, c=750

El. 546.8 to 549.3: A-1-a, assumed to be just a seam and not extend through entire section

- N60 = 82, use 40
- Cohesionless
- GB 7, ϕ'=35°, c'=0 psf, UW=135 pcf
- ϕ =35°, c=0 psf

El. 533.8 to 548.1: A-6a

- N60 from 21 to 38, use 21
- Cohesion (PI=12)
- GB 7, ϕ'=25°, c'=150 psf, UW=130 pcf
- SGE, Qu=4000 psf: ϕ =0°, c=2000 psf (say 1500 psf)

El 533.8 and below: A-4a (A-2-6 visually classified below considered part of this layer)

- N60 from 27 to >50, use 30
- Cohesion (PI=12)
- GB 7, ϕ'=26°, c'=200 psf, UW=135 pcf
- SGE, Qu=8000 psf: ϕ =0°, c=4000 psf (say 2000 psf)

Performed by:	Robert Lopina	**Date:**	7/28/2016
Checked by:	Eric Kistner	**Date:**	7/29/2016

STA 454+00 (B-033-0-15 and B-033-1-15)

El. 614.8 and above (embankment): A-2-6 (fill)

- N60 from 11 to 27, use 15
- Mostly coarse grained, treat as cohesionless
- GB 7, ϕ'=30°, c'=0 psf, UW=125pcf
- ϕ =30°, c=0 psf

El. 585.2 to 614.8 (embankment): A-6b (fill)

- N60 from 16 to 77, use 25
- Cohesion (PI =16 to 19)
- GB 7, ϕ'=25°, c'=150 psf, UW=130 pcf
- SGE, Qu=6000 psf: ϕ =0°, c=3000 psf (say 1500 psf)

El. 590.2 and above (ground): A-7-6

- N60 from 3 to 17, use 9
- Cohesion (PI=36)
- GB 7, ϕ'=22°, c'=100 psf, UW=120 pcf
- SGE, Qu=2000 psf: ϕ =0°, c=1000 psf (say 750 psf)

El 585.2 to 590.2 (ground): A-4b

- N60 = 17
- Slight cohesion (PI=7)
- From undisturbed testing, UW=130 pcf
- GB 7, ϕ'=24°, c'=150 psf
- SGE, Qu=4000 psf: ϕ =0°, c=2000 psf (say 1000 psf)

El. 585 and below: A-6b

- N60 from 23 to 51, use 25
- Cohesion (PI =16 to 19)
- GB 7, ϕ'=25°, c'=150 psf, UW=130 pcf
- SGE, Qu=6000 psf: ϕ =0°, c=3000 psf (say 1500 psf)

STA 462+00 (B-035-0-15 and B-035-1-15)

El. 634.5 and above: A-7-6 (fill)

- N60 from 9 to 19, use 9
- Cohesion (PI=28)
- GB 7, ϕ'=22°, c'=100 psf, UW=120 pcf
- SGE, Qu=2000 psf: ϕ =0°, c=1000 psf (say 750 psf)

El. 617.5 to 634.5: A-6b (fill)

- N60 from 15 to 28, use 16
- Some cohesion (PI=18-20)
- GB 7, ϕ'=24°, c'=150 psf, UW=125 pcf
- SGE, Qu=4000 psf: ϕ =0°, c=2000 psf (say 1000 psf)

El. 599.0 to 617.5: A-2-6 (fill)
- N60 from 28 to 56, use 30
- Mostly coarse grained material, treat as cohesionless
- GB 7, ϕ'=34°, c'=0 psf, UW=130 pcf
- ϕ =34°, c=0 psf

El. 594.4 to 599.0: A-7-6
- N60 from 3 to 23, use 15
- Some cohesion (PI=37)
- GB 7, ϕ'=24°, c'=150 psf, UW=125pcf
- SGE, Qu=4000 psf: ϕ =0°, c=2000 psf (say 1000 psf)

El. 583.9 to 594.4: A-4a
- N60 from 20 to 79, use 30
- Some cohesion (PI=10)
- From CU triaxial, ϕ'=28°, c'=0 psf, UW=125 pcf
- ϕ =22°, c=175 psf

El. 578.4 to 583.9 A-1-b, assumed to be just a seam and not extend through entire section
- N60 from 40 to 66, use 40
- Cohesionless
- GB 7, ϕ'=35°, c'=0 psf, UW=135 pcf
- ϕ =35°, c=0 psf

El. 583.9 and below: A-6a
- N60 from 18 to 46, use 18
- Some cohesion (PI=13)
- From UC and UU for this layer, UW=130 pcf
- Qu=3260 psf, Su=1630 psf (UC)
- Su = 1676 psf (UU)
- GB 7, ϕ'=24°, c'=150 psf
- ϕ =0°, c=1500 psf

Embankment Fill Material

Subsurface information from B-015-0-15 to B-019-0-15 (cut sections for project)
- A-2-4
- A-4a
- A-4b
- A-6a
- A-6b

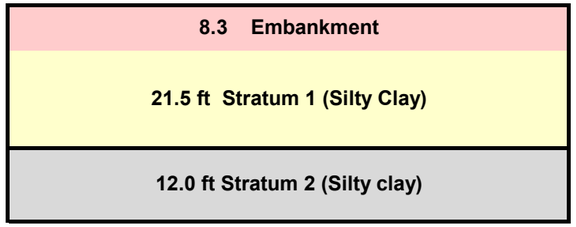
PI usually around 10-17. With PI = 17, ϕ' = 29

