Stantec

Report of Geotechnical Exploration – Rev2
TN ERFO FS CHRKE804 2020-2(5)

Cherokee National Forest, Tennessee

Citico Creek Road (FSR 35-1) - Ranger District – Tellico

Spring Creek Road (FSR 27) - Ranger District - Ocoee

Prepared for:

U.S. Federal Highway Administration (FHWA)
Eastern Federal Lands Highway Division

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1.0 INTRODUCTION

The United States Department of Transportation, specifically the Federal Highway Administration (FHWA) – Eastern Federal Lands Highway Division, is planning to repair storm and flood damage at two locations in the eastern part of the Cherokee National Forest in Tennessee. The two locations are designated as Spring Creek Road (FS 27) in Polk Co. and Citico Creek Road (FS 35-1) in Monroe Co. The damage along the two locations generally includes downslope landslides and erosion and culvert upgrade/replacement. Figure 1 shows the approximate locations of the damaged areas.

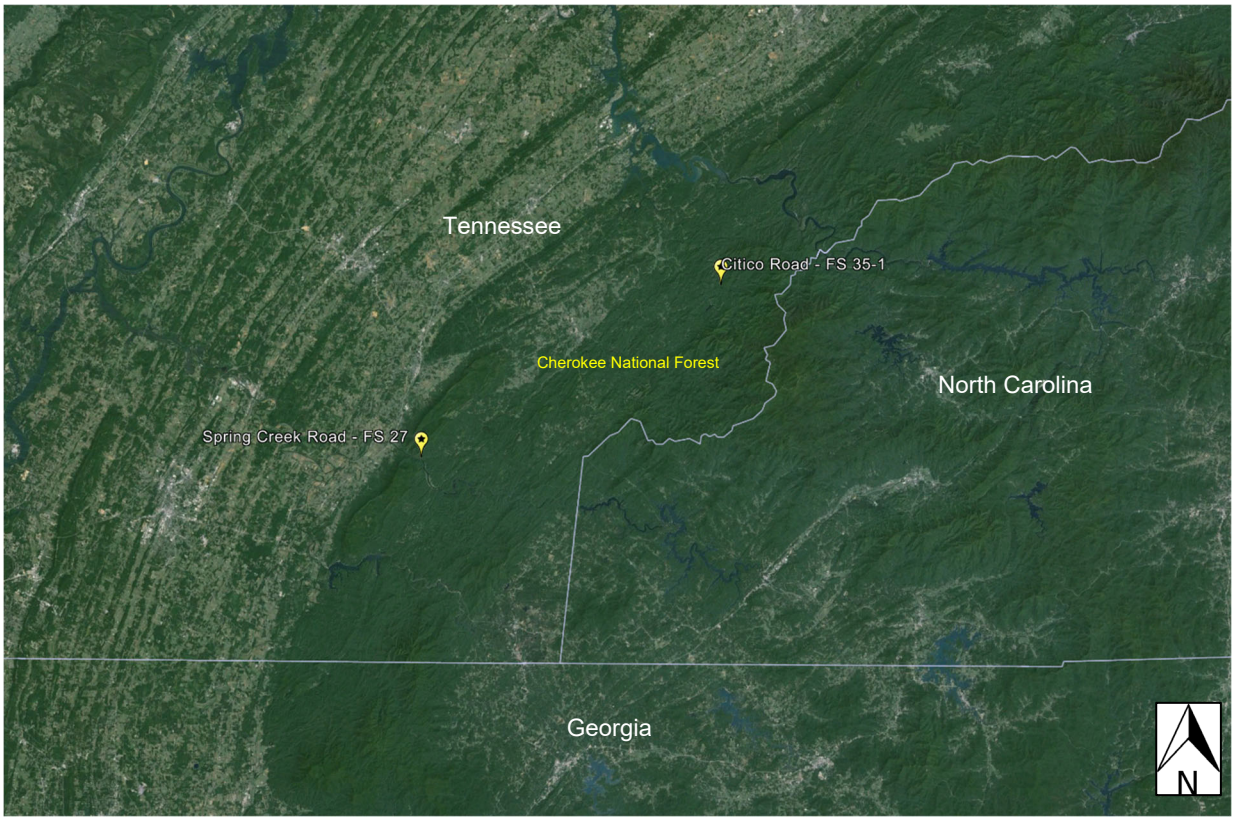

Figure 1. Aerial View
(Google Earth Pro, 2024)

2.0 GEOLOGIC SETTING

The two sites along Citico Creek Road and Spring Creek Road are located in the Unaka Mountains Physiographic Region. The Unaka Mountains are segments of the Blue Ridge and Appalachian Mountain systems. The Unakas have been severely dissected by stream erosion and in general are characterized by steep slopes and deep, narrow valleys that are clothed with hardwood forest. The overburden soils generally consist of relatively thin deposits of alluvial, colluvial, and material weathered from the parent bedrock.

The Geologic Map of Tennessee, East-Central Sheet (Tennessee Department of Conservation, 1966) indicates that the Citico project site is underlain by Precambrian age Wilhite, Shields, and Licklog formations described as follows: Wilhite formation as gray to green siltstone and slate with interbeds of pebble conglomerate, sandstone, and quartzite; Shield Formation as massive conglomerate, sandstone, argillaceous slate; and Licklog Formation as feldspathic sandstone, greenish phyllite, and bluish gray slate. The Spring Creek area is underlain by Precambrian age Sandsuck and Cochran Conglomerate formations described as follows: Sandsuck Formation as olive green and gray, argillaceous, micaceous shale with coarse feldspathic sandstone and quartz-pebble conglomerate; Cochran Conglomerate as Quartz-pebble conglomerate, gray pebbly arkose, siltstone and shale.

According to the Tennessee Landforms website, more than 54,000 sinkholes have been observed in the state, of which over 40 percent are located in the Ridge and Valley Physiographic Region. This region's eastern boundary is located about 1 mile west Spring Creek and 5 miles west Citico project sites.

3.0 SUBSURFACE EXPLORATION PROGRAM

3.1 SUBSURFACE EXPLORATION

Stantec created an exploratory plan that included 19 test borings to depths of about 20 to 30 feet below the existing roadway surface at the specific slide areas. The Tennessee 811 One Call System was contacted by Stantec to locate and clear the public utilities. A Stantec engineer provided oversight during the field exploration. Upon completion of the field work, Stantec surveyed the as drilled locations of the test borings and provided ground surface elevations. From April 16 through 19, 2024, the borings were advanced in general accordance with AASHTO guidelines. Borings were performed with a CME 45 truck-mounted drill rig (811) using 3¼-inch inside diameter (ID) hollow stem augers to advance the borings through the overburden materials. The tested efficiency of the automatic hammer is 87 percent (Appendix B).

3.2 FIELD TESTING AND SAMPLING

Each boring was logged and sampled in the field by a geotechnical engineer. Soils were logged paying particular attention to the soil type, consistency, moisture content, and color. Standard penetration test (SPT) samples were obtained at selected 2½ foot intervals within the upper 20 feet until auger refusal was

reached. The SPT is performed by advancing a 2-inch O.D. split-spoon sampler, in three 6-inch increments, 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 sum of the blow counts from the last two 6-inch increments is called the field N-value. Where auger refusal was encountered, rock coring was performed over a depth of about 5 to 15 feet.

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

The borings were checked for the presence of groundwater during drilling. Groundwater levels were not recorded at completion due to the addition of water during rock coring. The borings were backfilled with soil cuttings upon completion and capped with loose gravel.

3.3 LABORATORY TESTING

The soil and rock samples obtained from the borings were returned to Stantec's geotechnical laboratory for additional laboratory testing. 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 (AASHTO T 88) and Atterberg limits (AASHTO T 89 & T 90). The samples were classified according to the Unified Soil Classification System (USCS) and the American Association of State Highway Transportation Officials (AASHTO) classification method. Moisture Content tests followed ASTM D 2216 and AASHTO T 265 procedures.

Unconfined compression testing was performed samples of rock core strength testing (ASTM D 7012, Method C). Laboratory test results are presented in Appendix C. Tables 1 and 2 represent a summary of soil and rock laboratory test results, respectively.

Table 1. Summary of Soil Laboratory Test Results

Boring No.	Sample Depth (ft)	AASHTO Classification	USCS Classification	MC (%)	Gravel (%)	Sand (%)	Silt/Clay (%)
406	1.0-10.0	A-2-4 (0)	GC	8.7	48.7	37.8	13.5
406	13.5-20	A-4 (0)	SC-SM	29.6	4.9	54.5	40.6
406	21.0-25.0	A-4 (1)	CL-ML	34.3	0.0	42.3	57.7
411	1.0-7.5	A-2-4 (0)	SC	7.9	36.1	42.6	21.3
411	8.5-12.5	A-1-b (0)	SM	13.3	31.1	56.2	12.7
428-A	1.0-7.5	A-1-a (0)	GP-GM	4.1	47.5	43.2	9.3
433	3.5-10.0	A-2-4 (0)	SC-SM	9.7	30.8	51.1	18.1
452	3.5-7.5	A-2-4 (0)	SC-SM	6.8	28.4	53.7	17.9
466-A	1.0-10.0	A-2-4 (0)	SM	13.1	24.0	40.6	35.4
466-A	11.0-15.0	A-5 (1)	SM	29.1	13.7	46.0	40.3

Boring No.	Sample Depth (ft)	AASHTO Classification	USCS Classification	MC (%)	Gravel (%)	Sand (%)	Silt/Clay (%)
466-A	16.0-20.0	A-4 (0)	SM	15.3	7.4	52.0	40.6
466-B	1.0-7.5	A-6 (1)	SM	14.2	27.8	35.1	37.1
466-B	8.5-10.0	A-4 (1)	SM	14.2	3.3	52.0	44.7
466-B	13.5-20.0	A-4 (0)	SM	18.1	0.5	61.1	38.4
469	3.5-7.5	A-1-b (0)	GM	14.7	39.7	35.3	25.0
481-A	1.0-7.5	A-1-a (0)	SC-SM	3.1	35.4	49.6	15.0
481-B	1.0-2.5	A-1-a (0)	SC-SM	3.8	33.1	52.8	14.1
485	0.0-1.5	A-2-4 (0)	GP-GC	7.9	66.9	21.9	11.2
486	1.0-5.0	A-1-a (0)	GP-GC	7.9	58.5	29.9	11.6
487	1.0-5.0	A-2-4 (0)	GP-GC	5.3	57.2	31.9	10.9
487	8.5-12.5	A-1-a (0)	GW-GM	12.9	47.7	43.1	9.2
508	1.0-3.5	A-1-b (0)	SC-SM	3.5	39.8	40.7	19.5
515	1.0-5.0	A-1-a (0)	SW-SM	2.4	32.8	58.6	8.6
518-A	1.0-5.0	A-1-a (0)	GP-GC	3.6	54.4	34.5	11.1
518-B	1.0-5.0	A-2-4 (0)	SC-SM	13.8	37.0	42.1	20.9
518-B	6.0-9.0	A-1-b (0)	GC-GM	12.7	38.4	37.8	23.8
518-B	11.0-17.5	A-1-b (0)	SC-SM	5.9	30.0	53.3	16.7
518-C	1.0-7.5	A-1-b (0)	SC-SM	7.3	31.0	45.5	23.5
518-C	1.0-7.5	A-1-b (0)	SC-SM	7.3	31.0	45.5	23.5

Table 2. Summary of Rock UCS Tests

Boring No.	Sample Depth (ft)	Compressive Strength	
		psi	ksf
411	17.8-18.2	8200	1181
428-B	7.7-8.1	19,480	2805
431	8.1-8.5	19,000	2736
433	13.7-14.1	13,640	1964
452	18.7-19.1	9340	1345
466-A	22.0-22.4	13,230	1905
469	13.3-13.7	10,060	1449
481-A	10.1-10.5	14,560	2097
481-B	9.4-9.8	6080	876
485	8.0-8.4	14,090	2029
486	9.7-4.1	18,130	2611
487	13.1-13.5	16,070	2314
508	5.8-6.2	5460	786
518-A	8.1-8.5	19,600	2822
518-B	20.1-20.5	17,550	2527
518-C	10.9-11.3	18,510	2665
518-C	18.2-18.6	10,820	1558

4.0 SUBSURFACE CONDITIONS

4.1 GENERAL

Due to the steep terrain, which would require clearing and benching and affect the sensitive nature of the surrounding ecosystem, Stantec performed the exploratory activities on the existing roadways. A summary of the borings is presented in Table 3. Exploration locations are shown on the site plans provided in Appendix A and the boring logs are provided in Appendix B.

Table 3. Summary of Boring Locations

General Location	Boring No.	Latitude	Longitude	Ground Surface Elevation (feet)	Explored Depth (feet)
Spring Creek	406	35.2271935	-84.5367807	737.6	25.0
	411	35.2249292	-84.5306409	734.3	20.4
	428-A	35.2231921	-84.5130957	758.9	8.0
	428-B	35.2232098	-84.5131006	759.1	14.2
	431	35.2245684	-84.5069973	765.1	13.2
	433	35.2244383	-84.5039145	777.1	16.3
	452	35.2360103	-84.4920105	821.8	30.4
Citico Creek	466-A	35.3974928	-84.0986871	2053.8	29.8
	466-B	35.3974979	-84.0986199	2055.6	32.0
	469	35.4042798	-84.0910297	1912.2	15.5
	481-A	35.4078652	-84.0826902	1617.9	15.0
	481-B	35.4079827	-84.0826011	1616.3	15.3
	485	35.4106247	-84.0874076	1566.3	14.5
	486	35.4125589	-84.0873614	1519.3	14.6
	487	35.4159338	-84.0891832	1452.8	21.0
	508	35.431403	-84.1044271	1244.7	10.7
	515	35.4474285	-84.1093968	1047.3	29.7
	518-A	35.4506197	-84.1183505	1009.5	19.5
	518-B	35.4505427	-84.1181346	1010.1	21.2
	518-C	35.4504526	-84.1178033	1010.2	20.3

The surface conditions along the roads for Citico and Spring Creeks typically consisted of a crushed aggregate road base.

The subsurface conditions at the sixteen slope/wall and culvert locations generally consisted of varying thicknesses of granular soils overlying relatively shallow rock. Most of the samples tested were of relatively low plasticity (i.e., predominately granular). and classified as SM, SC, SC-SM, SW-SM, GC, GM, GP-GM, GP-GC, GW-GM, and CL-ML under the Unified Soil Classification System (USCS) and as A-2-4(0), A-1-a(0), A-1-b(0), A-4 (0), A-4 (1), A-5(1) and A-6(1) under the AASHTO method. SPT N-values ranged from

0 to over 50 blows per foot. Some of the blow counts and subsequent N-values may be misleading due to the larger particle sizes encountered (i.e., gravel, cobbles, and boulders). Moisture contents of the samples ranged from 0.7 to 36.6 percent with the majority of values between 5 and 15 percent. Corrosivity tests were performed on select soil samples with pH values ranging from 4.0 to 9.0 and soil resistivity values ranging from about 6700 to 23,100 ohms-cm. Typically, a pH value of 4.5 or less or a resistivity value less than 2000 ohms-cm is indicative of an aggressively corrosive environment.

The borings encountered auger refusal at depths of about 2 to 20 feet below the ground surface. Auger refusal is a point in the drilling process where if the driller were to continue drilling then there is a greater chance that significant damage to the augers or the drill rig is likely to occur. Rock coring was generally performed where auger refusal was encountered. Bedrock encountered during rock coring consisted of sandstone, siltstone, limestone, shale, and conglomerate. Rock Quality Designation (RQD) values ranged from 0 to 100 percent with the majority of values between 0 and 50 percent. Unconfined compressive strength tests on select rock core samples ranged from 5460 to 19,600 psi (786 to 2822 ksf).

During the performance of the explorations, groundwater was encountered at depths ranging from 7 to 19.6 feet in nine (9) of the borings performed for this project. Groundwater levels were not taken upon completion of drilling due to the addition of drilling fluids during the coring process. Boreholes were not left open for extended periods of time and were backfilled upon completion of drilling due to their location on the existing roadway and for safety concerns.

4.2 SPRING CREEK

4.2.1 MP/Boring 406

Soil Overburden

The overburden soils at the boring location consisted of loose to medium dense clayey gravel with sand (GC) and silty, clayey sand (SC-SM) to a depth of about 20.5 feet. Underlying the granular soils was very soft to soft sandy, silty clay (CL-ML) extending to a depth of 25 feet below the existing ground surface. Bedrock was not encountered at this boring location.

Groundwater

Groundwater was encountered at 12 feet during exploration activities.

4.2.2 MP/Boring 411

Soil Overburden

The overburden soils at the boring locations consisted of clayey sand with gravel (SC) and silty sand with gravel (SM) extending to a depth of 12.7 feet below the existing ground surface. The relative density of these materials ranged from medium dense to dense. Significant sandstone boulders were encountered below the granular soils to a depth of 20.4 feet.

Auger Refusal

Auger refusal was encountered on an apparent boulder at a depth of about 12.7 feet below the existing ground surface.

Rock Coring

Rock coring was performed from 12.7 to 20.4 feet and encountered sandstone boulders. Unconfined compressive strength of an intact piece of the sandstone was 8200 psi.

Groundwater

Groundwater was encountered at about 8.5 feet during exploration activities.

4.2.3 MP 428 (Borings 428-A, 428-B)

Soil Overburden

The overburden soils at the boring locations consisted of gravel with silt and sand (GP-GM) and silty sand with gravel (SM) extending to depths of 2.5 to 7.5 feet below the existing ground surface. The relative density of these materials ranged from medium dense to dense. Significant boulders were encountered below these materials.

Auger Refusal

Auger refusal was encountered on an apparent boulder at depths of 3.5 and 8 feet below the existing ground surface.

Rock Coring

Rock coring was performed to a depth of 14.2 feet at boring 428-B and encountered shale and sandstone boulders/cobbles. Unconfined compressive strength test of a sample of the sandstone was 19,480 psi.

Groundwater

Groundwater was not encountered during exploration activities.

4.2.4 MP/Boring 431

Soil Overburden

The overburden soils at the boring location consisted of clayey sand with gravel (SC) extending to a depth of 4 feet below the existing ground surface. The relative density of these materials was medium dense. Bedrock was encountered below these materials.

Split Spoon Refusal

Split spoon refusal was encountered in bedrock at a depth of 4.2 feet below the existing ground surface.

Rock Coring

Rock coring was performed to a depth of 13.2 feet below the existing ground surface and encountered limestone with an unconfined compressive strength of 19,000 psi.

Groundwater

No groundwater was encountered during exploration activities.

4.2.5 MP/Boring 433

Soil Overburden

The overburden soils at the boring location consisted of silty, clayey sand with gravel (SC-SM) extending to a depth of 11 feet below the existing ground surface. The relative density of these materials was loose to medium dense. Bedrock was encountered below these materials.

Split Spoon Refusal

Split spoon refusal was encountered in bedrock at a depth of 11 feet below the existing ground surface.

Rock Coring

Rock coring was performed to a depth of 16.3 feet below the existing ground surface and encountered shale with an unconfined compressive strength of 13,640 psi.

Groundwater

Groundwater was encountered at 7.5 feet during exploration activities.

4.2.6 MP/Boring 452

Soil Overburden

The overburden soils at the boring location consisted of silty gravel with sand (GM) and silty, clayey sand with gravel (SC-SM) extending to a depth of 8.5 feet below the existing ground surface. The relative density of these materials was medium dense. Significant boulders were encountered below the overburden soils to a depth of 27.4 feet below the existing ground surface. Bedrock was encountered below these materials.

Auger Refusal

Auger refusal was encountered on boulders at a depth of 9 feet below the existing ground surface.

Rock Coring

Rock coring was performed through the boulder field at depths of 9 feet to 27.4 feet. Bedrock (limestone) coring was performed from 27.4 to 30.4 feet below the existing ground surface. The unconfined compressive strength of the sandstone boulder was 9340 psi.

Groundwater

No groundwater was encountered during exploration activities.

4.3 CITICO CREEK

4.3.1 MP 466 (Borings 466-A, 466-B)

Soil Overburden

The overburden soils at the boring locations consisted of silty sand with varying amounts of gravel (SM) extending to depths of 21 to 23 feet below the existing ground surface. The relative density of these materials was very loose to very dense. Bedrock was encountered below these materials.

Split Spoon Refusal

Split spoon refusal was encountered in bedrock at depths of 21 to 23 feet below the existing ground surface.

Rock Coring

Rock coring was performed to depths of 29.8 to 30.5 feet below the existing ground surface and encountered sandstone and conglomerate. An unconfined compressive strength test of the sandstone was 13,230 psi.

Groundwater

At the two borings, groundwater was encountered at 19 and 19.6 feet during exploration activities.

4.3.2 MP/Boring 469

Soil Overburden

The overburden soils at the boring location consisted of silty sand with gravel (SM) and silty gravel with sand (GM) extending to a depth of 7.5 feet below the existing ground surface. The relative density of these materials was loose to medium dense. Bedrock was encountered below these materials.

Auger Refusal

Auger refusal was encountered in bedrock at a depth of 8 feet below the existing ground surface.

Rock Coring

Rock coring was performed to a depth of 15.5 feet below the existing ground surface and encountered shale. Unconfined compressive strength test of the shale was 10,060 psi.

Groundwater

Groundwater was encountered at 7 feet during exploration activities.

4.3.3 MP 481 (Borings 481-A, 481-B)

Soil Overburden

The overburden soils at the boring locations consisted of silty, clayey sand with gravel (SC-SM) extending to depths of 2.8 to 6 feet below the existing ground surface. The relative density of these materials was medium dense to dense. Bedrock was encountered below these materials.

Auger Refusal

Auger refusal was encountered in bedrock at depths of 3.3 to 6 feet below the existing ground surface.

Rock Coring

Rock coring was performed to depths of 15 to 15.3 feet below the existing ground surface and encountered sandstone. Unconfined compressive strength tests of the sandstone ranged from 6080 to 14,560 psi. Voids were encountered from 6.3 to 7.3 and 8.1 to 9.4 feet at 481-A and 481-B encountered a void from 6 to 8.5 feet.

Groundwater

Groundwater was encountered at 7 feet during exploration activities. Water was observed flowing through voids to the adjacent creek before the exploration/drilling.

4.3.4 MP/Boring 485

Soil Overburden

The overburden soils at the boring location consisted of poorly graded gravel with clay (GP-GC) extending to a depth of 1.5 feet below the existing ground surface. Bedrock was encountered below these materials.

Auger Refusal

Auger refusal was encountered in bedrock at a depth of 2 feet below the existing ground surface.

Rock Coring

Rock coring was performed to a depth of 14.5 feet below the existing ground surface and encountered sandstone. The unconfined compressive strength test of the sandstone was 14,090 psi.

Groundwater

No groundwater was encountered during exploration activities.

4.3.5 MP/Boring 486

Soil Overburden

The overburden soils at the boring location consisted of poorly graded gravel with clay (GP-GC) extending to depth of a 6.5 feet below the existing ground surface. The relative density of these materials was medium dense. Bedrock was encountered below these materials.

Auger Refusal

Auger refusal was encountered in bedrock at a depth of 7.3 feet below the existing ground surface.

Rock Coring

Rock coring was performed to a depth of 14.6 feet below the existing ground surface and encountered limestone. The unconfined compressive strength test of the limestone was 18,130 psi.

Groundwater

No groundwater was encountered during exploration activities.

4.3.6 MP/Boring 487

Soil Overburden

The overburden soils at the boring location consisted of poorly graded gravel with clay and sand (GP-GC) and well graded gravel with silt and sand (GW-GM) extending to a depth of 11.5 feet below the existing ground surface. The relative density of these materials was loose to medium dense. Bedrock was encountered below these materials.

Split Spoon Refusal

Split spoon refusal was encountered in bedrock at a depth of 11.7 feet below the existing ground surface.

Rock Coring

Rock coring was performed to a depth of 21 feet below the existing ground surface and encountered limestone. Unconfined compressive strength test of the limestone was 16,070 psi.

Groundwater

Groundwater was encountered at 11 feet during exploration activities.

4.3.7 MP/Boring 508

Soil Overburden

The overburden soils at the boring location consisted of silty, clayey sand with gravel (SC-SM) extending to a depth of 2.5 feet below the existing ground surface. The relative density of these materials was very dense. Bedrock was encountered below these materials.

Split Spoon Refusal

Split spoon refusal was encountered in bedrock at depths of 2 and 3.5 feet below the existing ground surface.

Rock Coring

Rock coring was performed to a depth of 10.7 feet below the existing ground surface and encountered shale. Unconfined compressive strength test of the shale was 5460 psi.

Groundwater

No groundwater was encountered during exploration activities.

4.3.8 MP/Boring 515

Soil Overburden

The overburden soils at the boring location consisted of well graded sand with silt and gravel (SW-SM) extending to a depth of 4 feet below the existing ground surface. The relative density of these materials was medium dense. Bedrock was encountered below these materials.

Split Spoon Refusal

Split spoon refusal was encountered in bedrock at depths of 4 and 6.5 feet below the existing ground surface.

Rock Coring

Rock coring was performed to a depth of 29.7 feet below the existing ground surface and encountered coal and calcareous and carbonaceous shale.

Groundwater

No groundwater was encountered during exploration activities.

4.3.9 MP 518 (Boring 518-A)

Soil Overburden

The overburden soils at the boring location consisted of poorly graded gravel with clay and sand (GP-GC) extending to depth of 5 feet below the existing ground surface. The relative density of these materials was loose to medium dense. Bedrock was encountered below these materials.

Auger Refusal

Auger refusal was encountered in bedrock at a depth of 5.5 feet below the existing ground surface.

Rock Coring

Rock coring was performed to a depth of 19.5 feet below the existing ground surface and encountered sandstone. The unconfined compressive strength test of the sandstone was 19,600 psi.

Groundwater

No groundwater was encountered during exploration activities.

4.3.10 MP 518-B (Borings 518-B, 518-C)

Soil Overburden

The overburden soils at the boring locations consisted of silty, clayey sand with gravel (SC-SM), clayey sand (SC), and silty, clayey gravel with sand (GC-GM) extending to depths of 6.3 to 9 feet below the existing ground surface. The relative density of these materials was very loose to medium dense. Significant boulders with soil layers were encountered to depths of 11.7 and 18.2 feet below the existing ground surface. The relative density of these materials was very dense. Bedrock was encountered below these materials.

Auger Refusal

Auger refusal was encountered on boulders and in bedrock at depths of 6.3 to 18.2 feet below the existing ground surface.

Rock Coring

Rock coring was performed to depths of 20.3 to 21.2 feet below the existing ground surface and encountered sandstone, sandy siltstone, and sandy shale. Unconfined compressive strength tests of the sandstone ranged from 17,550 to 18,510 psi and 10,820 psi for the sandy shale.

Groundwater

No groundwater was encountered during exploration activities.

5.0 ANALYSIS AND RECOMMENDATIONS

5.1 GENERAL

In February and April of 2020, a series of heavy rain events caused significant roadway damage within the Cherokee National Forest. The damaged roadways reduce/prevent roadway public access into various points of the Cherokee National Forest. Damages include landslides, roadway and shoulder washouts, clogged or damaged culverts, and other miscellaneous conditions. The FHWA has contracted with Stantec to perform geotechnical explorations laboratory testing and provide design recommendations for remediation of the affected areas. Two areas designated as Spring Creek and Citico Creek contain a total of sixteen specific slide and culvert locations.

The geotechnical explorations were performed on the existing roadways above the landslide or culvert. The lack of access to the hillside and downslope areas of the slides, due to safety and environmental concerns, generally limited exploration activities in these areas. Observation of the slopes along the respective alignments and the overall condition of the roadways indicates the adjacent hillsides to be generally stable. From our observations the downhill slope failures do not appear to be significantly impacting the existing roadways, i.e., limited or no distress or apparent cracking in the roadway surface or sinking of the shoulder. From the photographs provided and those taken during exploratory activities it appears that most of the slide activity is erosional or surficial in nature and not a deep-seated failure. 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.

5.2 SEISMIC HAZARD ANALYSIS

The two project areas are mapped generally within or in the vicinity of the East Tennessee Seismic Zone (ETSZ). Most earthquakes in the ETSZ generally occur in the highly tilted and folded rock layers and are thought to originate in the Precambrian basement structures not related to Appalachian orogeny. The ETSZ is located mainly in the Valley and Ridge province of the southern Appalachians and is the second-most seismically active area in the eastern United States, after the New Madrid seismic zone.
The seismic hazard of the ETSZ is difficult to assess, as there is no obvious surface faults found previously except a few recent paleo seismic field surveys, and no recorded historical earthquakes of magnitude greater than 5 (C. Daniels, et al).

In accordance with AASHTO Section 3.10, the overburden soils at the two areas, Spring Creek and Citico Creek, were classified by their stiffness for Site Class. Stantec conducted a review of the soil profile data for the borings completed for this exploration. Using the boring from each area with the deepest overburden profile, Stantec analyzed the soil and bedrock profile using the average Standard Penetration Test (Method B) over the upper 100 feet of profile in accordance with AASHTO Section 3.10.3.1. In general, the soil profile over a depth of about 100 feet consists of layers of granular soils (2 to 23 feet) overlying bedrock. The granular soils were typically loose to very dense. Based on the analyses each of the two areas can be classified as **Site Class D** with the exception of MP 406 which was classified as

Site Class E. Stantec used these site class designations along with the values from the national ground motion maps (PGA, S_s, S_1) to obtain the applicable site factors (F_{pga}, F_a, F_v). Applying the site factors and resulting acceleration coefficients indicates that these sites may be designed within **Seismic Zone 2**.

In accordance with AASHTO 11.5.4.2, a seismic design shall not be considered mandatory for wall located in Seismic Zones 1 through 3 or for walls at sites where the adjusted peak ground acceleration, A_s, is less than or equal to 0.4g, unless one or more of the following is true:

- Liquefaction induced lateral spreading or slope failure, or seismically induced slope failure, due to the presence of sensitive clays that lose strength during the seismic shaking, may impact the stability of the wall for the design earthquake.
- The wall supports another structure that is required, based on the applicable design code or specification for the supported structure, to be designed for seismic loading and poor seismic performance of the wall could impact the seismic performance of that structure.

In addition, a seismic design should be considered for Seismic Zone 2 or higher if the following is greater than 30 ft:

- the exposed wall height plus the average depth over the width of the wall of any soil surcharge present, or
- for tiered walls, the sum of the exposed height of all the tiers plus the average soil surcharge depth.

Based on the criteria listed above, the eight proposed wall/slope sites should not require a seismic design due to an adjusted PGA of 0.23 (< 0.4g), the sites are located in Seismic Zone 2, and the exposed wall heights plus surcharge is less than 30 feet high. Seismic analyses are included in Appendix D.

In accordance with AASHTO 11.6.5.2.1 the seismic horizontal acceleration coefficient (k_h) for computation of seismic lateral earth pressures shall be determined on the basis of the PGA at the ground surface (i.e., $k_{h0} = F_{pga} \cdot PGA = A_s$), assuming zero wall displacement occurs. The vertical acceleration coefficient, k_v, is assumed to be zero for determining lateral earth pressures. From AASHTO 11.6.5.2.2, a wall that is capable of displacement of 1 to 2 inches or more during the design seismic event, k_h may be reduced to $0.5k_{h0}$ without conducting a deformation analysis. The reduction in k_h can also be used to reduce the horizontal seismic forces applied to slope stability. Using a conservative Site Class analysis for Citico Creek the resulting A_s is equal to 0.23. Therefore, the reduced $k_h = 0.5\ A_s = 0.12$ for the slope stability analyses.

5.3 CULVERT AND AOP CROSSINGS

A total of seven major culverts, six along Spring Creek Road and one along Citico Creek Road are planned for replacement. Concrete box culverts (4-sided) are planned for the stream/creek crossings and corrugated aluminum arch culverts are planned for the Aquatic Organism Passage (AOP) crossings. The proposed locations and size of culverts are summarized in the table below.

Table 4. Summary of Culvert Structures

MP Location	Road Crossing	Size & Type	Length (ft)	Slope (%)	Proposed Headwall Height (ft)	Anticipated Subgrade Material
406	Spring Cr.	8'x5' Concrete Box	32.0	6.6	--	Clayey gravel w/sand
411	Spring Cr.	8'x5' Concrete Box	32.0	27.2	5.0	Clayey sand w/gravel, Sandstone boulders
428	Spring Cr.	8'x4' Concrete Box	30.0	11.1	2.0	Gravel w/silt and sand, Sandstone boulders
431	Spring Cr.	4'x4' Concrete Box	22.0	7.1	1.0	Clayey sand w/gravel
433	Spring Cr.	147"x53" Alum. Arch Culvert	24.0	2.8	--	Clayey sand w/gravel
452	Spring Cr.	218"x55" Alum. Arch Culvert	26.0	7.6	--	Clayey sand w/gravel, Sandstone boulders
469	Citico Cr.	8'x4' Concrete Box	24.0	7.5	2.0	Silty gravel w/sand

Based on the conditions encountered, a yielding foundation system is recommended for the culverts. Culverts are assumed to not require separate spread footings, except for the arch AOP structures. Foundation widths for culvert structures are assumed to equal the base width of the structure. Foundations for headwalls should be sized appropriately to resist the sliding, bearing, and lateral loads as necessary. The service limit state should use a resistance factor of 0.33 while the strength and extreme resistance factors used should be 0.45 and 1.0 for the strength and extreme limit state analyses. The table below summarizes the results of the foundation bearing resistance analyses for the proposed culverts.

Table 5. Summary of Culvert Bearing Resistances

MP Location	Road Crossing	Size & Type	Bearing Elevation		Bearing Resistance (ksf)		Coefficient of Friction, (tanδ)
			Inlet	Outlet	Nominal	Factored	
406	Spring Cr.	8'x5' Concrete Box	732.4	730.3	11.7	5.3	0.53

MP Location	Road Crossing	Size & Type	Bearing Elevation		Bearing Resistance (ksf)		Coefficient of Friction, (tanδ)
			Inlet	Outlet	Nominal	Factored	
411	Spring Cr.	8'x5' Concrete Box	729.4	720.7	11.7	5.3	0.53
428	Spring Cr.	8'x4' Concrete Box	755.5	752.2	12.1	5.5	0.55
431	Spring Cr.	4'x4' Concrete Box	763.5	761.9	7.2	3.3	0.55
469	Citico Cr.	8'x4' Concrete Box	1908.0	1906.2	9.6	4.3	0.55

For the two AOP structures (MP 433 and 452), concrete spread footings are anticipated to range from 3 to 5 feet wide. Bearing resistance for a 3-foot-wide footing is provided in the table below. Additional bearing resistances can be provided upon request. Guidance for AOP structures recommends the footings extend down below the lower vertical adjustment potential for scour protection (LVAP). This places the footing base at about 4 to 5 feet below the bottom of the metal arch structure.

Table 6. Summary of AOP Culvert Bearing Resistances

MP Location	Road Crossing	Size & Type	Bearing Elevation		Bearing Resistance 3 ft wide footing (ksf)		Coefficient of Friction, (tanδ)
			Inlet	Outlet	Nominal	Factored	
433	Spring Cr.	147"x60" Alum Arch Culvert	773.0	772.3	9.2	4.1	0.50
452	Spring Cr.	218"x60" Alum Arch Culvert	817.5	815.5	11.1	5.0	0.50

Because the culvert structures will be constructed on a slope the resistance to sliding should also be checked in general accordance with AASHTO Section 10.6.3.4. The coefficient of friction with respect to sliding is provided in the tables above. Bearing resistance analyses are included in Appendix D.

5.4 SLOPE STABILIZATION RECOMMENDATIONS

The issues associated with slope stability occur primarily in the Citico Creek area. Several slope remediation methods were suggested in the provided information for the various sites. These consisted of "hard faced" options such as gabion walls, a rip rap slope, and a rockery wall. Stantec reviewed provided photographs and photos taken during exploratory activities. Several of the proposed slope failures appear to be erosion problems associated with Citico Creek adjacent to the existing roadway.

Table 7. Summary of Proposed Slope Remediation

Embankment Location	Assumed Repair Dimensions (HxL)	Chosen Remediation	Anticipated Bearing Material	Estimated Overburden Thickness (ft)	Elev. Diff – Road to Creek (ft)
MP 466	15'x80'	Reinforced Soil Slope	Silty Sand	21	N/A
MP 481	8'x70'	Special Embankment	Bedrock	4 - 6	4 - 6
MP 485	12'x52'	Geocell	Sand & Gravel	2 - 3	N/A
MP 486	12'x30'	Special Embankment	Bedrock	6.5	7
MP 487	12'x25'	Special Embankment	Gravel w/silt & sand	11.5	6
MP 508	6'x40'	Replace Upper Wire Baskets	Existing gabion-Bedrock	2.5	8+
MP 515	12'x45'	Special Embankment	Coal Layer	4	5-6
MP 518-C	9'x20'	Special Embankment	Boulders	6	11-12
MP 518-B	15'x70	Special Embankment	Boulders	9	11-12
MP 518-C			Boulders	6	11-12

Where possible, mitigation methods were selected/designed so as not to trigger potential 401/404 environmental permit requirements. However, in order to not sacrifice roadway width, the toe of the Special Rock Embankment may encroach upon the edge of the creek at certain locations.

Stantec created several cross sections along the various alignments to evaluate the stability of existing slopes. Based on our visual observations along the roadway the existing soil slopes appear to be relatively stable. Most soil slopes do not appear to be excessively steep (steeper than 1H:1V) and given the relatively shallow depth to bedrock the soil cover is expected to be relatively thin. At several locations bedrock/boulders are exposed at the slope/stream bank surface. Based on the numerous rock outcroppings and boulders visible both up and down slopes and the size and density of foliage, we estimate the overburden soils on most slopes to be approximately 2 to 3 feet thick or less where bedrock is shallow. The overburden soils on slopes are likely residual in nature i.e., weathered from the parent bedrock and similar to what was encountered in the borings.

The Special Rock Embankment is controlled by FP-24, Section 252, Rockery, Special Rock Embankment, and Rock Buttresses. EFLHD Detail E252-01 was used as a guide for determining the preliminary dimensions of the rockfill zone. Certain dimensions such as the offset at the toe and the grade of the rock fill slope were considered impractical due to the confined space between the apparent edge of creek and edge of shoulder of the road. In most cases the maximum toe offset is about 1 foot. At MP481, MP487, MP515, and MP518 the toe of the special rock embankment may encroach on portions

of the creek in order to “reclaim” lost embankment and to maintain the roadway width. Due to the potential for heave at the base of the special rock embankments and the difficulties with dewatering next to the flowing creek, the rock fill embankments were designed to be constructed at the waterline of the creek.

Soil and rock parameters used in the analyses were derived from the laboratory test results and from correlations from FHWA manuals. In addition, Stantec estimated the parameters of the Special Rock Embankment. Coarse rockfill is difficult to characterize by testing. When a material contains cobbles or boulders, it is difficult to obtain representative samples and conduct meaningful tests with conventional laboratory equipment. Large-scale tests reported in the literature provide valuable data on the engineering properties of rockfill (See Figure 2 in Appendix F), but relatively few such tests have been published. However, appropriate properties can be usually selected on the basis of engineering judgment, where that judgment is supported by the performance of similar materials in other projects.

Fortunately, rockfill materials exhibit favorable engineering behavior. If the rockfill is relatively clean (voids between the larger rock particles are open), potential excess pore pressures will quickly dissipate. Interlocking between large, angular pieces of durable rock will result in relatively high shear strength. Satisfactory performance in these materials can usually be demonstrated, even when conservative estimates of strength are used. Based on our review of the available literature and provided the contractor constructs a dense well graded rockfill with strong particles in accordance with FP-24 Section 252, an internal friction angle of 48 degrees was used in our analyses. References are listed in Section 6.

5.4.1 MP 466

The existing slope at MP 466 is at approximately 1.5H to 2H:1V. From provided photographs and photos taken during field exploration minor surface sloughing appears to have occurred. Stantec performed a slope stability analysis of the existing conditions which resulted in a factor of safety of 1.28. With regrading and addition of rip rap to the slope, the factor of safety was 1.3. For the slope at 466-B, the application of seismic horizontal acceleration reduces the factor of safety to below 1.0. Removal and replacement of the existing soils with better quality aggregate does not sufficiently improve the factor of safety. Therefore, ground improvement consisting of a reinforced soil slope is recommended.

The suggested improvement plan consists of excavating the upper loose soils to a depth of about 8 to 9 feet below existing grade (about Elev. 2045 at 466-A and 2046 at 466-B). The base of the excavation should extend approximately 10 feet horizontally into the slope with a 1H:1V backslope. The Contractors responsible person shall make the final determination for the backslope in the field based on the exposed conditions. Using the existing granular soils and a biaxial geogrid with an ultimate tensile capacity of 2000 lbf/ft, reconstruct the 2H:1V slope with alternating layers of geogrid and 18-inch layers of compacted soil. The geogrid should wrap the face of each layer and extend a minimum of 3 feet beneath the next layer. A minimum of 4 inches of compacted soil should separate the 3-foot extension and the next overlying full-length reinforcement layer. The exposed geogrid face on the slope will likely require a filter fabric liner to prevent the loss of soil through the grid. The face of the reinforced slope as well as 5 feet below the reinforced zone should be covered with 12 inches of rip rap. The geogrid reinforcement should

not be left exposed to sunlight. Because of the roadway slope and curve adjacent to the top of the slope, a catchment ditch or some other way to direct surface runoff should be considered. The preliminary reinforced soil slope analysis is provided in Appendix F along with the MSE wall analyses. The final design of the reinforced soil slope (by the contractor's engineer) should also check to make sure that the selected geogrid meets pullout and tensile capacity requirements as outlined in Geotechnical Engineering Circular 11, Vol 2.

5.4.2 MP 481

From provided photographs and photos taken during field exploration minor erosion appears to have occurred at spots along the creek bank. The elevation change from the road to the edge of water is estimated at about 4 to 5 feet and portions of the bank are already armored with boulders and existing rock. To create a rockery wall here would require excavation of the existing boulders and bedrock and would likely infringe upon the existing waterway, thus requiring environmental permitting. We recommend the use of a special rock embankment placed just at/above the water's edge. This is similar to a rockery wall where gravity and friction keep the stacked stones in place. We recommend the slope face roughly match the slopes adjacent to the area being repaired but not be steeper than 1H:1V.

5.4.3 MP 485

At MP 485 the test boring indicates that bedrock is very shallow (at about 1.5 ft) and the provided photographs indicate possible minor surface sloughing of the slope. Creating a retaining wall or rock fill at the proposed 12-foot height would likely require significant rock excavation. We recommend using a geocell product to rebuild and protect the slope after grading has removed the scarp. A geocell solution provides a way to grow and maintain a vegetated slope as steep as 1H:1V. A geocell solution should also reduce the risk of erosion and future slides at this location. Stantec contacted a geocell supplier to determine the feasibility of this technique and provide a preliminary estimate. As geocell products tend to be supplier specific and supplier designed (propriety design), we have included some preliminary information in Appendix G to assist in the decision-making process. We would anticipate that regrading and the application of a "green type" of slope remediation would be more desirable and cost effective than extensive rock excavation. Near the bottom of the geocell system a two-foot-wide rip rap zone should be placed to reduce the risk of erosion at the toe.

5.4.4 MP 486

MP 486 is located along the inside curve of the creek where the erosion forces are the greatest. Based on provided photos, the height of the bank is approximately 7 feet to the water's edge. From the test boring performed in the road, the subsurface consists of about 6.5 feet of granular soils overlying bedrock. From the provided photographs the creek bed is lined with boulders and apparent bedrock. For remediation of the approximately 30 feet stream bank, we recommend a special rock embankment placed just at/above the water's edge. The rock fill is anticipated to bear on bedrock. We recommend the slope face roughly match the slopes adjacent to the area being repaired but not be steeper than 1H:1V.

5.4.5 MP 487

At the location of MP 487 the bank of the creek is eroding, likely due to an eddies pool that forms during high water flow just downstream of a large boulder. Based on provided photos, the height of the bank is approximately 5 to 6 feet to the water's edge. From the test boring performed in the road, the subsurface consists of about 11 feet of granular soils overlying bedrock. From the provided photographs the creek bed is lined with boulders and apparent bedrock. For remediation of the approximately 25 feet stream bank, we recommend a special rock embankment placed just at/above the water's edge. The rock fill is anticipated to bear on granular soils. We recommend the slope face roughly match the slopes adjacent to the area being repaired but not be steeper than 1H:1V. To stabilize the rock fill slope, biaxial geogrid is required within the rock fill due to the weaker anticipated soil subgrade.

5.4.6 MP 508

MP 508 is the approach to a bridge over Spring Creek. The existing approach on the north side of the creek is constructed of a short MSE wire basket framed wall over a gabion wall foundation. Both the MSE wire basket wall and gabion wall appear to be bearing on the existing bedrock. From the provided photographs the maximum wall height is estimated at about 8 feet tall. The photographs also show the existing wire baskets and gabion wall bulging.

We understand that the existing bridge is planned to be replaced in the near future. The existing gabion portion of the wall appears to be functioning adequately. Therefore, we recommend that the upper two layers of MSE wire baskets be removed and replaced with new baskets and fill. This will allow any voids or low spots between the MSE baskets and the gabion foundation to be filled and leveled. No additional analysis was performed for this area. Once the new bridge is designed, we recommend that a new concrete wing wall be included to replace the MSE wire baskets and gabion walls bearing on bedrock.

5.4.7 MP 515

MP 515 is another location where erosion of the creek bank is occurring. Based on provided photos, the height of the bank is approximately 6 to 7 feet to the water's edge. From the test boring performed in the road, the subsurface consists of about 4 feet of granular soils overlying bedrock (coal). From the provided photographs the creek bed is lined with cobbles and boulders and apparent bedrock. For remediation of the approximately 45 feet long stream bank, we recommend a special rock embankment placed just at/above the water's edge. We recommend the slope face roughly match the slopes adjacent to the area being repaired but not be steeper than 1H:1V. To stabilize the rock fill slope, biaxial geogrid is required within the rock fill due to the weaker anticipated coal subgrade.

5.4.8 MP 518-C

MP 518C is a location where erosion of the creek bank has occurred and is threatening the roadway. Based on the provided photos, the height of the bank is approximately 11 to 12 feet to the water's edge. From the test boring performed in the road, the subsurface conditions consist of about 7 feet of granular soil over interbedded boulders and soil overlying bedrock. From the provided photographs the creek bed

is lined with cobbles and boulders and apparent bedrock. For remediation of the approximately 20 feet long stream bank, we recommend a special rock embankment placed just above the water's edge. We recommend the slope face roughly match the slopes adjacent to the area being repaired but not be steeper than 1H:1.1V. To stabilize the rock fill slope, biaxial geogrid is required within the rock fill due to the anticipated weaker boulder and soil subgrade.

5.4.9 MP 518-B & C

MP 518B&C is another location where erosion of the creek bank has occurred and is threatening the roadway. Based on the provided photos, the height of the bank is approximately 11 to 12 feet to the water's edge. From the test borings performed in the road, the subsurface conditions consist of about 7 to 9 feet of granular soils over interbedded soil and boulders overlying bedrock. From the provided photographs the creek bed is lined with cobbles and boulders and apparent bedrock. For remediation of the approximately 70 feet long stream bank, we recommend a special rock embankment placed above the water's edge. We recommend the slope face roughly match the slopes adjacent to area being repaired but not be steeper than 1H:1.1V. To stabilize the rock fill slope, biaxial geogrid is required within the rock fill due to the anticipated weaker boulder and soil subgrade.

5.4.10 Slope Stabilization Results

Global stability analyses were performed for each of the special rock embankment locations and the reinforced soil slope. Typical highway minimum factors of safety of 1.3 (1.1 for seismic) are considered acceptable for slope stability. However, slope stability analyses do not typically account for the presence of boulders, rock out cropping, or vegetation such as underbrush and trees that have root balls that may anchor the slope. These also help with slope stabilization but cannot be quantified within the analysis.

Table 8. Summary of Slope Stability Analyses

Embankment Location	Assumed Repair (HxL)	Chosen Remediation	Anticipated Bearing Material	Slope Stability Factors of Safety		Reinforcement Required
				Static	Seismic	
MP 466	15'x80'	Reinforced Soil Slope	Silty Sand	1.62	1.24	Yes
MP 481	8'x70'	Special Embankment	Bedrock	1.43	1.18	N/A
MP 486	12'x30'	Special Embankment	Bedrock	1.34	1.18	N/A
MP 487	12'x25'	Special Embankment	Gravel w/silt & sand	1.39	1.16	Yes
MP 515	12'x45'	Special Embankment	Coal Layer	1.30	1.14	Yes
MP 518-C	9'x20'	Special Embankment	Boulders	1.48	1.21	Yes
MP 518-B	15'x70	Special Embankment	Boulders	1.41	1.14	Yes
MP 518-C			Boulders	1.48	1.21	Yes

As summarized in Table 8, biaxial geogrid is required in some of the special rock embankments (MP487, 515, 518B, and 518C) and the reinforced soil slope (MP466). The placement of geogrid is summarized in the table below.

Table 9. Summary of Biaxial Geogrid Placement.

Embankment Location	Biaxial Geogrid				
	Number of Layers	Grid Spacing from Bottom (ft)	Vert. Grid Spacing (ft)	Grid Lengths from Bottom of Embankment (ft)	Biaxial Geogrid Ultimate Tensile Strength (lb/ft)
MP 466	6	0	1.5	11, 9.5, 8.2, 6.5, 5, 3.5	2000
MP 481	0	--	--	--	N/A
MP 486	0	--	--	--	N/A
MP 487	2	3	2	10	2000
MP 515	3	1.5	1.5	7,12,12	2000
MP 518-C	3	2	2	7	3000
MP 518-B	4	2	2	8.5, 12.5, 12.5, 12.5	3000
MP 518-C	3	2	2	7	3000

Geogrid lengths are approximate and may require adjustment in field based on encountered subsurface conditions. For MP466 the geogrid spacing is considered preliminary and may change based on the design by the manufacturer and/or reinforced soil slope designer.

5.5 CONSTRUCTION CONSIDERATIONS

5.5.1 General Considerations

Based on the information obtained at the boring locations and our understanding of the proposed construction, we anticipate that shallow excavations and grading will likely not encounter groundwater. However, if perched groundwater is encountered or surface water run-off enters shallow excavations during construction, it can likely be removed by using a pump and filtered sump possibly in combination with collection trenches. Given the proximity of excavations to existing waterways, we recommend that excavation activities occur during the drier times of the year when the creek flow is likely to be lowest. We also recommend that excavated soil not be stockpiled immediately adjacent to the top of an excavation, nor should equipment be allowed to operate close to unsupported excavations. The Contractor is responsible for maintaining stable excavations. In addition, all excavations should conform with Occupational Safety and Health Administration (OSHA) requirements. Cohesive soil, if encountered on this project, should be classified as Type A or B, depending on its strength characteristics. The granular soils should be classified as Type C (according to OSHA) and should be treated accordingly.

5.5.2 Culvert Construction

The soil conditions at the culvert locations are based on the borings performed in proximity to those structures. Along with the anticipated soils conditions bedrock and boulders could also be encountered at the culvert invert elevations. In general, culvert installation should follow Section 602 of the current USDOT Standard Specifications for Road and Bridge Construction, FP-24 (USDOT SS) and foundation excavation and backfill should follow Section 209. The Designer should include a plan note on the drawings that states “For the purpose of maintaining uniform yielding conditions, any bedrock, boulders or soft soil materials encountered within two feet of the bottom of footing elevation (culvert and wingwalls) shall be over excavated and the resulting excavation backfilled with approved properly compacted backfill material in accordance with Section 209 of the USDOT SS. Prior to placement of any bedding material, we recommend that the excavated subgrade be thoroughly compacted to densify any loose soils. The Designer should include a note on the drawings stating, “Temporary sheeting, shoring, cofferdams, dewatering, or stream diversion methods may be required for the installation of the culvert.”

5.5.3 Embankment Construction

In general, special rock embankments should be placed in accordance with Section 252.02 (b) of the USDOT Standard Specifications for Road and Bridge Construction, FP-24 (USDOT SS). Where geogrid is required in special rock embankments and reinforced soil slopes, place geogrid in accordance with Section 207 and 714. Compaction of the special rock embankment fill will not be possible using conventional compaction equipment. The rock fill cannot be simply end dumped and covered. The rock fill must be placed in a stable orientation with minimal voids to produce a random pattern. Use rock smaller than the minimum rock size to choke the larger rock solidly in position and to fill voids between the large rocks. When placing geogrid, be sure to fill any voids to provide a level surface free of pockets where overlying fill is unlikely to puncture the geogrid.

It should also be noted that the acceptable thickness of loose lifts of engineered fill and/or the number of passes required by the compaction equipment to achieve the density recommended in the USDOT SS will be a function of the type of compaction equipment and techniques used, the soil type, as well as proper control of the soil moisture content and the season in which construction takes place. For soil and smaller aggregate fill, periodic field density tests should be performed during fill placement to determine the adequacy of the compactive effort. Larger particle sizes such as rip rap and boulders should be visually inspected. Large high energy compaction equipment is not recommended as it may cause hillside/slope instability below the proposed embankments. Given that granular soils were predominantly encountered at the boring locations and based on relative densities ranging from loose to very dense, we anticipate little to negligible post construction settlement should occur.

6.0 REFERENCES

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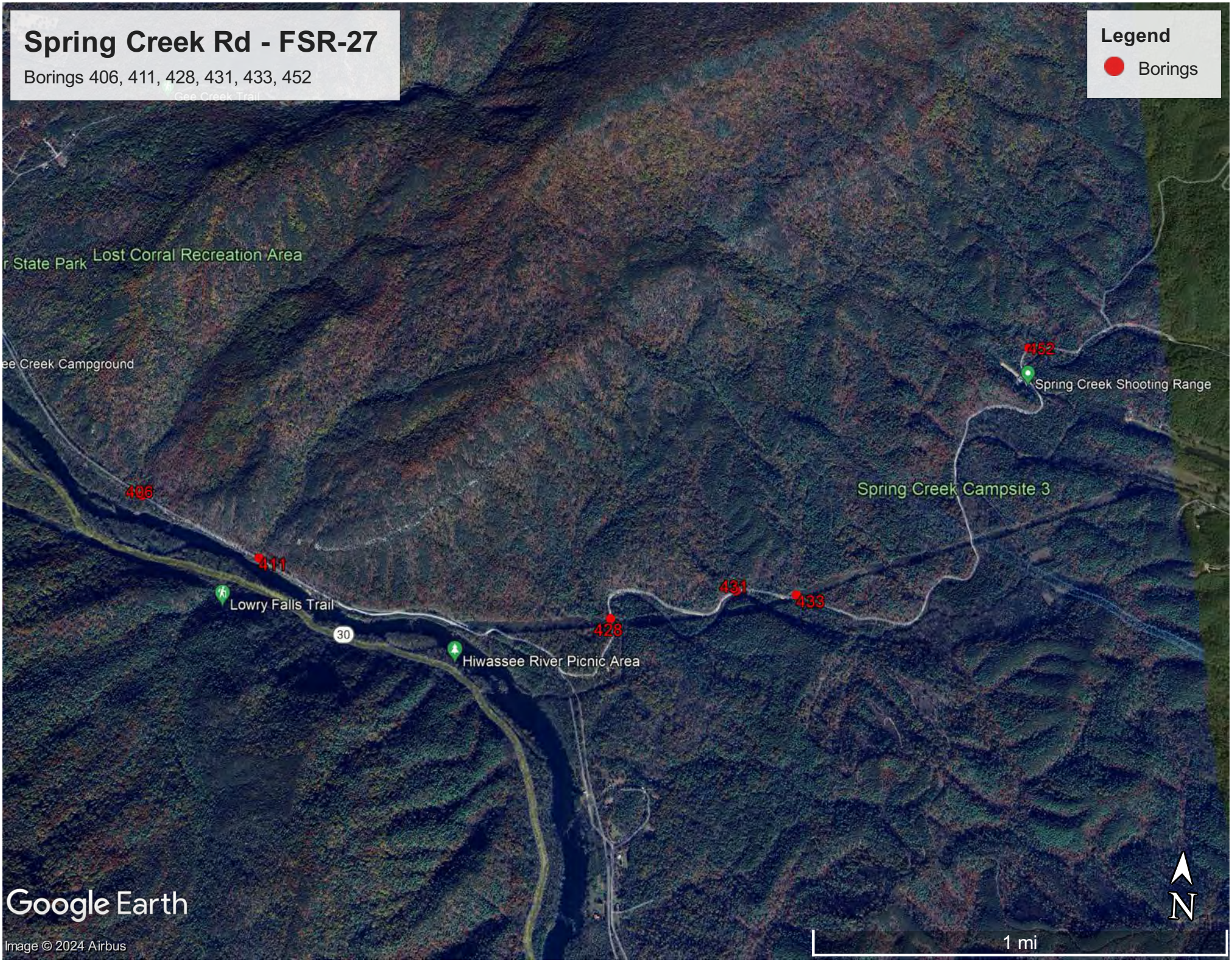
United States Department of Transportation, Standard Specifications for Road and Bridge Construction on Federal Highway Projects, FP-24 (USDOT SS), 2024

7.0 CLOSING

This evaluation has been conducted in accordance with generally accepted soil and foundation engineering practices. The conclusions and recommendations contained in this report are based on the field observations and subsurface information from the exploratory borings performed for this project. It is important to recognize that subsurface conditions can vary over relatively short distances. The boring/sounding logs and related information depict approximate subsurface conditions only at the specific boring locations noted and at the time of drilling. Conditions at other locations may differ from those occurring at the boring locations. Also, the passage of time may result in a change in the subsurface conditions at the boring locations.

APPENDIX A
Exploration Location Plans


Spring Creek Rd - FSR-27
Borings 406, 411, 428, 431, 433, 452
Legend
Borings
Gee Creek Trail
r State Park
Lost Corral Recreation Area
ee Creek Campground
452
Spring Creek Shooting Range
Spring Creek Campsite 3
406
411
Lowry Falls Trail
30
428
431
433
Hiwassee River Picnic Area
Google Earth
Image © 2024 Airbus
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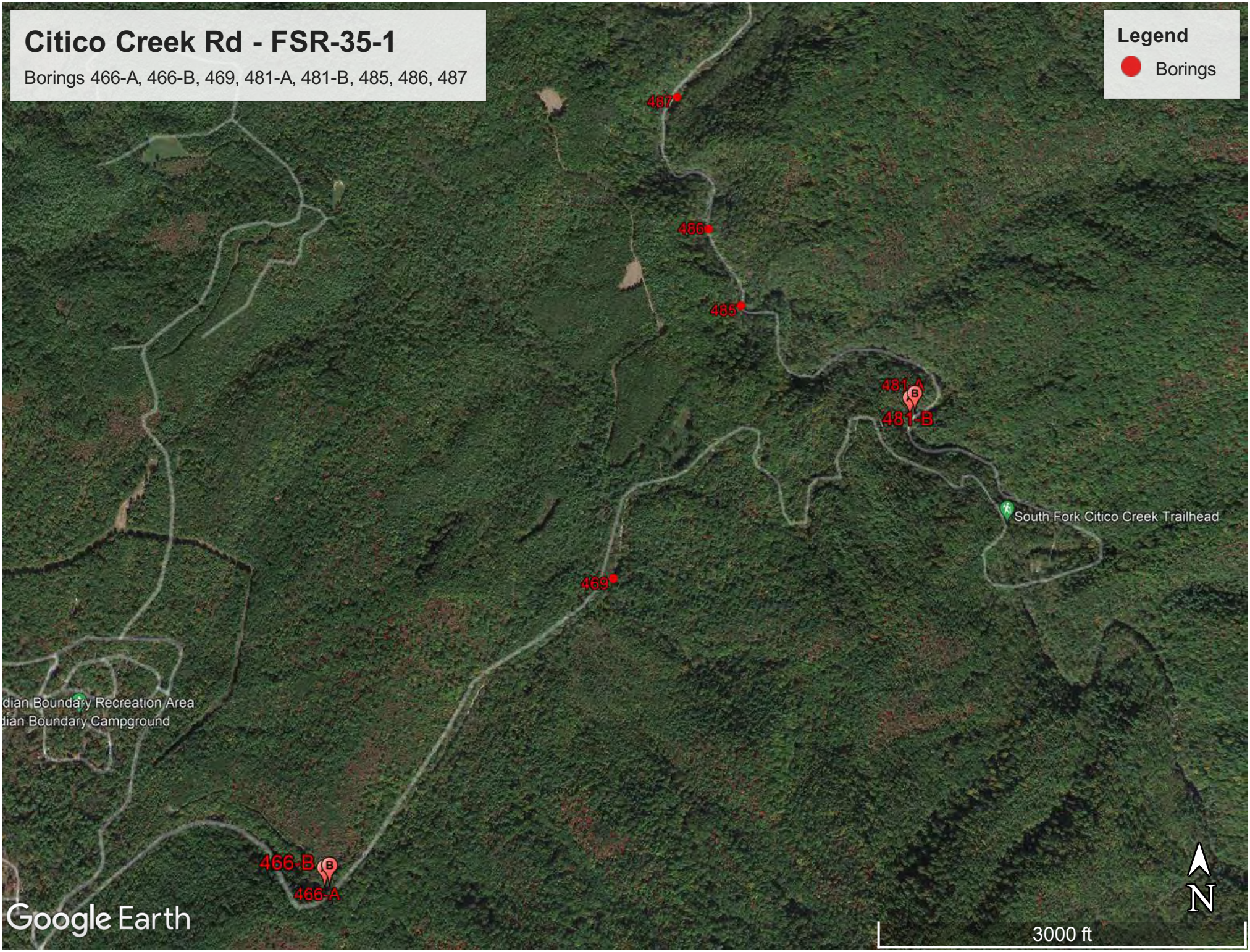
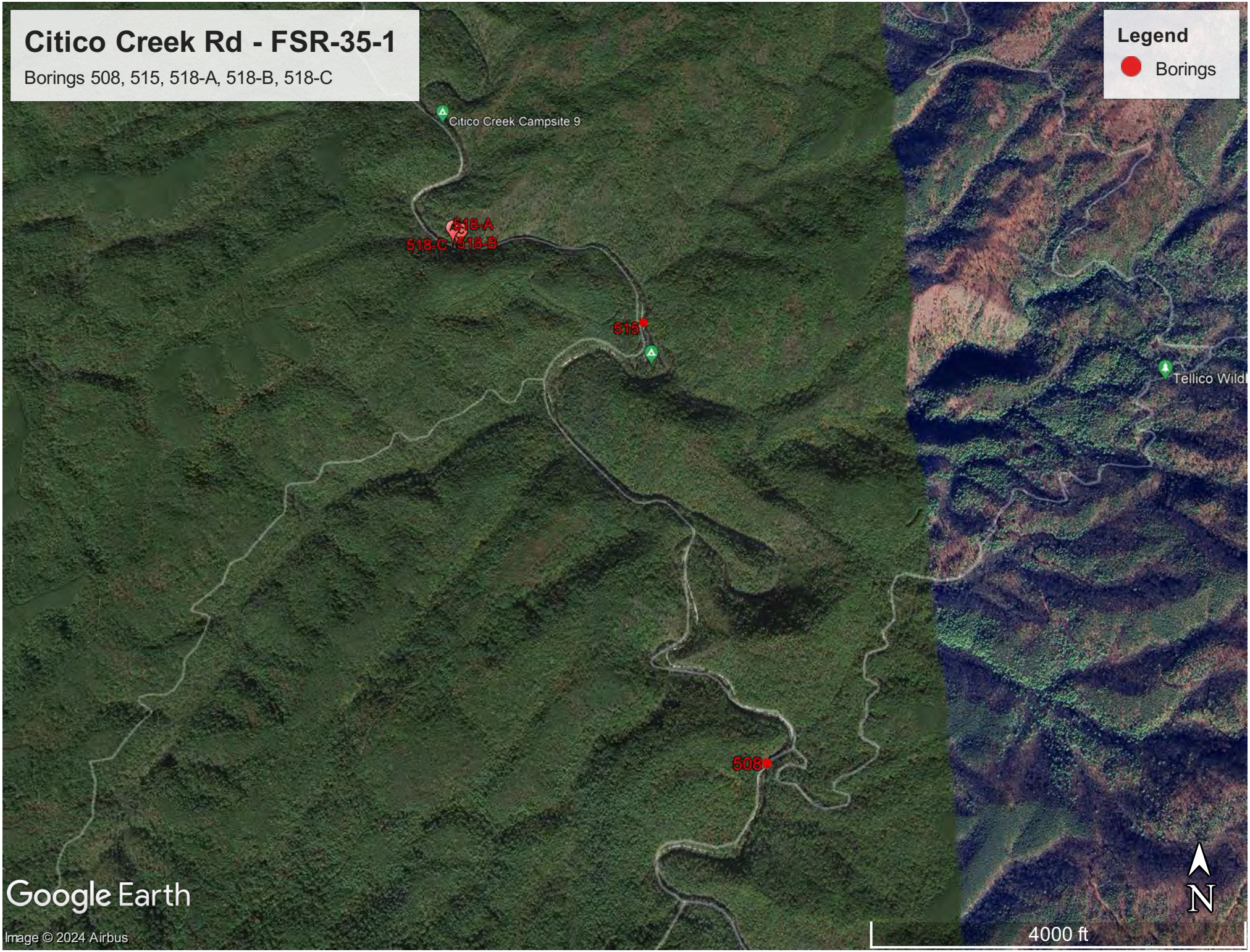

Citico Creek Rd - FSR-35-1
Borings 466-A, 466-B, 469, 481-A, 481-B, 485, 486, 487
Legend
Borings
487
486
485
481-A
481-B
South Fork Citico Creek Trailhead
469
466-B
466-A
Google Earth
N
3000 ft


Citico Creek Rd - FSR-35-1
Borings 508, 515, 518-A, 518-B, 518-C
Legend
Borings
Citico Creek Campsite 9
518-A
518-C
518-B
515
508
Tellico Wild
Google Earth
Image © 2024 Airbus
N
4000 ft

APPENDIX B
Boring Logs

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

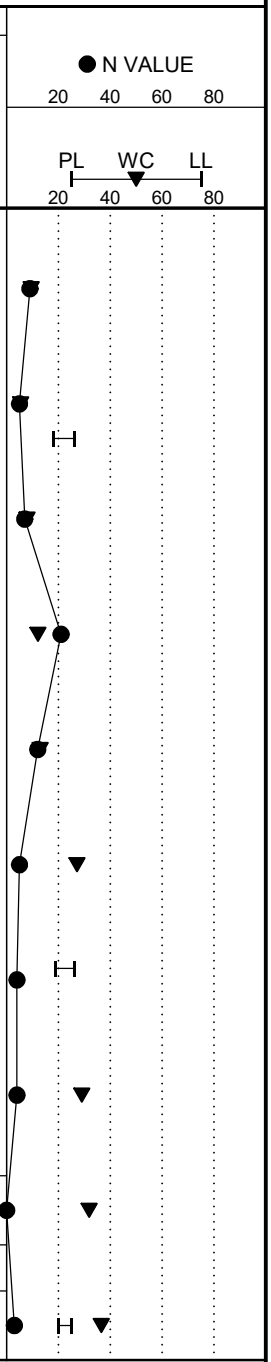
BORING LOG 406

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Project Location: Cherokee National Forest, TN
Groundwater Depth:
While Drilling: 12 ft / Elev 725.6 ft
At Completion: ---
After Drilling: ---
Notes:

Surface Elevation: 737.6 ft
Latitude: 35.2271935° Longitude: -84.5367807°
State Plane Coors N 328641.1672 ft E 2405506.805 ft
Date Started: 4/29/24 Date Completed: 4/29/24
Driller/Company: A. Clements/Stantec Drill CME-45
Hammer Type: 140 lbs Automatic Hammer Efficiency: 87.1 %
Logger/Company: Y. Oumoussi/Stantec
Weather: Sunny

Sheet: 1 of 1
Datum: NAVD88
Datum: NAD83

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Drilling Method	Type	No.	Field Blow Count (Recovery)	Test Results
		LOOSE GRAVEL - 1 INCH (0.1 ft / El. 737.5 ft)					
		CLAYEY GRAVEL WITH SAND (GC), brown with gray, loose to medium dense, dry to damp, contains iron oxide stains. Moderately organic from 0 to 5.5' Possible Cobble at 3.0' Posisble Cobble at 8.5'	3-1/4" HSA		SS-1	5-5-4 (6" = 33%)	
735					SS-2	4-3-2 (3" = 17%)	
	5				SS-3	5-4-3 (10" = 56%)	
730					SS-4	6-11-10 (16" = 89%)	
	10				SS-5	7-8-4 (18" = 100%)	
		12 ft / El. 725.6 ft					
725		SILTY, CLAYEY SAND (SC-SM), trace fine to coarse gravel, brown, loose, very moist to wet.			SS-6	5-3-2 (13" = 72%)	
	15				SS-7	2-2-2 (0" = 0%)	
720					SS-8	1-2-2 (8" = 44%)	
	20						
		20.5 ft / El. 717.1 ft					
		SANDY SILTY CLAY (CL-ML), gray, very soft to soft, wet.			SS-9	0-0-0 (13" = 72%)	PP = 0 tsf
715							
		25 ft / El. 712.6 ft			SS-10	1-1-2 (18" = 100%)	PP = 0 tsf
	25	Bottom of borehole at 25 ft.					



FHWA LOG - FHWA_DATATEMPLATE.GDT - 11/6/24 18:11 - C:\USERS\DPLEIMAN\ONEDRIVE - STANTEC\DOCUMENTS\TN ERFO FS\SITE 5\LOGS\TN ERFO SITE 5.GPJ

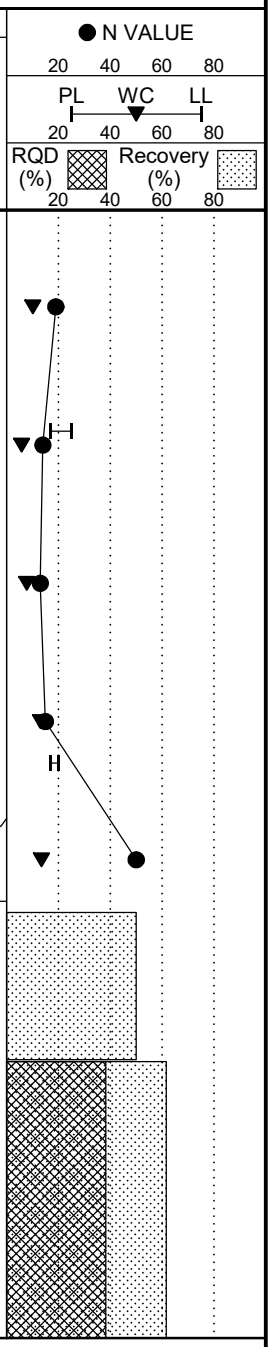
U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

BORING LOG 411

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Sheet: 1 of 1
Project Location: Cherokee National Forest, TN
Surface Elevation: 734.3 ft
Datum: NAVD88
Groundwater Depth:
Latitude: 35.2249292° Longitude: -84.5306409°
Datum: NAD83
While Drilling: 8.5 ft / Elev 725.8 ft
State Plane Coors N 327844.5472 ft E 2407352.779 ft
At Completion: ---
Date Started: 4/23/24
Date Completed: 4/29/24
After Drilling: ---
Driller/Company: A. Clements/Stantec
Drill CME-45
Notes:
Hammer Type: 140 lbs Automatic
Hammer Efficiency: 87.1 %
Drilling from 0 to 12.5 ft performed on 4/23/2024.
Logger/Company: Y. Oumoussi/Stantec
Drilling from 12.5 to 20.4 ft performed on 4/292024.
Weather: Sunny

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Sample Type	Sample No.	Field Blow Count (Recovery) / Core Rec., RQD, and Frac. Freq.	Test Results
			LOOSE GRAVEL - 2 INCHES 0.2 ft / El. 734.1 ft					
			CLAYEY SAND WITH GRAVEL (SC), brown, medium dense, damp, contains few iron oxide stains. Possible cobble from 7.5 to 8.0'	3-1/4" HSA	SS	SS-1	5-10-9 (16" = 89%)	
730	5				SS	SS-2	5-5-9 (12" = 67%)	
					SS	SS-3	6-6-7 (8" = 44%)	
			8 ft / El. 726.3 ft					
			SILTY SAND WITH GRAVEL (SM), brown and light brown, medium dense to dense, wet. Damp at 10.5' Possible boulder from 10.5 to 12.7'		SS	SS-4	5-5-10 (8" = 44%)	
725	10				SS	SS-5	25-35-15 (7" = 39%)	Difficult drilling from 10.5 to 12.7 ft SS-5 is mostly boulder material
			12.7 ft / El. 721.6 ft					
			SANDSTONE BOULDERS, brown and light gray, slightly strong, weathered, fractured to moderately fractured, hard to very hard, contains iron oxide stains. Soft from 15.9 to 17.8': Possible soil layer	NQ CORE	RC	RC-1	Rec = 50% RQD = 0%	
720	15				RC	RC-2	Rec = 62% RQD = 38%	Elv. 716.5 ft UC = 8200 psi Horizontal factures from 19.3 to 20.4 ft
715	20		20.4 ft / El. 713.9 ft					

Refusal at 12.7 ft.
Bottom of borehole at 20.4 ft.



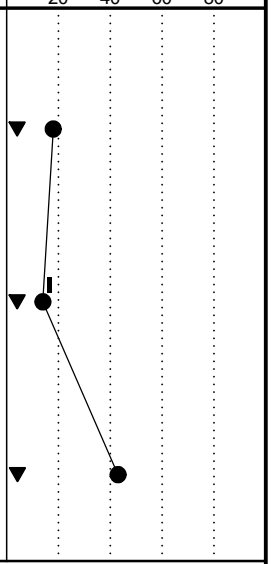
FHWA LOG - FHWA_DATATEMPLATE.GDT - 11/6/24 18:11 - C:\USERS\DPLEIMAN\ONEDRIVE - STANTEC\DOCUMENTS\TN ERFO FS\SITE 5\LOGS\TN ERFO SITE 5.GPJ

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

BORING LOG 428-A

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Sheet: 1 of 1
Project Location: Cherokee National Forest, TN
Surface Elevation: 758.9 ft
Datum: NAVD88
Groundwater Depth:
Latitude: 35.2231921° Longitude: -84.5130957°
Datum: NAD83
While Drilling: No Groundwater Encountered
State Plane Coord: N 327291.4485 ft E 2412602.1978 ft
At Completion: ---
Date Started: 4/23/24 Date Completed: 4/23/24
After Drilling: ---
Driller/Company: A. Clements/Stantec
Drill CME-45
Notes:
Hammer Type: 140 lbs Automatic
Hammer Efficiency: 87.1 %
Boring terminated at 8.0 ft due to bent auger.
Logger/Company: Y. Oumoussi/Stantec
Weather: Sunny

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	SAMPLE Type	No.	Field Blow Count (Recovery)	Test Results
			LOOSE GRAVEL - 1 INCH 0.1 ft / El. 758.8 ft					
			POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM), brown with gray, medium dense to dense, dry to damp, contains iron oxide stains. Cobbles from 0.5 to 1.0' Cobbles from 5.5 to 6.0'	3-1/4" HSA		SS-1	8-12-6 (12" = 67%)	
755	5					SS-2	7-9-5 (14" = 78%)	
						SS-3	8-20-23 (18" = 100%)	
			7.5 ft / El. 751.4 ft SHALE BOULDER 8 ft / El. 750.9 ft					Difficult drilling at 7.5 ft



Refusal at 8 ft.
Bottom of borehole at 8 ft.

FHWA LOG - FHWA_DATATEMPLATE.GDT - 11/6/24 18:11 - C:\USERS\DPLEIMAN\ONEDRIVE - STANTEC\DOCUMENTS\TN ERFO FS\SITE 5\LOGS\TN ERFO SITE 5.GPJ

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

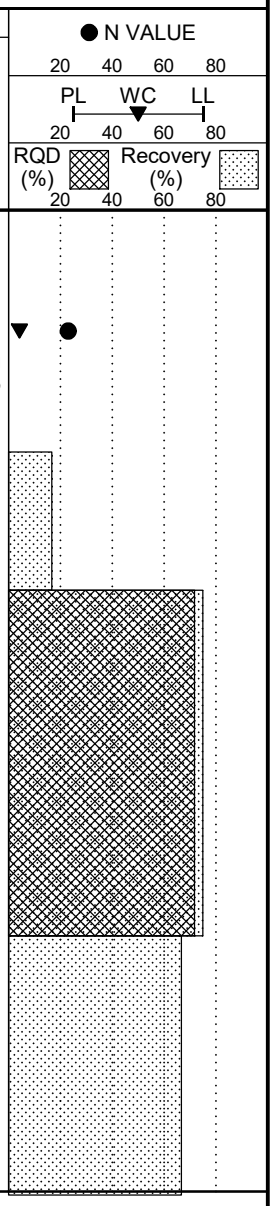
BORING LOG 428-B

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Project Location: Cherokee National Forest, TN
Groundwater Depth:
While Drilling: No Groundwater Encountered
At Completion: ---
After Drilling: ---
Notes:

Surface Elevation: 759.1 ft
Latitude: 35.2232098° Longitude: -84.5131006°
State Plane Coord: N 327297.8912 ft E 2412600.6188 ft
Date Started: 4/23/24 Date Completed: 4/23/24
Driller/Company: A. Clements/Stantec
Hammer Type: 140 lbs Automatic
Logger/Company: Y. Oumoussi/Stantec
Weather: Sunny

Sheet: 1 of 1
Datum: NAVD88
Datum: NAD83
Drill CME-45
Hammer Efficiency: 87.1 %

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	SAMPLE Type	No.	Field Blow Count (Recovery) / Core Rec., RQD, and Frac. Freq.	Test Results
			LOOSE GRAVEL - 1 INCH (0.1 ft / El. 759 ft)					
			SILTY SAND WITH GRAVEL (SM), brown with gray, medium dense, dry. (2.5 ft / El. 756.6 ft)	3-1/4" HSA		SS-1	9-9-14 (14" = 78%)	Difficult drilling from 2.5 to 3.5 ft
			SHALE AND SANDSTONE BOULDERS/COBBLES, gray then light reddish brown, strong, weathered, highly to moderately fractured, hard. (5.5 ft / El. 753.6 ft)					
755	5			NQ CORE		RC-1	Rec = 17% RQD = 0%	
			SANDSTONE BOULDER, light reddish brown and light gray, slightly strong, slightly weathread, moderately to slightly fractured, hard. (9.2 ft / El. 749.9 ft)			RC-2	Rec = 75% RQD = 72%	Elv. 751.2 ft UC = 19480 psi
750	10		SANDSTONE AND SHALE BOULDERS/COBBLES INTERBEDDED WITH THIN SOIL LAYERS, brown and gray, highly weathered, highly fractured. (14.2 ft / El. 744.9 ft)			RC-3	Rec = 67% RQD = 0%	
745								



Refusal at 3.5 ft.
Bottom of borehole at 14.2 ft.

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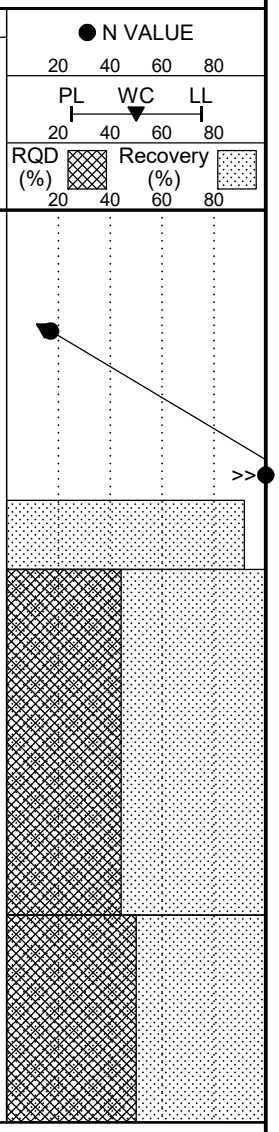
U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

BORING LOG 431

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Sheet: 1 of 1
Project Location: Cherokee National Forest, TN
Surface Elevation: 765.1 ft
Datum: NAVD88
Groundwater Depth:
Latitude: 35.2245684° Longitude: -84.5069973° Datum: NAD83
While Drilling: No Groundwater Encountered
State Plane Coord: N 327820.0921 ft E 2414415.8352 ft
At Completion: ---
Date Started: 4/22/24 Date Completed: 4/22/24
After Drilling: ---
Driller/Company: A. Clements/Stantec Drill CME-45
Notes:
Hammer Type: 140 lbs Automatic Hammer Efficiency: 87.1 %
Logger/Company: Y. Oumoussi/Stantec
Weather: Partly cloudy

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Sample Type	Sample No.	Field Blow Count (Recovery) / Core Rec., RQD, and Frac. Freq.	Test Results
			LOOSE GRAVEL - 0.75 INCH (0.1 ft / El. 765 ft)	3-1/4" HSA				
			CLAYEY SAND WITH GRAVEL (SC), brown with gray, medium dense, damp, contains iron oxide stains.		SS	SS-1	4-7-10 (18" = 100%)	
			(4 ft / El. 761.1 ft)		SS	SS-2	7-50/2" (6" = 75%)	
760	5		LIMESTONE, gray, moderately strong to strong, highly to moderately weathered, highly to moderately fractured, hard, contains iron oxide stains.	NQ CORE	RC	RC-1	Rec = 92% RQD = 0%	
			(7 ft / El. 758.1 ft) LIMESTONE, gray, strong to very strong, slightly weathered, moderately to slightly fractured, hard to very hard, contains iron oxide stains.		RC	RC-2	Rec = 100% RQD = 44%	Horizontal fractures from 7.0 to 7.8 ft Elv. 757.0 ft UC = 19000 psi Diagonal fractures from 9.0 to 13.2 ft
755	10				RC	RC-3	Rec = 100% RQD = 50%	
			(13.2 ft / El. 751.9 ft)					

Refusal at 4.2 ft.
Bottom of borehole at 13.2 ft.



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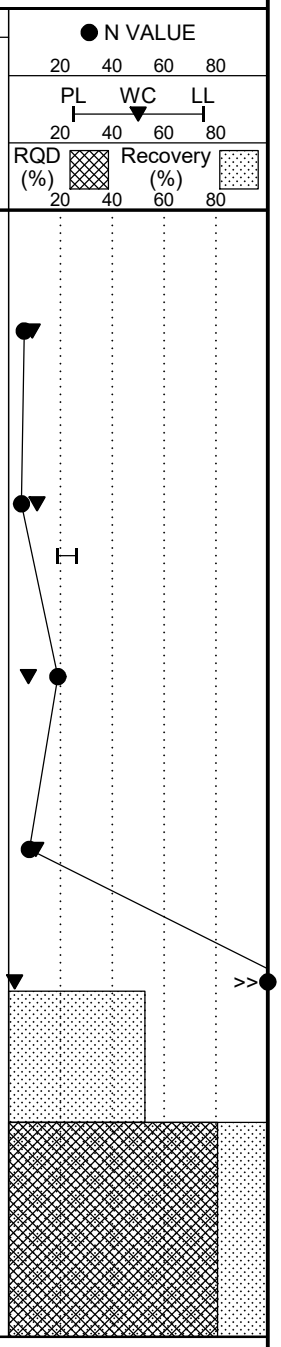
U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

BORING LOG 433

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Sheet: 1 of 1
Project Location: Cherokee National Forest, TN
Surface Elevation: 777.1 ft
Datum: NAVD88
Groundwater Depth:
Latitude: 35.2244383° Longitude: -84.5039145°
Datum: NAD83
While Drilling: 7.5 ft / Elev 769.6 ft Water at the bottom of SS-3.
State Plane Coords: N 327786.8115 ft E 2415337.2333 ft
At Completion: ---
Date Started: 4/22/24
Date Completed: 4/22/24
After Drilling: ---
Driller/Company: A. Clements/Stantec
Drill: CME-45
Notes:
Hammer Type: 140 lbs Automatic
Hammer Efficiency: 87.1 %
Logger/Company: Y. Oumoussi/Stantec
Weather: Partly cloudy

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Type	No.	Field Blow Count (Recovery) / Core Rec., RQD, and Frac. Freq.	Test Results
			LOOSE GRAVEL - 1 INCH 0.1 ft / El. 777 ft					
775			SILTY, CLAYEY SAND WITH GRAVEL (SC-SM), brown with gray, loose to medium dense, damp, contains few iron oxide stains. Moist from 6.0 to 7.5'	3-1/4' HSA		SS-1	3-3-3 (10" = 56%)	
						SS-2	2-3-2 (18" = 100%)	
	5					SS-3	6-9-10 (18" = 100%)	
770						SS-4	3-4-4 (7" = 39%)	
	10		11 ft / El. 766.1 ft					
			SHALE, gray, strong, slightly weathered, moderately to slightly fractured, hard.			SS-5	50/4" (4" = 100%)	
765				NQ CORE		RC-1	Rec = 53% RQD = 0%	
	15					RC-2	Rec = 100% RQD = 81%	Elv. 763.4 ft UC = 13640 psi Horizontal and diagonal fractures from 13.2 to 15.8 ft
			16.3 ft / El. 760.8 ft					



Refusal at 11.3 ft.
Bottom of borehole at 16.3 ft.

FHWA LOG - FHWA_DATATEMPLATE.GDT - 11/6/24 18:11 - C:\USERS\DPLEIMAN\ONEDRIVE - STANTEC\DOCUMENTS\TN ERFO FS\SITE 5\LOGS\TN ERFO SITE 5.GPJ

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

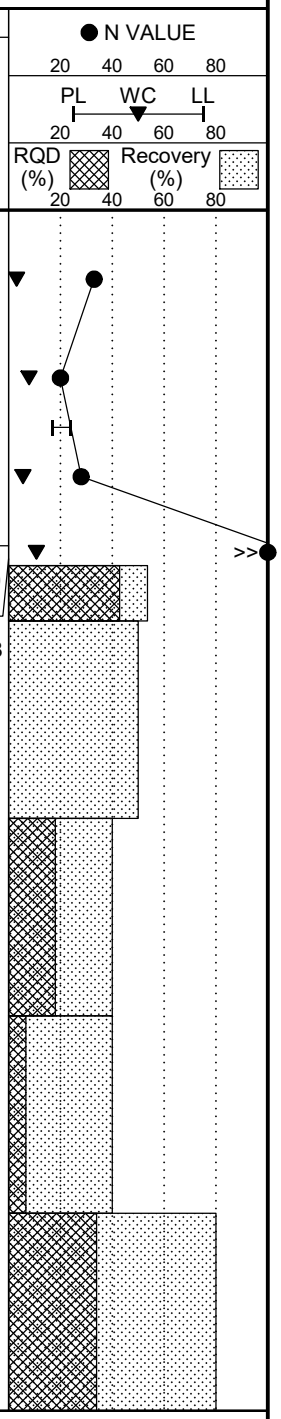
BORING LOG 452

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Project Location: Cherokee National Forest, TN
Groundwater Depth:
While Drilling: No Groundwater Encountered
At Completion: ---
After Drilling: ---
Notes:

Surface Elevation: 821.8 ft
Latitude: 35.2360103° Longitude: -84.4920105°
State Plane Coord: N 332053.0088 ft E 2418827.4353 ft
Date Started: 4/22/24 Date Completed: 4/22/24
Driller/Company: A. Clements/Stantec Drill CME-45
Hammer Type: 140 lbs Automatic Hammer Efficiency: 87.1 %
Logger/Company: Y. Oumoussi/Stantec
Weather: Partly cloudy

Sheet: 1 of 1
Datum: NAVD88
Datum: NAD83

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Type	No.	Field Blow Count (Recovery) Core Rec., RQD, and Frac. Freq.	Test Results
			LOOSE GRRAVEL - 0.75 INCH 0.1 ft / El. 821.7 ft					Mostly rock fragments
820			SILTY GRAVEL WITH SAND (GM), brown with light gray, dense, dry, contains few iron oxide stains. 3 ft / El. 818.8 ft	3-1/4" HSA	SS	SS-1	9-16-17 (9" = 50%)	
	5		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM), brown with light gray, medium dense, dry to damp, contains iron oxide stains.		SS	SS-2	2-7-13 (12" = 67%)	
815					SS	SS-3	11-14-14 (12" = 67%)	
			8.5 ft / El. 813.3 ft					
			SANDSTONE BOULDERS INTERBEDDED WITH SOIL LAYERS, light reddish brown becoming brown and gray, strong, weathered, highly fractured to fractured, hard. SHALE from 20.5 to 20.7'		SS	SS-4	50/4" (3" = 75%)	Difficult drilling from 8.5 to 9.0 ft
	10			NQ CORE	RC	RC-1	Rec = 54% RQD = 43%	Possible soil layers from 9.8 to 11.7 ft, 12.6 to 13.6 ft and 13.9 to 14.4 ft
810					RC	RC-2	Rec = 50% RQD = 0%	
	15							
805					RC	RC-3	Rec = 40% RQD = 18%	Elv. 803.1 ft UC = 9340 psi
	20							
800					RC	RC-4	Rec = 40% RQD = 7%	
	25							
795			27.4 ft / El. 794.4 ft					
			LIMESTONE, gray, strong, slightly weathered, moderately fractured, hard.		RC	RC-5	Rec = 80% RQD = 34%	Diagonal fractures from 27.0 to 28.2 ft
	30		30.4 ft / El. 791.4 ft					



Refusal at 9 ft.
Bottom of borehole at 30.4 ft.

FHWA LOG - FHWA_DATATEMPLATE.GDT - 11/6/24 18:11 - C:\USERS\DPLEIMAN\ONEDRIVE - STANTEC\DOCUMENTS\TN ERFO FS\SITE 5\LOGS\TN ERFO SITE 5.GPJ

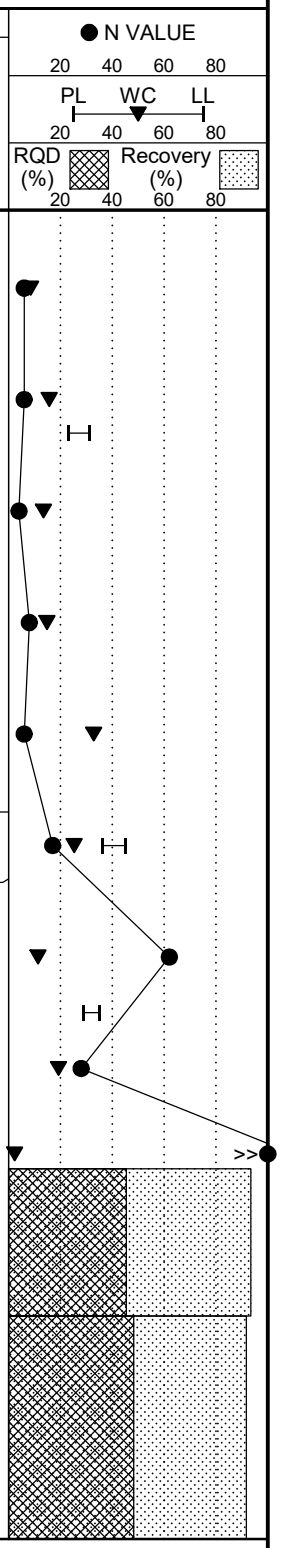
U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

BORING LOG 466-A

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Sheet: 1 of 1
Project Location: Cherokee National Forest, TN
Surface Elevation: 2053.8 ft
Datum: NAVD88
Groundwater Depth:
Latitude: 35.3974928° Longitude: -84.0986871° Datum: NAD83
While Drilling: 19.6 ft / Elev 2034.2 ft
State Plane Coord: N 392866.1857 ft E 2535129.6317 ft
At Completion: ---
Date Started: 4/21/24 Date Completed: 4/21/24
After Drilling: ---
Driller/Company: A. Clements/Stantec Drill CME-45
Notes:
Hammer Type: 140 lbs Automatic Hammer Efficiency: 87.1 %
Logger/Company: Y. Oumoussi/Stantec
Weather: Cloudy

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Type	No.	Field Blow Count (Recovery) / Core Rec., RQD, and Frac. Freq.	Test Results
			LOOSE GRAVEL - 0.75 INCH 0.1 ft / El. 2053.7 ft					
			SILTY SAND WITH GRAVEL (SM), reddish brown becoming brown, very loose to loose, damp, contains few iron oxide stains.	3-1/4" HSA	SS	SS-1	2-3-3 (8" = 44%)	
2050	5				SS	SS-2	3-2-4 (10" = 56%)	
					SS	SS-3	2-2-2 (10" = 56%)	
2045	10		10.5 ft / El. 2043.3 ft		SS	SS-4	2-4-4 (9" = 50%)	
			SILTY SAND (SM), little fine to coarse gravel, brown with gray, loose to medium dense, damp.		SS	SS-5	3-3-3 (12" = 67%)	
2040	15		15.5 ft / El. 2038.3 ft		SS	SS-6	5-6-11 (16" = 89%)	Groundwater seepage at 13.5 ft
			SILTY SAND (SM), trace to little gravel, similar to weathered rock, brown, medium dense to dense, damp to moist. Wet gravel seam (calcite) from 19.6 to 19.7'		SS	SS-7	20-30-32 (18" = 100%)	
2035	20		21 ft / El. 2032.8 ft		SS	SS-8	4-16-12 (7" = 39%)	
			SANDSTONE, gray, slightly strong, slightly weathered, moderately to slightly fractured, hard to very hard. 23.2 ft / El. 2030.6 ft		SS	SS-9	50/4" (2" = 50%)	Elv. 2031.8 ft UC = 13230 psi
2030	25		CONGLOMERATE, brown, fine grained, slightly strong, highly to moderately weathered, highly to moderately fractured, medium hard. Very soft from 23.5 to 24.2' Calcite from 25.0 to 25.1' 25.1 ft / El. 2028.7 ft	NQ CORE	RC	RC-1	Rec = 93% RQD = 45%	
			SANDSTONE (80%) INTERBEDDED WITH CONGLOMERATE (20%), gray and brown, strong, moderately to slightly weathered, moderately to slightly fractured, hard to very hard.		RC	RC-2	Rec = 92% RQD = 48%	Horizontal fractures from 25.9 to 28.3 ft
2025			29.8 ft / El. 2024 ft					

Refusal at 21.5 ft.
Bottom of borehole at 29.8 ft.



FHWA LOG - FHWA_DATATEMPLATE.GDT - 11/6/24 18:16 - C:\USERS\DPLEIMAN\ONEDRIVE - STANTEC\DOCUMENTS\TN ERFO FS\SITE 5\LOGS\TN ERFO SITE 5.GPJ

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

BORING LOG 466-B

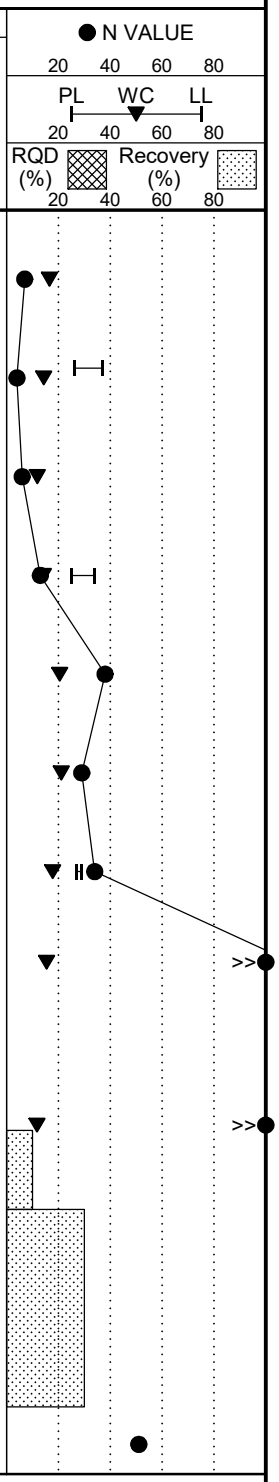
Project Name: TN ERFO FS CHRKE804 2020-2(5)
Project Location: Cherokee National Forest, TN
Groundwater Depth:
While Drilling: 19 ft / Elev 2036.6 ft
At Completion: ---
After Drilling: ---
Notes:

Surface Elevation: 2055.6 ft
Latitude: 35.3974979° Longitude: -84.0986199°
State Plane Coors N 392868.419 ft E 2535149.6107 ft
Date Started: 4/20/24 Date Completed: 4/20/24
Driller/Company: A. Clements/Stantec Drill CME-45
Hammer Type: 140 lbs Automatic Hammer Efficiency: 87.1 %
Logger/Company: Y. Oumoussi/Stantec
Weather: Cloudy

Sheet: 1 of 1
Datum: NAVD88
Datum: NAD83

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Type	No.	Field Blow Count (Recovery) Core Rec., RQD, and Frac. Freq.	Test Results
2055			LOOSE GRAVEL - 0.75 INCH					
			0.1 ft / El. 2055.5 ft					
			SILTY SAND WITH GRAVEL (SM), reddish brown, very loose to loose, damp, contains iron oxide stains.		SS	SS-1	2-3-4 (8" = 44%)	
					SS	SS-2	2-2-2 (14" = 78%)	
2050	5				SS	SS-3	1-2-4 (18" = 100%)	
			8 ft / El. 2047.6 ft					
			SILTY SAND (SM), trace to little gravel, light brown to tan becoming brown, medium dense to dense, dry to damp, contains iron oxide stains. similar to weathered sandstone/conglomerate from 10.5 to 23.0' very dense at 18.5'	3-1/4" HSA	SS	SS-4	3-5-8 (17" = 94%)	
2045	10				SS	SS-5	6-18-20 (18" = 100%)	
					SS	SS-6	6-15-14 (18" = 100%)	
2040	15				SS	SS-7	5-16-18 (14" = 78%)	
					SS	SS-8	24-20-50/1" (10" = 77%)	
2035	20							
			23 ft / El. 2032.6 ft					
			CONGLOMERATE, brown, weak, extremely to highly weathered, soft.		SS	SS-9	50/4" (4" = 100%)	
				NQ CORE	RC	RC-1	Rec = 10% RQD = 0%	
2030	25				RC	RC-2	Rec = 30% RQD = 0%	
2025	30			3-1/4" HSA	SS	SS-10	9-18-33 (18" = 100%)	
			32 ft / El. 2023.6 ft					

Bottom of borehole at 32 ft.



FHWA LOG - FHWA_DATATEMPLATE.GDT - 11/6/24 18:11 - C:\USERS\DPLEIMAN\ONEDRIVE - STANTEC\DOCUMENTS\TN ERFO FS\SITE 5\LOGS\TN ERFO SITE 5.GPJ

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

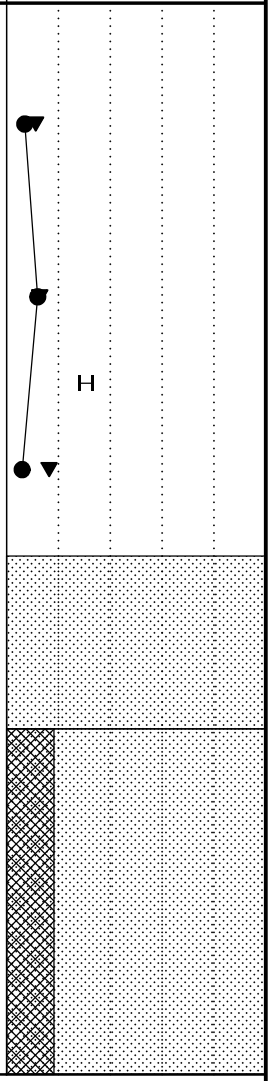
BORING LOG 469

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Project Location: Cherokee National Forest, TN
Groundwater Depth:
While Drilling: 7 ft / Elev 1905.2 ft
At Completion: ---
After Drilling: ---
Notes:

Surface Elevation: 1912.2 ft
Latitude: 35.4042798° Longitude: -84.0910297°
State Plane Coords: N 395380.5422 ft E 2537363.2143 ft
Date Started: 4/20/24 Date Completed: 4/20/24
Driller/Company: A. Clements/Stantec Drill CME-45
Hammer Type: 140 lbs Automatic Hammer Efficiency: 87.1 %
Logger/Company: Y. Oumoussi/Stantec
Weather: Cloudy

Sheet: 1 of 1
Datum: NAVD88
Datum: NAD83

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Type	No.	Field Blow Count (Recovery) / Core Rec., RQD, and Frac. Freq.	Test Results
			LOOSE GRAVEL - 1 INCH 0.1 ft / El. 1912.1 ft					
1910			SILTY SAND WITH GRAVEL (SM), trace clay, brown and gray, loose, damp. 3 ft / El. 1909.2 ft			SS-1	2-4-3 (5" = 28%)	
			SILTY GRAVEL WITH SAND (GM), brown with gray, loose to medium dense, damp, contains many iron oxide stains. Wet at 7.0'	3-1/4" HSA		SS-2	4-3-9 (18" = 100%)	
	5					SS-3	3-3-3 (8" = 44%)	
1905			7.5 ft / El. 1904.7 ft SHALE, gray, slightly to moderately strong, highly to moderately weathered, highly fractured to fractured, medium hard, contains few iron oxide stains. Moderately fractured from 14.0 to 14.6'					Difficult drilling from 7.0 to 7.5 ft Horizontal fractures from 8.0 to 15.5 ft
	10			NQ CORE		RC-1	Rec = 100% RQD = 0%	
1900						RC-2	Rec = 100% RQD = 18%	Elv. 1901.5 ft UC = 10060 psi
	15		15.5 ft / El. 1896.7 ft					



Refusal at 8 ft.
Bottom of borehole at 15.5 ft.

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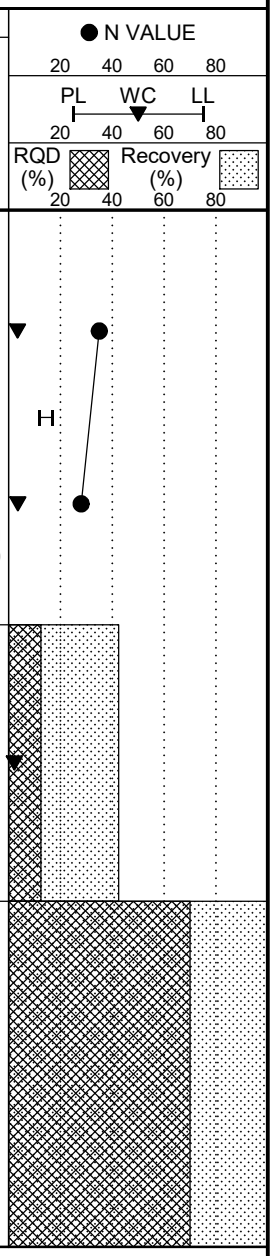
U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

BORING LOG 481-A

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Sheet: 1 of 1
Project Location: Cherokee National Forest, TN
Surface Elevation: 1617.9 ft
Datum: NAVD88
Groundwater Depth:
Latitude: 35.4078652° Longitude: -84.0826902° Datum: NAD83
While Drilling: 7 ft / Elev 1610.9 ft
State Plane Coord: N 396733.9595 ft E 2539822.4633 ft
At Completion: ---
Date Started: 4/19/24 Date Completed: 4/19/24
After Drilling: ---
Driller/Company: A. Clements/Stantec Drill CME-45
Notes:
Hammer Type: 140 lbs Automatic Hammer Efficiency: 87.1 %
Water flow observed from fractured rock on-site.
Logger/Company: Y. Oumoussi/Stantec
Weather: Light rain

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Type	No.	Field Blow Count (Recovery) / Core Rec., RQD, and Frac. Freq.	Test Results
			LOOSE GRAVEL - 1 INCH 0.1 ft / El. 1617.8 ft					
			SILTY, CLAYEY SAND WITH GRAVEL (SC-SM), gray and brown, medium dense to dense, dry to damp.	3-1/4" HSA	SS-1	SS-1	4-15-20 (6" = 33%)	
1615								
	5				SS-2	SS-2	13-13-15 (5" = 28%)	Difficult drilling from 5.0 to 6.0 ft
			6 ft / El. 1611.9 ft					
			SANDSTONE, fine to medium grained, gray, strong, weathered, fractured, hard. 6.3 ft / El. 1611.6 ft	NQ CORE	RC-1	RC-1	Rec = 43% RQD = 13%	Water loss during RC-1 SPT at 6.0 ft: 4-50/0.1 Diagonal fracture at 6.0 ft
			VOID 7.3 ft / El. 1610.6 ft					
1610			SANDSTONE, fine to medium grained, gray, strong, weathered, highly fractured, hard. 8.1 ft / El. 1609.8 ft					
			VOID 9.4 ft / El. 1608.5 ft					
	10		SANDSTONE, fine to medium grained, light gray, very strong, moderately to slightly weathered, moderately to slightly fractured, hard to very hard.		RC-2	RC-2	Rec = 100% RQD = 70%	Elv. 1604.8 ft UC = 14560 psi Diagonal and horiozontal fractures from 11.3 to 14.1 ft
1605								
			14.1 ft / El. 1603.8 ft					
	15		SANDSTONE, fine grained, gray with brown, moderately to slightly strong, moderately weathered, moderately fractured, medium hard. Clay material at fracture at 14.9' 15 ft / El. 1602.9 ft					

Refusal at 6 ft.
Bottom of borehole at 15 ft.