Use conservative values from GB6
- ϕ'=28°, c'=300 psf
- ϕ =0°, c=1700 psf
- Say UW = 125 pcf

APPENDIX G.3
EMBANKMENT SETTLEMENT CALCULATIONS

HAM-71-6.86
Settlement Calculations for Station 442+00

Nearest Boring
B-030-0-15



$If\ Po + \Delta P \leq Pc$: $S = \frac{C_r * H}{1 + e_0} \log\left(\frac{P_o + \Delta P}{P_o}\right)$

$If\ Po + \Delta P > Pc$: $S = \frac{C_r H}{1 + e_0} \log\left(\frac{P_c}{P_o}\right) + \frac{C_c H}{1 + e_0} \log\left(\frac{P_o + \Delta P}{P_c}\right)$

Boring B-030-0-15		
Embankment Crest Elev.	594.82	ft
Bottom of Adidtional Fill	586.50	ft
Stratum 1 Bottom Elev.	565.00	ft
Stratum 2 Bottom Elev.	553.00	ft

Whole Layer Settlement

Embankment and Silty Clay Unit Weight: **120 pcf**

Layer	H (ft)	Mid Pt. (ft)	Cr	Cc	e	Po (psf)	Pc (psf)	ΔP(psf)	Pf = Po+ΔP	ΔH
Stratum 1	21.50	10.75	0.04	0.21	0.6	1290.00	2580.00	1248.40	2538.40	0.16
Stratum 2	12.00	27.5	0.05	0.26	0.6	3300.00	6600.00	1248.40	4548.40	0.11

SUM = 0.27 feet
3.25 inches

Multiple Layers - 3 Feet Thick

Embankment and Silty Clay Unit Weight: **120 pcf**

Location	H (ft)	Mid Pt. (ft)	Cr	Cc	e	Po (psf)	Pc (psf)	ΔP(psf)	Pf = Po+ΔP	ΔH
Stratum 1	3	1.5	0.04	0.21	0.6	180.00	2500.00	1248.40	1428.40	0.07
	3	4.5	0.04	0.21	0.6	540.00	2500.00	1248.40	1788.40	0.04
	3	7.5	0.04	0.21	0.6	900.00	2500.00	1248.40	2148.40	0.03
	3	10.5	0.04	0.21	0.6	1260.00	2500.00	1248.40	2508.40	0.02
	3	13.5	0.04	0.21	0.6	1620.00	3240.00	1248.40	2868.40	0.02
	3	16.5	0.04	0.21	0.6	1980.00	3960.00	1248.40	3228.40	0.02
	3.5	20	0.04	0.21	0.6	2400.00	4800.00	1248.40	3648.40	0.02
Stratum 2	3	23	0.05	0.26	0.6	2760.00	5520.00	1248.40	4008.40	0.02
	3	26	0.05	0.26	0.6	3120.00	6240.00	1248.40	4368.40	0.01
	3	29	0.05	0.26	0.6	3480.00	6960.00	1248.40	4728.40	0.01
	3	32	0.05	0.26	0.6	3840.00	7680.00	1248.40	5088.40	0.01
	33.5									

SUM = 0.26 feet
3.13 inches

HAM-71-6.86
Settlement Calculations for Station 454+00

Nearest Boring
B-033-0-15

$$If\ Po + \Delta P \leq Pc: \quad S = \frac{C_r * H}{1 + e_0} \log\left(\frac{P_o + \Delta P}{P_o}\right)$$

$$If\ Po + \Delta P > Pc: \quad S = \frac{C_r H}{1 + e_0} \log\left(\frac{P_c}{P_o}\right) + \frac{C_c H}{1 + e_0} \log\left(\frac{P_o + \Delta P}{P_c}\right)$$

8.8 Embankment
32.2 ft Stratum 1 (Silty Clay)

Boring B-030-0-15		
Embankment Crest Elev.	626.31	ft
Bottom of Adidtional Fill	617.50	ft
Stratum 1 Bottom Elev.	585.30	ft

Whole Layer Settlement

Embankment and Silty Clay Unit Weight: **120 pcf**

Layer	H (ft)	Mid Pt. (ft)	Cr	Cc	e	Po (psf)	Pc (psf)	ΔP(psf)	Pf = Po+ΔP	ΔH
Stratum 1	32.20	16.1	0.04	0.21	0.6	1932.00	3864.00	1307.20	3239.20	0.18

SUM = 0.18 feet
2.17 inches

Multiple Layers - 3 Feet Thick

Embankment and Silty Clay Unit Weight: **120 pcf**

Location	H (ft)	Mid Pt. (ft)	Cr	Cc	e	Po (psf)	Pc (psf)	ΔP(psf)	Pf = Po+ΔP	ΔH
Stratum 1	3	1.5	0.04	0.21	0.6	180.00	2500.00	1307.20	1487.20	0.07
	3	4.5	0.04	0.21	0.6	540.00	2500.00	1307.20	1847.20	0.04
	3	7.5	0.04	0.21	0.6	900.00	2500.00	1307.20	2207.20	0.03
	3	10.5	0.04	0.21	0.6	1260.00	2500.00	1307.20	2567.20	0.03
	3	13.5	0.04	0.21	0.6	1620.00	2500.00	1307.20	2927.20	0.04
	3	16.5	0.04	0.21	0.6	1980.00	3960.00	1307.20	3287.20	0.02
	3	19.5	0.04	0.21	0.6	2340.00	4680.00	1307.20	3647.20	0.01
	3	22.5	0.04	0.21	0.6	2700.00	5400.00	1307.20	4007.20	0.01
	3	25.5	0.04	0.21	0.6	3060.00	6120.00	1307.20	4367.20	0.01
	3	28.5	0.04	0.21	0.6	3420.00	6840.00	1307.20	4727.20	0.01
	2.2	30.7	0.04	0.21	0.6	3684.00	7368.00	1307.20	4991.20	0.01
	32.2									

SUM = 0.28 feet
3.35 inches

HAM-71-6.86
Settlement Calculations for Station 462+00

5.7 Embankment
17.5 ft Stratum 1 (Silty Clay)

Nearest Boring
B-035-0-15

$$If\ Po + \Delta P \leq Pc: \quad S = \frac{C_r * H}{1 + e_0} \log\left(\frac{P_o + \Delta P}{P_o}\right)$$

$$If\ Po + \Delta P > Pc: \quad S = \frac{C_r H}{1 + e_0} \log\left(\frac{P_c}{P_o}\right) + \frac{C_c H}{1 + e_0} \log\left(\frac{P_o + \Delta P}{P_c}\right)$$

Boring B-030-0-15

Embankment Crest Elev.	640.70	ft
Bottom of Adidtional Fill	635.00	ft
Stratum 1 Bottom Elev.	617.50	ft

Whole Layer Settlement

Embankment and Silty Clay Unit Weight: **120 pcf**

Layer	H (ft)	Mid Pt. (ft)	Cr	Cc	e	Po (psf)	Pc (psf)	ΔP(psf)	Pf = Po+ΔP	ΔH
Stratum 1	17.50	8.75	0.04	0.22	0.6	1050.00	2100.00	934.00	1984.00	0.12

SUM = 0.12 feet
1.45 inches

Multiple Layers - 3 Feet Thick

Embankment and Silty Clay Unit Weight: **120 pcf**

Location	H (ft)	Mid Pt. (ft)	Cr	Cc	e	Po (psf)	Pc (psf)	ΔP(psf)	Pf = Po+ΔP	ΔH
Stratum 1	3	1.5	0.04	0.22	0.6	180.00	2500.00	934.00	1114.00	0.06
	3	4.5	0.04	0.22	0.6	540.00	2500.00	934.00	1474.00	0.03
	3	7.5	0.04	0.22	0.6	900.00	2500.00	934.00	1834.00	0.02
	3	10.5	0.04	0.22	0.6	1260.00	2500.00	934.00	2194.00	0.02
	3	13.5	0.04	0.22	0.6	1620.00	2500.00	934.00	2554.00	0.02
	2.5	16	0.04	0.22	0.6	1920.00	3840.00	934.00	2854.00	0.01
	17.5									

SUM = 0.16 feet
1.94 inches

APPENDIX H
ENGINEERING DESIGN CHECKLISTS

III.A. Centerline Cuts Checklist

C-R-S: HAM-71-6.86	PID: 94741	Reviewer: R. Lopina	Date: 8/15/2016

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

Soil Cuts			
[Y] N X	1	Does drilling provide continuous stratigraphic sections for the range of elevations that represent proposed cut slope areas?	
[Y] N X	2	Do the cut slopes have a minimum stability F.S. of 1.30 and are not steeper than 2:1?	
		Check stability calculation method used:	
		■ GSTABL7 or equivalent software	GeoStudio SLOPE/W
		□ hand calculations	
Y N [X]	3	If there is a "red bed" or other historically unstable soil or rock layer through the cut slopes, was this layer considered as a possible failure zone?	
Y N [X]	4	Have erosion protection measures been addressed for backslopes, side slopes, and ditches (including riprap recommendations or special slope treatments)?	
Y N [X]	5	Have issues related to any special usage of excavated soils been addressed?	
	6	If the cut is not completely above the water table,	
Y N [X]		a Did the design consider the construction or long term ramifications of cutting below the water table?	
Y N [X]		b Did the design consider additional drainage in the cut slope (springs / seeps) and roadway base?	
Rock Slopes			
		For rockfall and additional design considerations, see the "Rockfall Corrections Checklist."	
Y N [X]	7	Has the subsurface exploration adequately characterized the rock in accordance with the Geotechnical Bulletin 3: Rock Cut Slope and Catchment Design (GB 3)?	
Y N [X]	8	Have the slope angles, benching scheme, rockfall catchment design, and drainage controls been determined as prescribed in GB 3?	
Y N [X]	9	In accordance with GB 3, are the rock cut slopes, benches, and catchment areas indicated on all appropriate cross-sections?	

III.A. Centerline Cuts Checklist

Y N [X]	10	In accordance with GB 3, has the rockfall catchment software analysis output and the cost analysis comparing catchment configurations been provided?	