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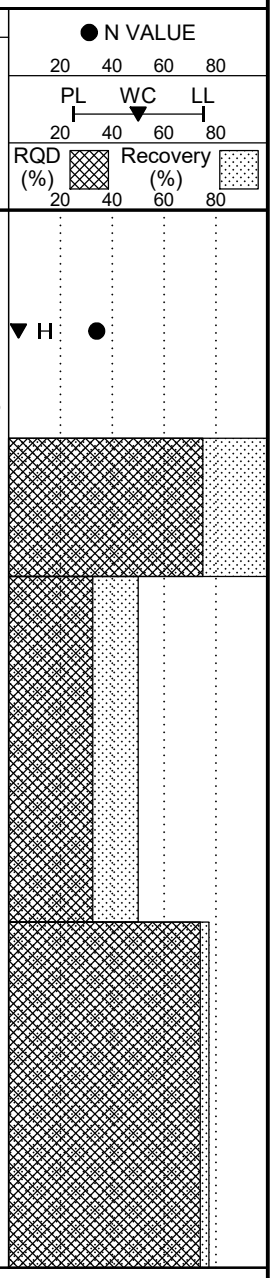
U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

BORING LOG 481-B

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Sheet: 1 of 1
Project Location: Cherokee National Forest, TN
Surface Elevation: 1616.3 ft
Datum: NAVD88
Groundwater Depth:
Latitude: 35.4079827° Longitude: -84.0826011° Datum: NAD83
While Drilling: 7.5 ft / Elev 1608.8 ft
State Plane Coord: N 396777.2128 ft E 2539848.1623 ft
At Completion: ---
Date Started: 4/19/24 Date Completed: 4/19/24
After Drilling: ---
Driller/Company: A. Clements/Stantec Drill CME-45
Notes:
Hammer Type: 140 lbs Automatic Hammer Efficiency: 87.1 %
Water flow observed from fractured rock on-site.
Logger/Company: Y. Oumoussi/Stantec
Weather: Light rain

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Type	No.	Field Blow Count (Recovery) / Core Rec., RQD, and Frac. Freq.	Test Results
			LOOSE GRAVEL - 1 INCH 0.1 ft / El. 1616.2 ft					
1615			SILTY, CLAYEY SAND WITH GRAVEL (SC-SM), gray with brown, dense, dry to damp. 2.8 ft / El. 1613.5 ft	3-1/4" HSA		SS-1	6-16-18 (18" = 100%)	Difficult drilling from 2.8 to 3.3 ft
			SANDSTONE, gray, strong, weathered, highly fractured, hard. 3.6 ft / El. 1612.7 ft					
	5		SANDSTONE, fine to medium grained, gray, strong to very strong, slightly weathered, slightly fractured, hard to very hard. 6 ft / El. 1610.3 ft	NQ CORE		RC-1	Rec = 100% RQD = 75%	
1610			VOID 8.5 ft / El. 1607.8 ft			RC-2	Rec = 50% RQD = 33%	
	10		SANDSTONE, fine to medium grained, light gray, very strong, slightly weathered, moderately to slightly fractured, hard to very hard. Highly fractured at 8.5, 10.3 and 12.0' Wood fragment at 9.5' Clay at fracture surface from 15.1 to 15.3'					Elv. 1606.9 ft UC = 6080 psi
1605						RC-3	Rec = 77% RQD = 74%	
	15		15.3 ft / El. 1601 ft					Diagnal fracture at 14.6 ft



Refusal at 3.3 ft.
Bottom of borehole at 15.3 ft.

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U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

BORING LOG 485

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Project Location: Cherokee National Forest, TN
Groundwater Depth:
While Drilling: No Groundwater Encountered
At Completion: ---
After Drilling: ---
Notes:

Surface Elevation: 1566.3 ft
Latitude: 35.4106247° Longitude: -84.0874076°
State Plane Coord: N 397710.7076 ft E 2538397.3172 ft
Date Started: 4/19/24 Date Completed: 4/19/24
Driller/Company: A. Clements/Stantec Drill CME-45
Hammer Type: 140 lbs Automatic Hammer Efficiency: 87.1 %
Logger/Company: Y. Oumoussi/Stantec
Weather: Light rain

Sheet: 1 of 1
Datum: NAVD88
Datum: NAD83

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	SAMPLE Type	No.	Field Blow Count (Recovery) Core Rec., RQD, and Frac. Freq.	Test Results	N VALUE (20 40 60 80) / PL WC LL / RQD (%) / Recovery (%)
			LOOSE GRAVEL - 0.75 INCH 0.1 ft / El. 1566.2 ft	3-1/4" HSA				Difficult drilling from 0.3 to 2.0 ft	
1565			POORLY GRADED GRAVEL WITH CLAY AND SAND (GP-GC), brown and gray, dry to damp. 1.5 ft / El. 1564.8 ft			GB-1	(17" = 100%)		
						SS-1	50/2" (0" = 0%)		>>
			SANDSTONE, medium grained, light gray, slightly strong to strong, highly to moderately weathered, highly to moderately fractured, medium hard to hard, contains few to some iron oxide stains. Soft from 9.0 to 9.3 ft	NQ CORE		RC-1	Rec = 100% RQD = 20%	Horizontal fractures from 2.0 to 14.5 ft	
1560	5					RC-2	Rec = 94% RQD = 18%	Elv. 1558.3 ft UC = 14090 psi	
1555	10					RC-3	Rec = 100% RQD = 62%		
			14.5 ft / El. 1551.8 ft						

Refusal at 2 ft.
Bottom of borehole at 14.5 ft.

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U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

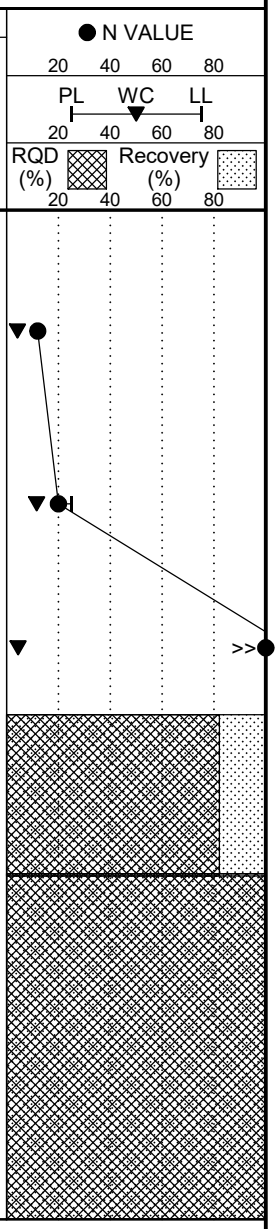
BORING LOG 486

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Project Location: Cherokee National Forest, TN
Groundwater Depth:
While Drilling: No Groundwater Encountered
At Completion: ---
After Drilling: ---
Notes:

Surface Elevation: 1519.3 ft
Latitude: 35.4125589° Longitude: -84.0873614°
State Plane Coord: N 398414.8486 ft E 2538114.6078 ft
Date Started: 4/18/24 Date Completed: 4/18/24
Driller/Company: A. Clements/Stantec Drill CME-45
Hammer Type: 140 lbs Automatic Hammer Efficiency: 87.1 %
Logger/Company: Y. Oumoussi/Stantec
Weather: Cloudy

Sheet: 1 of 1
Datum: NAVD88
Datum: NAD83

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Type	No.	Field Blow Count (Recovery) / Core Rec., RQD, and Frac. Freq.	Test Results
			LOOSE GRAVEL - 1 INCH 0.1 ft / El. 1519.2 ft					
			POORLY GRADED GRAVEL WITH CLAY AND SAND (GP-GC), brown with gray, medium dense, dry to damp, contains iron oxide stains. Possible cobble from 5.0 to 5.4'	3-1/4" HSA	SS	SS-1	4-4-8 (9" = 50%)	
1515	5				SS	SS-2	17-7-13 (13" = 72%)	
			6.5 ft / El. 1512.8 ft LIMESTONE, gray, slightly strong, weathered, highly fractured, medium hard to hard.		SS	SS-3	5-50/2" (6" = 75%)	Difficult drilling from 6.5 to 7.3 ft
			8 ft / El. 1511.3 ft LIMESTONE (90%) INTERBEDDED WITH SHALE (10%), fine to coarse grained, gray, strong, slightly weathered, moderately to slightly fractured, hard. Becomes intact at 11.4'	NQ CORE	RC	RC-1	Rec = 100% RQD = 82%	Horizontal fractures from 8.0 to 11.4 ft
1510	10				RC	RC-2	Rec = 100% RQD = 100%	Elv. 1509.6 ft UC = 18130 psi
1505			14.6 ft / El. 1504.7 ft					



Refusal at 7.3 ft.
Bottom of borehole at 14.6 ft.

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U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

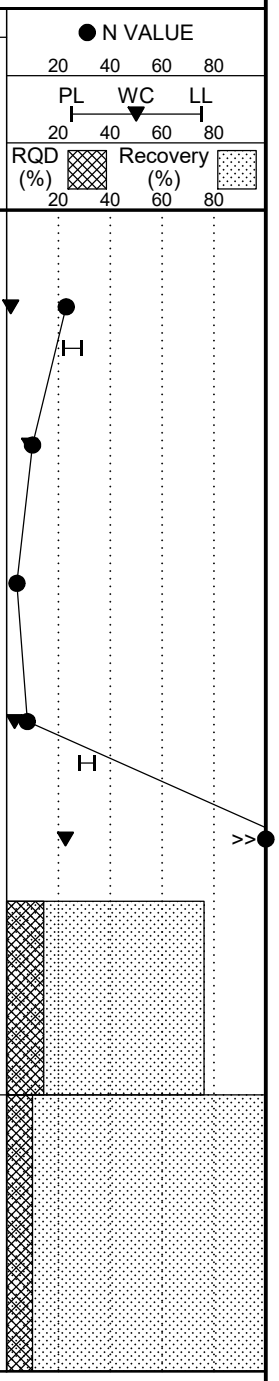
BORING LOG 487

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Project Location: Cherokee National Forest, TN
Groundwater Depth:
While Drilling: 11 ft / Elev 1441.8 ft During drilling.
At Completion: ---
After Drilling: 12 ft / Elev 1440.8 ft Before rock coring.
Notes:

Surface Elevation: 1452.8 ft
Latitude: 35.4159338° Longitude: -84.0891832°
State Plane Coord: N 399632.4797 ft E 2537830.5593 ft
Date Started: 4/18/24 Date Completed: 4/18/24
Driller/Company: A. Clements/Stantec Drill CME-45
Hammer Type: 140 lbs Automatic Hammer Efficiency: 87.1 %
Logger/Company: Y. Oumoussi/Stantec
Weather: Cloudy

Sheet: 1 of 1
Datum: NAVD88
Datum: NAD83

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Type	No.	Field Blow Count (Recovery) / Core Rec., RQD, and Frac. Freq.	Test Results
			LOOSE GRAVEL - 1 INCH 0.1 ft / El. 1452.7 ft					
			POORLY GRADED GRAVEL WITH CLAY AND SAND (GP-GC), brown and gray, loose to medium dense, dry. contains wood fragments and iron oxide stains at 3.5'	3-1/4" HSA	SS	SS-1	5-13-10 (8" = 44%)	
1450					SS	SS-2	5-5-5 (7" = 39%)	
	5		5.5 ft / El. 1447.3 ft WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM), gray with brown, loose, dry to damp. Wet at 11.0' Wood fragment at 11.0'		SS	SS-3	2-2-2 (0" = 0%)	
1445					SS	SS-4	2-4-4 (13" = 72%)	
	10		11.5 ft / El. 1441.3 ft LIMESTONE, gray and brown, weak, highly weathered, highly fractured, soft.		SS	SS-5	2-50/3" (5" = 56%)	Difficult drilling from 11.5 to 12.5 ft
1440			13.7 ft / El. 1439.1 ft LIMESTONE, medium to coarse grained, gray, strong, moderately to slightly weathered, fractured to moderately fractured, hard.	NQ CORE	RC	RC-1	Rec = 76% RQD = 14%	Elv. 1439.7 ft UC = 16070 psi
	15		14.4 ft / El. 1438.4 ft LIMESTONE, gray, strong, moderately weathered, fractured to moderately fractured, hard. Highly fractured from 17.1 to 17.6'		RC	RC-2	Rec = 100% RQD = 10%	Vertical and diagonal fractures from 13.7 to 21.0 ft
1435								
	20		21 ft / El. 1431.8 ft					



Refusal at 12.5 ft.
Bottom of borehole at 21 ft.

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U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

BORING LOG 508

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Project Location: Cherokee National Forest, TN
Groundwater Depth:
While Drilling: No Groundwater Encountered
At Completion: ---
After Drilling: ---
Notes:

Surface Elevation: 1244.7 ft
Latitude: 35.431403° Longitude: -84.1044271°
State Plane Coord: N 405173.7604 ft E 2533180.1496 ft
Date Started: 4/18/24 Date Completed: 4/18/24
Driller/Company: A. Clements/Stantec Drill CME-45
Hammer Type: 140 lbs Automatic Hammer Efficiency: 87.1 %
Logger/Company: Y. Oumoussi/Stantec
Weather: Cloudy

Sheet: 1 of 1
Datum: NAVD88
Datum: NAD83

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Sample Type	Sample No.	Field Blow Count (Recovery) / Core Rec., RQD, and Frac. Freq.	Test Results	N VALUE / PL WC LL / RQD (%) / Recovery (%)
			SILTY, CLAYEY SAND WITH GRAVEL (SC-SM), brown with gray, dense to very dense, moist, contains iron oxide stains.	3-1/4" HSA					
					SS-1		8-12-50/2" (9" = 64%)		>> H
			2.5 ft / El. 1242.2 ft						
			SHALE, light gray to gray, moderately strong to strong, weathered, highly fractured, medium hard to hard.		GB-1		(12" = 100%)	Difficult drilling from 2.5 to 3.5 ft	
			3.9 ft / El. 1240.8 ft	NQ CORE					
			SHALE, gray, strong, slightly weathered to unweathered, fractured to moderately fractured, hard to very hard. Highly fractured from 9.1 to 9.3		RC-1		Rec = 91% RQD = 53%	Horizontal and diagonal fractures from 3.9 to 9.1 ft	
1240	5				RC-2		Rec = 100% RQD = 82%	Elv. 1438.9 ft UC = 5460 psi	
1235	10		10.7 ft / El. 1234 ft						

Refusal at 3.5 ft.
Bottom of borehole at 10.7 ft.

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U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

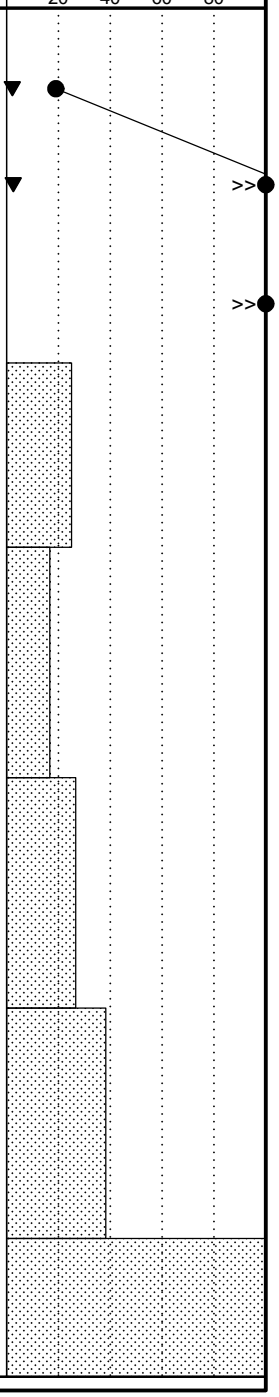
BORING LOG 515

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Project Location: Cherokee National Forest, TN
Groundwater Depth:
While Drilling: No Groundwater Encountered
At Completion: ---
After Drilling: ---
Notes:

Surface Elevation: 1047.3 ft
Latitude: 35.4474285° Longitude: -84.1093968°
State Plane Coord: N 410977.2443 ft E 2531587.2008 ft
Date Started: 4/17/24 Date Completed: 4/17/24
Driller/Company: A. Clements/Stantec Drill CME-45
Hammer Type: 140 lbs Automatic Hammer Efficiency: 87.1 %
Logger/Company: Y. Oumoussi/Stantec
Weather: Light Rain

Sheet: 1 of 1
Datum: NAVD88
Datum: NAD83

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Type	No.	Field Blow Count (Recovery) / Core Rec., RQD, and Frac. Freq.	Test Results
			LOOSE GRAVEL - 1 INCH (0.1 ft / El. 1047.2 ft)	3-1/4" HSA	GRAB	1	(12" = 100%)	
1045			WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM), dark gray, medium dense, dry, contains few iron oxide stains. (4 ft / El. 1043.3 ft)		SS	1	4-7-12 (14" = 78%)	
	5		COAL, black, weak, highly weathered, highly fractured, soft to medium hard.		SS	2	14-50/2" (8" = 100%)	
1040					SS	3	24-50/4" (8" = 80%)	
	10			NQ CORE	RC	1	Rec = 25% RQD = 0%	
1035					RC	2	Rec = 17% RQD = 0%	
	15							
1030			(18 ft / El. 1029.3 ft) CALCAREOUS AND CARBONACEOUS SHALE, dark gray, weak to slightly strong, highly weathered, highly fractured to fractured, medium hard.		RC	3	Rec = 27% RQD = 0%	
	20							
1025					RC	4	Rec = 38% RQD = 0%	
	25		(26.5 ft / El. 1020.8 ft) CALCAREOUS AND CARBONACEOUS SHALE, dark gray with white, moderately strong to strong, slightly weathered, highly fractured to fractured, hard.		RC	5	Rec = 100% RQD = 0%	
1020			(29.7 ft / El. 1017.6 ft)					



Bottom of borehole at 29.7 ft.

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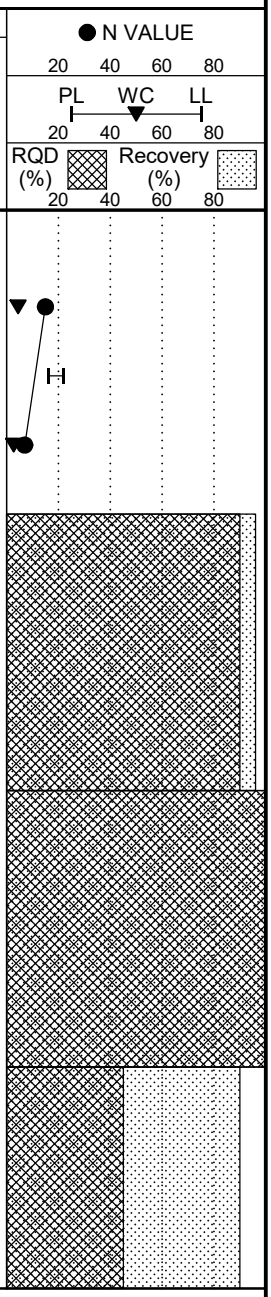
U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

BORING LOG 518-A

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Sheet: 1 of 1
Project Location: Cherokee National Forest, TN
Surface Elevation: 1009.5 ft
Datum: NAVD88
Groundwater Depth:
Latitude: 35.4506197° Longitude: -84.1183505°
Datum: NAD83
While Drilling: No Groundwater Encountered
State Plane Coord: N 412087.2048 ft E 2528898.4892 ft
At Completion: ---
Date Started: 4/17/24 Date Completed: 4/17/24
After Drilling: ---
Driller/Company: A. Clements/Stantec
Drill CME-45
Notes:
Hammer Type: 140 lbs Automatic
Hammer Efficiency: 87.1 %
Logger/Company: Y. Oumoussi/Stantec
Weather: Cloudy

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Sample Type	Sample No.	Field Blow Count (Recovery) / Core Rec., RQD, and Frac. Freq.	Test Results
			LOOSE GRAVEL - 1 INCH 0.1 ft / El. 1009.4 ft					
			POORLY GRADED GRAVEL WITH CLAY AND SAND (GP-GC), brown with dark gray, loose to medium dense, dry.	3-1/4" HSA	SS	SS-1	4-9-6 (5" = 28%)	
					SS	SS-2	3-5-2 (6" = 33%)	Difficult drilling from 5.0 to 5.5 ft
1005	5		5 ft / El. 1004.5 ft SANDSTONE, fine to medium grained, gray, strong to very strong, slightly weathered, slightly fractured, hard, contains few iron oxide stains. Highly fractured from 5.5 to 5.8' Clay from 10.2 to 10.4'	NQ CORE	RC	RC-1	Rec = 96% RQD = 90%	Elv. 1001.4 ft UC = 19600 psi
1000	10		10.4 ft / El. 999.1 ft SANDSTONE, medium to coarse grained, gray, very strong to extremely strong, slightly weathered, moderately to slightly fractured, very hard, contains iron oxide stains. Highly fractured from 15.8 to 16.4' Calcite fragments from 15.9 to 16.2' Becoming fine grained from 16.2' Highly fractured from 17.0 to 17.3'		RC	RC-2	Rec = 100% RQD = 100%	Diagonal and horizontal fractures from 12.2 to 16.9 ft Water loss from 13.5 to 15.5 ft
995	15				RC	RC-3	Rec = 90% RQD = 45%	
990			19.5 ft / El. 990 ft					



Refusal at 5.5 ft.
Bottom of borehole at 19.5 ft.

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U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

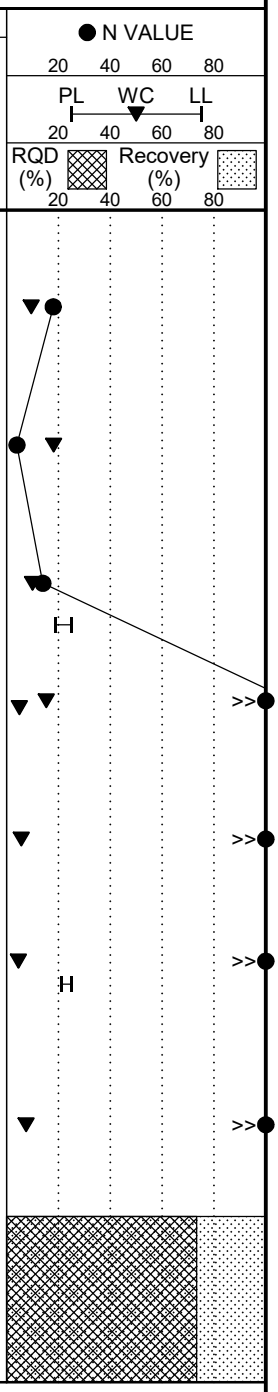
BORING LOG 518-B

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Project Location: Cherokee National Forest, TN
Groundwater Depth:
While Drilling: No Groundwater Encountered
At Completion: ---
After Drilling: ---
Notes:

Surface Elevation: 1010.1 ft
Latitude: 35.4505427° Longitude: -84.1181346°
State Plane Coord: N 412060.4089 ft E 2528963.3001 ft
Date Started: 4/16/24 Date Completed: 4/16/24
Driller/Company: A. Clements/Stanetc Drill CME-45
Hammer Type: 140 lbs Automatic Hammer Efficiency: 87.1 %
Logger/Company: Y. Oumoussi/Stantec
Weather: Partly Cloudy

Sheet: 1 of 1
Datum: NAVD88
Datum: NAD83

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Type	No.	Field Blow Count (Recovery) / Core Rec., RQD, and Frac. Freq.	Test Results
			LOOSE GRAVEL - 1.5 INCH 0.1 ft / El. 1010 ft					
			SILTY, CLAYEY SAND WITH GRAVEL (SC-SM), brown with gray, medium dense, damp. 3 ft / El. 1007.1 ft			SS-1	18-10-8 (17" = 94%)	
			CLAYEY SAND (SC), trace fine gravel, trace root fragments and organic odor, brown, very loose, moist. (Possible fill) 5.5 ft / El. 1004.6 ft			SS-2	2-2-2 (12" = 67%)	
1005	5		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM), brown with gray, medium dense to dense, damp to moist, contains iron oxide stains. 9 ft / El. 1001.1 ft			SS-3	2-8-6 (18" = 100%)	
			SANDSTONE BOULDER. 11 ft / El. 999.1 ft	3-1/4" HSA		SS-4	28-50/3" (6" = 67%)	Difficult drilling from 9.0 to 18.2 ft
1000	10		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM), brown and gray, very dense, dry to damp. 12 ft / El. 998.1 ft			SS-5	33-50/3" (4" = 44%)	
			SANDSTONE BOULDER. 14 ft / El. 996.1 ft			SS-6	50/2" (9" = 450%)	
995	15		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM), brown and gray, very dense, dry to damp. 16.5 ft / El. 993.6 ft			SS-7	8-33-50/1" (2" = 15%)	
			SANDSTONE BOULDER. 18.2 ft / El. 991.9 ft					
990	20		SANDSTONE, medium grained, light gray, strong to very strong, slightly weathered, moderately to slightly fractured. 21.2 ft / El. 988.9 ft	NQ CORE		RC-1	Rec = 100% RQD = 73%	Diagonal fracture from 19.0 to 19.5 ft Elv. 990.0 ft UC = 17550 psi



Refusal at 18.2 ft.
Bottom of borehole at 21.2 ft.

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U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL LANDS HIGHWAY DIVISION

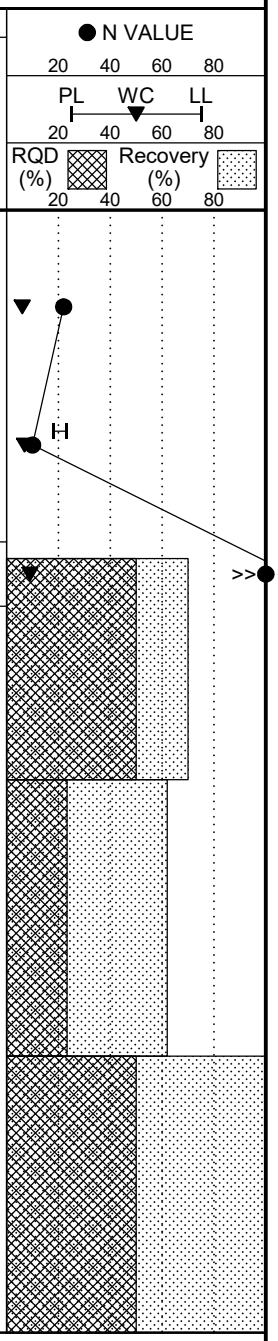
BORING LOG 518-C

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Project Location: Cherokee National Forest, TN
Groundwater Depth:
While Drilling: No Groundwater Encountered
At Completion: ---
After Drilling: ---
Notes:

Surface Elevation: 1010.2 ft
Latitude: 35.4504526° Longitude: -84.1178033°
State Plane Coord: N 412029.5159 ft E 2529062.6059 ft
Date Started: 4/16/24 Date Completed: 4/16/24
Driller/Company: A. Clements/Stantec Drill CME-45
Hammer Type: 140 lbs Automatic Hammer Efficiency: 87.1 %
Logger/Company: Y. Oumoussi/Stantec
Weather: Partly Cloudy

Sheet: 1 of 1
Datum: NAVD88
Datum: NAD83

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	Type	No.	Field Blow Count (Recovery) / Core Rec., RQD, and Frac. Freq.	Test Results
1010			LOOSE GRAVEL - 1 INCH 0.1 ft / El. 1010.1 ft					
			SILTY, CLAYEY SAND WITH GRAVEL(SC-SM), brown with gray, loose to medium dense, damp, contains iron oxide stains. Very dense at 6.0'	3-1/4" HSA		SS-1	17-14-8 (16" = 89%)	
						SS-2	9-6-4 (12" = 67%)	
1005	5		6.3 ft / El. 1003.9 ft					
			SANDSTONE BOULDER, gray and brown, strong, moderately weathered, moderately to slightly fractured, medium hard to hard.			SS-3	2-20-50/2" (12" = 86%)	Difficult drilling at 6.0 ft
			8.7 ft / El. 1001.5 ft	NQ CORE		RC-1	Rec = 70% RQD = 50%	
			CLAY LAYER.					
1000	10		10.8 ft / El. 999.4 ft					
			SANDSTONE BOULDER, gray with brown, strong, slightly weathered, moderately fractured, medium hard to hard. 11.7 ft / El. 998.5 ft			RC-2	Rec = 62% RQD = 23%	Elv. 999.3 ft UC = 18510 psi
			SANDY SILTSTONE, dark gray with brown, strong, highly to moderately weathered, highly to moderately fractured, medium hard to hard, contains many iron oxide stains. Possible soil layer from 14.7 to 15.0'					
995	15		17.7 ft / El. 992.5 ft			RC-3	Rec = 100% RQD = 50%	Horizontal and diagonal fractures from 11.7 to 20.3 ft Elv. 992.0 ft UC = 10820 psi
			SANDY SHALE, dark gray, moderately strong to strong, slightly weathered, moderately to slightly fractured, medium hard to hard.					
990	20		20.3 ft / El. 989.9 ft					



Refusal at 6.3 ft.
Bottom of borehole at 20.3 ft.

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Stantec Consulting Services Inc.
3052 Beaumont Centre Circle, Lexington KY 40513-1703

June 20, 2023 175599999

Attention: Mr. Daniel Rogers
Stantec Consulting Services Inc.
3052 Beaumont Centre Circle
Lexington, Kentucky 40513-1703

Reference: Automatic Hammer Energy Verification – CME 45C#2 (#811) Drill Rig SN: 273164

Dear Mr. Rogers,

Stantec Consulting Services Inc. (Stantec) is pleased to submit this letter regarding the automatic Standard Penetration Test (SPT) hammer energy verification of your 1996 CME 45C#2 (#811) SN: 273164. Included within this letter is a summary table followed by a detailed description of the testing equipment used, testing procedures and a summary of the test results.

Summary of Automatic Hammer Energy Verification	
Rig ID:	Stantec CME 45C#2 (#811) SN: 273164
Hammer Type:	CME Automatic (140-lb)
Project and Location:	Calibration Boring, Lexington, Kentucky
Test Date and Time:	January 5, 2023, 1530 - 1630
Equipment Operator:	Benjamin A. Halada (Stantec)
Drill Operator:	Andrew Clements (Stantec)
Energy Transfer Ratio (%) [Low-High-**Average**]	85.6% - 88.9% - **87.1%**

Equipment and Procedures

SPT hammer energy verification was performed on Thursday, January 5, 2023 while the drill was operating at Stantec's Maintenance Shop in Lexington, Kentucky. Stantec utilized energy measurement equipment manufactured by Pile Dynamics, Inc. (PDI), of Cleveland, Ohio. Equipment for data acquisition for energy measurements for dynamic penetrometers (per ASTM D 4633) consisted of PDI's Pile Driving Analyzer, Model SPT (SN 4565 TB), an instrumented AW-J rod (SN 420AWJ) with two strain gages (SN 420AWJ-1 and 420AWJ-2) and two piezoresistive accelerometers (SN K0166 and K2222). This system has a sampling frequency of 50 kHz. The instrumented rod measured two-feet in length and was located at the top of the drill string during energy measurement. The strain gages and accelerometers were located one-foot below the top of the instrumented rod. The SPTs were driven per ASTM D 1586.

The above referenced drill rig is equipped with a Central Mine Equipment (CME) automatic SPT hammer that utilizes a hydraulic motor to turn a chain that in turn lifts a 140-lb drive weight and releases the weight for a free fall distance of 30 inches. The drive weight impacts a CME anvil (12.75 inches in length and 2.50 inches in diameter) that is threaded into the top

of the instrumented rod. During the energy measurements, the hammer was operated in accordance with the manufacturers recommendations, was not lubricated between or during standard penetration tests, the blow rate was approximately 49 blows per minute and the auto hammer / sample rods were kept vertical during testing. At the time of the tests, the weather was 50° Fahrenheit with cloudy skies and a southwesterly wind of 12 to 15 miles per hour.

Standard Penetration Testing was performed using a standard two-inch outer diameter split spoon sampler that was driven 1.5 feet. Testing began at a depth of 30.0 feet below the ground surface and was performed intermittently to 50.0 feet below the ground surface. During the testing, the maximum transferred energy (EMX) was measured by the instrumented rod and compared to the theoretical potential energy (TPE) of the 140-lb drive weight dropping 30 inches. An energy transfer ratio (ETR) was then computed by dividing the EMX by the TPE.

Closing

The ETR for your 1996 CME 45C#2 (#811) SN: 273164 ranged from a low of 85.6% to a high of 88.9% with an average of 87.1%. Per ASTM D 4633, this hammer energy verification is valid for one year from the testing date of January 5, 2023. The attached Table 1 presents detailed results of the energy measurement.

Regards,

STANTEC CONSULTING SERVICES INC.

Benjamin A. Halada, PE
Senior Associate
Phone: (859) 422-3070
ben.halada@stantec.com

Attachment: Table 1: Summary of SPT Results – Stantec CME 45C#2 (#811)
Test interval summaries and plots of force and normalized velocity versus time
Pile Driving Analyzer, Model SPT Calibration
Rod Calibration
Piezoresistive Accelerometer Calibration

Table 1: Summary of SPT Results - CME 45C#2 (#811)

Stantec Consulting Services Inc.
Test Date: 1/5/2023
Drill Rig: CME 45C#2 (#811) SN: 273164
Rod Size: AW-J
Driller: Andrew Clements

Project Number: 175599999
Boring ID: CAL
Location: Lexington, KY
Hammer: 140 lbs
Drop Height: 30 inches
Theoretical Potential Energy (TPE): 350 lbs-ft

Test Date	Sample ID	Rod Length [1] (feet)	Beginning Depth [2] (feet)	Ending Depth [2] (feet)	Blow Counts (blows/6")	Field N-Value	Hammer Blow Rate (bpm)	Avg. Max Compressive Force (FMX) (kips)	Average Maximum Velocity (VMX) (ft/sec)	Transferred Energy (EMX) (lbs-ft)	Avg. Energy Transfer Ratio (ETR) [3] (%)
1/5/2023	SS01	35.0	30.0	31.5	**5 - 13 - 23**	**36**	49	29.8	19.3	311.1	88.9
1/5/2023	SS02	40.0	35.0	36.5	**7 - 16 - 20**	**36**	50	28.8	20.4	311.1	88.9
1/5/2023	SS03	45.0	40.0	41.5	**5 - 8 - 15**	**23**	50	28.7	19.5	302.6	86.4
1/5/2023	SS04	50.0	45.0	46.5	**7 - 12 - 26**	**38**	50	30.8	19.9	299.8	85.6
1/5/2023	SS05	54.0	50.0	51.5	**9 - 21 - 13**	**34**	50	30.5	19.2	299.8	85.7
							(bpm)	(kips)	(ft/sec)	(lbs-ft)	(%)
						Overall Average Values:	49	29.7	19.7	304.9	87.1
						Standard Deviation:	0.5	0.9	0.4	5.2	1.5

1 - Depth below the location of the gages.
2 - Depth from existing ground surface.
3 - Computed from the (EMX / TPE) * 100%

APPENDIX C
Laboratory Test Results

Stantec

Moisture Content of Soil

AASHTO T 265

Project Name TN ERFO FS CHRKE804 2020-2(5)

Project Number 2026252404

Tested By JP

Test Method AASHTO

Maximum Particle Size in Sample	No. 40	No. 4	1/2"	1"	2"	
Recommended Minimum Mass (g)	10	100	300	500	1,000	

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
406, 1.0'-2.5'	2	5/21/24	Dist	No. 4			No	21.18	52.63	49.89	9.5
406, 3.5'-5.0'	3	5/21/24	Dist	No. 4			No	20.88	37.93	37.05	5.4
406, 6.0'-7.5'	4	5/21/24	Dist	No. 4			No	21.69	51.77	49.57	7.9
406, 8.5'-10.0'	5	5/21/24	Dist	No. 4			No	20.82	51.26	47.97	12.1
406, 11.0'-12.5'	6	5/15/24	Dist	No. 4			No	32.51	83.50	77.64	13.0
406, 13.5'-15.0'	8	5/15/24	Dist	No. 4			No	32.31	71.74	63.32	27.2
406, 18.5'-20.0'	10	5/15/24	Dist	No. 4			No	31.89	62.14	55.33	29.1
406, 21.0'-22.5'	12	5/15/24	Dist	No. 4			No	31.15	68.39	59.38	31.9
406, 23.5'-25.0'	13	5/15/24	Hom	No. 4			No	30.57	62.98	54.29	36.6
411, 1.0'-2.5'	15	5/21/24	Dist	No. 4			No	21.06	51.35	48.56	10.1
411, 3.5'-5.0'	16	5/21/24	Dist	No. 4			No	21.10	51.18	49.52	5.8
411, 6.0'-7.5'	17	5/21/24	Dist	No. 4			No	21.15	51.29	49.12	7.8
411, 8.5'-10.0'	19	5/15/24	Dist	No. 4			No	31.95	63.22	59.60	13.1
411, 11.0'-12.5'	20	5/15/24	Dist	No. 4			No	32.17	63.76	60.02	13.4
428-A, 1.0'-2.5'	22	5/21/24	Dist	No. 4			No	20.78	50.85	49.67	4.1
428-A, 3.5'-5.0'	23	5/21/24	Dist	No. 4			No	21.04	51.04	49.86	4.1
428-A, 6.0'-7.5'	24	5/21/24	Dist	No. 4			No	20.81	50.85	49.63	4.2
428-B, 1.0'-2.5'	25	5/15/24	Dist	No. 4			No	31.27	73.82	72.09	4.2
431, 1.0'-2.5'	26	5/15/24	Dist	No. 4			No	32.26	69.45	64.68	14.7
433, 1.0'-2.5'	27	5/15/24	Dist	No. 4			No	21.07	83.68	78.46	9.1
433, 3.5'-5.0'	29	5/21/24	Dist	No. 4			No	20.69	52.95	49.74	11.0
433, 6.0'-7.5'	30	5/21/24	Dist	No. 4			No	20.92	51.40	49.25	7.6
433, 8.5'-10.0'	31	5/21/24	Dist	No. 4			No	21.04	51.46	48.56	10.5
433, 11.0'-12.5'	32	5/15/24	Dist	No. 4			No	21.16	64.86	63.85	2.4
452, 1.0'-2.5'	33	5/15/24	Dist	No. 4			No	21.69	59.15	58.01	3.1
452, 3.5'-5.0'	35	5/15/24	Dist	No. 4			No	21.11	62.41	59.40	7.9
452, 6.0'-7.5'	36	5/15/24	Dist	No. 4			No	20.79	55.70	53.84	5.6
452, 8.5'-10.0'	37	5/15/24	Dist	No. 4			No	20.69	63.83	59.64	10.8

Stantec

Moisture Content of Soil

AASHTO T 265

Project Name TN ERFO FS CHRKE804 2020-2(5)

Project Number 2026252404

Tested By JP

Test Method AASHTO

Maximum Particle Size in Sample	No. 40	No. 4	1/2"	1"	2"	
Recommended Minimum Mass (g)	10	100	300	500	1,000	

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
466-A, 1.0'-2.5'	39	5/21/24	Dist	No. 4			No	21.02	51.93	49.50	8.5
466-A, 3.5'-5.0'	40	5/21/24	Dist	No. 4			No	20.93	51.14	47.03	15.7
466-A, 6.0'-7.5'	41	5/21/24	Dist	No. 4			No	20.92	51.35	47.73	13.5
466-A, 8.5'-10.0'	42	5/21/24	Dist	No. 4			No	20.96	51.32	47.41	14.8
466-A, 11.0'-12.5'	44	5/15/24	Dist	No. 4			No	20.89	52.79	44.90	32.9
466-A, 13.5'-15.0'	45	5/15/24	Dist	No. 4			No	20.89	51.33	45.19	25.3
466-A, 16.0'-17.5'	47	5/15/24	Dist	No. 4			No	20.92	61.78	57.62	11.3
466-A, 18.5'-20.0'	48	5/15/24	Dist	No. 4			No	20.82	51.20	46.31	19.2
466-A, 21.0'-22.5'	49	5/15/24	Dist	No. 4			No	21.13	67.56	66.46	2.4
466-B, 1.0'-2.5'	51	5/21/24	Dist	No. 4			No	20.89	52.66	48.13	16.6
466-B, 3.5'-5.0'	52	5/21/24	Dist	No. 4			No	20.78	51.51	47.66	14.3
466-B, 6.0'-7.5'	53	5/21/24	Dist	No. 4			No	20.90	51.43	48.21	11.8
466-B, 8.5'-10.0'	54	5/15/24	Dist	No. 4			No	20.93	52.44	48.51	14.2
466-B, 11.0'-12.5'	55	5/15/24	Dist	No. 4			No	20.82	64.21	56.84	20.5
466-B, 13.5'-15.0'	57	5/15/24	Dist	No. 4			No	20.80	52.37	46.88	21.1
466-B, 16.0'-17.5'	58	5/15/24	Dist	No. 4			No	21.06	61.40	55.31	17.8
466-B, 18.5'-20.0'	59	5/15/24	Dist	No. 4			No	21.04	59.27	54.16	15.4
466-B, 23.0'-23.5'	60	5/15/24	Dist	No. 4			No	21.18	72.08	66.73	11.7
469, 1.0'-2.5'	61	5/15/24	Dist	No. 4			No	21.25	53.99	50.70	11.2
469, 3.5'-5.0'	63	5/15/24	Dist	No. 4			No	21.19	57.77	53.58	12.9
469, 6.0'-7.5'	64	5/15/24	Dist	No. 4			No	20.92	61.23	55.54	16.4
481-A, 1.0'-2.5'	66	5/15/24	Dist	No. 4			No	20.82	56.14	54.98	3.4
481-A, 3.5'-5.0'	67	5/15/24	Dist	No. 4			No	20.89	56.09	54.86	3.6
481-A, 6.0'-7.5'	68	5/15/24	Dist	No. 4			No	20.98	51.24	50.60	2.2
481-B, 1.0'-2.5'	69	5/15/24	Dist	No. 4			No	20.96	53.75	52.55	3.8
485, 0.0'-1.5'	70	5/15/24	Dist	No. 4			No	31.66	51.64	50.18	7.9
486, 1.0'-2.5'	72	5/15/24	Dist	No. 4			No	31.80	63.71	62.43	4.2
486, 3.5'-5.0'	73	5/15/24	Dist	No. 4			No	31.93	62.78	59.57	11.6

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Moisture Content of Soil

AASHTO T 265

Project Name TN ERFO FS CHRKE804 2020-2(5)

Project Number 2026252404

Tested By JP

Test Method AASHTO

Maximum Particle Size in Sample	No. 40	No. 4	1/2"	1"	2"	
Recommended Minimum Mass (g)	10	100	300	500	1,000	

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
486, 6.0'-7.5'	74	5/15/24	Dist	No. 4			No	31.94	64.26	62.91	4.4
487, 1.0'-2.5'	76	5/15/24	Dist	No. 4			No	32.23	62.71	62.24	1.6
487, 3.5'-5.0'	77	5/15/24	Dist	No. 4			No	32.17	65.02	62.33	8.9
487, 8.5'-10.0'	80	5/15/24	Dist	No. 4			No	32.21	65.98	64.98	3.1
487, 11.0'-12.5'	81	5/15/24	Dist	No. 4			No	32.05	62.87	57.17	22.7
508, 1.0'-2.5'	83	5/15/24	Dist	No. 4			No	31.67	62.02	60.24	6.2
508, 2.5'-3.5'	84	5/15/24	Dist	No. 4			No	32.25	63.31	63.09	0.7
515, 1.0'-2.5'	86	5/15/24	Dist	No. 4			No	31.89	61.98	61.33	2.2
515, 3.5'-5.0'	87	5/15/24	Dist	No. 4			No	30.71	61.01	60.23	2.6
518-A, 1.0'-2.5'	90	5/15/24	Dist	No. 4			No	30.72	60.97	59.70	4.4
518-A, 3.5'-5.0'	91	5/15/24	Dist	No. 4			No	31.63	61.75	60.96	2.7
518-B, 1.0'-2.5'	93	5/21/24	Dist	No. 4			No	20.96	54.80	51.87	9.5
518-B, 3.5'-5.0'	94	5/21/24	Dist	No. 4			No	20.79	51.29	46.62	18.1
518-B, 6.0'-7.5'	96	5/21/24	Dist	No. 4			No	21.19	51.70	48.92	10.0
518-B, 8.5'-9.0'	97	5/21/24	Dist	No. 4			No	21.17	51.60	47.56	15.3
518-B, 9.0'-9.3'	98	5/21/24	Dist	No. 4			No	31.82	69.58	67.81	4.9
518-B, 11.0'-12.5'	100	5/21/24	Dist	No. 4			No	32.21	65.77	63.97	5.7
518-B, 13.5'-15.0'	101	5/21/24	Dist	No. 4			No	32.06	62.29	60.96	4.6
518-B, 16.0'-17.5'	102	5/21/24	Dist	No. 4			No	31.93	64.70	62.41	7.5
518-C, 1.0'-2.5'	104	5/21/24	Dist	No. 4			No	32.22	65.23	63.32	6.1
518-C, 3.5'-5.0'	105	5/21/24	Dist	No. 4			No	32.26	64.01	61.96	6.9
518-C, 6.0'-7.5'	106	5/21/24	Dist	No. 4			No	30.67	64.54	61.73	9.0

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Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	406, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	1
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 8.7

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	82.2
3/8"	9.5	61.2
No. 4	4.75	51.3
No. 10	2	41.6
No. 40	0.425	27.3
No. 200	0.075	13.5
	0.02	12.2
	0.005	8.4
	0.002	7.0
Estimated	0.001	5.6

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	48.7	58.4
Coarse Sand	9.7	14.3
Medium Sand	14.3	---
Fine Sand	13.8	13.8
Silt	5.1	6.5
Clay	8.4	7.0

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	26
Plastic Limit:	18
Plasticity Index:	8
Activity Index:	1.1

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GC
Group Name:	Clayey Gravel with Sand
AASHTO Classification:	A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 406, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'

Project Number: 2026252404
Lab ID: 1

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-22-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	82.2
3/8"	61.2
No. 4	51.3
No. 10	41.6

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

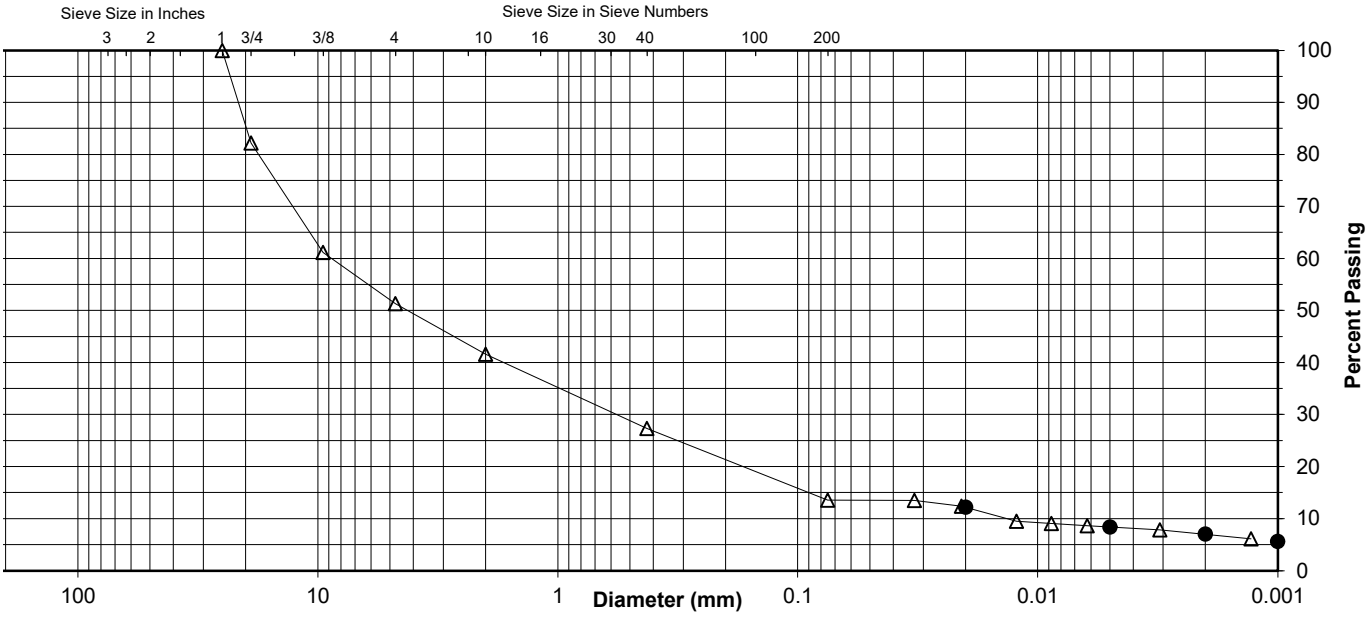
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	27.3
No. 200	13.5
0.02 mm	12.2
0.005 mm	8.4
0.002 mm	7.0
0.001 mm	5.6

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	17.8	30.9	9.7	14.3	13.8	5.1	8.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	58.4			14.3	13.8	6.5	7.0



Comments

Reviewed By REL

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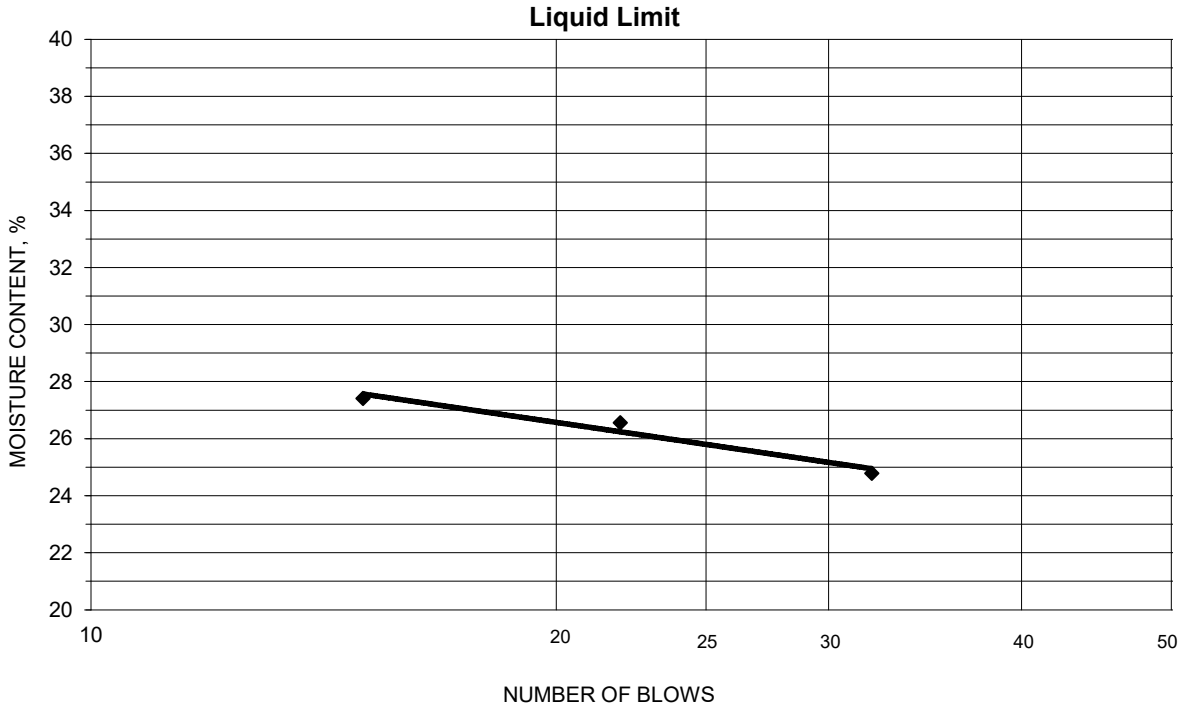
ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	406, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	1
		% + No. 40	73
Tested By	NU	Test Method	AASHTO T 89 & T 90
Test Date	05-30-2024	Prepared	Dry
		Date Received	05-13-2024

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.20	18.15	10.67	15	27.4	
19.46	17.59	10.55	22	26.6	
20.95	18.95	10.88	32	24.8	26



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.07	21.23	11.03	18.0	18	8
22.69	20.88	10.61	17.6		

Remarks: _____

Reviewed By REL

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Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	406, 13.5'-15.0', 18.5'-20.0'	Lab ID	7
Sample Type	SS-6 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 29.6

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
3/4"	19	100.0
3/8"	9.5	96.9
No. 4	4.75	95.1
No. 10	2	87.0
No. 40	0.425	76.3
No. 200	0.075	40.6
	0.02	25.7
	0.005	17.9
	0.002	14.5
Estimated	0.001	13.1

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	4.9	13.0
Coarse Sand	8.1	10.7
Medium Sand	10.7	---
Fine Sand	35.7	35.7
Silt	22.7	26.1
Clay	17.9	14.5

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	26
Plastic Limit:	19
Plasticity Index:	7
Activity Index:	0.5

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC-SM
Group Name:	Silty, Clayey Sand
AASHTO Classification:	A-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 406, 13.5'-15.0', 18.5'-20.0'

Project Number: 2026252404
Lab ID: 7

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-16-2024
Date Received: 05-13-2024

Maximum Particle Size: 3/4" Sieve

Sieve Size	% Passing
3/4"	100.0
3/8"	96.9
No. 4	95.1
No. 10	87.0

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	76.3
No. 200	40.6
0.02 mm	25.7
0.005 mm	17.9
0.002 mm	14.5
0.001 mm	13.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	4.9	8.1	10.7	35.7	22.7	17.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	13.0			10.7	35.7	26.1	14.5

Comments

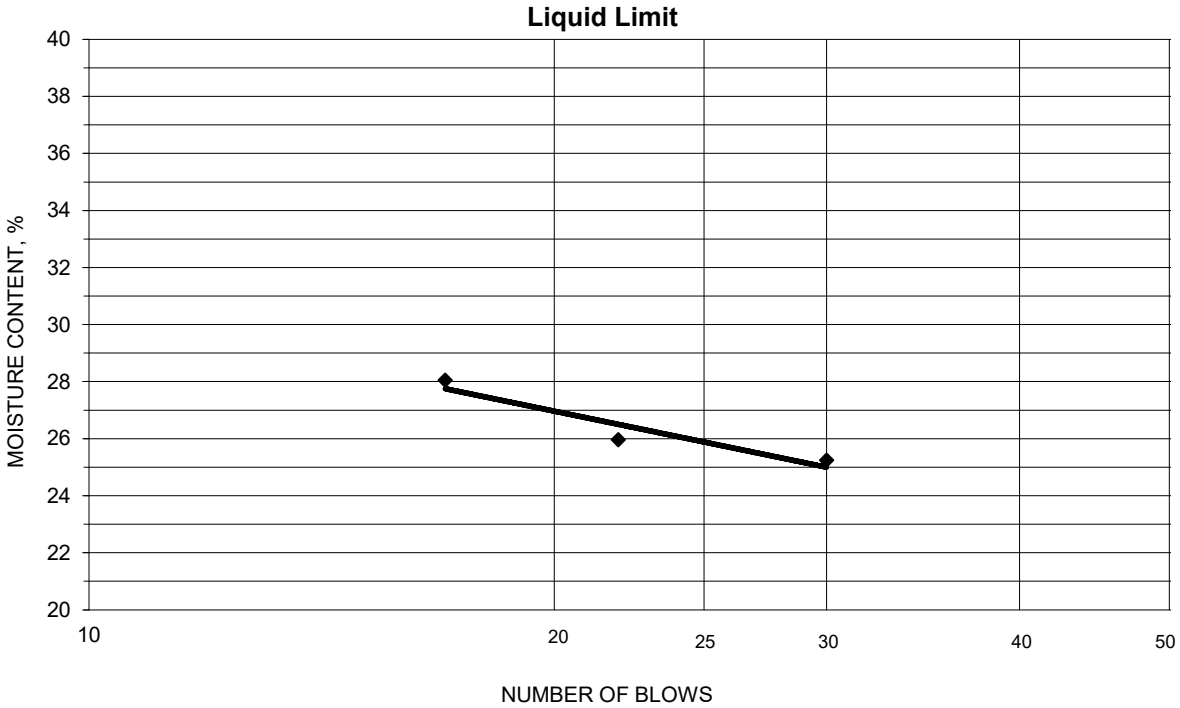
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	406, 13.5'-15.0', 18.5'-20.0'	Lab ID	7
		% + No. 40	24
Tested By	GK	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-21-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
22.28	19.82	11.05	17	28.1	
25.76	22.71	10.96	22	26.0	
26.28	23.21	11.05	30	25.2	26



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.21	19.53	11.01	19.7	19	7
22.40	20.57	11.02	19.2		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	406, 21.0'-22.5', 23.5'-25.0'	Lab ID	11
Sample Type	SS-9 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 34.3

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	99.1
No. 200	0.075	57.7
	0.02	31.4
	0.005	19.2
	0.002	16.7
Estimated	0.001	15.1

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.1
Coarse Sand	0.1	0.8
Medium Sand	0.8	---
Fine Sand	41.4	41.4
Silt	38.5	41.0
Clay	19.2	16.7

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	25
Plastic Limit:	20
Plasticity Index:	5
Activity Index:	0.3

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	CL-ML
Group Name:	Sandy Silty Clay
AASHTO Classification:	A-4 (1)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 406, 21.0'-22.5', 23.5'-25.0'

Project Number: 2026252404
Lab ID: 11

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-16-2024
Date Received: 05-13-2024

Maximum Particle Size: No. 4 Sieve

Sieve Size	% Passing
No. 4	100.0
No. 10	99.9

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

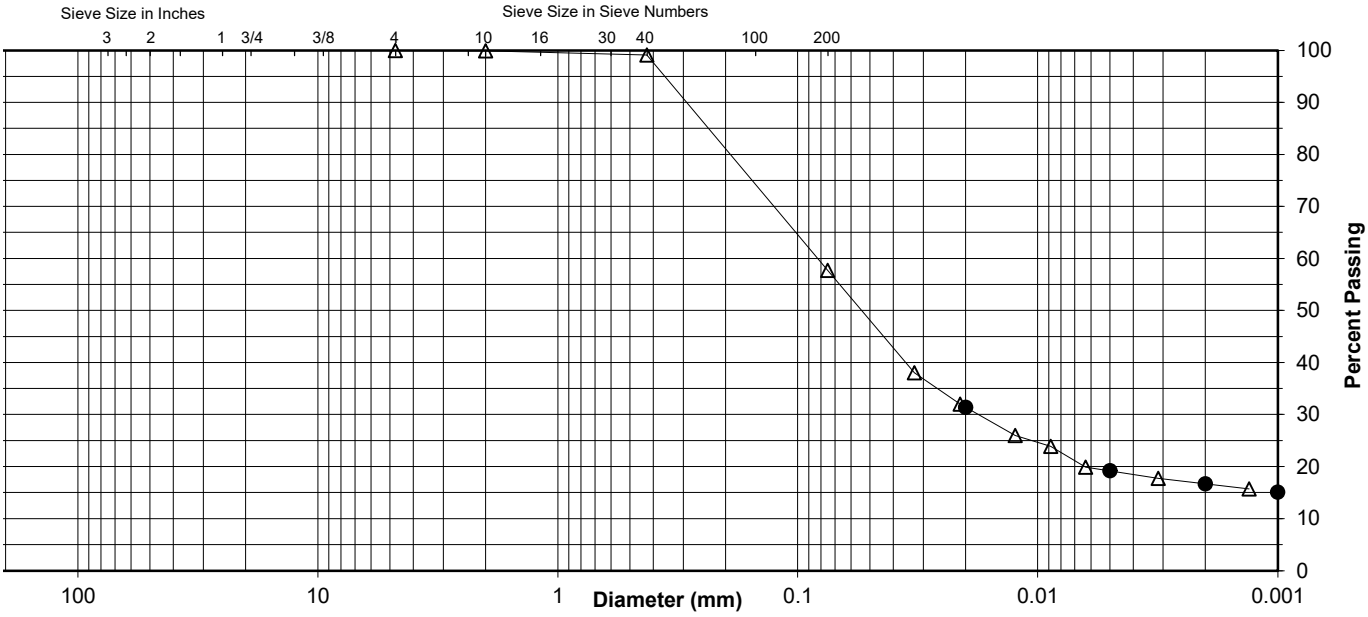
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	99.1
No. 200	57.7
0.02 mm	31.4
0.005 mm	19.2
0.002 mm	16.7
0.001 mm	15.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.1	0.8	41.4	38.5	19.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.1			0.8	41.4	41.0	16.7



Comments

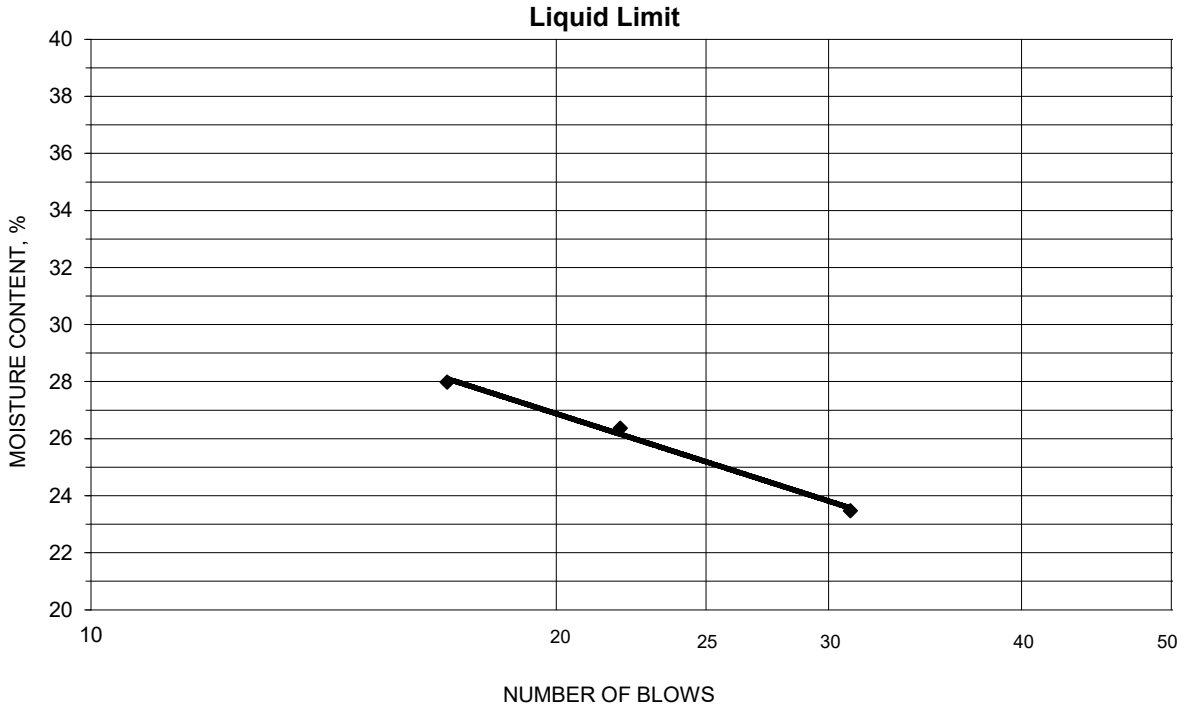
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	406, 21.0'-22.5', 23.5'-25.0'	Lab ID	11
		% + No. 40	1
Tested By	GK	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-29-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
21.87	19.50	11.03	17	28.0	25
24.23	21.39	10.62	22	26.4	
24.37	21.83	11.01	31	23.5	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.87	20.08	11.03	19.8	20	5
21.34	19.67	11.06	19.4		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	411, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	14
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 7.9

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	82.7
3/8"	9.5	72.1
No. 4	4.75	63.9
No. 10	2	53.3
No. 40	0.425	39.8
No. 200	0.075	21.3
	0.02	14.3
	0.005	9.5
	0.002	7.6
Estimated	0.001	6.3

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	36.1	46.7
Coarse Sand	10.6	13.5
Medium Sand	13.5	---
Fine Sand	18.5	18.5
Silt	11.8	13.7
Clay	9.5	7.6

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	25
Plastic Limit:	17
Plasticity Index:	8
Activity Index:	1.1

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC
Group Name:	Clayey Sand with Gravel
AASHTO Classification:	A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	411, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	14

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-22-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	82.7
3/8"	72.1
No. 4	63.9
No. 10	53.3

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

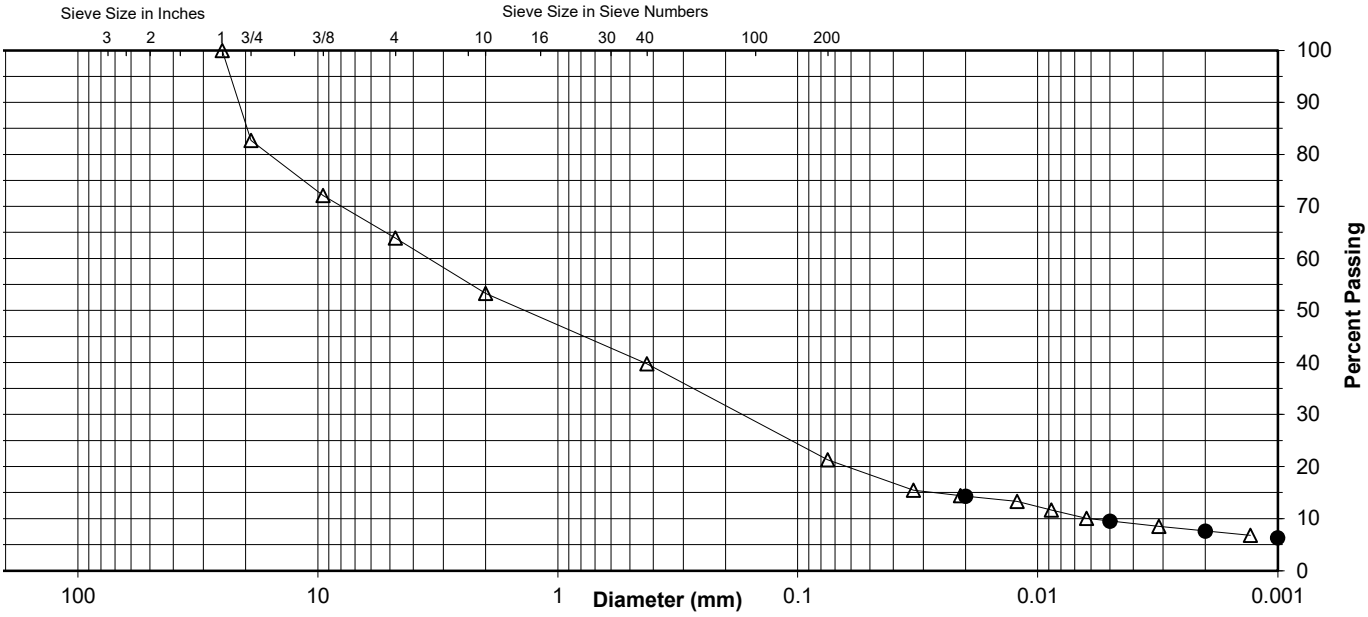
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	39.8
No. 200	21.3
0.02 mm	14.3
0.005 mm	9.5
0.002 mm	7.6
0.001 mm	6.3

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	17.3	18.8	10.6	13.5	18.5	11.8	9.5

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	46.7	13.5	18.5	13.7	7.6



Comments

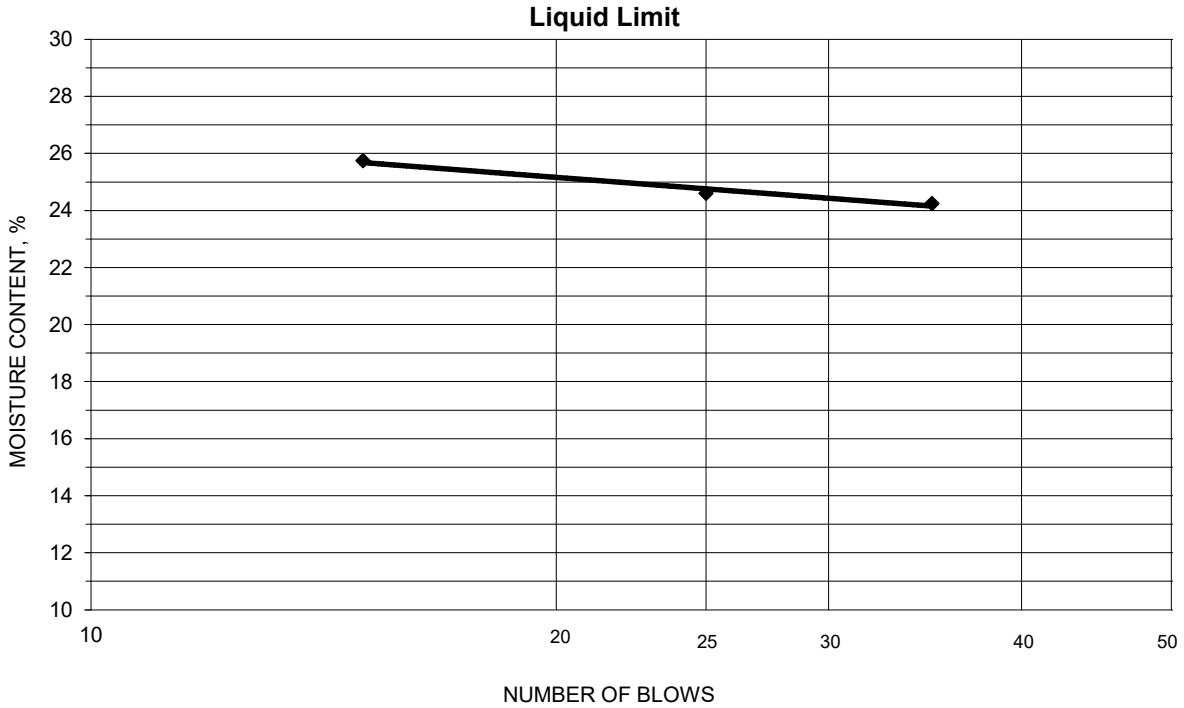
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	411, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	14
		% + No. 40	60
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-30-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.94	18.12	11.05	15	25.7	25
19.17	17.46	10.51	25	24.6	
19.75	17.98	10.68	35	24.2	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.18	21.40	11.07	17.2	17	8
23.17	21.44	11.00	16.6		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	411, 8.5'-10.0', 11.0'-12.5'	Lab ID	18
Sample Type	SS-4 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 13.3

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	82.1
3/8"	9.5	73.9
No. 4	4.75	68.9
No. 10	2	59.9
No. 40	0.425	34.7
No. 200	0.075	12.7
	0.02	9.3
	0.005	6.5
	0.002	5.4
Estimated	0.001	5.0

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	31.1	40.1
Coarse Sand	9.0	25.2
Medium Sand	25.2	---
Fine Sand	22.0	22.0
Silt	6.2	7.3
Clay	6.5	5.4

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	20
Plastic Limit:	17
Plasticity Index:	3
Activity Index:	0.6

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SM
Group Name:	Silty Sand with Gravel
AASHTO Classification:	A-1-b (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 411, 8.5'-10.0', 11.0'-12.5'

Project Number: 2026252404
Lab ID: 18

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-16-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	82.1
3/8"	73.9
No. 4	68.9
No. 10	59.9

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

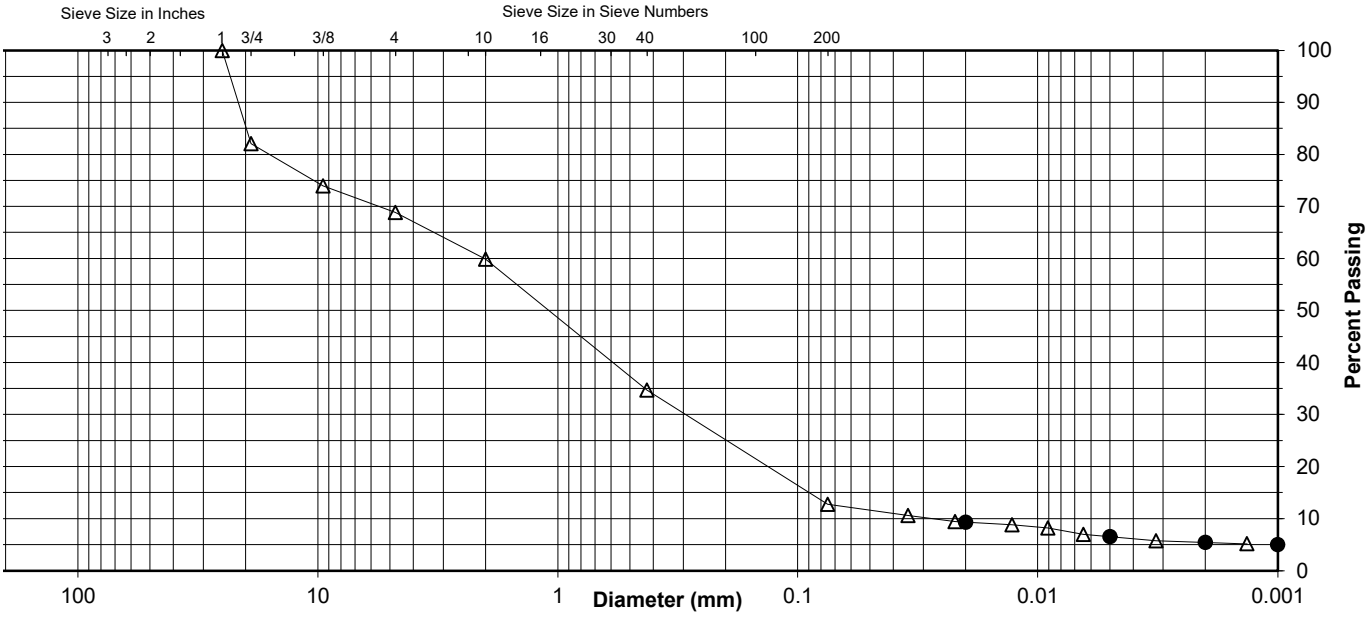
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	34.7
No. 200	12.7
0.02 mm	9.3
0.005 mm	6.5
0.002 mm	5.4
0.001 mm	5.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	17.9	13.2	9.0	25.2	22.0	6.2	6.5
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	40.1			25.2	22.0	7.3	5.4



Comments

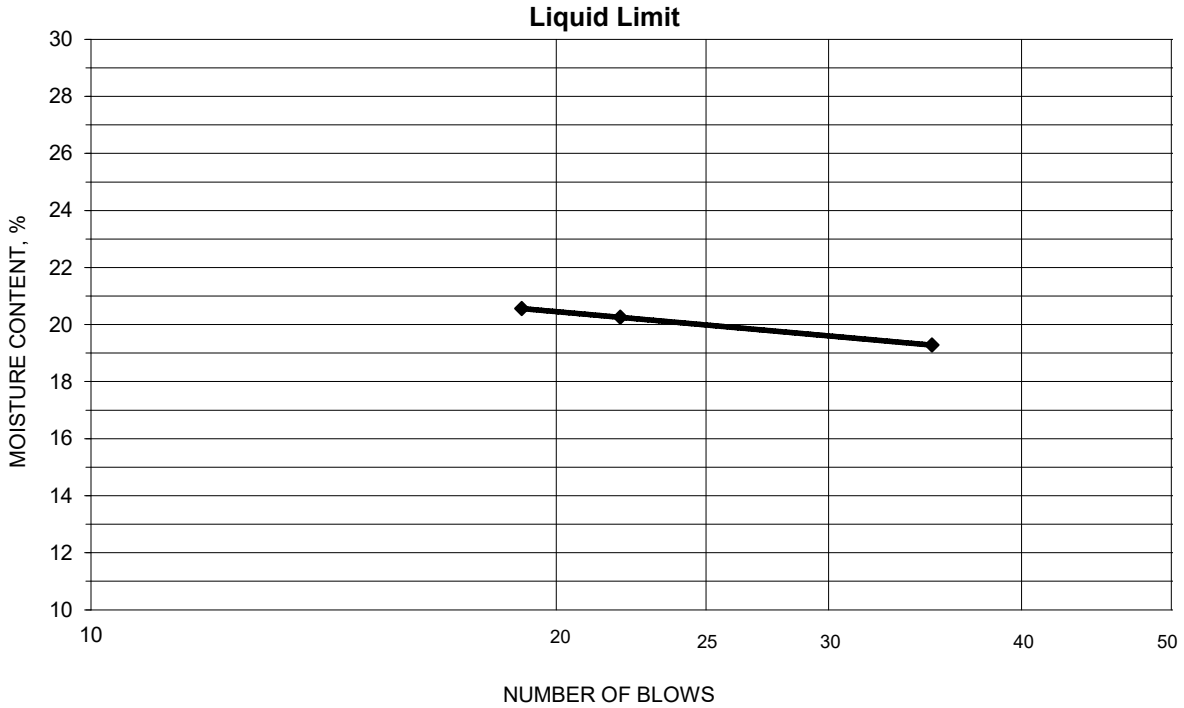
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	411, 8.5'-10.0', 11.0'-12.5'	Lab ID	18
		% + No. 40	65
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-23-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
18.24	16.92	10.50	19	20.6	20
20.52	18.93	11.08	22	20.3	
20.36	18.86	11.08	35	19.3	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
25.08	23.10	11.07	16.5	17	3
25.02	23.04	11.08	16.6		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	428-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	21
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 4.1

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	79.1
3/8"	9.5	62.2
No. 4	4.75	52.5
No. 10	2	45.6
No. 40	0.425	24.6
No. 200	0.075	9.3
	0.02	8.0
	0.005	6.4
	0.002	5.1
Estimated	0.001	4.0

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	47.5	54.4
Coarse Sand	6.9	21.0
Medium Sand	21.0	---
Fine Sand	15.3	15.3
Silt	2.9	4.2
Clay	6.4	5.1

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit: 17
Plastic Limit: 16
Plasticity Index: 1
Activity Index: 0.2

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: GP-GM
Group Name: Poorly Graded Gravel with Silt and Sand

AASHTO Classification: A-1-a (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	428-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	21

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-22-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	79.1
3/8"	62.2
No. 4	52.5
No. 10	45.6

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

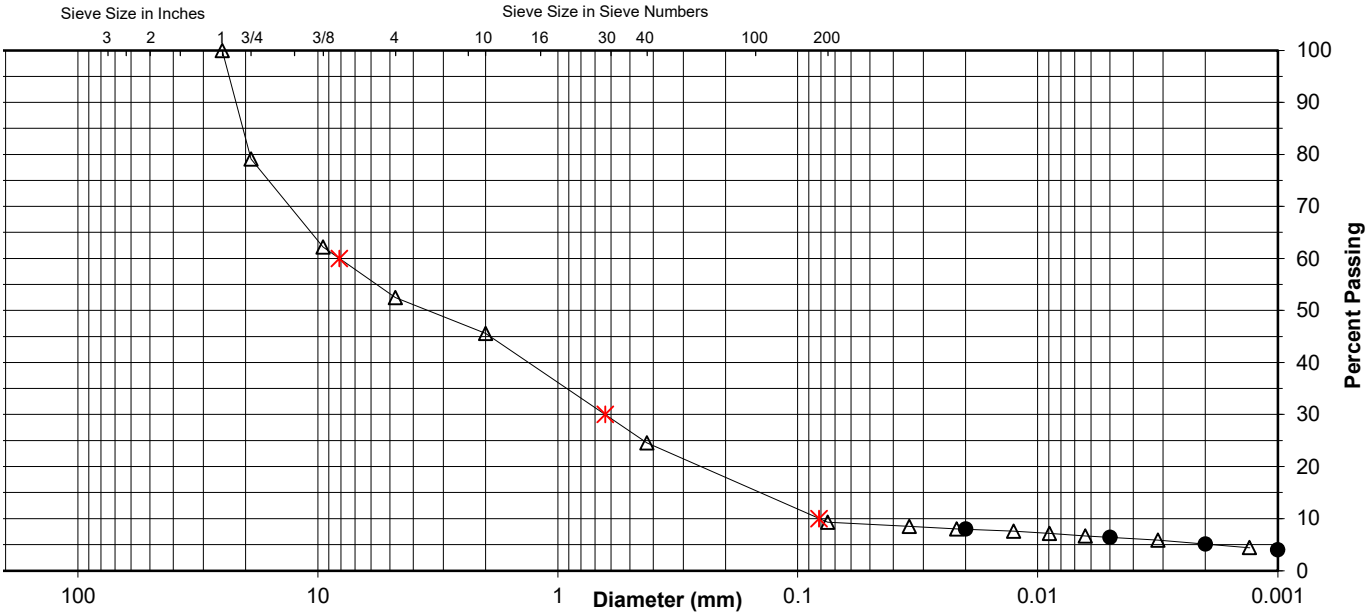
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	24.6
No. 200	9.3
0.02 mm	8.0
0.005 mm	6.4
0.002 mm	5.1
0.001 mm	4.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	20.9	26.6	6.9	21.0	15.3	2.9	6.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	54.4			21.0	15.3	4.2	5.1



Comments

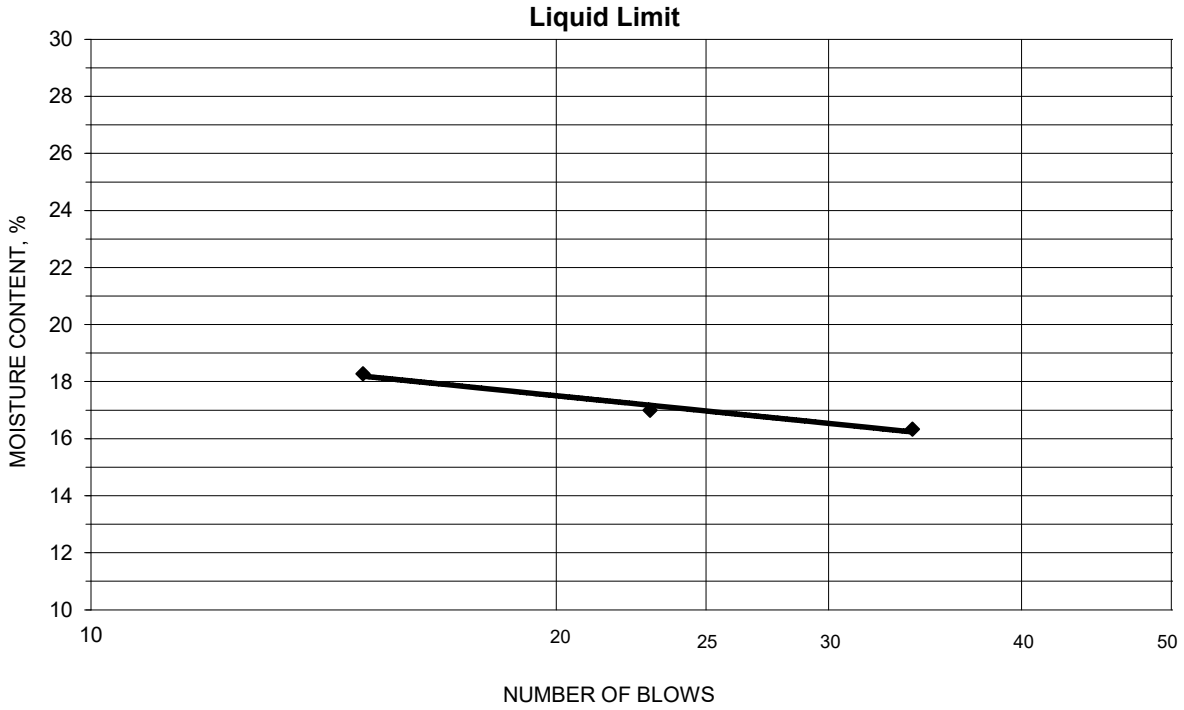
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	428-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	21
		% + No. 40	75
Tested By	GK	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-29-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
22.40	20.64	11.01	15	18.3	
20.97	19.52	10.64	34	16.3	
21.12	19.66	11.07	23	17.0	17



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
22.33	20.80	11.07	15.7	16	1
22.43	20.86	10.66	15.4		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	433, 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	28
Sample Type	SS-2 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 9.7

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	84.7
3/8"	9.5	75.0
No. 4	4.75	69.2
No. 10	2	60.3
No. 40	0.425	35.5
No. 200	0.075	18.1
	0.02	15.9
	0.005	12.1
	0.002	10.1
Estimated	0.001	8.1

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	30.8	39.7
Coarse Sand	8.9	24.8
Medium Sand	24.8	---
Fine Sand	17.4	17.4
Silt	6.0	8.0
Clay	12.1	10.1

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	26
Plastic Limit:	19
Plasticity Index:	7
Activity Index:	0.7

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC-SM
Group Name:	Silty, Clayey Sand with Gravel
AASHTO Classification:	A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	433, 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	28

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-22-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	84.7
3/8"	75.0
No. 4	69.2
No. 10	60.3

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

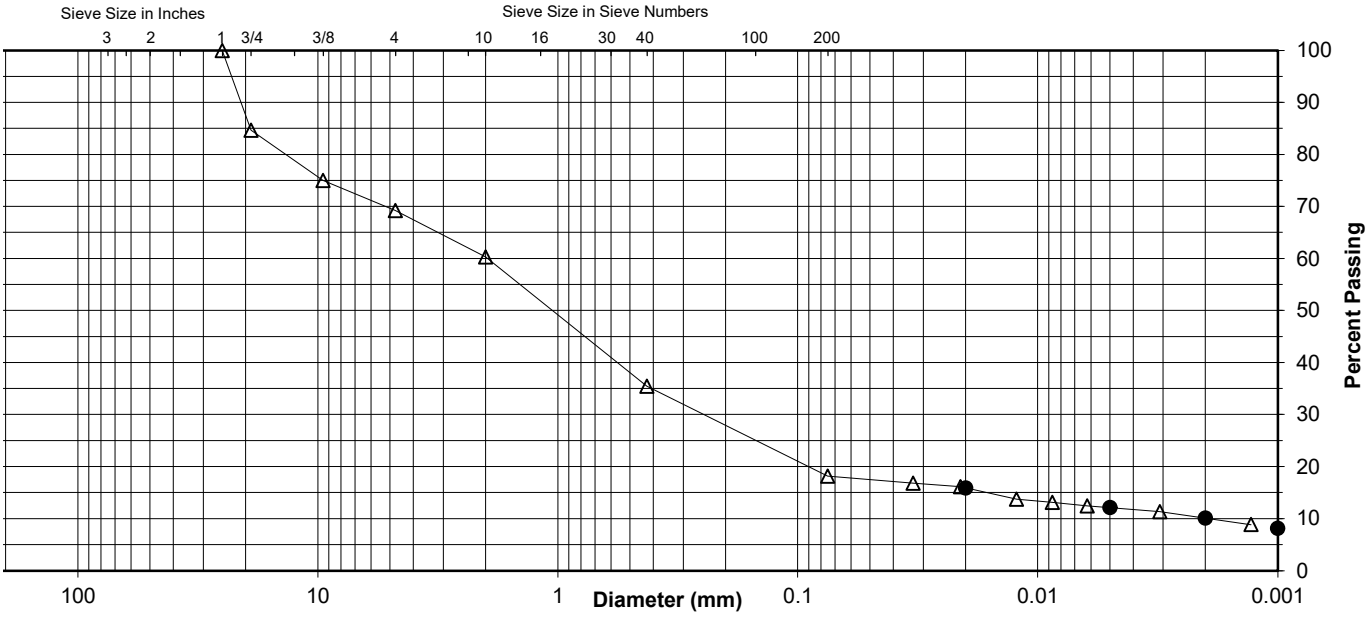
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	35.5
No. 200	18.1
0.02 mm	15.9
0.005 mm	12.1
0.002 mm	10.1
0.001 mm	8.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	15.3	15.5	8.9	24.8	17.4	6.0	12.1
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	39.7			24.8	17.4	8.0	10.1



Comments

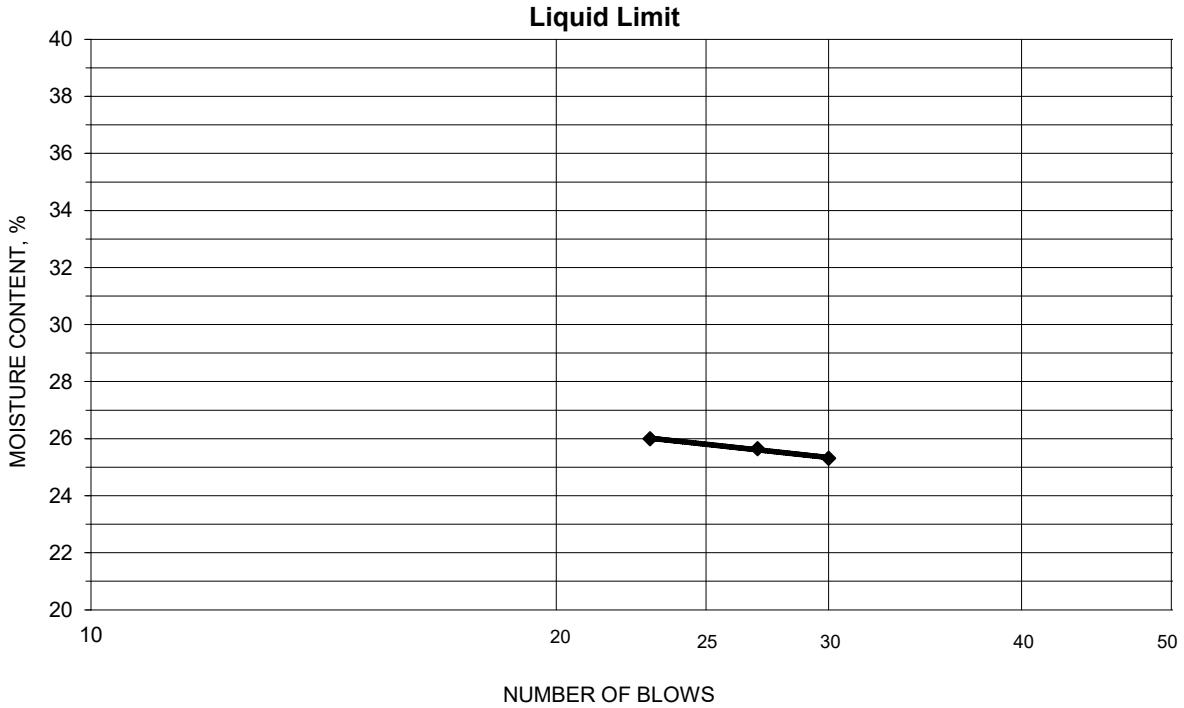
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	433, 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	28
		% + No. 40	65
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-30-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.87	18.05	11.05	23	26.0	26
19.90	18.02	10.69	27	25.6	
19.02	17.41	11.05	30	25.3	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.18	21.27	11.04	18.7	19	7
22.98	21.05	10.62	18.5		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	452, 3.5'-5.0', 6.0'-7.5'	Lab ID	34
Sample Type	SS-2 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 6.8

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	92.6
3/8"	9.5	78.7
No. 4	4.75	71.6
No. 10	2	59.6
No. 40	0.425	36.2
No. 200	0.075	17.9
	0.02	12.6
	0.005	7.7
	0.002	6.3
Estimated	0.001	5.4

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	28.4	40.4
Coarse Sand	12.0	23.4
Medium Sand	23.4	---
Fine Sand	18.3	18.3
Silt	10.2	11.6
Clay	7.7	6.3

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	24
Plastic Limit:	17
Plasticity Index:	7
Activity Index:	1.1

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC-SM
Group Name:	Silty, Clayey Sand with Gravel
AASHTO Classification:	A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	452, 3.5'-5.0', 6.0'-7.5'	Lab ID	34

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-16-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	92.6
3/8"	78.7
No. 4	71.6
No. 10	59.6

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

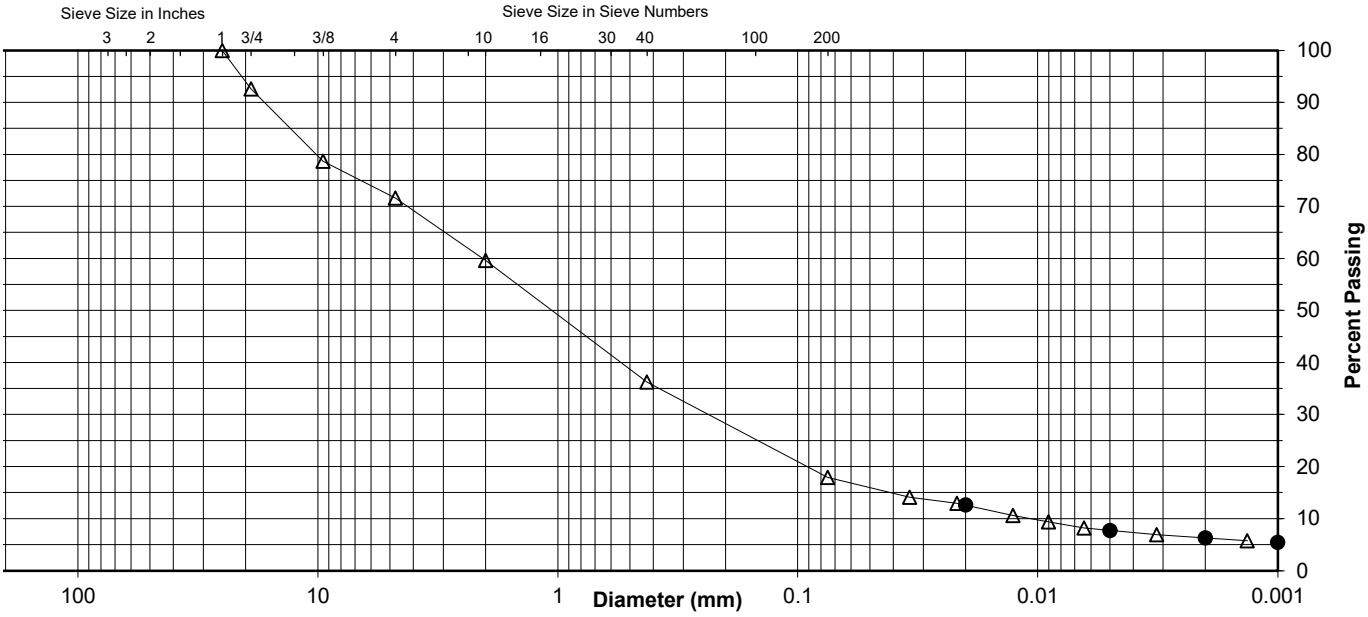
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	36.2
No. 200	17.9
0.02 mm	12.6
0.005 mm	7.7
0.002 mm	6.3
0.001 mm	5.4

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	7.4	21.0	12.0	23.4	18.3	10.2	7.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	40.4			23.4	18.3	11.6	6.3



Comments

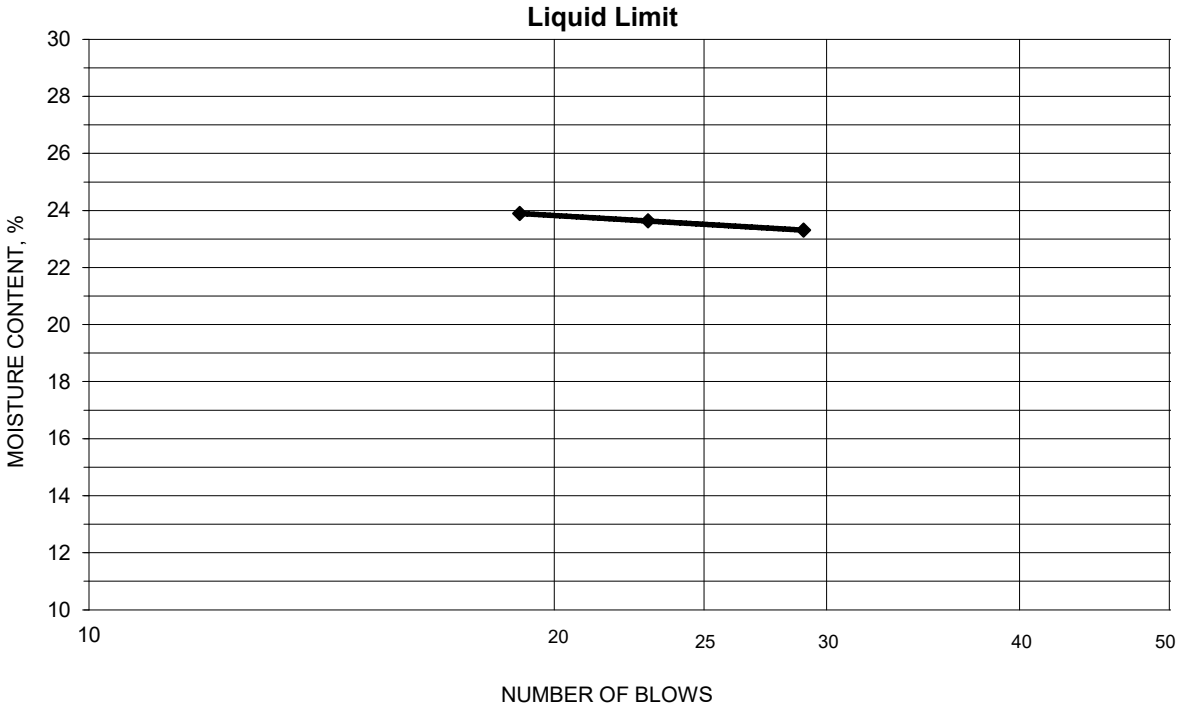
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	452, 3.5'-5.0', 6.0'-7.5'	Lab ID	34
		% + No. 40	64
Tested By	GK	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-21-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
24.38	21.82	10.99	23	23.6	24
25.03	22.31	10.64	29	23.3	
22.33	20.12	10.87	19	23.9	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.50	19.98	11.03	17.0	17	7
21.31	19.82	11.06	17.0		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	38
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 13.1

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	91.5
3/8"	9.5	81.7
No. 4	4.75	76.0
No. 10	2	68.7
No. 40	0.425	50.0
No. 200	0.075	35.4
	0.02	23.8
	0.005	13.7
	0.002	10.5
Estimated	0.001	7.7

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	24.0	31.3
Coarse Sand	7.3	18.7
Medium Sand	18.7	---
Fine Sand	14.6	14.6
Silt	21.7	24.9
Clay	13.7	10.5

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit: 31
Plastic Limit: 23
Plasticity Index: 8
Activity Index: 0.8

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SM
Group Name: Silty Sand with Gravel

AASHTO Classification: A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	38

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-22-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	91.5
3/8"	81.7
No. 4	76.0
No. 10	68.7

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	50.0
No. 200	35.4
0.02 mm	23.8
0.005 mm	13.7
0.002 mm	10.5
0.001 mm	7.7

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	8.5	15.5	7.3	18.7	14.6	21.7	13.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	31.3			18.7	14.6	24.9	10.5

Comments

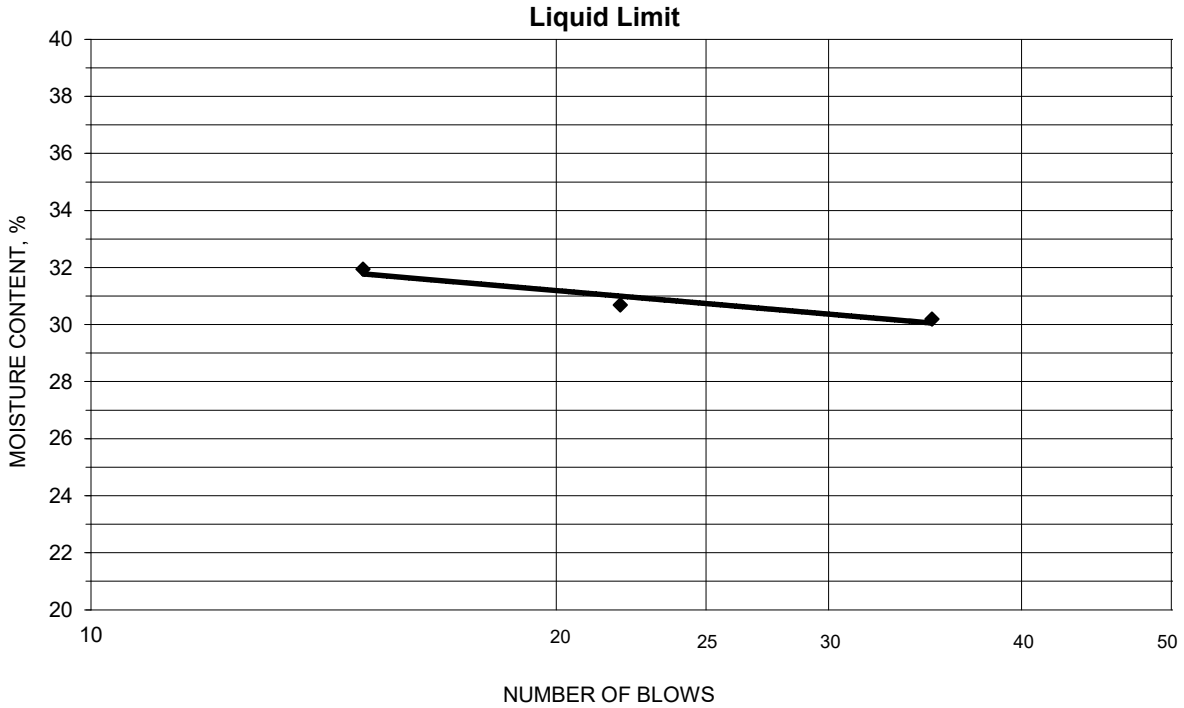
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	466-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	38
		% + No. 40	50
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-30-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.97	17.82	11.09	15	31.9	31
19.59	17.58	11.03	22	30.7	
19.73	17.71	11.02	35	30.2	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.98	21.54	10.99	23.1	23	8
24.03	21.57	11.07	23.4		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-A, 11.0'-12.5', 13.5'-15.0'	Lab ID	43
Sample Type	SS-5 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 29.1

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	89.8
3/8"	9.5	87.8
No. 4	4.75	86.3
No. 10	2	83.1
No. 40	0.425	63.6
No. 200	0.075	40.3
	0.02	24.1
	0.005	9.9
	0.002	6.3
Estimated	0.001	5.0

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	13.7	16.9
Coarse Sand	3.2	19.5
Medium Sand	19.5	---
Fine Sand	23.3	23.3
Silt	30.4	34.0
Clay	9.9	6.3

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	45
Plastic Limit:	36
Plasticity Index:	9
Activity Index:	1.4

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SM
Group Name:	Silty Sand
AASHTO Classification:	A-5 (1)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 466-A, 11.0'-12.5', 13.5'-15.0'

Project Number: 2026252404
Lab ID: 43

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-16-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	89.8
3/8"	87.8
No. 4	86.3
No. 10	83.1