Notes:

Stage 1:

III.B. Embankments Checklist

C-R-S: HAM-71-6.86	PID: 94741	Reviewer: R. Lopina	Date: 8/15/2016

Settlement

Y N [X] 1	If soil conditions and project requirements warrant, have settlement issues been addressed?		
	If not applicable (X), go to Question **14**		
Y N X 2	Have consolidation properties of the foundation soils been determined?		
	Check methods used:		
	□ laboratory consolidation tests		
	□ empirical correlations with moisture content and Atterberg values		
	□ other		
Y N X 3	Have calculations been performed to estimate the total expected embankment settlement and the time of consolidation?		
	Check method used:		
	□ EMBANK or equivalent software		
	□ hand calculations		
Y N X 4	If differing foundation soil and/or loading conditions occur throughout the embankment area, have sufficient analyses been completed to evaluate consolidation at locations representative of the most critical conditions?		
Y N X 5	Have the total settlement and the time of consolidation analyses indicated acceptable values at all locations for the scope of the embankment work?		
Y N X 6	If total settlement or time of consolidation is unacceptable, have the stations and lateral extent of the problem areas been defined?		
Y N X 7	Has a method been chosen as a solution to the settlement issues?		
	Check methods used:		
	□ waiting periods with monitoring		
	□ drainage blanket and wick drains		
	□ surcharge (preloading)		
	□ removal and replacement of weak soil		
	□ lowering proposed grade / change alignment		
	□ lightweight fill		
	□ other List Other items:		

III.B. Embankments Checklist

Y	N	X	8	Based on accepted design practices, and where applicable, adhering to published guidelines and design recommendations from FHWA, have calculations been performed to evaluate the effectiveness of the chosen solution(s)?	
Y	N	X	9	Has an economic analysis been performed to evaluate the cost benefits of the recommended solution compared to others?	
Y	N	X	10	Have all necessary notes, specifications, and details for the chosen solution been determined?	
Y	N	X	11	Have the need, locations, type, plan notes, and reading schedule for settlement platforms been determined?	
Y	N	X	12	Have the effects of the predicted settlement and the chosen solution been determined and accounted for on the construction schedule?	
Y	N	X	13	Has the effect of any foundation soil consolidation (including differential settlement) been evaluated with regard to adjacent structures (e.g., bridges, buildings, culverts, utilities) which will also undergo settlement and be subject to stresses induced by the consolidation of the surrounding soil?	

Notes :

Stage 1:

III.B. Embankments Checklist

Stability		
[Y] N X	14 If soil conditions and project requirements warrant, have stability issues been addressed? If not applicable (X), go to Question **29**	
[Y] N X	15 Has the total (short term) and effective (long term) shear strength of the foundation soils been determined? Check method used: ■ laboratory shear tests ■ estimation from SPT or field tests	
[Y] N X	16 Have the values of shear strength for proposed embankment fill material, as determined from Geotechnical Bulletin 6 Shear Strength of Proposed Embankments (GB 6), been used in the stability analyses?	
[Y] N X	17 Have calculations been performed to determine the F.S. for stability? Check method used: ■ GSTABL7, or equivalent software □ hand calculations	
	18 Have the following F.S. been met or exceeded, as determined by the calculations, for the given stability conditions:	
[Y] N X	a 1.30 for short term condition	
[Y] N X	b 1.30 for long term condition	
Y N [X]	c 1.10 for rapid drawdown, flood condition	
Y N [X]	d 1.50 for embankment supporting bridge abutments (not on deep foundations)	
[Y] N X	19 When differing soil or loading conditions occur throughout the embankment area, have sufficient analyses been completed to evaluate the stability at locations representative of the most critical conditions?	
Y N [X]	20 If the F.S. was not met or exceeded, have the stations and lateral extent of the problem areas been defined?	
Y N [X]	21 Has a method been chosen as a solution to the stability issues? Check the method(s) used: □ flattening slopes □ counterberm	

III.B. Embankments Checklist

				□ lightweight embankment □ reinforced soil slope □ soil nailing □ drainage blanket and wick drains □ removal of soft soil, adding shear key □ reduced grade / change alignment □ stage construction □ controlled rate of fill placement □ drilled shaft slope stabilization □ other List Other items:	
Y	N	X	22	Based on accepted design practices, and where applicable, adhering to published guidelines and design recommendations from FHWA, have calculations been performed to evaluate the effectiveness of the chosen solution(s)?	
Y	N	X	23	Has an economic analysis been performed to evaluate the cost benefits of the recommended solution compared to others?	
Y	N	X	24	Have all necessary notes, specifications, and details for the chosen solution been determined?	
Y	N	X	25	Have the need, location, type, plan notes, and reading schedule for piezometers and inclinometers been determined?	
Y	N	X	26	If piezometers will be used, has the critical pressure value been determined and the appropriate information included in the plans?	
Y	N	X	27	Have the effects of the stability solution been determined and accounted for on the construction schedule?	
Y	N	X	28	Has the effect of the stability solution been evaluated with regard to structures (e.g., bridges, buildings, culverts, utilities) which may be subject to unusual stresses or require special construction considerations?	

Notes:

Stage 1:

III.B. Embankments Checklist

Sidehill Fills					
[Y]	N	X	29	If soil conditions and project requirements warrant, have sidehill fill issues been addressed? If not applicable (X), go to Question **34**	
[Y]	N	X	30	In accordance with Geotechnical Bulletin 2: Special Benching and Sidehill Embankment Fills (GB 2), have sidehill fills been evaluated to determine if special benching or shear keys are needed?	
			31	In accordance with GB 2, if special benching or shear keys are required, has	
Y	N	[X]		a Plan Note G110 from L&D3 been included in the General Notes?	
Y	[N]	X		b quantities for both excavation and embankment been calculated for the benched areas and added to the plan General Quantities?	Not in scope
[Y]	N	X		c the special benching or shear keys been indicated on the appropriate cross sections?	
Y	N	[X]	32	Have water bearing zones been identified and their impact addressed?	Not applicable
Y	N	[X]	33	Have subsurface drainage controls been adequately addressed?	Not in scope

Notes:

Stage 1:

III.B. Embankments Checklist

Special			
Y N [X]	34	Have all of the environmental factors, including wetlands, stream mitigation, and landfills, been considered and incorporated prior to design and analysis of embankment settlement and stability, including EPA or other government agencies' involvement, mitigation, or special design or construction considerations?	Not in scope
	35	If an embankment is to be placed through standing water or over weak, wet soils (with or without a fabric separator), the fill should be placed by the method of end dumping to a given height above the standing water or until compaction is achievable over the soft soil. If end dumping is to be specified,	
Y N [X]		a has the material type for the fill to be end dumped been specified?	
Y N [X]		b has the need for a fabric separator or filter layer been determined?	
Y N [X]		c has the height of fill to be end dumped been determined?	
Y N [X]		d have all notes and specifications for end dumping been developed?	

Notes:

Stage 1:

III.C. Subgrade Checklist

C-R-S: HAM-71-6.86	PID: 94741	Reviewer: R. Lopina	Date: 8/15/2016

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

[Y] N X 1	Has the subsurface investigation adequately characterized the soil or rock according to Geotechnical Bulletin 1: Plan Subgrades (GB1)?	
[Y] N X 2	If soils classified as A-2-5, A-4b, A-5, A-7-5, A-8a, or A-8b, or having a LL>65, are present at the proposed subgrade (soil profile), do the plans specify that these materials need to be removed and replaced or chemically stabilized?	
Y N [X]	a If these materials are to be removed and replaced, have the station limits, depth, and lateral limits for the planned removal been provided?	Materials to be chemically stabilized
Y N [X] 3	If there is any rock, shale, or coal present at the proposed subgrade (CMS 204.05), do the plans specify the removal of the material?	
Y N [X]	a If removal of any rock, shale, or coal is required, have the station limits, depth, and lateral limits for the planned removal of the material at proposed subgrade been provided?	
[Y] N X 4	In accordance with GB1, do the SPT values and existing moisture contents for the proposed subgrade soils indicate the need for subgrade stabilization?	
Y N [X]	a If removal and replacement is applicable, has the detail of subgrade removal been shown on the plans, including depth of removal, station limits, lateral extent, replacement material, and plan notes (Item 204 – Subgrade Compaction and Proof Rolling)?	
Y [N] X	b If chemical stabilization is applicable, has the detail of this treatment been shown on the plans, including depth, percentage of chemical, station limits, lateral extent, and plan notes? Indicate type of subgrade treatment specified: □ cement treatment □ lime treatment □ lime kiln dust □ other	Depth and extent have been recommended Percentage of chemical and chemical type not in scope
Y N X 5	If drainage or groundwater is an issue with the proposed subgrade, has an appropriate drainage system (e.g., pipe, underdrains) been provided?	
Y N [X] 6	Has an appropriate quantity of Proof Rolling been included in the plans (CMS 204.06)?	
[Y] N X 7	Has a design CBR value been provided?	

III.C. Subgrade Checklist

Notes:

Stage 1:

IV.A Foundations/Structures - Non-bridge Applications

C-R-S: HAM-71-6.86	PID: 94741	Reviewer: R. Lopina	Date: 8/15/2016

If you do not have such a foundation or structure on the project, you do not have to fill out this checklist.

Soil and Bedrock Strength Data					
[Y]	N	X	1	Has the shear strength of the foundation soils been determined? Check method used: □ laboratory shear tests ■ estimation from SPT or field tests	
[Y]	N	X	2	Have sufficient soil shear strength, consolidation, and other parameters been determined so that the required allowable loads for the foundation/structure can be designed?	
Y	N	[X]	3	Has the shear strength of the foundation bedrock been determined? Check method used: □ laboratory shear tests □ other List Other items:	Bedrock not encountered

Notes:

Stage 1:

IV.A Foundations/Structures - Non-bridge Applications

Spread Footings					
[Y]	N		4	Are there spread footings on the project? If no, go to Question **11**	Culvert extension
[Y]	N	X	5	Has the recommended bottom of footing elevation and reason for this recommendation been provided?	
Y	N	[X]		a Has the recommended bottom of footing elevation taken scour from streams or other water flow into account?	
			6	Were representative sections analyzed for the entire length of the structure for the following:	
Y	N	[X]		a bearing capacity?	
Y	N	[X]		b sliding?	
Y	N	[X]		c overturning?	
Y	N	[X]		d settlement?	
Y	N	[X]	7	Has the need for a shear key been evaluated?	
Y	N	[X]		a If needed, have the details been included in the plans?	
Y	N	[X]	8	If special conditions exist (e.g. geometry, sloping rock, varying soil conditions), was the bottom of footing “stepped” to accommodate them?	
[Y]	N	X	9	Has the recommended allowable soil or rock bearing pressure been provided?	
Y	N	[X]	10	If weak soil is present at the proposed foundation level, has the removal / treatment of this soil been developed and included in the plans?	
Y	N	[X]		a Have the procedure and quantities related to this removal / treatment been included in the plans?	