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

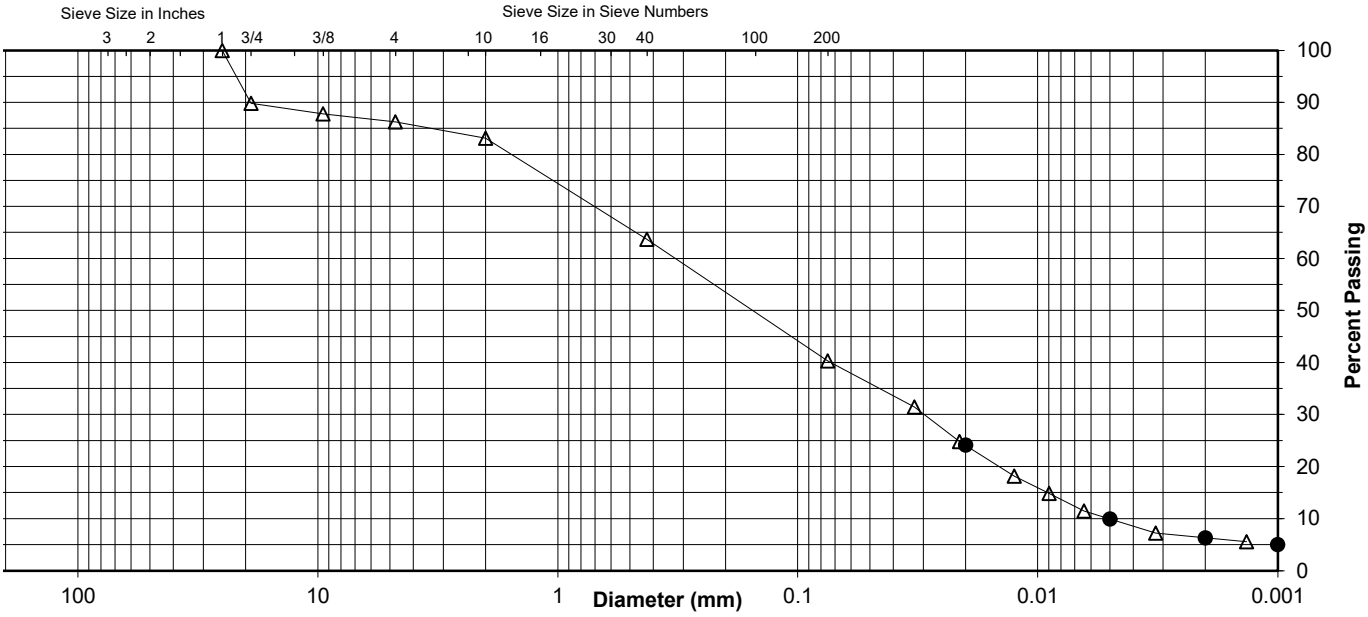
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	63.6
No. 200	40.3
0.02 mm	24.1
0.005 mm	9.9
0.002 mm	6.3
0.001 mm	5.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	10.2	3.5	3.2	19.5	23.3	30.4	9.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	16.9			19.5	23.3	34.0	6.3



Comments

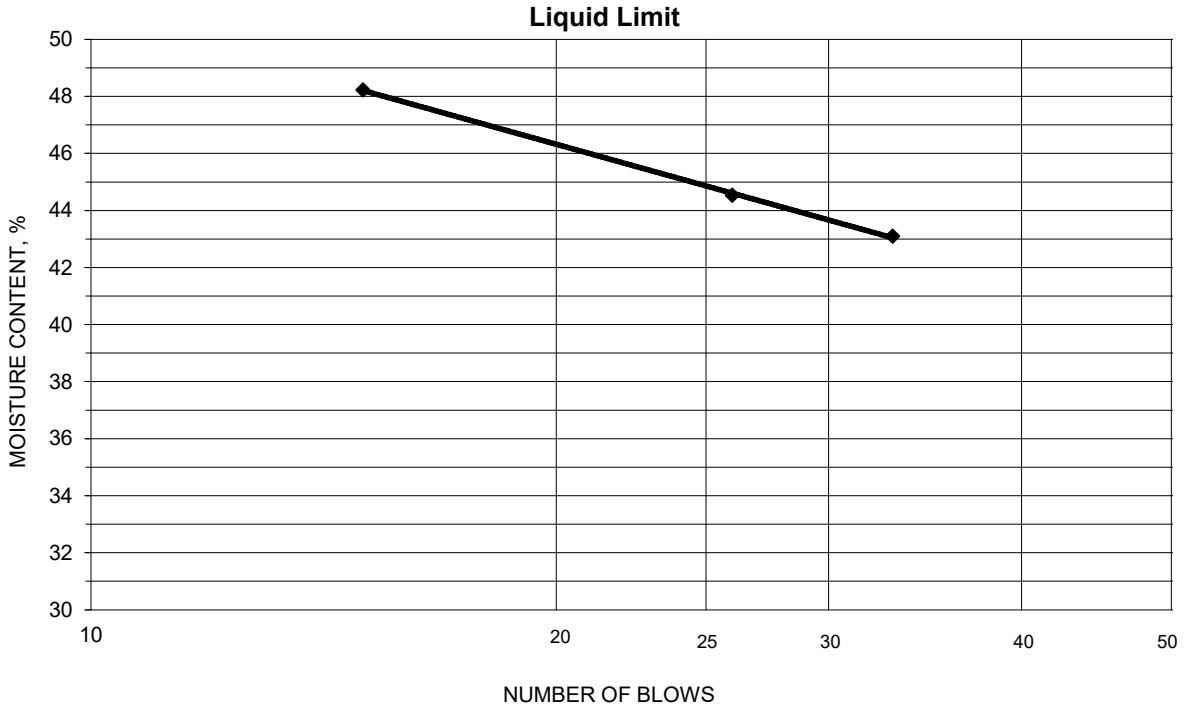
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	466-A, 11.0'-12.5', 13.5'-15.0'	Lab ID	43
		% + No. 40	36
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-21-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.44	16.72	11.08	15	48.2	45
20.19	17.38	11.07	26	44.5	
19.20	16.61	10.60	33	43.1	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.89	20.42	10.97	36.7	36	9
23.99	20.51	10.83	36.0		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-A, 16.0'-17.5', 18.5'-20.0'	Lab ID	46
Sample Type	SS-7 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 15.3

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	98.1
3/8"	9.5	93.5
No. 4	4.75	92.6
No. 10	2	88.5
No. 40	0.425	73.1
No. 200	0.075	40.6
	0.02	20.0
	0.005	5.8
	0.002	3.7
Estimated	0.001	3.1

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	7.4	11.5
Coarse Sand	4.1	15.4
Medium Sand	15.4	---
Fine Sand	32.5	32.5
Silt	34.8	36.9
Clay	5.8	3.7

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	35
Plastic Limit:	29
Plasticity Index:	6
Activity Index:	1.6

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SM
Group Name:	Silty Sand
AASHTO Classification:	A-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 466-A, 16.0'-17.5', 18.5'-20.0'

Project Number: 2026252404
Lab ID: 46

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-16-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	98.1
3/8"	93.5
No. 4	92.6
No. 10	88.5

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	73.1
No. 200	40.6
0.02 mm	20.0
0.005 mm	5.8
0.002 mm	3.7
0.001 mm	3.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	1.9	5.5	4.1	15.4	32.5	34.8	5.8
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	11.5			15.4	32.5	36.9	3.7

Comments

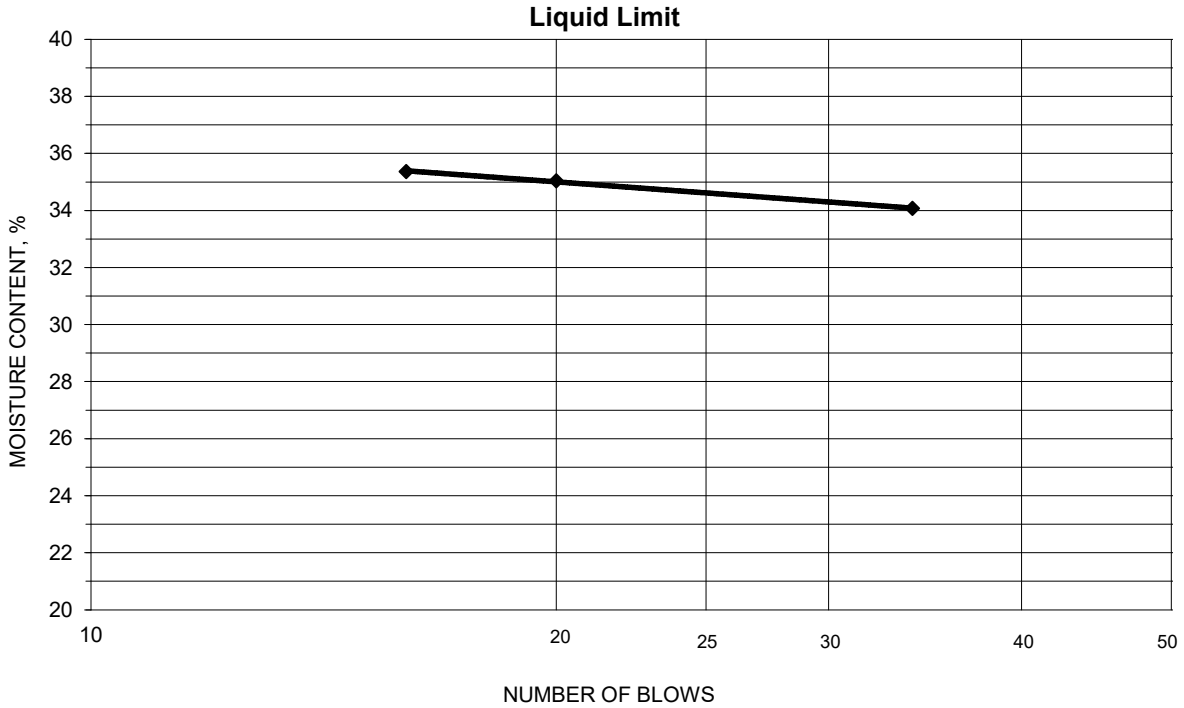
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	466-A, 16.0'-17.5', 18.5'-20.0'	Lab ID	46
		% + No. 40	27
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-23-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.46	17.26	11.04	16	35.4	
20.61	18.14	11.09	20	35.0	
18.98	16.83	10.52	34	34.1	35



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
24.70	21.53	10.60	29.0	29	6
25.13	21.99	11.05	28.7		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-B, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	50
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 14.2

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	95.6
3/8"	9.5	81.6
No. 4	4.75	72.2
No. 10	2	62.1
No. 40	0.425	47.9
No. 200	0.075	37.1
	0.02	29.2
	0.005	17.1
	0.002	12.8
Estimated	0.001	9.2

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	27.8	37.9
Coarse Sand	10.1	14.2
Medium Sand	14.2	---
Fine Sand	10.8	10.8
Silt	20.0	24.3
Clay	17.1	12.8

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit: 37
Plastic Limit: 26
Plasticity Index: 11
Activity Index: 0.9

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SM
Group Name: Silty Sand with Gravel

AASHTO Classification: A-6 (1)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 466-B, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'

Project Number: 2026252404
Lab ID: 50

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-22-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	95.6
3/8"	81.6
No. 4	72.2
No. 10	62.1

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

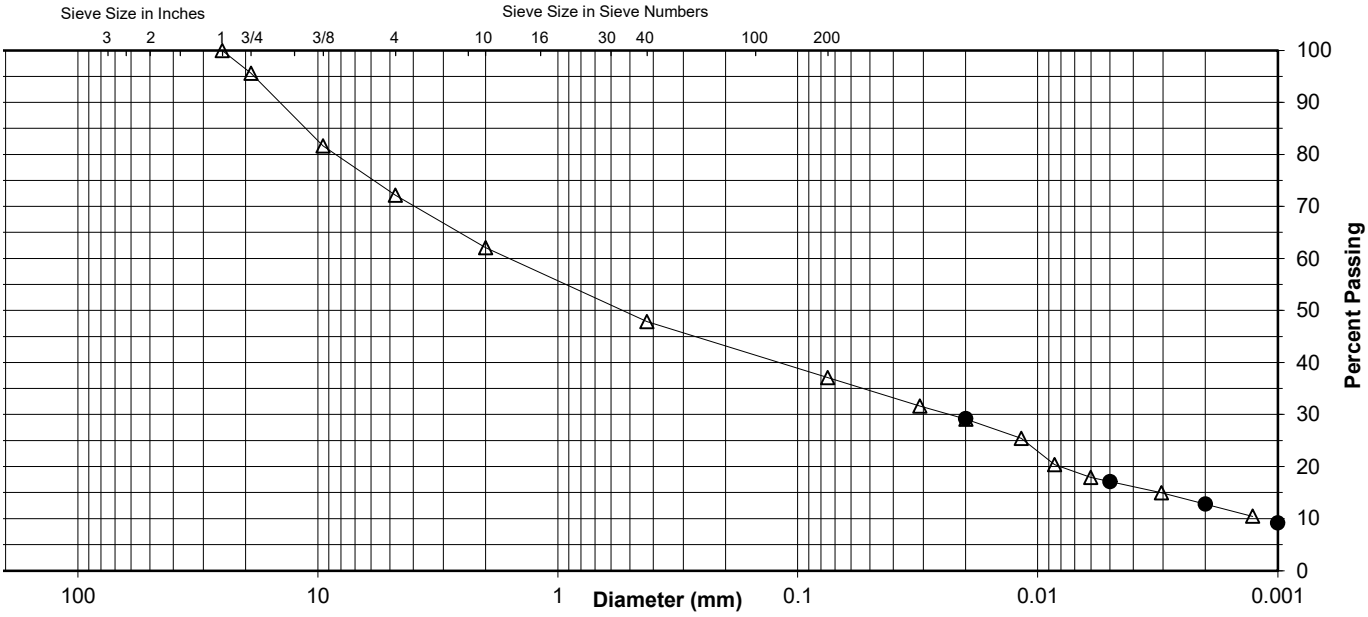
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	47.9
No. 200	37.1
0.02 mm	29.2
0.005 mm	17.1
0.002 mm	12.8
0.001 mm	9.2

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	4.4	23.4	10.1	14.2	10.8	20.0	17.1

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	37.9	14.2	10.8	24.3	12.8



Comments

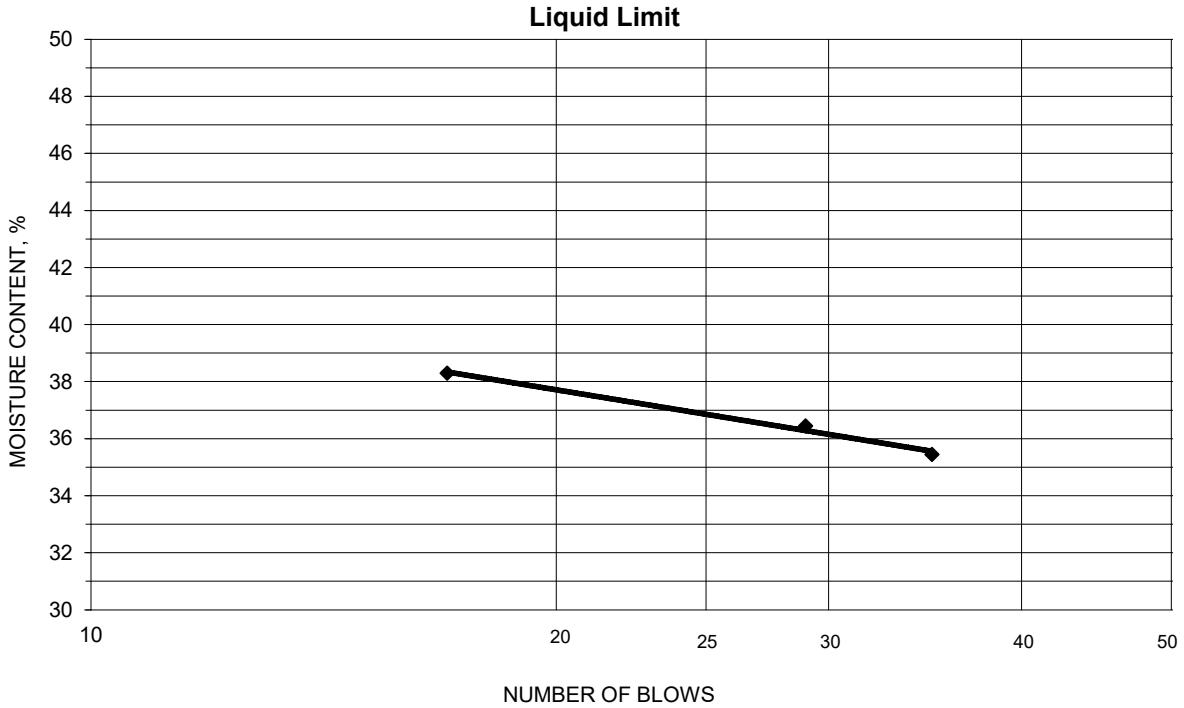
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	466-B, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	50
		% + No. 40	52
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-30-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.04	17.52	10.94	17	38.3	
19.20	17.05	11.15	29	36.4	
19.14	16.90	10.58	35	35.4	37



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.51	20.96	11.07	25.8	26	11
23.36	20.80	10.82	25.7		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-B, 8.5'-10.0'	Lab ID	54
Sample Type	SS-4	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: AASHTO T 265

Moisture Content (%): 14.2

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
3/8"	9.5	100.0
No. 4	4.75	96.7
No. 10	2	83.7
No. 40	0.425	62.7
No. 200	0.075	44.7
	0.02	29.3
	0.005	13.7
	0.002	10.6
Estimated	0.001	9.1

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	3.3	16.3
Coarse Sand	13.0	21.0
Medium Sand	21.0	---
Fine Sand	18.0	18.0
Silt	31.0	34.1
Clay	13.7	10.6

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	34
Plastic Limit:	25
Plasticity Index:	9
Activity Index:	0.8

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SM
Group Name:	Silty Sand
AASHTO Classification:	A-4 (1)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 466-B, 8.5'-10.0'

Project Number: 2026252404
Lab ID: 54

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-17-2024
Date Received: 05-13-2024

Maximum Particle Size: 3/8" Sieve

Sieve Size	% Passing
3/8"	100.0
No. 4	96.7
No. 10	83.7

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

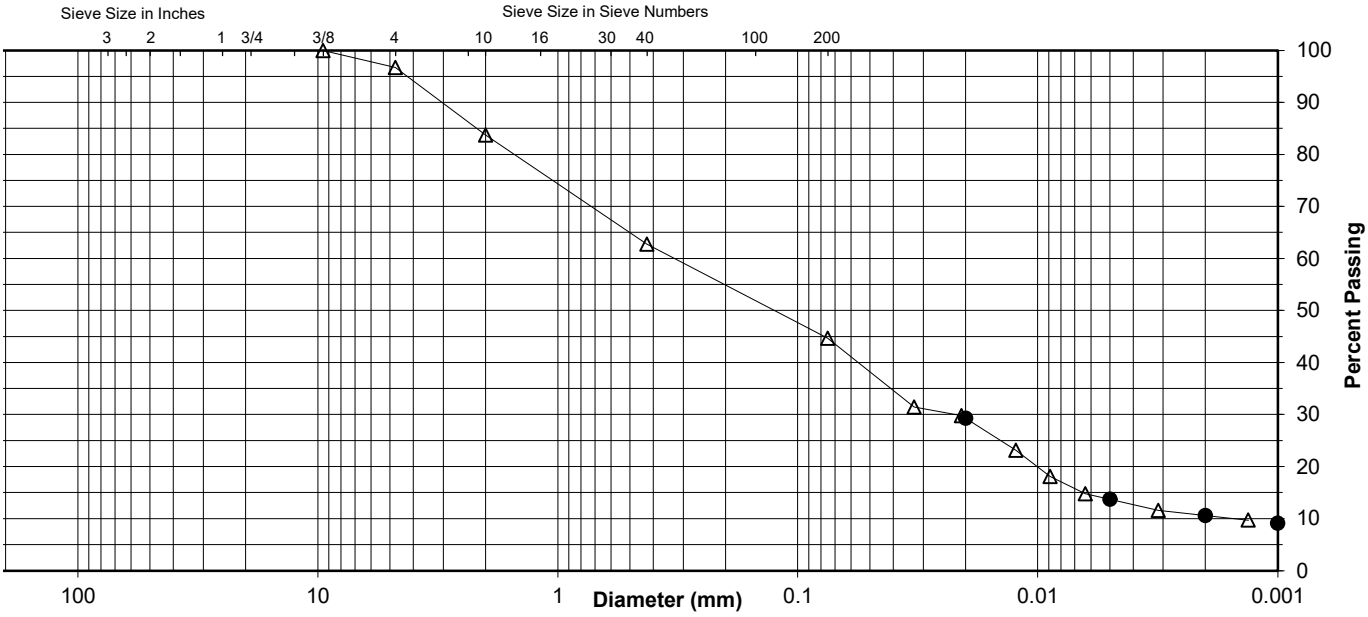
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	62.7
No. 200	44.7
0.02 mm	29.3
0.005 mm	13.7
0.002 mm	10.6
0.001 mm	9.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	3.3	13.0	21.0	18.0	31.0	13.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	16.3			21.0	18.0	34.1	10.6



Comments

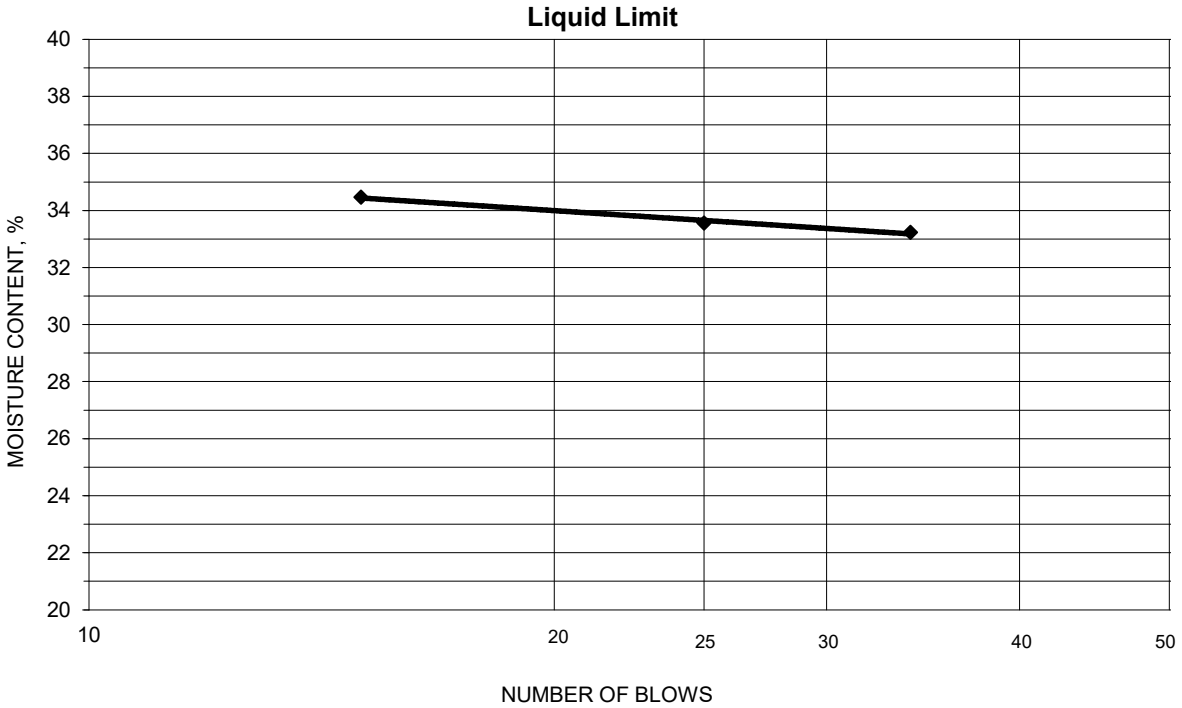
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	466-B, 8.5'-10.0'	Lab ID	54
		% + No. 40	37
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-22-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.08	17.76	11.03	15	34.5	34
20.77	18.32	11.02	25	33.6	
19.52	17.29	10.58	34	33.2	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
24.22	21.61	11.02	24.6	25	9
24.50	21.88	11.15	24.4		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-B, 13.5'-15.0', 16.0'-17.5', 18.5'-20.0'	Lab ID	56
Sample Type	SS-6 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 18.1

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
3/8"	9.5	100.0
No. 4	4.75	99.5
No. 10	2	95.7
No. 40	0.425	71.3
No. 200	0.075	38.4
	0.02	18.3
	0.005	6.8
	0.002	4.5
Estimated	0.001	2.8

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.5	4.3
Coarse Sand	3.8	24.4
Medium Sand	24.4	---
Fine Sand	32.9	32.9
Silt	31.6	33.9
Clay	6.8	4.5

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	29
Plastic Limit:	27
Plasticity Index:	2
Activity Index:	0.4

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SM
Group Name:	Silty Sand
AASHTO Classification:	A-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-B, 13.5'-15.0', 16.0'-17.5', 18.5'-20.0'	Lab ID	56

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-17-2024
Date Received: 05-13-2024

Maximum Particle Size: 3/8" Sieve

Sieve Size	% Passing
3/8"	100.0
No. 4	99.5
No. 10	95.7

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

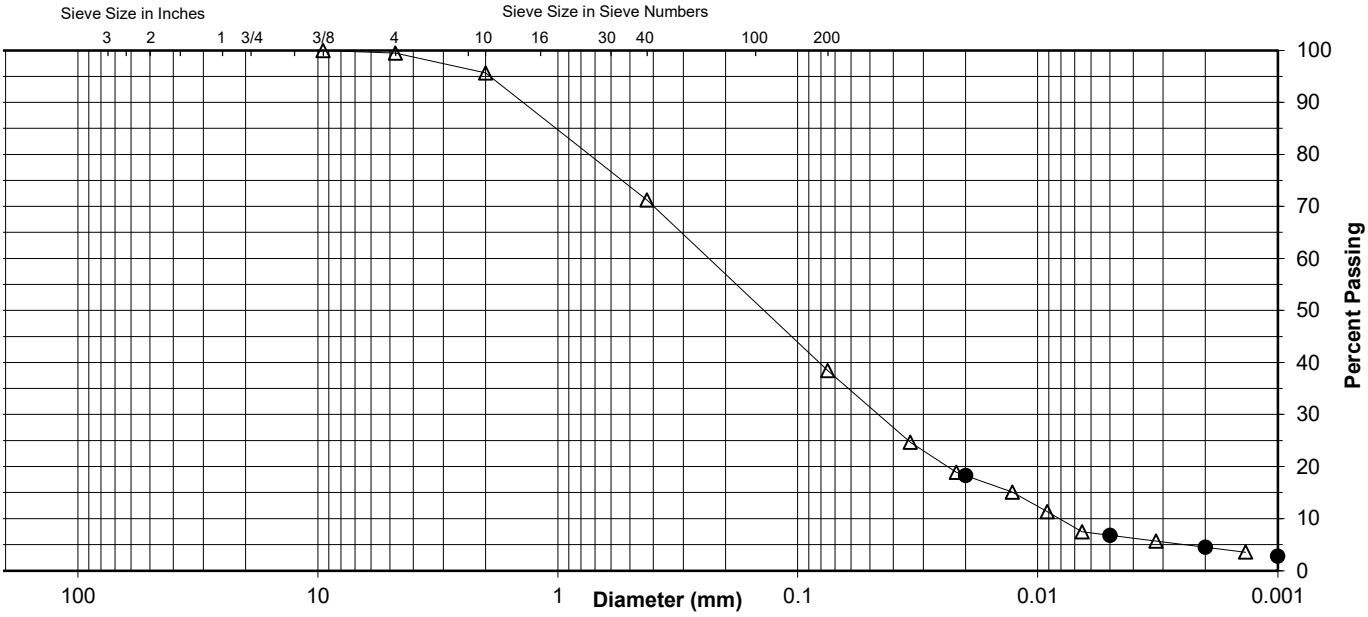
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	71.3
No. 200	38.4
0.02 mm	18.3
0.005 mm	6.8
0.002 mm	4.5
0.001 mm	2.8

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.5	3.8	24.4	32.9	31.6	6.8

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	4.3	24.4	32.9	33.9	4.5



Comments

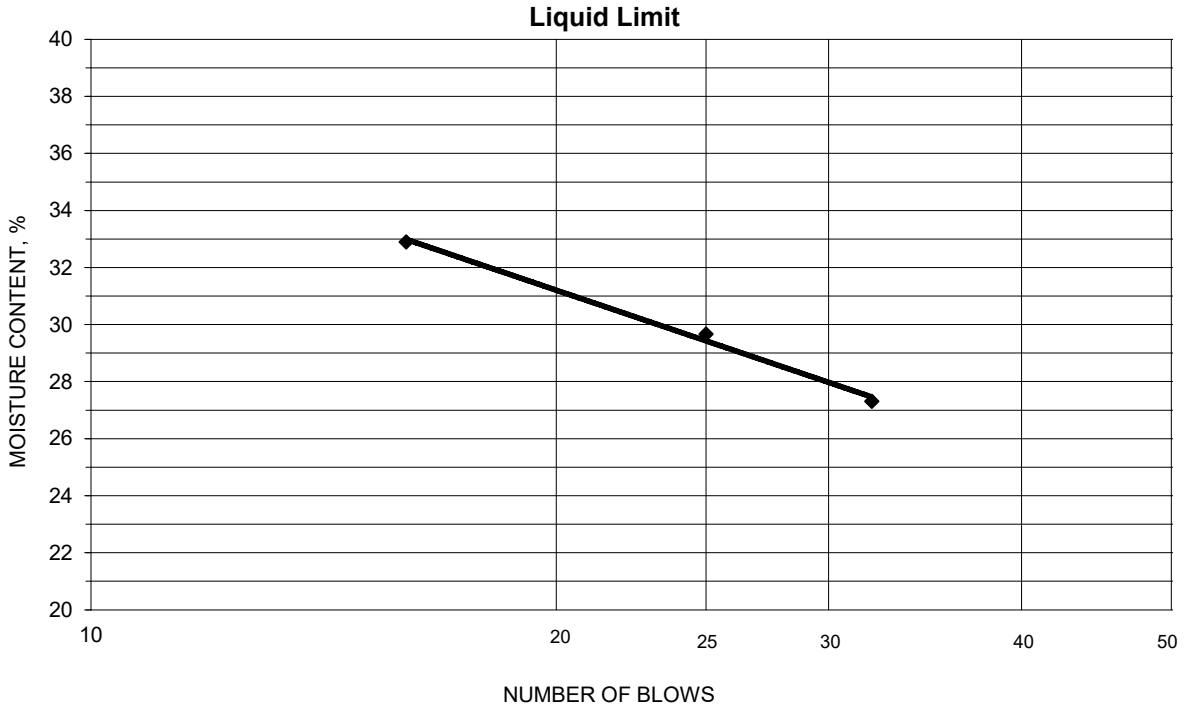
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	466-B, 13.5'-15.0', 16.0'-17.5', 18.5'-20.0'	Lab ID	56
		% + No. 40	29
Tested By	GK	Test Method	AASHTO T 89 & T 90	Date Received	05-13-2024
Test Date	05-29-2024	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
21.28	18.75	11.06	16	32.9	29
21.19	18.76	10.57	25	29.7	
21.12	18.87	10.63	32	27.3	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.80	19.52	11.00	26.8	27	2
22.30	19.89	11.02	27.2		

Remarks: _____

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	469, 3.5'-5.0', 6.0'-7.5'	Lab ID	62
Sample Type	SS-2 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 14.7

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	86.1
3/8"	9.5	70.2
No. 4	4.75	60.3
No. 10	2	50.6
No. 40	0.425	36.7
No. 200	0.075	25.0
	0.02	15.7
	0.005	6.3
	0.002	4.1
Estimated	0.001	2.9

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	39.7	49.4
Coarse Sand	9.7	13.9
Medium Sand	13.9	---
Fine Sand	11.7	11.7
Silt	18.7	20.9
Clay	6.3	4.1

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	33
Plastic Limit:	28
Plasticity Index:	5
Activity Index:	1.2

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GM
Group Name:	Silty Gravel with Sand
AASHTO Classification:	A-1-b (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 469, 3.5'-5.0', 6.0'-7.5'

Project Number: 2026252404
Lab ID: 62

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-17-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	86.1
3/8"	70.2
No. 4	60.3
No. 10	50.6

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

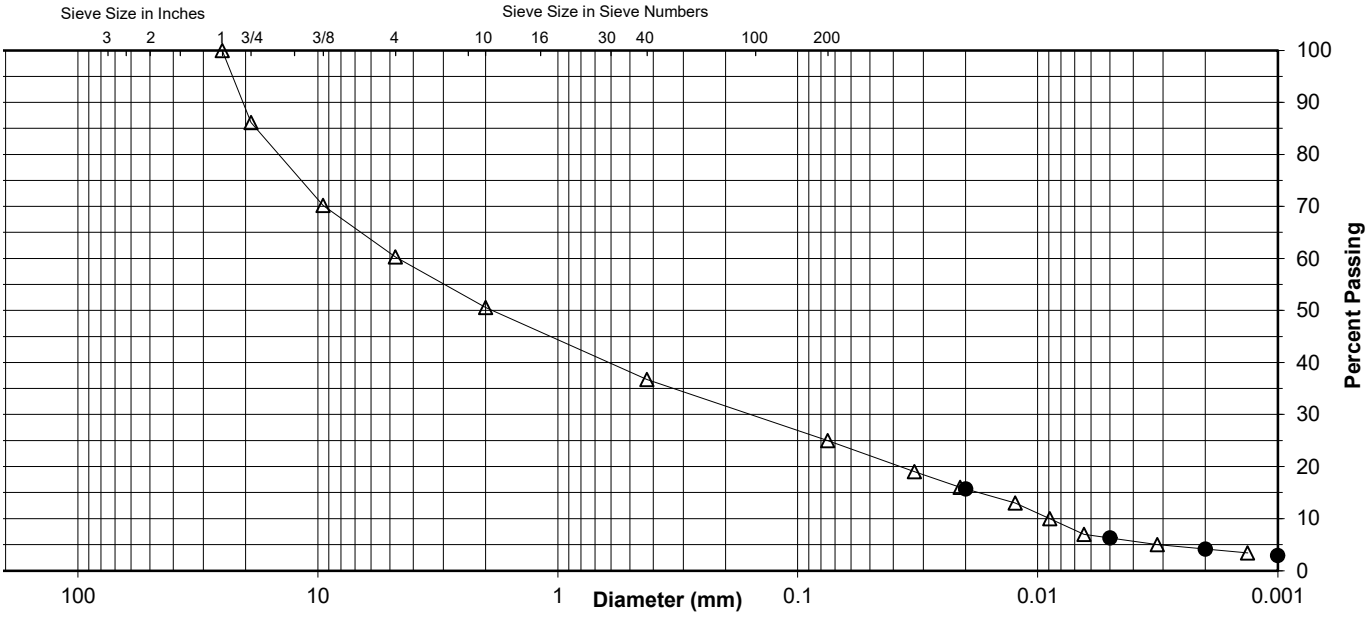
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	36.7
No. 200	25.0
0.02 mm	15.7
0.005 mm	6.3
0.002 mm	4.1
0.001 mm	2.9

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	13.9	25.8	9.7	13.9	11.7	18.7	6.3
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	49.4			13.9	11.7	20.9	4.1



Comments

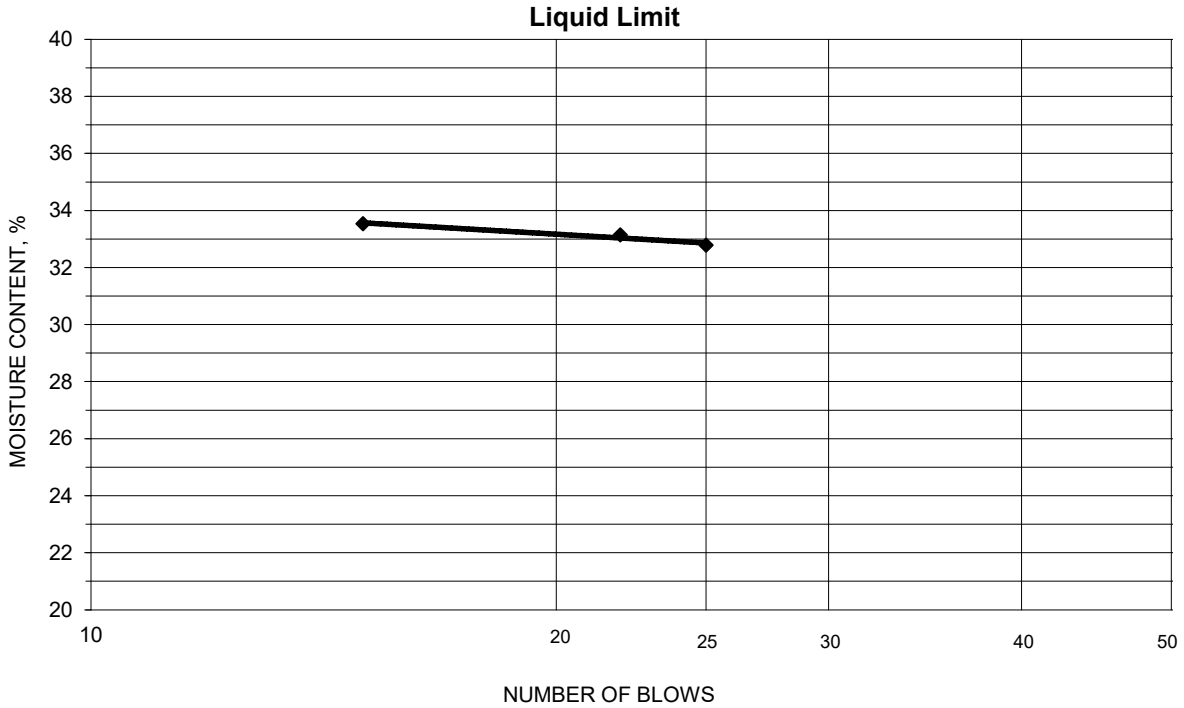
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	469, 3.5'-5.0', 6.0'-7.5'	Lab ID	62
		% + No. 40	63
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-24-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
17.06	15.45	10.65	15	33.5	33
17.95	16.23	11.04	22	33.1	
19.05	17.07	11.03	25	32.8	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
24.13	21.27	11.05	28.0	28	5
24.22	21.39	11.01	27.3		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	481-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	65
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 3.1

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	92.4
3/8"	9.5	75.2
No. 4	4.75	64.6
No. 10	2	46.5
No. 40	0.425	25.3
No. 200	0.075	15.0
	0.02	10.7
	0.005	6.0
	0.002	4.9
Estimated	0.001	4.1

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	35.4	53.5
Coarse Sand	18.1	21.2
Medium Sand	21.2	---
Fine Sand	10.3	10.3
Silt	9.0	10.1
Clay	6.0	4.9

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	17
Plastic Limit:	12
Plasticity Index:	5
Activity Index:	1.0

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SC-SM

Group Name: Silty, Clayey Sand with Gravel

AASHTO Classification: A-1-a (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	481-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	65

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-17-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	92.4
3/8"	75.2
No. 4	64.6
No. 10	46.5

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	25.3
No. 200	15.0
0.02 mm	10.7
0.005 mm	6.0
0.002 mm	4.9
0.001 mm	4.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	7.6	27.8	18.1	21.2	10.3	9.0	6.0

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	53.5	21.2	10.3	10.1	4.9

Comments

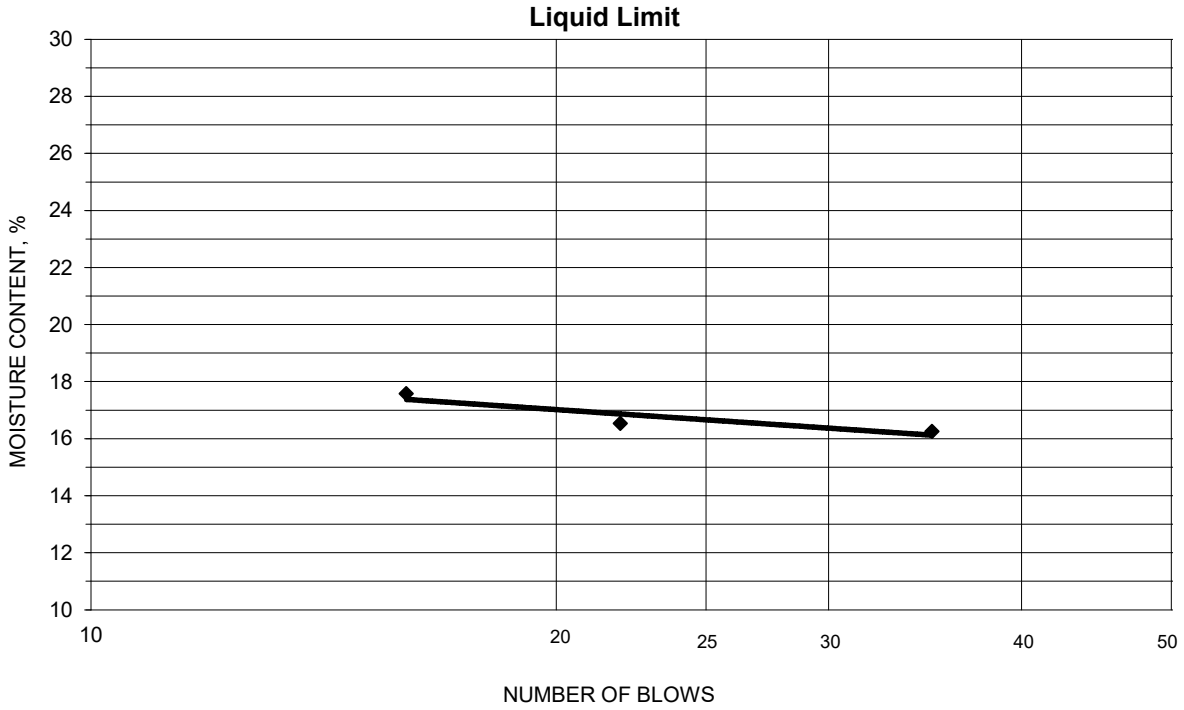
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	481-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	65
		% + No. 40	75
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-28-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.97	19.42	10.60	16	17.6	
21.22	19.78	11.07	22	16.5	
19.50	18.24	10.49	35	16.3	17



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.31	21.99	11.03	12.0	12	5
23.46	22.14	11.01	11.9		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	481-B, 1.0'-2.5'	Lab ID	69
Sample Type	SS-1	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: AASHTO T 265

Moisture Content (%): 3.8

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	94.6
3/8"	9.5	80.1
No. 4	4.75	66.9
No. 10	2	48.6
No. 40	0.425	22.8
No. 200	0.075	14.1
	0.02	10.0
	0.005	6.8
	0.002	5.1
Estimated	0.001	3.8

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	33.1	51.4
Coarse Sand	18.3	25.8
Medium Sand	25.8	---
Fine Sand	8.7	8.7
Silt	7.3	9.0
Clay	6.8	5.1

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	16
Plastic Limit:	12
Plasticity Index:	4
Activity Index:	0.8

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC-SM
Group Name:	Silty, Clayey Sand with Gravel
AASHTO Classification:	A-1-a (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 481-B, 1.0'-2.5'

Project Number: 2026252404
Lab ID: 69

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-20-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	94.6
3/8"	80.1
No. 4	66.9
No. 10	48.6

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

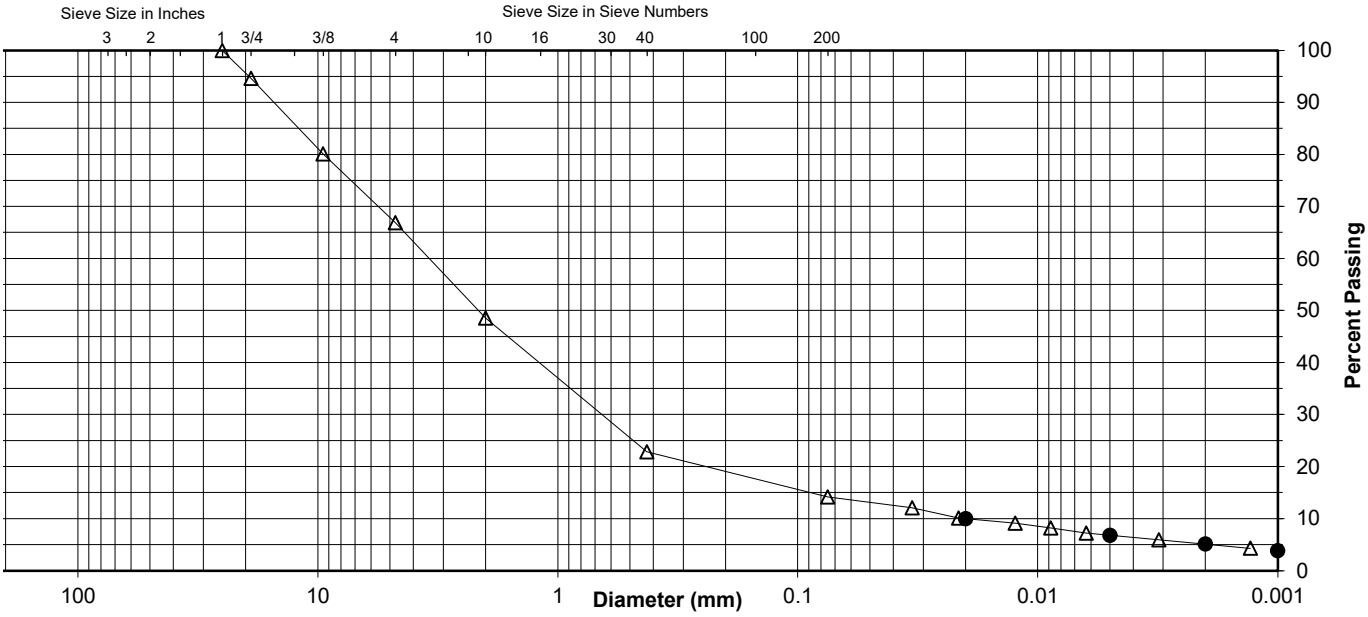
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	22.8
No. 200	14.1
0.02 mm	10.0
0.005 mm	6.8
0.002 mm	5.1
0.001 mm	3.8

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	5.4	27.7	18.3	25.8	8.7	7.3	6.8
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	51.4			25.8	8.7	9.0	5.1



Comments

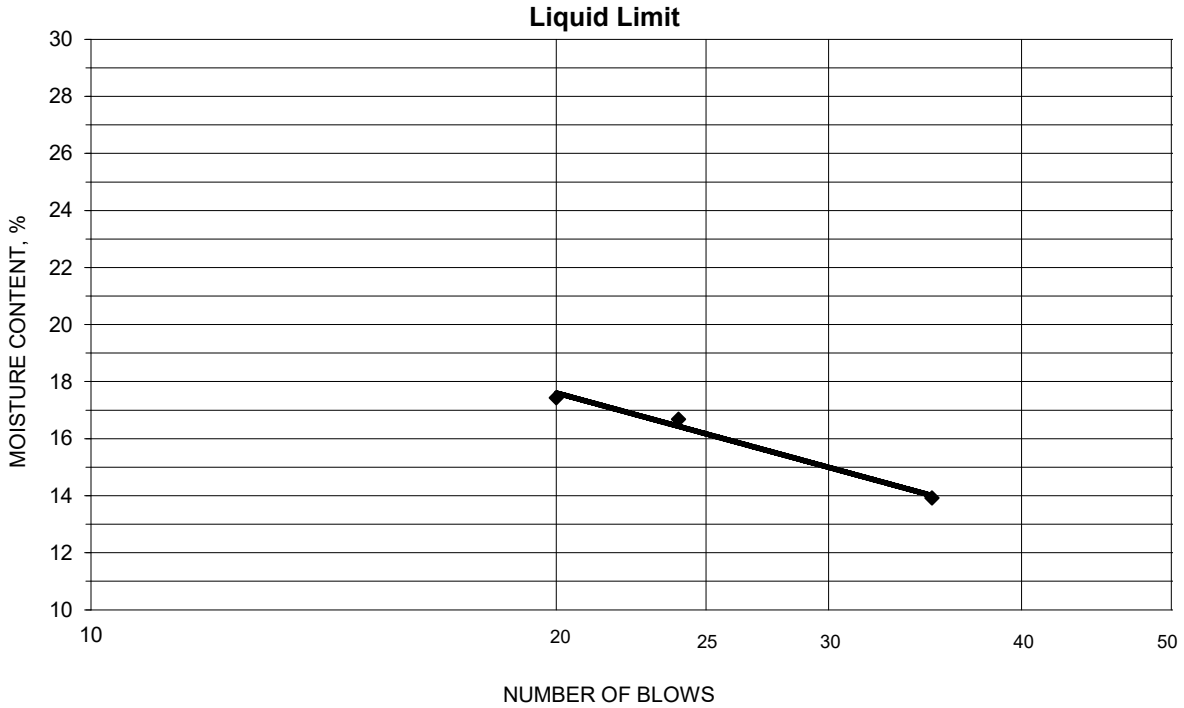
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	481-B, 1.0'-2.5'	Lab ID	69
		% + No. 40	77
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-29-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.50	18.25	11.08	20	17.4	
21.68	20.16	11.05	24	16.7	
20.36	19.21	10.95	35	13.9	16



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.42	20.26	11.05	12.6	12	4
22.34	21.11	11.10	12.3		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	485, 0.0'-1.5'	Lab ID	70
Sample Type	GRAB	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: AASHTO T 265

Moisture Content (%): 7.9

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	50.1
3/8"	9.5	41.8
No. 4	4.75	33.1
No. 10	2	24.1
No. 40	0.425	14.9
No. 200	0.075	11.2
	0.02	8.8
	0.005	5.7
	0.002	4.2
Estimated	0.001	3.2

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	66.9	75.9
Coarse Sand	9.0	9.2
Medium Sand	9.2	---
Fine Sand	3.7	3.7
Silt	5.5	7.0
Clay	5.7	4.2

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	27
Plastic Limit:	18
Plasticity Index:	9
Activity Index:	2.1

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GP-GC
Group Name:	Poorly Graded Gravel with Clay and Sand (or Silty Clay and Sand)
AASHTO Classification:	A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 485, 0.0'-1.5'

Project Number: 2026252404
Lab ID: 70

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-20-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	50.1
3/8"	41.8
No. 4	33.1
No. 10	24.1

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

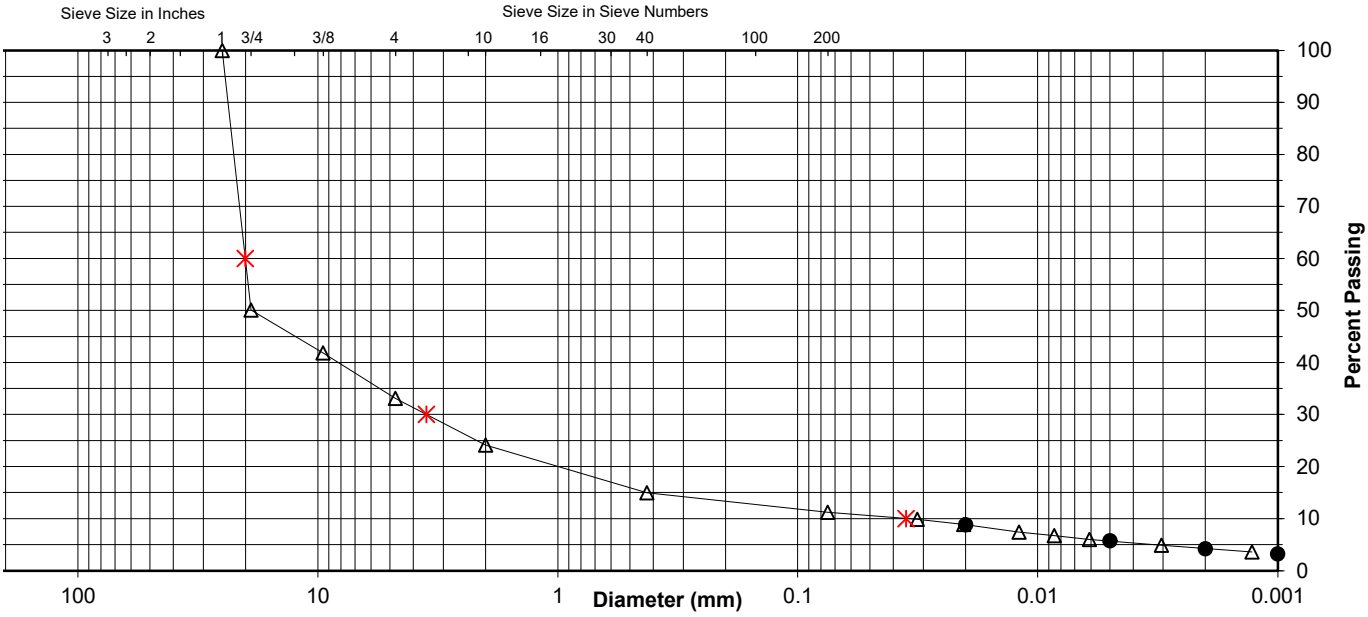
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	14.9
No. 200	11.2
0.02 mm	8.8
0.005 mm	5.7
0.002 mm	4.2
0.001 mm	3.2

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	49.9	17.0	9.0	9.2	3.7	5.5	5.7

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	75.9	9.2	3.7	7.0	4.2



Comments

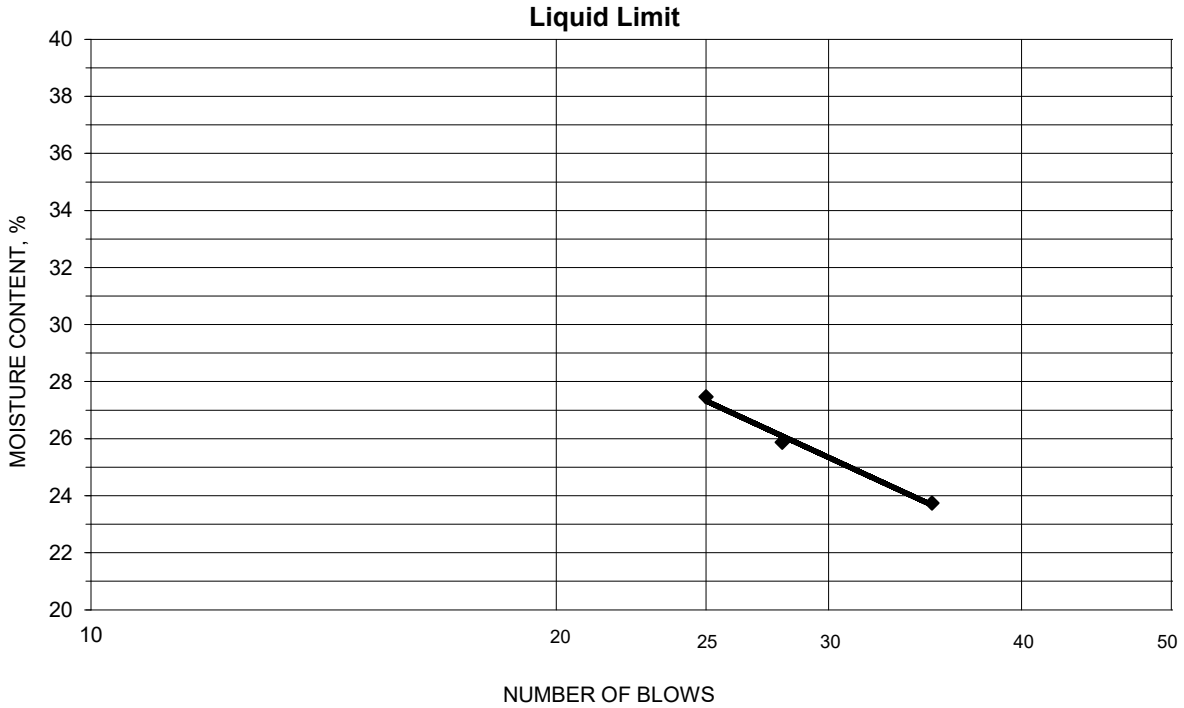
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	485, 0.0'-1.5'	Lab ID	70
		% + No. 40	85
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-31-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.79	17.90	11.02	25	27.5	
17.92	16.51	11.06	28	25.9	
18.46	17.04	11.06	35	23.7	27



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
20.61	19.02	10.60	18.9	18	9
21.33	19.76	11.04	18.0		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	486, 1.0'-2.5', 3.5'-5.0'	Lab ID	71
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 7.9

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	72.4
3/8"	9.5	53.9
No. 4	4.75	41.5
No. 10	2	31.5
No. 40	0.425	18.2
No. 200	0.075	11.6
	0.02	8.9
	0.005	4.9
	0.002	3.5
Estimated	0.001	2.4

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	58.5	68.5
Coarse Sand	10.0	13.3
Medium Sand	13.3	---
Fine Sand	6.6	6.6
Silt	6.7	8.1
Clay	4.9	3.5

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	25
Plastic Limit:	20
Plasticity Index:	5
Activity Index:	1.4

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GP-GC
Group Name:	Poorly Graded Gravel with Clay and Sand (or Silty Clay and Sand)
AASHTO Classification:	A-1-a (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	486, 1.0'-2.5', 3.5'-5.0'	Lab ID	71

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-20-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	72.4
3/8"	53.9
No. 4	41.5
No. 10	31.5

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

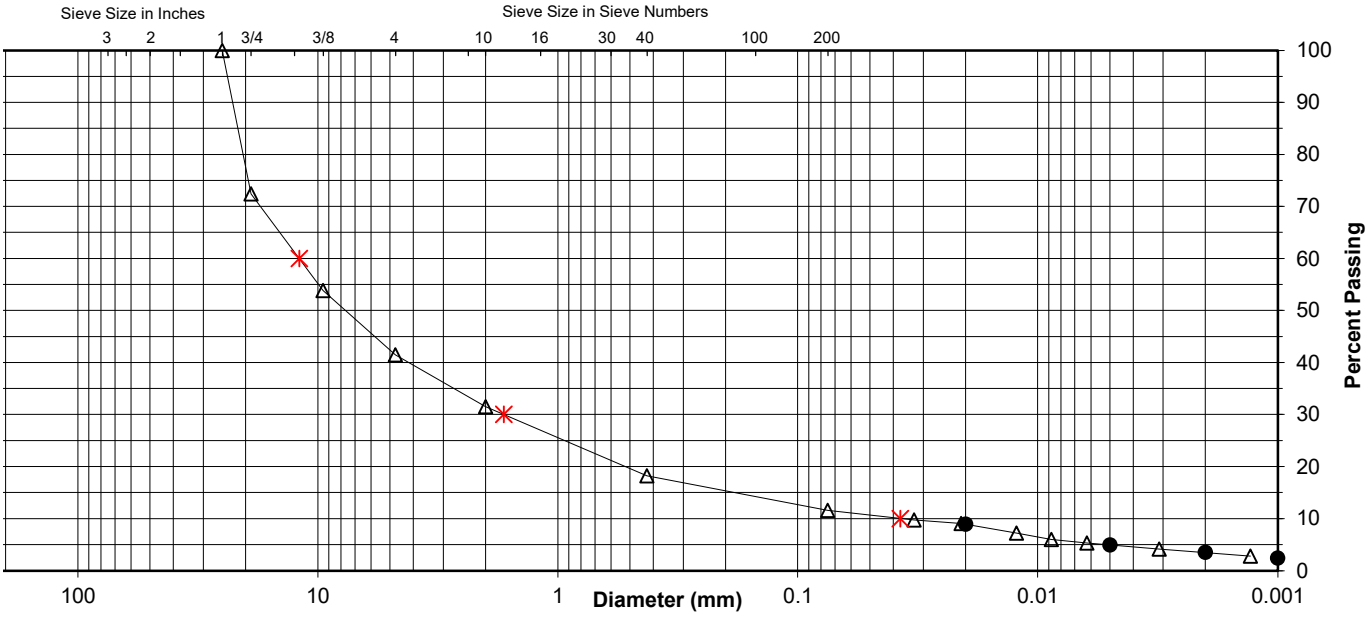
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	18.2
No. 200	11.6
0.02 mm	8.9
0.005 mm	4.9
0.002 mm	3.5
0.001 mm	2.4

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	27.6	30.9	10.0	13.3	6.6	6.7	4.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	68.5			13.3	6.6	8.1	3.5



Comments

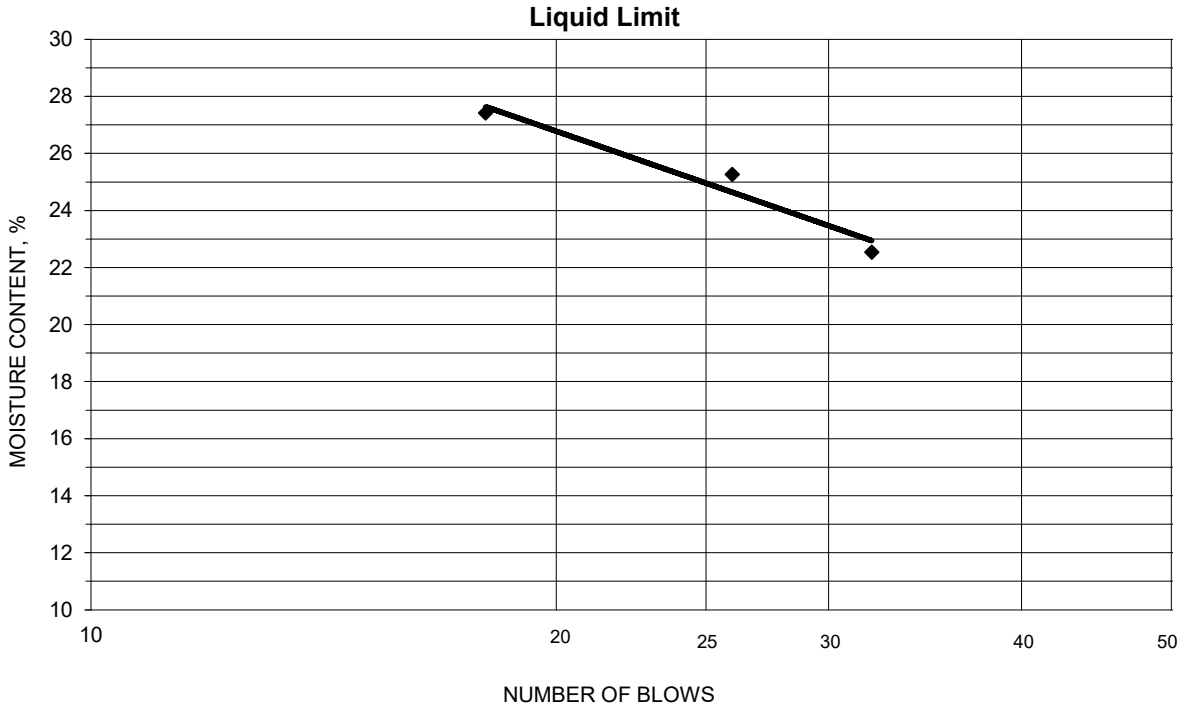
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	486, 1.0'-2.5', 3.5'-5.0'	Lab ID	71
		% + No. 40	82
Tested By	GK	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-23-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.69	18.62	11.07	18	27.4	25
21.85	19.68	11.09	26	25.3	
21.63	19.68	11.03	32	22.5	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.09	19.37	10.63	19.7	20	5
21.80	20.03	11.00	19.6		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	487, 1.0'-2.5', 3.5'-5.0'	Lab ID	75
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 5.3

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	82.6
3/8"	9.5	58.3
No. 4	4.75	42.8
No. 10	2	29.9
No. 40	0.425	17.4
No. 200	0.075	10.9
	0.02	7.8
	0.005	4.1
	0.002	2.7
Estimated	0.001	1.7

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	57.2	70.1
Coarse Sand	12.9	12.5
Medium Sand	12.5	---
Fine Sand	6.5	6.5
Silt	6.8	8.2
Clay	4.1	2.7

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	29
Plastic Limit:	22
Plasticity Index:	7
Activity Index:	2.6

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GP-GC
Group Name:	Poorly Graded Gravel with Clay and Sand (or Silty Clay and Sand)
AASHTO Classification:	A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 487, 1.0'-2.5', 3.5'-5.0'

Project Number: 2026252404
Lab ID: 75

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-20-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	82.6
3/8"	58.3
No. 4	42.8
No. 10	29.9

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

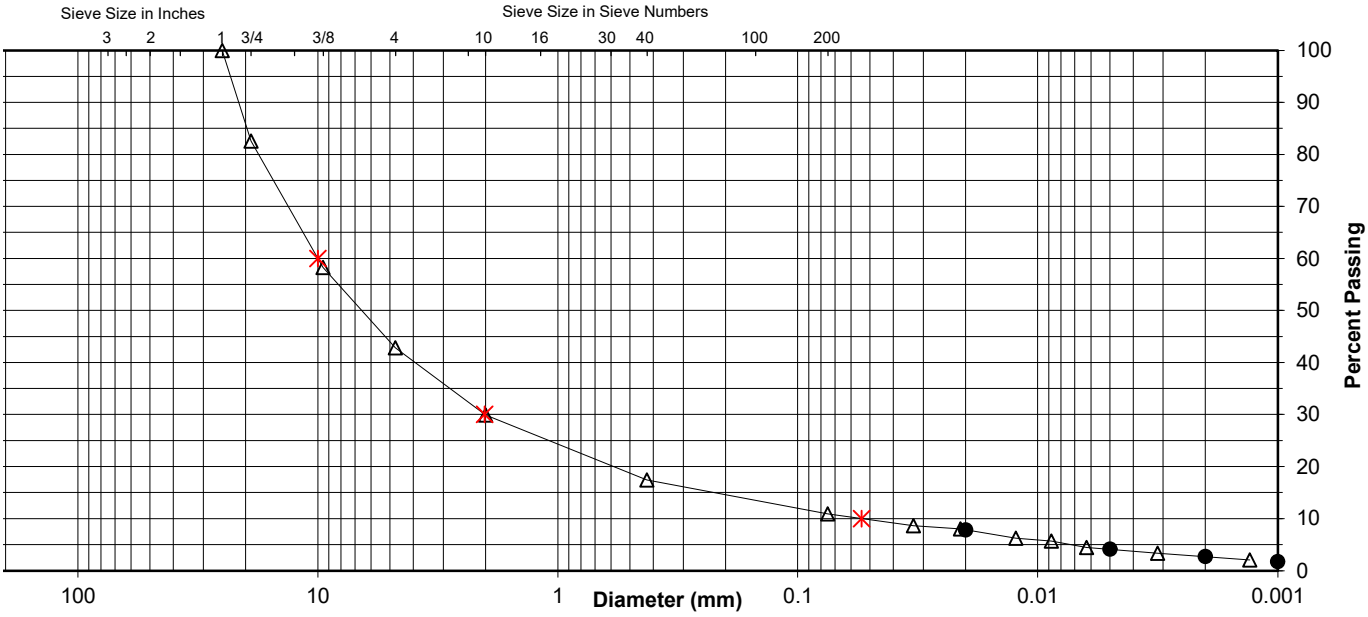
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	17.4
No. 200	10.9
0.02 mm	7.8
0.005 mm	4.1
0.002 mm	2.7
0.001 mm	1.7

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	17.4	39.8	12.9	12.5	6.5	6.8	4.1

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	70.1	12.5	6.5	8.2	2.7



Comments

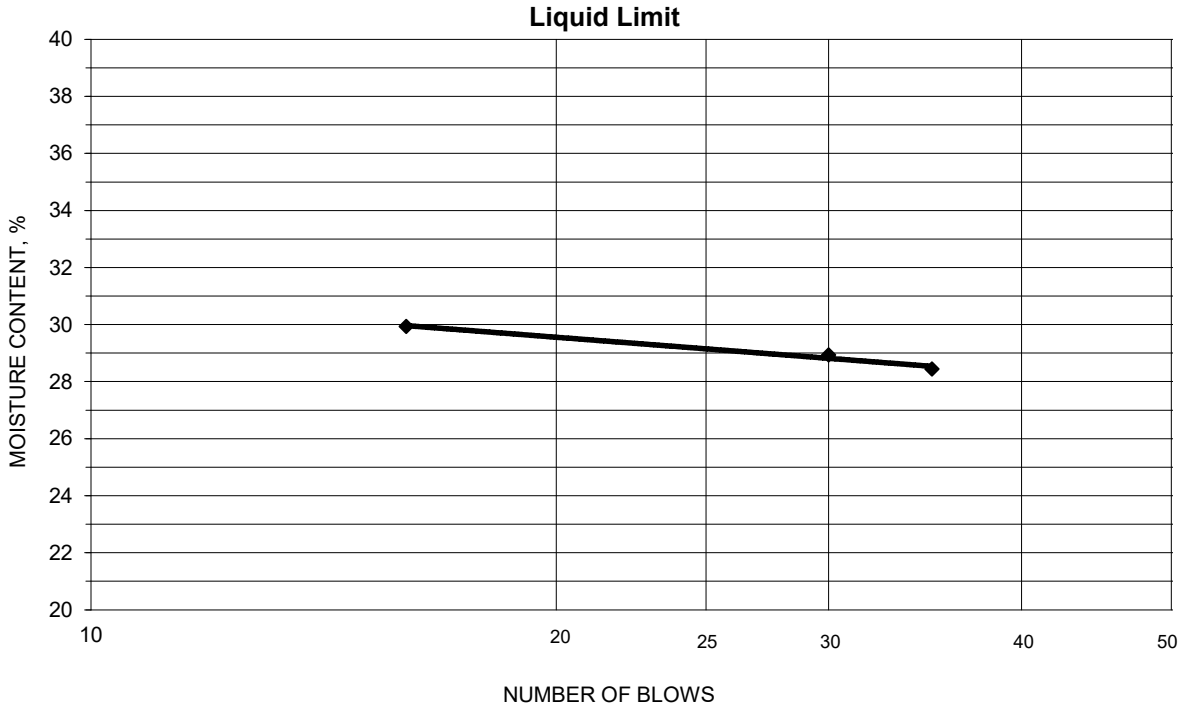
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	487, 1.0'-2.5', 3.5'-5.0'	Lab ID	75
		% + No. 40	83
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-31-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.63	17.66	11.08	16	29.9	29
18.61	16.81	10.59	30	28.9	
19.28	17.46	11.06	35	28.4	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.53	19.59	11.00	22.6	22	7
22.74	20.62	11.07	22.2		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	487, 8.5'-10.0', 11.0'-12.5'	Lab ID	79
Sample Type	SS-4 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 12.9

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	83.1
3/8"	9.5	66.1
No. 4	4.75	52.3
No. 10	2	36.9
No. 40	0.425	16.9
No. 200	0.075	9.2
	0.02	5.7
	0.005	2.6
	0.002	1.7
Estimated	0.001	1.1

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	47.7	63.1
Coarse Sand	15.4	20.0
Medium Sand	20.0	---
Fine Sand	7.7	7.7
Silt	6.6	7.5
Clay	2.6	1.7

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	34
Plastic Limit:	28
Plasticity Index:	6
Activity Index:	3.5

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GW-GM
Group Name:	Well-Graded Gravel with Silt and Sand
AASHTO Classification:	A-1-a (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 487, 8.5'-10.0', 11.0'-12.5'

Project Number: 2026252404
Lab ID: 79

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-17-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	83.1
3/8"	66.1
No. 4	52.3
No. 10	36.9

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

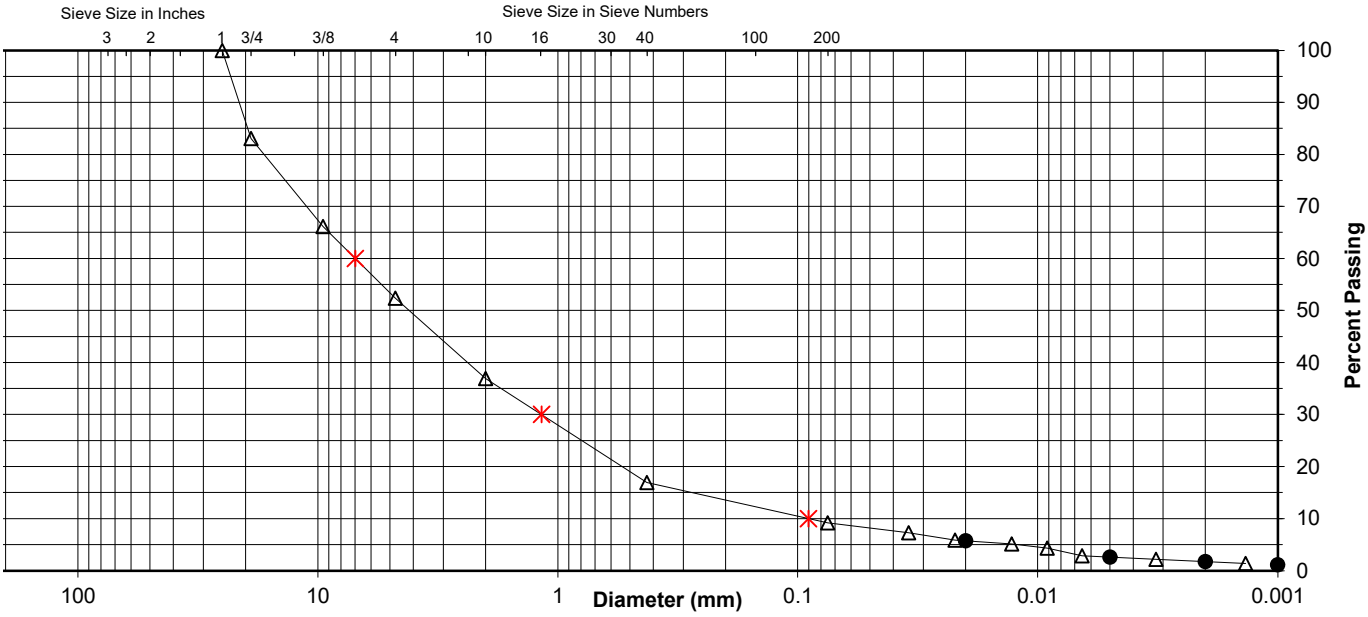
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	16.9
No. 200	9.2
0.02 mm	5.7
0.005 mm	2.6
0.002 mm	1.7
0.001 mm	1.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	16.9	30.8	15.4	20.0	7.7	6.6	2.6

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	63.1	20.0	7.7	7.5	1.7



Comments

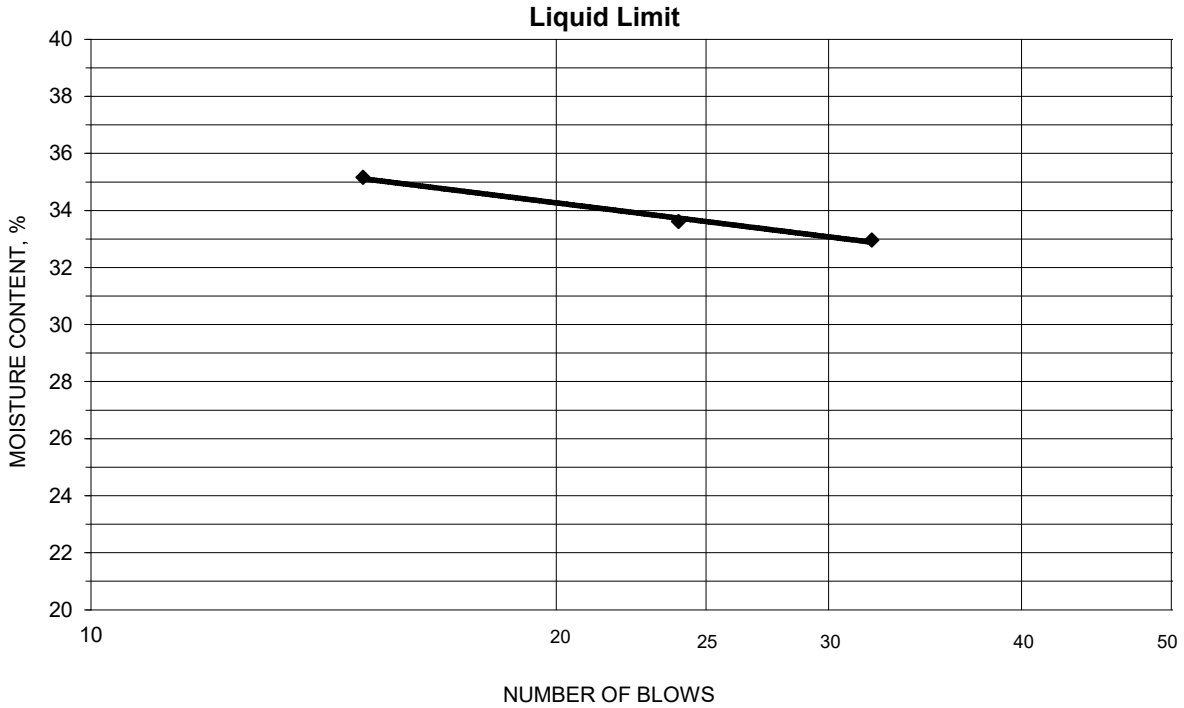
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	487, 8.5'-10.0', 11.0'-12.5'	Lab ID	79
		% + No. 40	83
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-21-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.93	17.62	11.05	15	35.2	34
19.05	17.03	11.02	24	33.6	
19.43	17.35	11.04	32	33.0	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.77	20.99	11.08	28.1	28	6
23.81	21.06	11.01	27.4		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	508, 1.0'-2.5', 2.5'-3.5'	Lab ID	82
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 3.5

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	91.2
3/8"	9.5	75.5
No. 4	4.75	60.2
No. 10	2	44.7
No. 40	0.425	29.2
No. 200	0.075	19.5
	0.02	10.9
	0.005	5.0
	0.002	2.9
Estimated	0.001	1.8

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	39.8	55.3
Coarse Sand	15.5	15.5
Medium Sand	15.5	---
Fine Sand	9.7	9.7
Silt	14.5	16.6
Clay	5.0	2.9

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	24
Plastic Limit:	20
Plasticity Index:	4
Activity Index:	1.4

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC-SM
Group Name:	Silty, Clayey Sand with Gravel
AASHTO Classification:	A-1-b (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	508, 1.0'-2.5', 2.5'-3.5'	Lab ID	82

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-21-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	91.2
3/8"	75.5
No. 4	60.2
No. 10	44.7

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

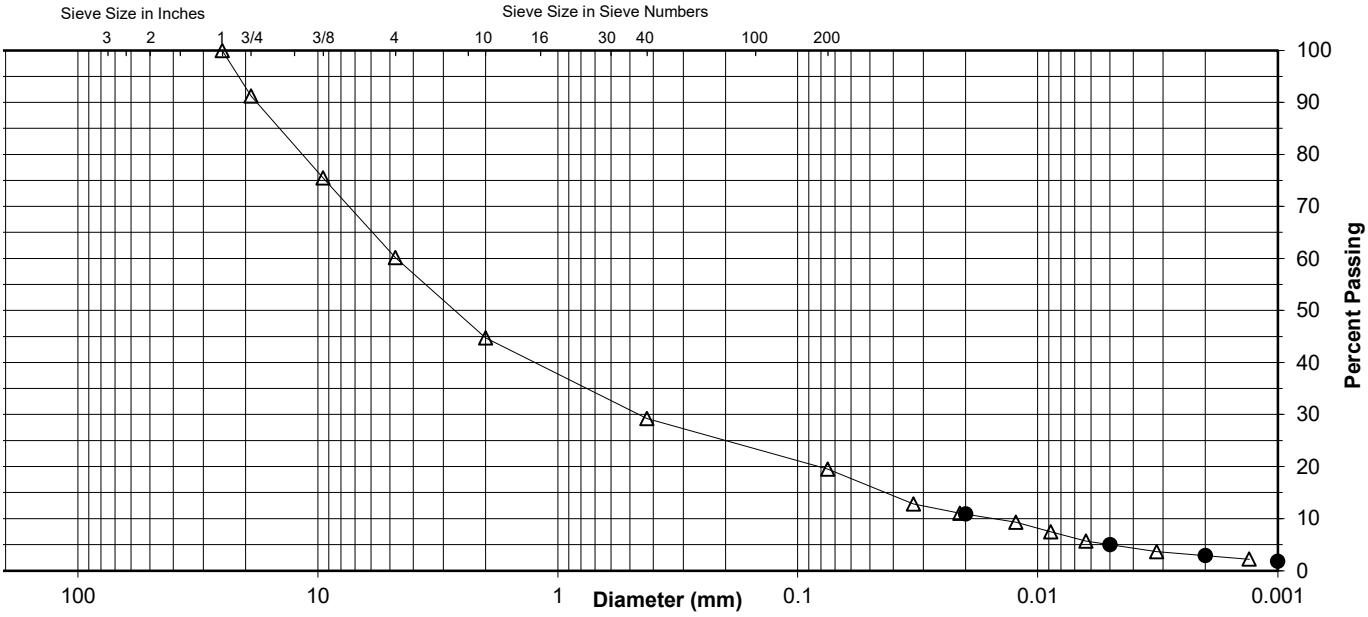
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	29.2
No. 200	19.5
0.02 mm	10.9
0.005 mm	5.0
0.002 mm	2.9
0.001 mm	1.8

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	8.8	31.0	15.5	15.5	9.7	14.5	5.0

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	55.3	15.5	9.7	16.6	2.9



Comments

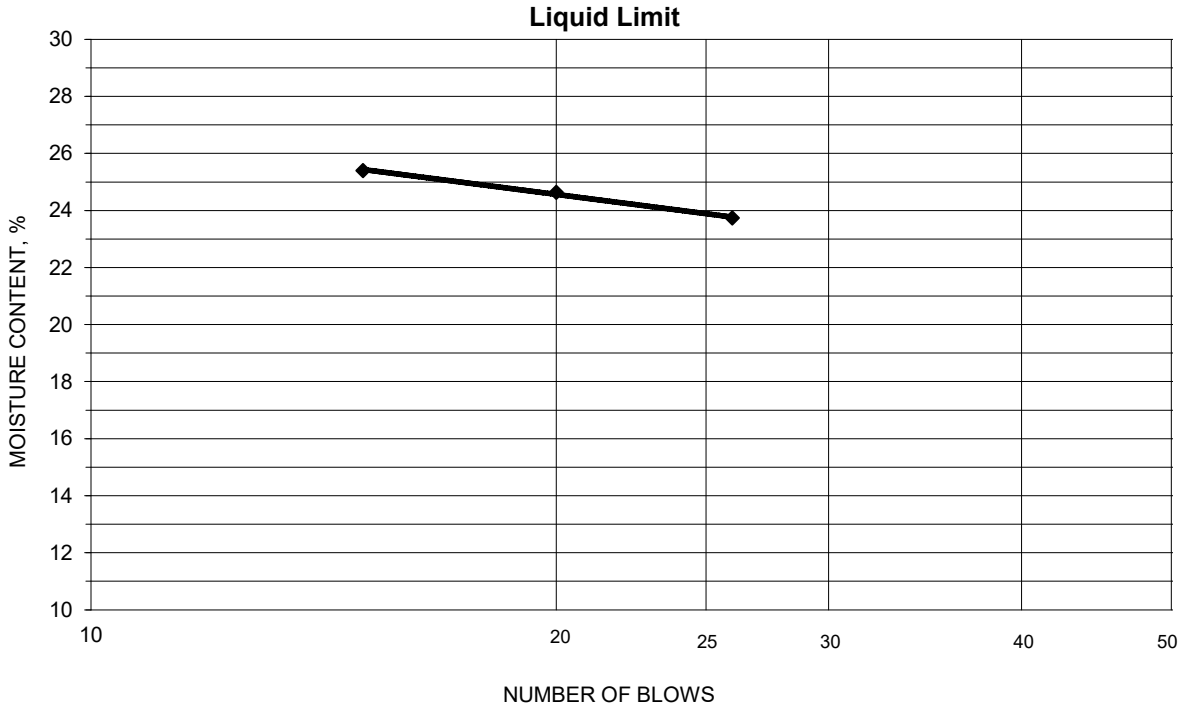
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	508, 1.0'-2.5', 2.5'-3.5'	Lab ID	82
		% + No. 40	71
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-22-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.60	17.87	11.06	15	25.4	24
20.41	18.56	11.05	20	24.6	
20.67	18.75	10.66	26	23.7	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.92	20.03	10.61	20.1	20	4
22.68	20.76	10.99	19.7		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	515, 1.0'-2.5', 3.5'-5.0'	Lab ID	85
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 2.4

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	92.9
3/8"	9.5	81.3
No. 4	4.75	67.2
No. 10	2	46.6
No. 40	0.425	22.9
No. 200	0.075	8.6
	0.02	3.9
	0.005	3.2
	0.002	2.2
Estimated	0.001	1.2

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	32.8	53.4
Coarse Sand	20.6	23.7
Medium Sand	23.7	---
Fine Sand	14.3	14.3
Silt	5.4	6.4
Clay	3.2	2.2

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit: NP
Plastic Limit: NP
Plasticity Index: NP
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SW-SM
Group Name: Well-Graded Sand with Silt and Gravel

AASHTO Classification: A-1-a (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 515, 1.0'-2.5', 3.5'-5.0'

Project Number: 2026252404
Lab ID: 85

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-21-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	92.9
3/8"	81.3
No. 4	67.2
No. 10	46.6

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

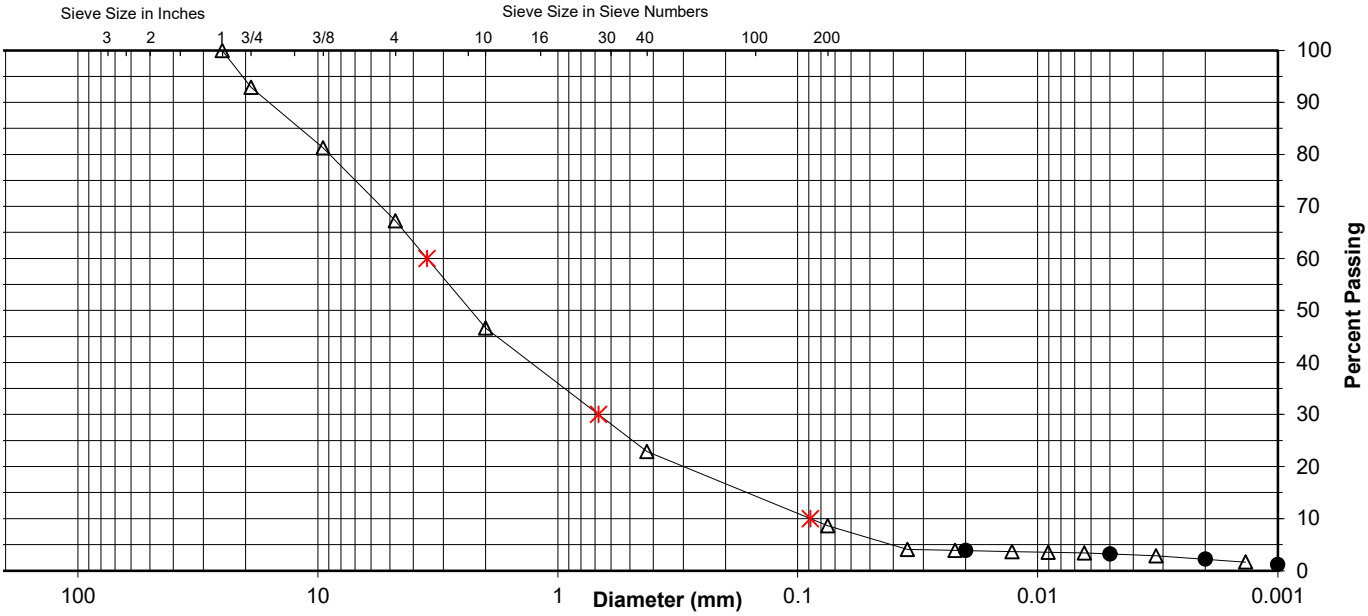
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	22.9
No. 200	8.6
0.02 mm	3.9
0.005 mm	3.2
0.002 mm	2.2
0.001 mm	1.2

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	7.1	25.7	20.6	23.7	14.3	5.4	3.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	53.4			23.7	14.3	6.4	2.2



Comments

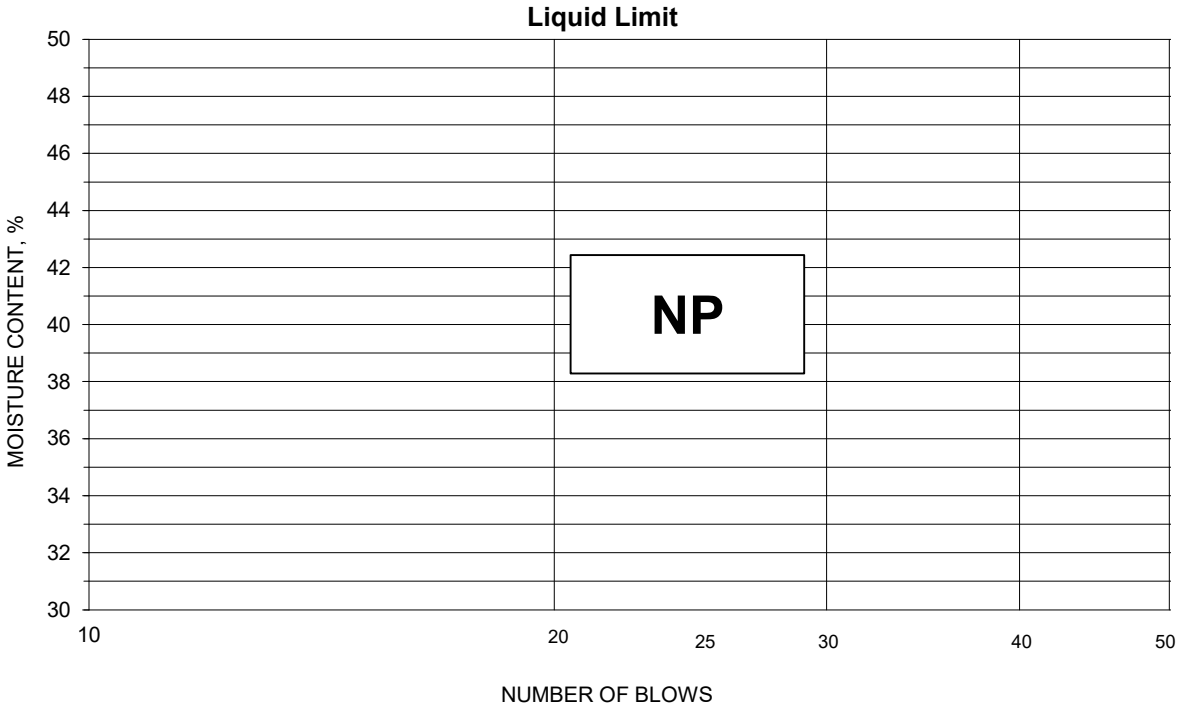
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	515, 1.0'-2.5', 3.5'-5.0'	Lab ID	85
		% + No. 40	77
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-29-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-A, 1.0'-2.5', 3.5'-5.0'	Lab ID	89
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 3.6

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	83.3
3/8"	9.5	60.7
No. 4	4.75	45.6
No. 10	2	31.4
No. 40	0.425	18.1
No. 200	0.075	11.1
	0.02	7.3
	0.005	4.5
	0.002	3.4
Estimated	0.001	2.8

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	54.4	68.6
Coarse Sand	14.2	13.3
Medium Sand	13.3	---
Fine Sand	7.0	7.0
Silt	6.6	7.7
Clay	4.5	3.4

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	22
Plastic Limit:	16
Plasticity Index:	6
Activity Index:	1.8

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GP-GC
Group Name:	Poorly Graded Gravel with Clay and Sand (or Silty Clay and Sand)
AASHTO Classification:	A-1-a (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 518-A, 1.0'-2.5', 3.5'-5.0'

Project Number: 2026252404
Lab ID: 89

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-17-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	83.3
3/8"	60.7
No. 4	45.6
No. 10	31.4

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

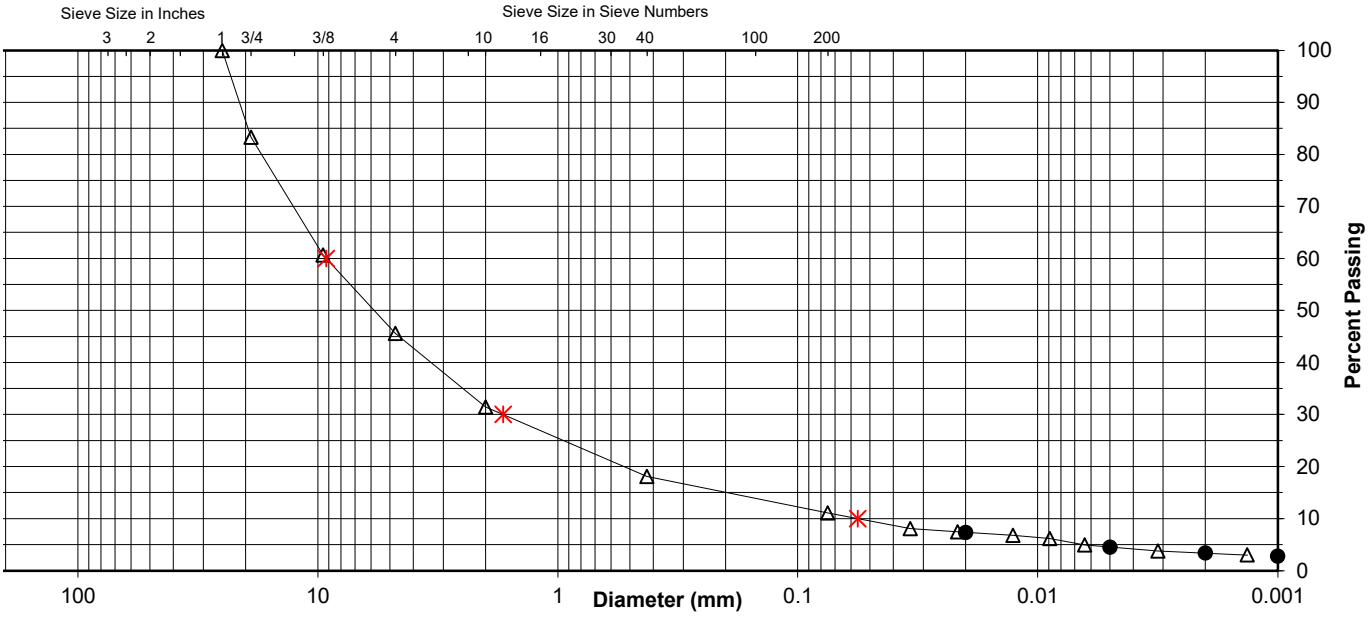
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	18.1
No. 200	11.1
0.02 mm	7.3
0.005 mm	4.5
0.002 mm	3.4
0.001 mm	2.8

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	16.7	37.7	14.2	13.3	7.0	6.6	4.5

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	68.6	13.3	7.0	7.7	3.4



Comments

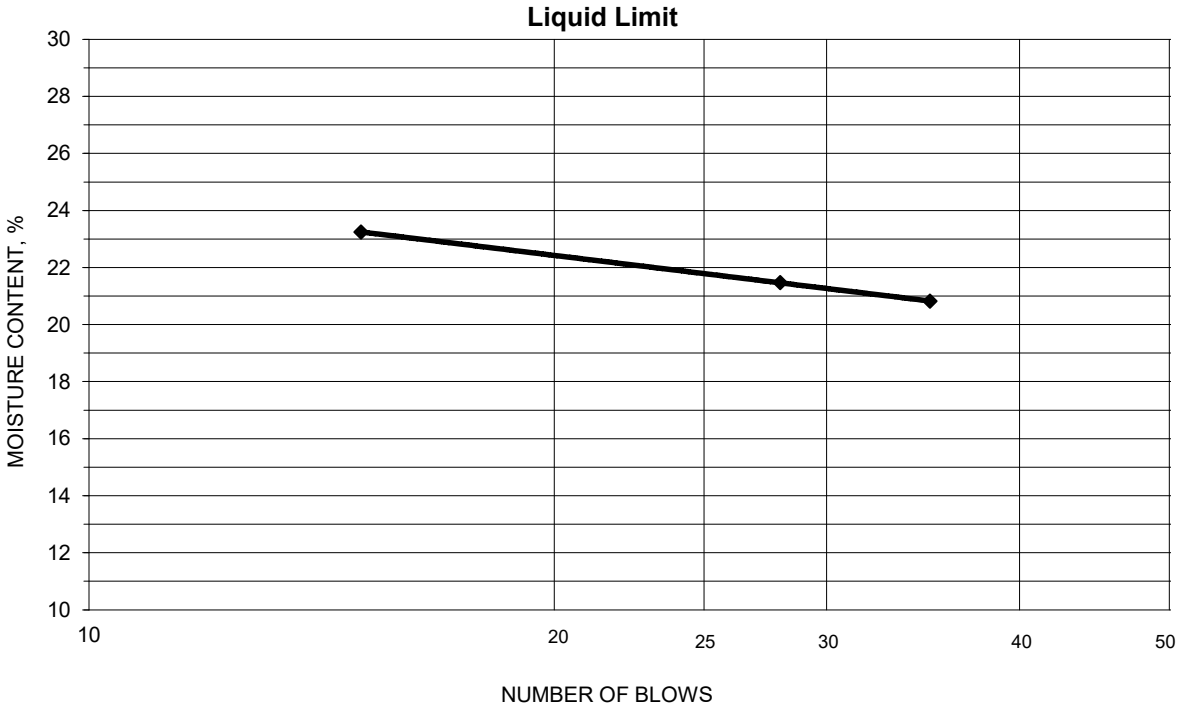
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	518-A, 1.0'-2.5', 3.5'-5.0'	Lab ID	89
		% + No. 40	82
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-23-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.05	18.36	11.09	15	23.2	
18.97	17.48	10.54	28	21.5	
19.24	17.82	11.00	35	20.8	22



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.87	22.06	11.07	16.5	16	6
23.04	21.30	10.69	16.4		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-B, 1.0'-2.5', 3.5'-5.0'	Lab ID	92
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 13.8

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	90.6
3/8"	9.5	76.6
No. 4	4.75	63.0
No. 10	2	47.8
No. 40	0.425	32.8
No. 200	0.075	20.9
	0.02	15.5
	0.005	9.5
	0.002	6.8
Estimated	0.001	4.0

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	37.0	52.2
Coarse Sand	15.2	15.0
Medium Sand	15.0	---
Fine Sand	11.9	11.9
Silt	11.4	14.1
Clay	9.5	6.8

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	28
Plastic Limit:	21
Plasticity Index:	7
Activity Index:	1.0

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC-SM
Group Name:	Silty, Clayey Sand with Gravel
AASHTO Classification:	A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-B, 1.0'-2.5', 3.5'-5.0'	Lab ID	92

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: JP
Test Date: 05-24-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	90.6
3/8"	76.6
No. 4	63.0
No. 10	47.8

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

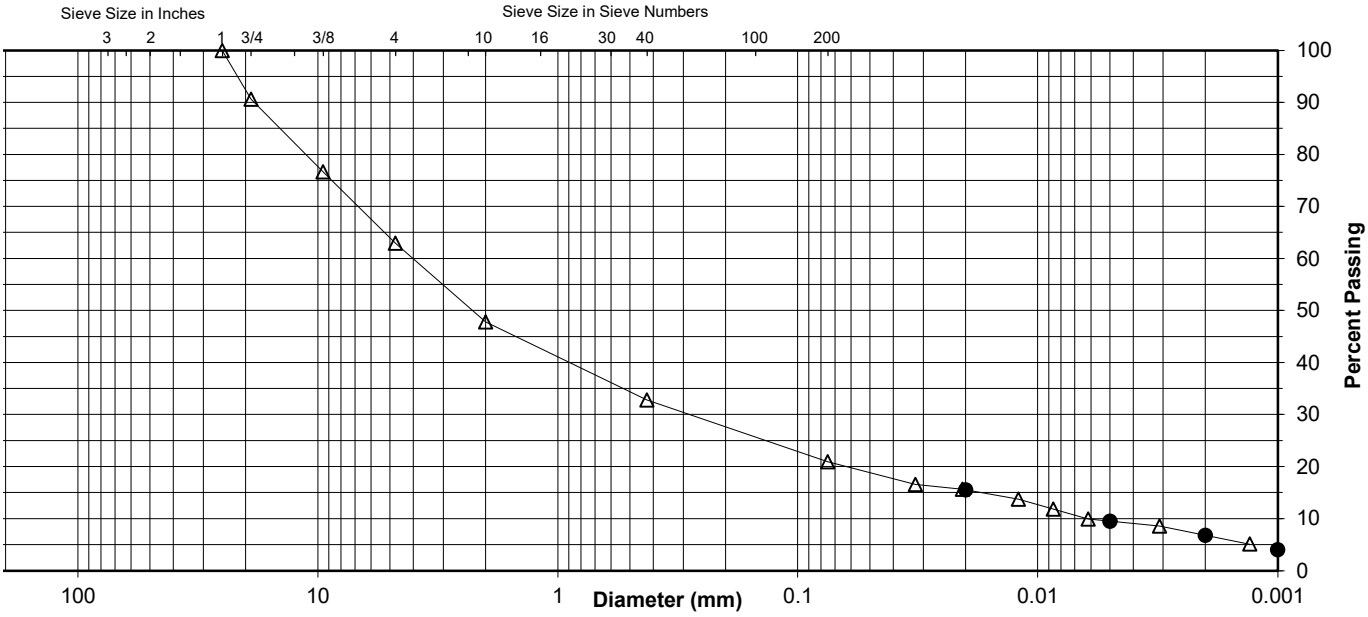
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	32.8
No. 200	20.9
0.02 mm	15.5
0.005 mm	9.5
0.002 mm	6.8
0.001 mm	4.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	9.4	27.6	15.2	15.0	11.9	11.4	9.5
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	52.2			15.0	11.9	14.1	6.8



Comments

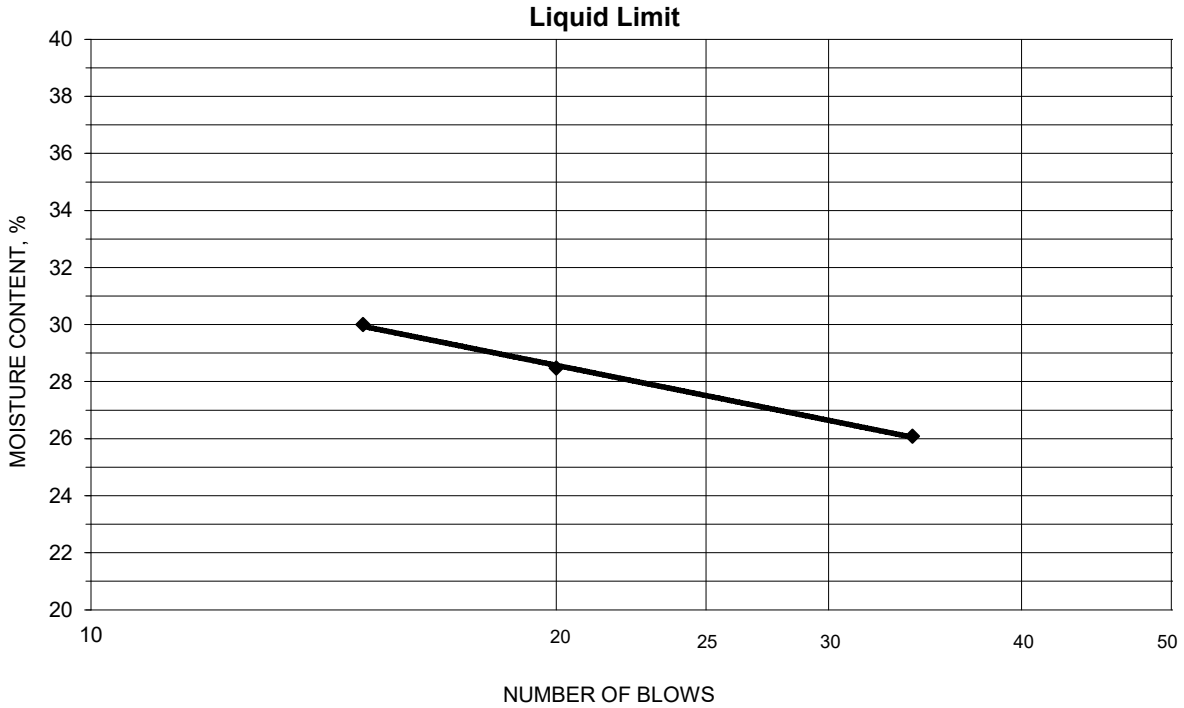
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	518-B, 1.0'-2.5', 3.5'-5.0'	Lab ID	92
		% + No. 40	67
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-30-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.60	18.38	10.98	15	30.0	28
20.45	18.26	10.57	20	28.5	
20.38	18.45	11.05	34	26.1	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.06	20.90	10.58	20.9	21	7
23.32	21.13	10.49	20.6		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-B, 6.0'-7.5', 8.5'-9.0'	Lab ID	95
Sample Type	SS-3 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 12.7