Notes:

Stage 1:

IV.A Foundations/Structures - Non-bridge Applications

Pile Structures				
Y [N]		11	Are there piles on the project? If no, go to Question **17**	
Y N		12	Has an appropriate pile type been selected? Check the type selected: □ H-pile (driven) □ H-pile (drilled) □ Cast In-place Concrete □ other List Other items:	
Y N	X	13	Have the estimated pile length or tip elevation and section (diameter) been specified? Check method used: □ SPILE, DRIVEN, or equivalent software □ hand calculations	
		14	If required for design, have sufficient soil parameters been provided and calculations performed to evaluate the:	
Y N	X		a Lateral load capacity and maximum deflection of the piles?	
Y N	X		b Vertical load capacity and maximum settlement of the piles?	
Y N	X		c Negative skin friction on piles driven through new embankment or soft foundation layers?	
Y N	X		d Potential for and impact of lateral squeeze from soft foundation soils?	
Y N	X	15	If piles are to be driven to bedrock, have “pile points” been recommended to assure secure contact with the rock surface, as per BDM 202.2.3.2.a?	
Y N	X	16	If subsurface obstacles exist, has preboring been recommended to avoid these obstructions?	

Notes:

Stage 1:

IV.A Foundations/Structures - Non-bridge Applications

Drilled Shafts					
[Y]	N		17	Are there drilled shafts on the project? If no, go to the next checklist.	Drilled shafts for noise barriers
Y	[N]	X	18	Have the drilled shaft diameter and embedment length been specified?	Drilled shafts to be designed according to 2007 ODOT BDM for noise barriers
Y	[N]	X	19	Have the recommended drilled shaft diameter and embedment been developed based on side friction and end bearing for vertical loading situations?	Drilled shafts to be designed according to 2007 ODOT BDM for noise barriers
			20	For shafts undergoing lateral loading, have the following been determined:	
Y	N	[X]		a. maximum lateral shear	
Y	N	X		b. maximum bending moment	
Y	N	X		c. maximum deflection	
Y	N	X		d. reinforcement design	
Y	N	[X]	21	Generally, bedrock sockets are 6" smaller in diameter than the soil embedment section of the drilled shaft. Has this factor been accounted for in the drilled shaft design?	
Y	N	[X]	22	If a bedrock socket is required below soil embedment, have separate quantities been estimated based on shaft diameters and materials to be excavated?	
[Y]	N	X	23	Has the site been assessed for groundwater influence?	No groundwater encountered
Y	N	[X]		a If yes, if artesian flow is a potential concern, does the design address control of groundwater flow during construction?	
Y	N	[X]	24	If special construction features (e.g., slurry, casing, load tests) are required, have all the proper items been included in the plans?	

Notes:

Stage 1

IV.B. Retaining Wall Checklist

C-R-S: HAM-71-6.86	PID: 94741	Reviewer: R. Lopina	Date: 8/15/2016

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

Soil Data and Preliminary Calculations		
Y N [X] 1	Has a justification study been performed to determine the necessity of a wall as opposed to ROW purchase or other project alternatives?	
[Y] N X 2	Have the necessary soil strength parameters and unit weights been determined?	
	Check method used:	
	■ laboratory shear tests	
	■ estimation from SPT or field tests	
Y N [X] 3	Has the groundwater elevation been determined?	
[Y] N X 4	Have the proper loading conditions been determined?	
	a If yes, check which loading conditions apply:	
	Backfill: □ flat or ■ sloped	
	Surcharge: ■ yes or □ no	Traffic live load
Y N [X] 5	If applicable, has the influence of groundwater been taken into account with regards to soil unit weights and active pressures?	
Y N [X] 6	Has the Coulomb method been utilized to determine the lateral earth pressure?	

Notes:

IV.B. Retaining Wall Checklist

Design					
[Y]	N	X	7	For preliminary wall design, has the design criteria and wall type selection process been followed as instructed in BDM 204.6?	
Y	N	[X]	8	Was an economic analysis performed to evaluate the cost benefits of the chosen wall type compared to others?	
[Y]	N	X	9	Have all the required F.S. been calculated?	
				a Do the F.S. meet or exceed the minimums listed below (for non-proprietary walls):	
[Y]	N	X		Bearing Capacity (minimum F.S. = 3.0)	
[Y]	N	X		External Stability (minimum F.S. = 1.3 when not supporting abutments)	
[Y]	N	X		Overturning (minimum F.S. = 2.00)	
[Y]	N	X		Sliding (minimum F.S. = 1.50)	
			10	If poor foundation soils are present, has a solution been determined with respect to the following:	
Y	N	[X]		a excessive settlement?	
Y	N	[X]		b inadequate bearing capacity?	
Y	N	[X]		c sliding?	
Y	N	[X]		d global stability?	
			11	For non-proprietary walls, each wall type has design recommendations which need to be determined. For the wall type being evaluated, have the following design recommendations been determined by accepted design methods or, where applicable, FHWA design guidelines:	
Y	N	[X]		a Cantilever, Gravity - footing width, allowable bearing capacity (BDM 204 & 303.4)	
Y	N	[X]		b Cellular - type, bearing pressure, fill material	
Y	N	[X]		c Drilled H-Pile - type, embedment, spacing, lagging, maximum moment, section modulus, maximum deflection	
Y	N	[X]		d Drilled Shafts - diameter, embedment, spacing, maximum moment, maximum deflection (see BDM 303.4.3)	
Y	N	[X]		e H-pile Lagging - pile size, embedment, lagging design, spacing, facing, maximum deflection	
Y	N	[X]		f Sheet Pile - embedment, section modulus, maximum deflection	

IV.B. Retaining Wall Checklist

[Y] N X		g Soil Nailing - spacing, loading per nail, facing, embedment	
Y N [X]		h Tieback - load per tieback, number of rows, wale design, type of anchor	
Y N [X]	12	Proprietary wall designs require a special process for detail design, as outlined in BDM 303.5. Has this procedure been followed for this project?	
	13	The presence and quality of water behind the wall structure and in the backfill can be a major source of overloading and failure.	
Y N [X]		a Has the quality / chemistry of the groundwater been accounted for in the drainage system?	
Y N [X]		b Has an adequate drainage system been included in the detail wall design?	
Y N [X]		c If there is a water source behind the wall, has additional drainage been added to control the effect of this water source on the wall?	
Y N [X]	14	Have the effects of the wall design and construction procedure been determined and accounted for on the construction schedule?	
[Y] N X	15	Has the effect of the wall design and construction been evaluated with regard to structures (e.g., culverts, utilities), which may be subject to unusual stresses or require special design or construction considerations?	Existing bridge abutment piles

Notes:

IV.B. Retaining Wall Checklist

Plans and Contract Documents		
Y N [X] 16	Have all the necessary notes, specifications, special provisions, and details for the construction of the wall system been included in the plans?	Not in scope
Y N [X] 17	Has the need, location, type, plan notes, and reading schedule for any instrumentation been determined and included in the plans? Check the types of instrumentation specified: □ inclinometers □ strain gages □ load cells □ settlement platforms □ monitoring wells / piezometers □ other List other items:	Not in scope

Notes:

VI.A. Soil Profile Checklist

C-R-S: HAM-71-6.86	PID: 94741	Reviewer: E. Kistner	Date: 5/23/2017

General Presentation		
[Y] N X 1	Has a paper copy and electronic copy of all geotechnical submissions been provided to the District Geotechnical Engineer (DGE)?	
[Y] N X 2	Has the geotechnical specification (title and date) under which the work was performed been clearly identified on every submission (reports, plans, etc.)?	
[Y] N X 3	Has the first complete version of all documents being submitted been labeled as 'Draft'?	
[Y] N X 4	Subsequent to ODOT's review and approval, has the complete version of the revised documents being submitted been labeled as 'Final'?	
Y N [X] 5	Have the electronic copies of the final geotechnical plan sheets been submitted as TIFF images?	
[Y] N X 6	If the project includes structures, have all structure explorations been presented in the Soil Profile? (Do not create separate Structure Foundation Exploration Sheets)	
[Y] N X 7	Have the plan sheets been prepared using the size, lettering, format, file management, and CADD standards as prescribed in the applicable sections of the ODOT CADD Engineering Standards Manual?	
[Y] N X 8	Has a scale of 1"=1' been used for cover sheets and laboratory test data sheets?	
[Y] N X 9	Based on the project length, has the correct horizontal scale been used to plot the project data? Check scale used: □ 1" = 20', 30', 40', or 50' for projects 1500' or less (use largest scale appropriate to present entire plan on one sheet) ■ 1" = 50' projects greater than 1500'	
[Y] N X 10	Has a scale of 1" = 10' been utilized for the vertical scale of the project data?	
[Y] N X 11	Have the cross-sections been plotted at a scale of 1" = 10' (preferred) or 1" = 20' (for higher or wider slopes)?	

VI.A. Soil Profile Checklist

Cover Sheet			
		12	Has the following general information been provided on the cover sheet
Y	N X		a. Brief description of the project, including the bridge number of each bridge involved in the plan set, if any?
Y	N X		b. Brief presentation of geological and topographical information? Include comments on structure and pavement conditions.
Y	N X		c. Brief presentation of boring and sampling methods? Include date of last calibration and drill rod energy ratio as a percent for the hammer systems used.
Y	N X		d. Summary of general soil, bedrock, and groundwater conditions, including a generalized interpretation of findings?
Y	N X		e. Statement of where original drawings and data may be inspected?
Y	N X		f. Statement of where soil or rock samples may be inspected, if applicable?
Y	N X		g. Initials of personnel and dates they performed field reconnaissance, subsurface exploration and preparation of the soil profile?
Y	N X	13	Has a Legend been provided?
		14	Have the following items been included in the Legend:
Y	N X		a. Symbols and usual descriptions for only the soil and bedrock types presented in the Soil Profile, as per the Soil and Rock Symbology Chart in Appendix D of the SGE?
Y	N X		b. All miscellaneous symbols and acronyms, used on any of the sheets, defined?
Y	N X		c. The number of soil samples for each classification that were mechanically classified and visually described in the current exploration?
Y	N X	15	Has a Location Map, showing the beginning and end stations for the project, been shown on the cover sheet, sized per the L&D Manual?
Y	N X	16	Have the station limits for each plan and profile sheet for projects with multiple alignments, or greater than 1500', been identified in a table?