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	92.7
3/8"	9.5	72.1
No. 4	4.75	61.6
No. 10	2	49.8
No. 40	0.425	35.5
No. 200	0.075	23.8
	0.02	17.2
	0.005	10.6
	0.002	7.1
Estimated	0.001	4.2

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	38.4	50.2
Coarse Sand	11.8	14.3
Medium Sand	14.3	---
Fine Sand	11.7	11.7
Silt	13.2	16.7
Clay	10.6	7.1

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	25
Plastic Limit:	19
Plasticity Index:	6
Activity Index:	0.8

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GC-GM
Group Name:	Silty, Clayey Gravel with Sand
AASHTO Classification:	A-1-b (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 518-B, 6.0'-7.5', 8.5'-9.0'

Project Number: 2026252404
Lab ID: 95

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: JP
Test Date: 05-23-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	92.7
3/8"	72.1
No. 4	61.6
No. 10	49.8

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

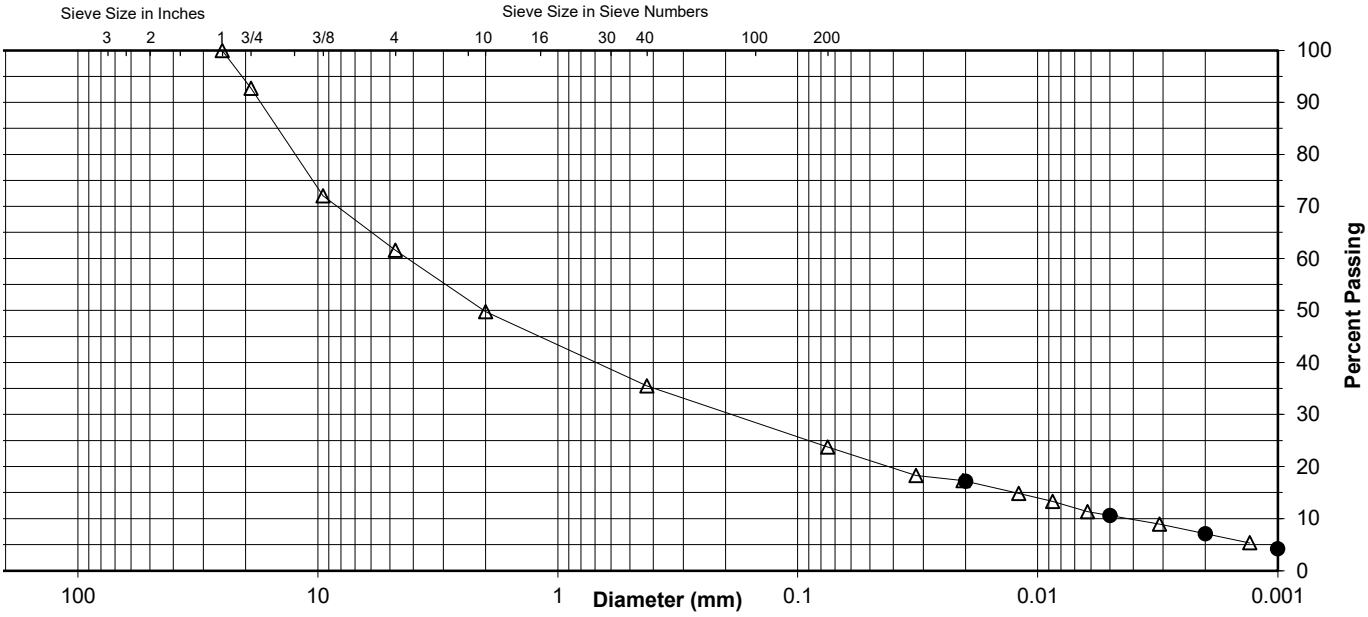
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	35.5
No. 200	23.8
0.02 mm	17.2
0.005 mm	10.6
0.002 mm	7.1
0.001 mm	4.2

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	7.3	31.1	11.8	14.3	11.7	13.2	10.6

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	50.2	14.3	11.7	16.7	7.1



Comments

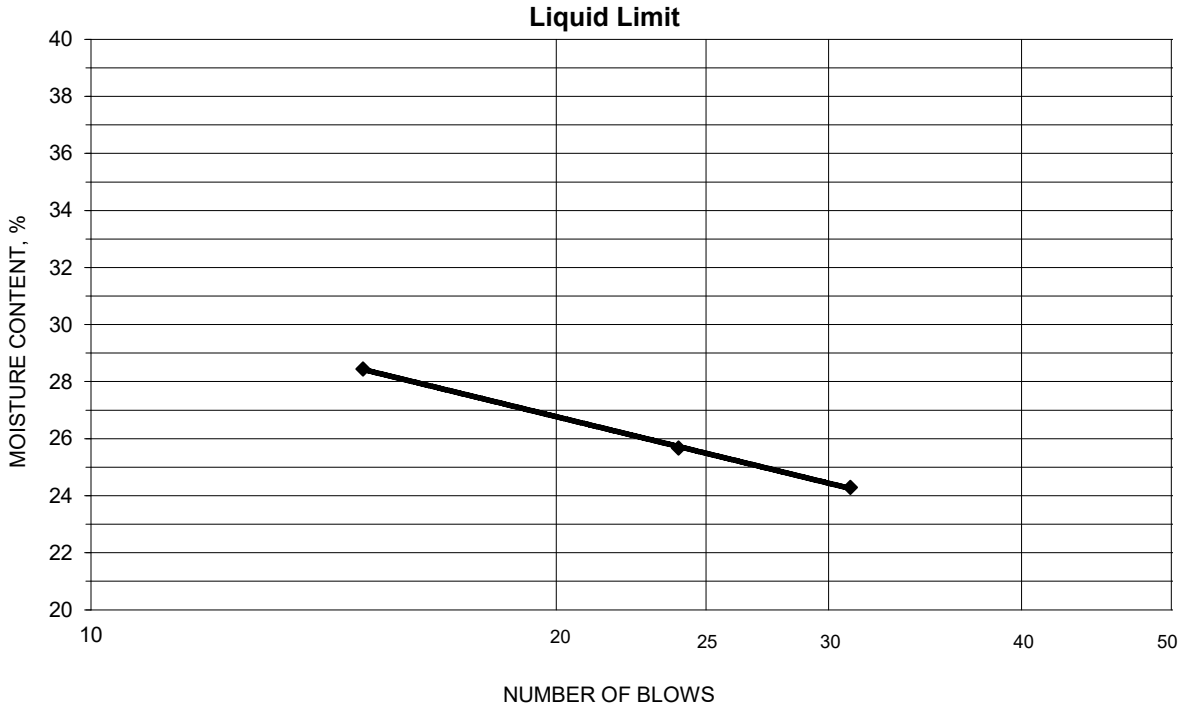
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	518-B, 6.0'-7.5', 8.5'-9.0'	Lab ID	95
		% + No. 40	65
Tested By	GK	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-29-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.81	18.54	10.56	15	28.4	
21.35	19.23	10.97	24	25.7	
22.04	19.82	10.68	31	24.3	25



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
24.40	22.25	11.05	19.2	19	6
23.14	21.14	10.59	19.0		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-B, 11.0'-12.5', 13.5'-15.0', 16.0'-17.5'	Lab ID	99
Sample Type	SS-5 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 5.9

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	92.8
3/8"	9.5	81.8
No. 4	4.75	70.0
No. 10	2	52.0
No. 40	0.425	32.3
No. 200	0.075	16.7
	0.02	11.6
	0.005	7.8
	0.002	4.7
Estimated	0.001	2.6

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	30.0	48.0
Coarse Sand	18.0	19.7
Medium Sand	19.7	---
Fine Sand	15.6	15.6
Silt	8.9	12.0
Clay	7.8	4.7

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	25
Plastic Limit:	21
Plasticity Index:	4
Activity Index:	0.9

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC-SM
Group Name:	Silty, Clayey Sand with Gravel
AASHTO Classification:	A-1-b (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-B, 11.0'-12.5', 13.5'-15.0', 16.0'-17.5'	Lab ID	99

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: JP
Test Date: 05-24-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	92.8
3/8"	81.8
No. 4	70.0
No. 10	52.0

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

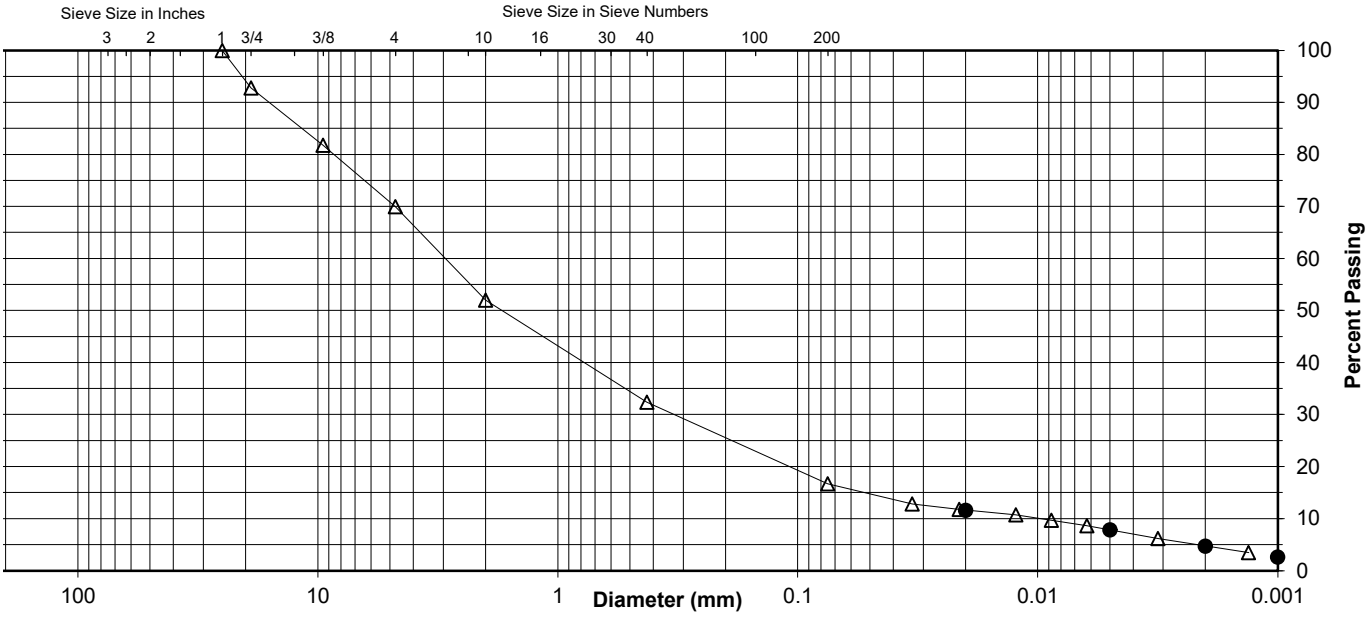
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	32.3
No. 200	16.7
0.02 mm	11.6
0.005 mm	7.8
0.002 mm	4.7
0.001 mm	2.6

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	7.2	22.8	18.0	19.7	15.6	8.9	7.8

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	48.0	19.7	15.6	12.0	4.7



Comments

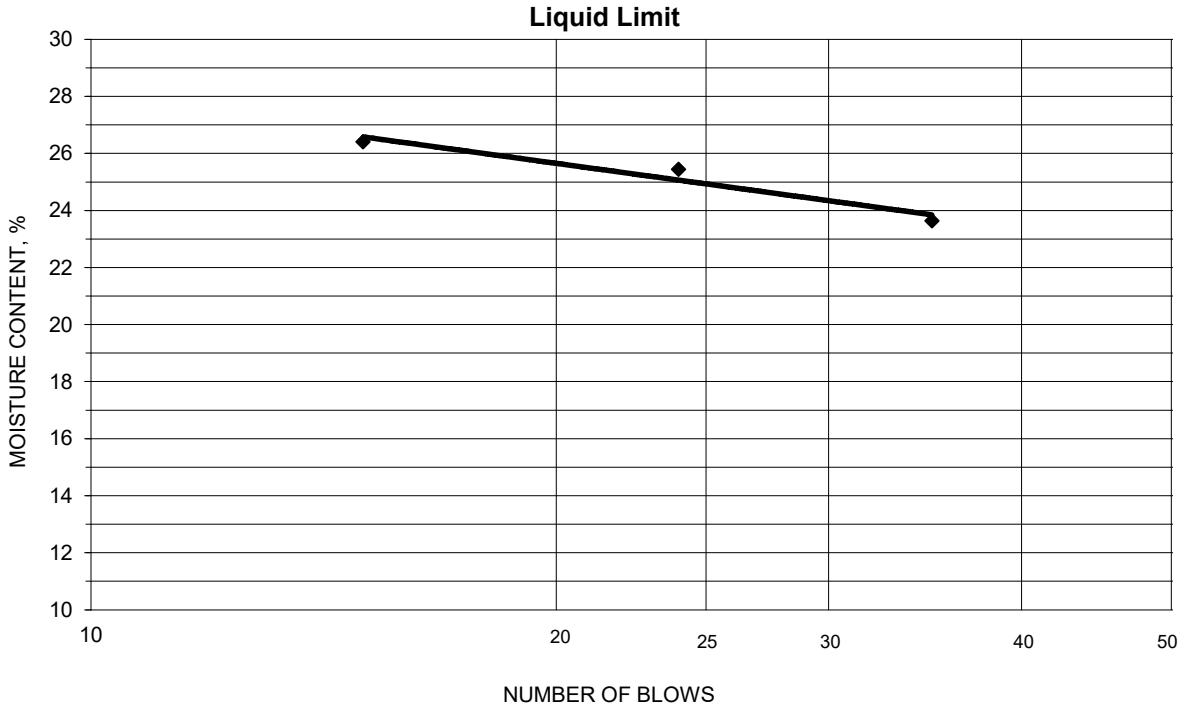
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	518-B, 11.0'-12.5', 13.5'-15.0', 16.0'-17.5'	Lab ID	99
		% + No. 40	68
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-31-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.51	17.64	10.56	15	26.4	
20.28	18.41	11.06	24	25.4	
19.02	17.50	11.07	35	23.6	25



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
24.05	21.81	11.06	20.8	21	4
24.18	21.95	11.06	20.5		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-C, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	103
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 7.3

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	92.8
3/8"	9.5	77.6
No. 4	4.75	69.0
No. 10	2	58.3
No. 40	0.425	40.8
No. 200	0.075	23.5
	0.02	19.4
	0.005	12.3
	0.002	8.8
Estimated	0.001	6.4

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	31.0	41.7
Coarse Sand	10.7	17.5
Medium Sand	17.5	---
Fine Sand	17.3	17.3
Silt	11.2	14.7
Clay	12.3	8.8

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit: 23
Plastic Limit: 18
Plasticity Index: 5
Activity Index: 0.6

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SC-SM
Group Name: Silty, Clayey Sand with Gravel

AASHTO Classification: A-1-b (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-C, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	103

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-22-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	92.8
3/8"	77.6
No. 4	69.0
No. 10	58.3

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

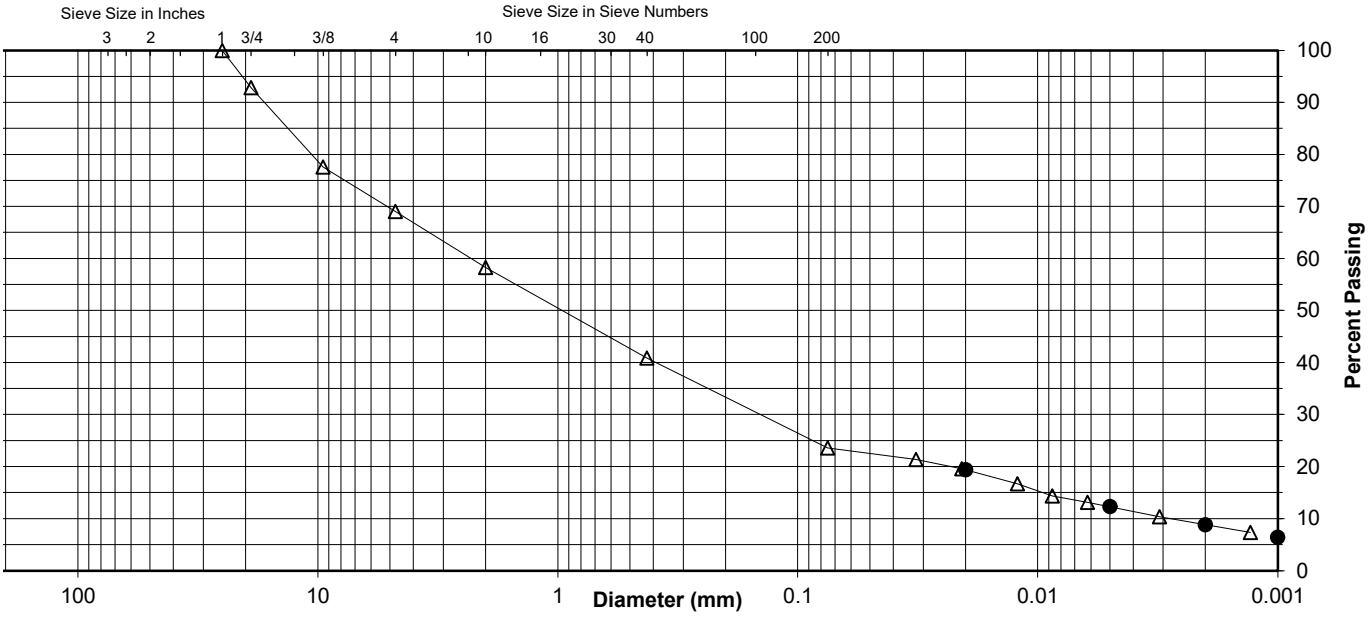
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	40.8
No. 200	23.5
0.02 mm	19.4
0.005 mm	12.3
0.002 mm	8.8
0.001 mm	6.4

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	7.2	23.8	10.7	17.5	17.3	11.2	12.3
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	41.7			17.5	17.3	14.7	8.8



Comments

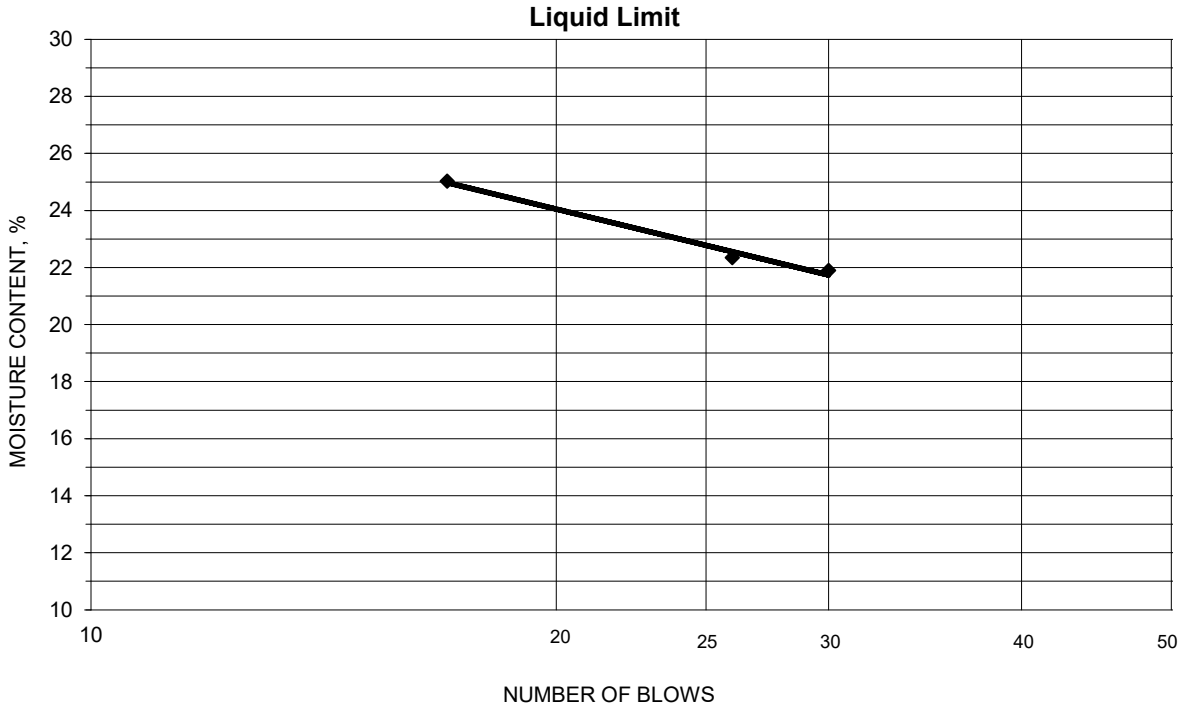
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	518-C, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	103
		% + No. 40	59
Tested By	GK	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-29-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
21.52	19.41	10.98	17	25.0	23
21.29	19.42	11.05	26	22.3	
21.31	19.44	10.90	30	21.9	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.67	19.99	10.69	18.1	18	5
21.47	19.85	11.03	18.4		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	406, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	1
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 8.7

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	82.2
3/8"	9.5	61.2
No. 4	4.75	51.3
No. 10	2	41.6
No. 40	0.425	27.3
No. 200	0.075	13.5
	0.02	12.2
	0.005	8.4
	0.002	7.0
Estimated	0.001	5.6

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	48.7	58.4
Coarse Sand	9.7	14.3
Medium Sand	14.3	---
Fine Sand	13.8	13.8
Silt	5.1	6.5
Clay	8.4	7.0

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	26
Plastic Limit:	18
Plasticity Index:	8
Activity Index:	1.1

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GC
Group Name:	Clayey Gravel with Sand
AASHTO Classification:	A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 406, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'

Project Number: 2026252404
Lab ID: 1

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-22-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	82.2
3/8"	61.2
No. 4	51.3
No. 10	41.6

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

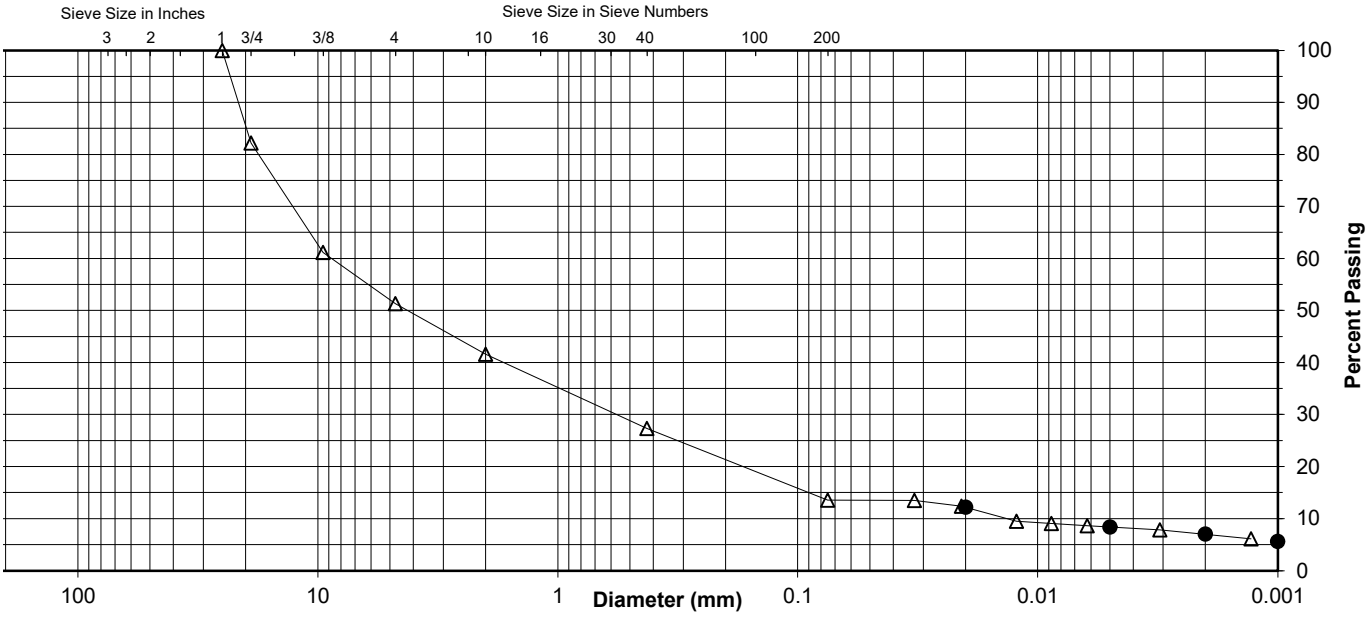
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	27.3
No. 200	13.5
0.02 mm	12.2
0.005 mm	8.4
0.002 mm	7.0
0.001 mm	5.6

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	17.8	30.9	9.7	14.3	13.8	5.1	8.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	58.4			14.3	13.8	6.5	7.0



Comments

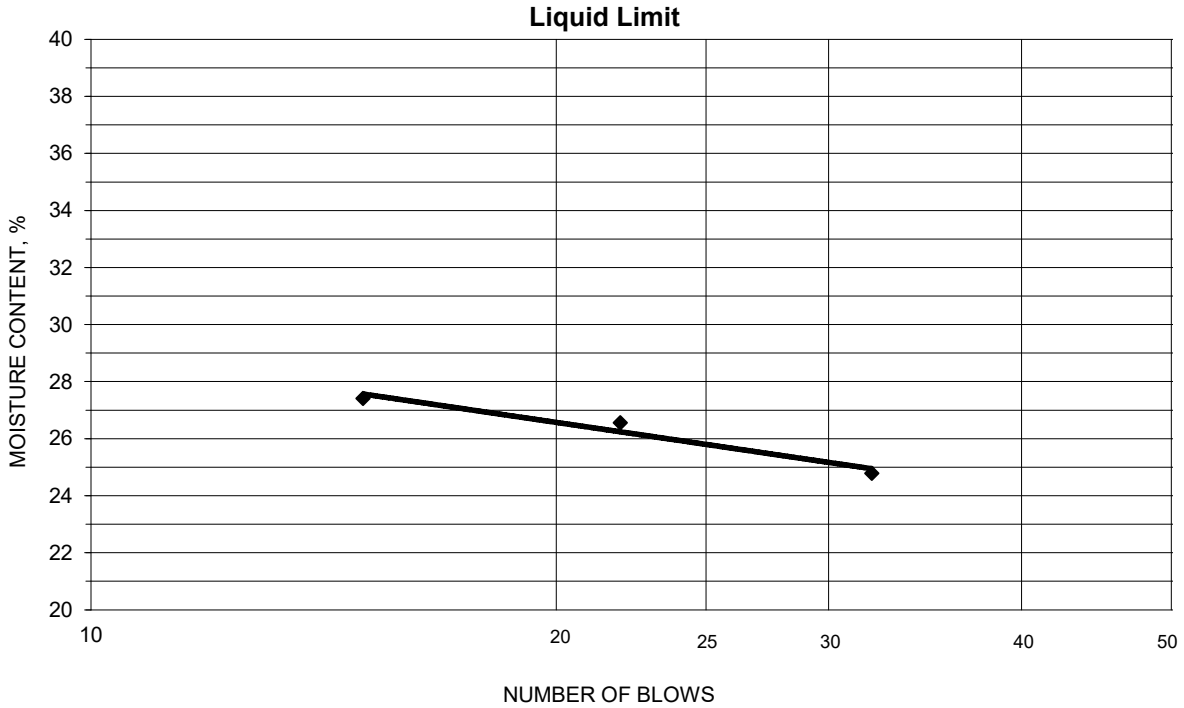
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	406, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	1
		% + No. 40	73
Tested By	NU	Test Method	AASHTO T 89 & T 90
Test Date	05-30-2024	Prepared	Dry
		Date Received	05-13-2024

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.20	18.15	10.67	15	27.4	
19.46	17.59	10.55	22	26.6	
20.95	18.95	10.88	32	24.8	26



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.07	21.23	11.03	18.0	18	8
22.69	20.88	10.61	17.6		

Remarks: _____

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	406, 13.5'-15.0', 18.5'-20.0'	Lab ID	7
Sample Type	SS-6 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 29.6

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
3/4"	19	100.0
3/8"	9.5	96.9
No. 4	4.75	95.1
No. 10	2	87.0
No. 40	0.425	76.3
No. 200	0.075	40.6
	0.02	25.7
	0.005	17.9
	0.002	14.5
Estimated	0.001	13.1

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	4.9	13.0
Coarse Sand	8.1	10.7
Medium Sand	10.7	---
Fine Sand	35.7	35.7
Silt	22.7	26.1
Clay	17.9	14.5

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	26
Plastic Limit:	19
Plasticity Index:	7
Activity Index:	0.5

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC-SM
Group Name:	Silty, Clayey Sand
AASHTO Classification:	A-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 406, 13.5'-15.0', 18.5'-20.0'

Project Number: 2026252404
Lab ID: 7

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-16-2024
Date Received: 05-13-2024

Maximum Particle Size: 3/4" Sieve

Sieve Size	% Passing
3/4"	100.0
3/8"	96.9
No. 4	95.1
No. 10	87.0

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	76.3
No. 200	40.6
0.02 mm	25.7
0.005 mm	17.9
0.002 mm	14.5
0.001 mm	13.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	4.9	8.1	10.7	35.7	22.7	17.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	13.0			10.7	35.7	26.1	14.5

Comments

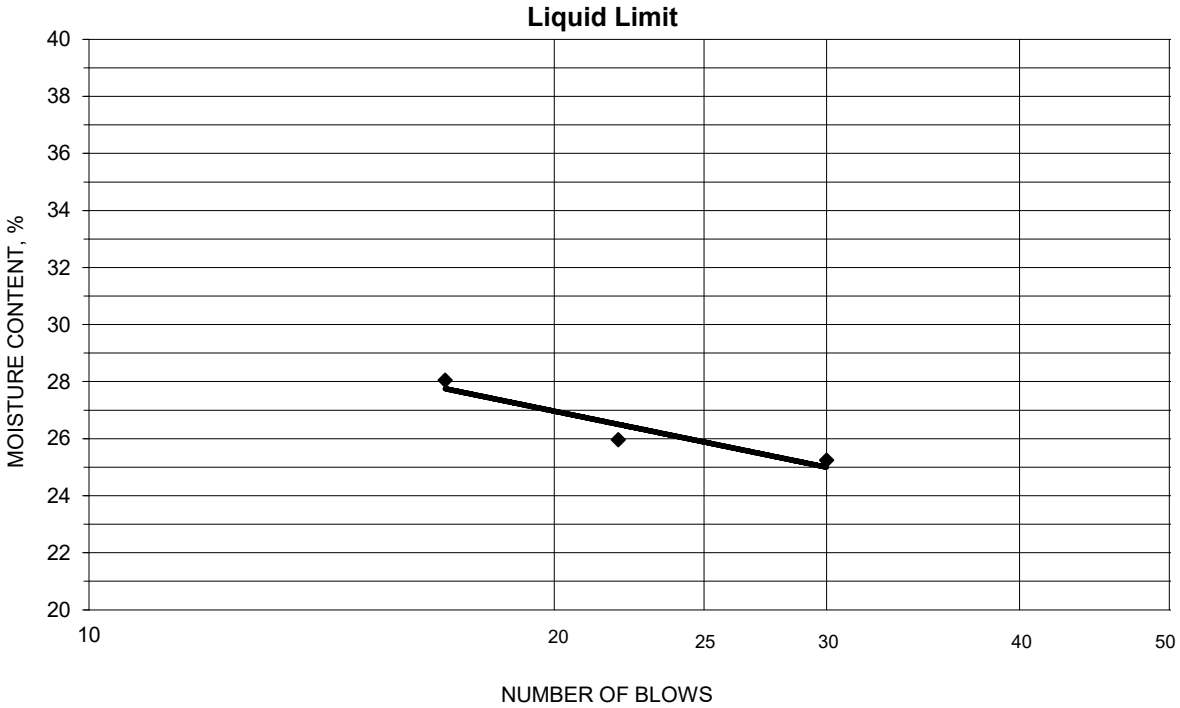
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	406, 13.5'-15.0', 18.5'-20.0'	Lab ID	7
		% + No. 40	24
Tested By	GK	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-21-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
22.28	19.82	11.05	17	28.1	
25.76	22.71	10.96	22	26.0	
26.28	23.21	11.05	30	25.2	26



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.21	19.53	11.01	19.7	19	7
22.40	20.57	11.02	19.2		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	406, 21.0'-22.5', 23.5'-25.0'	Lab ID	11
Sample Type	SS-9 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 34.3

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	99.1
No. 200	0.075	57.7
	0.02	31.4
	0.005	19.2
	0.002	16.7
Estimated	0.001	15.1

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.1
Coarse Sand	0.1	0.8
Medium Sand	0.8	---
Fine Sand	41.4	41.4
Silt	38.5	41.0
Clay	19.2	16.7

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	25
Plastic Limit:	20
Plasticity Index:	5
Activity Index:	0.3

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	CL-ML
Group Name:	Sandy Silty Clay
AASHTO Classification:	A-4 (1)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 406, 21.0'-22.5', 23.5'-25.0'

Project Number: 2026252404
Lab ID: 11

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-16-2024
Date Received: 05-13-2024

Maximum Particle Size: No. 4 Sieve

Sieve Size	% Passing
No. 4	100.0
No. 10	99.9

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

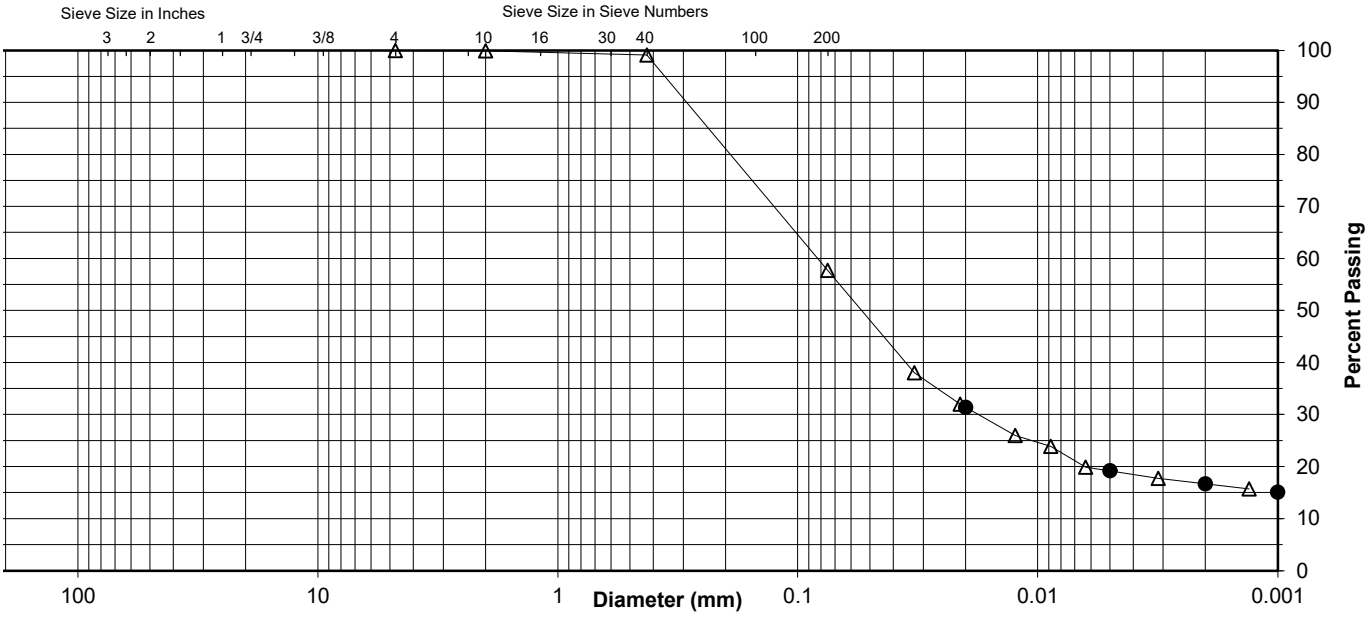
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	99.1
No. 200	57.7
0.02 mm	31.4
0.005 mm	19.2
0.002 mm	16.7
0.001 mm	15.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.1	0.8	41.4	38.5	19.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.1			0.8	41.4	41.0	16.7



Comments

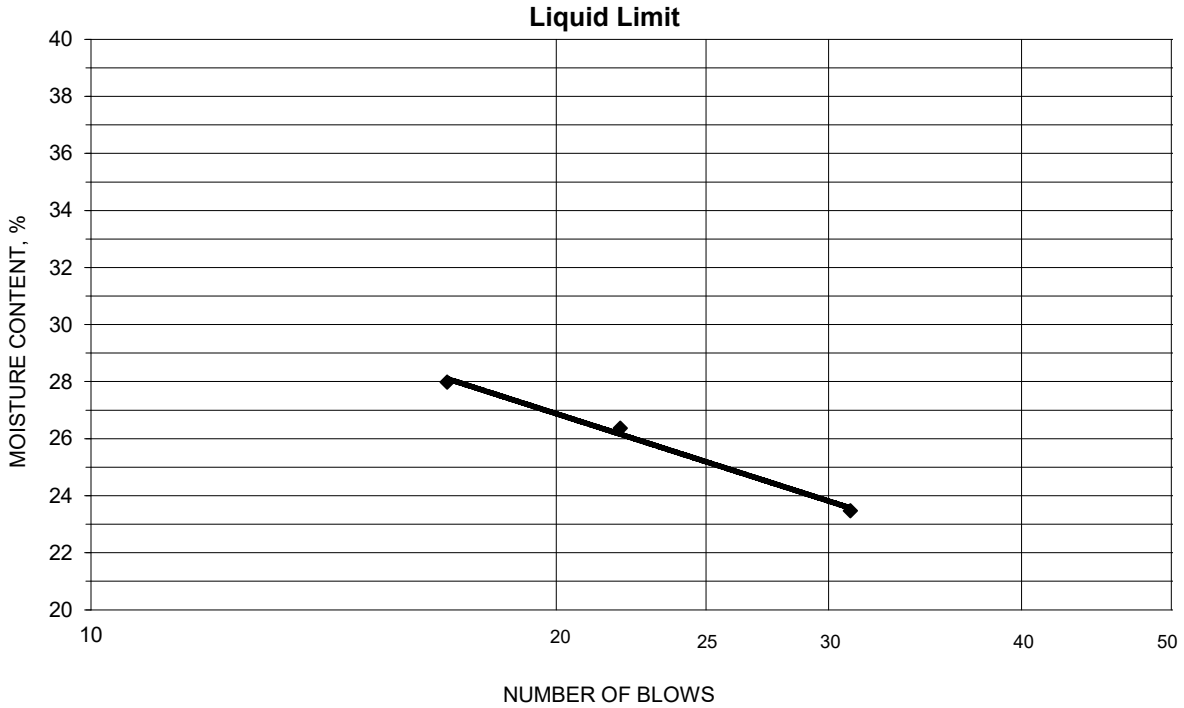
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	406, 21.0'-22.5', 23.5'-25.0'	Lab ID	11
		% + No. 40	1
Tested By	GK	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-29-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
21.87	19.50	11.03	17	28.0	25
24.23	21.39	10.62	22	26.4	
24.37	21.83	11.01	31	23.5	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.87	20.08	11.03	19.8	20	5
21.34	19.67	11.06	19.4		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	411, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	14
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 7.9

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	82.7
3/8"	9.5	72.1
No. 4	4.75	63.9
No. 10	2	53.3
No. 40	0.425	39.8
No. 200	0.075	21.3
	0.02	14.3
	0.005	9.5
	0.002	7.6
Estimated	0.001	6.3

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	36.1	46.7
Coarse Sand	10.6	13.5
Medium Sand	13.5	---
Fine Sand	18.5	18.5
Silt	11.8	13.7
Clay	9.5	7.6

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	25
Plastic Limit:	17
Plasticity Index:	8
Activity Index:	1.1

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC
Group Name:	Clayey Sand with Gravel
AASHTO Classification:	A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	411, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	14

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-22-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	82.7
3/8"	72.1
No. 4	63.9
No. 10	53.3

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

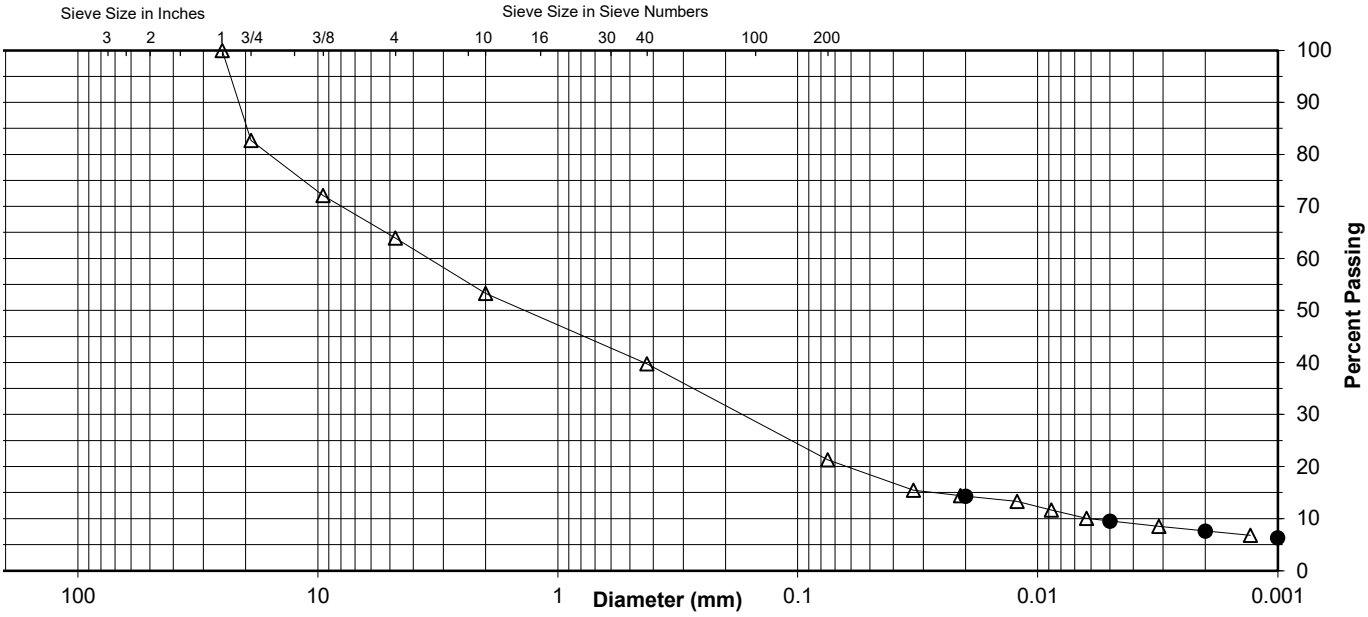
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	39.8
No. 200	21.3
0.02 mm	14.3
0.005 mm	9.5
0.002 mm	7.6
0.001 mm	6.3

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	17.3	18.8	10.6	13.5	18.5	11.8	9.5

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	46.7	13.5	18.5	13.7	7.6



Comments

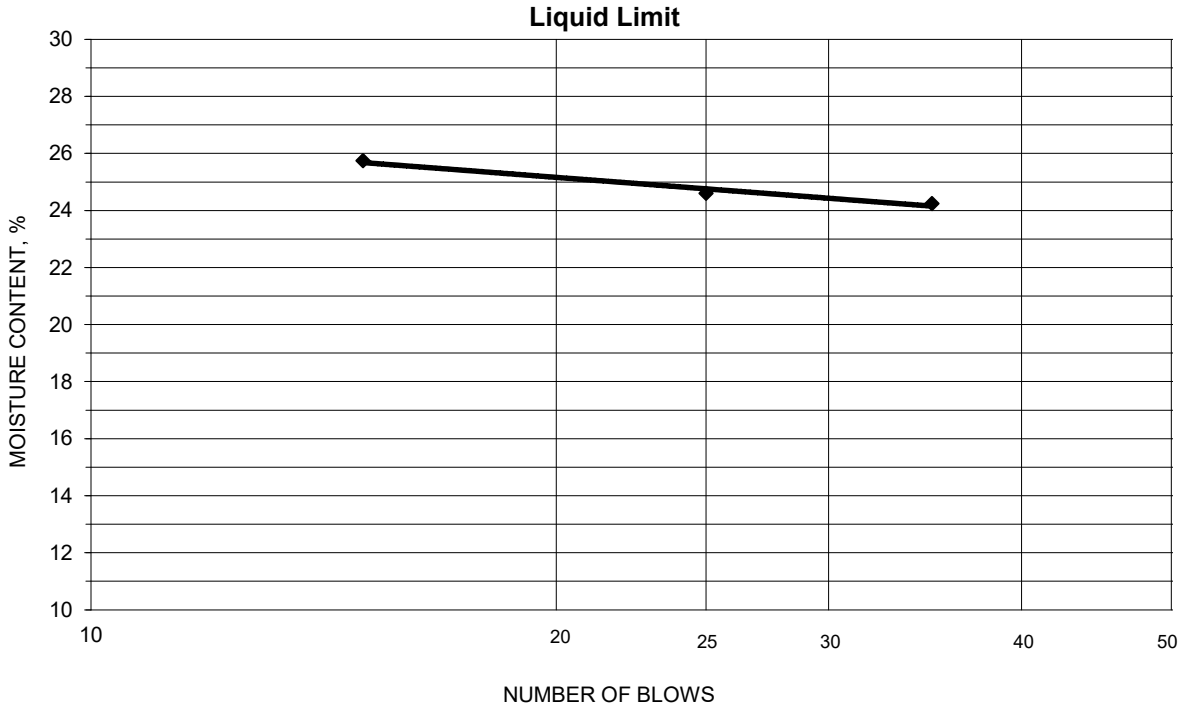
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	411, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	14
		% + No. 40	60
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-30-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.94	18.12	11.05	15	25.7	25
19.17	17.46	10.51	25	24.6	
19.75	17.98	10.68	35	24.2	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.18	21.40	11.07	17.2	17	8
23.17	21.44	11.00	16.6		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	411, 8.5'-10.0', 11.0'-12.5'	Lab ID	18
Sample Type	SS-4 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 13.3

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	82.1
3/8"	9.5	73.9
No. 4	4.75	68.9
No. 10	2	59.9
No. 40	0.425	34.7
No. 200	0.075	12.7
	0.02	9.3
	0.005	6.5
	0.002	5.4
Estimated	0.001	5.0

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	31.1	40.1
Coarse Sand	9.0	25.2
Medium Sand	25.2	---
Fine Sand	22.0	22.0
Silt	6.2	7.3
Clay	6.5	5.4

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	20
Plastic Limit:	17
Plasticity Index:	3
Activity Index:	0.6

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SM
Group Name:	Silty Sand with Gravel
AASHTO Classification:	A-1-b (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 411, 8.5'-10.0', 11.0'-12.5'

Project Number: 2026252404
Lab ID: 18

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-16-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	82.1
3/8"	73.9
No. 4	68.9
No. 10	59.9

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

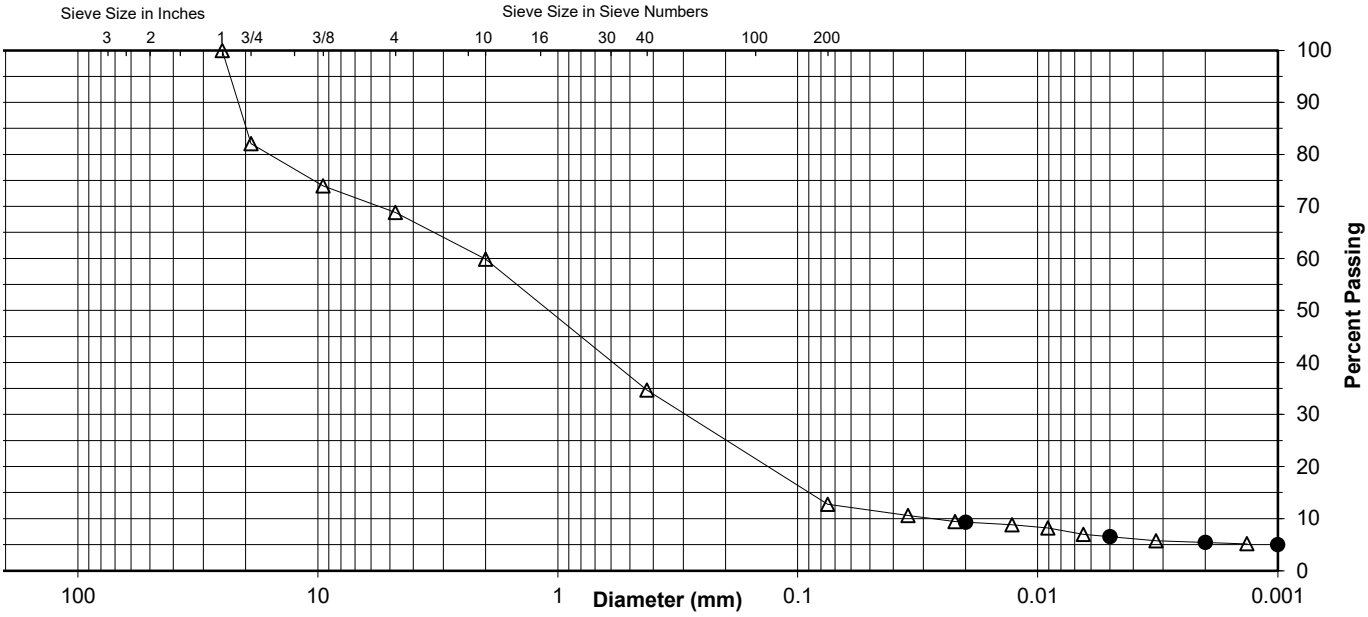
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	34.7
No. 200	12.7
0.02 mm	9.3
0.005 mm	6.5
0.002 mm	5.4
0.001 mm	5.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	17.9	13.2	9.0	25.2	22.0	6.2	6.5
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	40.1			25.2	22.0	7.3	5.4



Comments

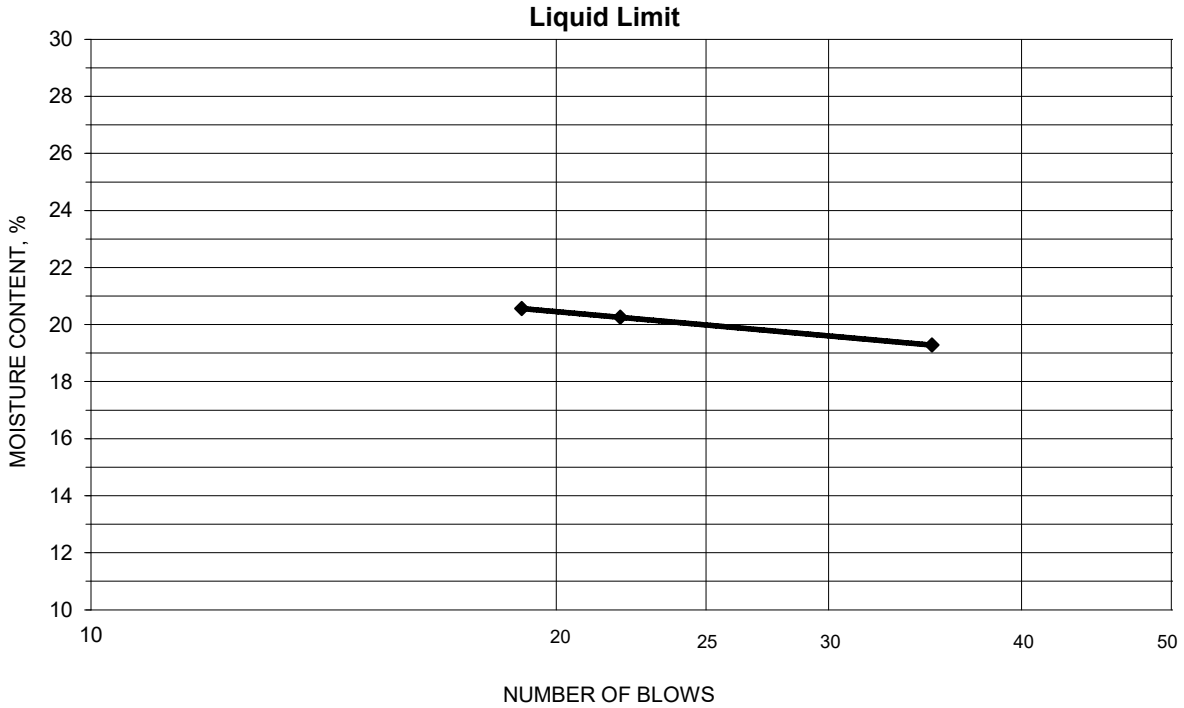
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	411, 8.5'-10.0', 11.0'-12.5'	Lab ID	18
		% + No. 40	65
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-23-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
18.24	16.92	10.50	19	20.6	20
20.52	18.93	11.08	22	20.3	
20.36	18.86	11.08	35	19.3	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
25.08	23.10	11.07	16.5	17	3
25.02	23.04	11.08	16.6		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	428-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	21
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 4.1

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	79.1
3/8"	9.5	62.2
No. 4	4.75	52.5
No. 10	2	45.6
No. 40	0.425	24.6
No. 200	0.075	9.3
	0.02	8.0
	0.005	6.4
	0.002	5.1
Estimated	0.001	4.0

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	47.5	54.4
Coarse Sand	6.9	21.0
Medium Sand	21.0	---
Fine Sand	15.3	15.3
Silt	2.9	4.2
Clay	6.4	5.1

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit: 17
Plastic Limit: 16
Plasticity Index: 1
Activity Index: 0.2

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: GP-GM
Group Name: Poorly Graded Gravel with Silt and Sand

AASHTO Classification: A-1-a (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	428-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	21

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-22-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	79.1
3/8"	62.2
No. 4	52.5
No. 10	45.6

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

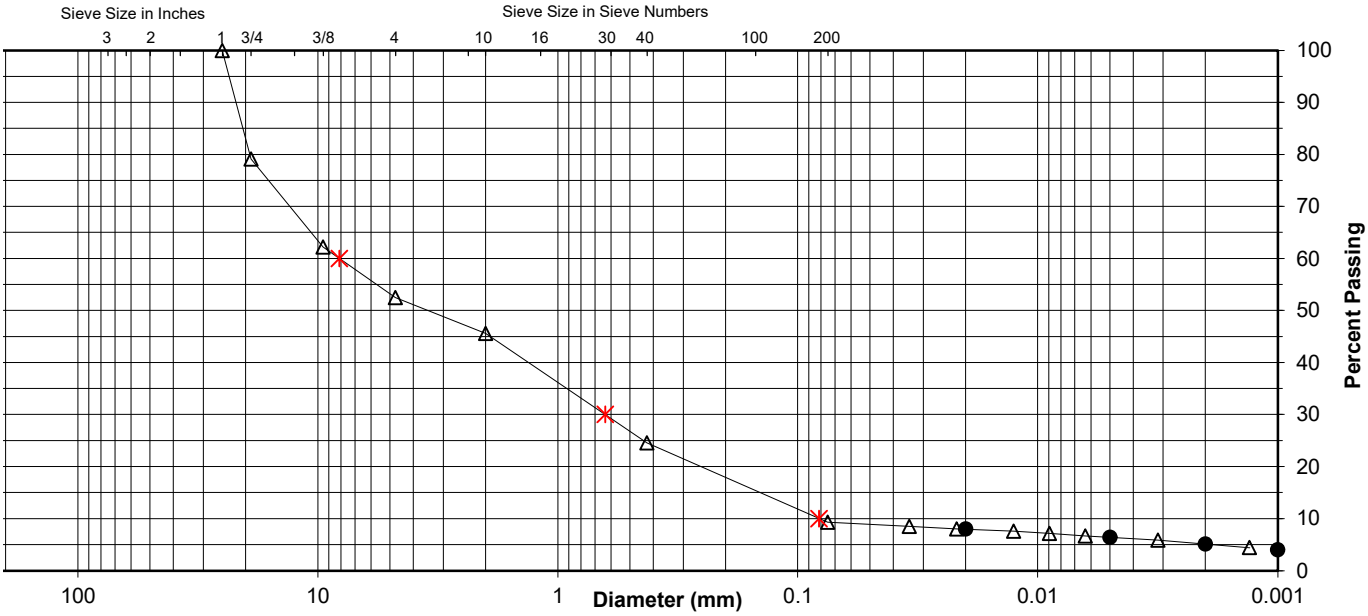
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	24.6
No. 200	9.3
0.02 mm	8.0
0.005 mm	6.4
0.002 mm	5.1
0.001 mm	4.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	20.9	26.6	6.9	21.0	15.3	2.9	6.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	54.4			21.0	15.3	4.2	5.1



Comments

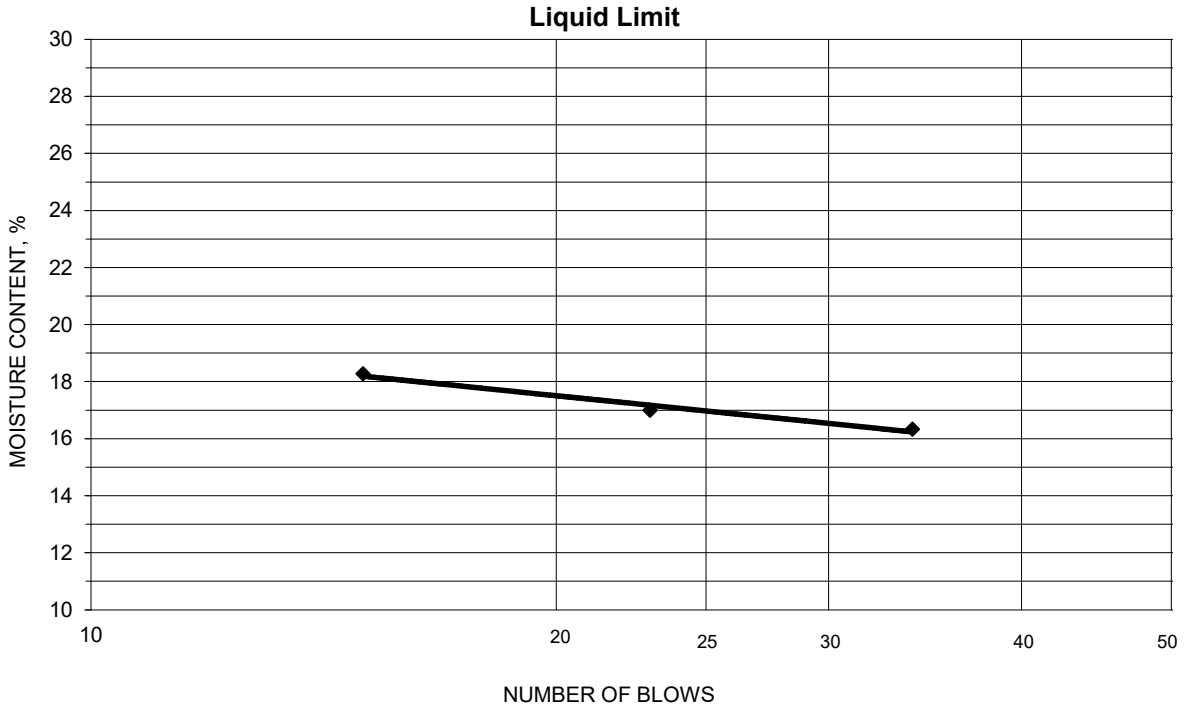
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	428-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	21
		% + No. 40	75
Tested By	GK	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-29-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
22.40	20.64	11.01	15	18.3	
20.97	19.52	10.64	34	16.3	
21.12	19.66	11.07	23	17.0	17



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
22.33	20.80	11.07	15.7	16	1
22.43	20.86	10.66	15.4		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	433, 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	28
Sample Type	SS-2 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 9.7

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	84.7
3/8"	9.5	75.0
No. 4	4.75	69.2
No. 10	2	60.3
No. 40	0.425	35.5
No. 200	0.075	18.1
	0.02	15.9
	0.005	12.1
	0.002	10.1
Estimated	0.001	8.1

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	30.8	39.7
Coarse Sand	8.9	24.8
Medium Sand	24.8	---
Fine Sand	17.4	17.4
Silt	6.0	8.0
Clay	12.1	10.1

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	26
Plastic Limit:	19
Plasticity Index:	7
Activity Index:	0.7

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC-SM
Group Name:	Silty, Clayey Sand with Gravel
AASHTO Classification:	A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	433, 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	28

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-22-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	84.7
3/8"	75.0
No. 4	69.2
No. 10	60.3

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

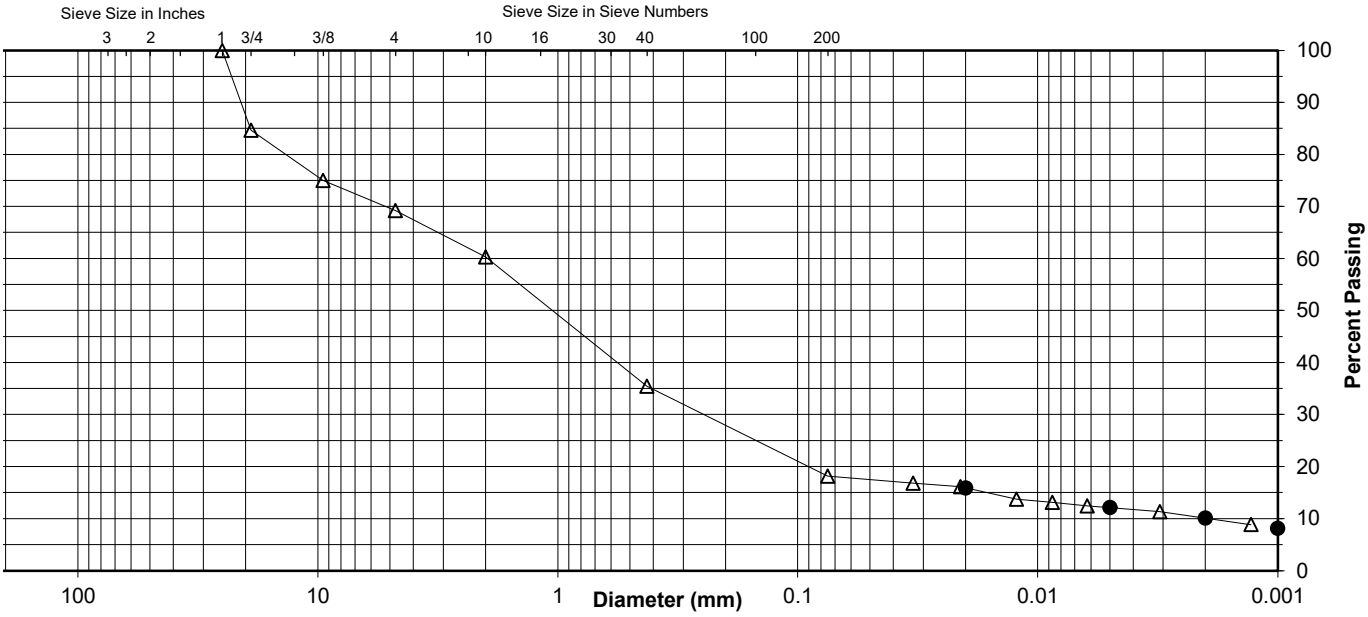
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	35.5
No. 200	18.1
0.02 mm	15.9
0.005 mm	12.1
0.002 mm	10.1
0.001 mm	8.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	15.3	15.5	8.9	24.8	17.4	6.0	12.1
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	39.7			24.8	17.4	8.0	10.1



Comments

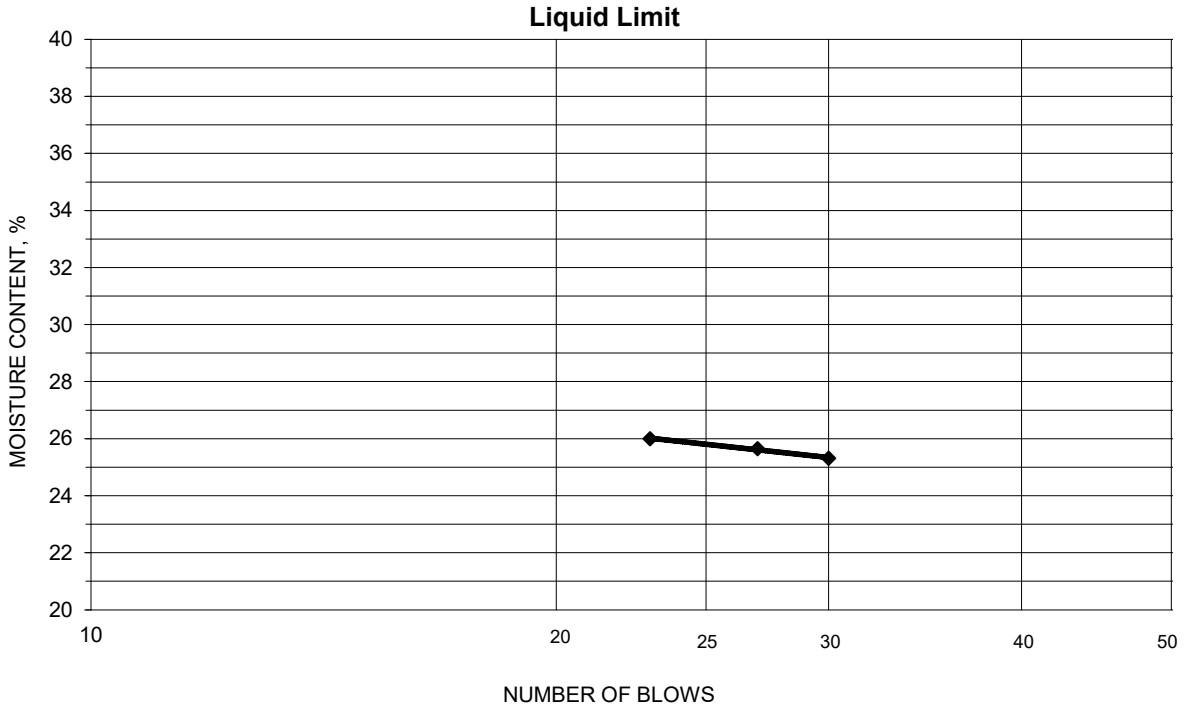
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	433, 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	28
		% + No. 40	65
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-30-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.87	18.05	11.05	23	26.0	26
19.90	18.02	10.69	27	25.6	
19.02	17.41	11.05	30	25.3	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.18	21.27	11.04	18.7	19	7
22.98	21.05	10.62	18.5		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	452, 3.5'-5.0', 6.0'-7.5'	Lab ID	34
Sample Type	SS-2 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 6.8

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	92.6
3/8"	9.5	78.7
No. 4	4.75	71.6
No. 10	2	59.6
No. 40	0.425	36.2
No. 200	0.075	17.9
	0.02	12.6
	0.005	7.7
	0.002	6.3
Estimated	0.001	5.4

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	28.4	40.4
Coarse Sand	12.0	23.4
Medium Sand	23.4	---
Fine Sand	18.3	18.3
Silt	10.2	11.6
Clay	7.7	6.3

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	24
Plastic Limit:	17
Plasticity Index:	7
Activity Index:	1.1

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC-SM
Group Name:	Silty, Clayey Sand with Gravel
AASHTO Classification:	A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	452, 3.5'-5.0', 6.0'-7.5'	Lab ID	34

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-16-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	92.6
3/8"	78.7
No. 4	71.6
No. 10	59.6

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

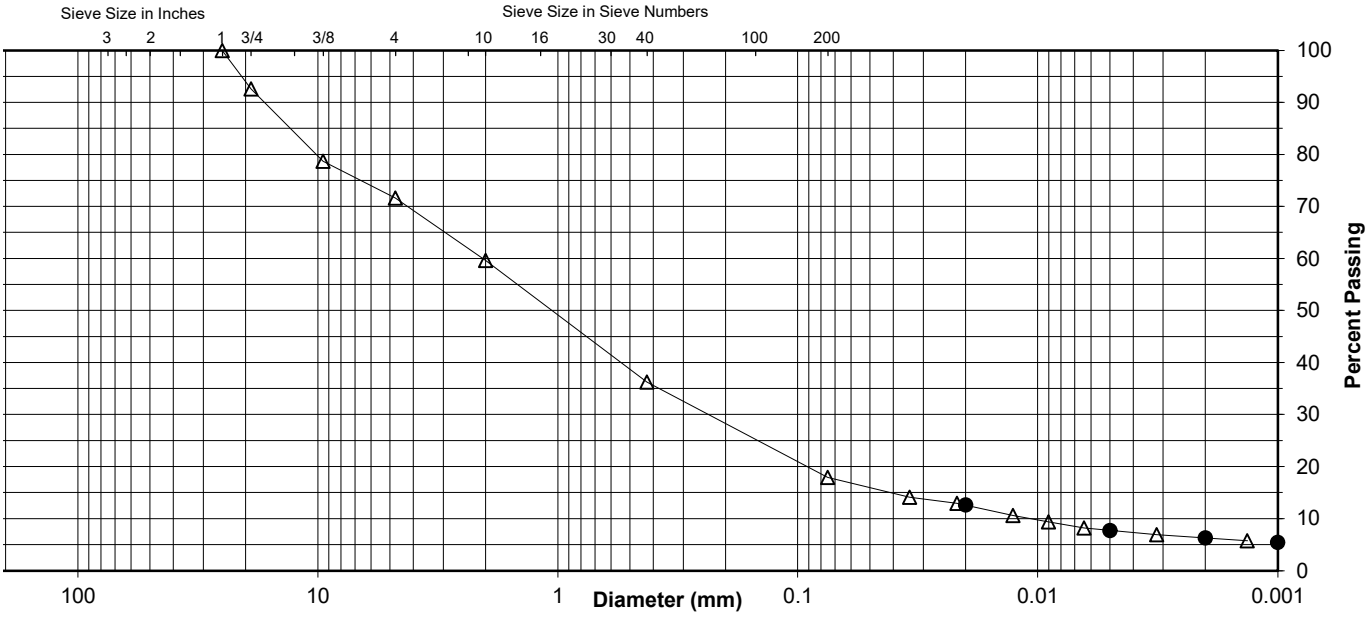
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	36.2
No. 200	17.9
0.02 mm	12.6
0.005 mm	7.7
0.002 mm	6.3
0.001 mm	5.4

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	7.4	21.0	12.0	23.4	18.3	10.2	7.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	40.4			23.4	18.3	11.6	6.3



Comments

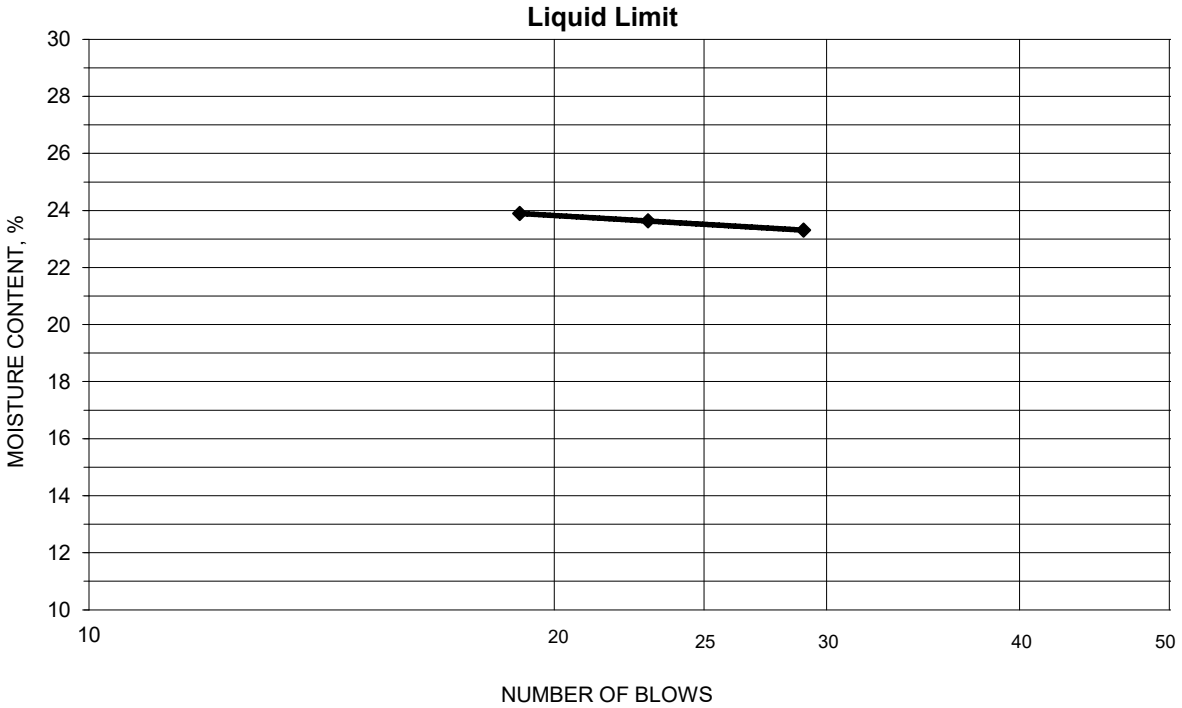
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	452, 3.5'-5.0', 6.0'-7.5'	Lab ID	34
		% + No. 40	64
Tested By	GK	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-21-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
24.38	21.82	10.99	23	23.6	24
25.03	22.31	10.64	29	23.3	
22.33	20.12	10.87	19	23.9	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.50	19.98	11.03	17.0	17	7
21.31	19.82	11.06	17.0		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	38
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 13.1

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	91.5
3/8"	9.5	81.7
No. 4	4.75	76.0
No. 10	2	68.7
No. 40	0.425	50.0
No. 200	0.075	35.4
	0.02	23.8
	0.005	13.7
	0.002	10.5
Estimated	0.001	7.7

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	24.0	31.3
Coarse Sand	7.3	18.7
Medium Sand	18.7	---
Fine Sand	14.6	14.6
Silt	21.7	24.9
Clay	13.7	10.5

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit: 31
Plastic Limit: 23
Plasticity Index: 8
Activity Index: 0.8

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SM
Group Name: Silty Sand with Gravel

AASHTO Classification: A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	38

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-22-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	91.5
3/8"	81.7
No. 4	76.0
No. 10	68.7

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	50.0
No. 200	35.4
0.02 mm	23.8
0.005 mm	13.7
0.002 mm	10.5
0.001 mm	7.7

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	8.5	15.5	7.3	18.7	14.6	21.7	13.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	31.3			18.7	14.6	24.9	10.5

Comments

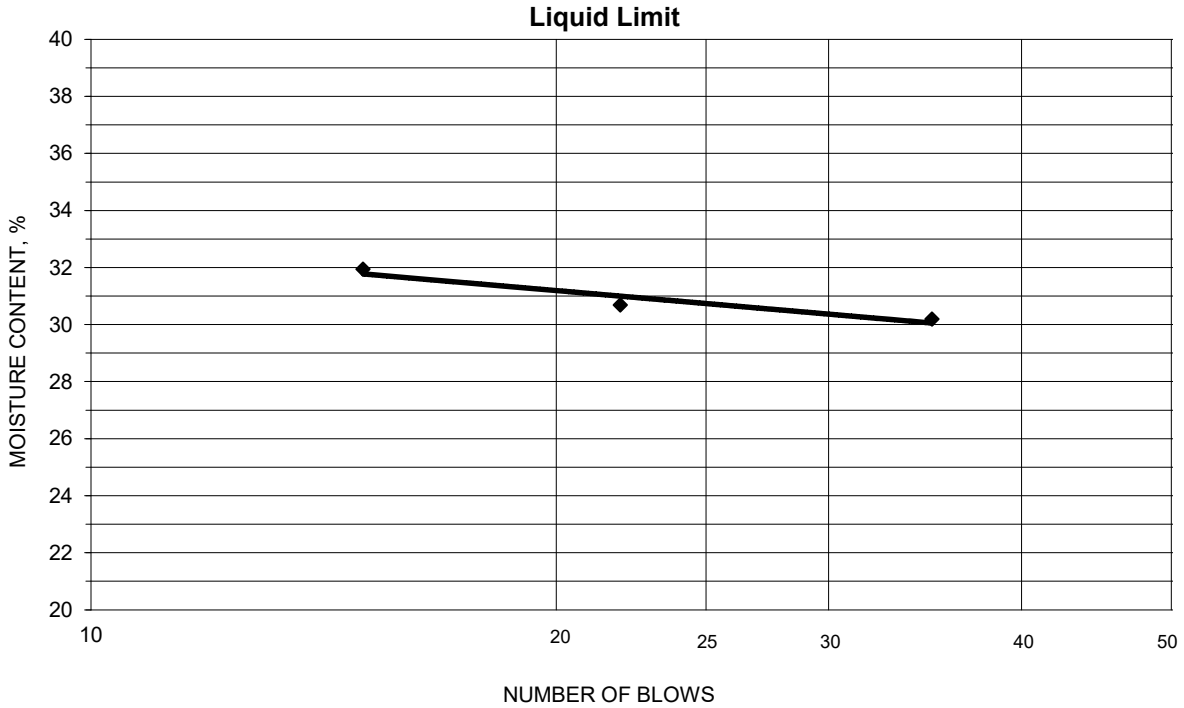
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	466-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	Lab ID	38
		% + No. 40	50
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-30-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.97	17.82	11.09	15	31.9	31
19.59	17.58	11.03	22	30.7	
19.73	17.71	11.02	35	30.2	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.98	21.54	10.99	23.1	23	8
24.03	21.57	11.07	23.4		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-A, 11.0'-12.5', 13.5'-15.0'	Lab ID	43
Sample Type	SS-5 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 29.1

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	89.8
3/8"	9.5	87.8
No. 4	4.75	86.3
No. 10	2	83.1
No. 40	0.425	63.6
No. 200	0.075	40.3
	0.02	24.1
	0.005	9.9
	0.002	6.3
Estimated	0.001	5.0

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	13.7	16.9
Coarse Sand	3.2	19.5
Medium Sand	19.5	---
Fine Sand	23.3	23.3
Silt	30.4	34.0
Clay	9.9	6.3

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	45
Plastic Limit:	36
Plasticity Index:	9
Activity Index:	1.4

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SM
Group Name:	Silty Sand
AASHTO Classification:	A-5 (1)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 466-A, 11.0'-12.5', 13.5'-15.0'

Project Number: 2026252404
Lab ID: 43

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-16-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	89.8
3/8"	87.8
No. 4	86.3
No. 10	83.1

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

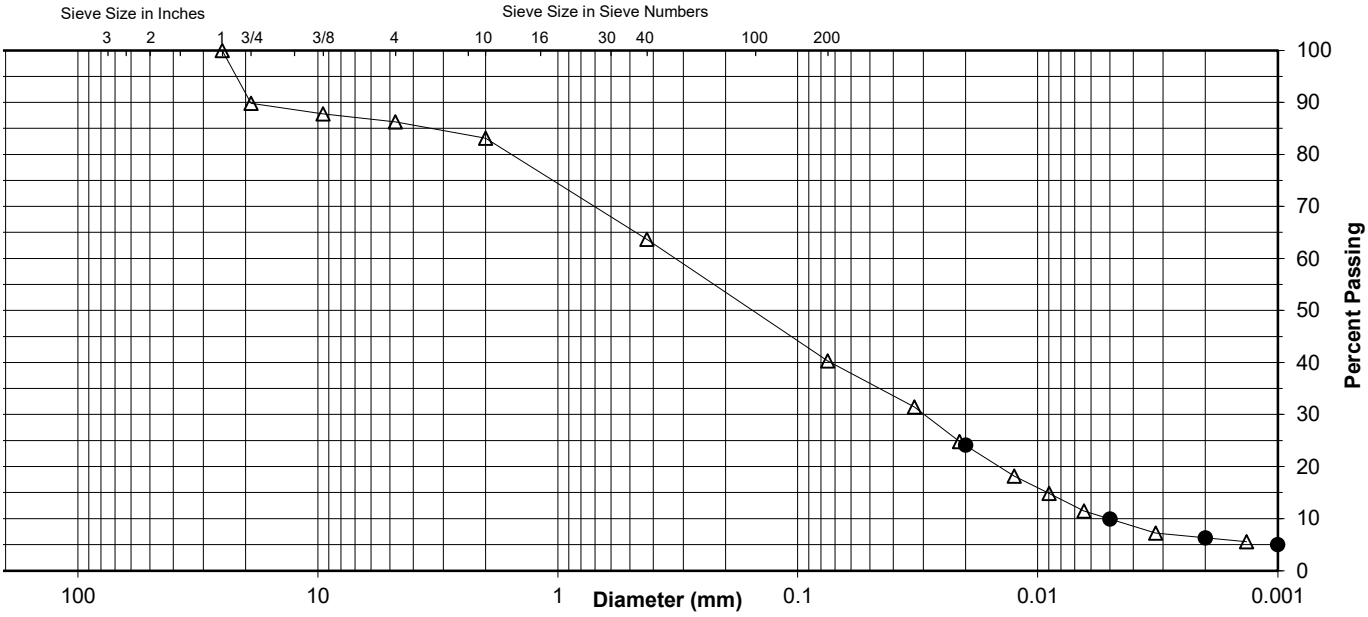
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	63.6
No. 200	40.3
0.02 mm	24.1
0.005 mm	9.9
0.002 mm	6.3
0.001 mm	5.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	10.2	3.5	3.2	19.5	23.3	30.4	9.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	16.9			19.5	23.3	34.0	6.3



Comments

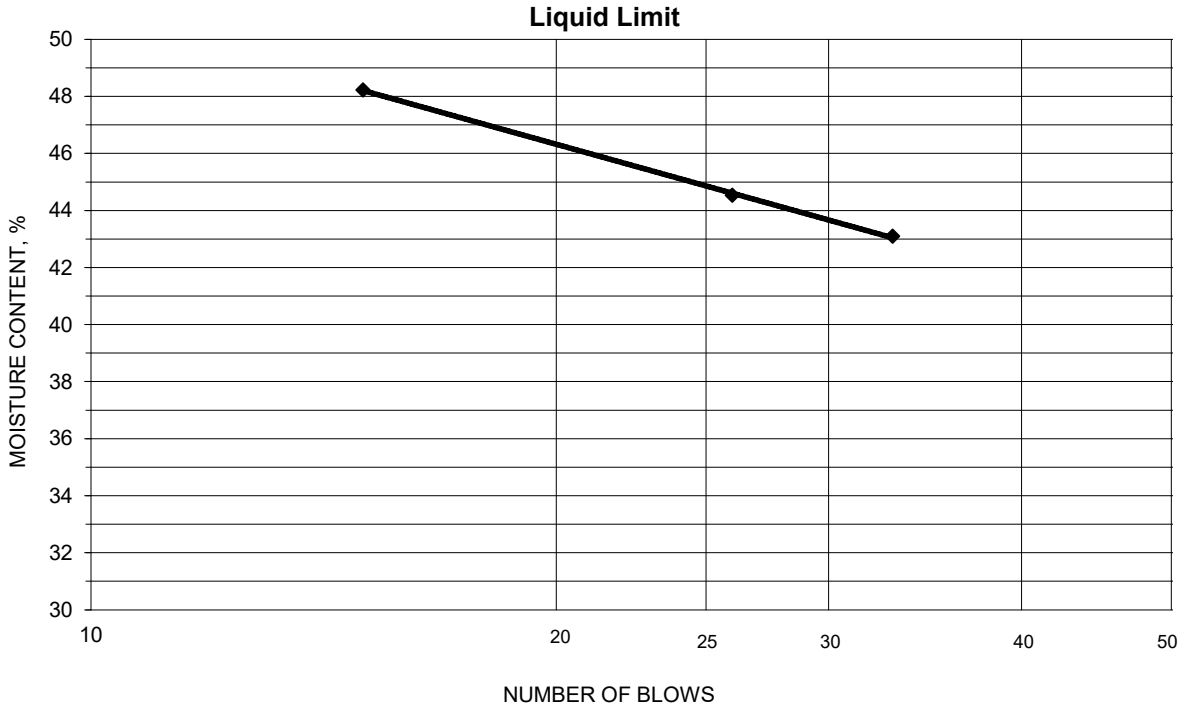
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	466-A, 11.0'-12.5', 13.5'-15.0'	Lab ID	43
		% + No. 40	36
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-21-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.44	16.72	11.08	15	48.2	45
20.19	17.38	11.07	26	44.5	
19.20	16.61	10.60	33	43.1	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.89	20.42	10.97	36.7	36	9
23.99	20.51	10.83	36.0		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-A, 16.0'-17.5', 18.5'-20.0'	Lab ID	46
Sample Type	SS-7 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 15.3

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	98.1
3/8"	9.5	93.5
No. 4	4.75	92.6
No. 10	2	88.5
No. 40	0.425	73.1
No. 200	0.075	40.6
	0.02	20.0
	0.005	5.8
	0.002	3.7
Estimated	0.001	3.1

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	7.4	11.5
Coarse Sand	4.1	15.4
Medium Sand	15.4	---
Fine Sand	32.5	32.5
Silt	34.8	36.9
Clay	5.8	3.7

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	35
Plastic Limit:	29
Plasticity Index:	6
Activity Index:	1.6

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SM
Group Name:	Silty Sand
AASHTO Classification:	A-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 466-A, 16.0'-17.5', 18.5'-20.0'

Project Number: 2026252404
Lab ID: 46

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-16-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	98.1
3/8"	93.5
No. 4	92.6
No. 10	88.5

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	73.1
No. 200	40.6
0.02 mm	20.0
0.005 mm	5.8
0.002 mm	3.7
0.001 mm	3.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	1.9	5.5	4.1	15.4	32.5	34.8	5.8
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	11.5			15.4	32.5	36.9	3.7

Comments

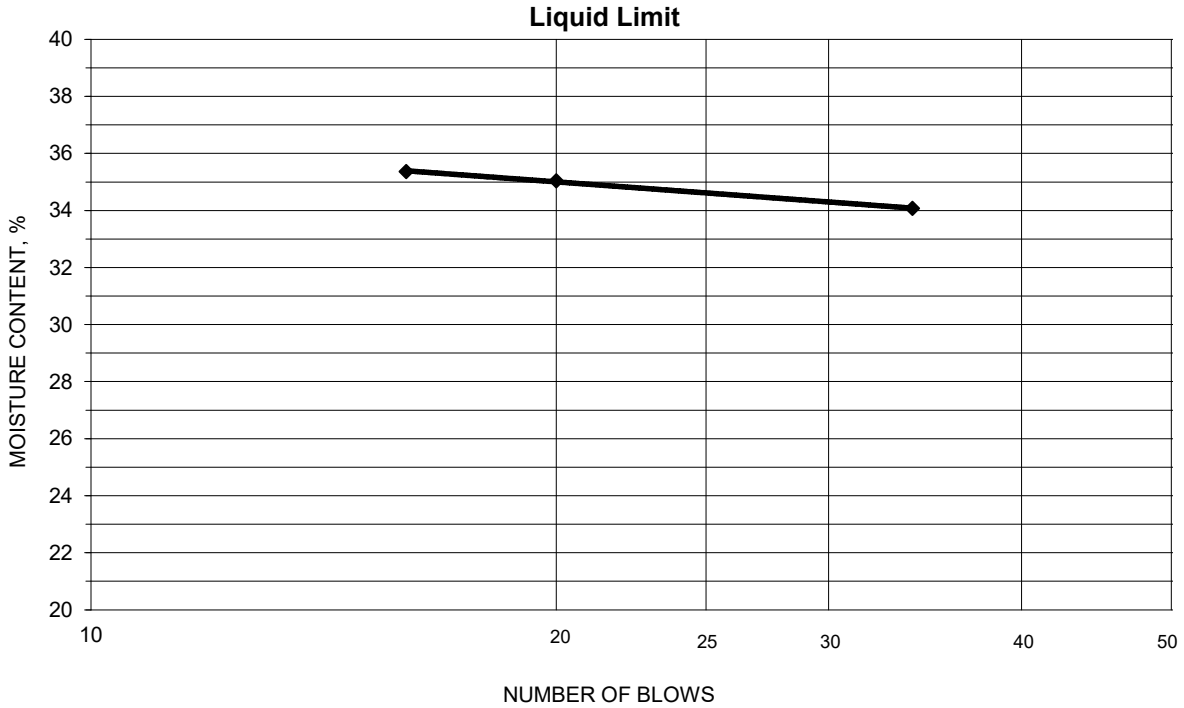
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	466-A, 16.0'-17.5', 18.5'-20.0'	Lab ID	46
		% + No. 40	27
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-23-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.46	17.26	11.04	16	35.4	
20.61	18.14	11.09	20	35.0	
18.98	16.83	10.52	34	34.1	35



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
24.70	21.53	10.60	29.0	29	6
25.13	21.99	11.05	28.7		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-B, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	50
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 14.2

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	95.6
3/8"	9.5	81.6
No. 4	4.75	72.2
No. 10	2	62.1
No. 40	0.425	47.9
No. 200	0.075	37.1
	0.02	29.2
	0.005	17.1
	0.002	12.8
Estimated	0.001	9.2

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	27.8	37.9
Coarse Sand	10.1	14.2
Medium Sand	14.2	---
Fine Sand	10.8	10.8
Silt	20.0	24.3
Clay	17.1	12.8

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit: 37
Plastic Limit: 26
Plasticity Index: 11
Activity Index: 0.9

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SM
Group Name: Silty Sand with Gravel

AASHTO Classification: A-6 (1)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 466-B, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'

Project Number: 2026252404
Lab ID: 50

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-22-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	95.6
3/8"	81.6
No. 4	72.2
No. 10	62.1

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

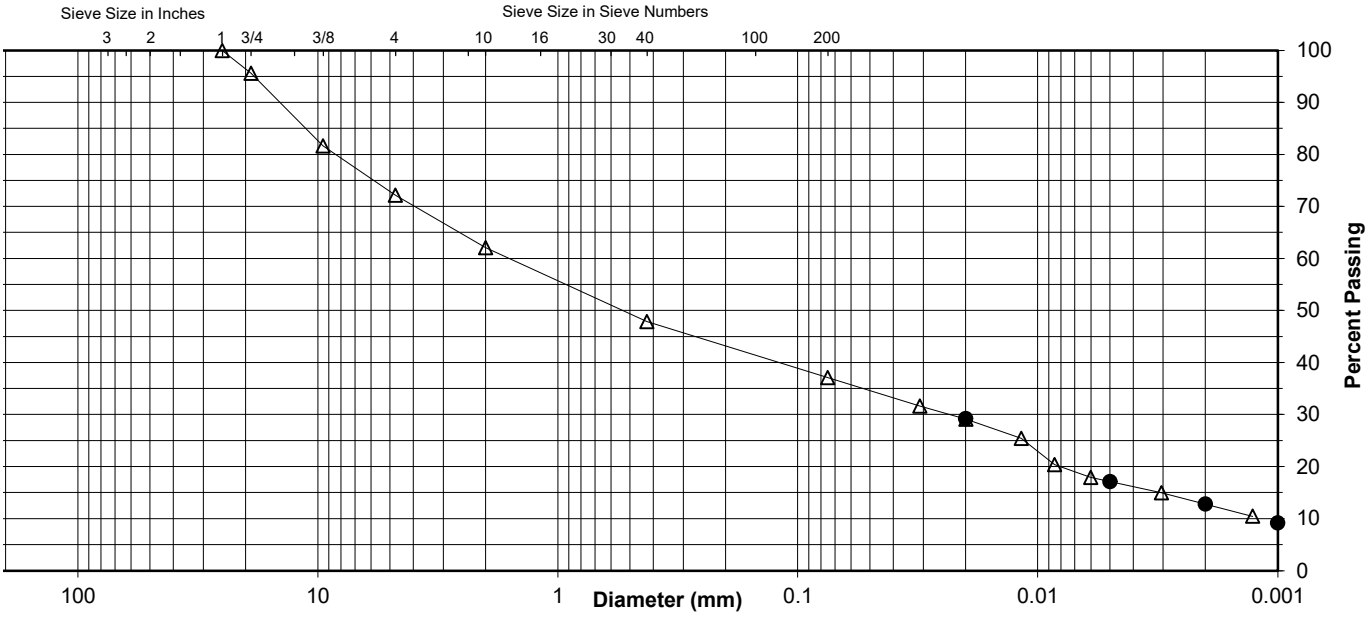
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	47.9
No. 200	37.1
0.02 mm	29.2
0.005 mm	17.1
0.002 mm	12.8
0.001 mm	9.2

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	4.4	23.4	10.1	14.2	10.8	20.0	17.1

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	37.9	14.2	10.8	24.3	12.8



Comments

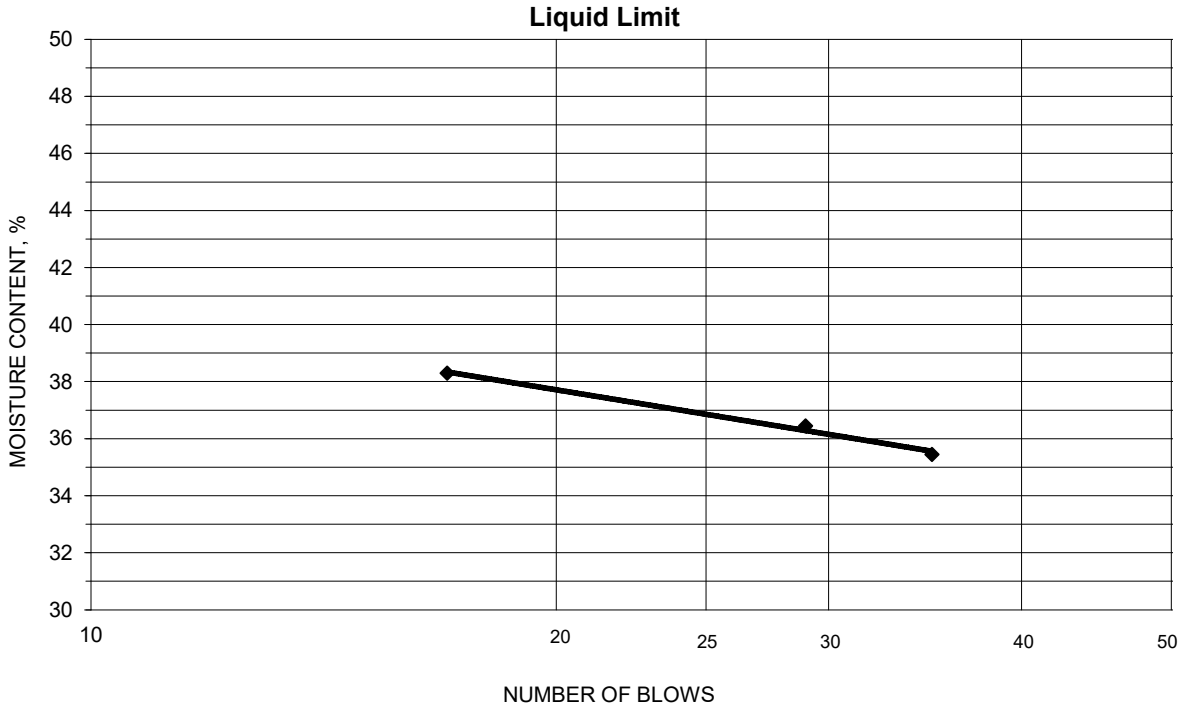
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	466-B, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	50
		% + No. 40	52
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-30-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.04	17.52	10.94	17	38.3	
19.20	17.05	11.15	29	36.4	
19.14	16.90	10.58	35	35.4	37



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.51	20.96	11.07	25.8	26	11
23.36	20.80	10.82	25.7		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-B, 8.5'-10.0'	Lab ID	54
Sample Type	SS-4	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: AASHTO T 265

Moisture Content (%): 14.2

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
3/8"	9.5	100.0
No. 4	4.75	96.7
No. 10	2	83.7
No. 40	0.425	62.7
No. 200	0.075	44.7
	0.02	29.3
	0.005	13.7
	0.002	10.6
Estimated	0.001	9.1

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	3.3	16.3
Coarse Sand	13.0	21.0
Medium Sand	21.0	---
Fine Sand	18.0	18.0
Silt	31.0	34.1
Clay	13.7	10.6

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	34
Plastic Limit:	25
Plasticity Index:	9
Activity Index:	0.8

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SM
Group Name:	Silty Sand
AASHTO Classification:	A-4 (1)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 466-B, 8.5'-10.0'

Project Number: 2026252404
Lab ID: 54

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-17-2024
Date Received: 05-13-2024

Maximum Particle Size: 3/8" Sieve

Sieve Size	% Passing
3/8"	100.0
No. 4	96.7
No. 10	83.7

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

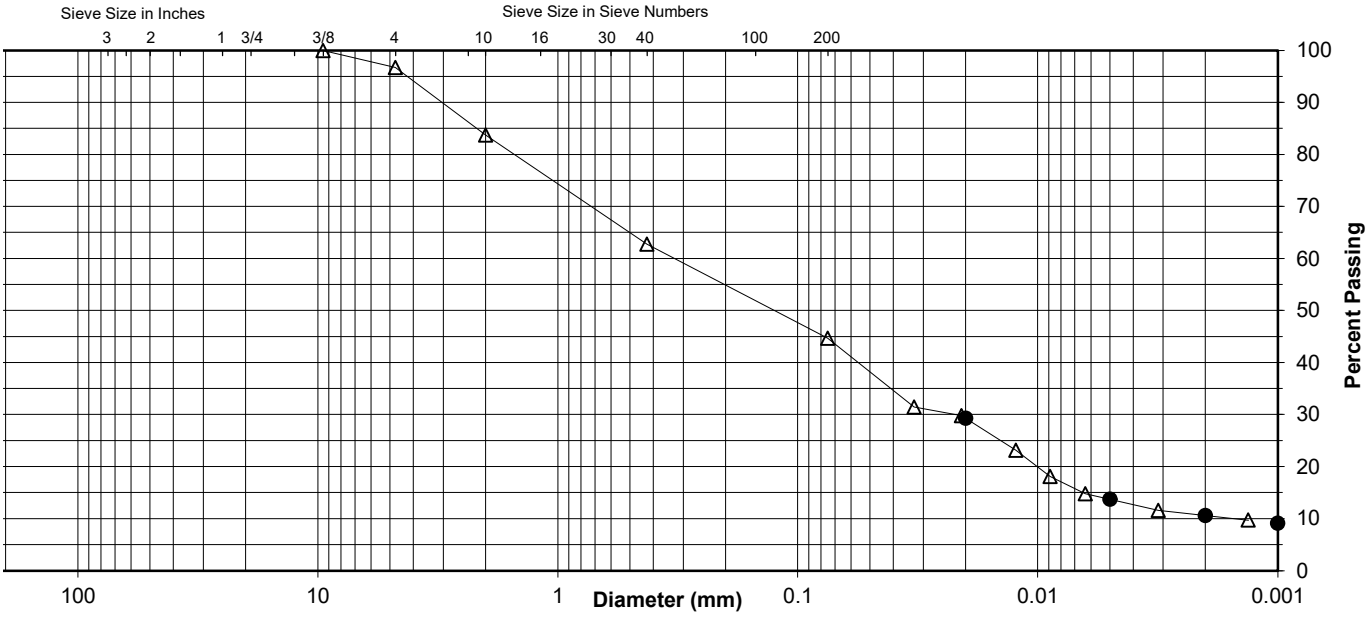
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	62.7
No. 200	44.7
0.02 mm	29.3
0.005 mm	13.7
0.002 mm	10.6
0.001 mm	9.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	3.3	13.0	21.0	18.0	31.0	13.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	16.3			21.0	18.0	34.1	10.6



Comments

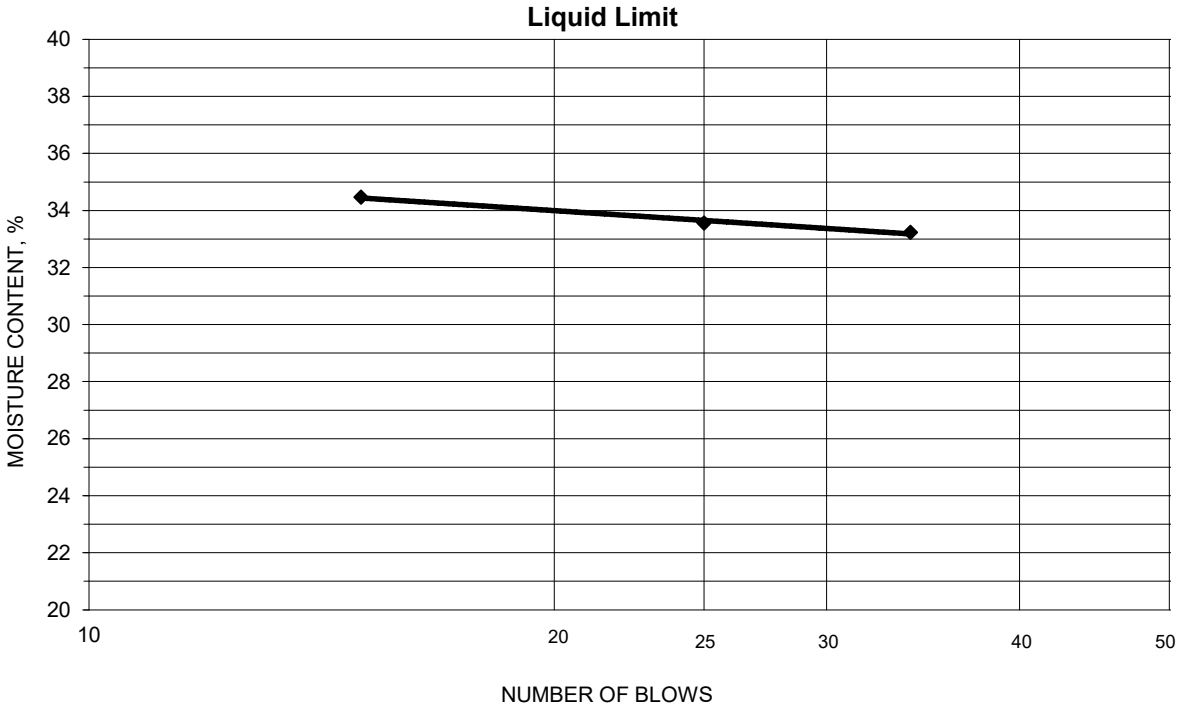
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	466-B, 8.5'-10.0'	Lab ID	54
		% + No. 40	37
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-22-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.08	17.76	11.03	15	34.5	34
20.77	18.32	11.02	25	33.6	
19.52	17.29	10.58	34	33.2	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
24.22	21.61	11.02	24.6	25	9
24.50	21.88	11.15	24.4		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-B, 13.5'-15.0', 16.0'-17.5', 18.5'-20.0'	Lab ID	56
Sample Type	SS-6 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 18.1

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
3/8"	9.5	100.0
No. 4	4.75	99.5
No. 10	2	95.7
No. 40	0.425	71.3
No. 200	0.075	38.4
	0.02	18.3
	0.005	6.8
	0.002	4.5
Estimated	0.001	2.8

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.5	4.3
Coarse Sand	3.8	24.4
Medium Sand	24.4	---
Fine Sand	32.9	32.9
Silt	31.6	33.9
Clay	6.8	4.5

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	29
Plastic Limit:	27
Plasticity Index:	2
Activity Index:	0.4

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SM
Group Name:	Silty Sand
AASHTO Classification:	A-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	466-B, 13.5'-15.0', 16.0'-17.5', 18.5'-20.0'	Lab ID	56

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-17-2024
Date Received: 05-13-2024

Maximum Particle Size: 3/8" Sieve

Sieve Size	% Passing
3/8"	100.0
No. 4	99.5
No. 10	95.7

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

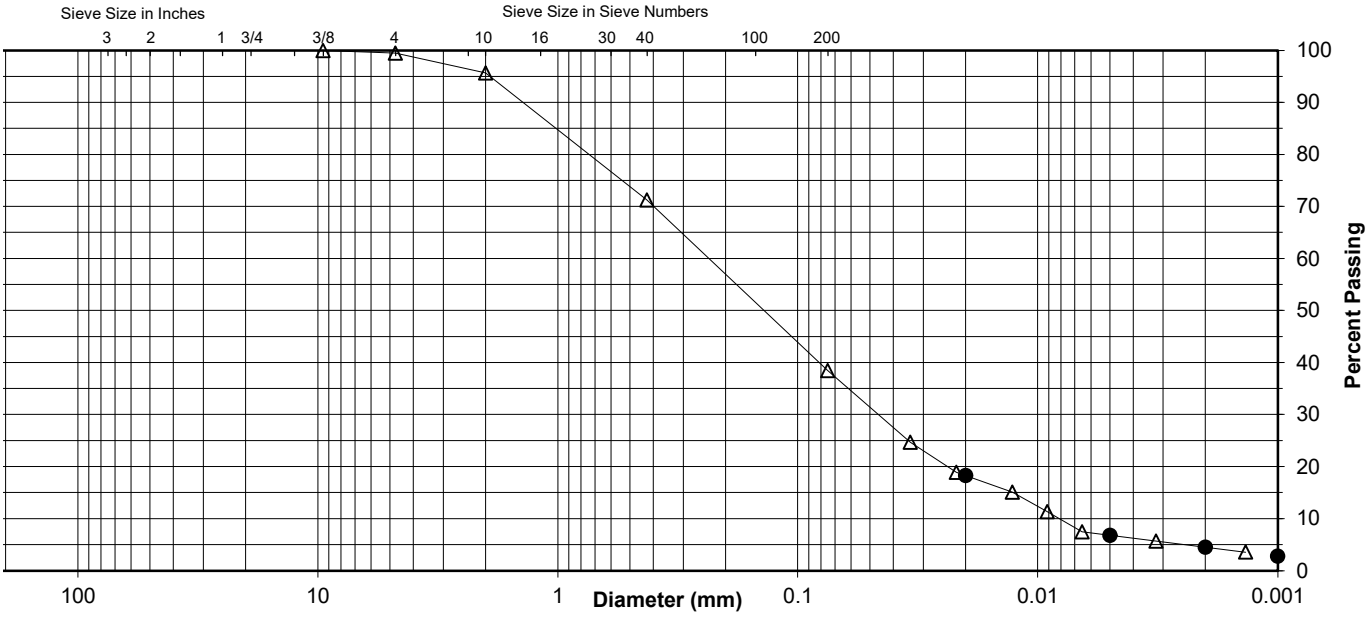
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	71.3
No. 200	38.4
0.02 mm	18.3
0.005 mm	6.8
0.002 mm	4.5
0.001 mm	2.8

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.5	3.8	24.4	32.9	31.6	6.8

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	4.3	24.4	32.9	33.9	4.5



Comments

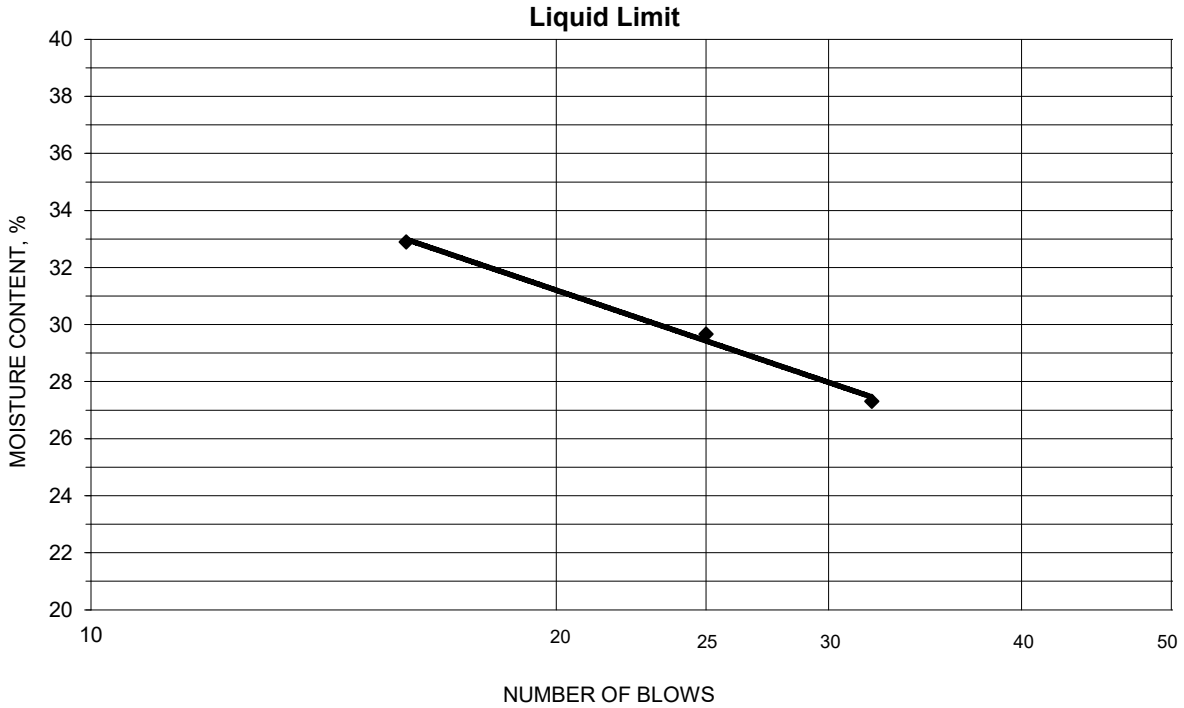
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	466-B, 13.5'-15.0', 16.0'-17.5', 18.5'-20.0'	Lab ID	56
		% + No. 40	29
Tested By	GK	Test Method	AASHTO T 89 & T 90	Date Received	05-13-2024
Test Date	05-29-2024	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
21.28	18.75	11.06	16	32.9	29
21.19	18.76	10.57	25	29.7	
21.12	18.87	10.63	32	27.3	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.80	19.52	11.00	26.8	27	2
22.30	19.89	11.02	27.2		

Remarks: _____

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	469, 3.5'-5.0', 6.0'-7.5'	Lab ID	62
Sample Type	SS-2 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 14.7

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	86.1
3/8"	9.5	70.2
No. 4	4.75	60.3
No. 10	2	50.6
No. 40	0.425	36.7
No. 200	0.075	25.0
	0.02	15.7
	0.005	6.3
	0.002	4.1
Estimated	0.001	2.9

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	39.7	49.4
Coarse Sand	9.7	13.9
Medium Sand	13.9	---
Fine Sand	11.7	11.7
Silt	18.7	20.9
Clay	6.3	4.1

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	33
Plastic Limit:	28
Plasticity Index:	5
Activity Index:	1.2

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GM
Group Name:	Silty Gravel with Sand
AASHTO Classification:	A-1-b (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 469, 3.5'-5.0', 6.0'-7.5'

Project Number: 2026252404
Lab ID: 62

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-17-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	86.1
3/8"	70.2
No. 4	60.3
No. 10	50.6

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

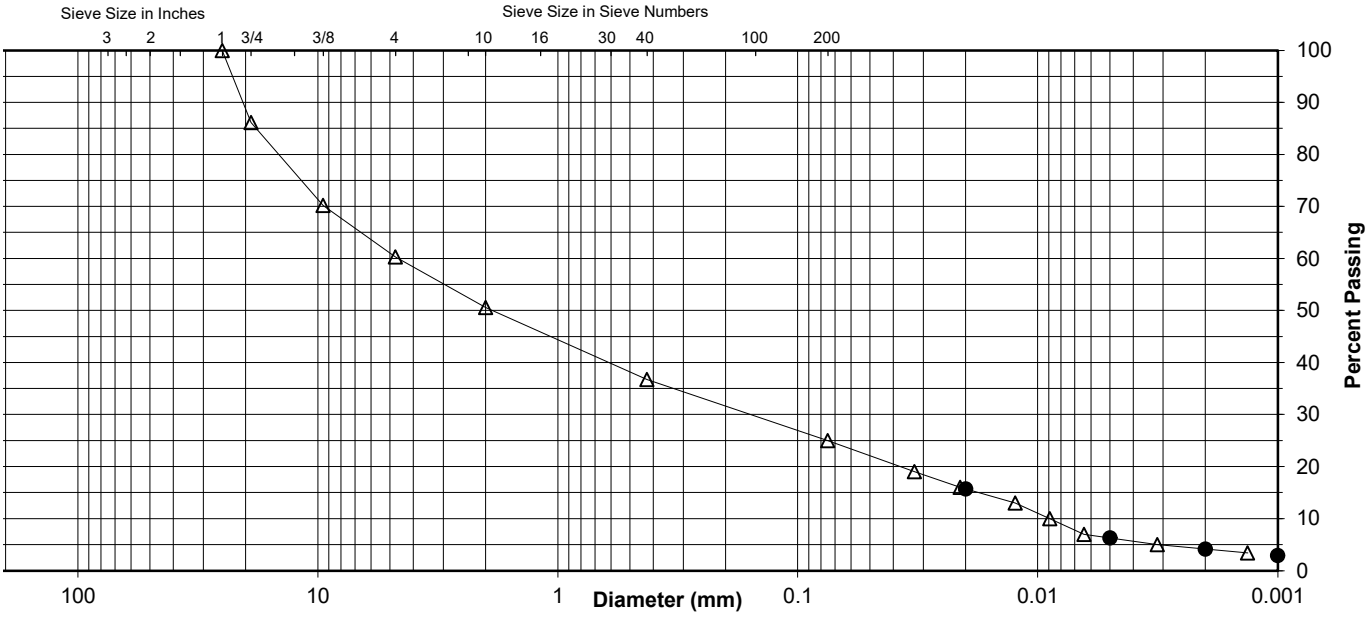
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	36.7
No. 200	25.0
0.02 mm	15.7
0.005 mm	6.3
0.002 mm	4.1
0.001 mm	2.9

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	13.9	25.8	9.7	13.9	11.7	18.7	6.3
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	49.4			13.9	11.7	20.9	4.1



Comments

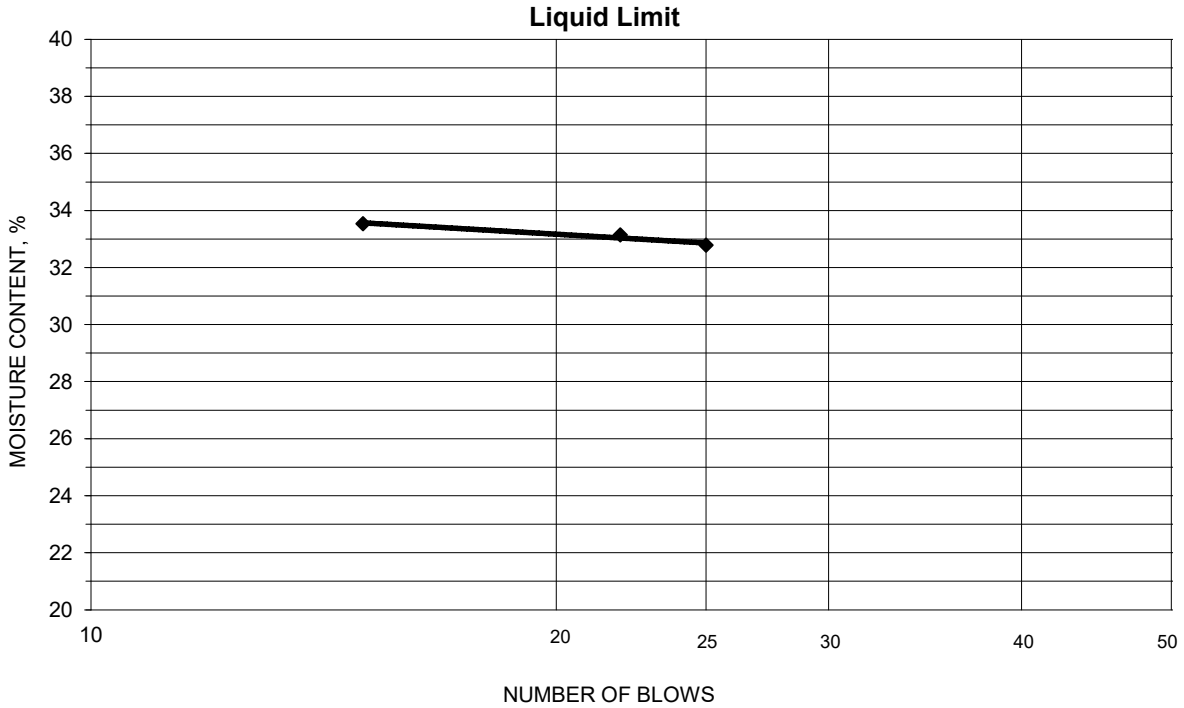
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	469, 3.5'-5.0', 6.0'-7.5'	Lab ID	62
		% + No. 40	63
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-24-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
17.06	15.45	10.65	15	33.5	33
17.95	16.23	11.04	22	33.1	
19.05	17.07	11.03	25	32.8	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
24.13	21.27	11.05	28.0	28	5
24.22	21.39	11.01	27.3		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	481-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	65
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 3.1

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	92.4
3/8"	9.5	75.2
No. 4	4.75	64.6
No. 10	2	46.5
No. 40	0.425	25.3
No. 200	0.075	15.0
	0.02	10.7
	0.005	6.0
	0.002	4.9
Estimated	0.001	4.1

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	35.4	53.5
Coarse Sand	18.1	21.2
Medium Sand	21.2	---
Fine Sand	10.3	10.3
Silt	9.0	10.1
Clay	6.0	4.9

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	17
Plastic Limit:	12
Plasticity Index:	5
Activity Index:	1.0

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SC-SM

Group Name: Silty, Clayey Sand with Gravel

AASHTO Classification: A-1-a (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	481-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	65

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-17-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	92.4
3/8"	75.2
No. 4	64.6
No. 10	46.5

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	25.3
No. 200	15.0
0.02 mm	10.7
0.005 mm	6.0
0.002 mm	4.9
0.001 mm	4.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	7.6	27.8	18.1	21.2	10.3	9.0	6.0

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	53.5	21.2	10.3	10.1	4.9

Comments

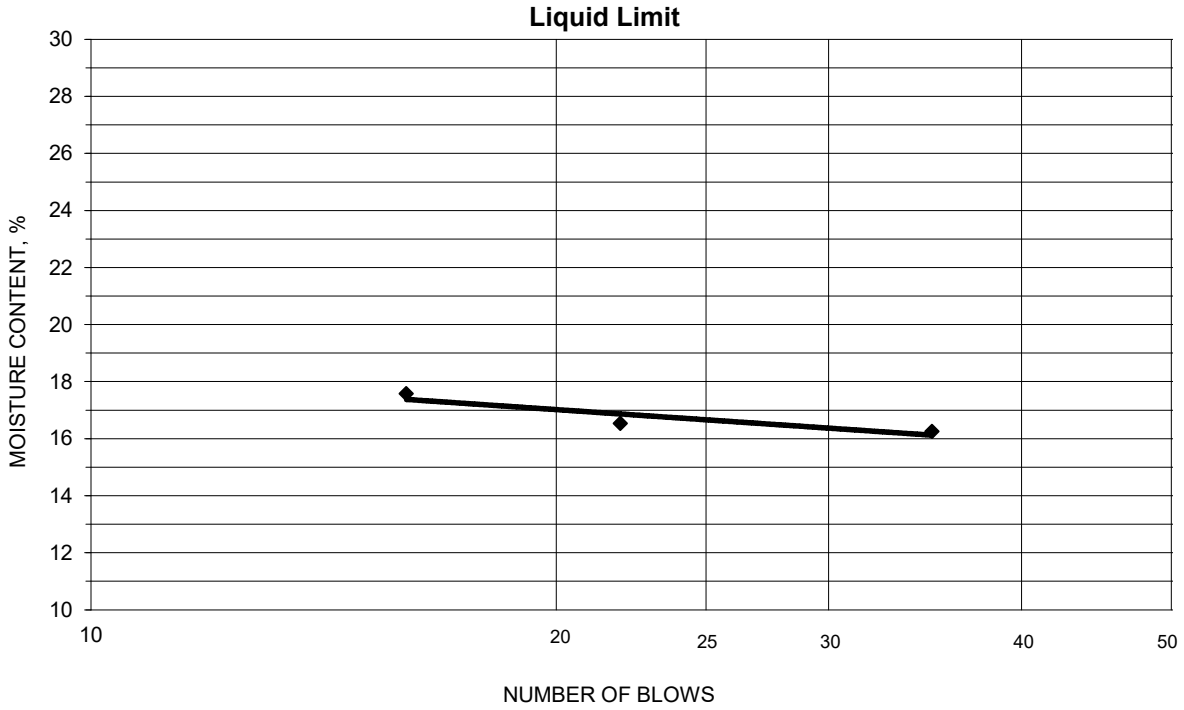
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	481-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	65
		% + No. 40	75
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-28-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.97	19.42	10.60	16	17.6	
21.22	19.78	11.07	22	16.5	
19.50	18.24	10.49	35	16.3	17



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.31	21.99	11.03	12.0	12	5
23.46	22.14	11.01	11.9		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	481-B, 1.0'-2.5'	Lab ID	69
Sample Type	SS-1	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: AASHTO T 265

Moisture Content (%): 3.8

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	94.6
3/8"	9.5	80.1
No. 4	4.75	66.9
No. 10	2	48.6
No. 40	0.425	22.8
No. 200	0.075	14.1
	0.02	10.0
	0.005	6.8
	0.002	5.1
Estimated	0.001	3.8

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	33.1	51.4
Coarse Sand	18.3	25.8
Medium Sand	25.8	---
Fine Sand	8.7	8.7
Silt	7.3	9.0
Clay	6.8	5.1

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	16
Plastic Limit:	12
Plasticity Index:	4
Activity Index:	0.8

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC-SM
Group Name:	Silty, Clayey Sand with Gravel
AASHTO Classification:	A-1-a (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 481-B, 1.0'-2.5'

Project Number: 2026252404
Lab ID: 69

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-20-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	94.6
3/8"	80.1
No. 4	66.9
No. 10	48.6

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

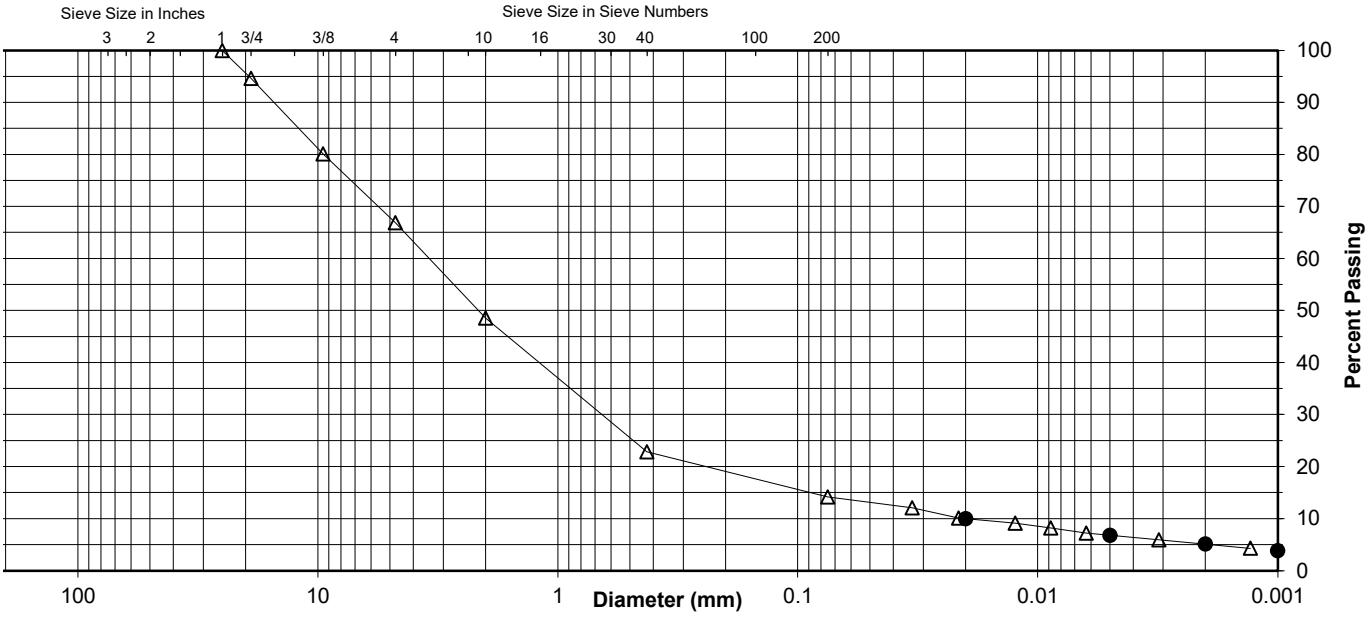
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	22.8
No. 200	14.1
0.02 mm	10.0
0.005 mm	6.8
0.002 mm	5.1
0.001 mm	3.8

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	5.4	27.7	18.3	25.8	8.7	7.3	6.8
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	51.4			25.8	8.7	9.0	5.1



Comments

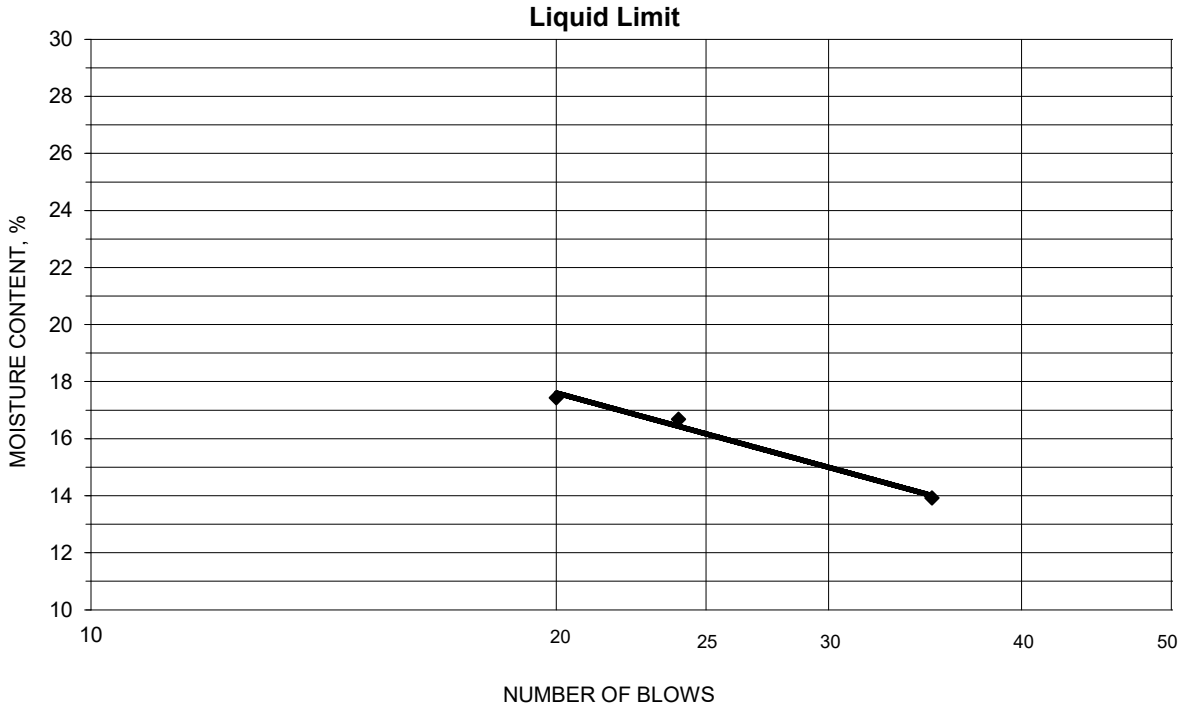
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	481-B, 1.0'-2.5'	Lab ID	69
		% + No. 40	77
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-29-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.50	18.25	11.08	20	17.4	
21.68	20.16	11.05	24	16.7	
20.36	19.21	10.95	35	13.9	16



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.42	20.26	11.05	12.6	12	4
22.34	21.11	11.10	12.3		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	485, 0.0'-1.5'	Lab ID	70
Sample Type	GRAB	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: AASHTO T 265

Moisture Content (%): 7.9

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	50.1
3/8"	9.5	41.8
No. 4	4.75	33.1
No. 10	2	24.1
No. 40	0.425	14.9
No. 200	0.075	11.2
	0.02	8.8
	0.005	5.7
	0.002	4.2
Estimated	0.001	3.2

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	66.9	75.9
Coarse Sand	9.0	9.2
Medium Sand	9.2	---
Fine Sand	3.7	3.7
Silt	5.5	7.0
Clay	5.7	4.2

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	27
Plastic Limit:	18
Plasticity Index:	9
Activity Index:	2.1

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GP-GC
Group Name:	Poorly Graded Gravel with Clay and Sand (or Silty Clay and Sand)
AASHTO Classification:	A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 485, 0.0'-1.5'

Project Number: 2026252404
Lab ID: 70

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-20-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	50.1
3/8"	41.8
No. 4	33.1
No. 10	24.1

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

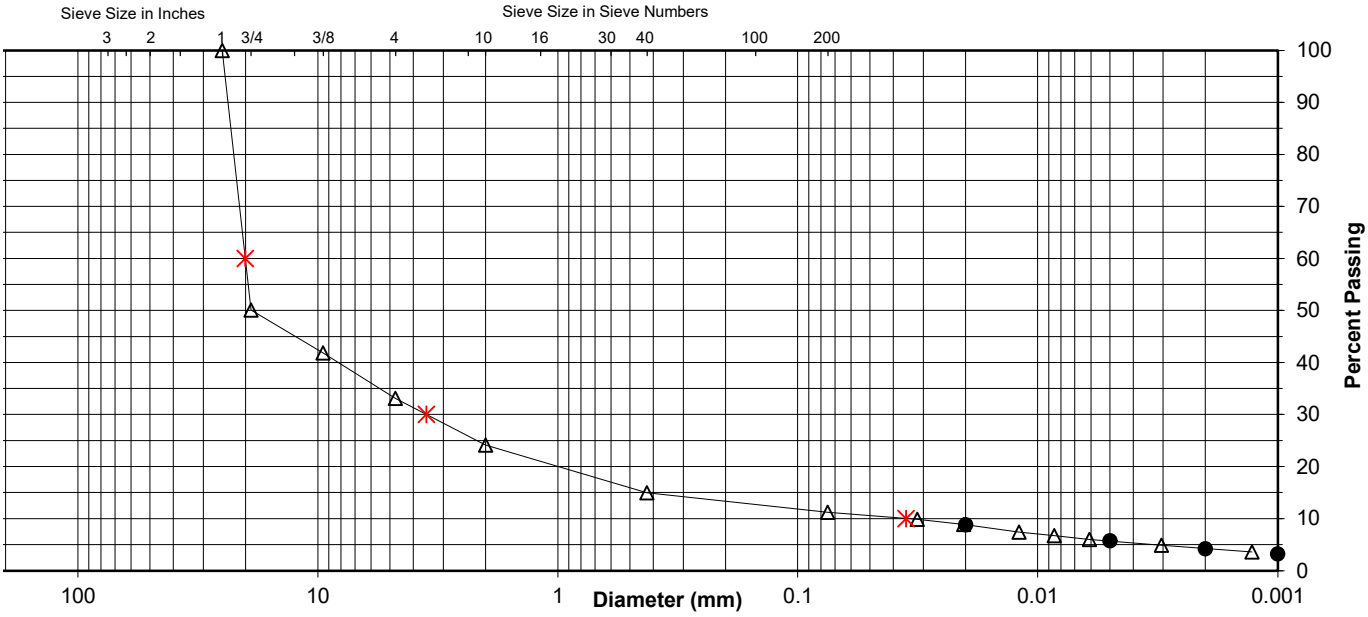
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	14.9
No. 200	11.2
0.02 mm	8.8
0.005 mm	5.7
0.002 mm	4.2
0.001 mm	3.2

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	49.9	17.0	9.0	9.2	3.7	5.5	5.7

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	75.9	9.2	3.7	7.0	4.2



Comments

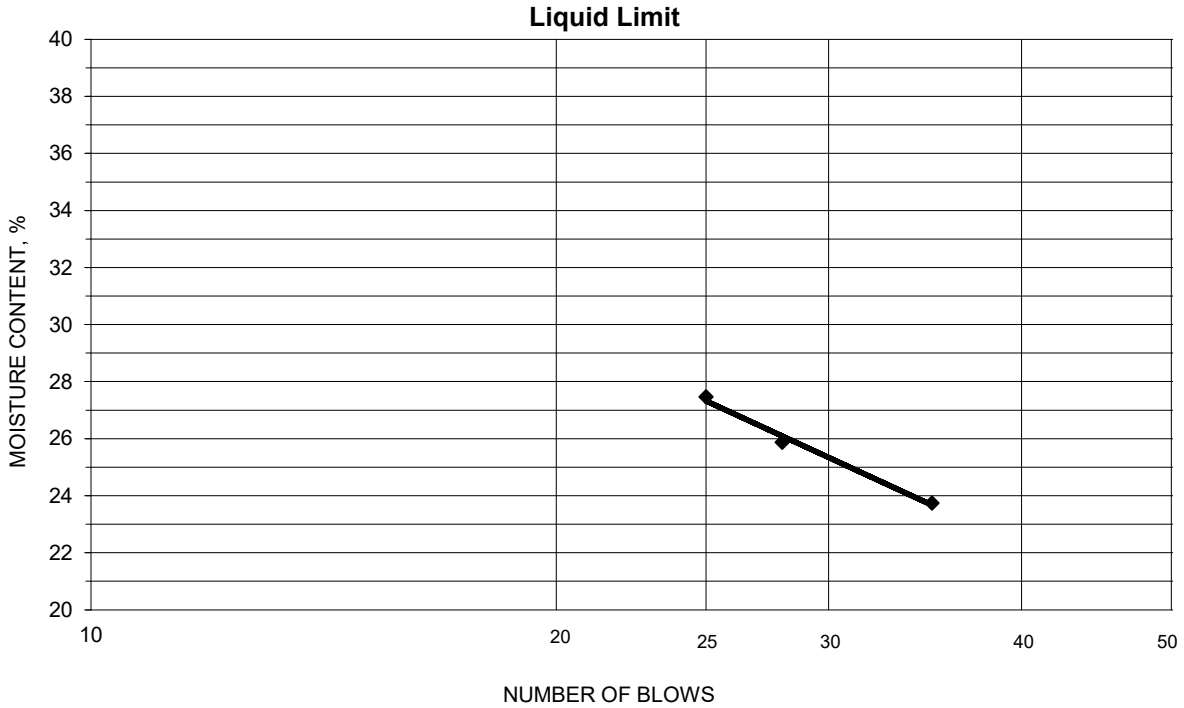
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	485, 0.0'-1.5'	Lab ID	70
		% + No. 40	85
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-31-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.79	17.90	11.02	25	27.5	
17.92	16.51	11.06	28	25.9	
18.46	17.04	11.06	35	23.7	27



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
20.61	19.02	10.60	18.9	18	9
21.33	19.76	11.04	18.0		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	486, 1.0'-2.5', 3.5'-5.0'	Lab ID	71
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 7.9

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	72.4
3/8"	9.5	53.9
No. 4	4.75	41.5
No. 10	2	31.5
No. 40	0.425	18.2
No. 200	0.075	11.6
	0.02	8.9
	0.005	4.9
	0.002	3.5
Estimated	0.001	2.4

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	58.5	68.5
Coarse Sand	10.0	13.3
Medium Sand	13.3	---
Fine Sand	6.6	6.6
Silt	6.7	8.1
Clay	4.9	3.5

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	25
Plastic Limit:	20
Plasticity Index:	5
Activity Index:	1.4

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GP-GC
Group Name:	Poorly Graded Gravel with Clay and Sand (or Silty Clay and Sand)
AASHTO Classification:	A-1-a (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	486, 1.0'-2.5', 3.5'-5.0'	Lab ID	71

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-20-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	72.4
3/8"	53.9
No. 4	41.5
No. 10	31.5

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

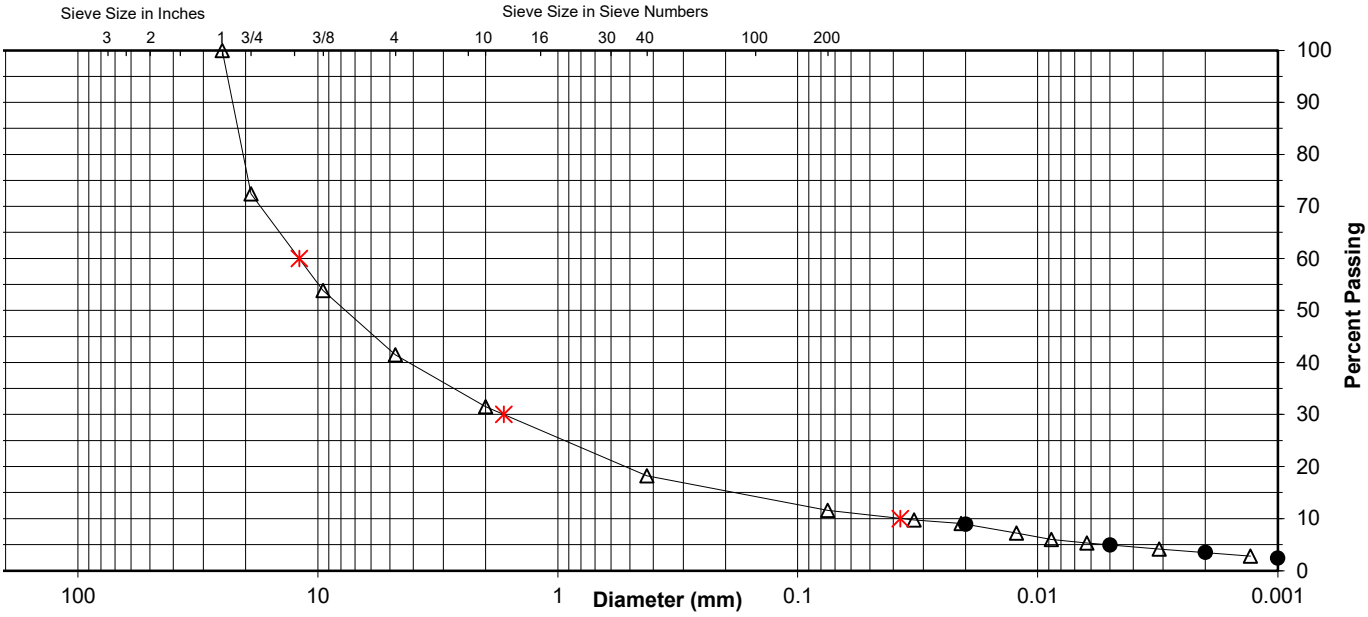
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	18.2
No. 200	11.6
0.02 mm	8.9
0.005 mm	4.9
0.002 mm	3.5
0.001 mm	2.4

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	27.6	30.9	10.0	13.3	6.6	6.7	4.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	68.5			13.3	6.6	8.1	3.5



Comments

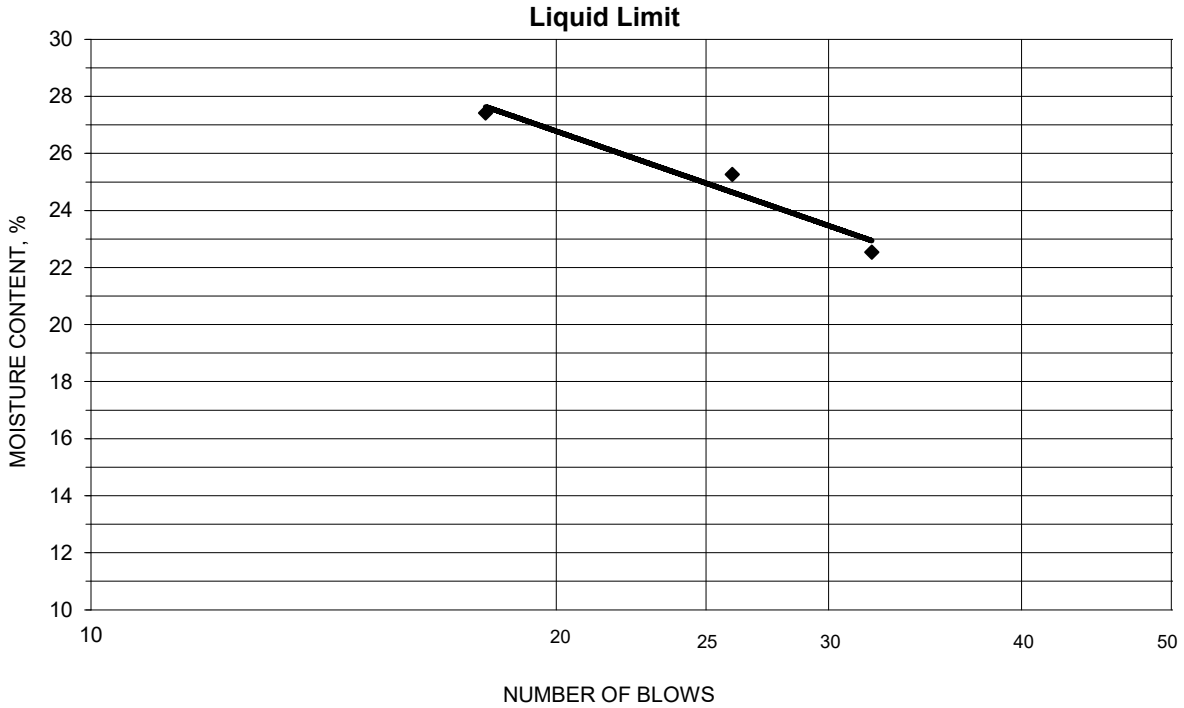
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	486, 1.0'-2.5', 3.5'-5.0'	Lab ID	71
		% + No. 40	82
Tested By	GK	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-23-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.69	18.62	11.07	18	27.4	25
21.85	19.68	11.09	26	25.3	
21.63	19.68	11.03	32	22.5	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.09	19.37	10.63	19.7	20	5
21.80	20.03	11.00	19.6		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	487, 1.0'-2.5', 3.5'-5.0'	Lab ID	75
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 5.3

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	82.6
3/8"	9.5	58.3
No. 4	4.75	42.8
No. 10	2	29.9
No. 40	0.425	17.4
No. 200	0.075	10.9
	0.02	7.8
	0.005	4.1
	0.002	2.7
Estimated	0.001	1.7

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	57.2	70.1
Coarse Sand	12.9	12.5
Medium Sand	12.5	---
Fine Sand	6.5	6.5
Silt	6.8	8.2
Clay	4.1	2.7

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	29
Plastic Limit:	22
Plasticity Index:	7
Activity Index:	2.6

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GP-GC
Group Name:	Poorly Graded Gravel with Clay and Sand (or Silty Clay and Sand)
AASHTO Classification:	A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 487, 1.0'-2.5', 3.5'-5.0'

Project Number: 2026252404
Lab ID: 75

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-20-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	82.6
3/8"	58.3
No. 4	42.8
No. 10	29.9

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

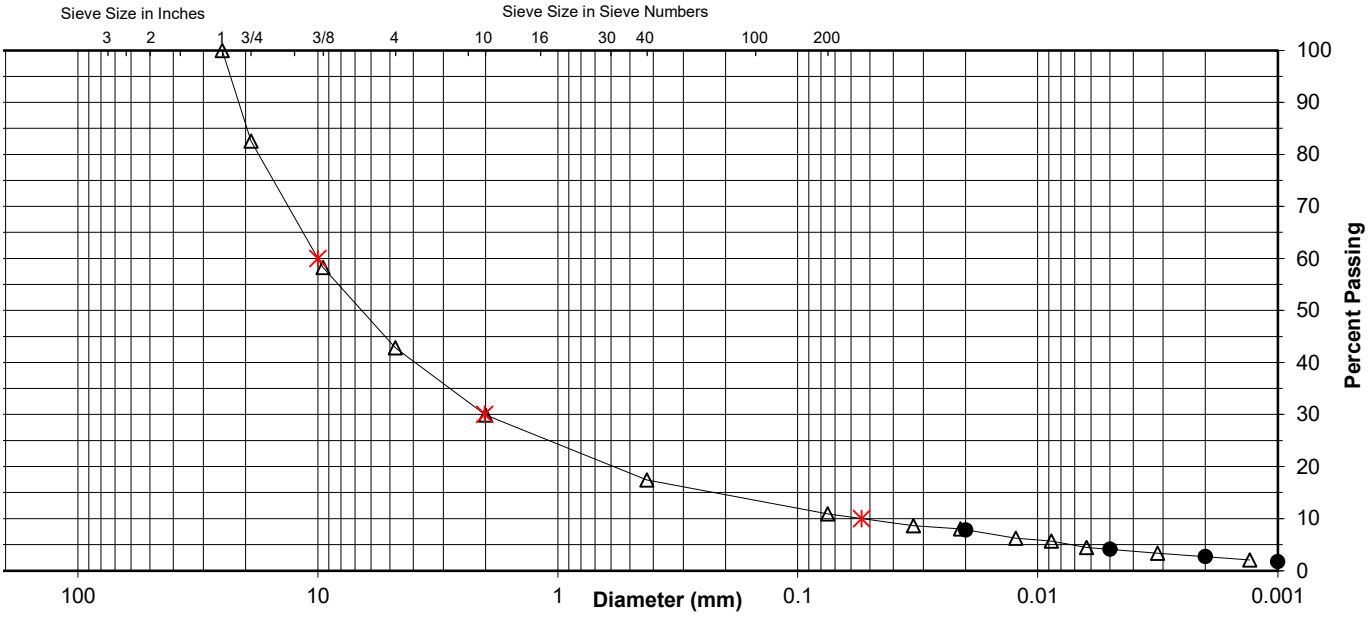
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	17.4
No. 200	10.9
0.02 mm	7.8
0.005 mm	4.1
0.002 mm	2.7
0.001 mm	1.7

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	17.4	39.8	12.9	12.5	6.5	6.8	4.1

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	70.1	12.5	6.5	8.2	2.7



Comments

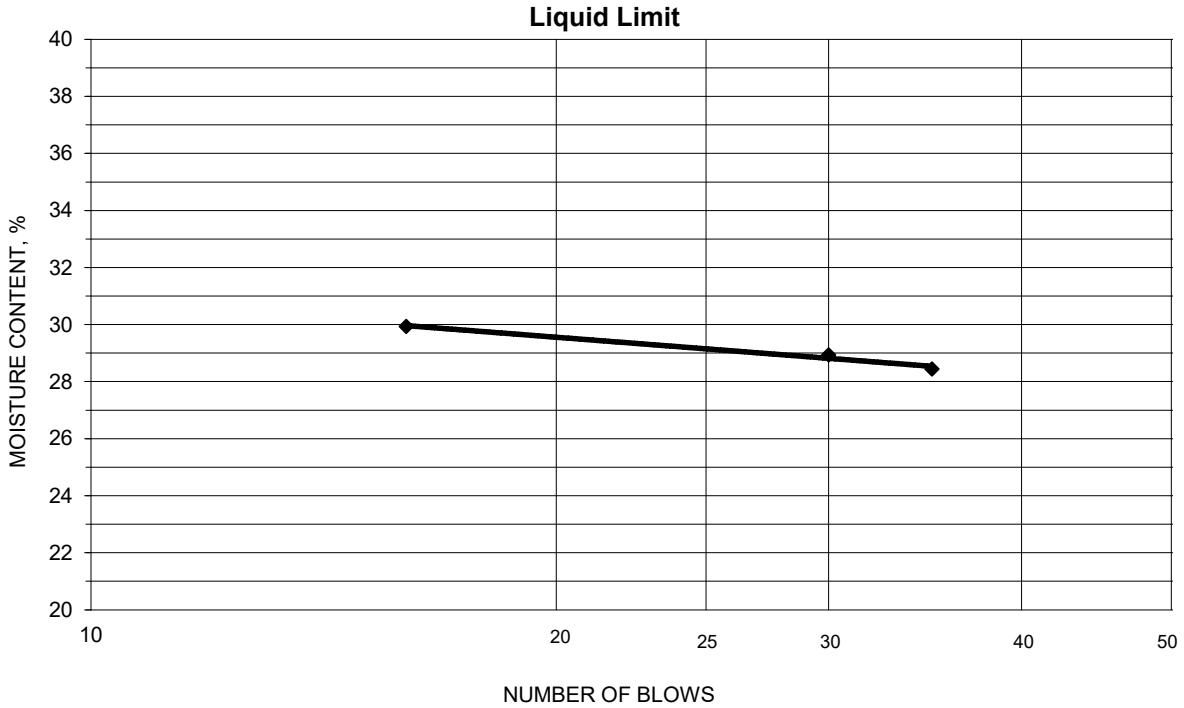
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	487, 1.0'-2.5', 3.5'-5.0'	Lab ID	75
		% + No. 40	83
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-31-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.63	17.66	11.08	16	29.9	29
18.61	16.81	10.59	30	28.9	
19.28	17.46	11.06	35	28.4	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.53	19.59	11.00	22.6	22	7
22.74	20.62	11.07	22.2		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	487, 8.5'-10.0', 11.0'-12.5'	Lab ID	79
Sample Type	SS-4 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 12.9

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	83.1
3/8"	9.5	66.1
No. 4	4.75	52.3
No. 10	2	36.9
No. 40	0.425	16.9
No. 200	0.075	9.2
	0.02	5.7
	0.005	2.6
	0.002	1.7
Estimated	0.001	1.1

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	47.7	63.1
Coarse Sand	15.4	20.0
Medium Sand	20.0	---
Fine Sand	7.7	7.7
Silt	6.6	7.5
Clay	2.6	1.7

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	34
Plastic Limit:	28
Plasticity Index:	6
Activity Index:	3.5

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GW-GM
Group Name:	Well-Graded Gravel with Silt and Sand
AASHTO Classification:	A-1-a (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 487, 8.5'-10.0', 11.0'-12.5'

Project Number: 2026252404
Lab ID: 79

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-17-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	83.1
3/8"	66.1
No. 4	52.3
No. 10	36.9

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

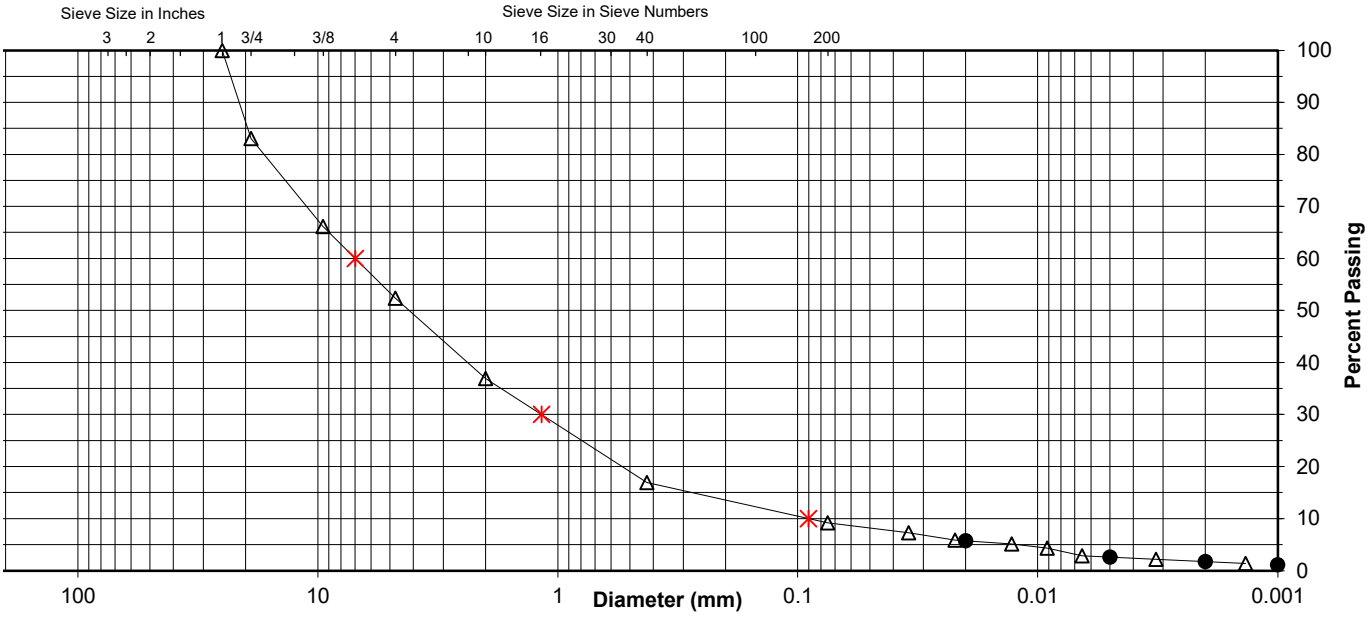
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	16.9
No. 200	9.2
0.02 mm	5.7
0.005 mm	2.6
0.002 mm	1.7
0.001 mm	1.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	16.9	30.8	15.4	20.0	7.7	6.6	2.6

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	63.1	20.0	7.7	7.5	1.7



Comments

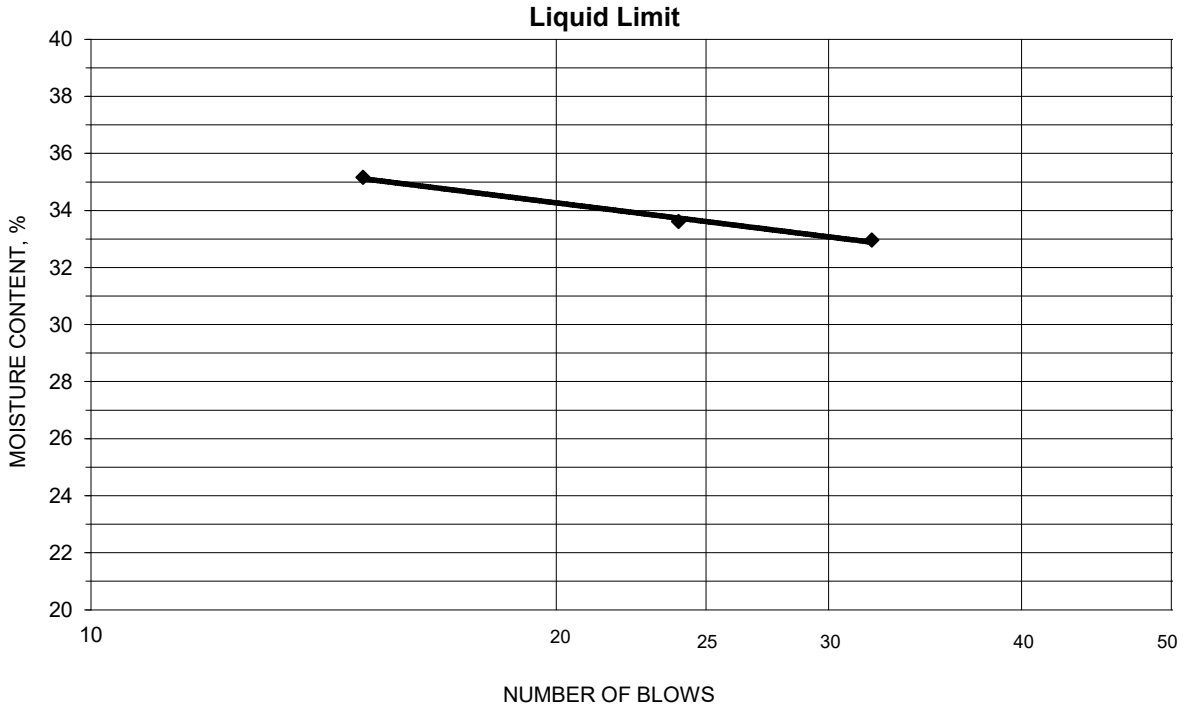
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	487, 8.5'-10.0', 11.0'-12.5'	Lab ID	79
		% + No. 40	83
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-21-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.93	17.62	11.05	15	35.2	34
19.05	17.03	11.02	24	33.6	
19.43	17.35	11.04	32	33.0	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.77	20.99	11.08	28.1	28	6
23.81	21.06	11.01	27.4		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	508, 1.0'-2.5', 2.5'-3.5'	Lab ID	82
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 3.5

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	91.2
3/8"	9.5	75.5
No. 4	4.75	60.2
No. 10	2	44.7
No. 40	0.425	29.2
No. 200	0.075	19.5
	0.02	10.9
	0.005	5.0
	0.002	2.9
Estimated	0.001	1.8

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	39.8	55.3
Coarse Sand	15.5	15.5
Medium Sand	15.5	---
Fine Sand	9.7	9.7
Silt	14.5	16.6
Clay	5.0	2.9

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	24
Plastic Limit:	20
Plasticity Index:	4
Activity Index:	1.4

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC-SM
Group Name:	Silty, Clayey Sand with Gravel
AASHTO Classification:	A-1-b (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	508, 1.0'-2.5', 2.5'-3.5'	Lab ID	82

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-21-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	91.2
3/8"	75.5
No. 4	60.2
No. 10	44.7

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

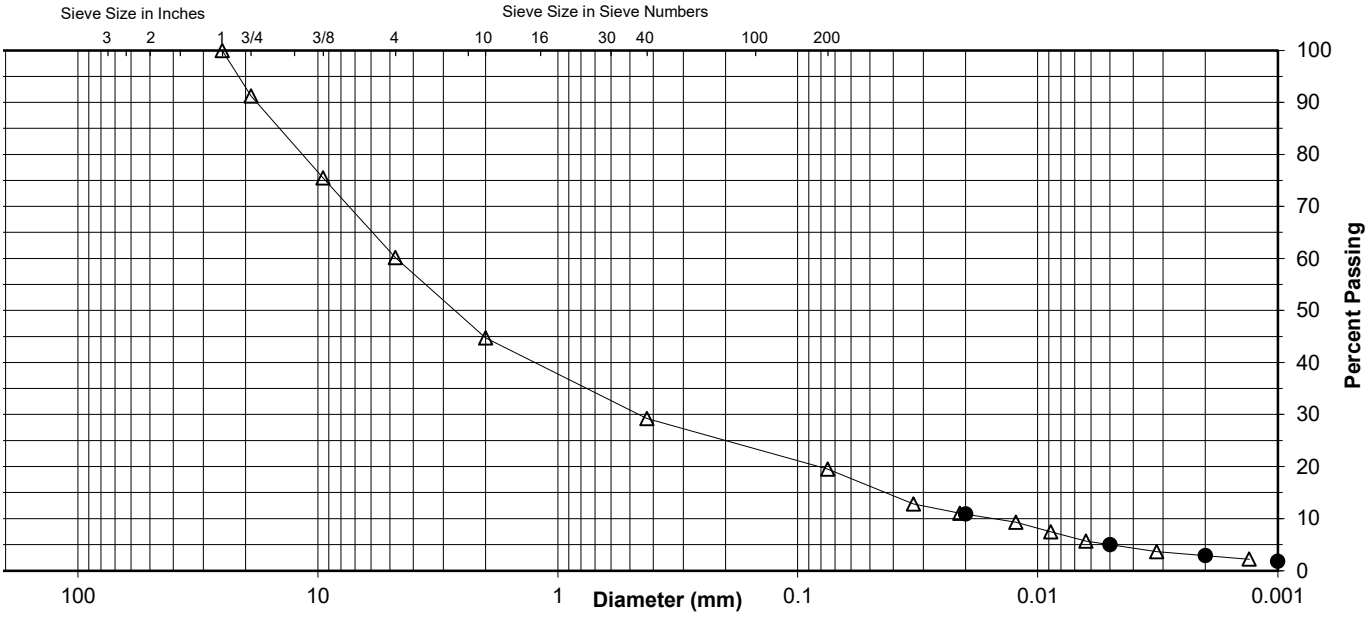
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	29.2
No. 200	19.5
0.02 mm	10.9
0.005 mm	5.0
0.002 mm	2.9
0.001 mm	1.8

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	8.8	31.0	15.5	15.5	9.7	14.5	5.0

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	55.3	15.5	9.7	16.6	2.9



Comments

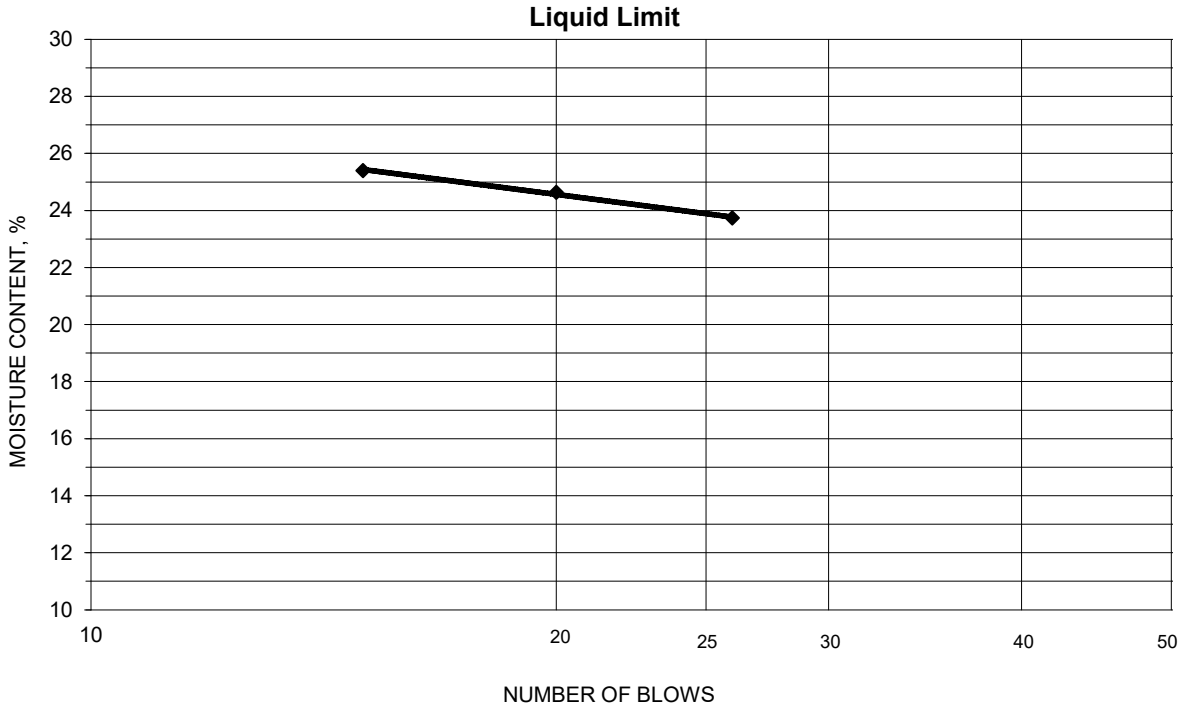
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	508, 1.0'-2.5', 2.5'-3.5'	Lab ID	82
		% + No. 40	71
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-22-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.60	17.87	11.06	15	25.4	24
20.41	18.56	11.05	20	24.6	
20.67	18.75	10.66	26	23.7	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.92	20.03	10.61	20.1	20	4
22.68	20.76	10.99	19.7		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	515, 1.0'-2.5', 3.5'-5.0'	Lab ID	85
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 2.4

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	92.9
3/8"	9.5	81.3
No. 4	4.75	67.2
No. 10	2	46.6
No. 40	0.425	22.9
No. 200	0.075	8.6
	0.02	3.9
	0.005	3.2
	0.002	2.2
Estimated	0.001	1.2

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	32.8	53.4
Coarse Sand	20.6	23.7
Medium Sand	23.7	---
Fine Sand	14.3	14.3
Silt	5.4	6.4
Clay	3.2	2.2

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit: NP
Plastic Limit: NP
Plasticity Index: NP
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SW-SM
Group Name: Well-Graded Sand with Silt and Gravel

AASHTO Classification: A-1-a (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 515, 1.0'-2.5', 3.5'-5.0'

Project Number: 2026252404
Lab ID: 85

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GK
Test Date: 05-21-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	92.9
3/8"	81.3
No. 4	67.2
No. 10	46.6

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

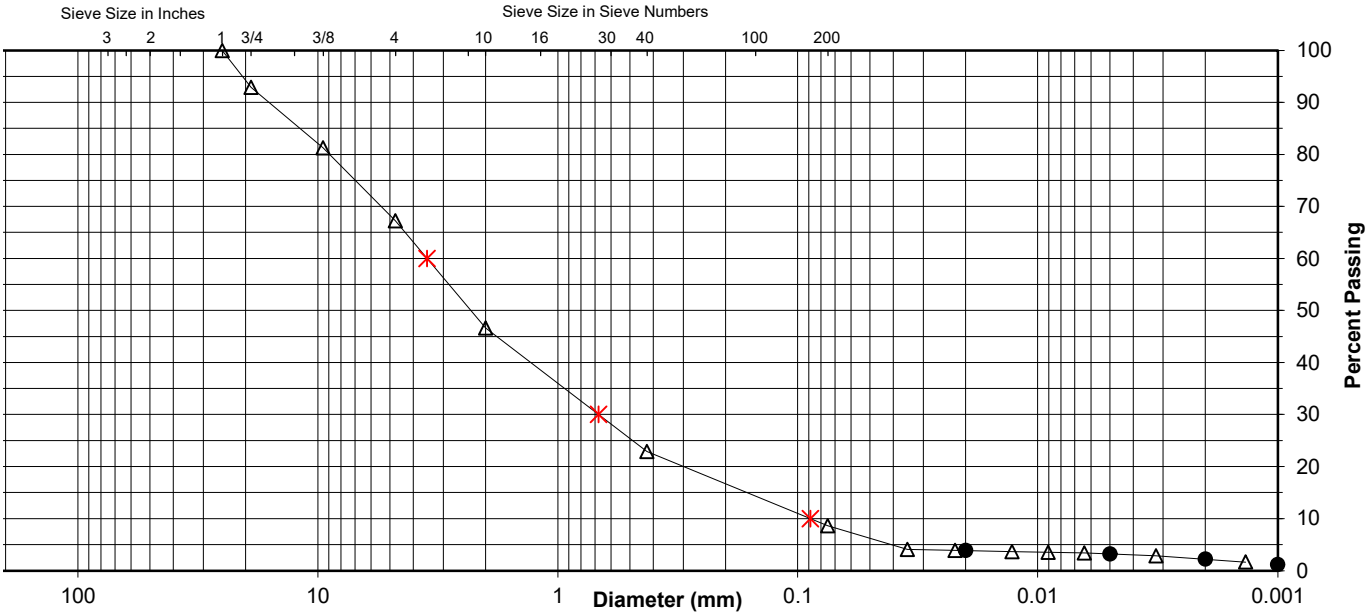
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	22.9
No. 200	8.6
0.02 mm	3.9
0.005 mm	3.2
0.002 mm	2.2
0.001 mm	1.2

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	7.1	25.7	20.6	23.7	14.3	5.4	3.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	53.4			23.7	14.3	6.4	2.2



Comments

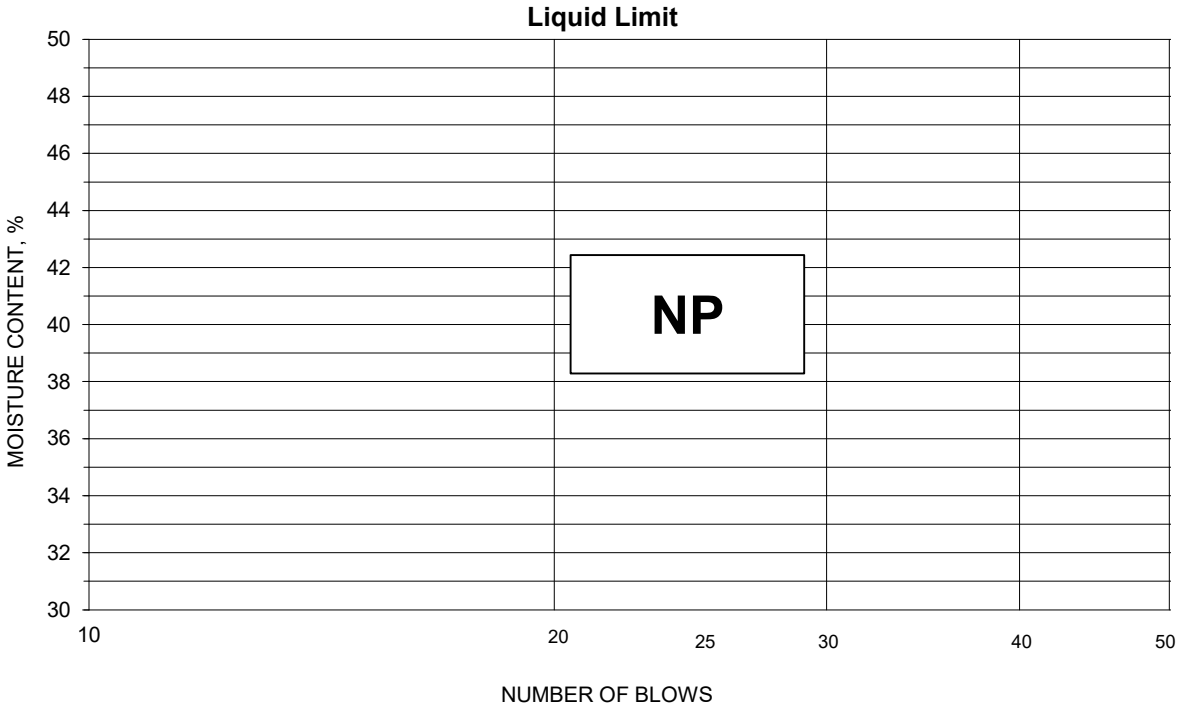
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	515, 1.0'-2.5', 3.5'-5.0'	Lab ID	85
		% + No. 40	77
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-29-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-A, 1.0'-2.5', 3.5'-5.0'	Lab ID	89
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 3.6

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	83.3
3/8"	9.5	60.7
No. 4	4.75	45.6
No. 10	2	31.4
No. 40	0.425	18.1
No. 200	0.075	11.1
	0.02	7.3
	0.005	4.5
	0.002	3.4
Estimated	0.001	2.8

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	54.4	68.6
Coarse Sand	14.2	13.3
Medium Sand	13.3	---
Fine Sand	7.0	7.0
Silt	6.6	7.7
Clay	4.5	3.4

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	22
Plastic Limit:	16
Plasticity Index:	6
Activity Index:	1.8

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GP-GC
Group Name:	Poorly Graded Gravel with Clay and Sand (or Silty Clay and Sand)
AASHTO Classification:	A-1-a (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 518-A, 1.0'-2.5', 3.5'-5.0'

Project Number: 2026252404
Lab ID: 89

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-17-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	83.3
3/8"	60.7
No. 4	45.6
No. 10	31.4

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

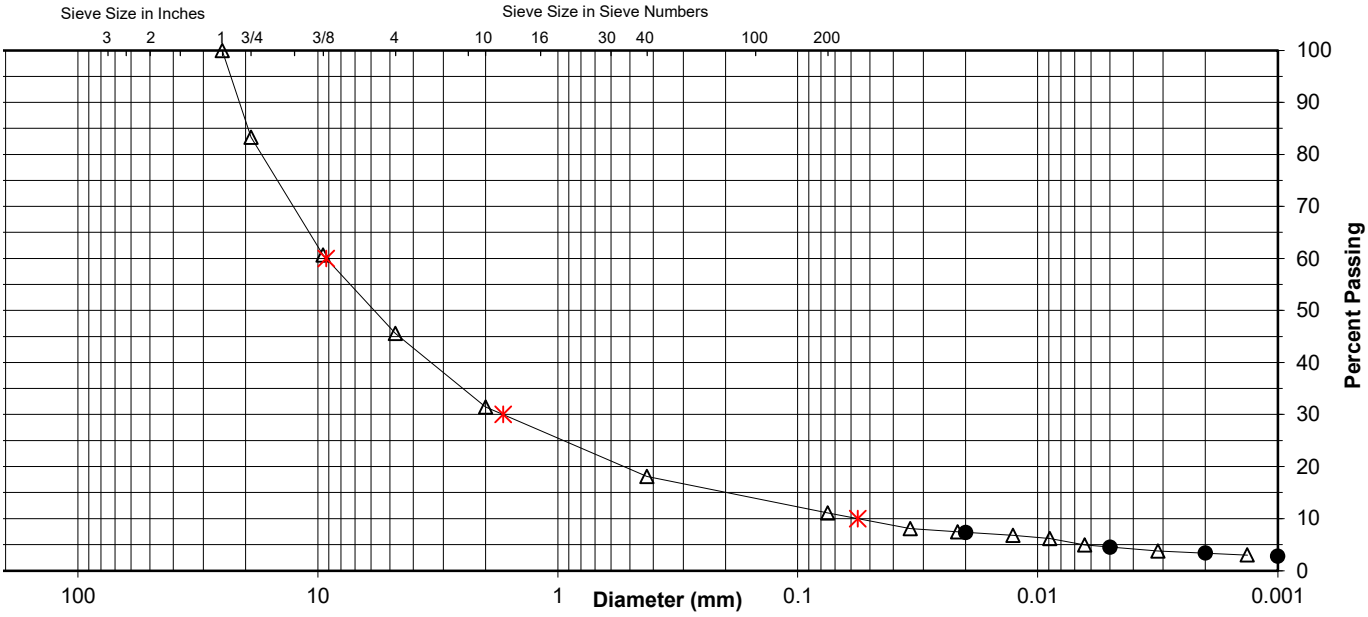
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	18.1
No. 200	11.1
0.02 mm	7.3
0.005 mm	4.5
0.002 mm	3.4
0.001 mm	2.8

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	16.7	37.7	14.2	13.3	7.0	6.6	4.5

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	68.6	13.3	7.0	7.7	3.4



Comments

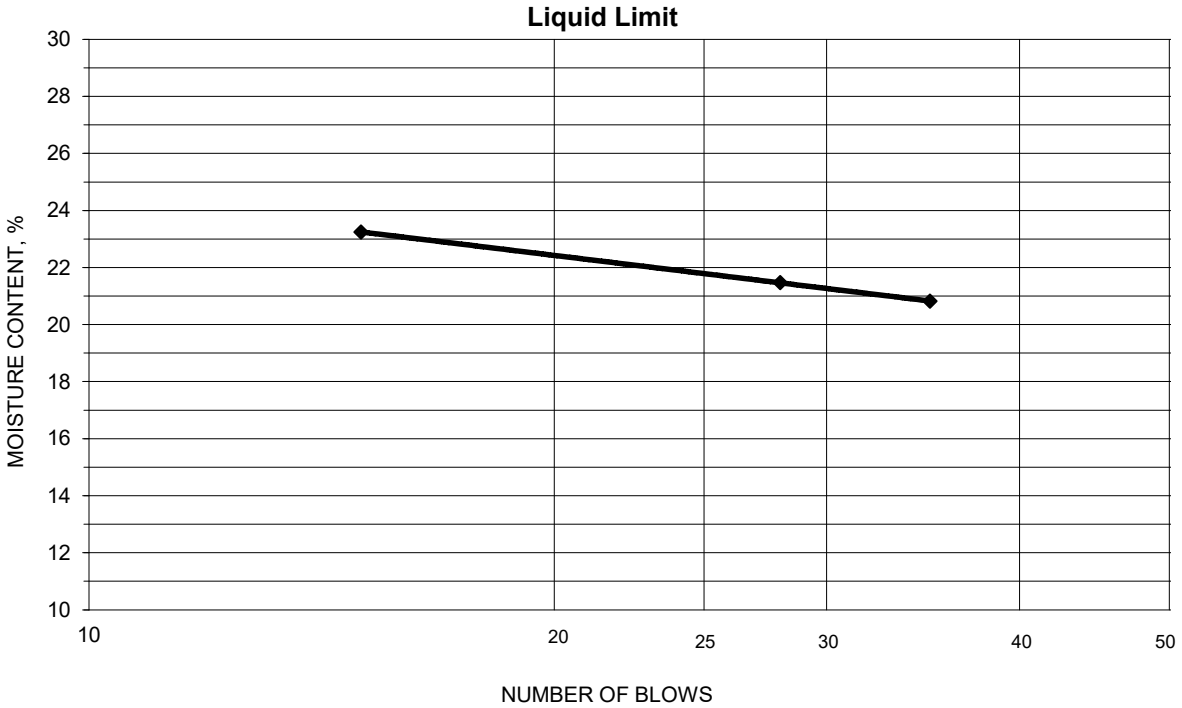
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	518-A, 1.0'-2.5', 3.5'-5.0'	Lab ID	89
		% + No. 40	82
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-23-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.05	18.36	11.09	15	23.2	
18.97	17.48	10.54	28	21.5	
19.24	17.82	11.00	35	20.8	22



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.87	22.06	11.07	16.5	16	6
23.04	21.30	10.69	16.4		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-B, 1.0'-2.5', 3.5'-5.0'	Lab ID	92
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 13.8

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	90.6
3/8"	9.5	76.6
No. 4	4.75	63.0
No. 10	2	47.8
No. 40	0.425	32.8
No. 200	0.075	20.9
	0.02	15.5
	0.005	9.5
	0.002	6.8
Estimated	0.001	4.0

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	37.0	52.2
Coarse Sand	15.2	15.0
Medium Sand	15.0	---
Fine Sand	11.9	11.9
Silt	11.4	14.1
Clay	9.5	6.8

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	28
Plastic Limit:	21
Plasticity Index:	7
Activity Index:	1.0

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC-SM
Group Name:	Silty, Clayey Sand with Gravel
AASHTO Classification:	A-2-4 (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-B, 1.0'-2.5', 3.5'-5.0'	Lab ID	92

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: JP
Test Date: 05-24-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	90.6
3/8"	76.6
No. 4	63.0
No. 10	47.8

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

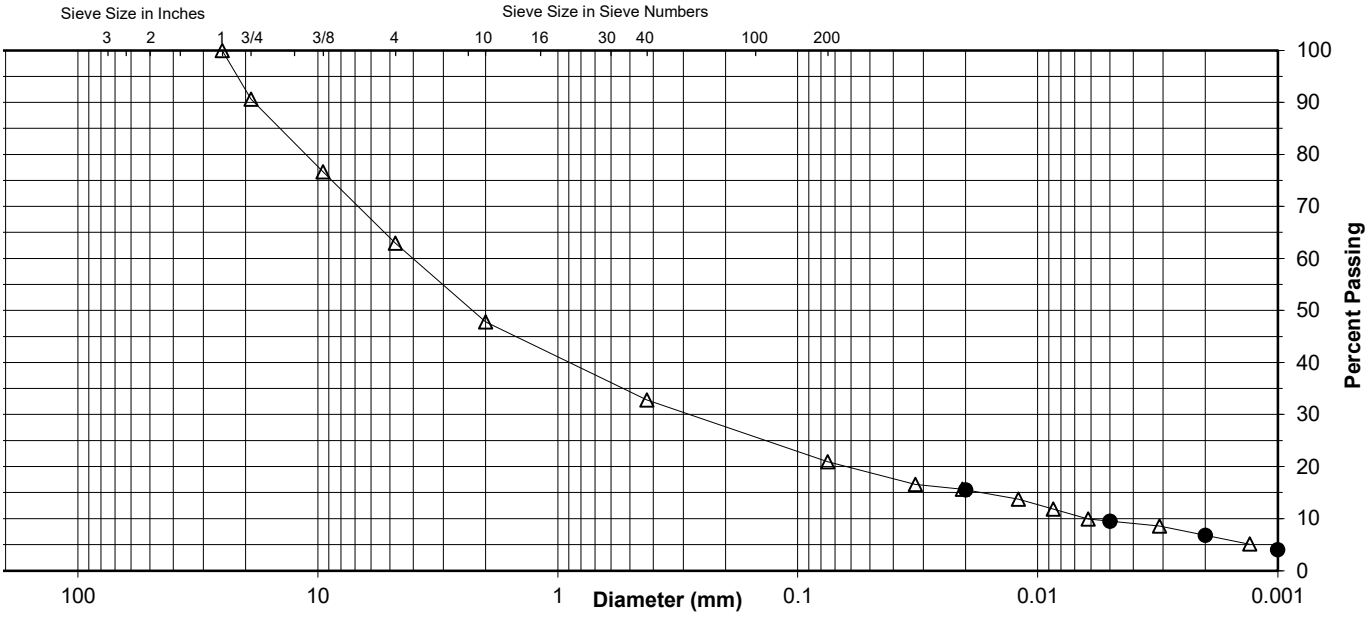
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	32.8
No. 200	20.9
0.02 mm	15.5
0.005 mm	9.5
0.002 mm	6.8
0.001 mm	4.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	9.4	27.6	15.2	15.0	11.9	11.4	9.5
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	52.2			15.0	11.9	14.1	6.8



Comments

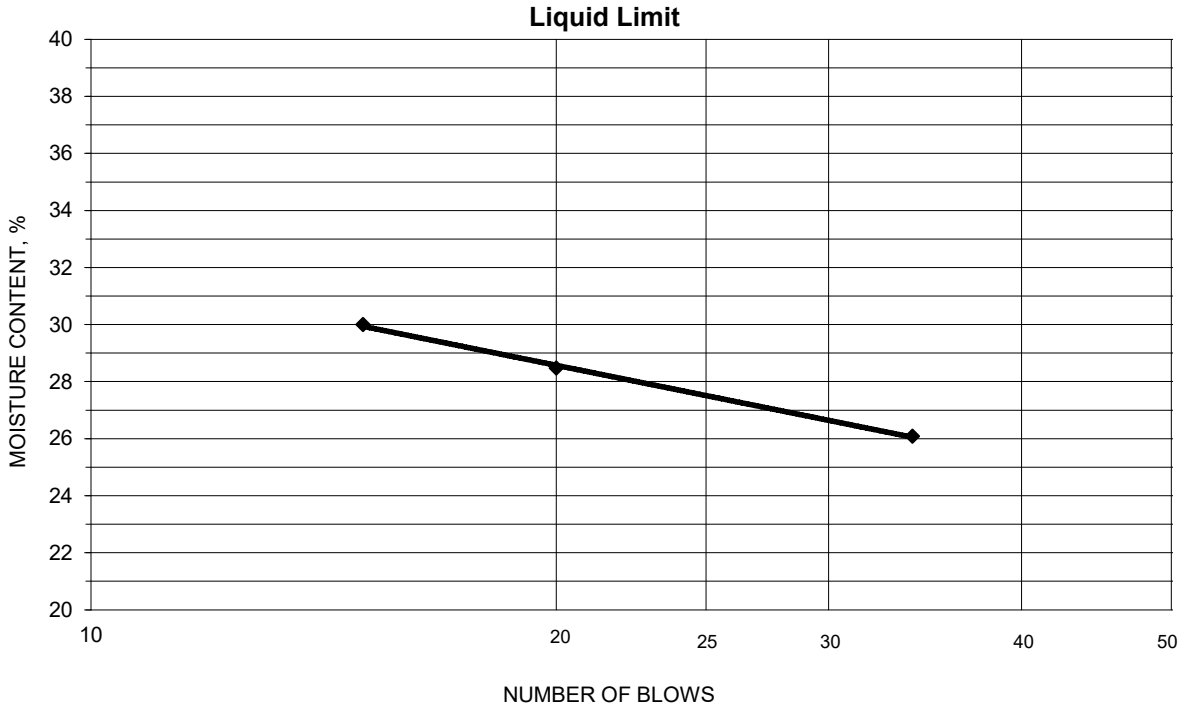
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	518-B, 1.0'-2.5', 3.5'-5.0'	Lab ID	92
		% + No. 40	67
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-30-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.60	18.38	10.98	15	30.0	28
20.45	18.26	10.57	20	28.5	
20.38	18.45	11.05	34	26.1	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
23.06	20.90	10.58	20.9	21	7
23.32	21.13	10.49	20.6		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-B, 6.0'-7.5', 8.5'-9.0'	Lab ID	95
Sample Type	SS-3 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 12.7

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	92.7
3/8"	9.5	72.1
No. 4	4.75	61.6
No. 10	2	49.8
No. 40	0.425	35.5
No. 200	0.075	23.8
	0.02	17.2
	0.005	10.6
	0.002	7.1
Estimated	0.001	4.2

Plus 3 in. Material, Not Included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	38.4	50.2
Coarse Sand	11.8	14.3
Medium Sand	14.3	---
Fine Sand	11.7	11.7
Silt	13.2	16.7
Clay	10.6	7.1

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	25
Plastic Limit:	19
Plasticity Index:	6
Activity Index:	0.8

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	GC-GM
Group Name:	Silty, Clayey Gravel with Sand
AASHTO Classification:	A-1-b (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name: TN ERFO FS CHRKE804 2020-2(5)
Source: 518-B, 6.0'-7.5', 8.5'-9.0'

Project Number: 2026252404
Lab ID: 95

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: JP
Test Date: 05-23-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	92.7
3/8"	72.1
No. 4	61.6
No. 10	49.8

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

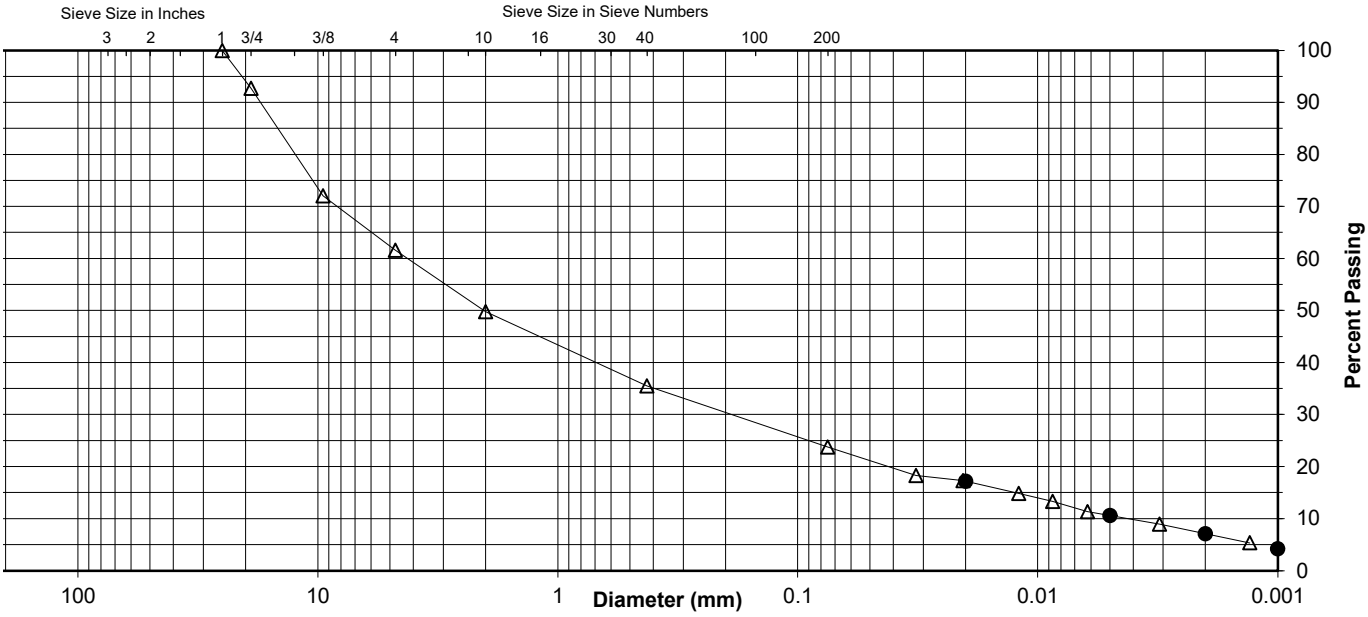
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	35.5
No. 200	23.8
0.02 mm	17.2
0.005 mm	10.6
0.002 mm	7.1
0.001 mm	4.2

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	7.3	31.1	11.8	14.3	11.7	13.2	10.6

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	50.2	14.3	11.7	16.7	7.1



Comments

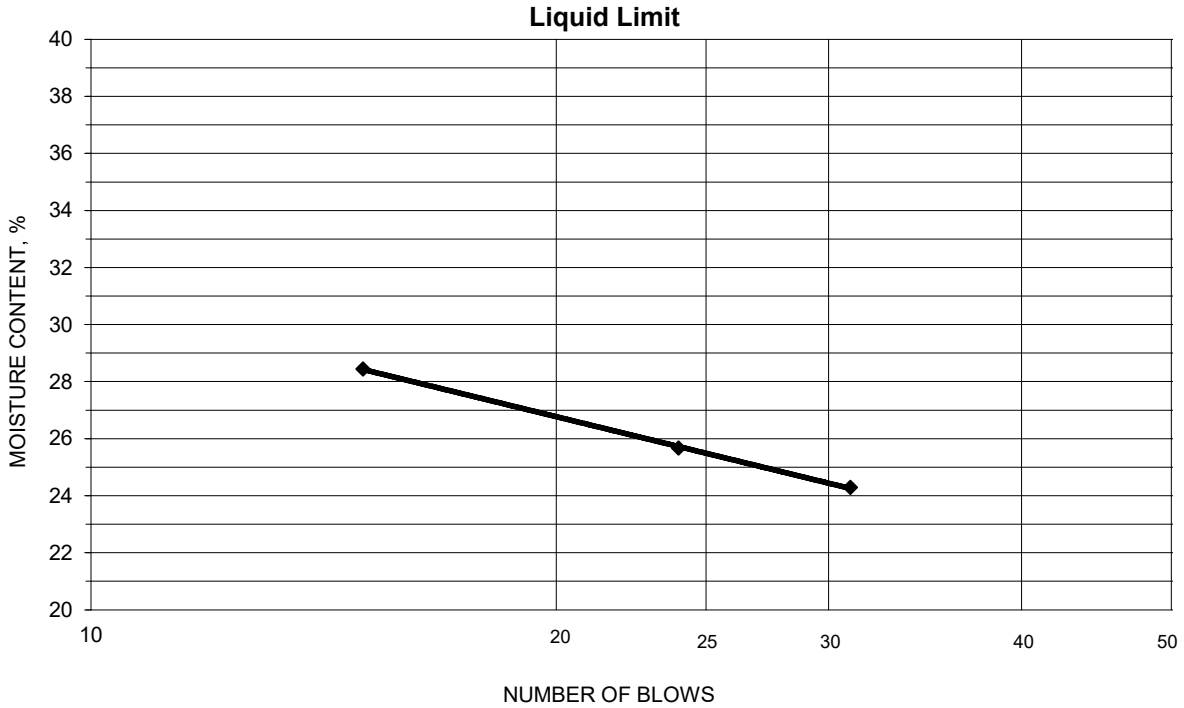
Reviewed By: REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	518-B, 6.0'-7.5', 8.5'-9.0'	Lab ID	95
		% + No. 40	65
Tested By	GK	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-29-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.81	18.54	10.56	15	28.4	
21.35	19.23	10.97	24	25.7	
22.04	19.82	10.68	31	24.3	25



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
24.40	22.25	11.05	19.2	19	6
23.14	21.14	10.59	19.0		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-B, 11.0'-12.5', 13.5'-15.0', 16.0'-17.5'	Lab ID	99
Sample Type	SS-5 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 5.9

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	92.8
3/8"	9.5	81.8
No. 4	4.75	70.0
No. 10	2	52.0
No. 40	0.425	32.3
No. 200	0.075	16.7
	0.02	11.6
	0.005	7.8
	0.002	4.7
Estimated	0.001	2.6

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	30.0	48.0
Coarse Sand	18.0	19.7
Medium Sand	19.7	---
Fine Sand	15.6	15.6
Silt	8.9	12.0
Clay	7.8	4.7

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit:	25
Plastic Limit:	21
Plasticity Index:	4
Activity Index:	0.9

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC-SM
Group Name:	Silty, Clayey Sand with Gravel
AASHTO Classification:	A-1-b (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-B, 11.0'-12.5', 13.5'-15.0', 16.0'-17.5'	Lab ID	99

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: JP
Test Date: 05-24-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	92.8
3/8"	81.8
No. 4	70.0
No. 10	52.0

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

Specific Gravity: 2.7

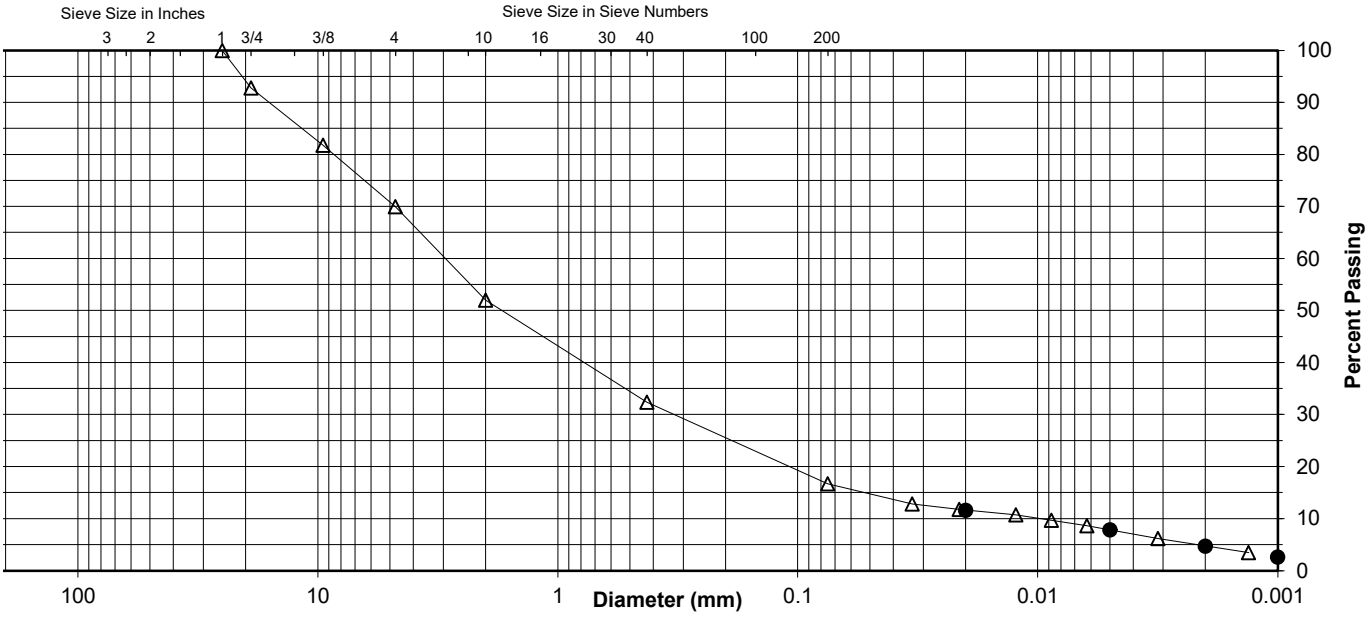
Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	32.3
No. 200	16.7
0.02 mm	11.6
0.005 mm	7.8
0.002 mm	4.7
0.001 mm	2.6

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	7.2	22.8	18.0	19.7	15.6	8.9	7.8

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	48.0	19.7	15.6	12.0	4.7



Comments

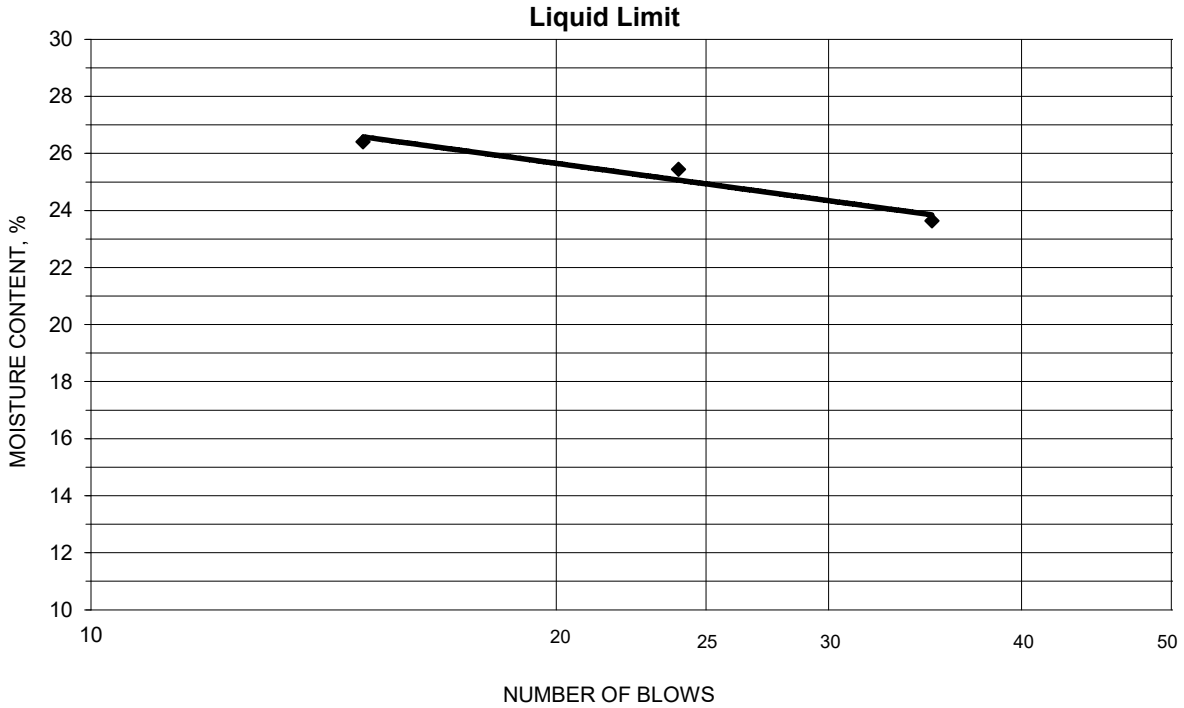
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	518-B, 11.0'-12.5', 13.5'-15.0', 16.0'-17.5'	Lab ID	99
		% + No. 40	68
Tested By	NU	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-31-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.51	17.64	10.56	15	26.4	
20.28	18.41	11.06	24	25.4	
19.02	17.50	11.07	35	23.6	25



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
24.05	21.81	11.06	20.8	21	4
24.18	21.95	11.06	20.5		

Remarks:

Reviewed By REL

Stantec

Summary of Soil Tests

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-C, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	103
Sample Type	SS-1 Composite	Date Received	5-13-24
		Date Reported	6-3-24

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 7.3

Particle Size Analysis

Preparation Method: AASHTO T 87
Gradation Method: AASHTO T 88
Hydrometer Method: AASHTO T 88

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
1"	25	100.0
3/4"	19	92.8
3/8"	9.5	77.6
No. 4	4.75	69.0
No. 10	2	58.3
No. 40	0.425	40.8
No. 200	0.075	23.5
	0.02	19.4
	0.005	12.3
	0.002	8.8
Estimated	0.001	6.4

Plus 3 in. Material, Not Included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	31.0	41.7
Coarse Sand	10.7	17.5
Medium Sand	17.5	---
Fine Sand	17.3	17.3
Silt	11.2	14.7
Clay	12.3	8.8

Atterberg Limits

Test Method: AASHTO T 89 & T 90
Prepared: Dry

Liquid Limit: 23
Plastic Limit: 18
Plasticity Index: 5
Activity Index: 0.6

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SC-SM
Group Name: Silty, Clayey Sand with Gravel

AASHTO Classification: A-1-b (0)

Comments:

Reviewed By REL

Stantec

Particle-Size Analysis of Soils
AASHTO T 88

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Source	518-C, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	103

Sieve Analysis for the Portion Coarser than the No. 10 Sieve

Test Method: AASHTO T 88
Prepared Using: AASHTO T 87

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: NU
Test Date: 05-22-2024
Date Received: 05-13-2024

Maximum Particle Size: 1" Sieve

Sieve Size	% Passing
1"	100.0
3/4"	92.8
3/8"	77.6
No. 4	69.0
No. 10	58.3

Analysis for the Portion Finer than the No. 10 Sieve

Analysis Based on -3 inch Fraction Only

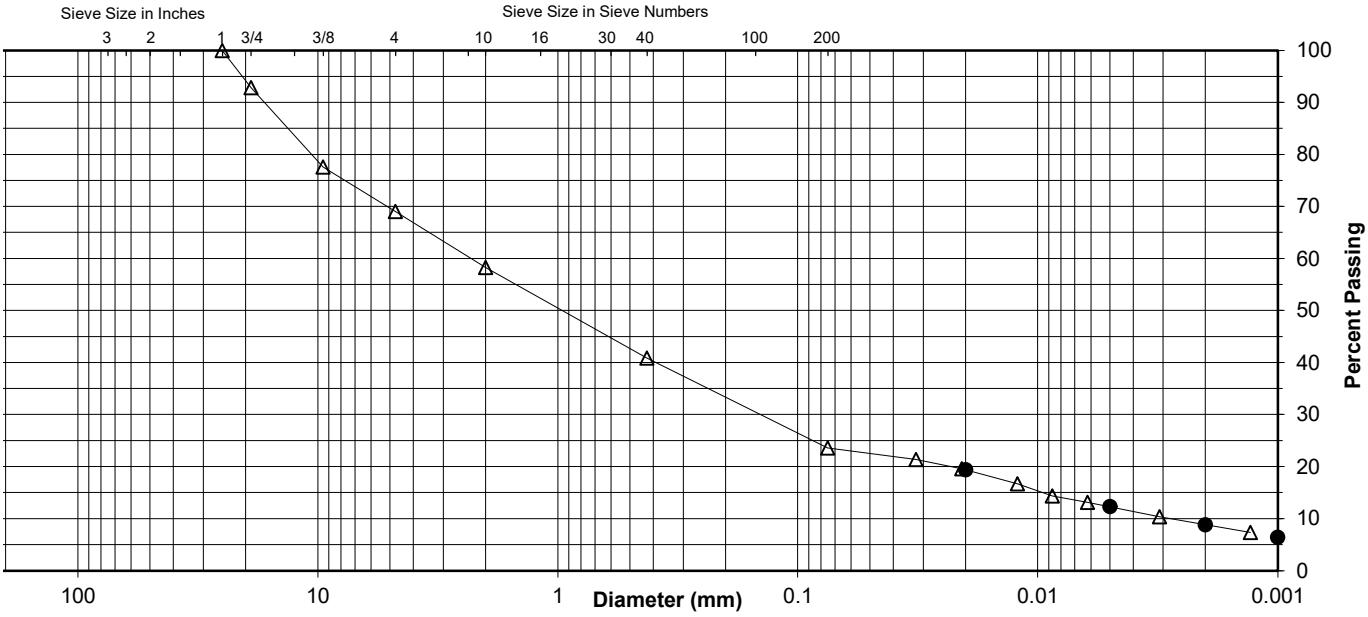
Specific Gravity: 2.7

Dispersed Using: Apparatus A - Mechanical, for 1 Minute

No. 40	40.8
No. 200	23.5
0.02 mm	19.4
0.005 mm	12.3
0.002 mm	8.8
0.001 mm	6.4

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	7.2	23.8	10.7	17.5	17.3	11.2	12.3
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	41.7			17.5	17.3	14.7	8.8



Comments

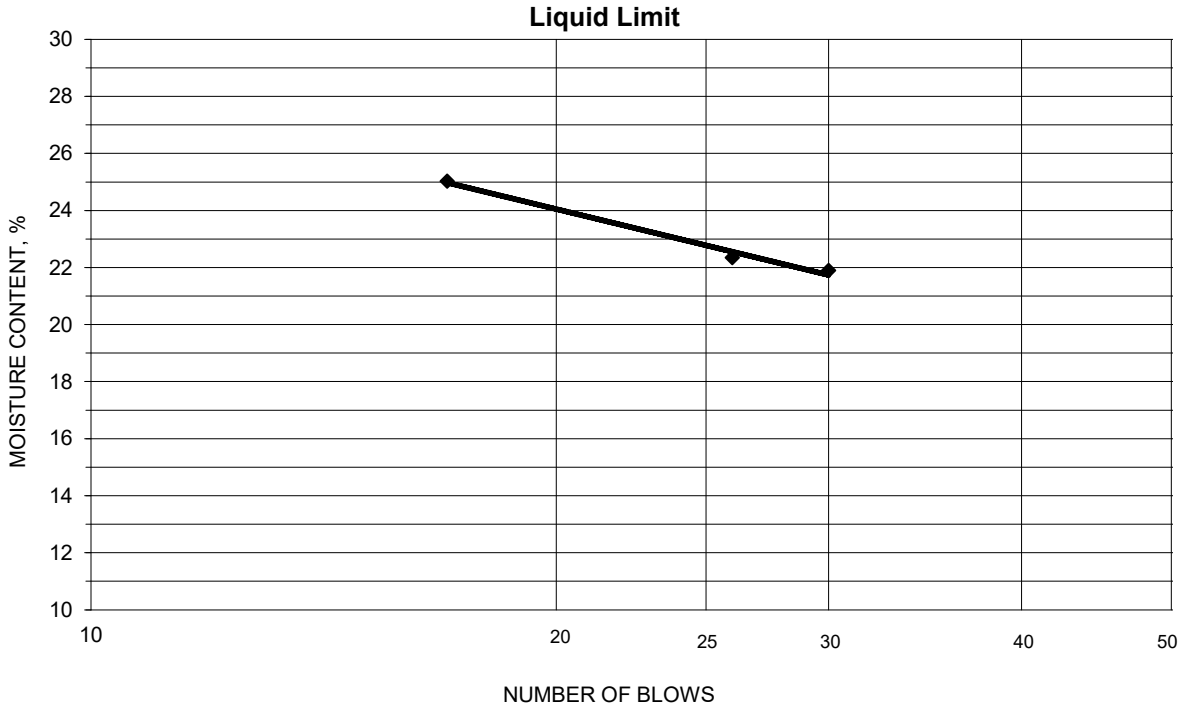
Reviewed By REL

Stantec

ATTERBERG LIMITS

Project	TN ERFO FS CHRKE804 2020-2(5)	Project No.	2026252404
Source	518-C, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	Lab ID	103
		% + No. 40	59
Tested By	GK	Test Method	AASHTO T 89 & T 90
Date Received	05-13-2024		
Test Date	05-29-2024	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
21.52	19.41	10.98	17	25.0	23
21.29	19.42	11.05	26	22.3	
21.31	19.44	10.90	30	21.9	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.67	19.99	10.69	18.1	18	5
21.47	19.85	11.03	18.4		

Remarks:

Reviewed By REL

Stantec

Determination of pH of Soils

ASTM D 4972

Project Name TN ERFO FS CHRKE804 2020-2(5) Project No. 2026252404

pH Meter ID PH-1 Balance ID BL-3 Thermometer ID TH-16 Date 6/3/2024 Technician JP

Meter Standardized prior to first test? [x] Yes Method A [X] B [ ]

Sample Source	Lab ID	Maximum Particle Size Used in Test*,[1]	Mixing Container ID	Mass of Soil (grams)	Slurry Temp at Time of Test (°C)	**pH in Water**	Mixing Container ID	Mass of Soil	Slurry Temp at Time of Test (°C)	**pH in Calcium Chloride Solution**
406, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	1	No. 10	ph-9	10.02	24.0	**7.9**	ph-1	10.01	24.1	**7.4**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable:									*N/A	[ ]
Description and Classification of Soil: Clayey Gravel with Sand										
411, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	14	No. 10	ph-7	10.08	22.9	**7.4**	ph-4	10.02	23.4	**6.9**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable.									*N/A	[ ]
Description and Classification of Soil: Clayey Sand with Gravel										
428-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	21	No. 10	ph-6	10.03	23.3	**6.5**	ph-2	10.04	23.6	**5.4**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable.									*N/A	[ ]
Description and Classification of Soil: Poorly Graded Gravel with Silt and Sand										
433, 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	28	No. 10	ph-9	10.06	23.8	**6.8**	ph-5	10.01	23.6	**6.0**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable.									*N/A	[ ]
Description and Classification of Soil: Silty, Clayey Sand with Gravel										
452, 3.5'-5.0', 6.0'-7.5'	34	No. 10	ph-6	10.08	23.2	**6.4**	ph-4	10.03	23.7	**5.6**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable.									*N/A	[ ]
Description and Classification of Soil: Silty, Clayey Sand with Gravel										

pH Meter Standardization check using pH 7.0 Buffer Solution at completion of testing or after 10 tests

Reading 7.1 *If result is less than 6.9 or greater than 7.1 then re-standardize pH meter and retest previous specimens*

[1] *If soil or soil fractions with particles larger than 2.0 mm are used, the results may be significantly different*

Reviewed By: REL

Stantec

Determination of pH of Soils

ASTM D 4972

Project Name TN ERFO FS CHRKE804 2020-2(5) Project No. 2026252404

pH Meter ID PH-1 Balance ID BL-3 Thermometer ID TH-16 Date 6/3/2024 Technician JP

Meter Standardized prior to first test? [x] Yes Method A [X] B [ ]

Sample Source	Lab ID	Maximum Particle Size Used in Test*,[1]	Mixing Container ID	Mass of Soil (grams)	Slurry Temp at Time of Test (°C)	**pH in Water**	Mixing Container ID	Mass of Soil	Slurry Temp at Time of Test (°C)	**pH in Calcium Chloride Solution**
466-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5', 8.5'-10.0'	38	No. 10	ph-2	10.06	23.1	**6.8**	ph-1	10.04	23.5	**6.3**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable:									*N/A	[ ]
Description and Classification of Soil: Silty Sand with Gravel										
466-A, 11.0'-12.5', 13.5'-15.0'	43	No. 10	ph-6	10.04	23.0	**6.0**	ph-4	10.02	23.2	**5.4**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable.									*N/A	[ ]
Description and Classification of Soil: Silty Sand										
466-B, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	50	No. 10	ph-2	10.08	22.8	**4.9**	ph-7	10.05	23.1	**4.5**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable.									*N/A	[ ]
Description and Classification of Soil: Silty Sand with Gravel										
466-B, 13.5'-15.0', 16.0'-17.5', 18.5'-20.0'	56	No. 10	ph-5	10.06	22.9	**6.2**	ph-9	10.07	23.3	**5.4**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable.									*N/A	[ ]
Description and Classification of Soil: Silty Sand										
469, 3.5'-5.0', 6.0'-7.5'	62	No. 10	ph-2	10.03	23.4	**6.8**	ph-4	10.06	23.4	**6.4**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable.									*N/A	[ ]
Description and Classification of Soil: Silty Gravel with Sand										

pH Meter Standardization check using pH 7.0 Buffer Solution at completion of testing or after 10 tests

Reading 7.0 *If result is less than 6.9 or greater than 7.1 then re-standardize pH meter and retest previous specimens*

[1] *If soil or soil fractions with particles larger than 2.0 mm are used, the results may be significantly different*

Reviewed By: REL

Stantec

Determination of pH of Soils

ASTM D 4972

Project Name TN ERFO FS CHRKE804 2020-2(5) Project No. 2026252404

pH Meter ID PH-1 Balance ID BL-3 Thermometer ID TH-16 Date 6/3/2024 Technician JP

Meter Standardized prior to first test? [x] Yes Method A [X] B [ ]

Sample Source	Lab ID	Maximum Particle Size Used in Test*,[1]	Mixing Container ID	Mass of Soil (grams)	Slurry Temp at Time of Test (°C)	**pH in Water**	Mixing Container ID	Mass of Soil	Slurry Temp at Time of Test (°C)	**pH in Calcium Chloride Solution**
481-A, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	65	No. 10	ph-4	10.01	24.6	**8.5**	ph-2	10.02	24.7	**8.0**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable:									*N/A	[ ]
Description and Classification of Soil: Silty, Clayey Sand with Gravel										
481-B, 1.0'-2.5'	69	No. 10	ph-7	10.03	24.0	**8.8**	ph-1	10.05	24.5	**8.2**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable.									*N/A	[ ]
Description and Classification of Soil: Silty, Clayey Sand with Gravel										
486, 1.0'-2.5', 3.5'-5.0'	71	No. 10	ph-5	10.05	24.5	**7.6**	ph-9	10.05	24.5	**7.2**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable.									*N/A	[ ]
Description and Classification of Soil: Poorly Graded Gravel with Clay and Sand										
487, 1.0'-2.5', 3.5'-5.0'	75	No. 10	ph-7	10.07	24.5	**7.7**	ph-4	10.06	24.8	**7.5**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable.									*N/A	[ ]
Description and Classification of Soil: Poorly Graded Gravel with Clay and Sand										
508, 1.0'-2.5', 2.5'-3.5'	82	No. 10	ph-9	10.07	23.5	**8.4**	ph-5	10.08	24	**8.0**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable.									*N/A	[ ]
Description and Classification of Soil: Silty, Clayey Sand with Gravel										

pH Meter Standardization check using pH 7.0 Buffer Solution at completion of testing or after 10 tests

Reading 7.1 *If result is less than 6.9 or greater than 7.1 then re-standardize pH meter and retest previous specimens*

[1] *If soil or soil fractions with particles larger than 2.0 mm are used, the results may be significantly different*

Reviewed By: REL

Stantec

Determination of pH of Soils

ASTM D 4972

Project Name TN ERFO FS CHRKE804 2020-2(5) Project No. 2026252404

pH Meter ID PH-1 Balance ID BL-3 Thermometer ID TH-16 Date 6/3/2024 Technician JP

Meter Standardized prior to first test? [x] Yes Method A [X] B [ ]

Sample Source	Lab ID	Maximum Particle Size Used in Test*,[1]	Mixing Container ID	Mass of Soil (grams)	Slurry Temp at Time of Test (°C)	**pH in Water**	Mixing Container ID	Mass of Soil	Slurry Temp at Time of Test (°C)	**pH in Calcium Chloride Solution**
515, 1.0'-2.5', 3.5'-5.0'	85	No. 10	ph-1	10.02	23.9	**4.4**	ph-2	10.07	23.7	**4.0**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable:									*N/A	[ ]
Description and Classification of Soil: Well-Graded Sand with Silt and Gravel										
518-A, 1.0'-2.5', 3.5'-5.0'	89	No. 10	ph-1	10.00	24.0	**9.0**	ph-2	10.01	24	**8.2**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable.									*N/A	[ ]
Description and Classification of Soil: Poorly Graded Gravel with Clay and Sand										
518-B, 1.0'-2.5', 3.5'-5.0'	92	No. 10	ph-6	10.09	23.7	**7.5**	ph-5	10.03	23.8	**7.0**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable.									*N/A	[ ]
Description and Classification of Soil: Silty, Clayey Sand with Gravel										
518-C, 1.0'-2.5', 3.5'-5.0', 6.0'-7.5'	103	No. 10	ph-9	10.02	23.8	**8.2**	ph-7	10.02	23.8	**7.6**
*Description of Material Excluded from Test and Special Selection or Preparation if Applicable.									*N/A	[ ]
Description and Classification of Soil: Silty, Clayey Sand with Gravel										

pH Meter Standardization check using pH 7.0 Buffer Solution at completion of testing or after 10 tests

Reading 7.1 *If result is less than 6.9 or greater than 7.1 then re-standardize pH meter and retest previous specimens*

[1] *If soil or soil fractions with particles larger than 2.0 mm are used, the results may be significantly different*

Reviewed By: REL

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	Sandstone, light brown, slightly strong	Lab ID	UCR-107
Hole Number	411	Depth (ft) 15.9'-16.3'	Date Received 05/13/2024

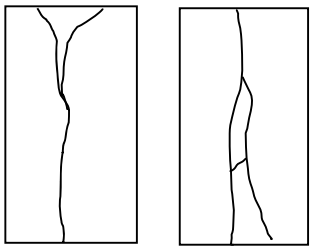
Temperature (°C)	22.2	Moisture Condition	As Prepared, Moist	Date Tested	05/31/2024

Side Planeness	N/A	Height (in)	4.415	Wet Unit Weight (pcf)	155.6
Perpendicularity	N/A	Diameter (in)	1.965	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.033	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	76
Peak Load (lbf)	24860
Failure Type	Cone and Split
Compressive Strength (psi)	8200
Compressive Strength (psf)	1180800
Compressive Strength (tsf)	590

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

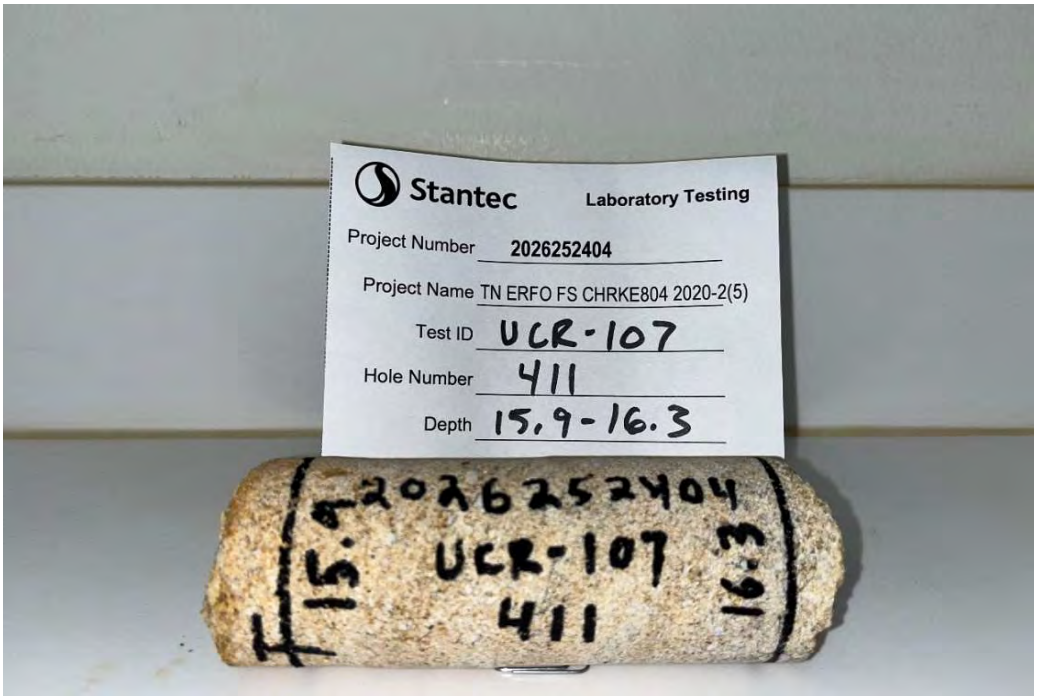
Reviewed By REL

Stantec

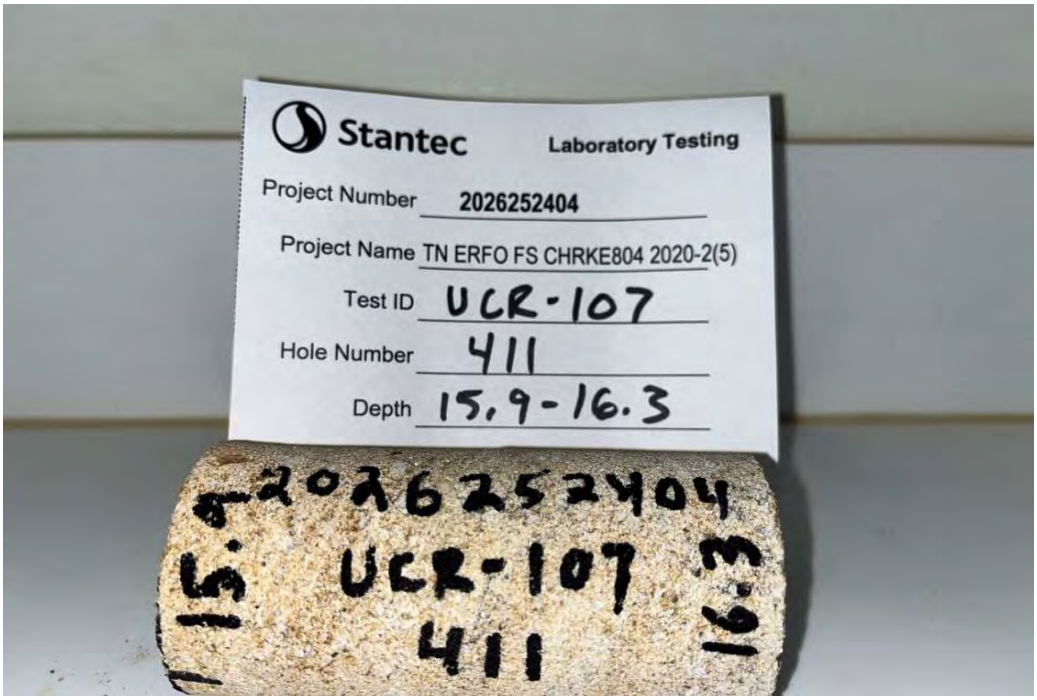
Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology Sandstone, light brown, slightly strong
Lab ID UCR-107
Hole Number 411
Depth (ft) 15.9'-16.3'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received



Core Preparation

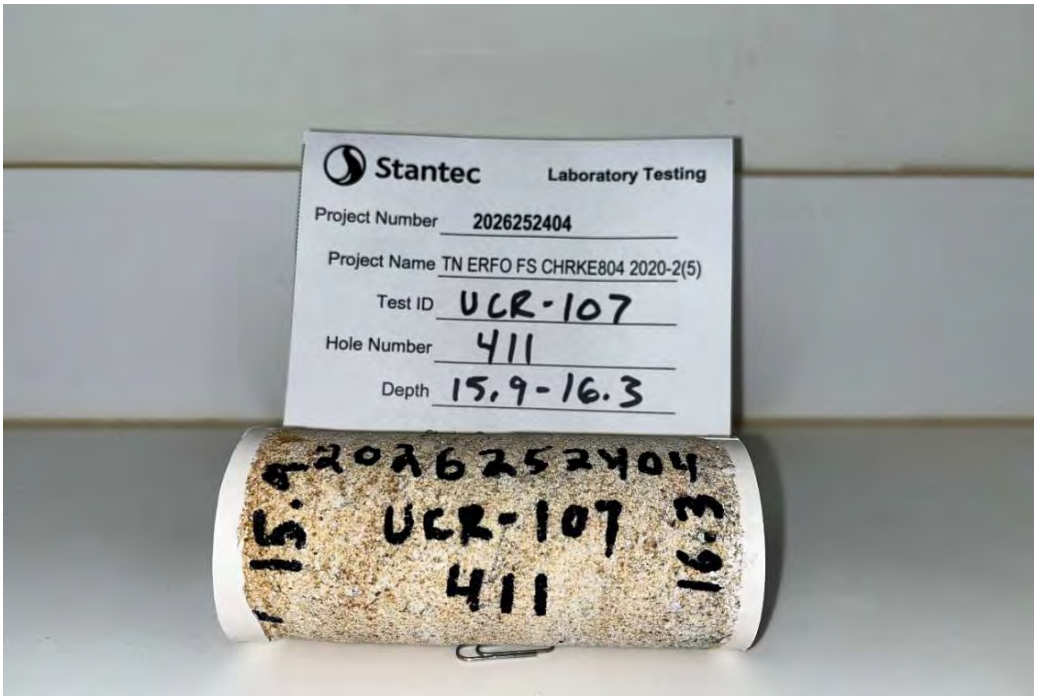


Stantec

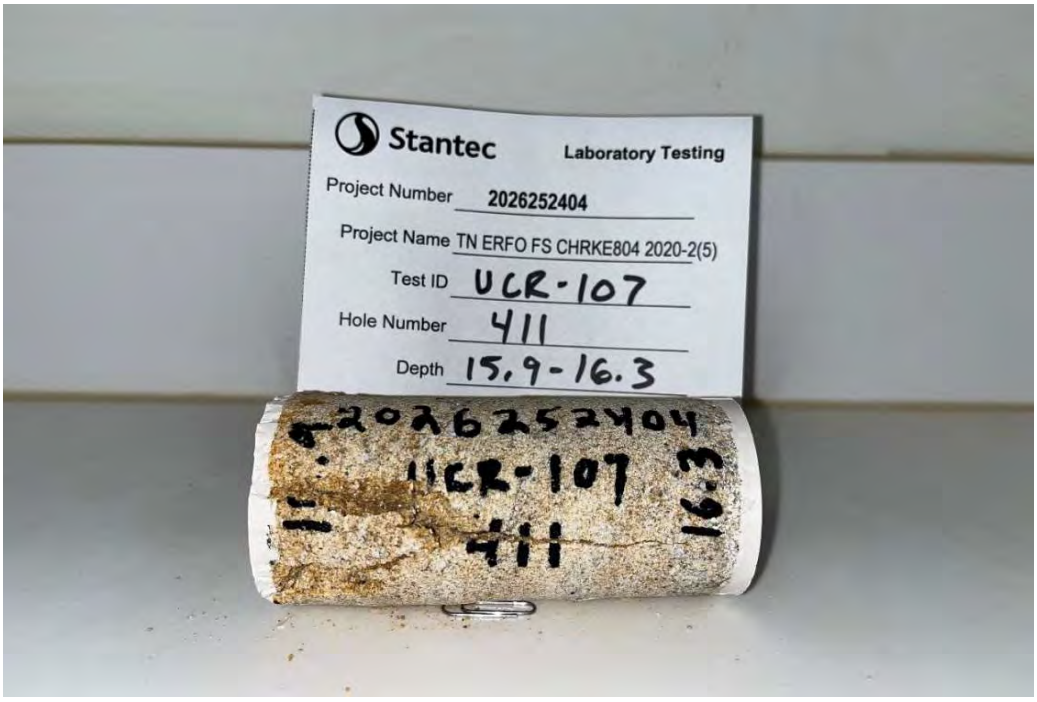
Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology Sandstone, light brown, slightly strong
Lab ID UCR-107
Hole Number 411
Depth (ft) 15.9'-16.3'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation



Post Test



Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology Sandstone, light brown, slightly strong
Lab ID UCR-107
Hole Number 411
Depth (ft) 15.9'-16.3'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	sandstone, light brown/white, slightly strong	Lab ID	UCR-108
Hole Number	428-B	Depth (ft)	7.7'-8.1'
Date Received	05/13/2024		

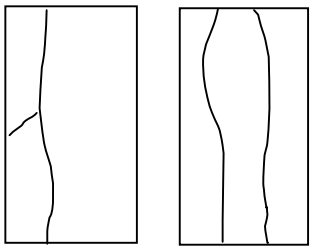
Temperature (°C)	21.9	Moisture Condition	As Prepared, Moist	Date Tested	05/29/2024

Side Planeness	N/A	Height (in)	4.694	Wet Unit Weight (pcf)	160.4
Perpendicularity	N/A	Diameter (in)	1.989	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.106	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	75
Peak Load (lbf)	60500
Failure Type	Shear
Compressive Strength (psi)	19480
Compressive Strength (psf)	2805120
Compressive Strength (tsf)	1403

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

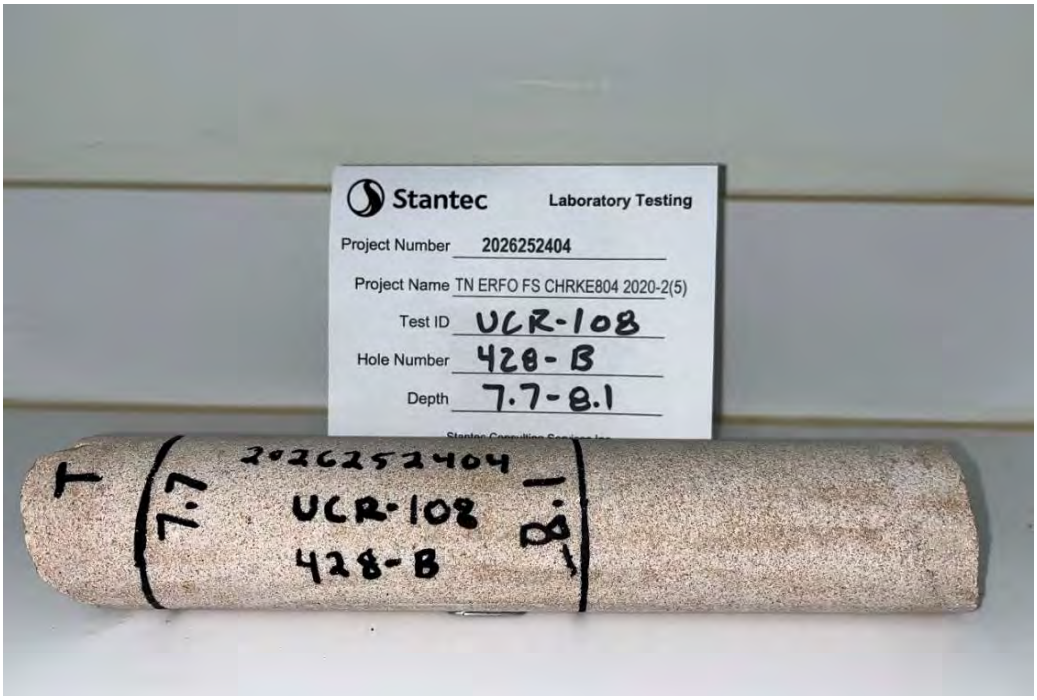
Reviewed By REL

Stantec

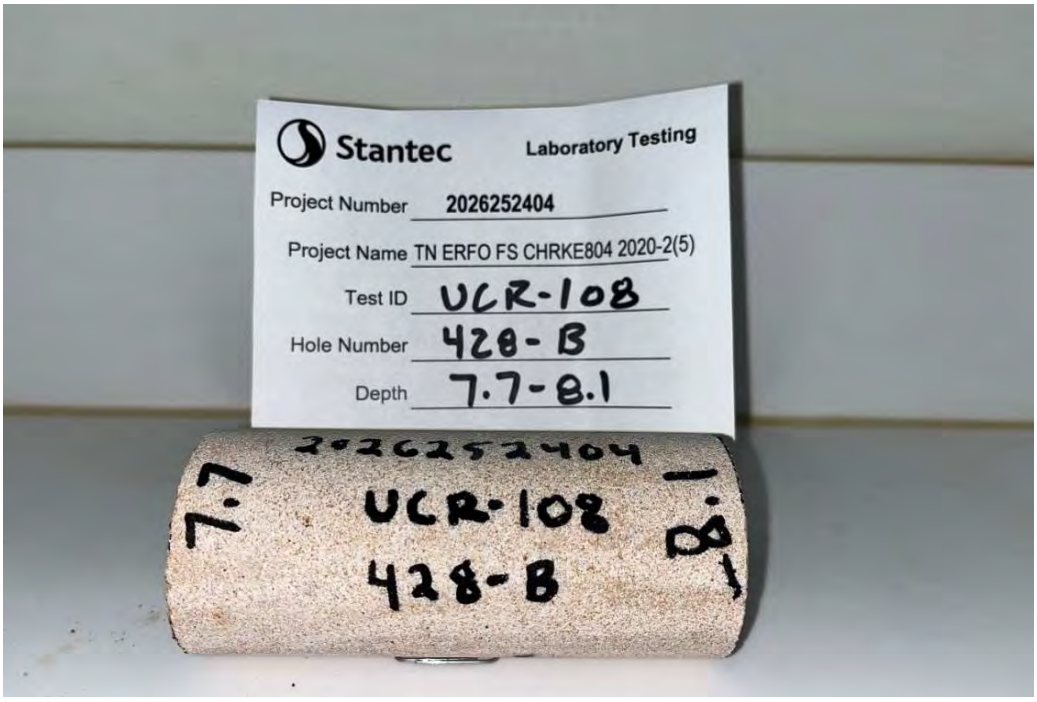
Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light brown/white, slightly strong
Lab ID UCR-108
Hole Number 428-B
Depth (ft) 7.7'-8.1'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received



Core Preparation



Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light brown/white, slightly strong
Lab ID UCR-108
Hole Number 428-B
Depth (ft) 7.7'-8.1'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation

Post Test

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light brown/white, slightly strong
Lab ID UCR-108
Hole Number 428-B
Depth (ft) 7.7'-8.1'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	limestone/dolostone, grey, strong	Lab ID	UCR-109
Hole Number	431	Depth (ft)	8.1'-8.5'
Date Received	05/13/2024		

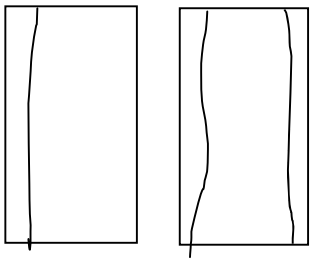
Temperature (°C)	22	Moisture Condition	As Prepared, Moist	Date Tested	05/29/2024

Side Planeness	N/A	Height (in)	4.310	Wet Unit Weight (pcf)	171.0
Perpendicularity	N/A	Diameter (in)	1.972	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.053	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	134
Peak Load (lbf)	58000
Failure Type	Shear
Compressive Strength (psi)	19000
Compressive Strength (psf)	2736000
Compressive Strength (tsf)	1368

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

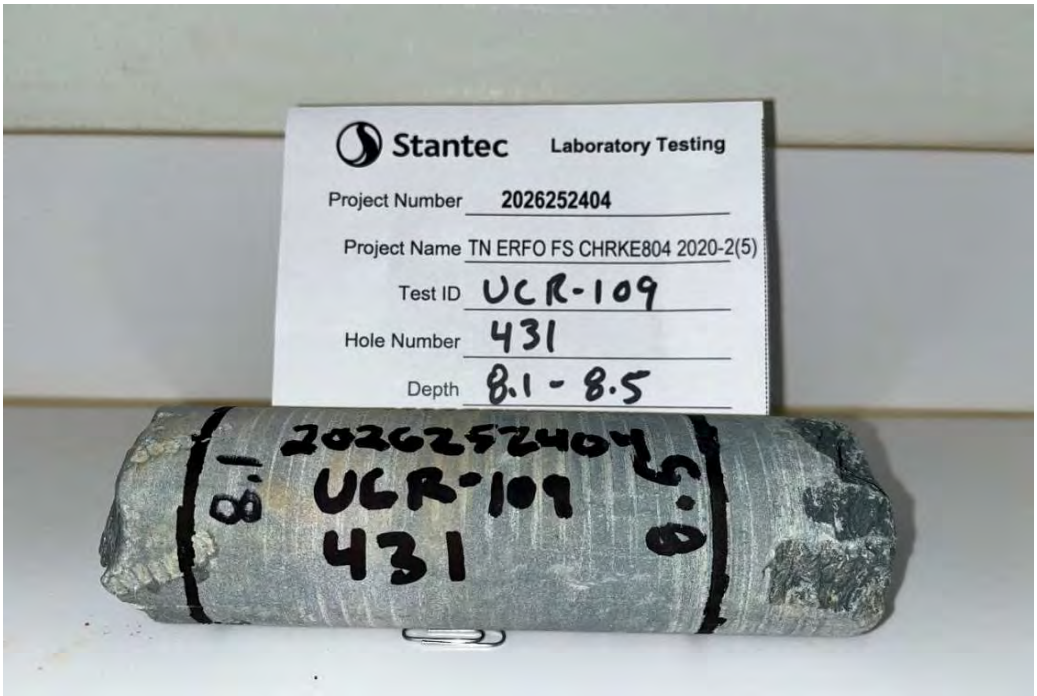
Reviewed By REL

Stantec

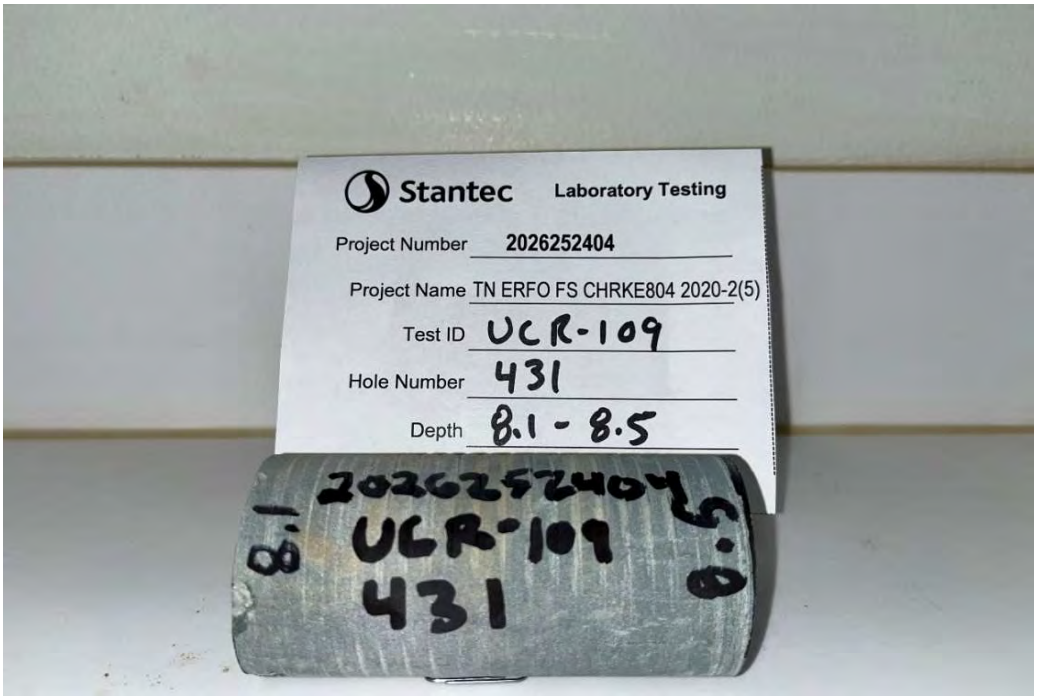
Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology limestone/dolostone, grey, strong
Lab ID UCR-109
Hole Number 431
Depth (ft) 8.1'-8.5'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received



Core Preparation

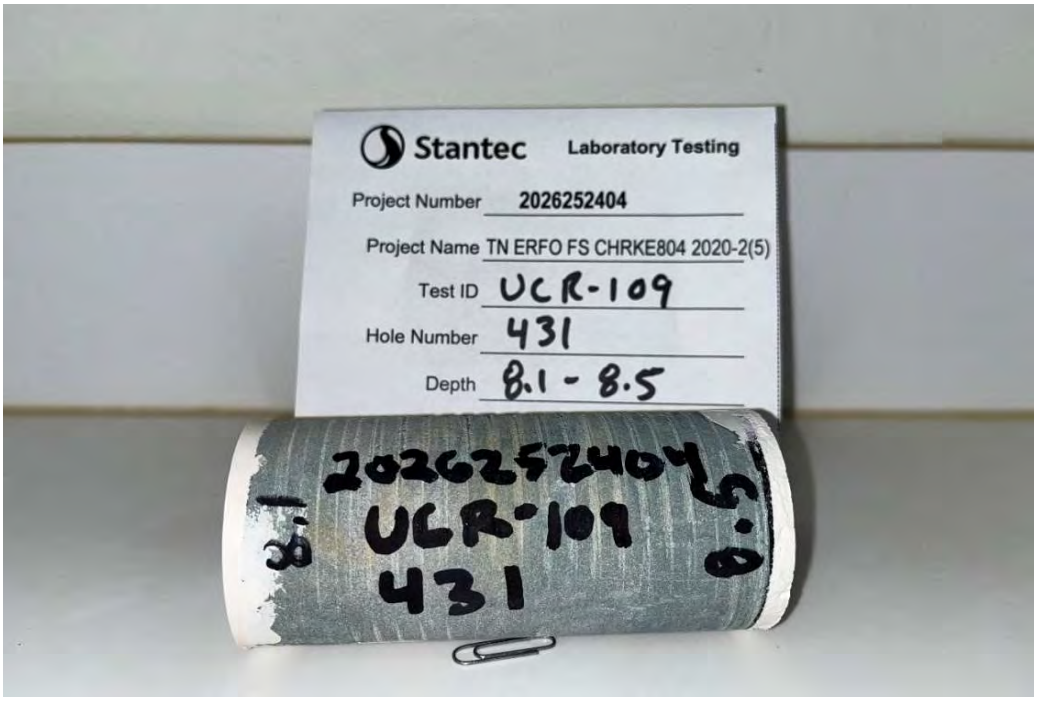


Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology limestone/dolostone, grey, strong
Lab ID UCR-109
Hole Number 431
Depth (ft) 8.1'-8.5'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation



Post Test

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology limestone/dolostone, grey, strong
Lab ID UCR-109
Hole Number 431
Depth (ft) 8.1'-8.5'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	shale, dark grey, strong	Lab ID	UCR-110
Hole Number	433	Depth (ft) 13.7'-14.1'	Date Received 05/13/2024

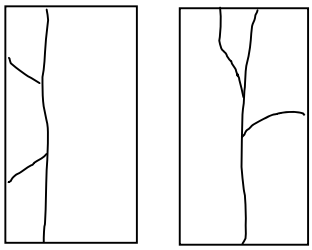
Temperature (°C)	22.1	Moisture Condition	As Prepared, Moist	Date Tested	05/29/2024

Side Planeness	N/A	Height (in)	4.589	Wet Unit Weight (pcf)	173.8
Perpendicularity	N/A	Diameter (in)	1.966	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.036	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	109
Peak Load (lbf)	41410
Failure Type	Cone and Split
Compressive Strength (psi)	13640
Compressive Strength (psf)	1964160
Compressive Strength (tsf)	982

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

Reviewed By REL

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology shale, dark grey, strong
Lab ID UCR-110
Hole Number 433
Depth (ft) 13.7'-14.1'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received

Core Preparation

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology shale, dark grey, strong
Lab ID UCR-110
Hole Number 433
Depth (ft) 13.7'-14.1'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation

Post Test

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology shale, dark grey, strong
Lab ID UCR-110
Hole Number 433
Depth (ft) 13.7'-14.1'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	sandstone, light brown, strong	Lab ID	UCR-111
Hole Number	452	Depth (ft) 18.7'-19.1'	Date Received 05/13/2024

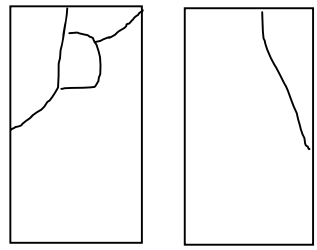
Temperature (°C)	22.1	Moisture Condition	As Prepared, Moist	Date Tested	05/31/2024

Side Planeness	N/A	Height (in)	4.617	Wet Unit Weight (pcf)	154.4
Perpendicularity	N/A	Diameter (in)	1.970	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.048	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	114
Peak Load (lbf)	28460
Failure Type	Cone and Shear
Compressive Strength (psi)	9340
Compressive Strength (psf)	1344960
Compressive Strength (tsf)	672

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

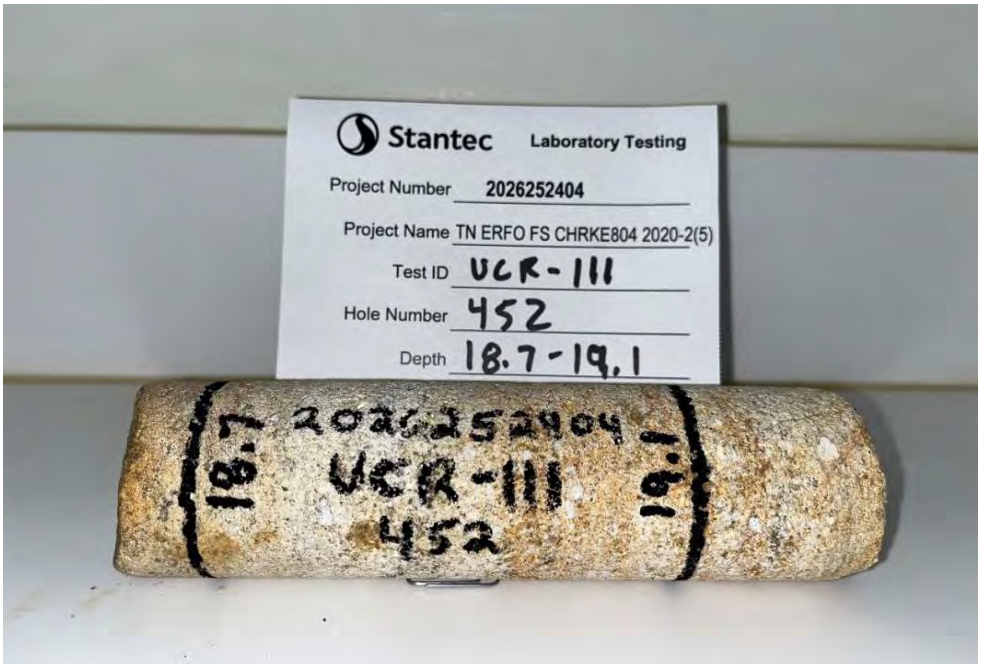
Reviewed By REL

Stantec

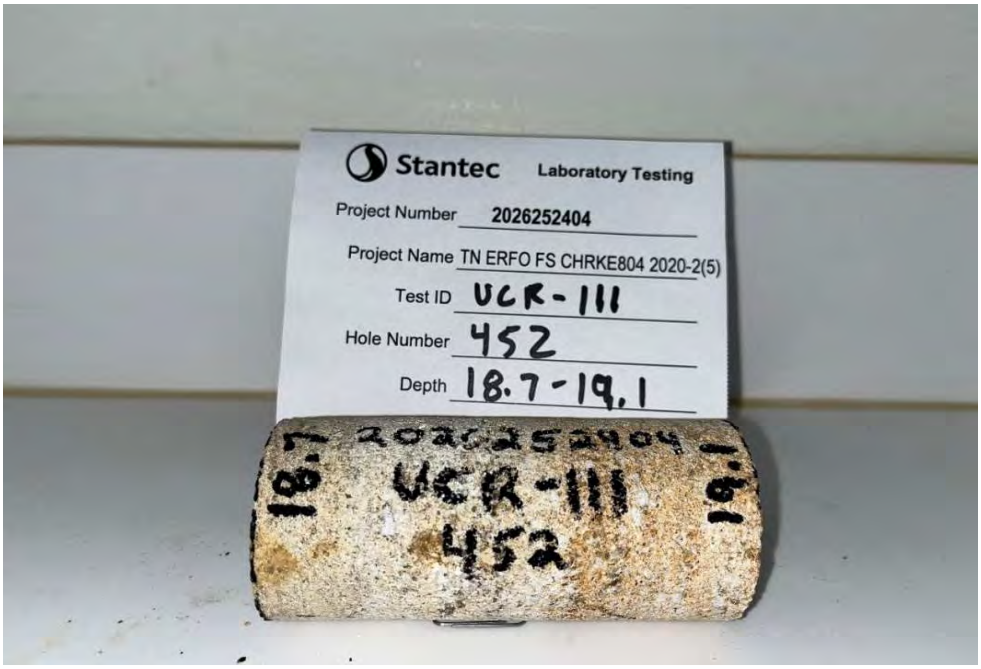
Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light brown, strong
Lab ID UCR-111
Hole Number 452
Depth (ft) 18.7'-19.1'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received



Core Preparation



Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light brown, strong
Lab ID UCR-111
Hole Number 452
Depth (ft) 18.7'-19.1'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation

Post Test

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light brown, strong
Lab ID UCR-111
Hole Number 452
Depth (ft) 18.7'-19.1'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	sandstone, light grey, slightly strong	Lab ID	UCR-112
Hole Number	466-A	Depth (ft)	22.0'-22.4'
Date Received	05/13/2024		

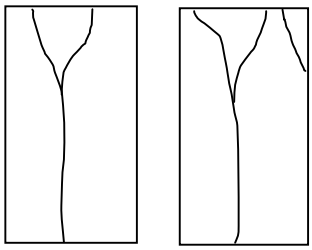
Temperature (°C)	22.1	Moisture Condition	As Prepared, Moist	Date Tested	05/31/2024

Side Planeness	N/A	Height (in)	4.546	Wet Unit Weight (pcf)	162.4
Perpendicularity	N/A	Diameter (in)	1.972	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.054	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	111
Peak Load (lbf)	40400
Failure Type	Cone and Split
Compressive Strength (psi)	13230
Compressive Strength (psf)	1905120
Compressive Strength (tsf)	952

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

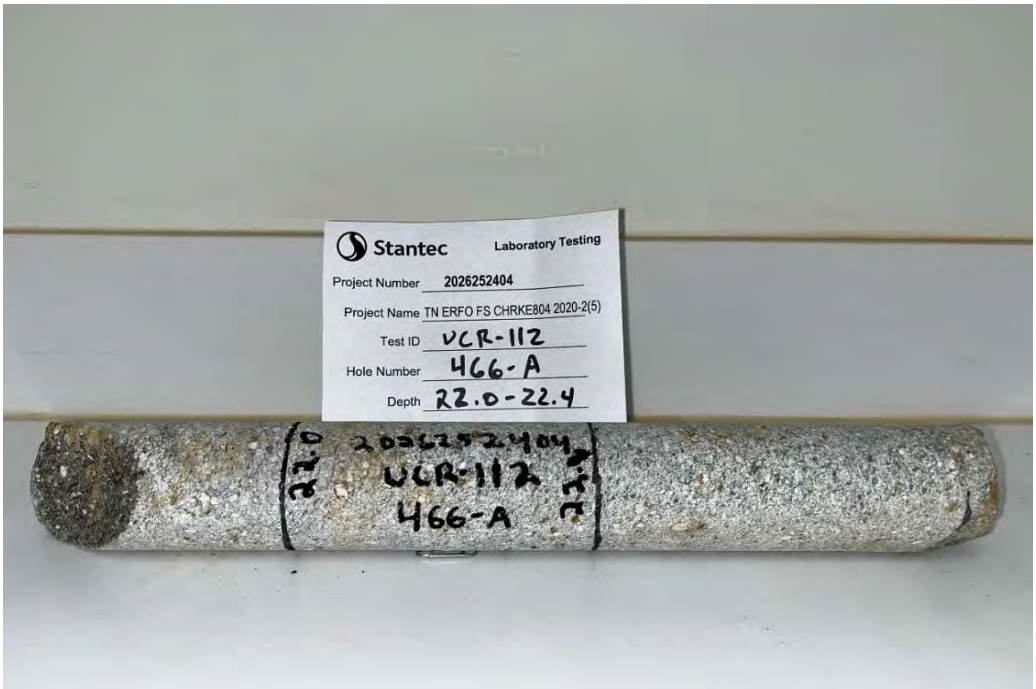
Reviewed By REL

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, slightly strong
Lab ID UCR-112
Hole Number 466-A
Depth (ft) 22.0'-22.4'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received



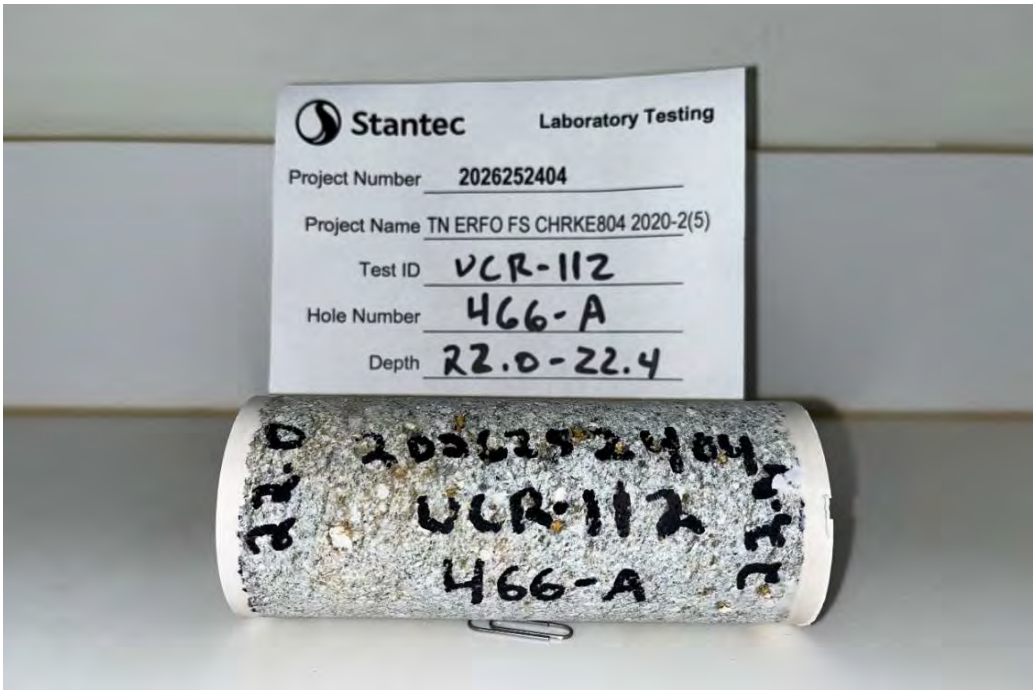
Core Preparation

Stantec

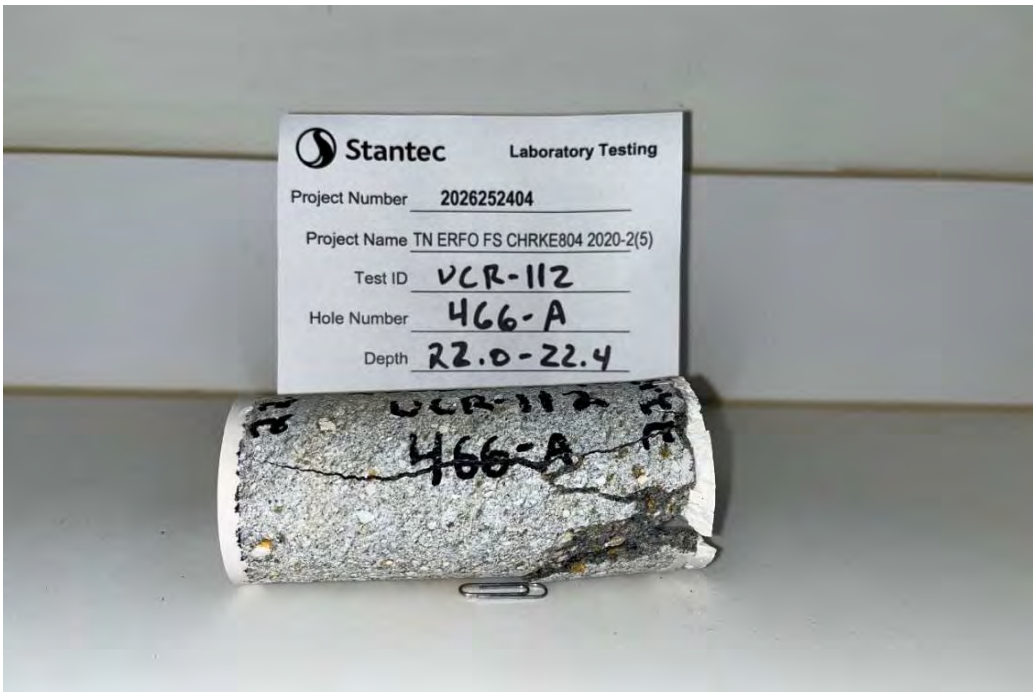
Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, slightly strong
Lab ID UCR-112
Hole Number 466-A
Depth (ft) 22.0'-22.4'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation



Post Test



Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, slightly strong
Lab ID UCR-112
Hole Number 466-A
Depth (ft) 22.0'-22.4'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	shale, grey, slightly strong	Lab ID	UCR-113
Hole Number	469	Depth (ft) 13.3'-13.7'	Date Received 05/13/2024

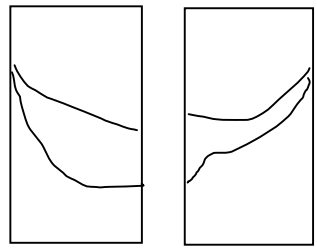
Temperature (°C)	22.2	Moisture Condition	As Prepared, Moist	Date Tested	05/31/2024

Side Planeness	N/A	Height (in)	4.674	Wet Unit Weight (pcf)	169.4
Perpendicularity	N/A	Diameter (in)	1.970	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.048	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	112
Peak Load (lbf)	30660
Failure Type	Cone and Shear
Compressive Strength (psi)	10060
Compressive Strength (psf)	1448640
Compressive Strength (tsf)	724

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

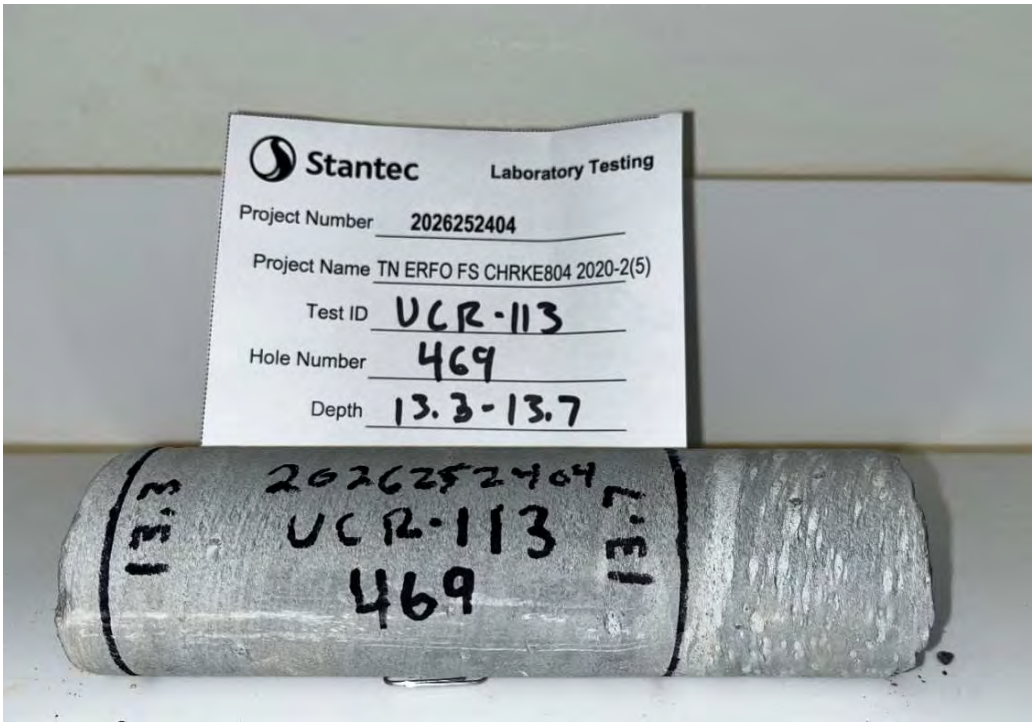
Reviewed By REL

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology shale, grey, slightly strong
Lab ID UCR-113
Hole Number 469
Depth (ft) 13.3'-13.7'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received



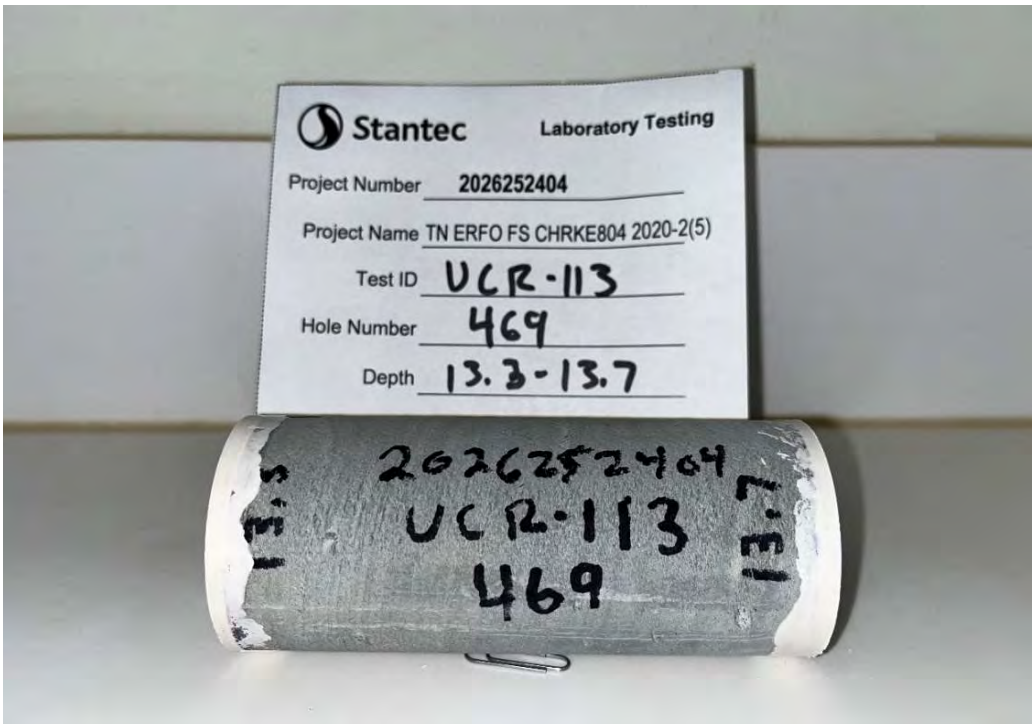
Core Preparation

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology shale, grey, slightly strong
Lab ID UCR-113
Hole Number 469
Depth (ft) 13.3'-13.7'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation



Post Test

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology shale, grey, slightly strong
Lab ID UCR-113
Hole Number 469
Depth (ft) 13.3'-13.7'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	sandstone, grey, slightly strong	Lab ID	UCR-114
Hole Number	481-A	Depth (ft)	10.1'-10.5'
Date Received	05/13/2024		

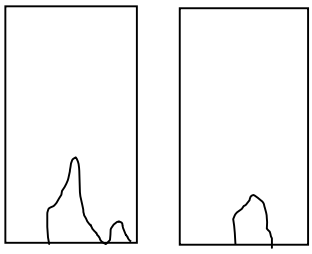
Temperature (°C)	22.3	Moisture Condition	As Prepared, Moist	Date Tested	05/31/2024

Side Planeness	N/A	Height (in)	4.765	Wet Unit Weight (pcf)	166.1
Perpendicularity	N/A	Diameter (in)	1.976	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.065	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	60
Peak Load (lbf)	44630
Failure Type	Cone
Compressive Strength (psi)	14560
Compressive Strength (psf)	2096640
Compressive Strength (tsf)	1048

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

Reviewed By REL

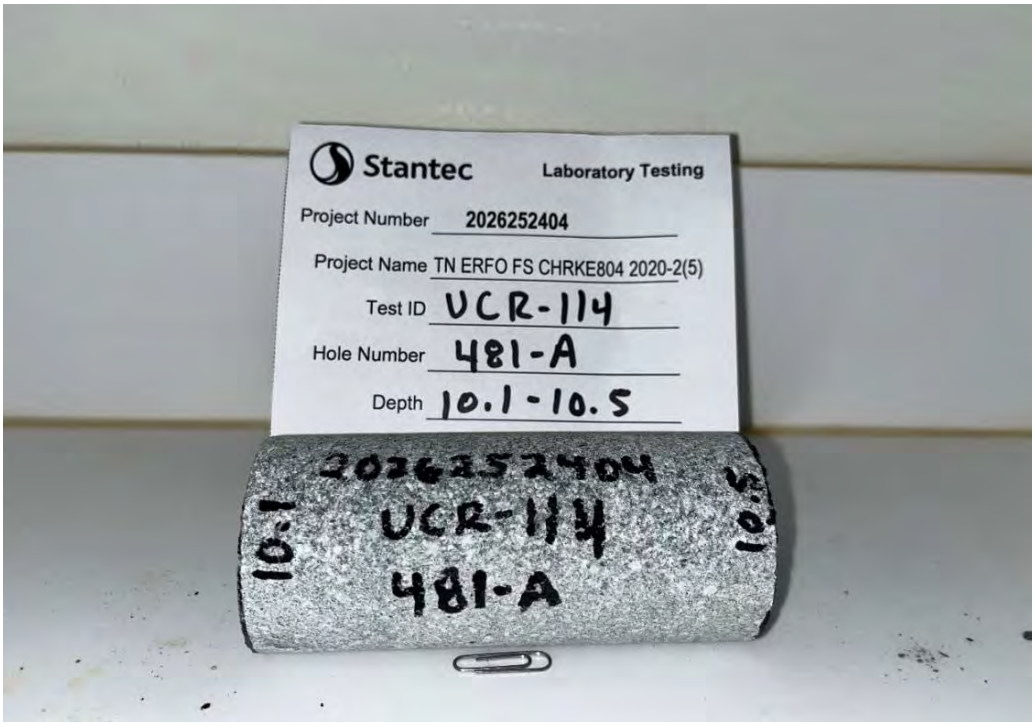
Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, grey, slightly strong
Lab ID UCR-114
Hole Number 481-A
Depth (ft) 10.1'-10.5'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received

Core Preparation



Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, grey, slightly strong
Lab ID UCR-114
Hole Number 481-A
Depth (ft) 10.1'-10.5'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation

Post Test

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, grey, slightly strong
Lab ID UCR-114
Hole Number 481-A
Depth (ft) 10.1'-10.5'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	sandstone, light grey, slightly strong	Lab ID	UCR-115
Hole Number	481-B	Depth (ft)	9.4'-9.8'
Date Received	05/13/2024		

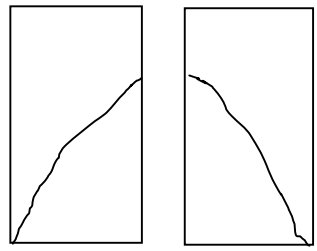
Temperature (°C)	22.4	Moisture Condition	As Prepared, Moist	Date Tested	05/31/2024

Side Planeness	N/A	Height (in)	4.486	Wet Unit Weight (pcf)	167.5
Perpendicularity	N/A	Diameter (in)	1.973	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.057	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	78
Peak Load (lbf)	18590
Failure Type	Shear
Compressive Strength (psi)	6080
Compressive Strength (psf)	875520
Compressive Strength (tsf)	438

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

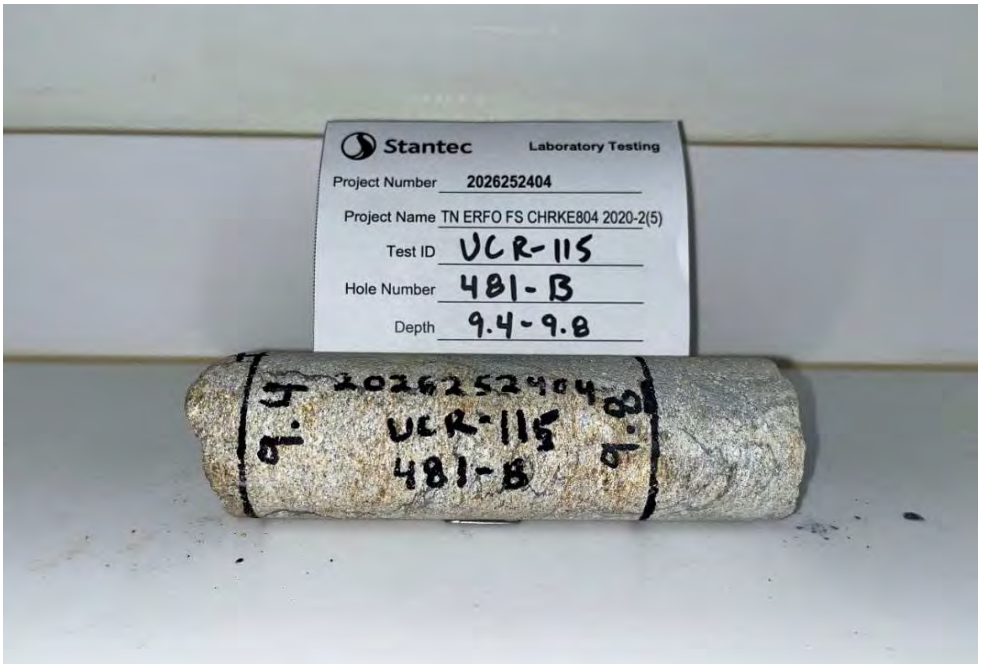
Reviewed By REL

Stantec

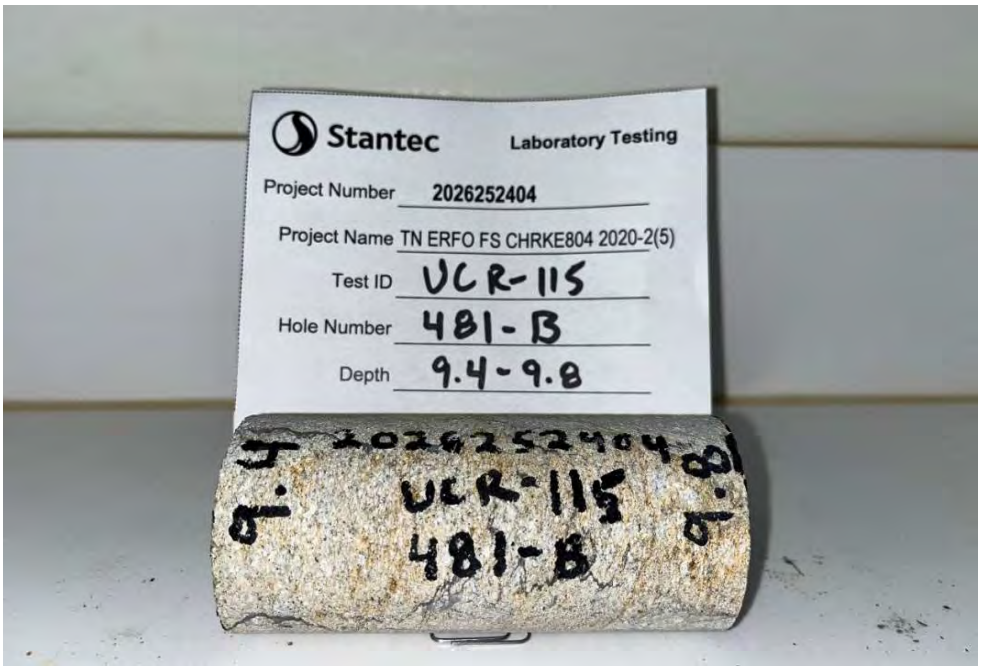
Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, slightly strong
Lab ID UCR-115
Hole Number 481-B
Depth (ft) 9.4'-9.8'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received



Core Preparation

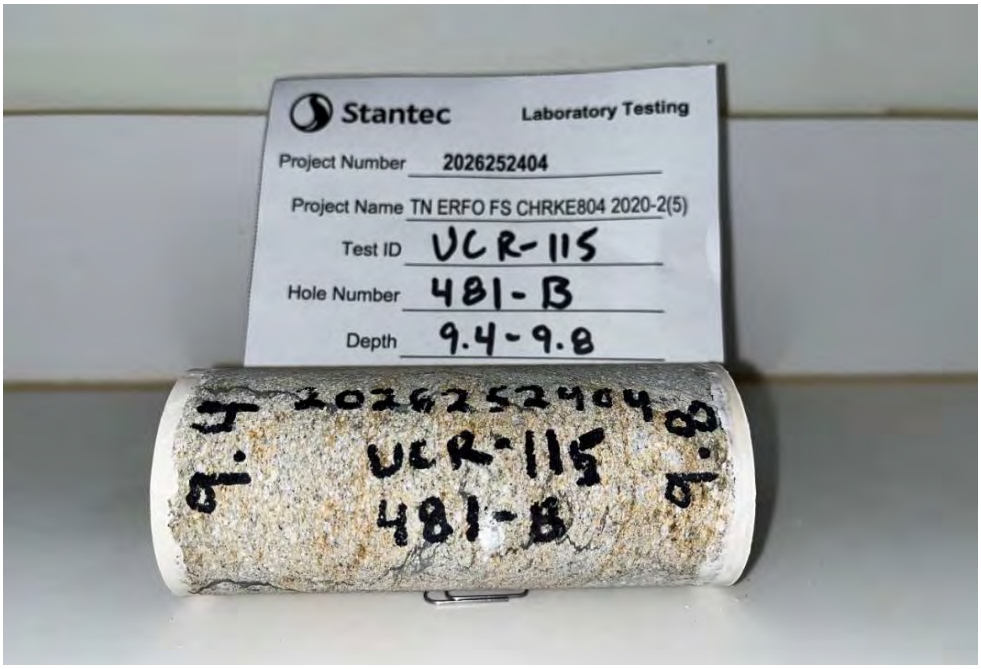


Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, slightly strong
Lab ID UCR-115
Hole Number 481-B
Depth (ft) 9.4'-9.8'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation



Post Test

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, slightly strong
Lab ID UCR-115
Hole Number 481-B
Depth (ft) 9.4'-9.8'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	sandstone, light grey, slightly strong	Lab ID	UCR-116
Hole Number	485	Depth (ft) 8.0'-8.4'	Date Received 05/13/2024

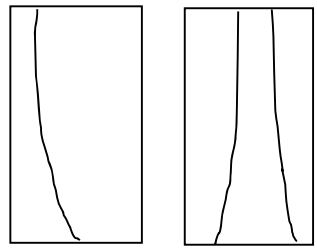
Temperature (°C)	22.4	Moisture Condition	As Prepared, Moist	Date Tested	05/31/2024

Side Planeness	N/A	Height (in)	4.349	Wet Unit Weight (pcf)	166.5
Perpendicularity	N/A	Diameter (in)	1.973	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.056	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	85
Peak Load (lbf)	43070
Failure Type	Cone and Shear
Compressive Strength (psi)	14090
Compressive Strength (psf)	2028960
Compressive Strength (tsf)	1015

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

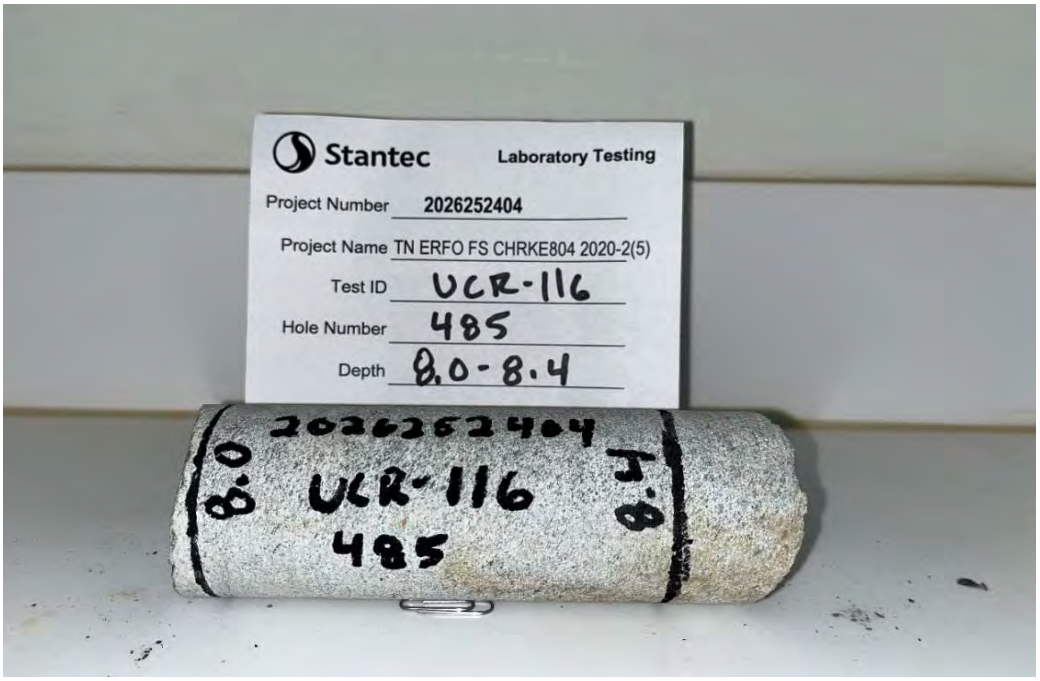
Reviewed By REL

Stantec

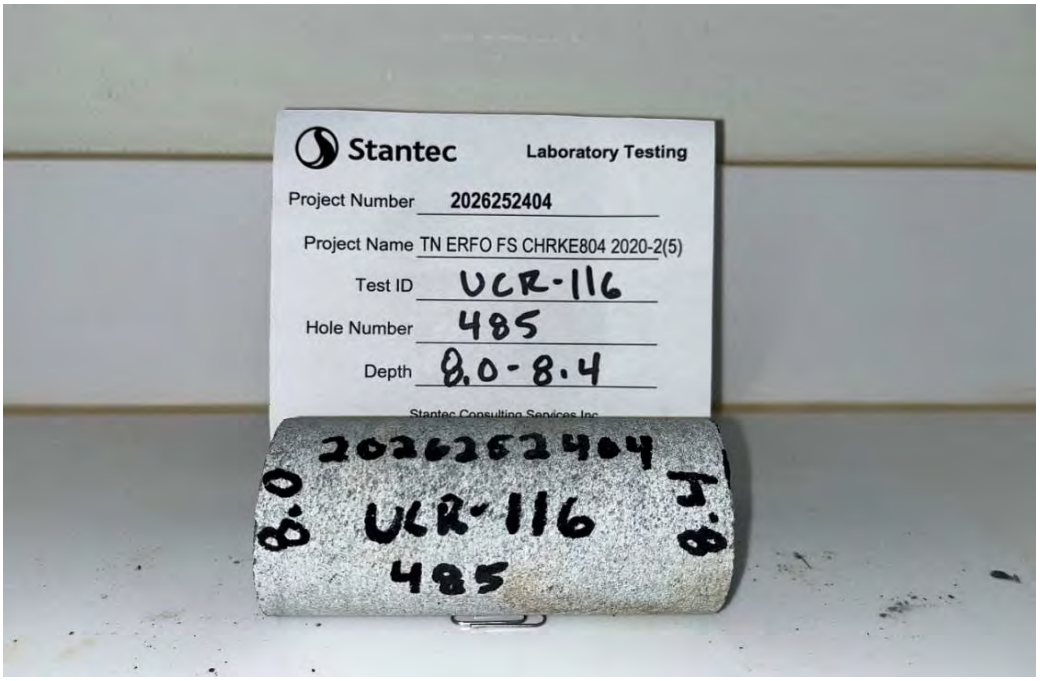
Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, slightly strong
Lab ID UCR-116
Hole Number 485
Depth (ft) 8.0'-8.4'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received



Core Preparation

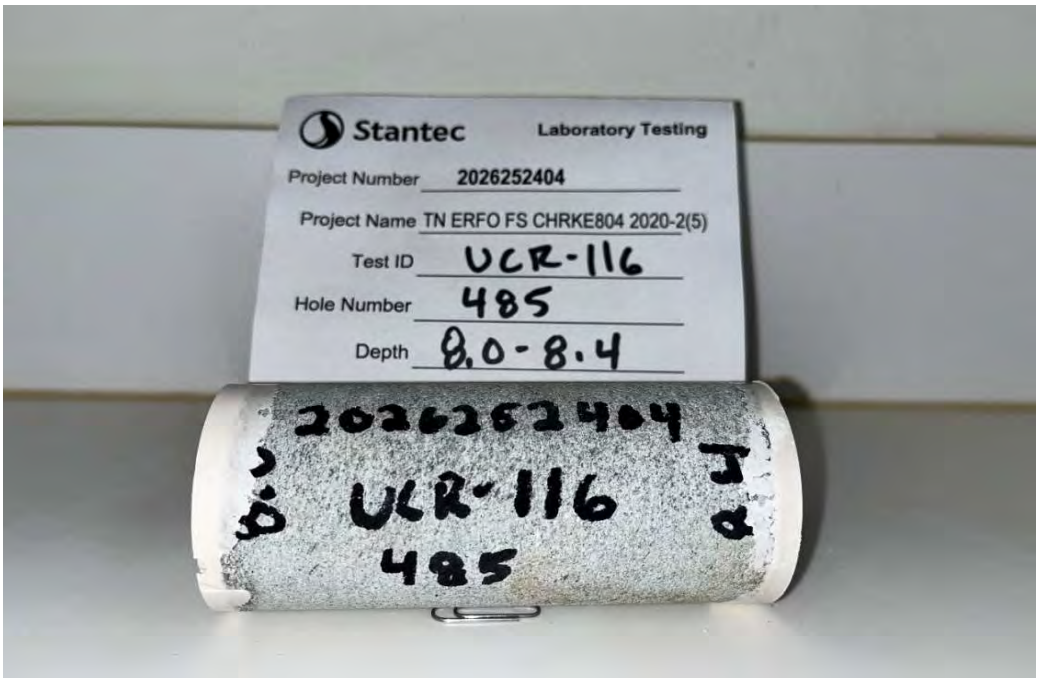


Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, slightly strong
Lab ID UCR-116
Hole Number 485
Depth (ft) 8.0'-8.4'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation



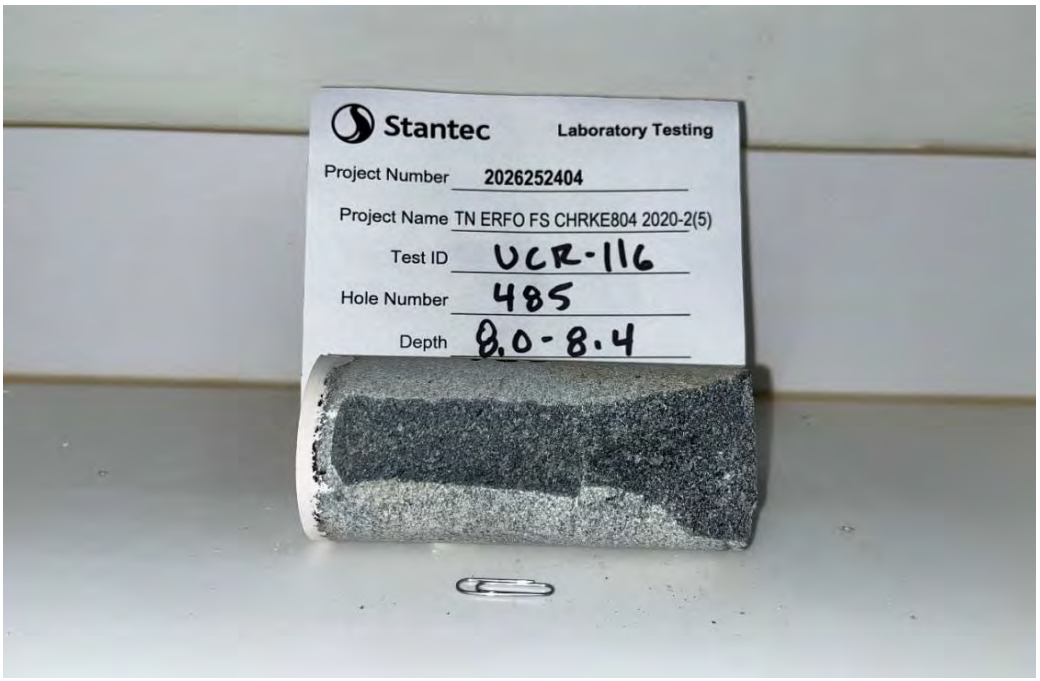
Post Test

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, slightly strong
Lab ID UCR-116
Hole Number 485
Depth (ft) 8.0'-8.4'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test



Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	limestone/dolostone, grey, strong	Lab ID	UCR-117
Hole Number	486	Depth (ft)	9.7'-10.1'
Date Received	05/13/2024		

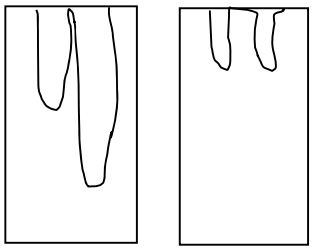
Temperature (°C)	23	Moisture Condition	As Prepared, Moist	Date Tested	06/03/2024

Side Planeness	N/A	Height (in)	4.565	Wet Unit Weight (pcf)	169.4
Perpendicularity	N/A	Diameter (in)	1.987	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.100	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	106
Peak Load (lbf)	56200
Failure Type	Cone
Compressive Strength (psi)	18130
Compressive Strength (psf)	2610720
Compressive Strength (tsf)	1305

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

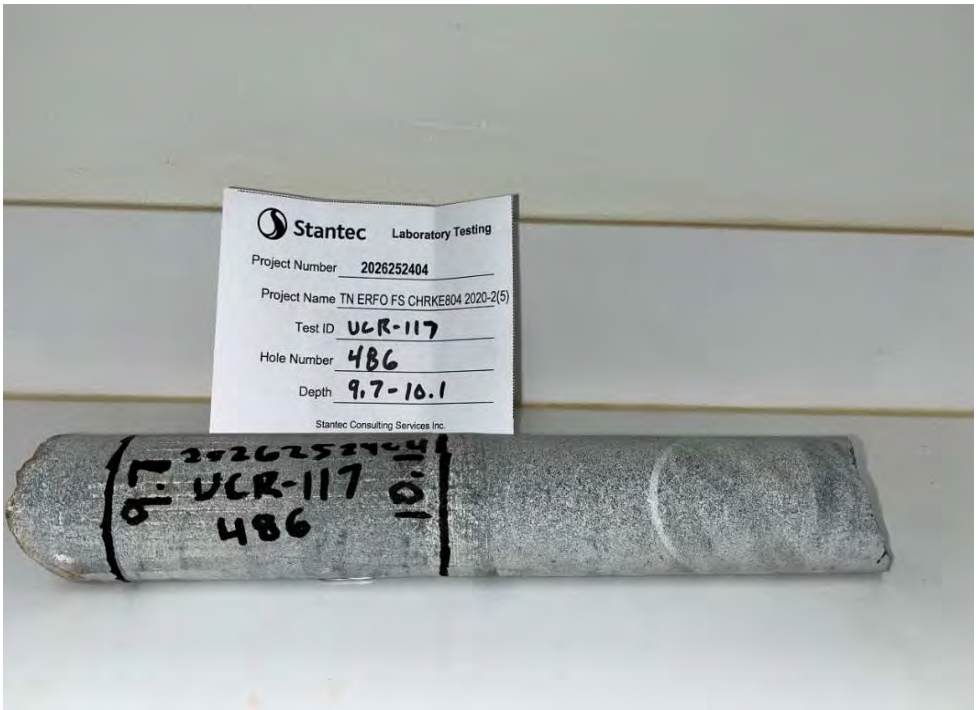
Reviewed By REL

Stantec

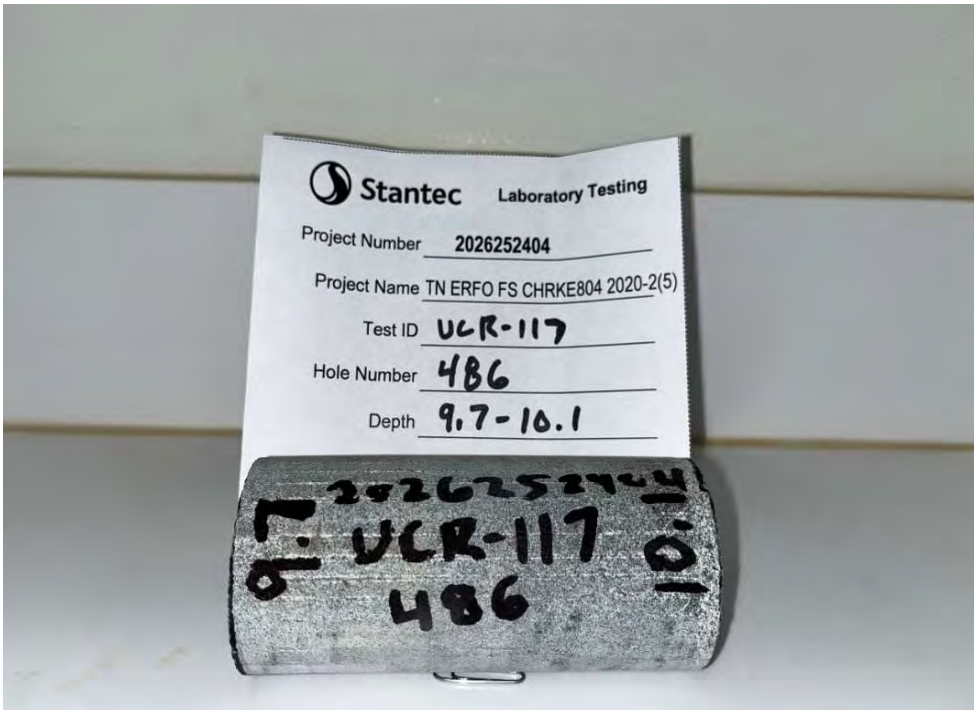
Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology limestone/dolostone, grey, strong
Lab ID UCR-117
Hole Number 486
Depth (ft) 9.7'-10.1'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received



Core Preparation

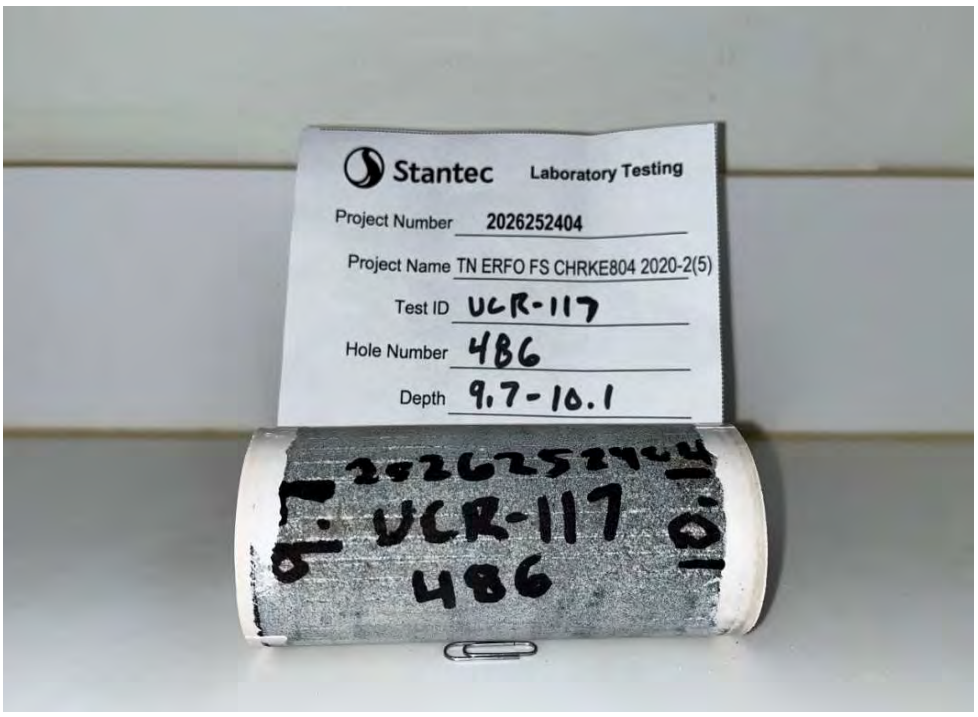


Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology limestone/dolostone, grey, strong
Lab ID UCR-117
Hole Number 486
Depth (ft) 9.7'-10.1'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation



Post Test

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology limestone/dolostone, grey, strong
Lab ID UCR-117
Hole Number 486
Depth (ft) 9.7'-10.1'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	limestone, grey, strong	Lab ID	UCR-118
Hole Number	487	Depth (ft)	13.1'-13.5'
Date Received	05/13/2024		

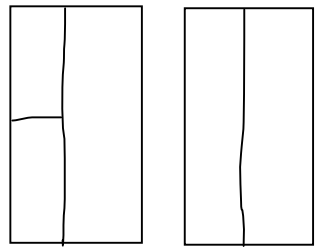
Temperature (°C)	23	Moisture Condition	As Prepared, Moist	Date Tested	06/03/2024

Side Planeness	N/A	Height (in)	4.359	Wet Unit Weight (pcf)	166.4
Perpendicularity	N/A	Diameter (in)	1.985	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.093	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	110
Peak Load (lbf)	49700
Failure Type	Columnar
Compressive Strength (psi)	16070
Compressive Strength (psf)	2314080
Compressive Strength (tsf)	1157

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

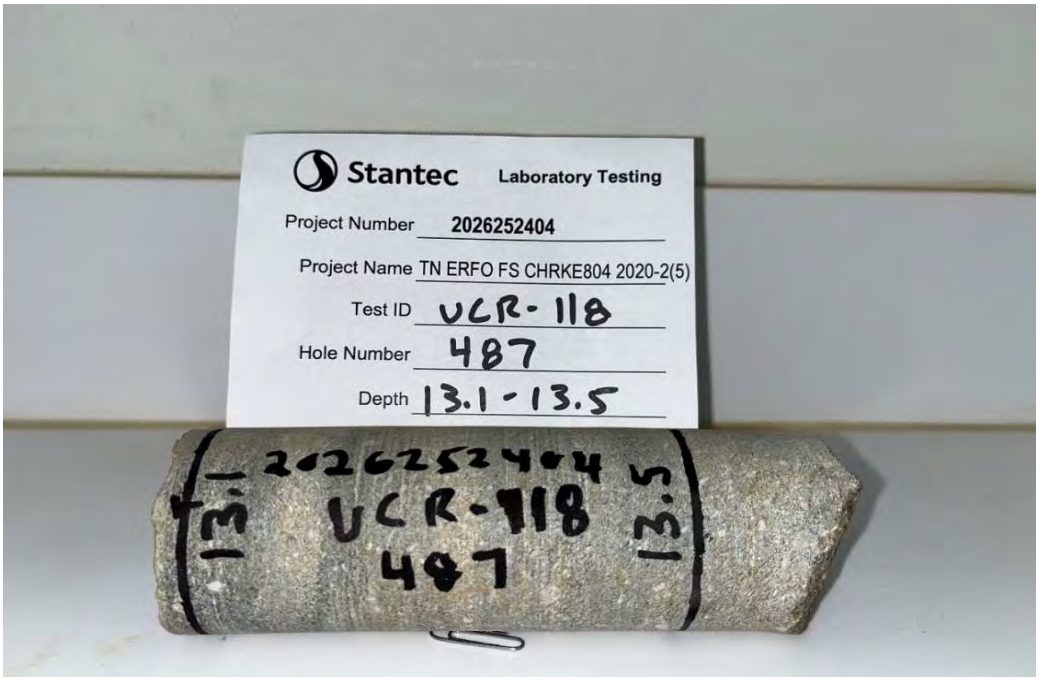
Reviewed By REL

Stantec

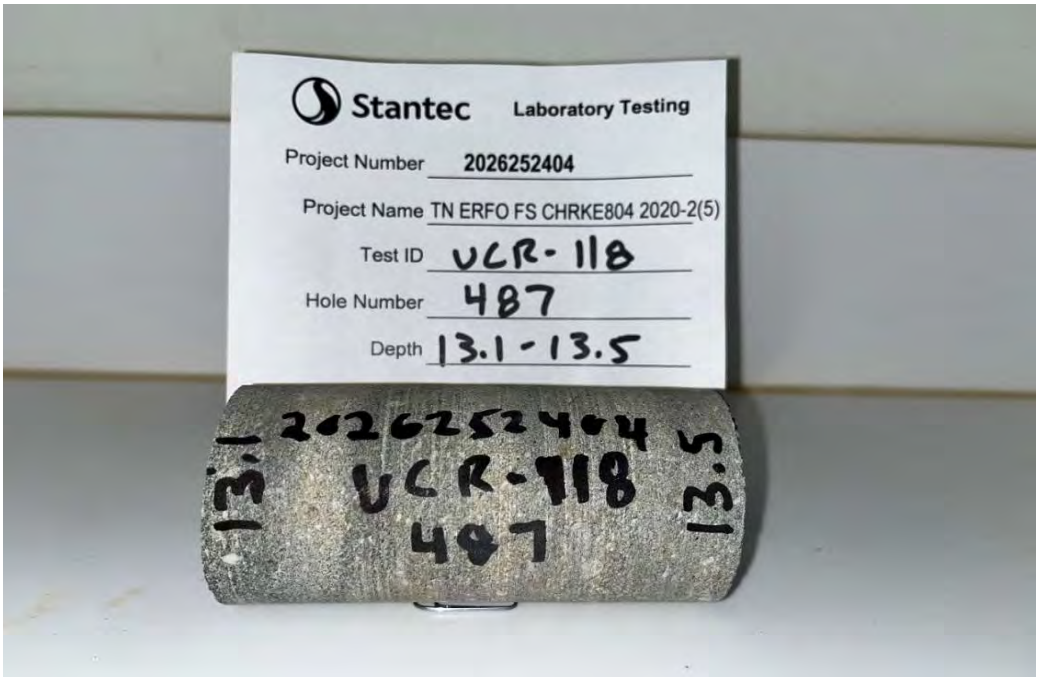
Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology limestone, grey, strong
Lab ID UCR-118
Hole Number 487
Depth (ft) 13.1'-13.5'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received



Core Preparation

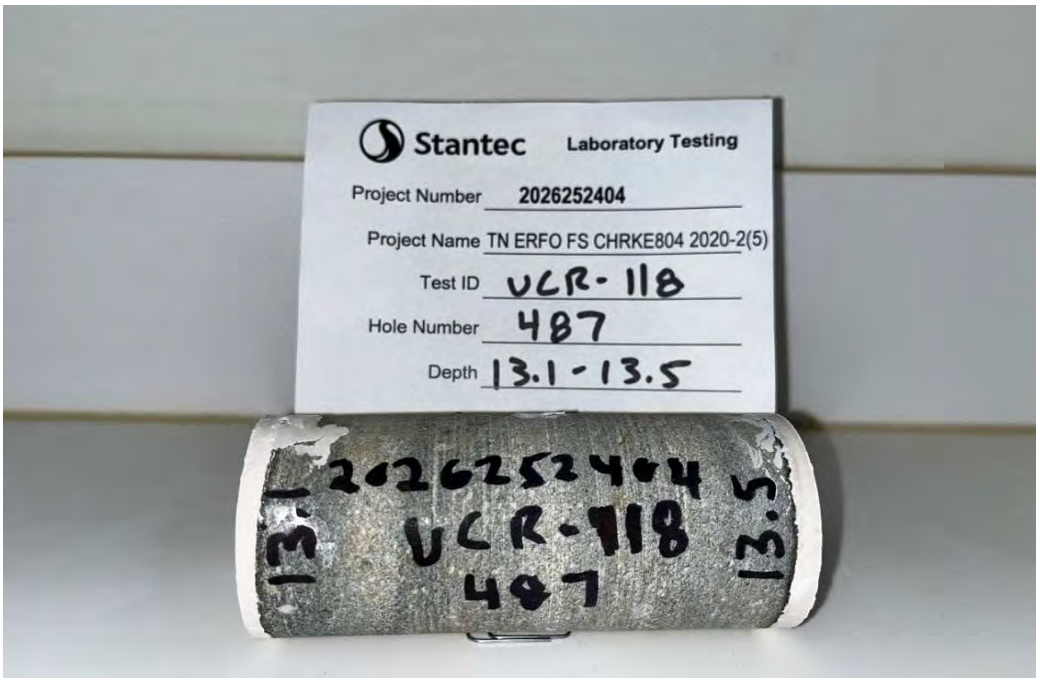


Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology limestone, grey, strong
Lab ID UCR-118
Hole Number 487
Depth (ft) 13.1'-13.5'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation



Post Test

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology limestone, grey, strong
Lab ID UCR-118
Hole Number 487
Depth (ft) 13.1'-13.5'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	shale, grey, slightly strong	Lab ID	UCR-119
Hole Number	508	Depth (ft)	5.8'-6.2'
Date Received	05/13/2024		

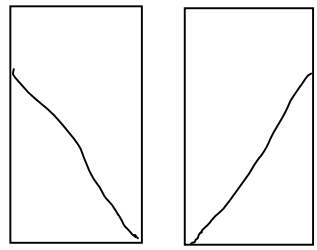
Temperature (°C)	23	Moisture Condition	As Prepared, Moist	Date Tested	06/03/2024

Side Planeness	N/A	Height (in)	4.444	Wet Unit Weight (pcf)	175.2
Perpendicularity	N/A	Diameter (in)	1.976	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.068	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	97
Peak Load (lbf)	16760
Failure Type	Shear
Compressive Strength (psi)	5460
Compressive Strength (psf)	786240
Compressive Strength (tsf)	393

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

Reviewed By REL

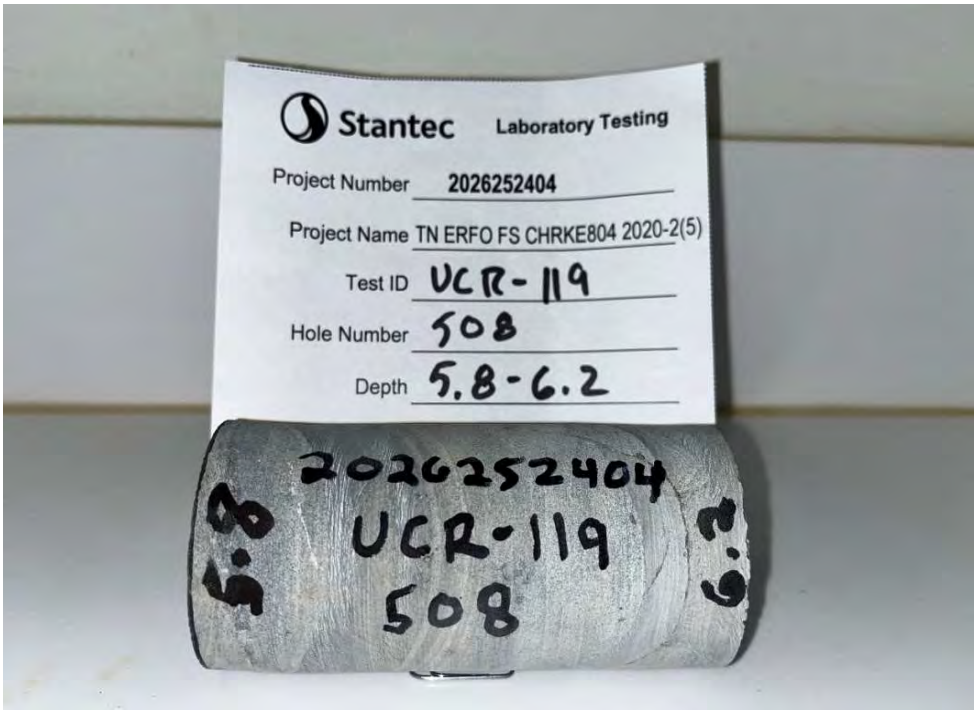
Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology shale, grey, slightly strong
Lab ID UCR-119
Hole Number 508
Depth (ft) 5.8'-6.2'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received

Core Preparation

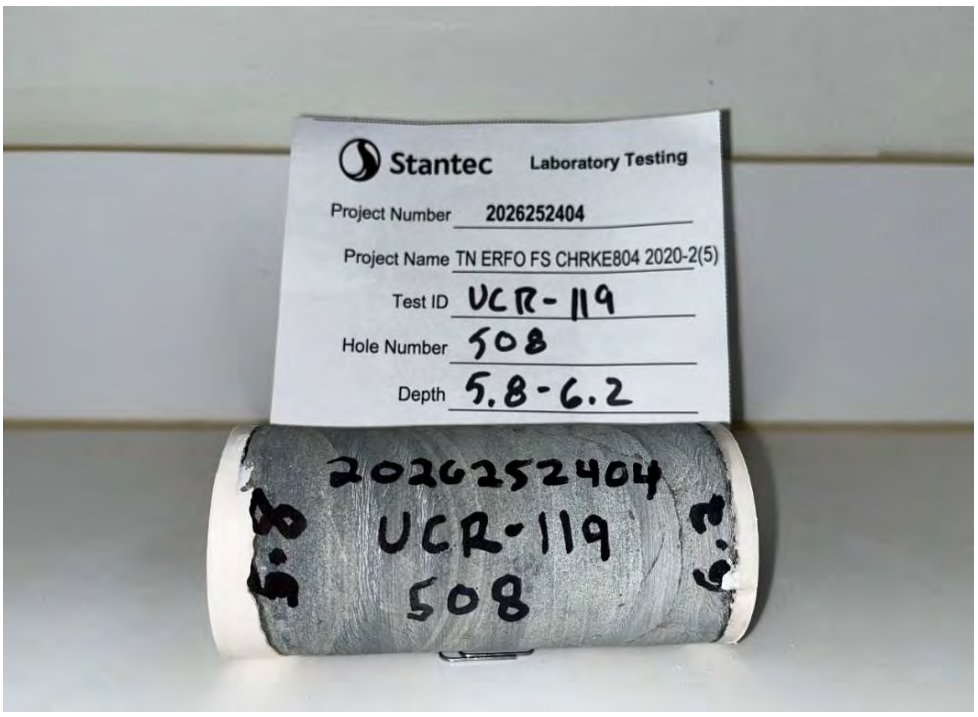


Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology shale, grey, slightly strong
Lab ID UCR-119
Hole Number 508
Depth (ft) 5.8'-6.2'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation



Post Test

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology shale, grey, slightly strong
Lab ID UCR-119
Hole Number 508
Depth (ft) 5.8'-6.2'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	sandstone, light grey, strong, healed fractures	Lab ID	UCR-120
Hole Number	518-A	Depth (ft)	8.1'-8.5'
Date Received	05/13/2024		

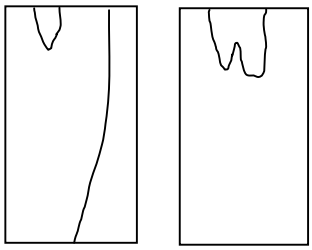
Temperature (°C)	23	Moisture Condition	As Prepared, Moist	Date Tested	06/03/2024

Side Planeness	N/A	Height (in)	4.367	Wet Unit Weight (pcf)	168.9
Perpendicularity	N/A	Diameter (in)	1.971	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.052	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	94
Peak Load (lbf)	59820
Failure Type	Cone and Shear
Compressive Strength (psi)	19600
Compressive Strength (psf)	2822400
Compressive Strength (tsf)	1411

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

Reviewed By REL

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, strong, healed fractures
Lab ID UCR-120
Hole Number 518-A
Depth (ft) 8.1'-8.5'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received

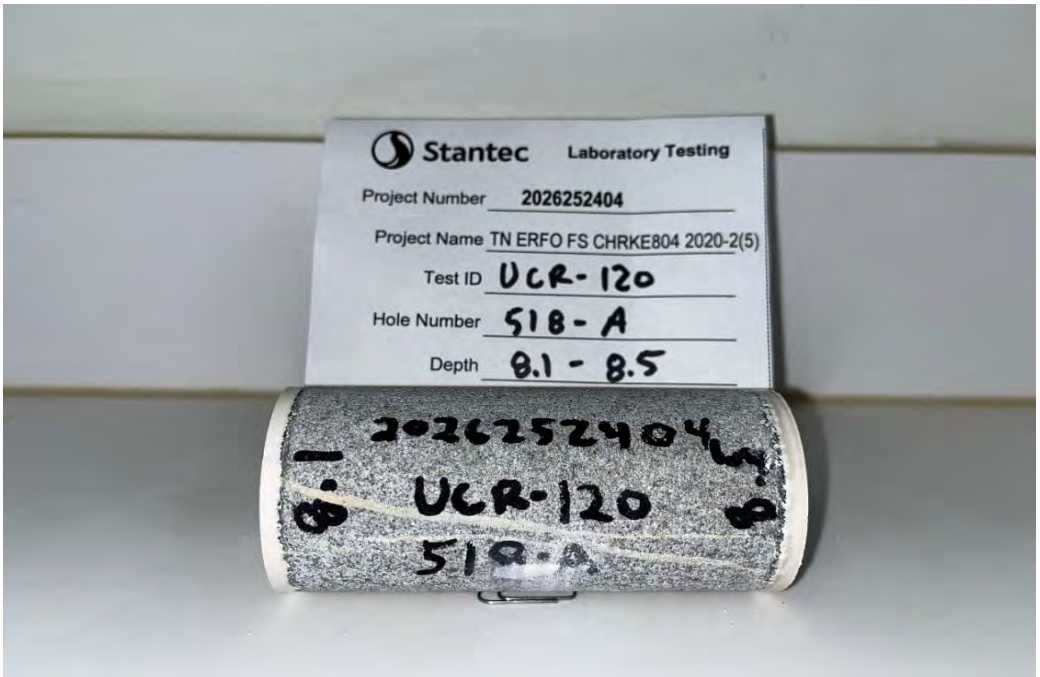
Core Preparation

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, strong, healed fractures
Lab ID UCR-120
Hole Number 518-A
Depth (ft) 8.1'-8.5'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation



Post Test

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, strong, healed fractures
Lab ID UCR-120
Hole Number 518-A
Depth (ft) 8.1'-8.5'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	sandstone, light grey, strong	Lab ID	UCR-121
Hole Number	518-B	Depth (ft)	20.1'-20.5'
Date Received	05/13/2024		

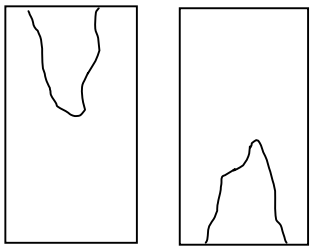
Temperature (°C)	23	Moisture Condition	As Prepared, Moist	Date Tested	06/03/2024

Side Planeness	N/A	Height (in)	4.255	Wet Unit Weight (pcf)	170.0
Perpendicularity	N/A	Diameter (in)	1.970	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.047	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	86
Peak Load (lbf)	53490
Failure Type	Cone
Compressive Strength (psi)	17550
Compressive Strength (psf)	2527200
Compressive Strength (tsf)	1264

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

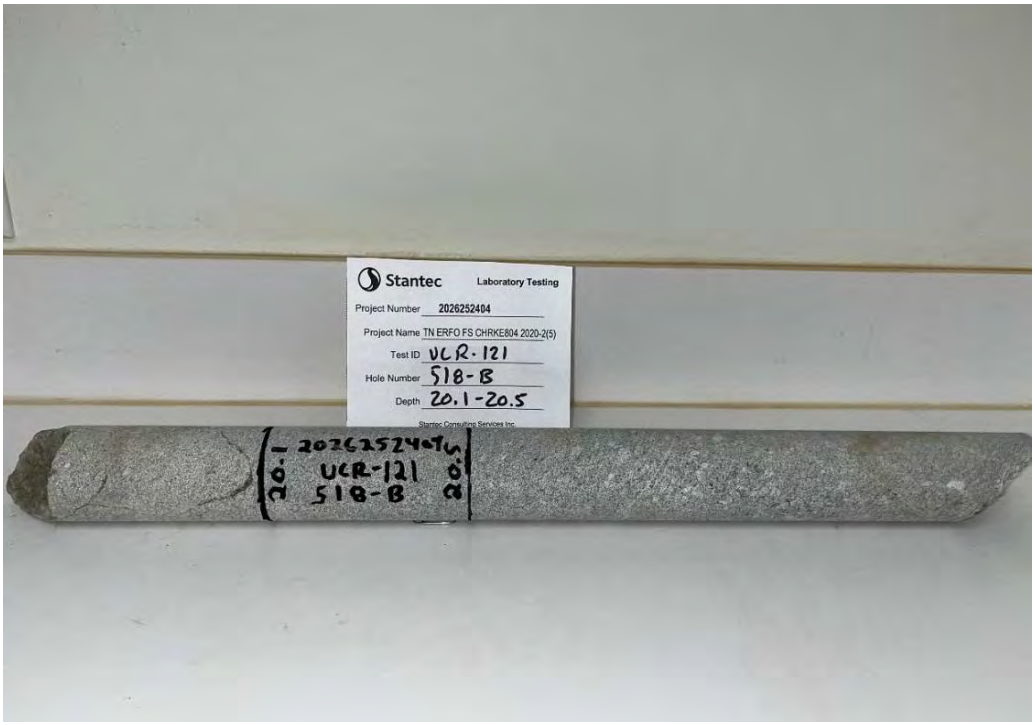
Reviewed By REL

Stantec

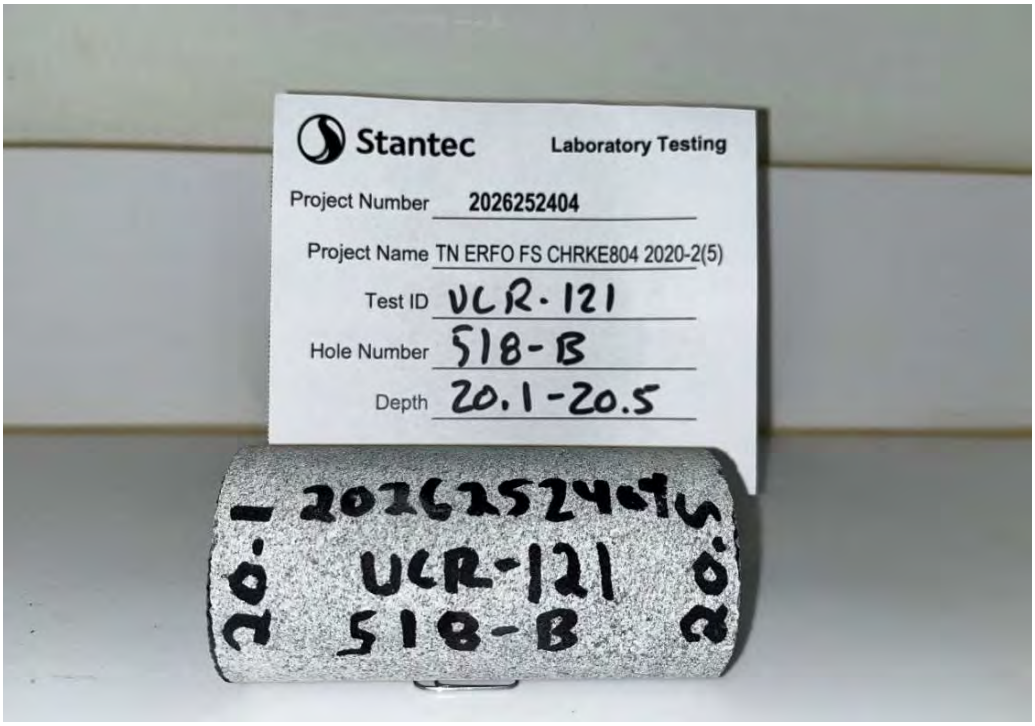
Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, strong
Lab ID UCR-121
Hole Number 518-B
Depth (ft) 20.1'-20.5'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received



Core Preparation



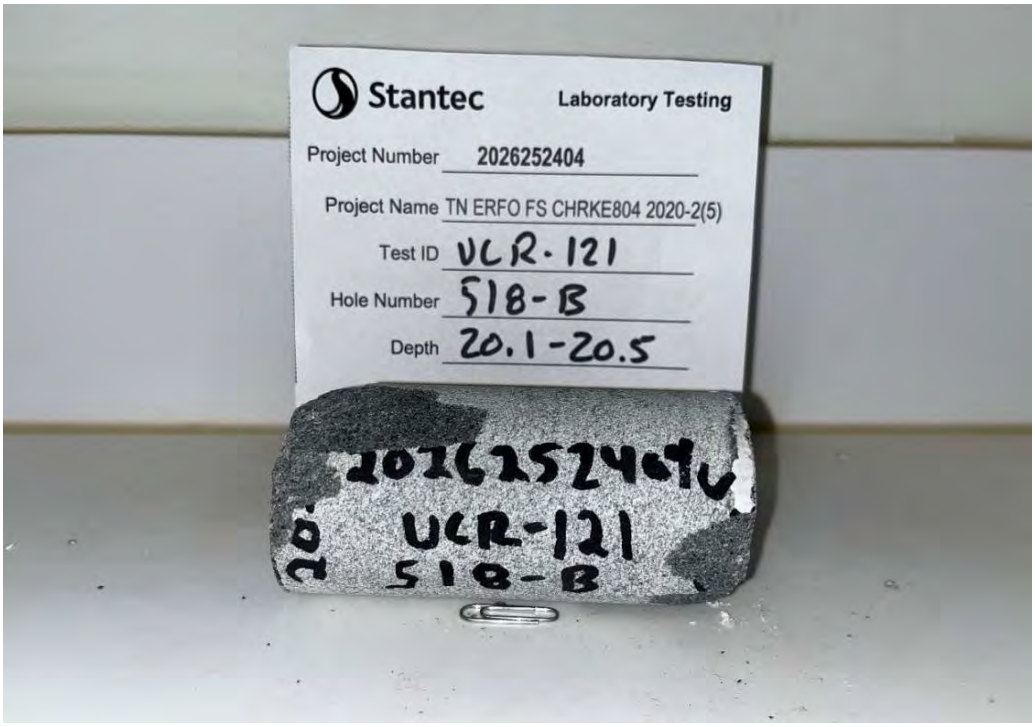
Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, strong
Lab ID UCR-121
Hole Number 518-B
Depth (ft) 20.1'-20.5'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation

Post Test



Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, strong
Lab ID UCR-121
Hole Number 518-B
Depth (ft) 20.1'-20.5'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	sandstone, light grey, strong	Lab ID	UCR-122
Hole Number	518-C	Depth (ft)	10.9'-11.3'
Date Received	05/13/2024		

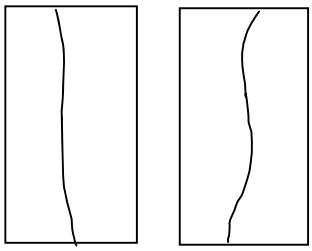
Temperature (°C)	22	Moisture Condition	As Prepared, Moist	Date Tested	06/03/2024

Side Planeness	N/A	Height (in)	4.535	Wet Unit Weight (pcf)	167.3
Perpendicularity	N/A	Diameter (in)	1.968	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.042	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	118
Peak Load (lbf)	56300
Failure Type	Shear
Compressive Strength (psi)	18510
Compressive Strength (psf)	2665440
Compressive Strength (tsf)	1332

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

Reviewed By REL

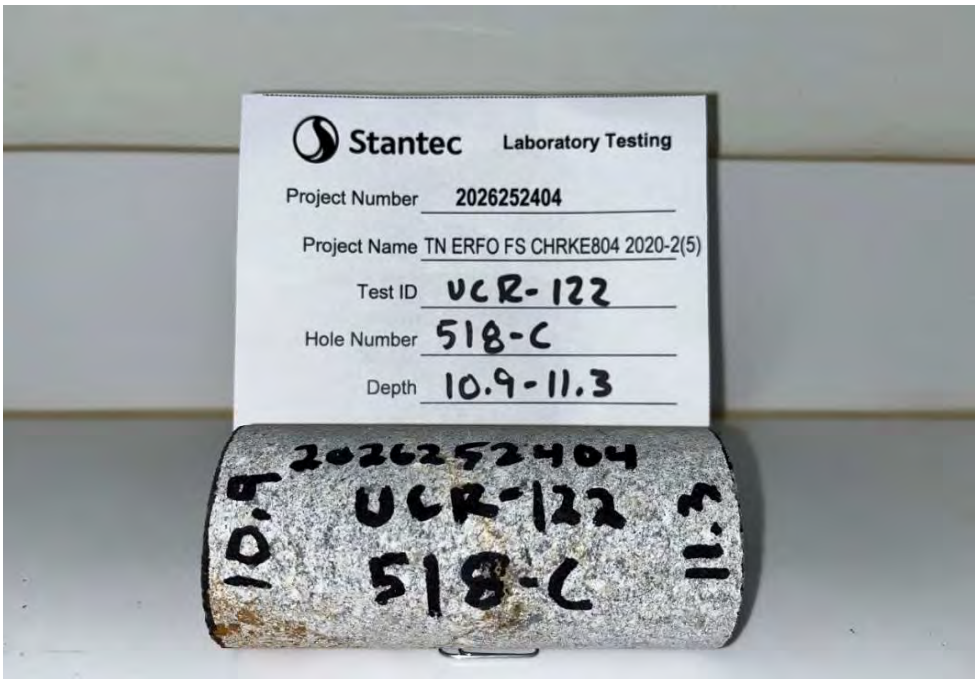
Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, strong
Lab ID UCR-122
Hole Number 518-C
Depth (ft) 10.9'-11.3'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received

Core Preparation



Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, strong
Lab ID UCR-122
Hole Number 518-C
Depth (ft) 10.9'-11.3'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation

Post Test

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology sandstone, light grey, strong
Lab ID UCR-122
Hole Number 518-C
Depth (ft) 10.9'-11.3'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

Stantec

Uniaxial Compressive Strength of Intact Rock Core Specimens

ASTM D 7012, Method C

Project Name	TN ERFO FS CHRKE804 2020-2(5)	Project Number	2026252404
Lithology	shale, dark grey, strong	Lab ID	UCR-123
Hole Number	518-C	Depth (ft) 18.2'-18.6'	Date Received 05/13/2024

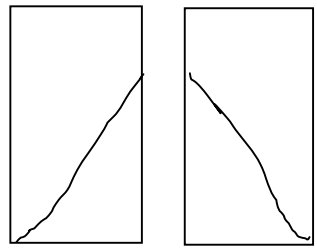
Temperature (°C) 22 | Moisture Condition As Prepared, Moist | Date Tested 06/03/2024

Side Planeness	N/A	Height (in)	4.483	Wet Unit Weight (pcf)	175.7
Perpendicularity	N/A	Diameter (in)	1.966	Dry Unit Weight (pcf)	N/A
End Planeness	N/A	Area (in^2)	3.036	Moisture Content (%)	N/A
Parallelism	N/A				

Dimensions were not confirmed.

Loading Rate (lbf/sec)	109
Peak Load (lbf)	32860
Failure Type	Shear
Compressive Strength (psi)	10820
Compressive Strength (psf)	1558080
Compressive Strength (tsf)	779

Failure Sketches



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone. Dimensional tolerances were not confirmed.

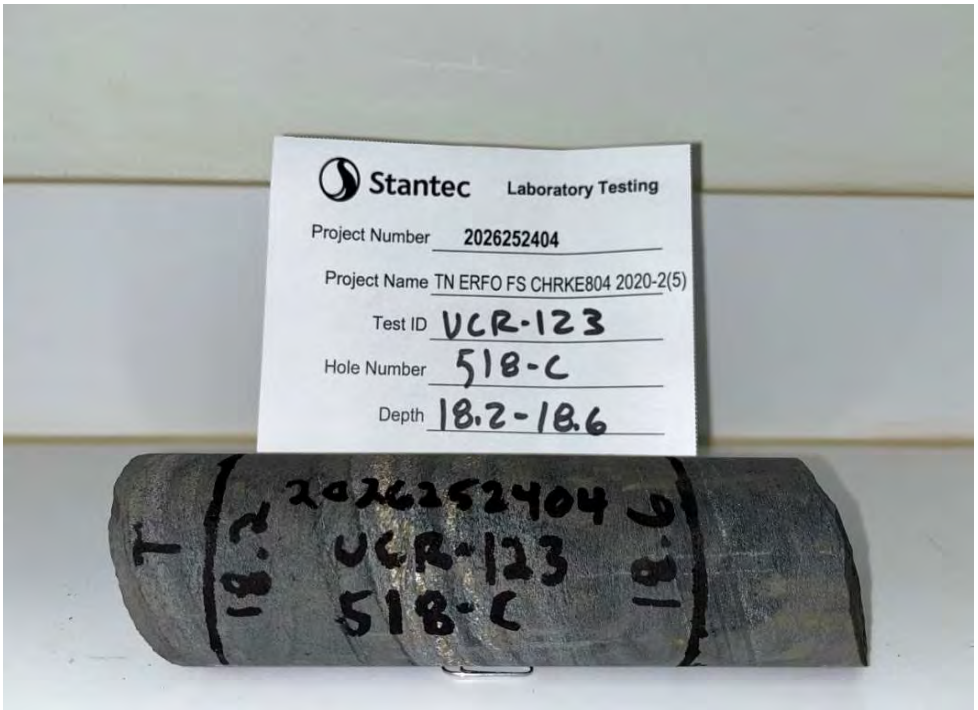
Reviewed By REL

Stantec

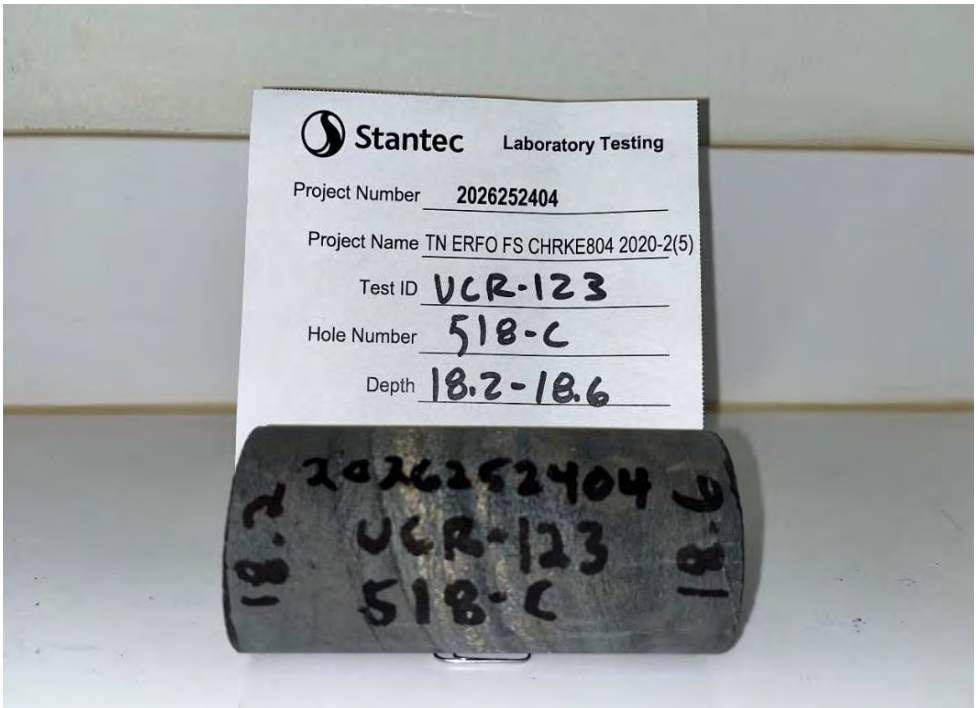
Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology shale, dark grey, strong
Lab ID UCR-123
Hole Number 518-C
Depth (ft) 18.2'-18.6'
Test Type Uniaxial Compressive Strength of Intact Rock Core

As Received



Core Preparation

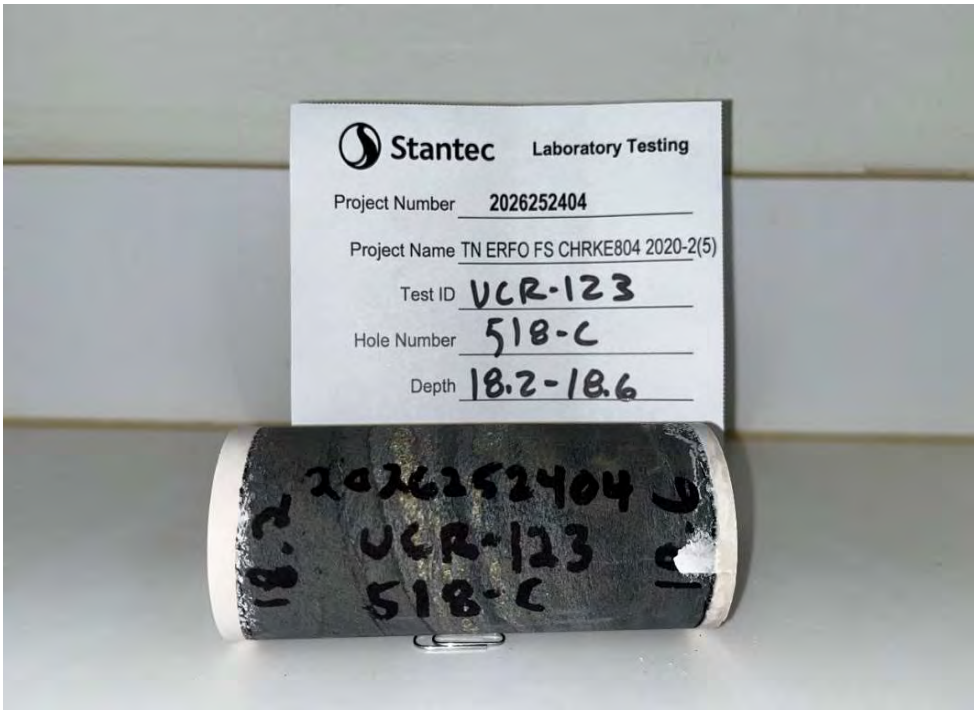


Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology shale, dark grey, strong
Lab ID UCR-123
Hole Number 518-C
Depth (ft) 18.2'-18.6'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Core Preparation



Post Test

Stantec

Photo Report

Project Name TN ERFO FS CHRKE804 2020-2(5)
Project Number 2026252404
Lithology shale, dark grey, strong
Lab ID UCR-123
Hole Number 518-C
Depth (ft) 18.2'-18.6'
Test Type Uniaxial Compressive Strength of Intact Rock Core

Post Test

APPENDIX D
Seismic and Culvert Analyses

Seismic Site Class Analysis

Spring Creek - Polk Co.

Boring: 406
N-average

	N-value	Depth	Range	Range/N
Sand	9	2.5	2.5	0.28
	5	5	2.5	0.50
	7	7.5	2.5	0.36
	21	10	2.5	0.12
	12	12.5	2.5	0.21
	5	15	2.5	0.50
	4	17.5	2.5	0.63
	4	20	2.5	0.63
	1	22.5	2.5	2.50
	3	25	2.5	0.83
Rock	100	30	5	0.05
	100	35	5	0.05
	100	40	5	0.05
	100	45	5	0.05
	100	50	5	0.05
	100	55	5	0.05
	100	60	5	0.05
	100	65	5	0.05
	100	70	5	0.05
	100	75	5	0.05
	100	80	5	0.05
	100	85	5	0.05
	100	90	5	0.05
	100	95	5	0.05
	100	100	5	0.05

Σ Range/N 7.30
N = 13.7 bpf

For Site Class = E

		%
PGA	15	0.15
Ss	27	0.27
S1	6.9	0.069
Fpga	0.1<PGA<0.2	2.1
Fa	0.25<Ss<0.5	2.42
Fv	S1<0.1	3.5
SD1	0.15 <	0.24 < 0.3

Seismic Zone = 2

As 0.32

In accordance with Method B and based on AASHTO Table 3.10.3.1-1 Site Class Definitions
the Site Class = E (N<15 bpf) over 100 ft.

Seismic Site Class Analysis

Spring Creek - Polk Co.

Boring: 433
N-average

	N-value	Depth	Range	Range/N
Sand	6	2.5	2.5	0.42
	5	5	2.5	0.50
	19	7.5	2.5	0.13
	8	10	2.5	0.31
Rock	100	15	5	0.05
	100	20	5	0.05
	100	25	5	0.05
	100	30	5	0.05
	100	35	5	0.05
	100	40	5	0.05
	100	45	5	0.05
	100	50	5	0.05
	100	55	5	0.05
	100	60	5	0.05
	100	65	5	0.05
	100	70	5	0.05
	100	75	5	0.05
	100	80	5	0.05
	100	85	5	0.05
	100	90	5	0.05
	100	95	5	0.05
	100	100	5	0.05

Σ Range/N 2.26
N = 44.2 bpf

For Site Class = D

	%			
PGA	15	0.15		
Ss	27	0.27		
S1	6.9	0.069		
Fpga	0.1<PGA<0.2	1.5		
Fa	0.25<Ss<0.5	1.58		
Fv	S1<0.1	2.4		
SD1	0.15 <	0.166	<	0.3
	Seismic Zone =	**2**		
As	0.23			

In accordance with Method B and based on AASHTO Table 3.10.3.1-1 Site Class Definitions the Site Class = D (15<N<50 bpf) over 100 ft.

Seismic Site Class Analysis

Citico Creek - Monroe Co.

Boring: 466-A
N-average

	N-value	Depth	Range	Range/N
Sand	6	2.5	2.5	0.42
	6	5	2.5	0.42
	4	7.5	2.5	0.63
	8	10	2.5	0.31
	6	12.5	2.5	0.42
	17	15	2.5	0.15
	62	17.5	2.5	0.04
	28	20	2.5	0.09
Rock	100	25	5	0.05
	100	30	5	0.05
	100	35	5	0.05
	100	40	5	0.05
	100	45	5	0.05
	100	50	5	0.05
	100	55	5	0.05
	100	60	5	0.05
	100	65	5	0.05
	100	70	5	0.05
	100	75	5	0.05
	100	80	5	0.05
	100	85	5	0.05
	100	90	5	0.05
	100	95	5	0.05
	100	100	5	0.05

For Site Class = D

	%		
PGA	15.2	0.152	
Ss	28	0.28	
S1	7	0.07	
Fpga	0.1<PGA<0.2	1.5	
Fa	0.25<Ss<0.5	1.58	
Fv	S1<0.1	2.4	
SD1	0.15 <	0.168	< 0.3
	Seismic Zone =	**2**	
As	0.23		

Σ Range/N 3.26
N = 30.6 bpf

In accordance with Method B and based on AASHTO Table 3.10.3.1-1 Site Class Definitions the Site Class = D (15<N<50 bpf) over 100 ft.

TN ERFO FS CHRKE804 2020-2(5)

CORRELATION OF SPT DATA TO UNIT WEIGHTS AND SHEAR STRENGTHS

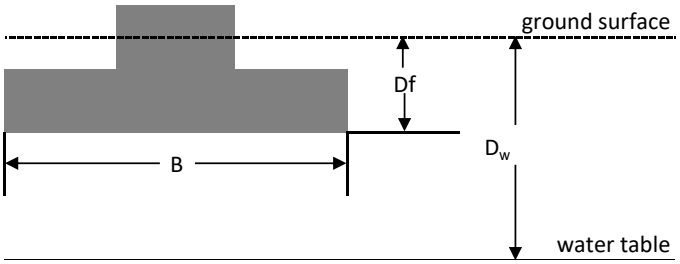
FOR COARSE GRAINED SOILS

Sample Interval	Depth of Mid. Pt. of Sample (ft.)	Assumed Estimated Unit Weight (pcf) γ	Vertical Effective Stress (ksf) σ'	SPT N Value N80	SPT N Value N60	Correction Factor CN	Corrected N-Value (N1)60	Relative Density (%) Dr	Unified Soil Classification	Internal Angle of Friction (degrees) ϕ
			62.40	pcf						
		Hammer Effic.	87	%						NAVFAC 7.1
406		Water Depth	7.5	ft						
1.5 - 3.0	2.25	120	0.27	9	13	1.67	22	68	GC	36
3.5 - 5.0	4.25	120	0.51	5	7	1.46	11	47	GC	34
6.0 - 7.5	6.75	120	0.81	7	10	1.30	13	53	GC	34
8.5 - 10.0	9.25	120	0.95	21	30	1.25	38	87	GC	39
11.0 - 12.5	11.75	120	1.10	12	17	1.20	21	67	SC-SM	34
13.5 - 15.0	14.25	120	1.24	5	7	1.16	8	41	SC-SM	31
16.0 - 17.5	16.75	115	1.37	4	6	1.13	7	35	SC-SM	30
18.5 - 20.0	19.25	115	1.51	4	6	1.10	6	35	SC-SM	30
21.0 - 22.5	21.75	110	1.62	1	1	1.07	2	11	CL-ML	NA
23.5 - 25.0	24.25	110	1.74	3	4	1.05	5	27	CL-ML	NA

Project	TN ERFO Site 2(5) - MP 406		
Sheet No.	1 of 1	Scale	NTS
Calculated By	Y. Oumoussi	Date	11/5/2024
Checked By	D. Pleiman	Date	

Bearing Capacity Determination

(Does not cover inclined loads or circlar foundations)



Soil and Foundation Parameters

c =	0	psf	N_c =	42.2	
ϕ =	34.0		N_q =	29.4	
γ =	120	pcf	N_γ =	41.1	
B =	8.00	ft	c* =	0	psf
D_f =	1.5	ft	ϕ* =	34.0	°
L =	32.0	ft			
D_w =	1.4	ft			
	no	Consideration for punching ? (yes no)			

$q_n = c\,N_{cm} + \gamma\,D_f\,N_{qm}\,C_{wq} + 0.5\,\gamma\,B\,N_{\gamma m}\,C_{w\gamma}$ Nominal Bearing Capacity Eq. (10.6.3.1.2a-1)

$q_R = \phi_b\,q_n$ Factored Bearing Capacity Eq. (10.6.3.1.1-1)

$N_{cm} = N_c s_c$	N_{cm} =	49.37	s_c =	1.17	
$N_{qm} = N_q s_q d_q$	N_{qm} =	34.40	s_q =	1.17	
$N_{\gamma m} = N_\gamma s_\gamma$	$N_{\gamma m}$ =	36.99	s_γ =	0.90	
	C_{wq} =	0.5	d_q =	1.00	Value set to 1 to be conservative
	$C_{w\gamma}$ =	0.5	R_γ =	0.97	* (from EM 1110-1-1905 for B>6 ft)
			ϕ* =	0.45	
			Service Limit =	3.0	

ϕ* =	0.45	For Spread Footings (10.5.5.2.2-1)
ϕ* =	0.55	For Grav & CIP Walls (11.5.7-1)
ϕ* =	0.65	For MSE walls (11.5.7-1)

q_n = 11707.3 psf

q_f = 5268.3 psf Factored Bearing Capacity (Strength Limit)

q_a = 3902.4 psf Allowable Bearing Capacity / Service Limit

* Note - R_γ only applies for granluar bearing medium and is applied to the $0.5\gamma BN_\gamma$ term.

TN ERFO FS CHRKE804 2020-2(5)

CORRELATION OF SPT DATA TO UNIT WEIGHTS AND SHEAR STRENGTHS

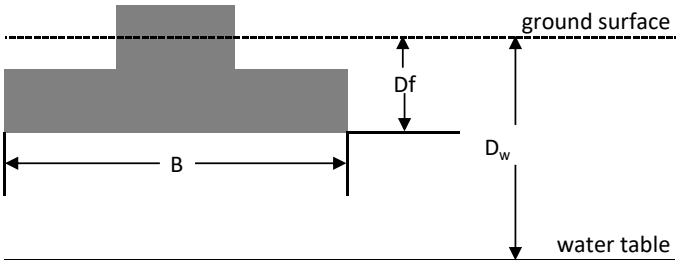
FOR COARSE GRAINED SOILS

Sample Interval	Depth of Mid. Pt. of Sample (ft.)	Assumed Estimated Unit Weight (pcf) γ	Vertical Effective Stress (ksf) σ'	SPT N Value N80	SPT N Value N60	Correction Factor CN	Corrected N-Value (N1)60	Relative Density (%) Dr	Unified Soil Classification	Internal Angle of Friction (degrees) ϕ
			62.40	pcf						
		Hammer Effic.	87	%						NAVFAC 7.1
411		Water Depth	7.5	ft						
1.5 - 3.0	2.25	115	0.26	19	28	1.69	47	95	SC	37
3.5 - 5.0	4.25	115	0.49	14	20	1.47	30	79	SC	35
6.0 - 7.5	6.75	118	0.78	13	19	1.32	25	73	SC	34
8.5 - 10.0	9.25	115	0.92	15	22	1.26	28	77	SM	35
11.0 - 12.5	11.75	120	1.06	50	73	1.21	88	100	SM	38

Project	TN ERFO Site 2(5) - MP 411		
Sheet No.	1 of 1	Scale	NTS
Calculated By	Y. Oumoussi	Date	11/5/2024
Checked By	D. Pleiman	Date	

Bearing Capacity Determination

(Does not cover inclined loads or circlar foundations)



Soil and Foundation Parameters

c =	0	psf	N_c =	42.2	
ϕ =	34.0		N_q =	29.4	
γ =	120	pcf	N_γ =	41.1	
B =	8.00	ft	c* =	0	psf
D_f =	1.5	ft	ϕ* =	34.0	°
L =	32.0	ft			
D_w =	1.4	ft			
	no	Consideration for punching ? (yes no)			

$q_n = c\,N_{cm} + \gamma\,D_f\,N_{qm}\,C_{wq} + 0.5\,\gamma\,B\,N_{\gamma m}\,C_{w\gamma}$ Nominal Bearing Capacity Eq. (10.6.3.1.2a-1)

$q_R = \phi_b\,q_n$ Factored Bearing Capacity Eq. (10.6.3.1.1-1)

$N_{cm} = N_c s_c$	N_{cm} =	49.37	s_c =	1.17	
$N_{qm} = N_q s_q d_q$	N_{qm} =	34.40	s_q =	1.17	
$N_{\gamma m} = N_\gamma s_\gamma$	$N_{\gamma m}$ =	36.99	s_γ =	0.90	
	C_{wq} =	0.5	d_q =	1.00	Value set to 1 to be conservative
	$C_{w\gamma}$ =	0.5	R_γ =	0.97	* (from EM 1110-1-1905 for B>6 ft)
			ϕ* =	0.45	
			Service Limit =	3.0	

ϕ* =	0.45	For Spread Footings (10.5.5.2.2-1)
ϕ* =	0.55	For Grav & CIP Walls (11.5.7-1)
ϕ* =	0.65	For MSE walls (11.5.7-1)

q_n = 11707.3 psf

q_f = 5268.3 psf Factored Bearing Capacity (Strength Limit)

q_a = 3902.4 psf Allowable Bearing Capacity / Service Limit

* Note - R_γ only applies for granluar bearing medium and is applied to the $0.5\gamma BN_\gamma$ term.

TN ERFO FS CHRKE804 2020-2(5)

CORRELATION OF SPT DATA TO UNIT WEIGHTS AND SHEAR STRENGTHS

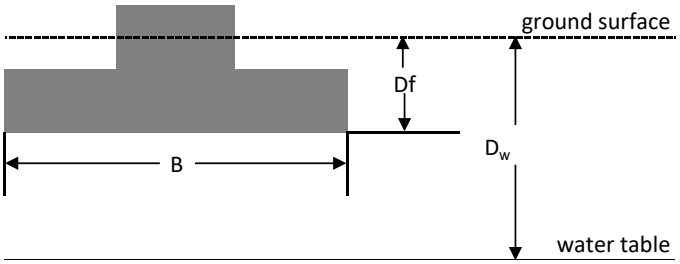
FOR COARSE GRAINED SOILS

Sample Interval	Depth of Mid. Pt. of Sample (ft.)	Assumed Estimated Unit Weight (pcf) γ	Vertical Effective Stress (ksf) σ'	SPT N Value N80	SPT N Value N60	Correction Factor CN	Corrected N-Value (N1)60	Relative Density (%) Dr	Unified Soil Classification	Internal Angle of Friction (degrees) ϕ
			62.40	pcf						
		Hammer Effic.	87	%						NAVFAC 7.1
428		Water Depth	7.5	ft						
1.5 - 3.0	2.25	115	0.26	18	26	1.69	44	93	GP-GM	40
3.5 - 5.0	4.25	115	0.49	14	20	1.47	30	79	GP-GM	38
6.0 - 7.5	6.75	118	0.78	43	62	1.32	82	100	GP-GM	42

Project	TN ERFO Site 2(5) - MP 428		
Sheet No.	1 of 1	Scale	NTS
Calculated By	Y. Oumoussi	Date	11/5/2024
Checked By	D. Pleiman	Date	

Bearing Capacity Determination

(Does not cover inclined loads or circlar foundations)



Soil and Foundation Parameters

c =	0	psf	N_c =	42.2	
ϕ =	34.0		N_q =	29.4	
γ =	125	pcf	N_γ =	41.1	
B =	8.00	ft	c* =	0	psf
D_f =	1.5	ft	ϕ* =	34.0	°
L =	30.0	ft			
D_w =	1.4	ft			
	no	Consideration for punching ? (yes no)			

$q_n = c\,N_{cm} + \gamma\,D_f\,N_{qm}\,C_{wq} + 0.5\,\gamma\,B\,N_{\gamma m}\,C_{w\gamma}$ Nominal Bearing Capacity Eq. (10.6.3.1.2a-1)

$q_R = \phi_b\,q_n$ Factored Bearing Capacity Eq. (10.6.3.1.1-1)

$N_{cm} = N_c s_c$	N_{cm} =	50.22	s_c =	1.19	
$N_{qm} = N_q s_q d_q$	N_{qm} =	34.69	s_q =	1.18	
$N_{\gamma m} = N_\gamma s_\gamma$	$N_{\gamma m}$ =	36.58	s_γ =	0.89	
	C_{wq} =	0.5	d_q =	1.00	Value set to 1 to be conservative
	$C_{w\gamma}$ =	0.5	R_γ =	0.97	* (from EM 1110-1-1905 for B>6 ft)
			ϕ* =	0.45	
			Service Limit =	3.0	

ϕ* =	0.45	For Spread Footings (10.5.5.2.2-1)
ϕ* =	0.55	For Grav & CIP Walls (11.5.7-1)
ϕ* =	0.65	For MSE walls (11.5.7-1)

q_n = 12122.8 psf

q_f = 5455.3 psf Factored Bearing Capacity (Strength Limit)

q_a = 4040.9 psf Allowable Bearing Capacity / Service Limit

* Note - R_γ only applies for granluar bearing medium and is applied to the $0.5\gamma BN_\gamma$ term.

TN ERFO FS CHRKE804 2020-2(5)

CORRELATION OF SPT DATA TO UNIT WEIGHTS AND SHEAR STRENGTHS

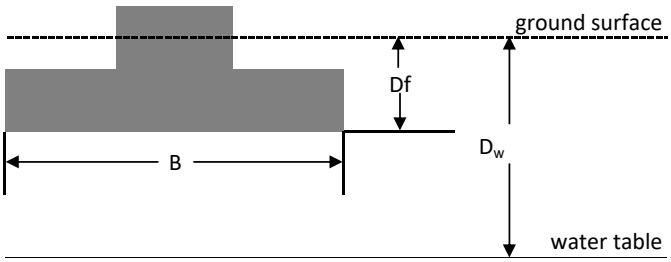
FOR COARSE GRAINED SOILS

Sample Interval	Depth of Mid. Pt. of Sample (ft.)	Assumed Estimated Unit Weight (pcf) γ	Vertical Effective Stress (ksf) σ'	SPT N Value N80	SPT N Value N60	Correction Factor CN	Corrected N-Value (N1)60	Relative Density (%) Dr	Unified Soil Classification	Internal Angle of Friction (degrees) ϕ
			62.40	pcf						
		Hammer Effic.	87	%						NAVFAC 7.1
431		Water Depth	7.5	ft						
1.5 - 3.0	2.25	115	0.26	17	25	1.69	42	91	SC	37
3.5 - 5.0	4.25	115	0.49	50	73	1.47	107	100	SC	38

Project	TN ERFO Site 2(5) - MP 431		
Sheet No.	1 of 1	Scale	NTS
Calculated By	Y. Oumoussi	Date	11/5/2024
Checked By	D. Pleiman	Date	

Bearing Capacity Determination

(Does not cover inclined loads or circlar foundations)



Soil and Foundation Parameters

c =	0	psf	N_c =	42.2	
ϕ =	34.0		N_q =	29.4	
γ =	115	pcf	N_γ =	41.1	
B =	4.00	ft	c* =	0	psf
D_f =	1.5	ft	ϕ* =	34.0	°
L =	22.0	ft			
D_w =	1.4	ft			
	no	Consideration for punching ? (yes no)			

$q_n = c\,N_{cm} + \gamma\,D_f\,N_{qm}\,C_{wq} + 0.5\,\gamma\,B\,N_{\gamma m}\,C_{w\gamma}$ Nominal Bearing Capacity Eq. (10.6.3.1.2a-1)

$q_R = \phi_b\,q_n$ Factored Bearing Capacity Eq. (10.6.3.1.1-1)

$N_{cm} = N_c s_c$	N_{cm} =	47.69	s_c =	1.13	
$N_{qm} = N_q s_q d_q$	N_{qm} =	32.93	s_q =	1.12	
$N_{\gamma m} = N_\gamma s_\gamma$	$N_{\gamma m}$ =	38.22	s_γ =	0.93	
	C_{wq} =	0.5	d_q =	1.00	Value set to 1 to be conservative
	$C_{w\gamma}$ =	0.5	R_γ =	1.00	* (from EM 1110-1-1905 for B>6 ft)
			ϕ* =	0.45	
			Service Limit =	3.0	

ϕ* =	0.45	For Spread Footings (10.5.5.2.2-1)
ϕ* =	0.55	For Grav & CIP Walls (11.5.7-1)
ϕ* =	0.65	For MSE walls (11.5.7-1)

q_n = 7235.5 psf

q_f = 3256.0 psf Factored Bearing Capacity (Strength Limit)

q_a = 2411.8 psf Allowable Bearing Capacity / Service Limit

* Note - R_γ only applies for granluar bearing medium and is applied to the $0.5\gamma BN_\gamma$ term.

TN ERFO FS CHRKE804 2020-2(5)

CORRELATION OF SPT DATA TO UNIT WEIGHTS AND SHEAR STRENGTHS

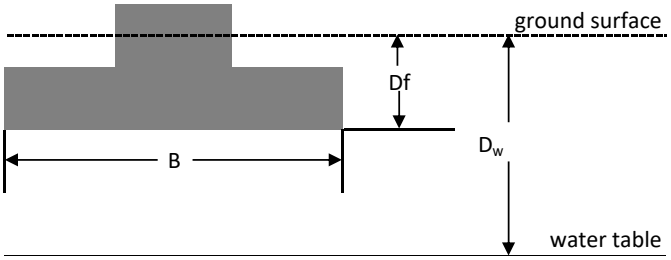
FOR COARSE GRAINED SOILS

Sample Interval	Depth of Mid. Pt. of Sample (ft.)	Assumed Estimated Unit Weight (pcf) γ	Vertical Effective Stress (ksf) σ'	SPT N Value N80	SPT N Value N60	Correction Factor CN	Corrected N-Value (N1)60	Relative Density (%) Dr	Unified Soil Classification	Internal Angle of Friction (degrees) ϕ
			62.40	pcf						
		Hammer Effic.	87	%						NAVFAC 7.1
433		Water Depth	7.5	ft						
1.5 - 3.0	2.25	115	0.26	6	9	1.69	15	56	SC-SM	33
3.5 - 5.0	4.25	115	0.49	5	7	1.47	11	47	SC-SM	31
6.0 - 7.5	6.75	118	0.78	19	28	1.32	36	86	SC-SM	36
8.5 - 10.0	9.25	115	0.92	8	12	1.26	15	56	SC-SM	33

Project	TN ERFO Site 2(5) - MP 433		
Sheet No.	1 of 1	Scale	NTS
Calculated By	Y. Oumoussi	Date	4/23/2025
Checked By	D. Pleiman	Date	

Bearing Capacity Determination

(Does not cover inclined loads or circlar foundations)



Soil and Foundation Parameters

c =	0	psf		N_c =	38.6
ϕ =	33.0			N_q =	26.1
γ =	118	pcf		N_γ =	35.2
B =	3.00	ft		c* =	0 psf
D_f =	3.8	ft	or LVAP	ϕ* =	33.0 °
L =	24.0	ft			
D_w =	2.0	ft			
	no	Consideration for punching ? (yes no)			

$q_n = c\, N_{cm} + \gamma\, D_f\, N_{qm}\, C_{wq} + 0.5\, \gamma\, B\, N_{\gamma m}\, C_{w\gamma}$ Nominal Bearing Capacity Eq. (10.6.3.1.2a-1)

$q_R = \phi_b\, q_n$ Factored Bearing Capacity Eq. (10.6.3.1.1-1)

$N_{cm} = N_c s_c$	N_{cm} =	41.69	s_c =	1.08	
$N_{qm} = N_q s_q d_q$	N_{qm} =	28.19	s_q =	1.08	
$N_{\gamma m} = N_\gamma s_\gamma$	$N_{\gamma m}$ =	33.44	s_γ =	0.95	
	C_{wq} =	0.5	d_q =	1.00	Value set to 1 to be conservative
	$C_{w\gamma}$ =	0.5	R_γ =	1.00	* (from EM 1110-1-1905 for B>6 ft)
			ϕ* =	0.45	ϕ* = 0.45 For Spread Footings (10.5.5.2.2-1)
			Service Limit =	3.0	ϕ* = 0.55 For Grav & CIP Walls (11.5.7-1)
q_n =	9196.5 psf				ϕ* = 0.65 For MSE walls (11.5.7-1)

q_f = 4138.4 psf Factored Bearing Capacity (Strength Limit)

q_a = 3065.5 psf Allowable Bearing Capacity / Service Limit

* Note - R_γ only applies for granluar bearing medium and is applied to the $0.5\gamma B N_\gamma$ term.

LVAP - lower vertical adjustment potential for scour protection

TN ERFO FS CHRKE804 2020-2(5)

CORRELATION OF SPT DATA TO UNIT WEIGHTS AND SHEAR STRENGTHS

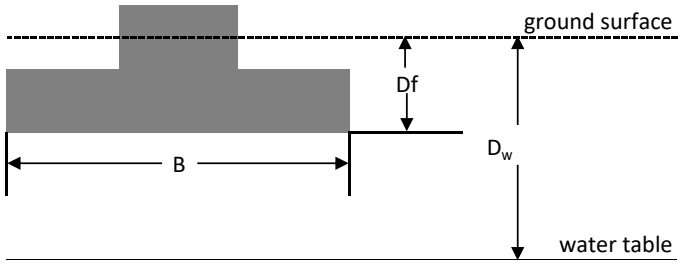
FOR COARSE GRAINED SOILS

Sample Interval	Depth of Mid. Pt. of Sample (ft.)	Assumed Estimated Unit Weight (pcf) γ	Vertical Effective Stress (ksf) σ'	SPT N Value N80	SPT N Value N60	Correction Factor CN	Corrected N-Value (N1)60	Relative Density (%) Dr	Unified Soil Classification	Internal Angle of Friction (degrees) ϕ
			62.40	pcf						
		Hammer Effic.	87	%		0.74				NAVFAC 7.1
452		Water Depth	9.0	ft						
1.5 - 3.0	2.25	120	0.27	33	48	1.67	80	100	GM	42
3.5 - 5.0	4.25	115	0.50	20	29	1.47	43	91	SC-SM	37
6.0 - 7.5	6.75	120	0.80	28	41	1.31	53	99	SC-SM	37

Project	TN ERFO Site 2(5) - MP 452		
Sheet No.	1 of 1	Scale	NTS
Calculated By	Y. Oumoussi	Date	4/23/2025
Checked By	D. Pleiman	Date	

Bearing Capacity Determination

(Does not cover inclined loads or circlar foundations)



Soil and Foundation Parameters

c =	0	psf	N_c =	42.2	
ϕ =	34.0		N_q =	29.4	
γ =	120	pcf	N_γ =	41.1	
B =	3.00	ft	c* =	0	psf
D_f =	4.0	ft	ϕ* =	34.0	°
L =	26.0	ft			
D_w =	2.0	ft			
	no	Consideration for punching ? (yes no)			

$q_n = c\, N_{cm} + \gamma\, D_f\, N_{qm}\, C_{wq} + 0.5\, \gamma\, B\, N_{\gamma m}\, C_{w\gamma}$ Nominal Bearing Capacity Eq. (10.6.3.1.2a-1)

$q_R = \phi_b\, q_n$ Factored Bearing Capacity Eq. (10.6.3.1.1-1)

$N_{cm} = N_c s_c$	N_{cm} =	45.58	s_c =	1.08	
$N_{qm} = N_q s_q d_q$	N_{qm} =	31.75	s_q =	1.08	
$N_{\gamma m} = N_\gamma s_\gamma$	$N_{\gamma m}$ =	39.05	s_γ =	0.95	
	C_{wq} =	0.5	d_q =	1.00	Value set to 1 to be conservative
	$C_{w\gamma}$ =	0.5	R_γ =	1.00	* (from EM 1110-1-1905 for B>6 ft)
			ϕ* =	0.45	
			Service Limit =	3.0	

ϕ* =	0.45	For Spread Footings (10.5.5.2.2-1)
ϕ* =	0.55	For Grav & CIP Walls (11.5.7-1)
ϕ* =	0.65	For MSE walls (11.5.7-1)

q_n = 11134.5 psf

q_f = 5010.5 psf Factored Bearing Capacity (Strength Limit)

q_a = 3711.5 psf Allowable Bearing Capacity / Service Limit

* Note - R_γ only applies for granluar bearing medium and is applied to the $0.5\gamma BN_\gamma$ term.

TN ERFO FS CHRKE804 2020-2(5)

CORRELATION OF SPT DATA TO UNIT WEIGHTS AND SHEAR STRENGTHS

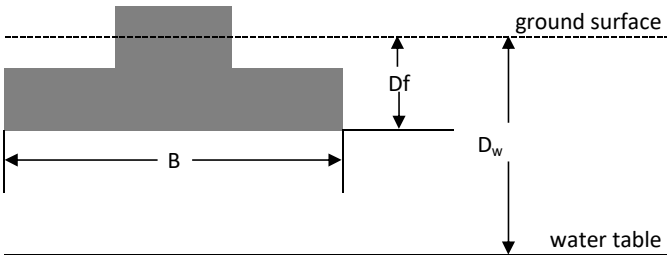
FOR COARSE GRAINED SOILS

Sample Interval	Depth of Mid. Pt. of Sample (ft.)	Assumed Estimated Unit Weight (pcf) γ	Vertical Effective Stress (ksf) σ'	SPT N Value N80	SPT N Value N60	Correction Factor CN	Corrected N-Value (N1)60	Relative Density (%) Dr	Unified Soil Classification	Internal Angle of Friction (degrees) ϕ
			62.40	pcf						
		Hammer Effic.	87	%						
469		Water Depth	8.0	ft						
1.5 - 3.0	2.25	115	0.13	7	10	1.92	20	65	SM	34
3.5 - 5.0	4.25	115	0.36	12	17	1.58	28	77	GC	38
6.0 - 7.5	6.75	115	0.65	6	9	1.38	12	52	GC	34

Project	TN ERFO Site 2(5) - MP 469		
Sheet No.	1 of 1	Scale	NTS
Calculated By	Y. Oumoussi	Date	11/6/2024
Checked By	D. Pleiman	Date	

Bearing Capacity Determination

(Does not cover inclined loads or circlar foundations)



Soil and Foundation Parameters

c =	0	psf	N_c =	38.6	
ϕ =	33.0		N_q =	26.1	
γ =	115	pcf	N_γ =	35.2	
B =	8.00	ft	c* =	0	psf
D_f =	1.5	ft	ϕ* =	33.0	°
L =	24.0	ft			
D_w =	1.4	ft			
	no	Consideration for punching ? (yes no)			

$q_n = c\, N_{cm} + \gamma\, D_f\, N_{qm}\, C_{wq} + 0.5\, \gamma\, B\, N_{\gamma m}\, C_{w\gamma}$ Nominal Bearing Capacity Eq. (10.6.3.1.2a-1)

$q_R = \phi_b\, q_n$ Factored Bearing Capacity Eq. (10.6.3.1.1-1)

$N_{cm} = N_c s_c$	N_{cm} =	47.48	s_c =	1.23	
$N_{qm} = N_q s_q d_q$	N_{qm} =	31.84	s_q =	1.22	
$N_{\gamma m} = N_\gamma s_\gamma$	$N_{\gamma m}$ =	30.62	s_γ =	0.87	
	C_{wq} =	0.5	d_q =	1.00	Value set to 1 to be conservative
	$C_{w\gamma}$ =	0.5	R_γ =	0.97	* (from EM 1110-1-1905 for B>6 ft)
			ϕ* =	0.45	
			Service Limit =	3.0	

ϕ* =	0.45	For Spread Footings (10.5.5.2.2-1)
ϕ* =	0.55	For Grav & CIP Walls (11.5.7-1)
ϕ* =	0.65	For MSE walls (11.5.7-1)

q_n = 9577.5 psf

q_f = 4309.9 psf Factored Bearing Capacity (Strength Limit)

q_a = 3192.5 psf Allowable Bearing Capacity / Service Limit

* Note - R_γ only applies for granluar bearing medium and is applied to the $0.5\gamma B N_\gamma$ term.

APPENDIX E
Subsurface Profiles

Spring Creek and Citco Creek
Culvert and AOP Profiles

STRATIGRAPHY & GW - A SIZE - FHWA_DATATEMPLATE_20171103.GDT - 11/4/24 10:55 - C:\USERS\DPLEIMAN\ONEDRIVE - STANTEC\DOCUMENTS\TN ERFO FS\SITE 5\LOGS\TN ERFO SITE 5.GPJ

Stantec

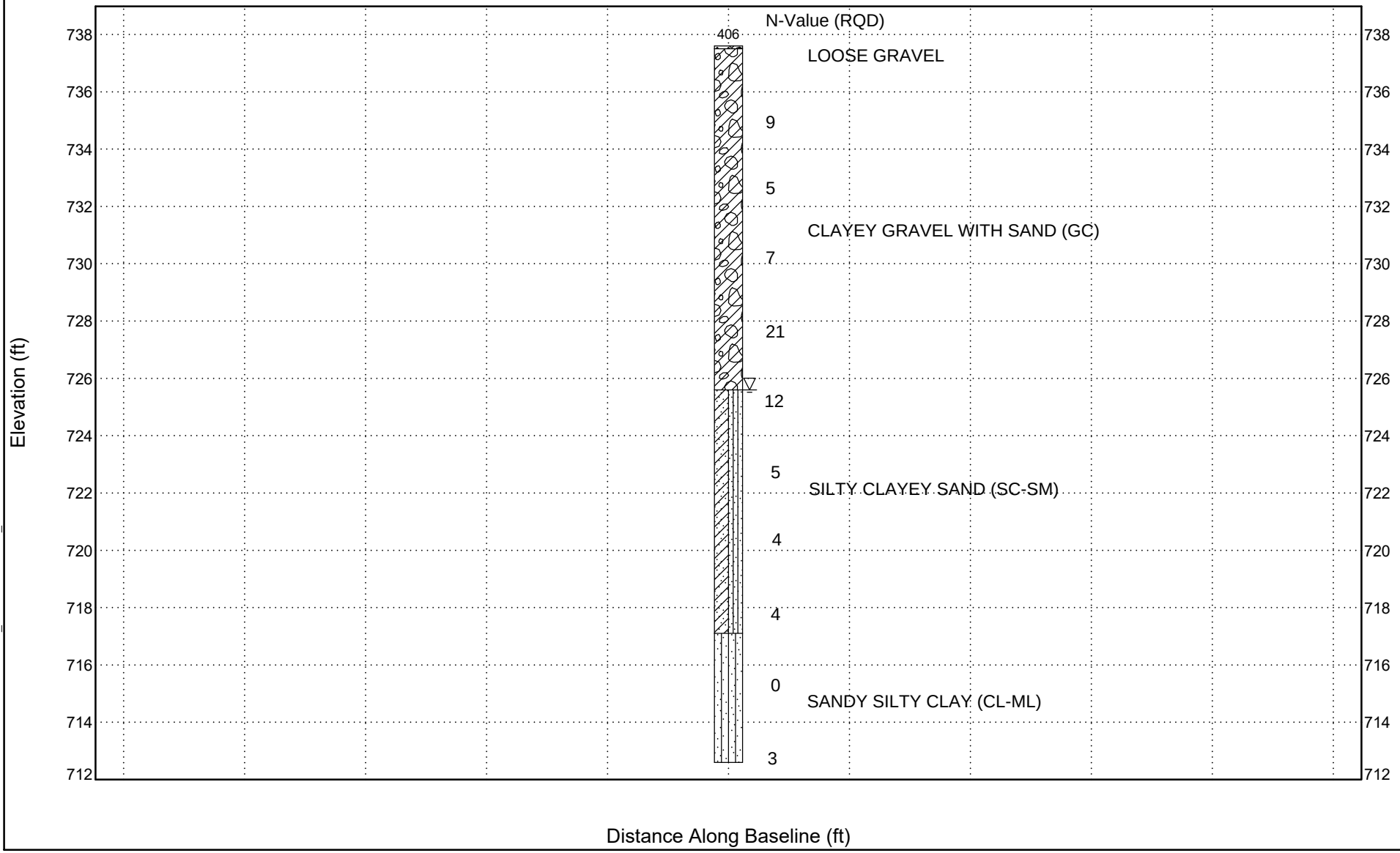
SUBSURFACE DIAGRAM
Boring 406

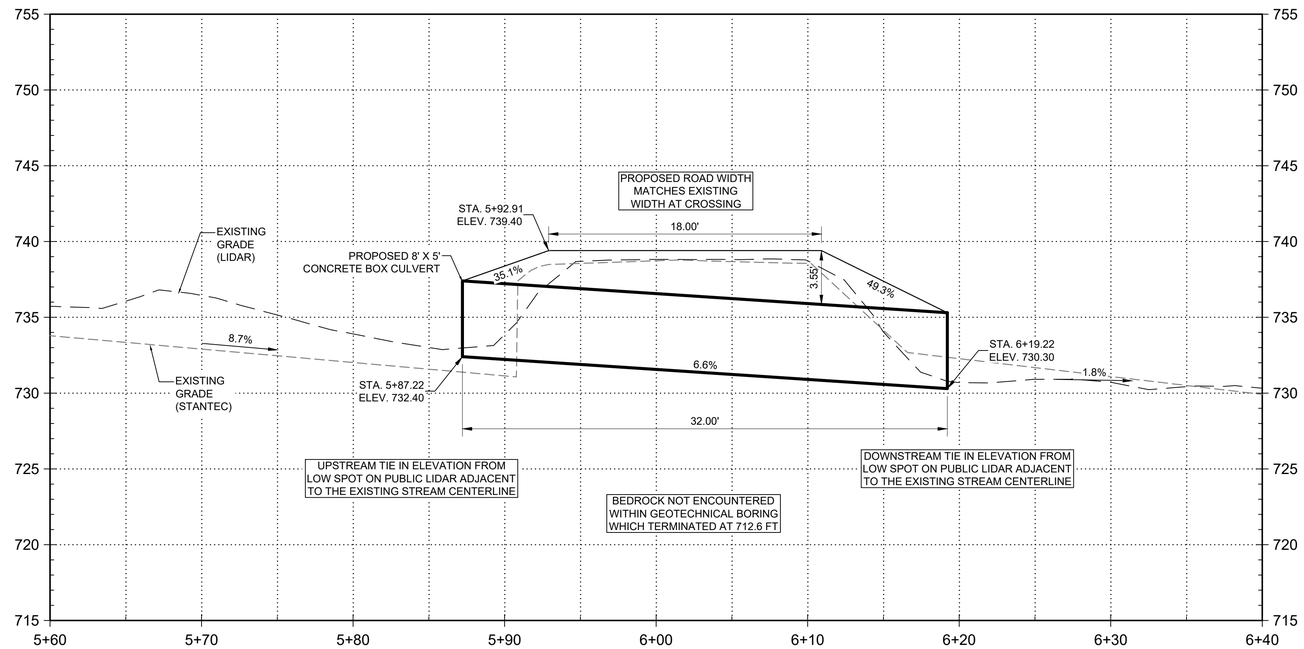
CLIENT FHWA

PROJECT NUMBER 2026252404

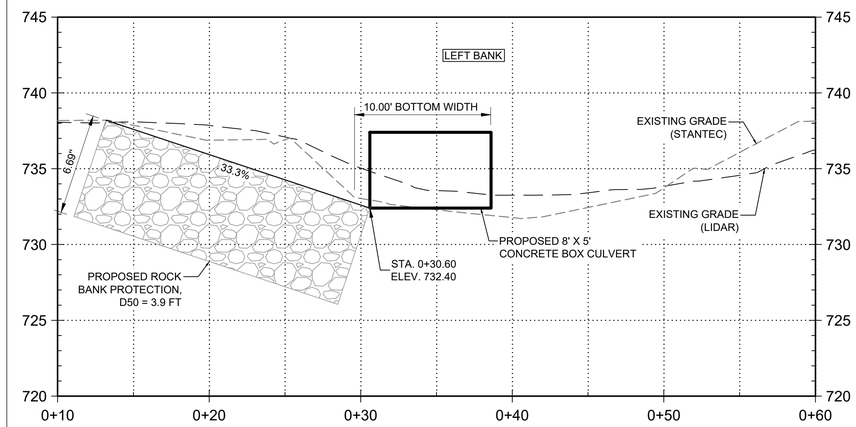
PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN

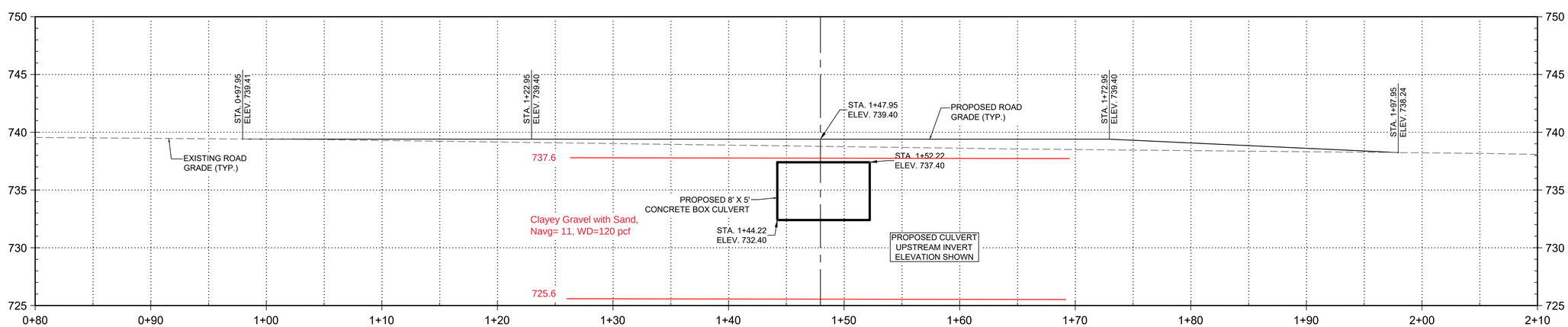




EXISTING STREAM CENTERLINE - SPRING CREEK MP 406



UPSTREAM CHANNEL BEND CROSS SECTION (STA 5+83) - SPRING CREEK MP 406



EXISTING ROAD CENTERLINE - SPRING CREEK MP 406

LEGEND

- PROPOSED STRUCTURE
- EXISTING GRADE
- PROPOSED GRADE

ANALYSIS WAS CONDUCTED WITH TOPOGRAPHIC INPUTS FROM 2024 STANTEC TOPOGRAPHIC SURVEY SUPPLEMENTED BY PUBLICLY AVAILABLE EAST TENNESSEE FY16 LIDAR DATA. EXISTING CONDITIONS TO BE FURTHER VERIFIED BY SITE SPECIFIC TOPOGRAPHIC SURVEYS .

0 5' 10'

ORIGINAL SHEET - ANSI D

Stantec
Stantec
601 Crossmere Park Road, Suite 22
Nashville, Tennessee 37211-3681
Tel: (615) 885-1144
www.stantec.com

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Client/Project
EASTERN FEDERAL LANDS HIGHWAY DIVISION
TN ERFO FS CHRKE804 2020-2(5)
POLK COUNTY, TENNESSEE

Project No.: 2026252404
File Name: CNF SPRING CITICO P&P

Scale: AS NOTED

AOB	AOB	2025.03.03
Dwn.	Dsgn.	YYYY.MM.DD

Title
SPRING CREEK 406
PROFILE & SECTION

Revision: N/A Sheet: 9 of 19
Drawing No.

STRATIGRAPHY & GW - A SIZE - FHWA_DATATEMPLATE_20171103.GDT - 11/4/24 10:59 - C:\USERS\DPLEIMAN\ONEDRIVE - STANTEC\DOCUMENTS\TN ERFO FS\SITE 5\LOGS\TN ERFO SITE 5.GPJ

Stantec

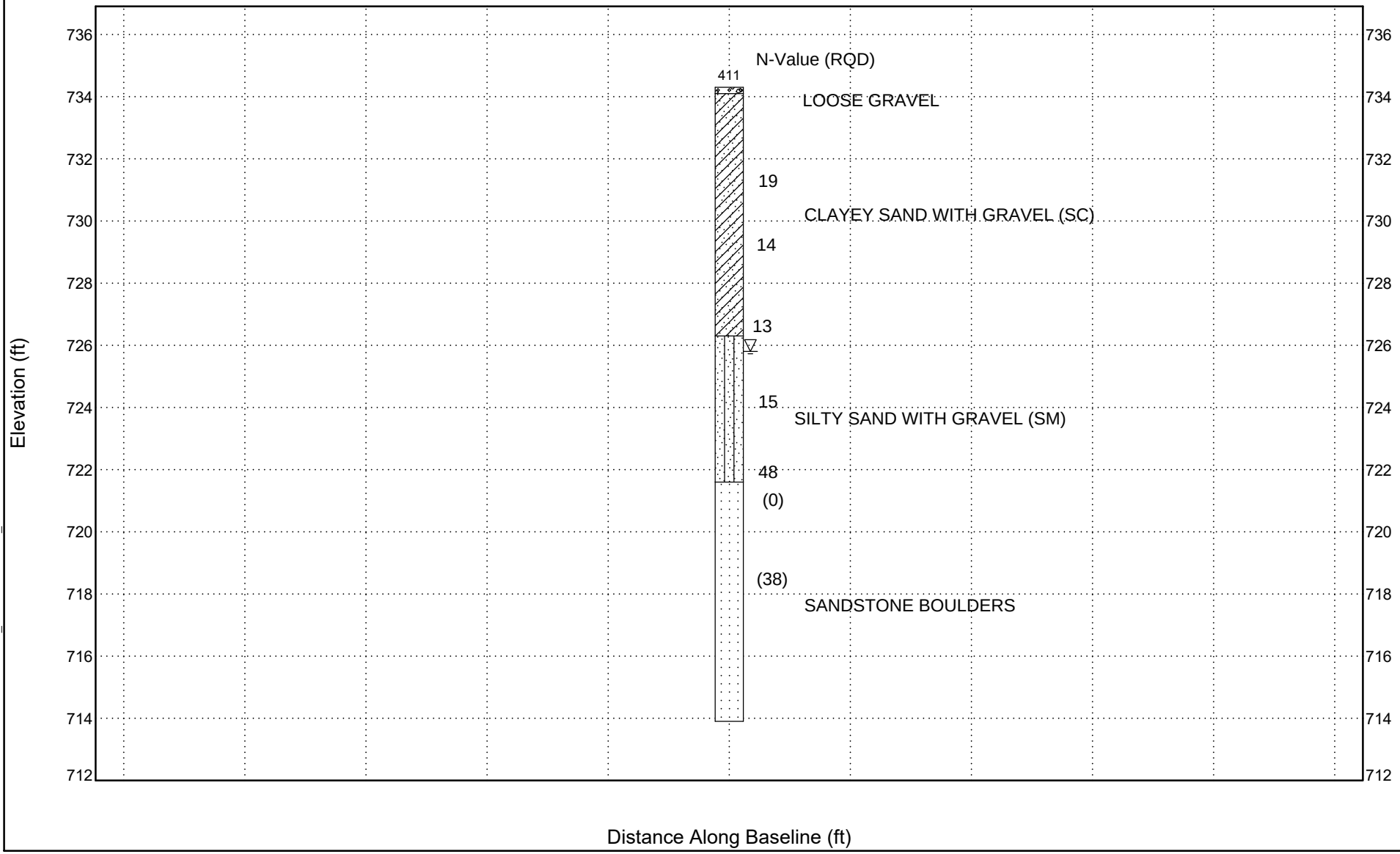
SUBSURFACE DIAGRAM
Boring 411

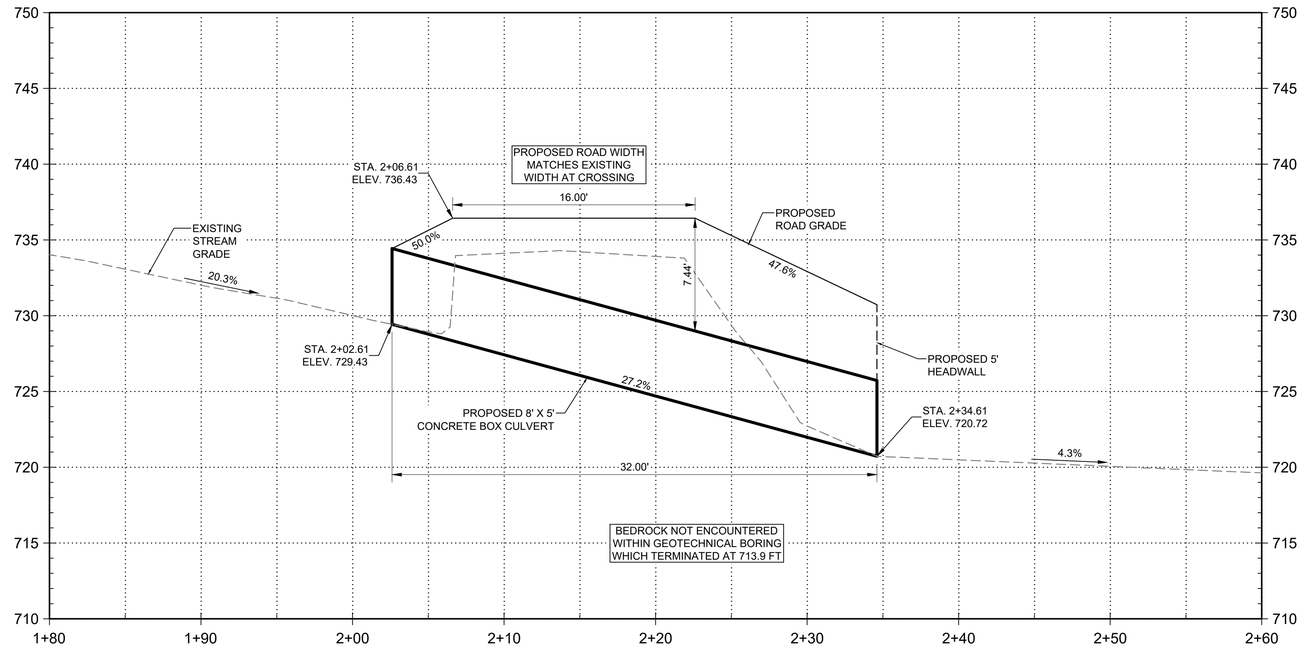
CLIENT FHWA

PROJECT NUMBER 2026252404

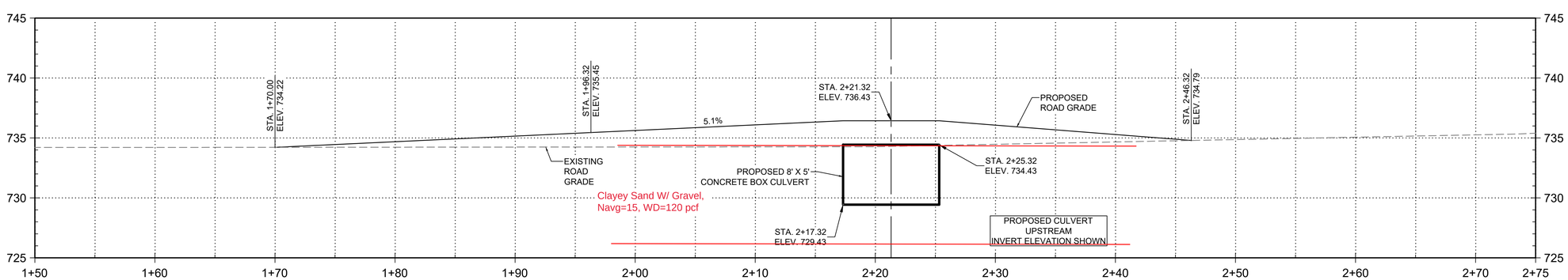
PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN





EXISTING STREAM CENTERLINE - SPRING CREEK MP 411



EXISTING ROAD CENTERLINE - SPRING CREEK MP 411

LEGEND

- PROPOSED STRUCTURE
- EXISTING GRADE
- PROPOSED GRADE
- PROPOSED HEADWALL

ANALYSIS WAS CONDUCTED WITH TOPOGRAPHIC INPUTS FROM STANTEC TOPOGRAPHIC SURVEY CONDUCTED IN 2024.

0 5' 10'

ORIGINAL SHEET - ANSI D

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Nashville, Tennessee 37211-3681
Tel: (615) 885-1144
www.stantec.com

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A			
0			

Permit/Seal

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Client/Project
EASTERN FEDERAL LANDS HIGHWAY DIVISION
TN ERFO FS CHRKE804 2020-2(5)
POLK COUNTY, TENNESSEE

Project No.: 2026252404
File Name: CNF SPRING CITICO P&P

Scale: AS NOTED

AOB	AOB	2025.03.03
Dwn.	Dsgn.	YYYY.MM.DD

Title
SPRING CREEK 411
PROFILE & SECTION

Revision: N/A Sheet: 10 of 19
Drawing No.

Stantec

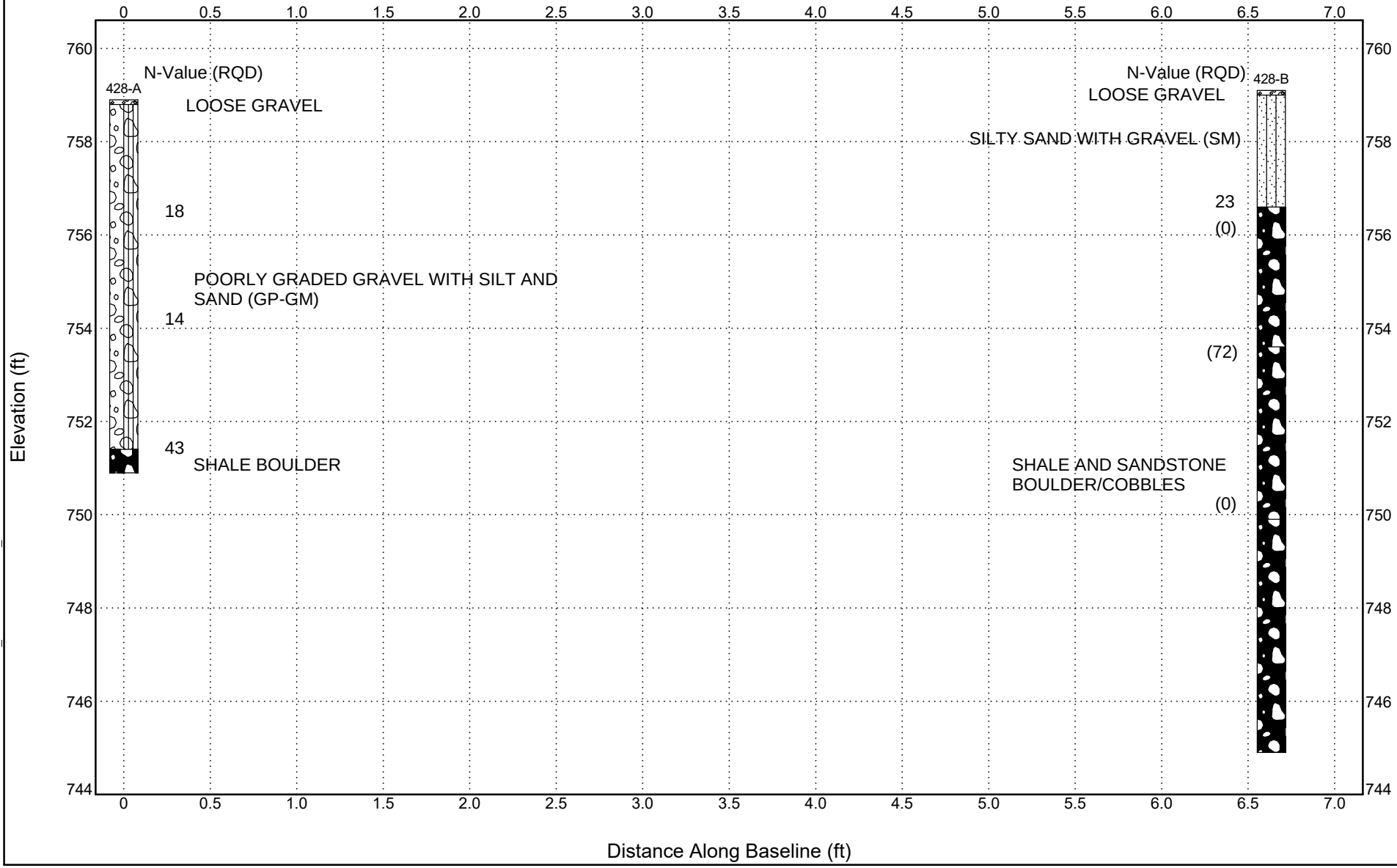
SUBSURFACE DIAGRAM
Boring 428A & B

CLIENT FHWA

PROJECT NUMBER 2026252404

PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN



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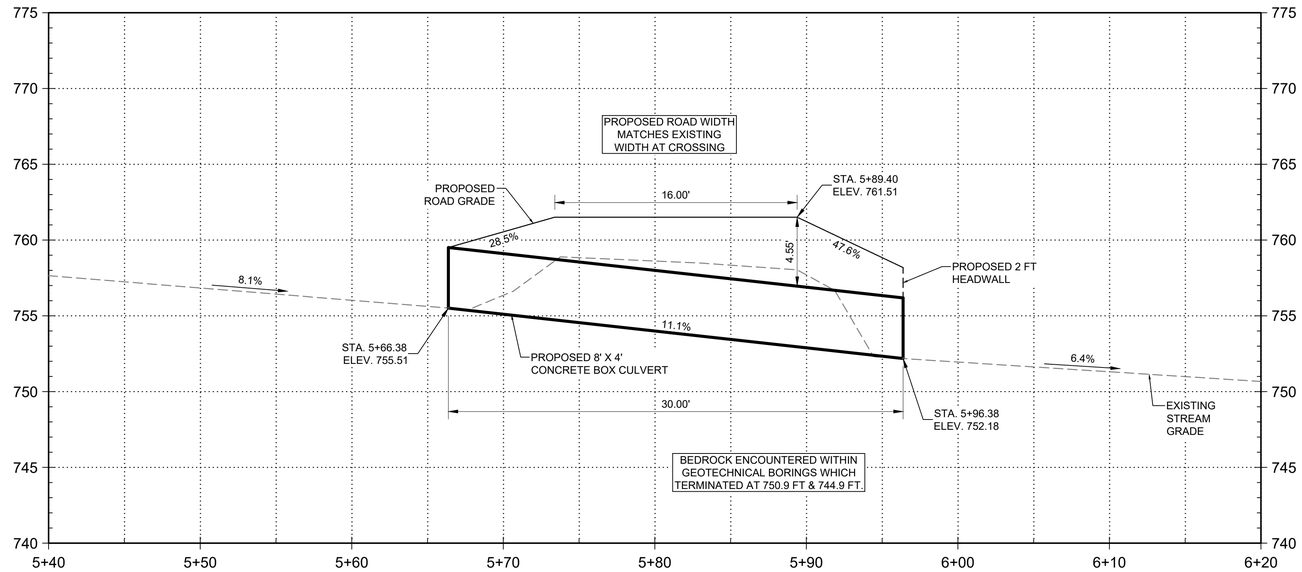
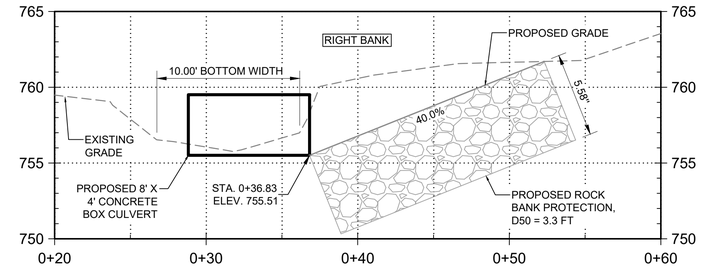
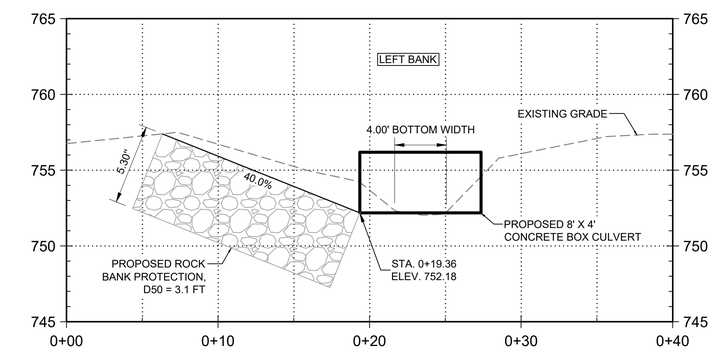


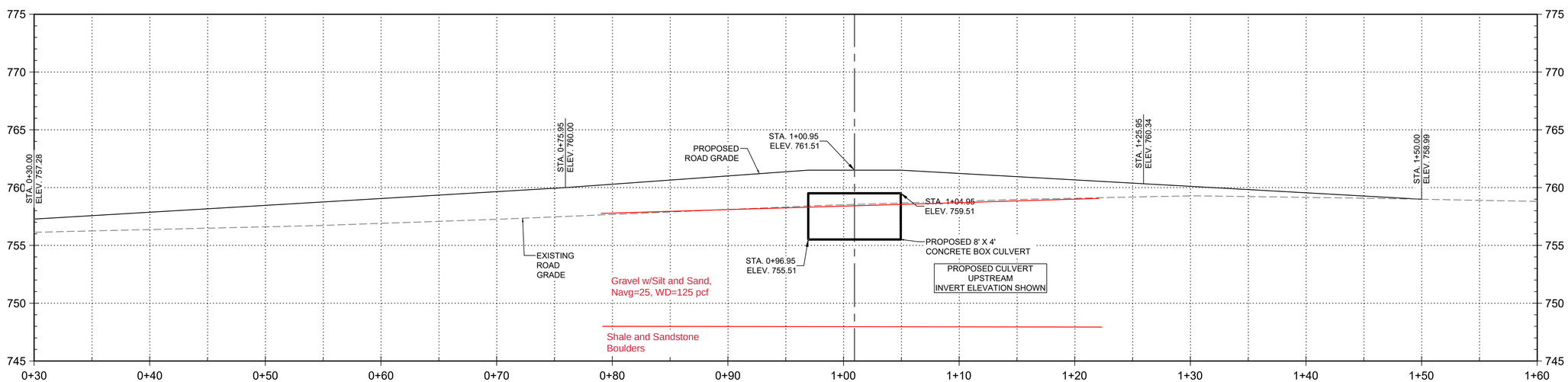
EXISTING STREAM CENTERLINE - SPRING CREEK MP 428



UPSTREAM CHANNEL BEND CROSS SECTION (STA 5+63) - SPRING CREEK MP 428



DOWNSTREAM CHANNEL BEND CROSS SECTION (STA 5+99) - SPRING CREEK MP 452



EXISTING ROAD CENTERLINE - SPRING CREEK MP 428

LEGEND

- PROPOSED STRUCTURE
- EXISTING GRADE
- PROPOSED GRADE
- PROPOSED HEADWALL

ANALYSIS WAS CONDUCTED WITH TOPOGRAPHIC INPUTS FROM STANTEC TOPOGRAPHIC SURVEY CONDUCTED IN 2024.

0 5' 10'

ORIGINAL SHEET - ANSI D

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Client/Project
EASTERN FEDERAL LANDS HIGHWAY DIVISION
TN ERFO FS CHRKE804 2020-2(5)
POLK COUNTY, TENNESSEE

Project No.: 2026252404
File Name: CNF SPRING CITICO P&P
Scale: AS NOTED

AOB	AOB	2025.03.03
Dwn.	Dsgn.	YYYY.MM.DD

Title
SPRING CREEK 428 PROFILE & SECTION

Revision: N/A Sheet: 13 of 19
Drawing No.

STRATIGRAPHY & GW - A SIZE - FHWA_DATATEMPLATE_20171103.GDT - 11/4/24 11:06 - C:\USERS\DPLEIMAN\ONEDRIVE - STANTEC\DOCUMENTS\TN ERFO FS\SITE 5\LOGS\TN ERFO SITE 5.GP.

Stantec

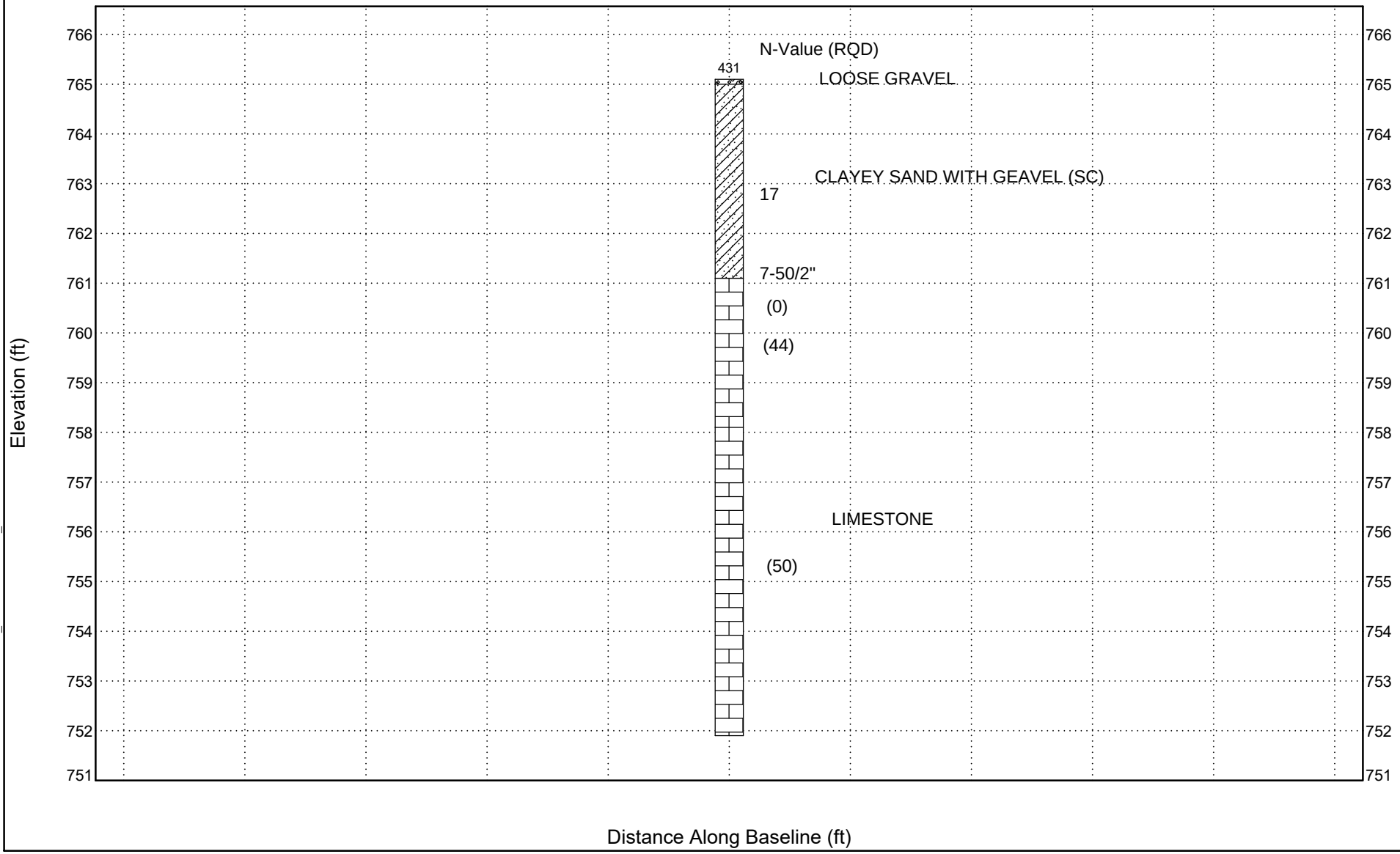
SUBSURFACE DIAGRAM
Boring 431

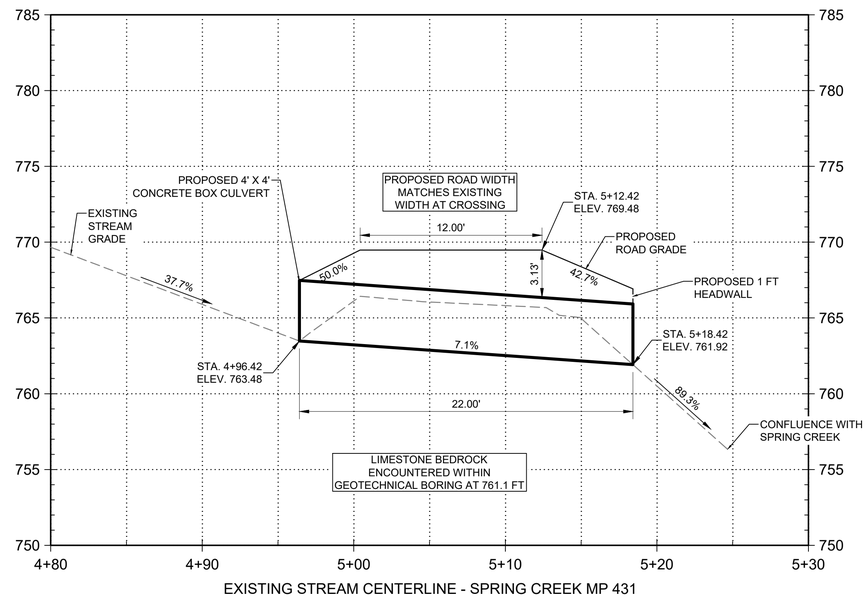
CLIENT FHWA

PROJECT NUMBER 2026252404

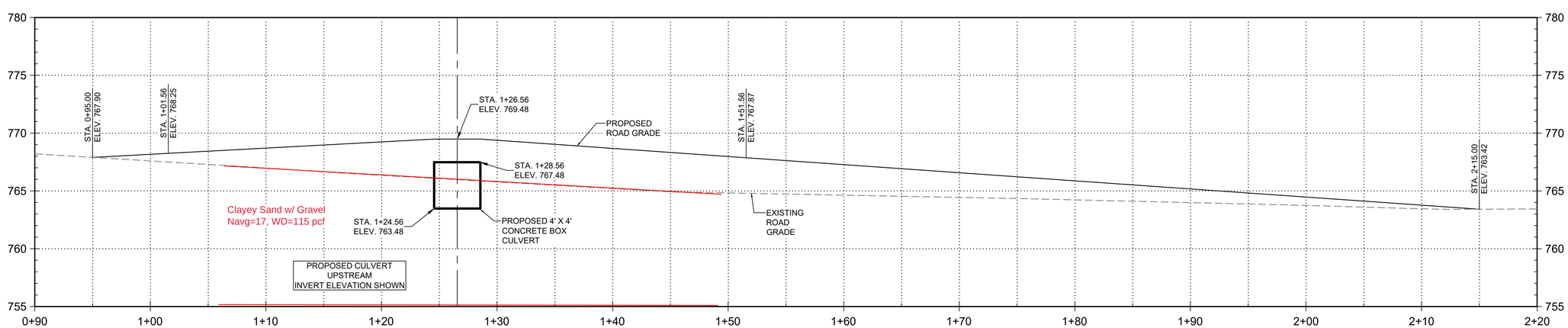
PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN





EXISTING STREAM CENTERLINE - SPRING CREEK MP 431



EXISTING ROAD CENTERLINE - SPRING CREEK MP 431

LEGEND

- PROPOSED STRUCTURE
- EXISTING GRADE
- PROPOSED GRADE
- PROPOSED HEADWALL

ANALYSIS WAS CONDUCTED WITH TOPOGRAPHIC INPUTS FROM STANTEC TOPOGRAPHIC SURVEY CONDUCTED IN 2024.

0 5' 10'

ORIGINAL SHEET - ANSI D

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Client/Project
EASTERN FEDERAL LANDS HIGHWAY DIVISION
TN ERFO FS CHRKE804 2020-2(5)
POLK COUNTY, TENNESSEE

Project No.: 2026252404
File Name: CNF SPRING CITICO P&P

Scale: AS NOTED

AOB	AOB	2025.03.03
Dwn.	Dsgn.	YYYY.MM.DD

Title
SPRING CREEK 431
PROFILE & SECTION

Revision: N/A Sheet: 14 of 19
Drawing No.

STRATIGRAPHY & GW - A SIZE - FHWA_DATATEMPLATE_20171103.GDT - 11/4/24 11:07 - C:\USERS\DPLEIMAN\ONEDRIVE - STANTEC\DOCUMENTS\TN ERFO FS\SITE 5\LOGS\TN ERFO SITE 5.GP.

Stantec

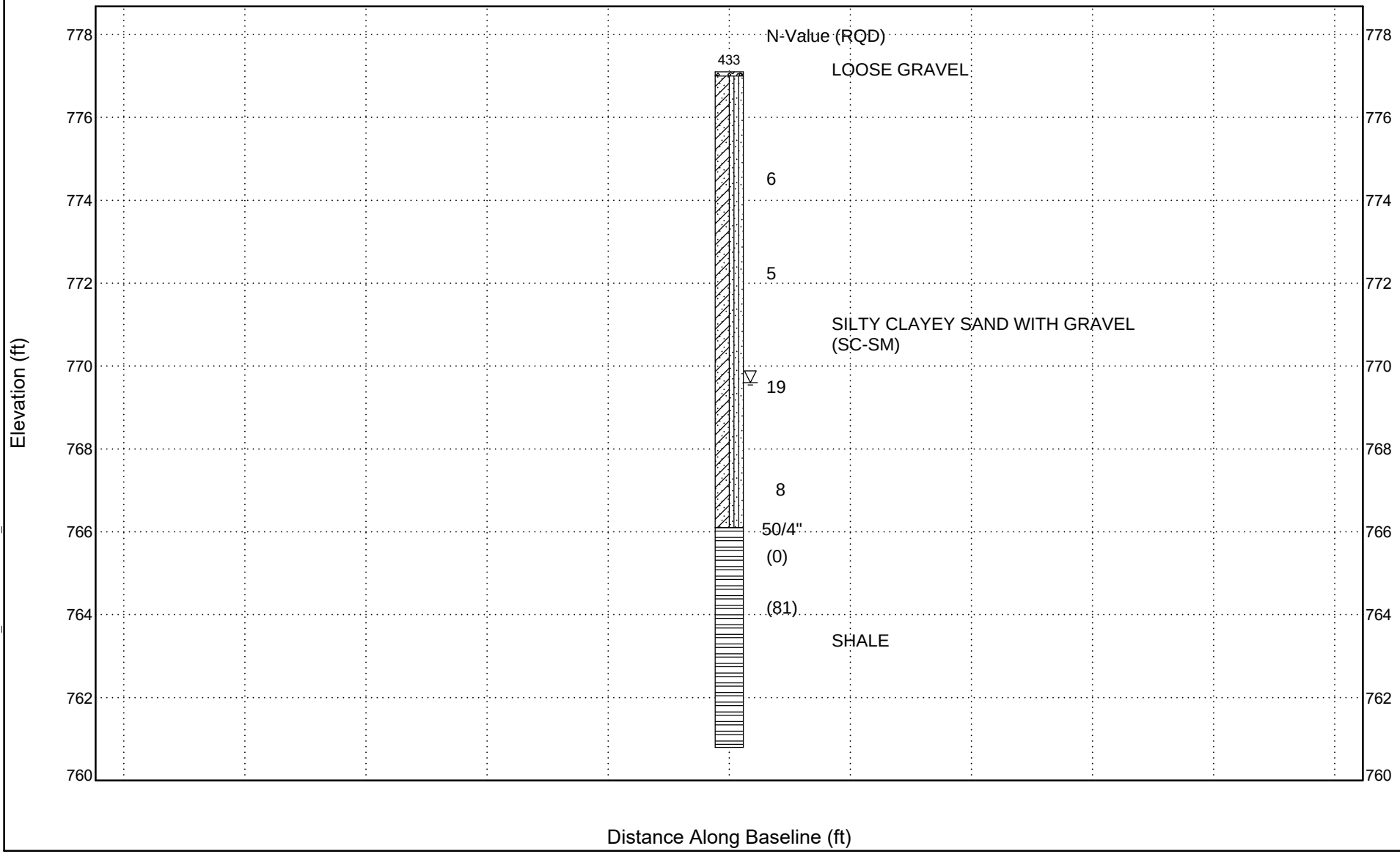
SUBSURFACE DIAGRAM
Boring 433

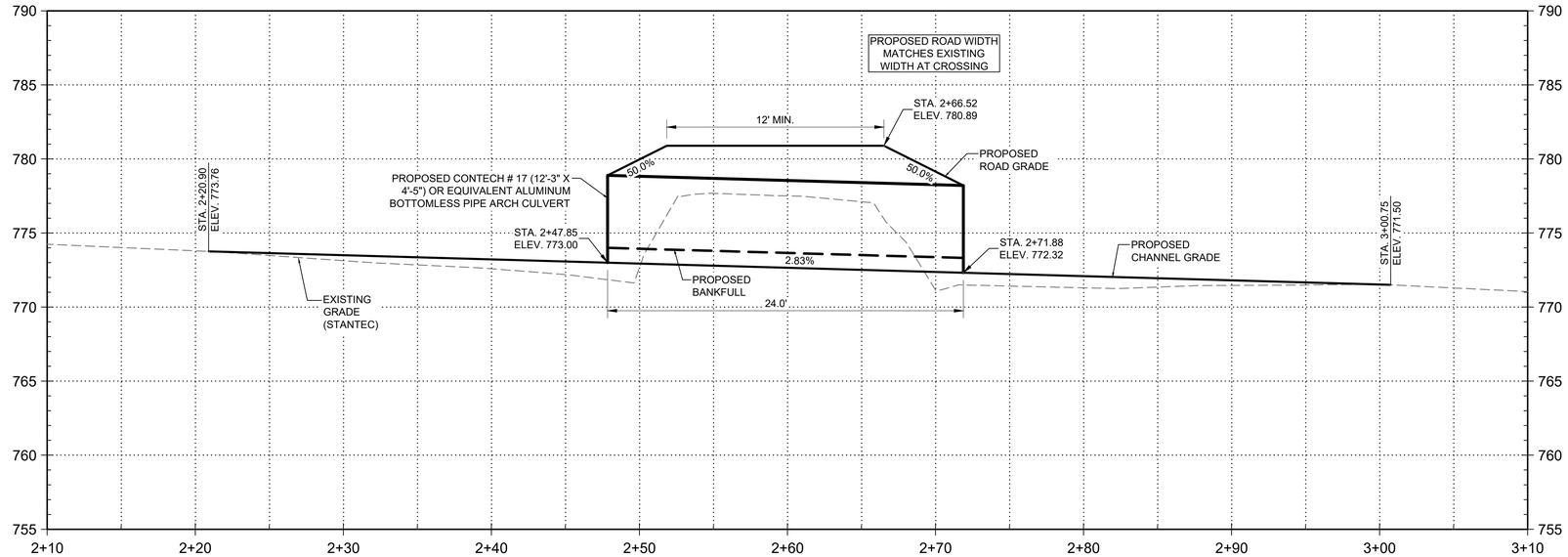
CLIENT FHWA

PROJECT NUMBER 2026252404

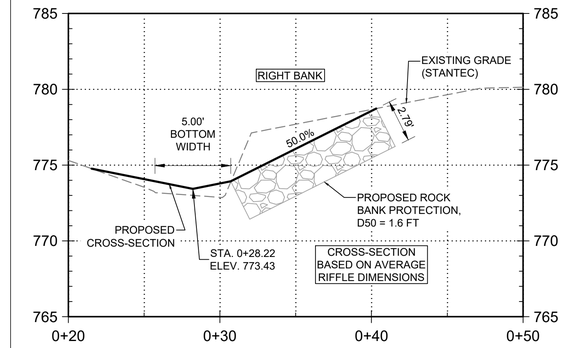
PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN

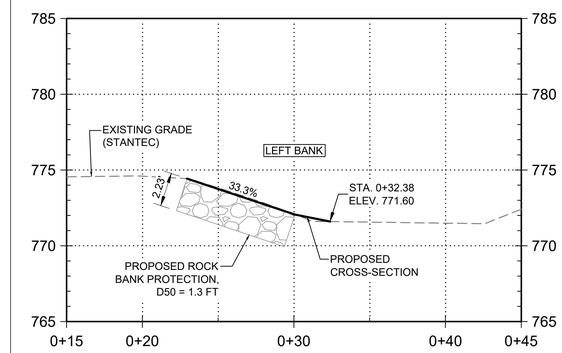




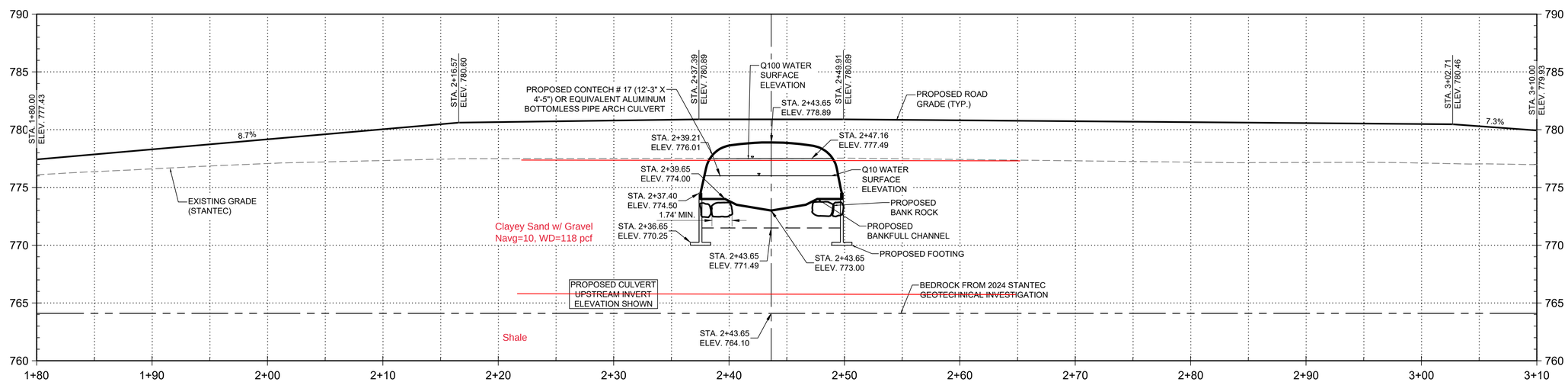
EXISTING STREAM CENTERLINE - SPRING CREEK MP 433



UPSTREAM CHANNEL BEND XS (STA 2+32) - SPRING CREEK MP 433



DOWNSTREAM CHANNEL BEND XS (STA 2+99) - SPRING CREEK MP 433



EXISTING ROAD CENTERLINE - SPRING CREEK MP 433

LEGEND

- PROPOSED STRUCTURE
- EXISTING GRADE
- PROPOSED GRADE
- WATER SURFACE
- PROPOSED BANKFULL
- LOWER VERTICAL ADJUSTMENT POTENTIAL (LVAP)

ANALYSIS WAS CONDUCTED WITH TOPOGRAPHIC INPUTS FROM 2024 STANTEC TOPOGRAPHIC SURVEY SUPPLEMENTED BY PUBLICLY AVAILABLE EAST TENNESSEE FY16 LIDAR DATA. EXISTING CONDITIONS TO BE FURTHER VERIFIED BY SITE SPECIFIC TOPOGRAPHIC SURVEYS.

0 5' 10'

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Revision	By	Appd	YYYY.MM.DD
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A			

Permit/Seal

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Client/Project
EASTERN FEDERAL LANDS HIGHWAY DIVISION
TN ERFO FS CHRKE804 2020-2(5)
POLK COUNTY, TENNESSEE

Project No.: 2026252404
File Name: CNF MP 433 MP 452 LONG PRO
Scale: AS NOTED

AOB	AOB	2025.03.03
Dwn.	Dsgn.	YYYY.MM.DD

Title
SPRING CREEK MP 433 DESIGN PROFILE

Revision: N/A Sheet: 6 of 19
Drawing No.

ORIGINAL SHEET - ANSI D

STRATIGRAPHY & GW - A SIZE - FHWA_DATATEMPLATE_20171103.GDT - 11/4/24 11:07 - C:\USERS\DPLEIMAN\ONEDRIVE - STANTEC\DOCUMENTS\TN ERFO FS\SITE 5\LOGS\TN ERFO SITE 5.GPJ

Stantec

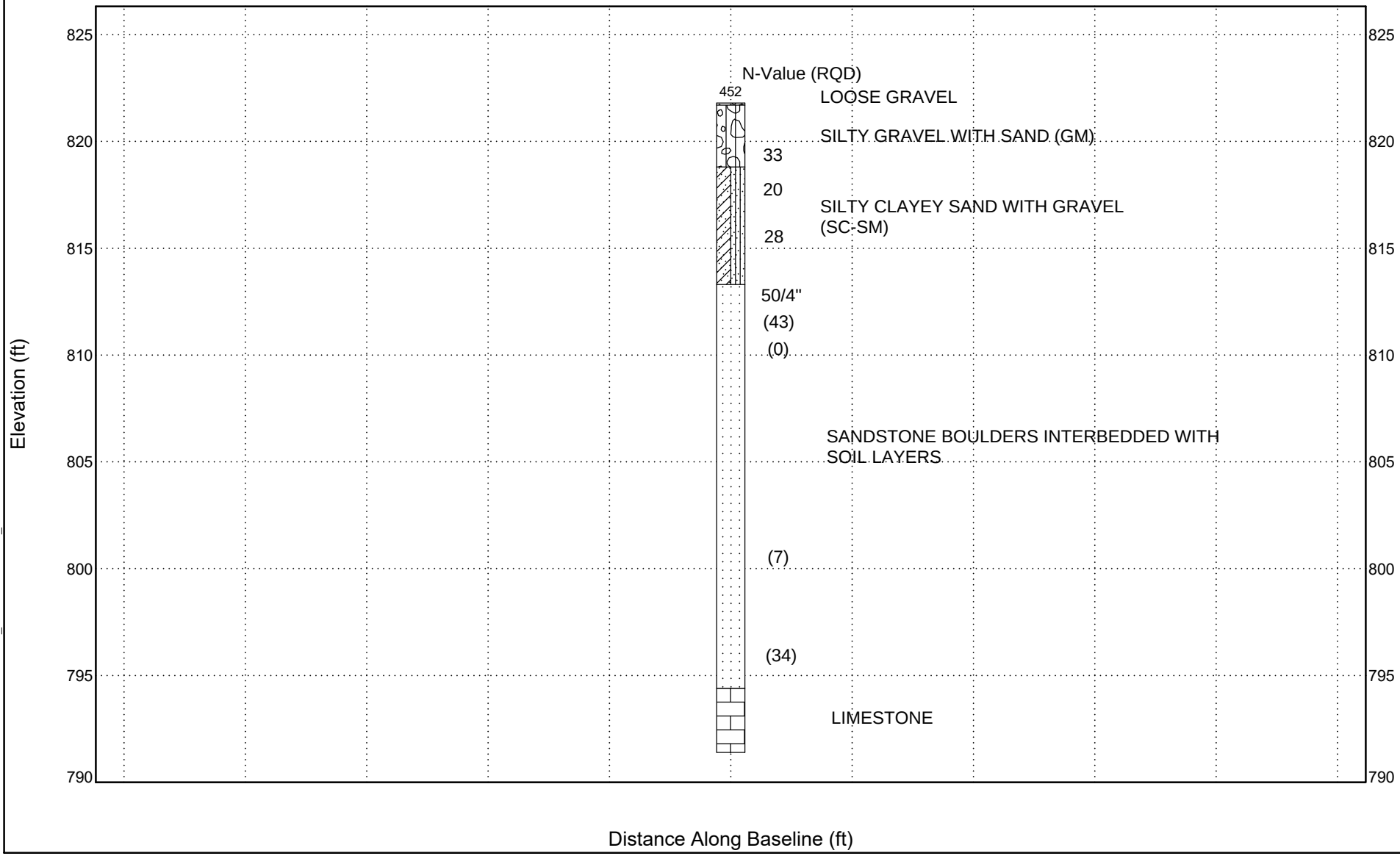
SUBSURFACE DIAGRAM
Boring 452

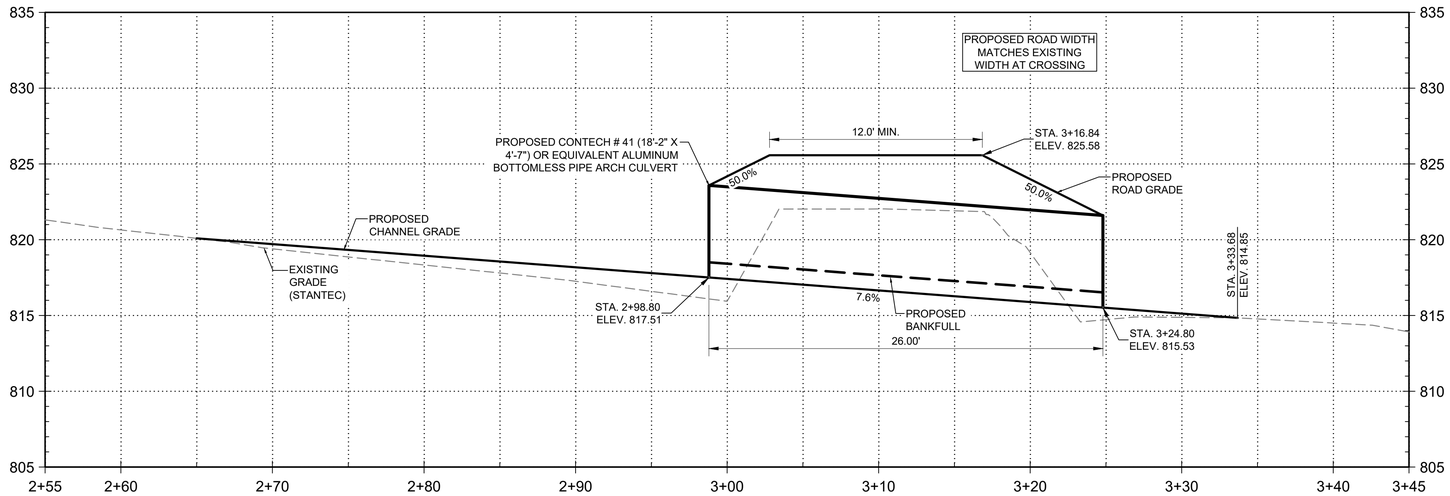
CLIENT FHWA

PROJECT NUMBER 2026252404

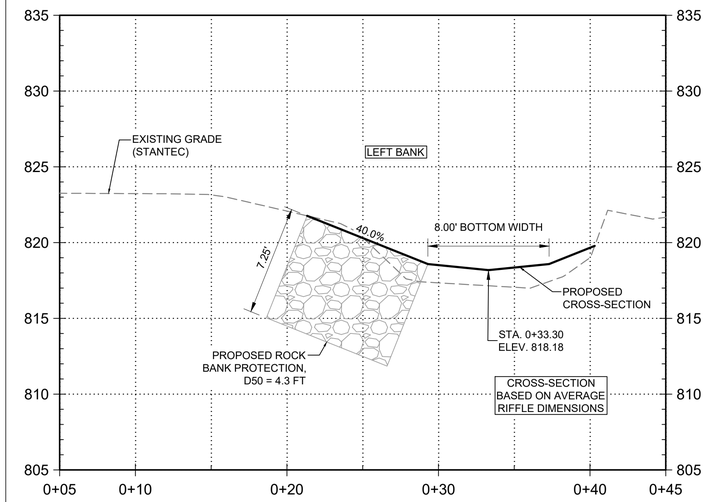
PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN

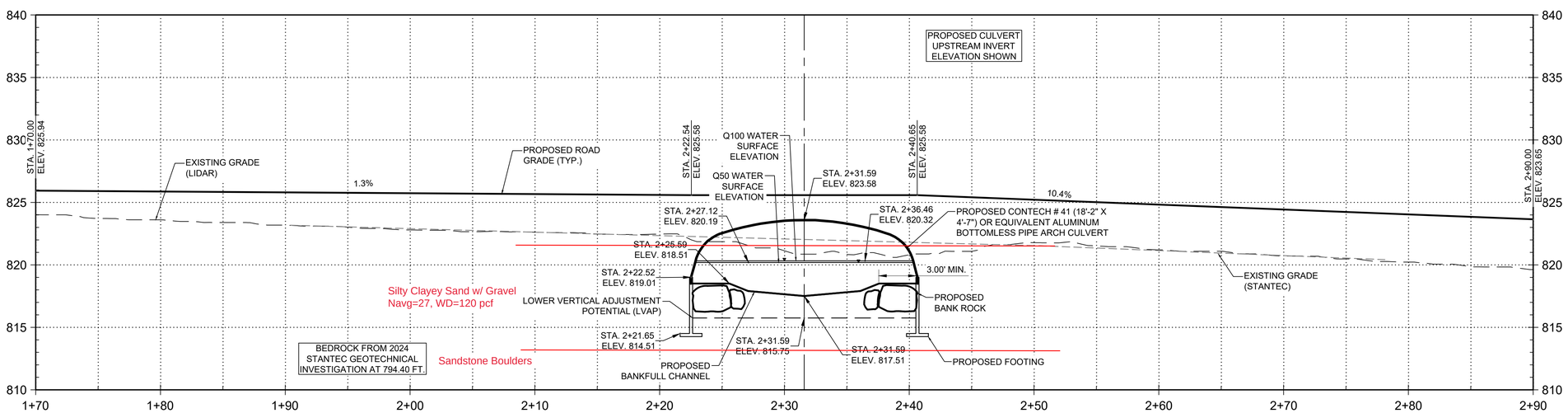




EXISTING STREAM CENTERLINE - SPRING CREEK MP 452



UPSTREAM CHANNEL BEND CROSS SECTION (STA 2+91) - SPRING CREEK MP 452



EXISTING ROAD CENTERLINE - SPRING CREEK MP 452

LEGEND

- PROPOSED STRUCTURE
- EXISTING GRADE
- PROPOSED GRADE
- WATER SURFACE
- PROPOSED BANKFULL
- LOWER VERTICAL ADJUSTMENT POTENTIAL (LVAP)

ANALYSIS WAS CONDUCTED WITH TOPOGRAPHIC INPUTS FROM 2024 STANTEC TOPOGRAPHIC SURVEY SUPPLEMENTED BY PUBLICLY AVAILABLE EAST TENNESSEE FY16 LIDAR DATA. EXISTING CONDITIONS TO BE FURTHER VERIFIED BY SITE SPECIFIC TOPOGRAPHIC SURVEYS.

0 5' 10'

ORIGINAL SHEET - ANSI D

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Client/Project
EASTERN FEDERAL LANDS HIGHWAY DIVISION
TN ERFO FS CHRKE804 2020-2(5)
POLK COUNTY, TENNESSEE

Project No.: 2026252404
File Name: CNF MP 433 MP 452 LONG PRO
Scale: AS NOTED

AOB	AOB	2025.03.03
Dwn.	Dsgn.	YYYY.MM.DD

Title
SPRING CREEK MP 452
DESIGN PROFILE

Revision: N/A Sheet: 7 of 19
Drawing No.

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Stantec

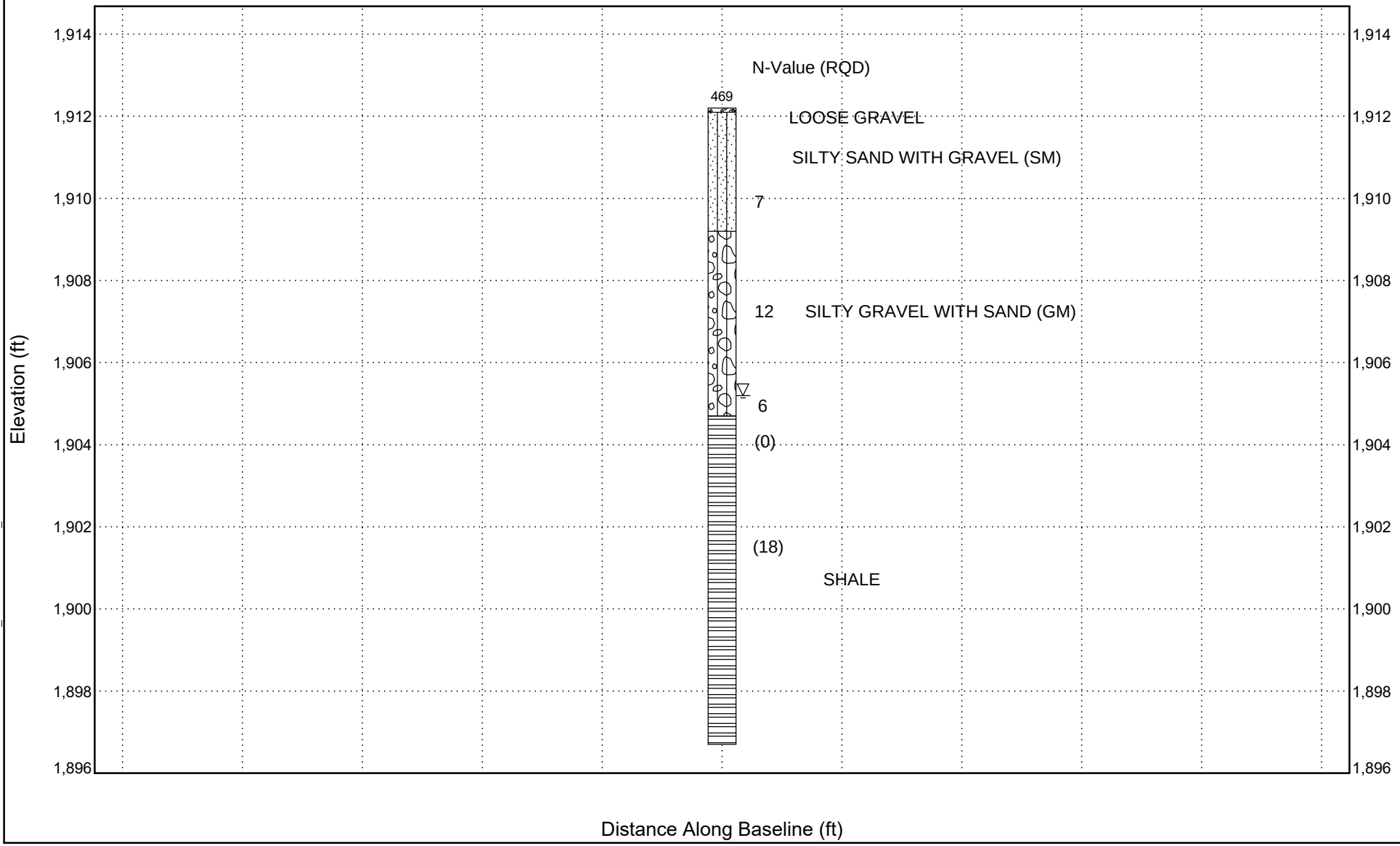
SUBSURFACE DIAGRAM
Boring 469

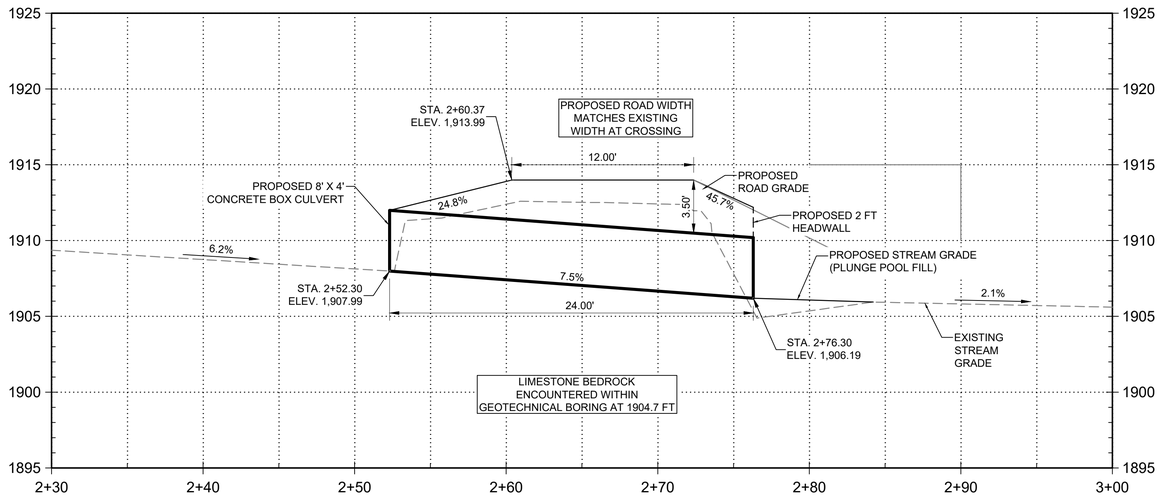
CLIENT FHWA

PROJECT NUMBER 2026252404

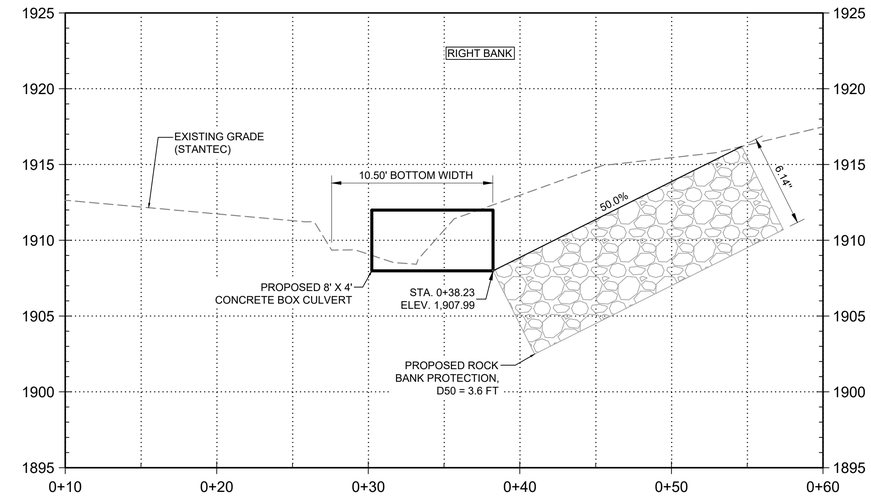
PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN

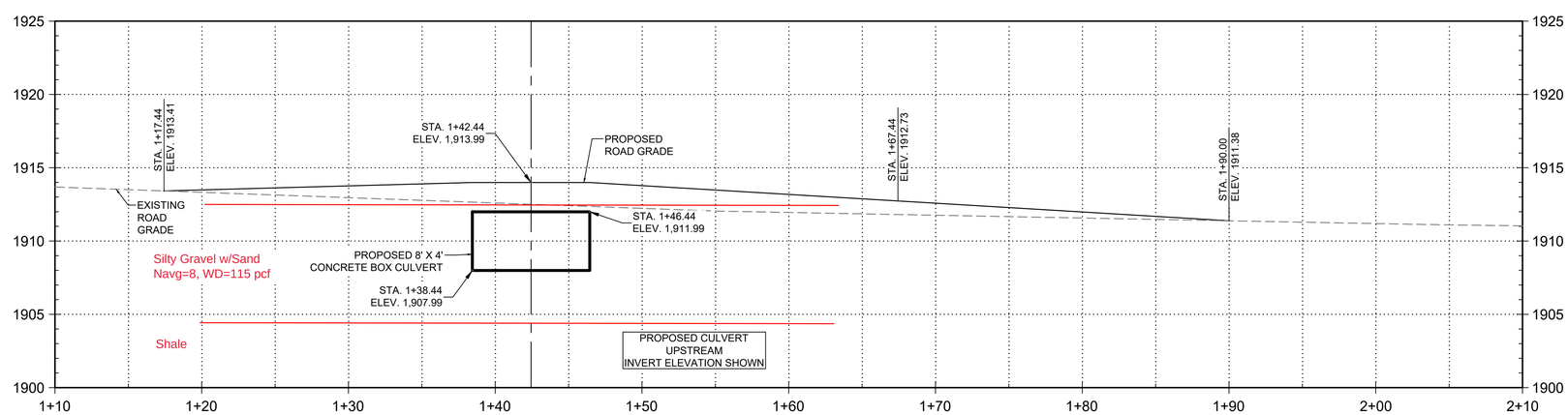




EXISTING STREAM CENTERLINE - CITICO CREEK MP 469



UPSTREAM CHANNEL BEND CROSS SECTION (STA 2+43) - CITICO CREEK MP 469



EXISTING ROAD CENTERLINE - CITICO CREEK MP 469

LEGEND

- PROPOSED STRUCTURE
- EXISTING GRADE
- PROPOSED GRADE
- PROPOSED HEADWALL

ANALYSIS WAS CONDUCTED WITH TOPOGRAPHIC INPUTS FROM STANTEC TOPOGRAPHIC SURVEY CONDUCTED IN 2024.

0 5' 10'

ORIGINAL SHEET - ANSI D

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Client/Project
EASTERN FEDERAL LANDS HIGHWAY DIVISION
TN ERFO FS CHRKE804 2020-2(5)
MONROE COUNTY, TENNESSEE

Project No.: 2026252404
File Name: CNF SPRING CITICO P&P
Scale: AS NOTED

AOB	AOB	2025.03.03
Dwn.	Dsgn.	YYYY.MM.DD

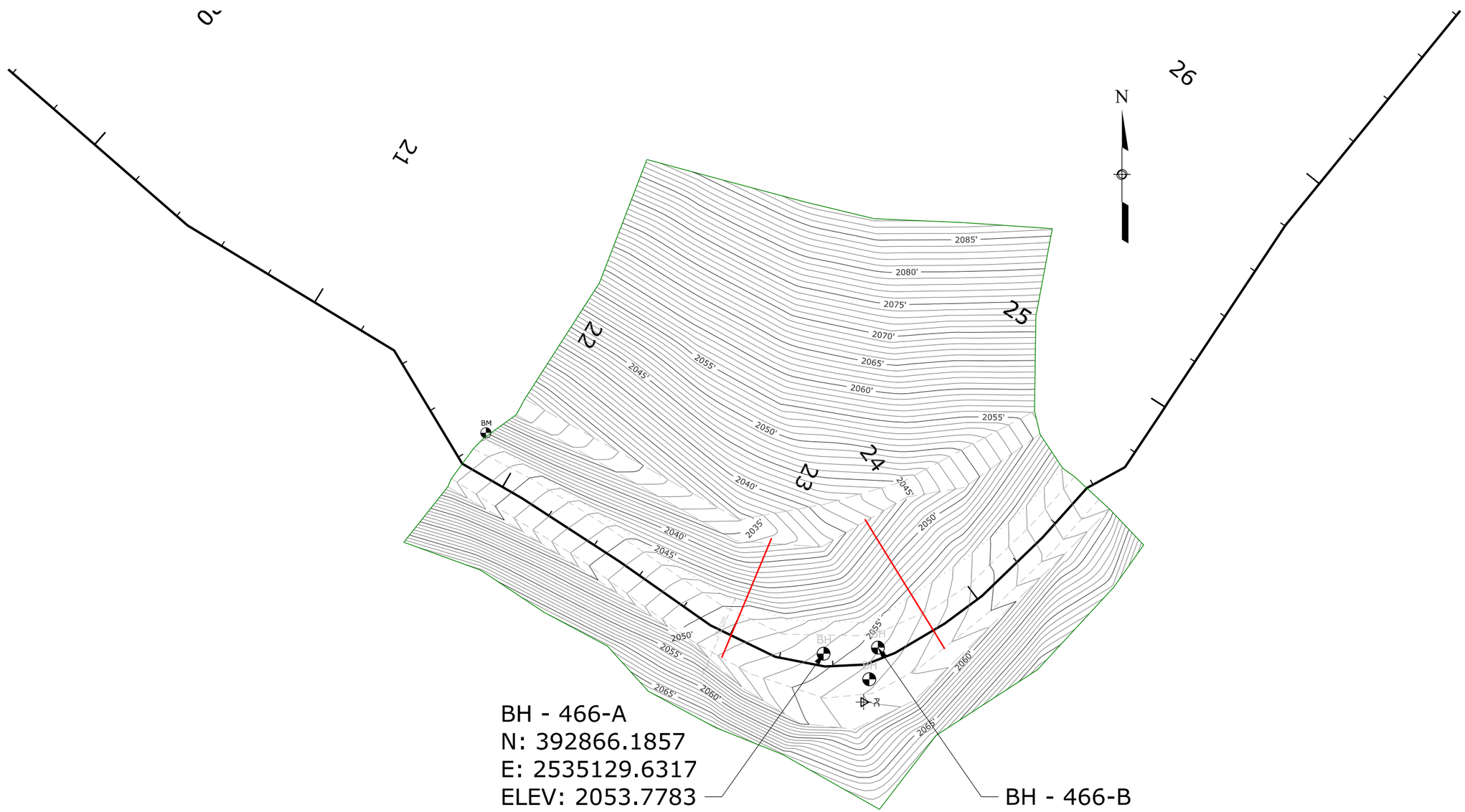
Title
CITICO CREEK 469
PROFILE & SECTION

Revision: N/A Sheet: 17 of 19
Drawing No.

Citico Creek Subsurface Profiles

NPS PMIS No. xxxxxx NPS Drwg No. xxxxxx

PROJECT	SHEET NUMBER
	A001



BH - 466-A
N: 392866.1857
E: 2535129.6317
ELEV: 2053.7783

BH - 466-B
N: 392868.4190
E: 2535149.6107
ELEV: 2055.5881

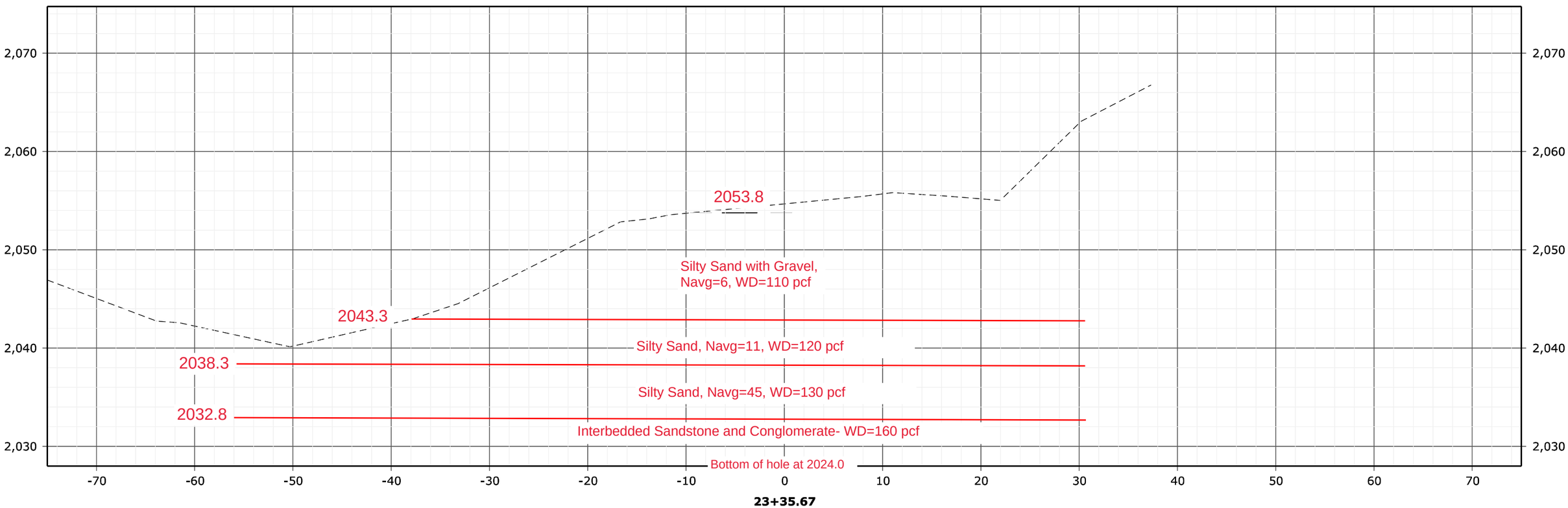
MP 466
PLAN SHEET

cc:\pw_working\infra03\lrakes\d0149759\Cliffico Creek.dgn [MP 466 (Sheet)]

21 August 2024 3:57 PM

NPS PMIS No. xxxxxx NPS Drwg No. xxxxxx

PROJECT	SHEET NUMBER
	A001



FHWA, Office of Federal Lands Highway

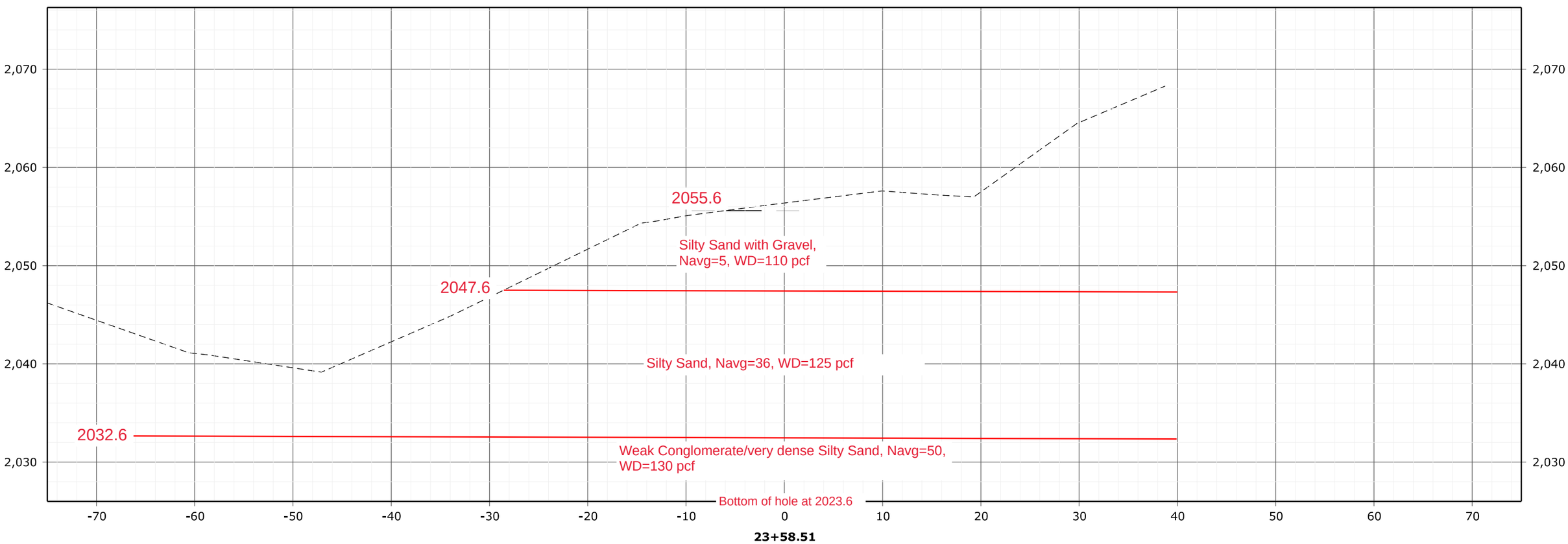
BH 466-A

c:\pw_working\infra03\lrakes\d0149758\Citico Creek.dgn [466-A - 23+35.67 [Sheet1]]

21 August 2024 3:57 PM

NPS PMIS No. xxxxxx NPS Drwg No. xxxxxx

PROJECT	SHEET NUMBER
	A002



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21 August 2024 3:32 PM

FHWA, Office of Federal Lands Highway

BH 466-B

STRATIGRAPHY & GW - A SIZE - FHWA_DATATEMPLATE_20171103.GDT - 11/4/24 11:08 - C:\USERS\DPLEIMAN\ONEDRIVE - STANTEC\DOCUMENTS\TN ERFO FS\SITE 5\LOGS\TN ERFO SITE 5.GPJ

Stantec

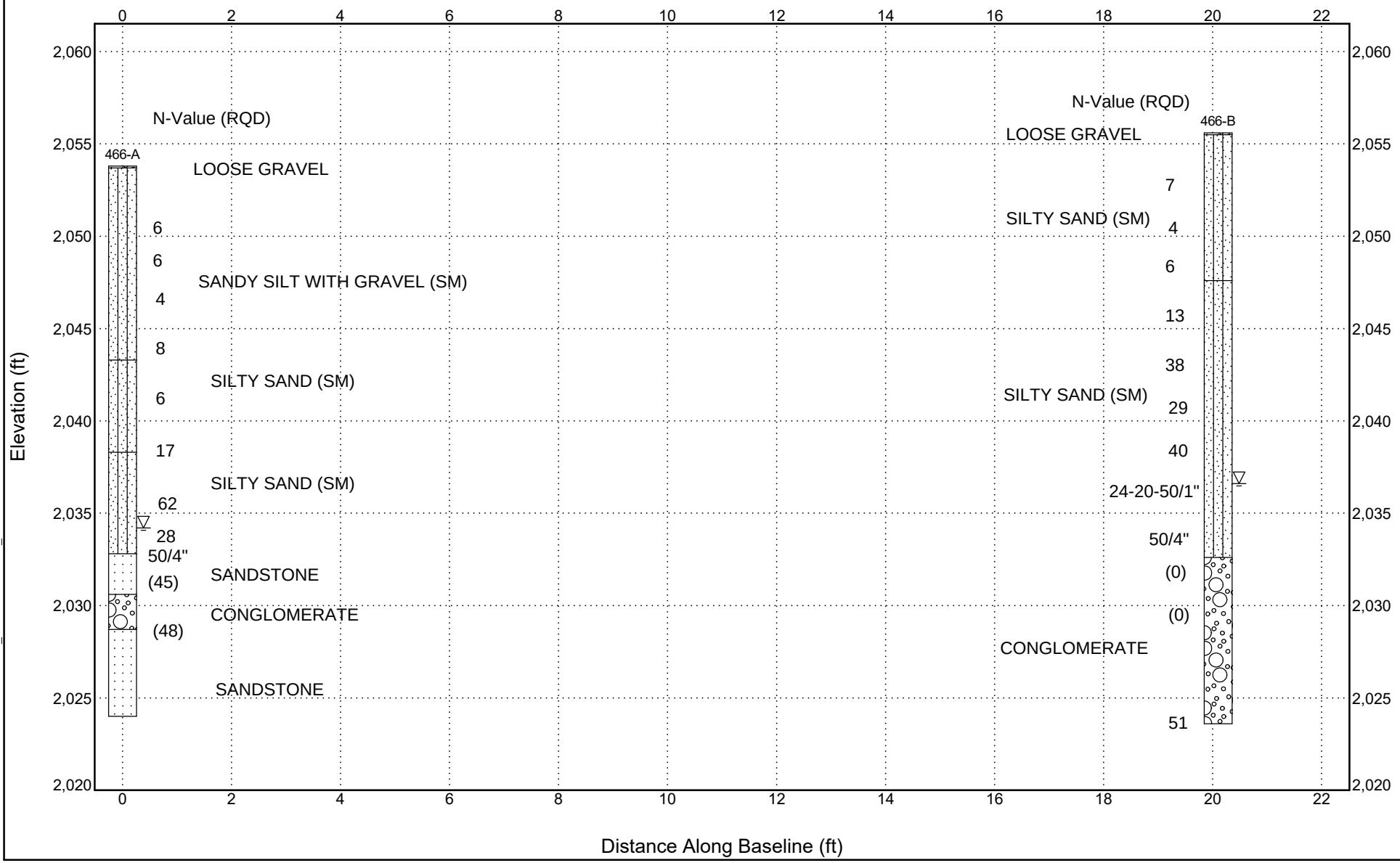
SUBSURFACE DIAGRAM
Boring 466A & B

CLIENT FHWA

PROJECT NUMBER 2026252404

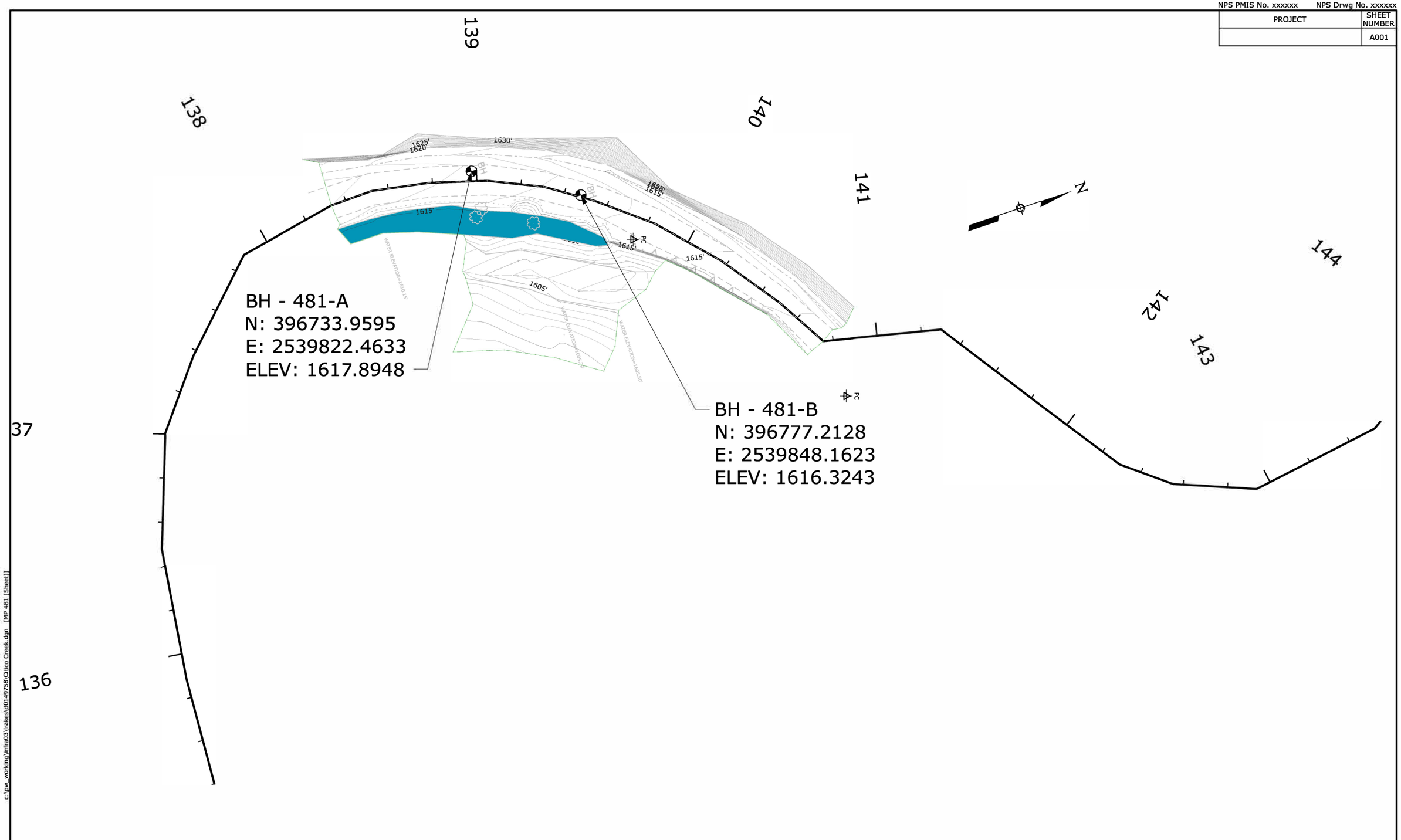
PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN



NPS PMIS No. xxxxxx NPS Drwg No. xxxxxx

PROJECT	SHEET NUMBER
	A001



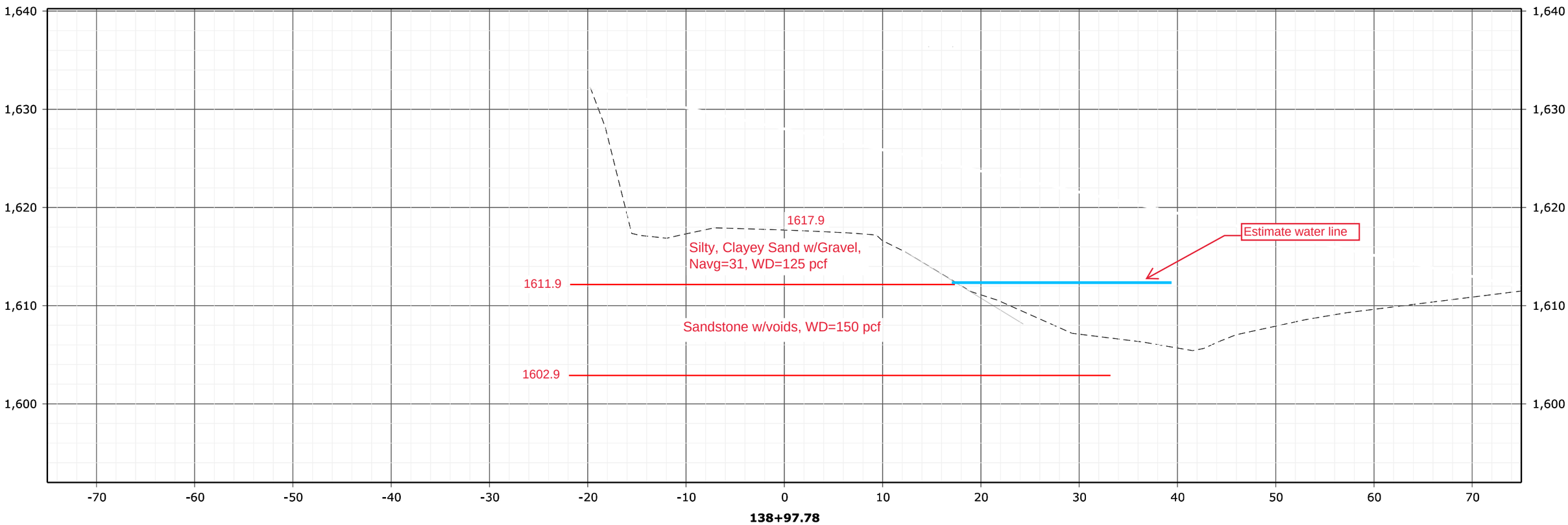
MP 481
PLAN SHEET

c:\pw_working\infra03\krakes\d0149758\Cliico Creek.dgn [MP 481 [Sheet]]

21 August 2024 3:57 PM

NPS PMIS No. xxxxxx NPS Drwg No. xxxxxx

PROJECT	SHEET NUMBER
	A001



FHWA, Office of Federal Lands Highway

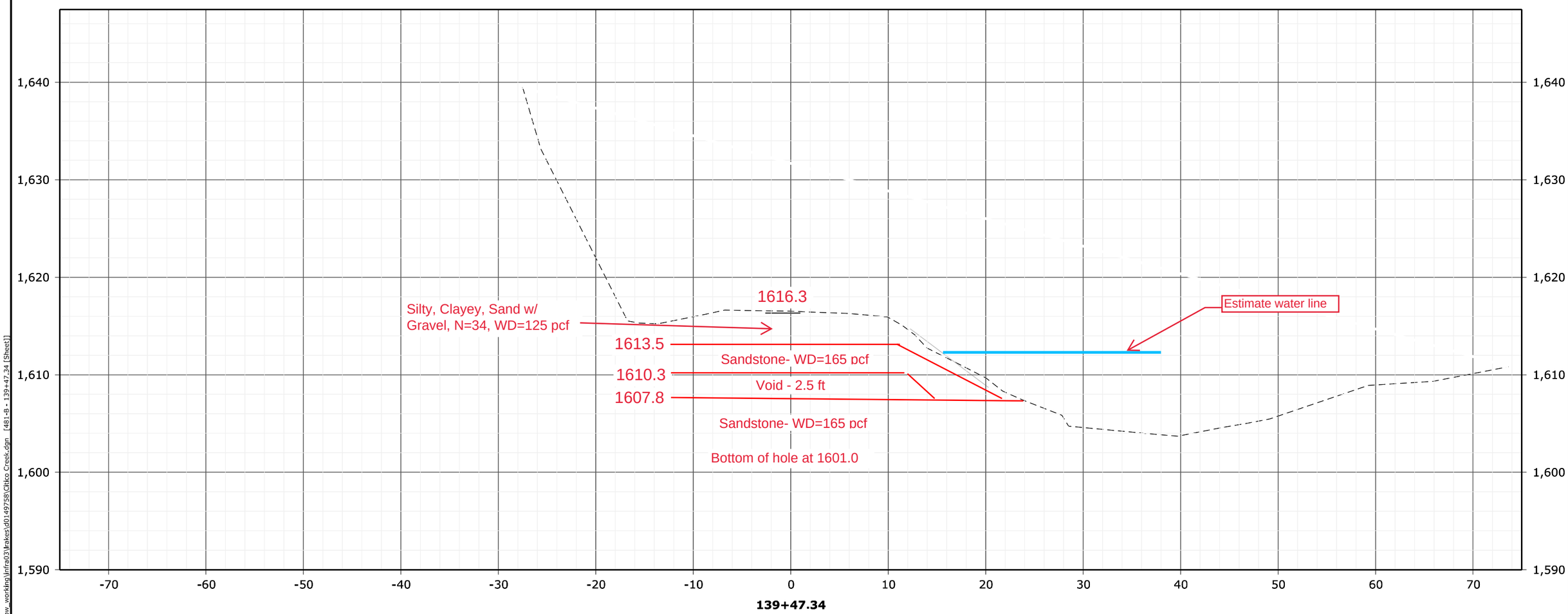
BH 481-A

c:\pw_working\infra03\lrakes\d0149758\Chico Creek.dgn [481-A - 138+97.78 [Sheet]]

21 August 2024 3:57 PM

NPS PMIS No. xxxxxx NPS Drwg No. xxxxxx

PROJECT	SHEET NUMBER
	A001



FHWA, Office of Federal Lands Highway

BH 481-B

c:\pw_working\infra03\frakes\d0149758\Chico Creek.dgn [481-B - 139+47.34 [Sheet]]

21 August 2024 3:57 PM

Stantec

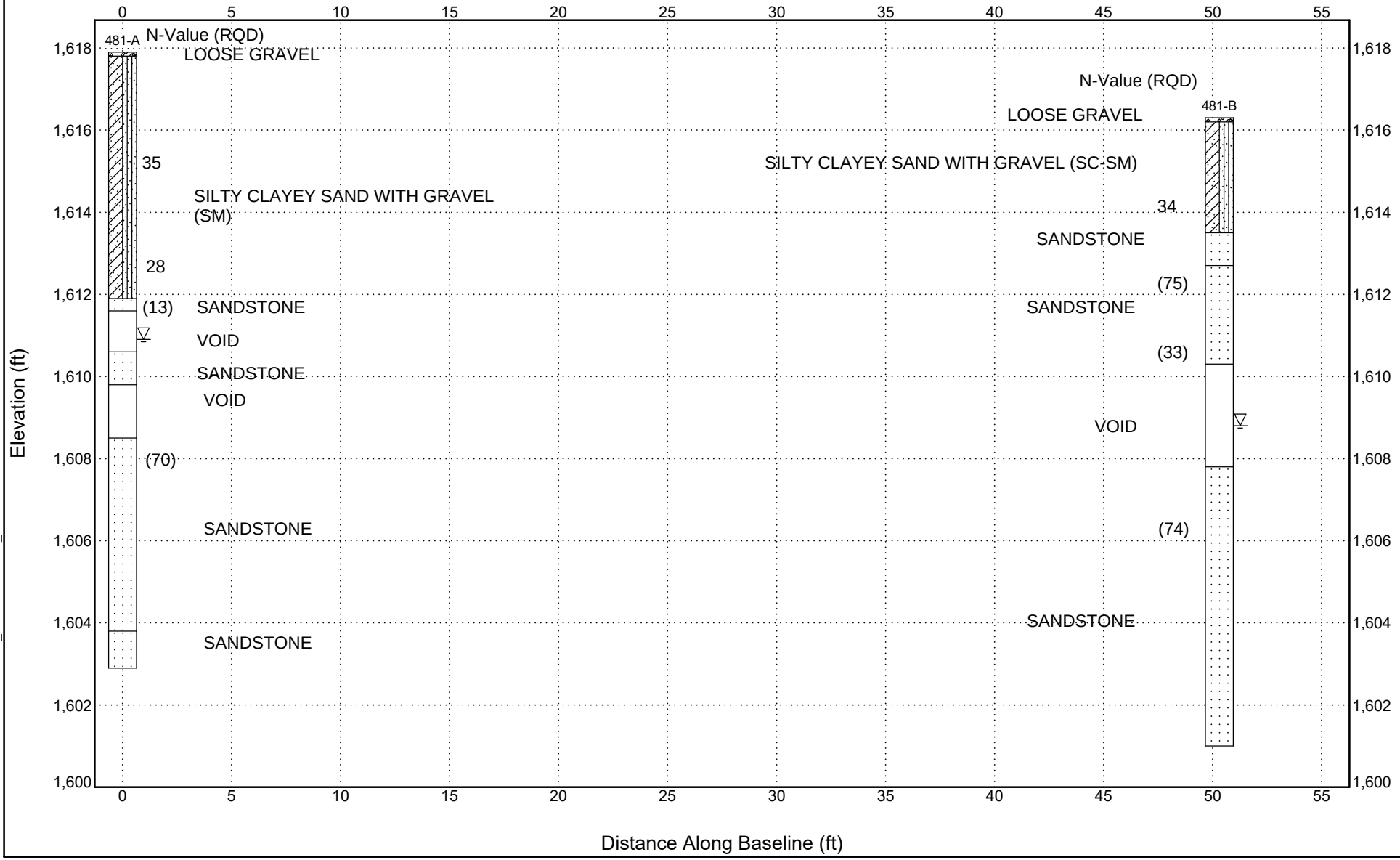
SUBSURFACE DIAGRAM
Boring 481A & B

CLIENT FHWA

PROJECT NUMBER 2026252404

PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN



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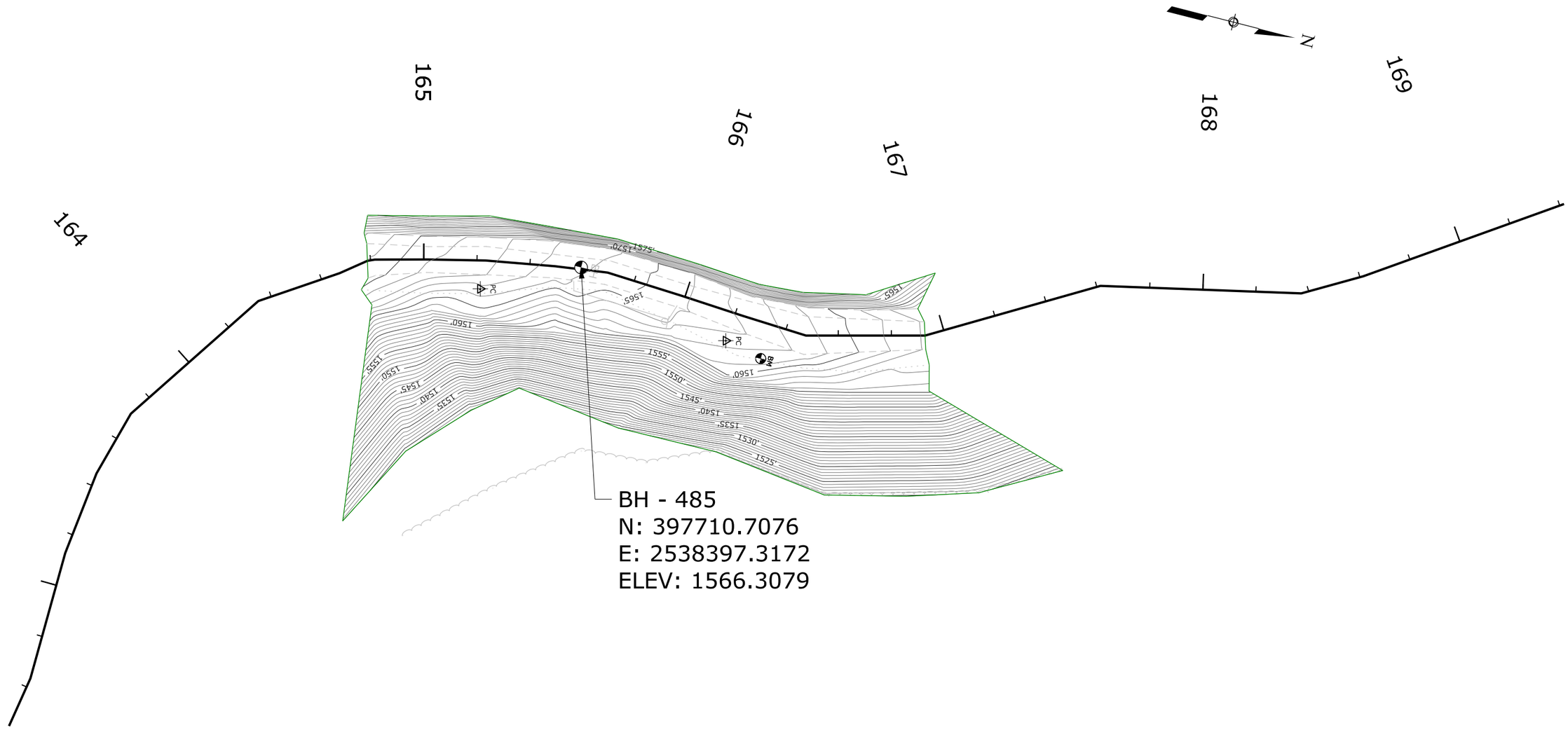

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21 August 2024 3:57 PM

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PROJECT	SHEET NUMBER
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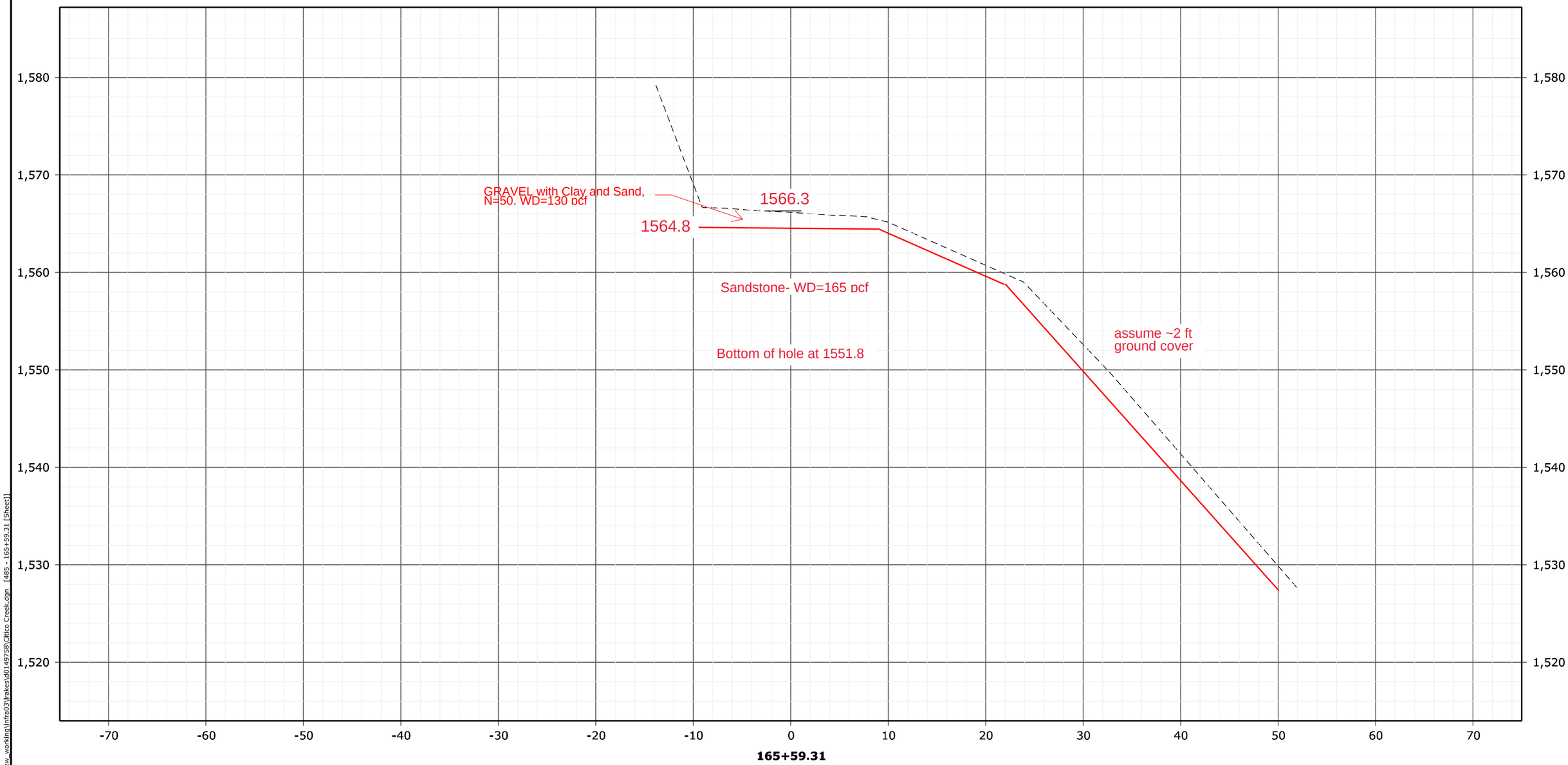

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BH 485

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Stantec

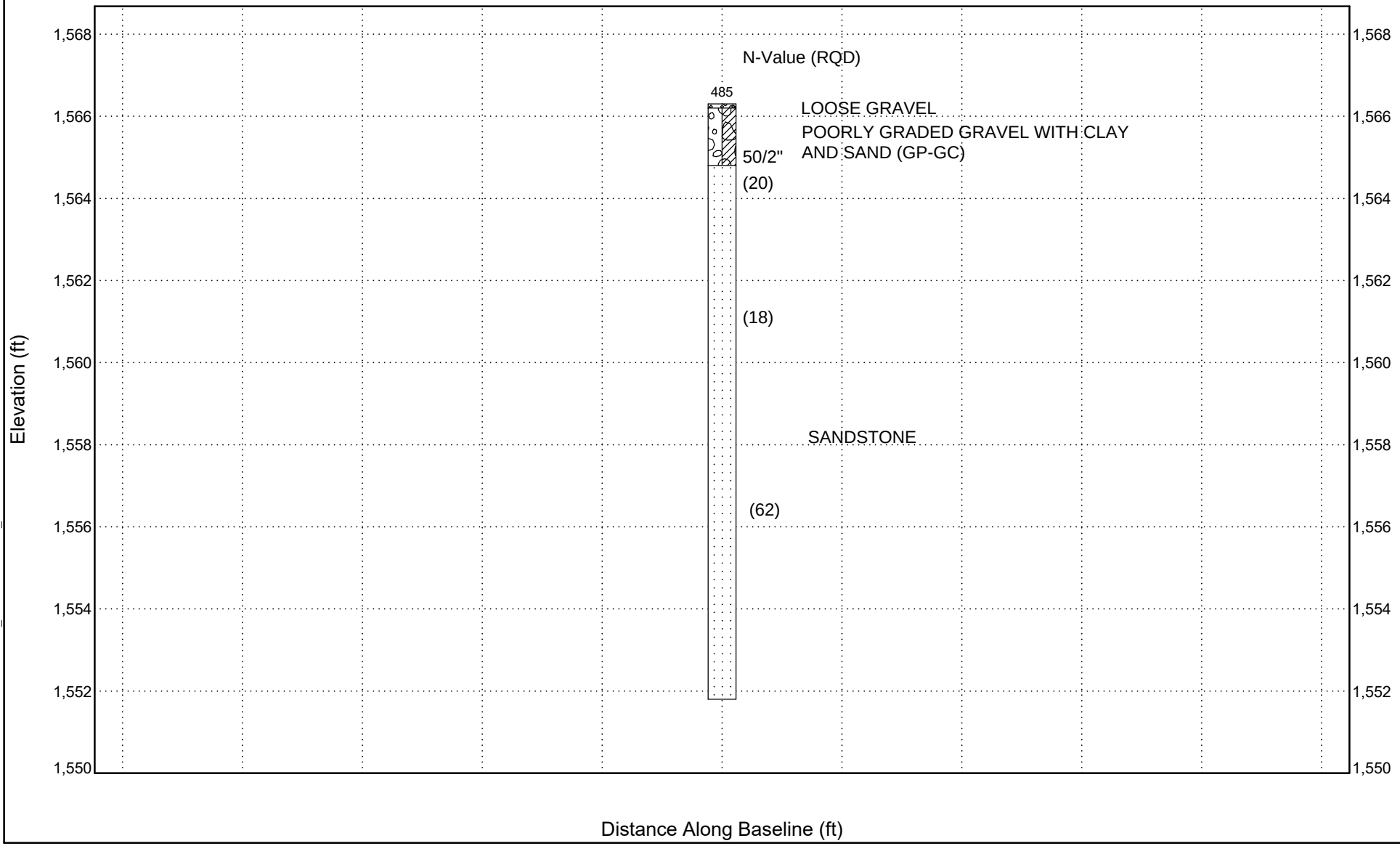
SUBSURFACE DIAGRAM
Boring 485

CLIENT FHWA

PROJECT NUMBER 2026252404

PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN



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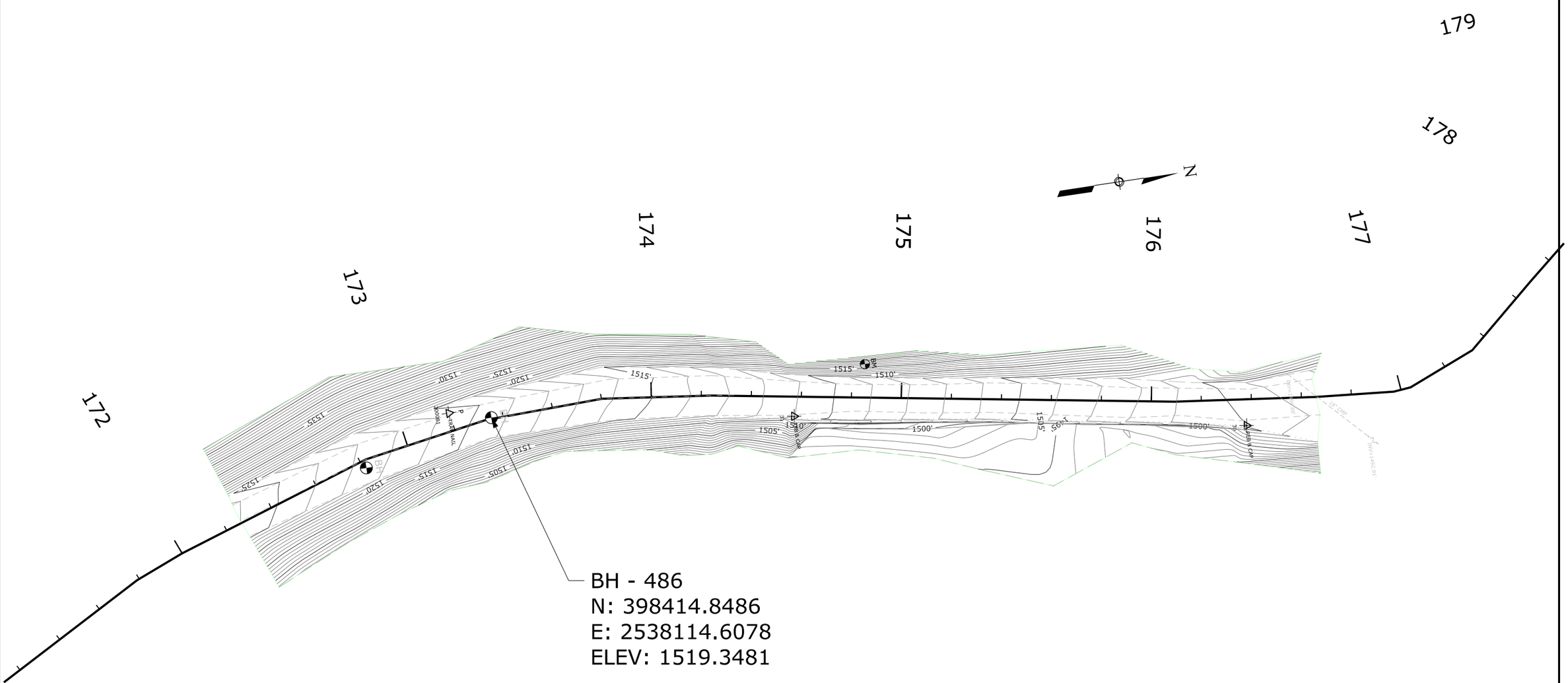

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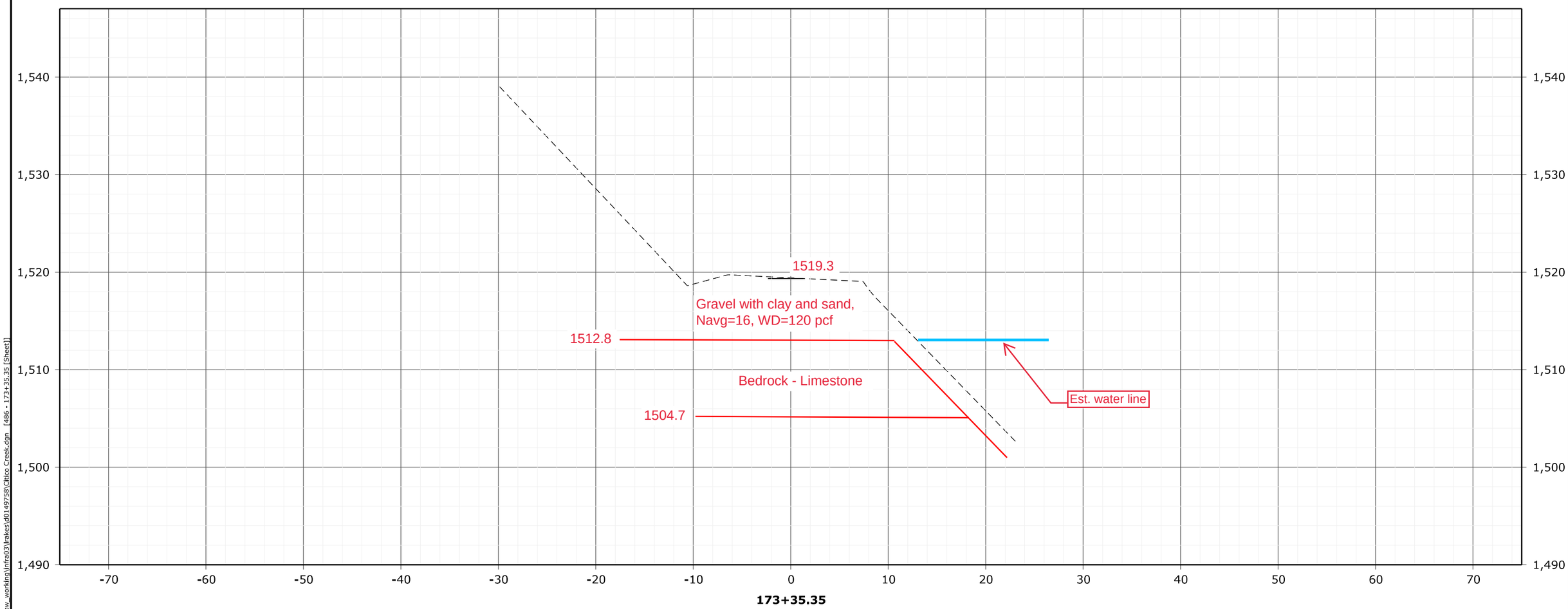

FHWA, Office of Federal Lands Highway

BH 486

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9 September 2024 3:50 PM

Stantec

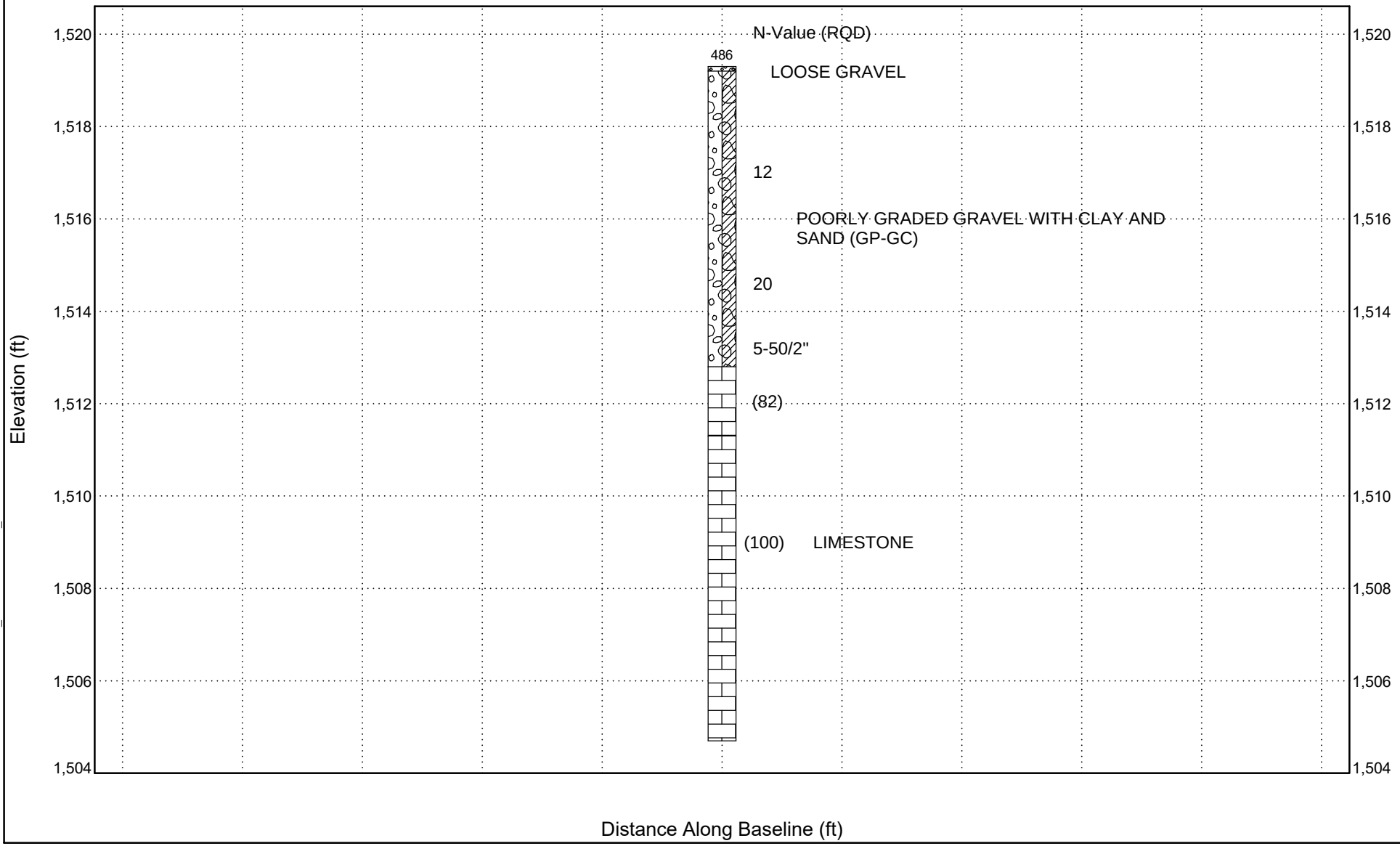
SUBSURFACE DIAGRAM
Boring 486

CLIENT FHWA

PROJECT NUMBER 2026252404

PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN



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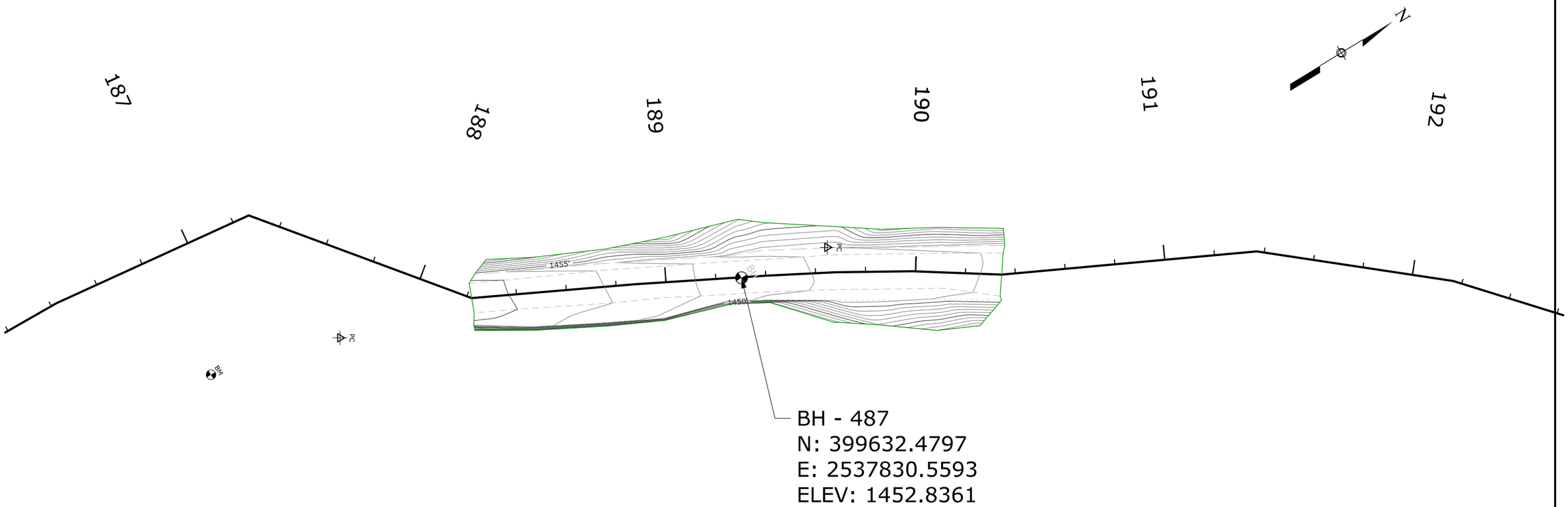

MP 487
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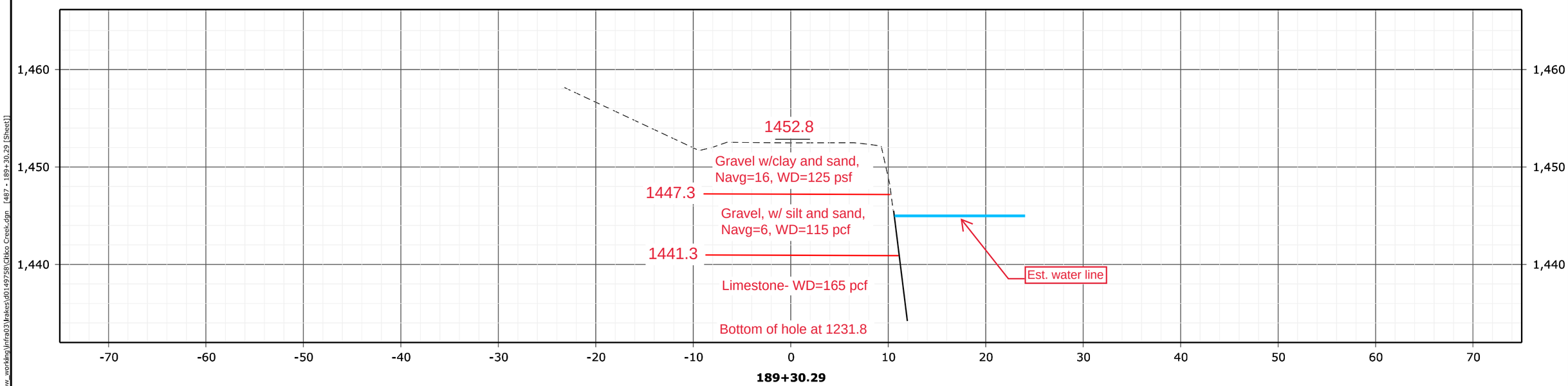

FHWA, Office of Federal Lands Highway

BH 487

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Stantec

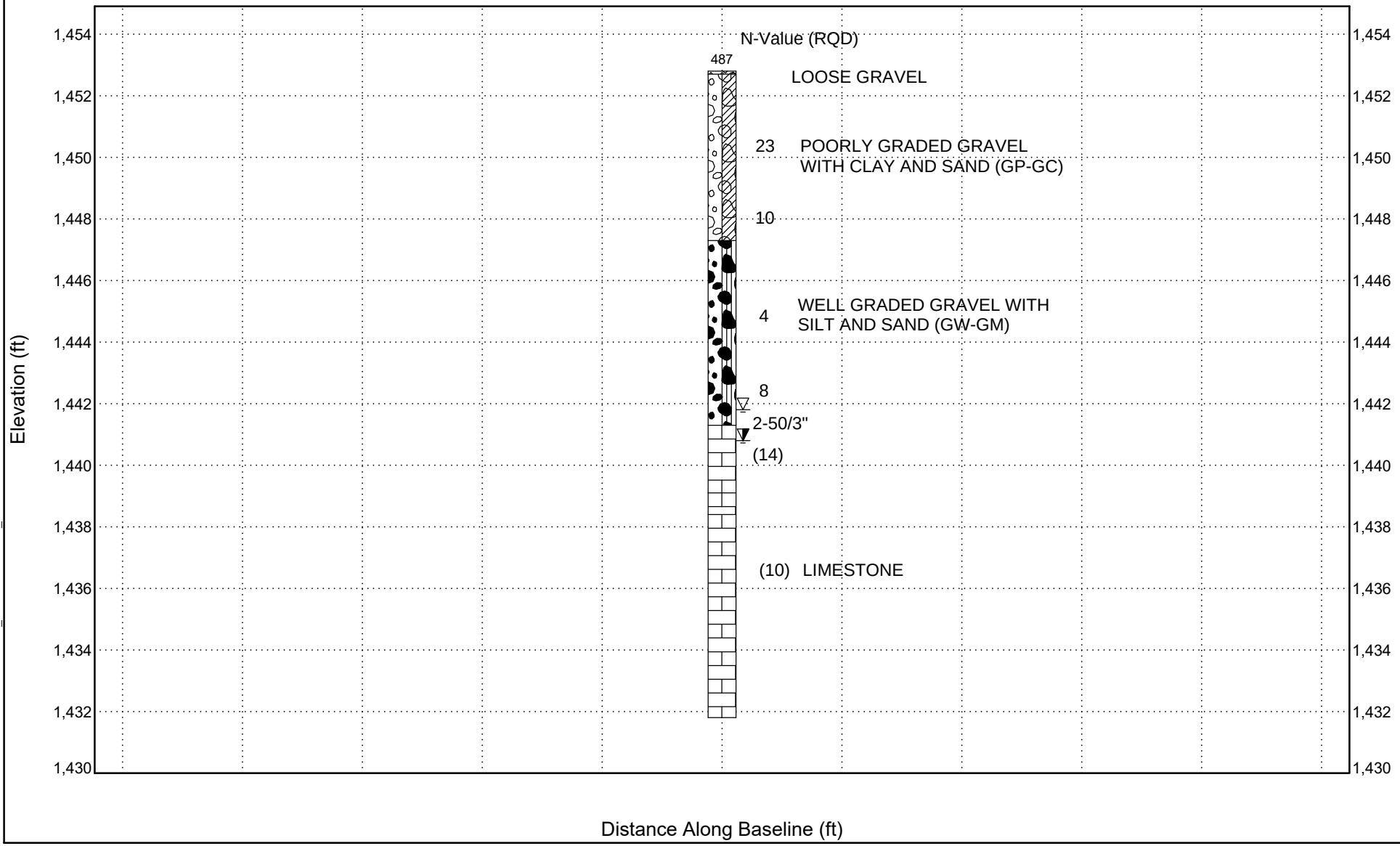
SUBSURFACE DIAGRAM
Boring 487

CLIENT FHWA

PROJECT NUMBER 2026252404

PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN



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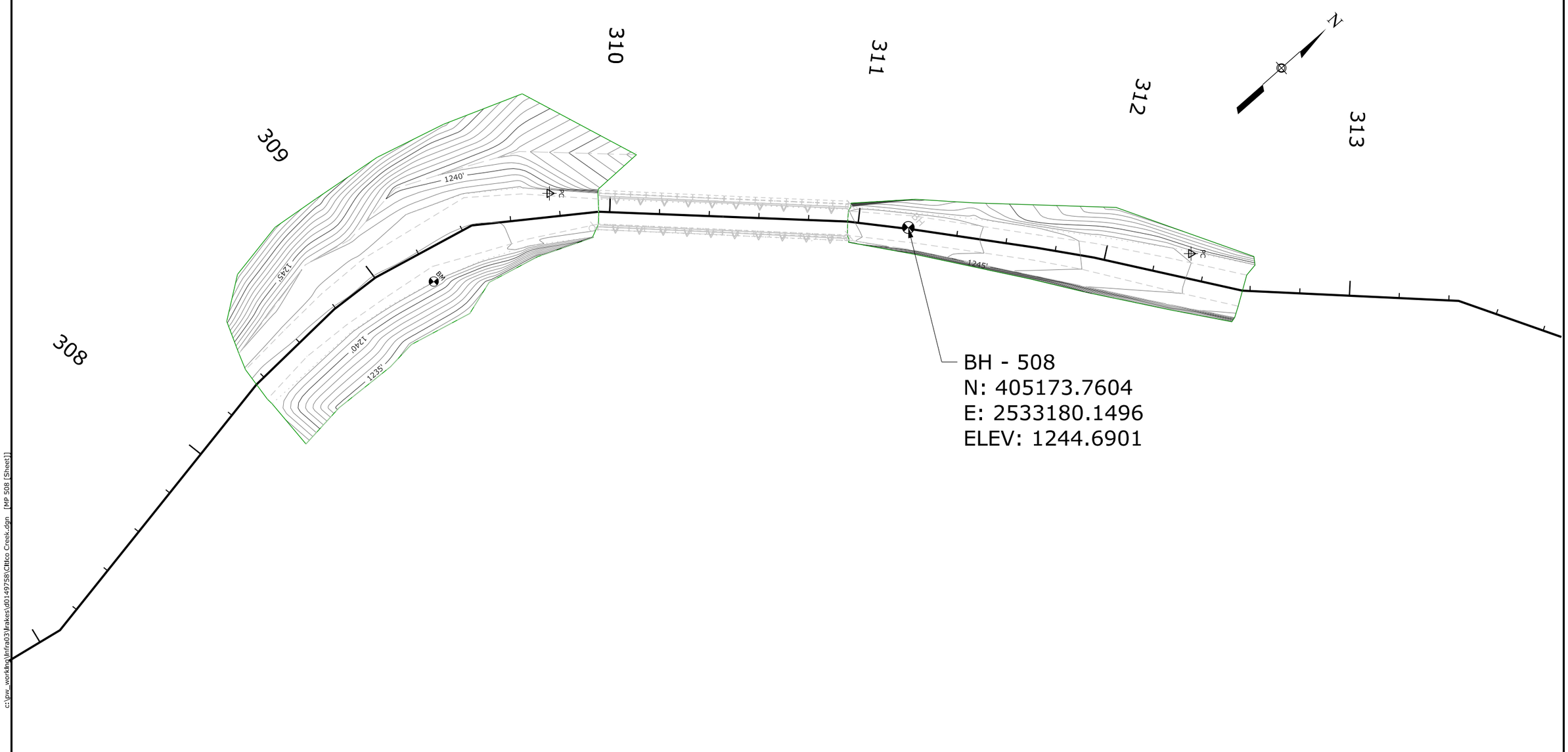

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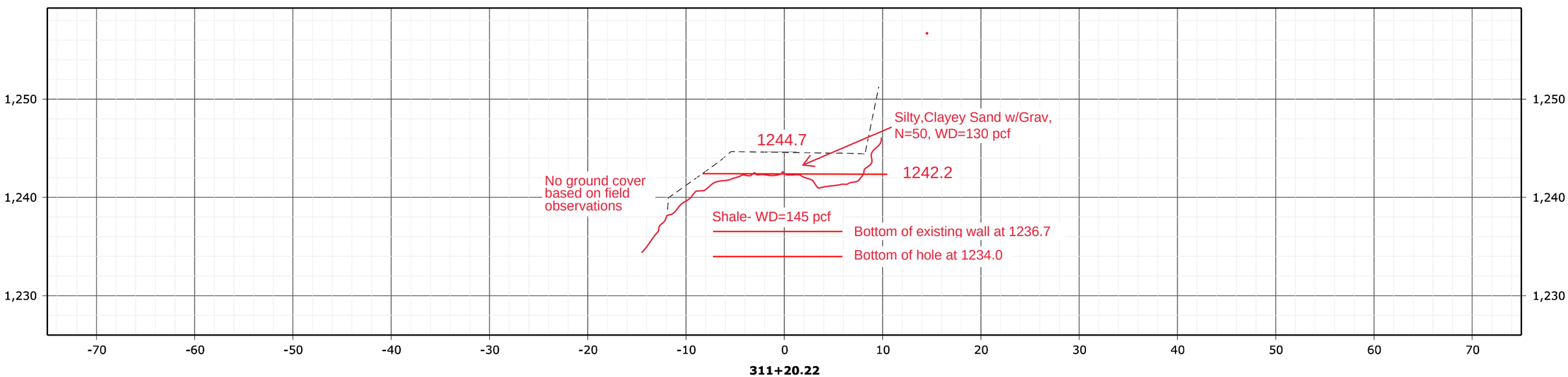

FHWA, Office of Federal Lands Highway

BH 508

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Stantec

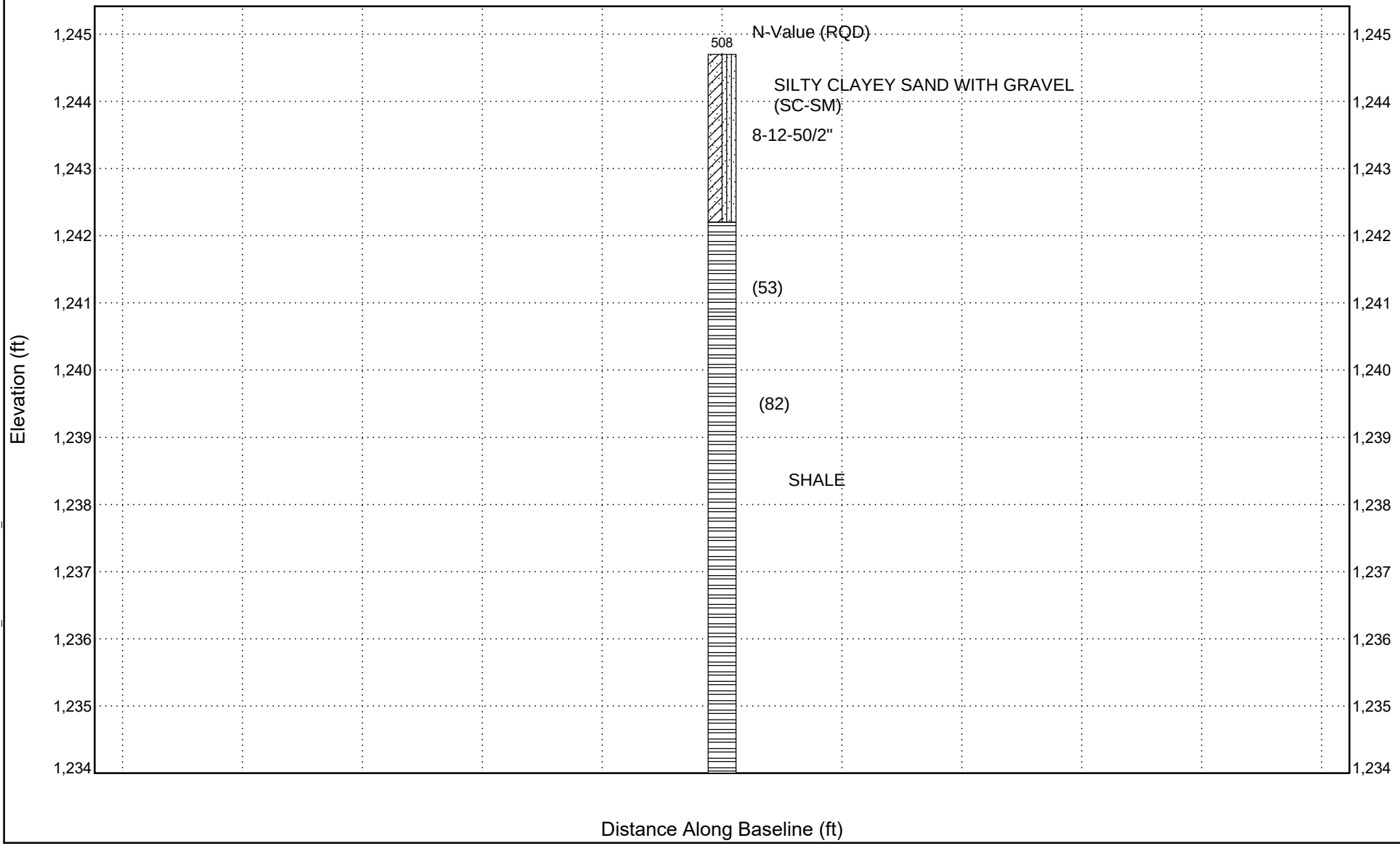
SUBSURFACE DIAGRAM
Boring 508

CLIENT FHWA

PROJECT NUMBER 2026252404

PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN



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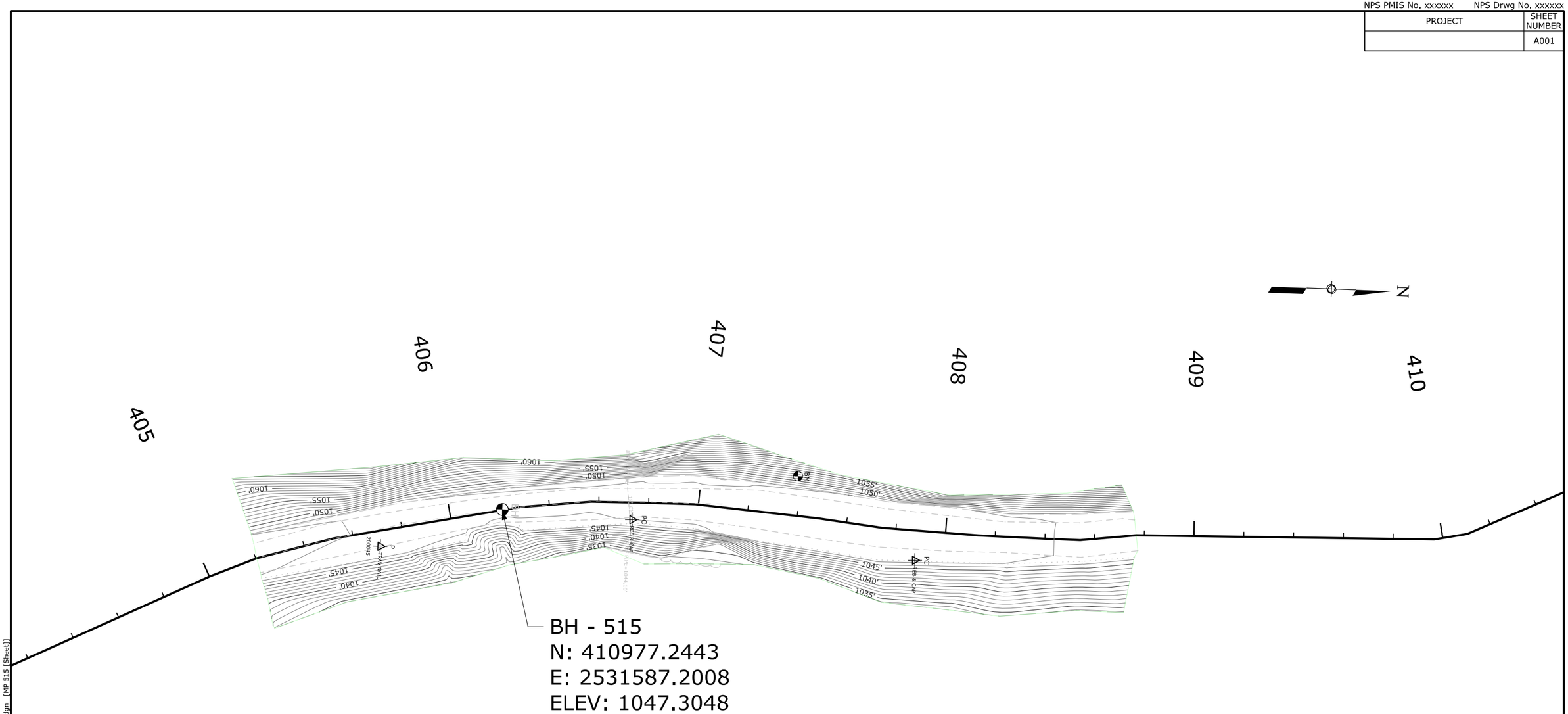

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PROJECT	SHEET NUMBER
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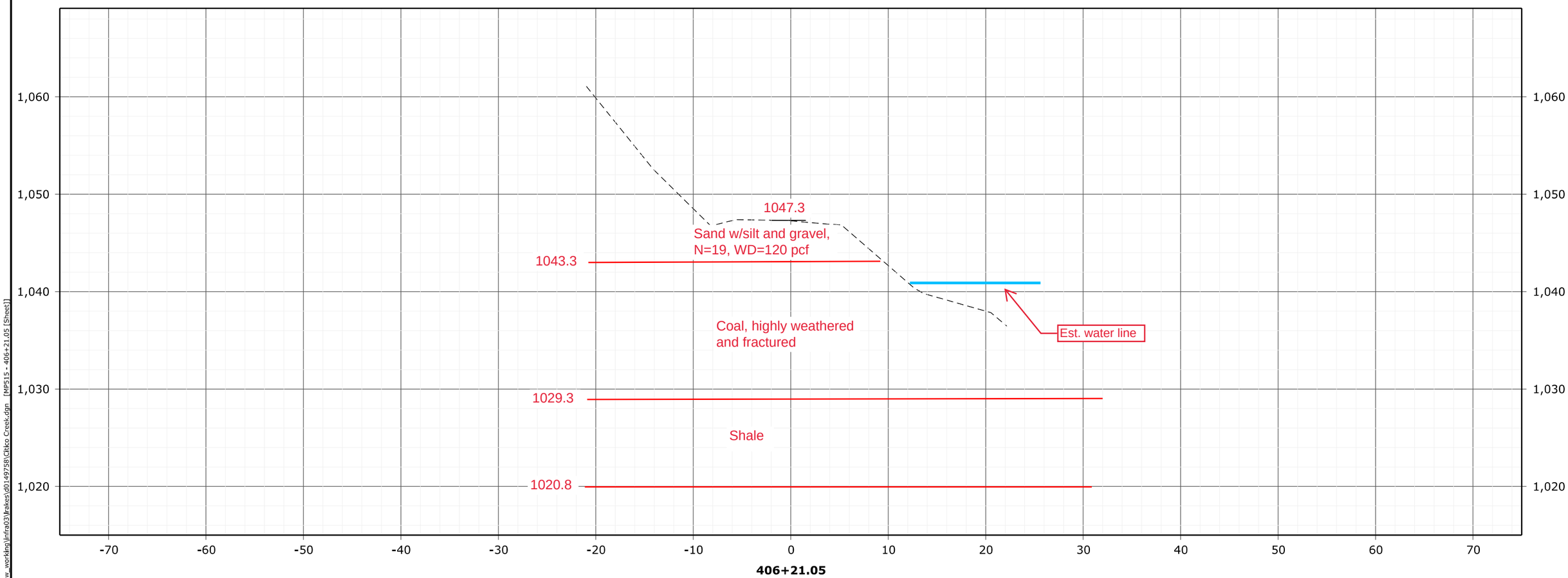

FHWA, Office of Federal Lands Highway

BH 515

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Stantec

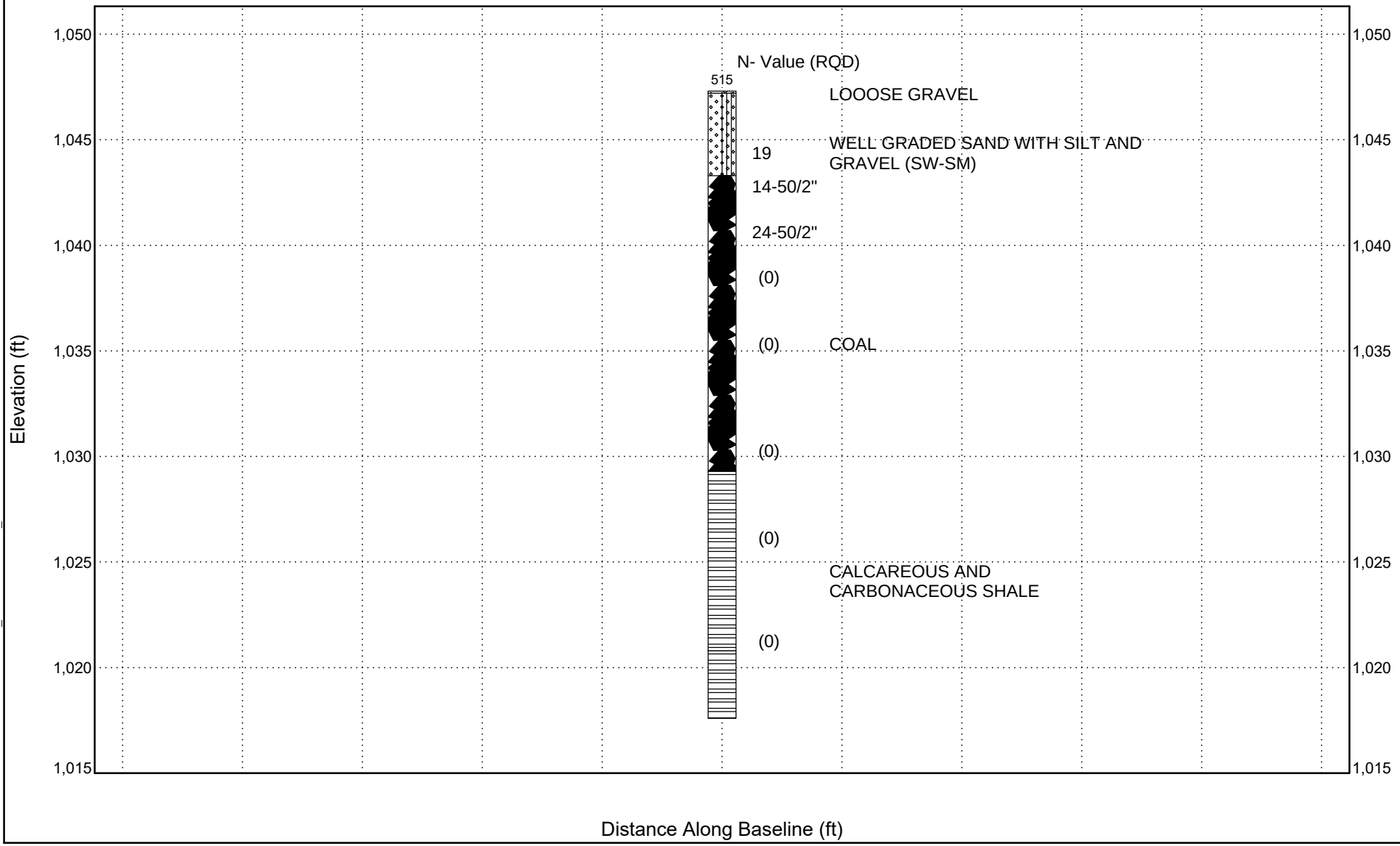
SUBSURFACE DIAGRAM
Boring 515

CLIENT FHWA

PROJECT NUMBER 2026252404

PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN



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PROJECT	SHEET NUMBER
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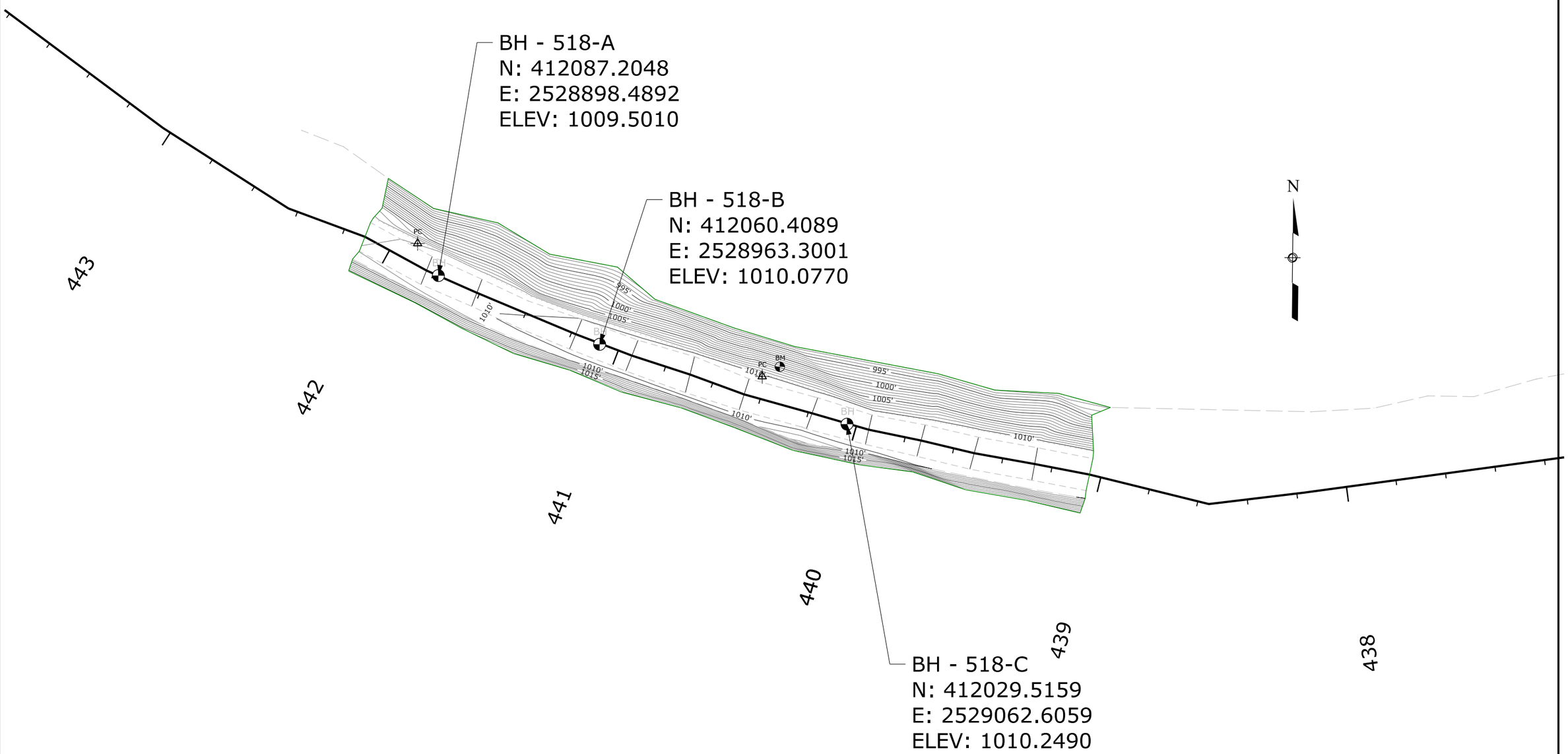

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PROJECT	SHEET NUMBER
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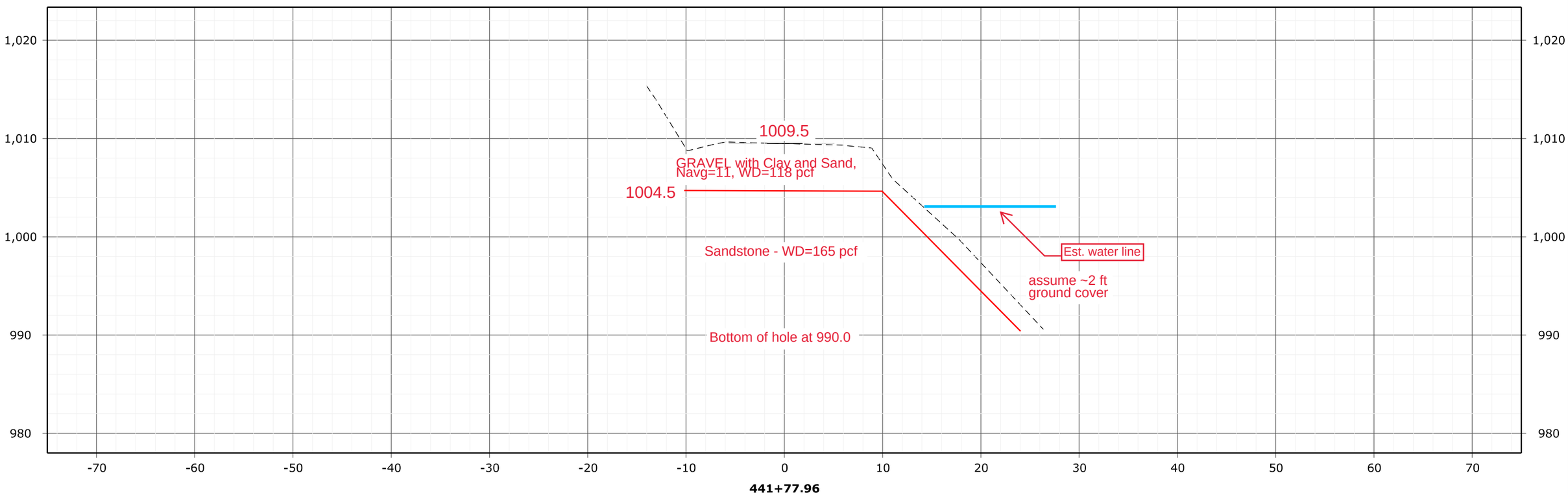

FHWA, Office of Federal Lands Highway

BH 518-A

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Stantec

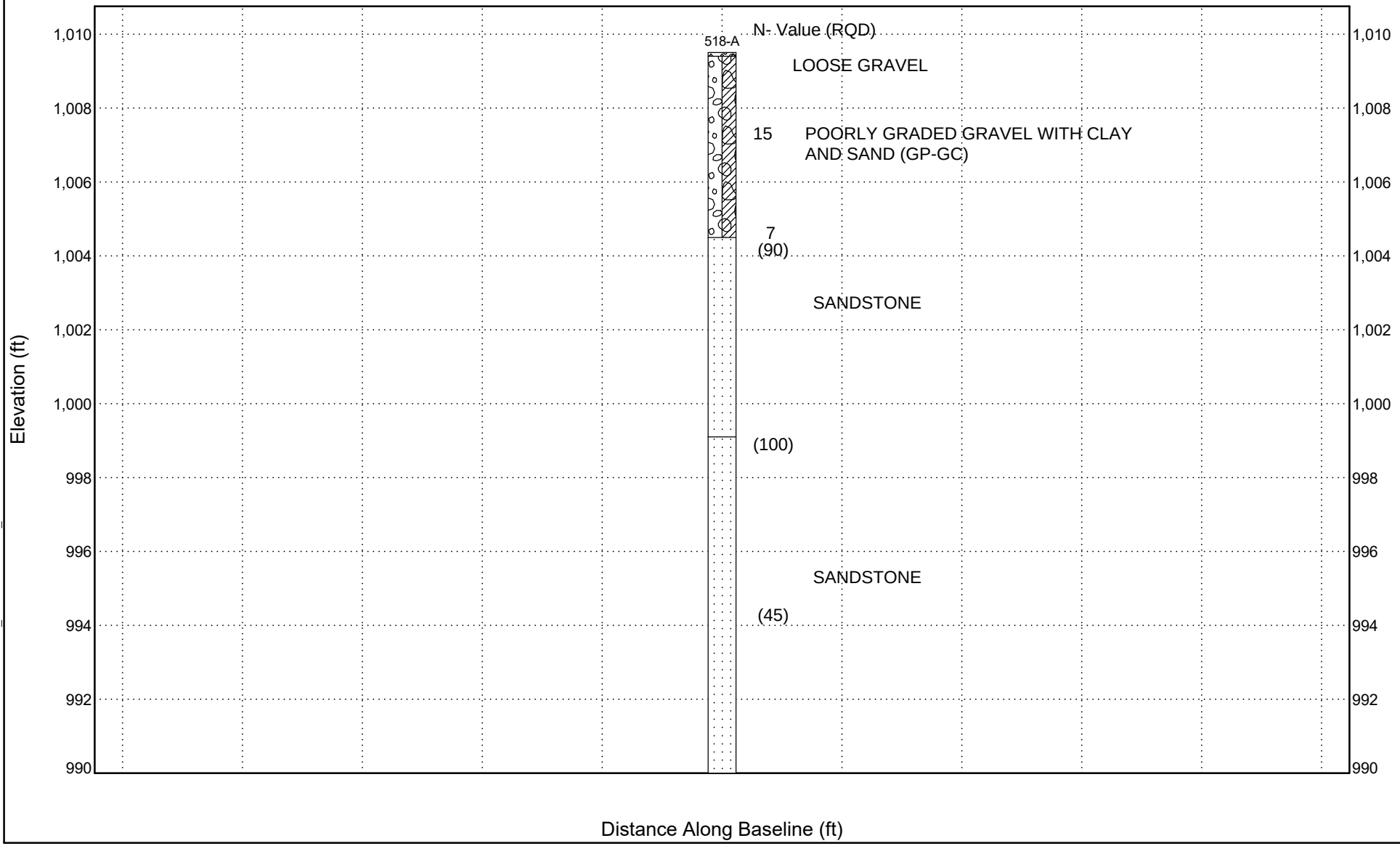
SUBSURFACE DIAGRAM
Boring 518A

CLIENT FHWA

PROJECT NUMBER 2026252404

PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN



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PROJECT	SHEET NUMBER
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