VI.A. Soil Profile Checklist

[Y] N X	17	Have the station limits for any cross section sheets been identified in the same table?
[Y] N X	18	Has a summary table of test data for all roadway and subgrade boring samples been shown?
Y N [X]	19	If sampling and testing for a scour analysis was performed, has this data been shown in tabular form?
[Y] N X	20	If borings from previous subsurface explorations are being used, has that data been shown in a separate table?
[Y] N X	21	In the summary table, has the data been displayed by roadway and subgrade boring in ascending stationing order for each roadway?
[Y] N X	22	Have the centerline or baseline station, offset, and exploration identification number been provided for each boring presented in the table?
	23	For each sample, has the following information been provided in the summary table:
[Y] N X		a. Sample depth interval?
[Y] N X		b. Sample number and type (other than split spoon)?
[Y] N X		c. Percent recovery?
[Y] N X		d. Percentage of aggregate, coarse sand, fine sand, silt, and clay size particles?
[Y] N X		e. Liquid limit, plastic limit, plasticity index, and water content, all rounded to the nearest percent or whole number?
[Y] N X		f. ODOT classification, and Group Index?
[Y] N X		g. Visual description of samples not mechanically classified, including water content, and estimated ODOT classification with 'Visual' in parentheses?
[Y] N X	24	Have all undisturbed test results been displayed in graphical format on the sheet prior to the plan and profile sheets?

Placed at end

VI.A. Soil Profile Checklist

Surface Data					
			25	Has the following information been shown in a roadway plan drawing:	
☒	N	X		a Existing surface features described in Section 702.5.1?	
☒	N	X		b Proposed construction items, as described in Section 702.5.2?	
☒	N	X		c Project and historic boring locations, with appropriate exploration targets and exploration identification numbers?	
☒	N	X		d Notes regarding observations not readily shown by drawings?	
☒	N	X	26	Have the existing ground surface contours been presented?	
☒	N	X	27	If cross sections are to be developed for stationing covered on a plan sheet, has an index for the appropriate cross section sheets been included on the plan sheet?	
Subsurface Data					
☒	N	X	28	Has all the subsurface data been presented in the form of a profile along the centerline or baseline, and on cross sections where applicable?	
			29	Have the graphical boring logs been correctly shown, as follows:	
☒	N	X		a. Location and depth of boring indicated by a heavy dashed vertical line?	
☒	N	X		b. Exploration identification number above the boring?	
☒	N	X		c. Logs indicate soil and bedrock layers with symbols 0.4” wide and centered on the heavy dashed vertical line where possible?	
☒	N	X		d. Bedrock exposures with 0.4” wide symbols, but without a heavy dashed vertical line?	
☒	N	X		e. Soil and bedrock symbols as per ODOT Soil and Rock Symbology chart (SGE - Appendix D)?	
☒	N	X		f. Historical borings shown in same manner with the exploration identification number above the boring?	
☒	N	X	30	Have the proposed groundline and existing groundline been shown on the profile view, according to ODOT CADD standards?	

VI.A. Soil Profile Checklist

[Y] N X	31	Have the offsets from centerline or baseline been indicated above the borings in the profile view?
[Y] N X	32	Have borings located immediately adjacent to the centerline or baseline and considered representative of centerline or baseline subsurface conditions been referenced directly to the centerline or baseline?
[Y] N X	33	Have offset borings in or near the same elevation interval of a centerline or baseline boring been plotted either on a cross section or immediately above or below the centerline boring in a box containing an elevation scale?
[Y] N X	34	Have cross-sections been developed to show subsurface conditions disclosed by a series of borings drilled transverse to centerline or baseline?
[Y] N X	35	Have the existing and proposed groundlines been displayed on cross section sheets according to ODOT CADD standards?
Y N [X]	36	Have bedrock exposures shown on the cross sections been plotted along the contour of the cross section?
	37	Has the following information been provided adjacent to the graphical logs or bedrock exposure:
[Y] N X		a. Thickness, to the nearest 0.1', of sod/topsoil or other shallow surface material written above the boring (with corresponding symbology at top of log)?
[Y] N X		b. Moisture content, to nearest whole percent, with the bottom of the text aligned with the bottom of the sample? Label this column as 'WC' at bottom of the boring.
[Y] N X		c. $N_{60,}$ aligned with the bottom of sample? Label column as 'N_{60}' at bottom of boring.
[Y] N X		d. Free water indicated by a horizontal line with a 'w' attached, and static water indicated by a shaded equilateral triangle, point down?
Y N [X]		e. Complete geologic description of each bedrock unit, including unit core loss, unit RQD, SDI, and compressive strength test results? (Do not present geologic descriptions for structure borings for which this information is presented on the boring logs as described in 703.3)
Y N [X]		f. Visual description of any uncontrolled fill or interval not adequately defined by a graphical symbol?

VI.A. Soil Profile Checklist

Y	N	[X]		g. Organic content with modifiers, per 603.5?	
[Y]	N	X		h. Designate a plastic soil with moisture content equal to or greater than the liquid limit minus three with a 1/8" solid black circle adjacent to the moisture content?	
[Y]	N	X		i. Designate a non-plastic soil with moisture content exceeding 25% or exceeding 19% but appearing wet initially, with a 1/8" open circle with a horizontal line through it adjacent to the moisture content?	
[Y]	N	X		j. The reason for discontinuing a boring prior to reaching the planned depth indicated immediately below the boring?	
[Y]	N	X	38	Have the boring logs of all structure borings and any roadway borings drilled in the vicinity of the structures been shown on the boring log sheets following the plan and profile sheets? (Create the logs in accordance with 703.3)	

Notes:

VI.D. Geotechnical Reports

C-R-S: HAM-71-6.86	PID: 94741	Reviewer: E. Kistner	Date: 5/23/2017

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

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

VI.D. Geotechnical Reports

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

Notes: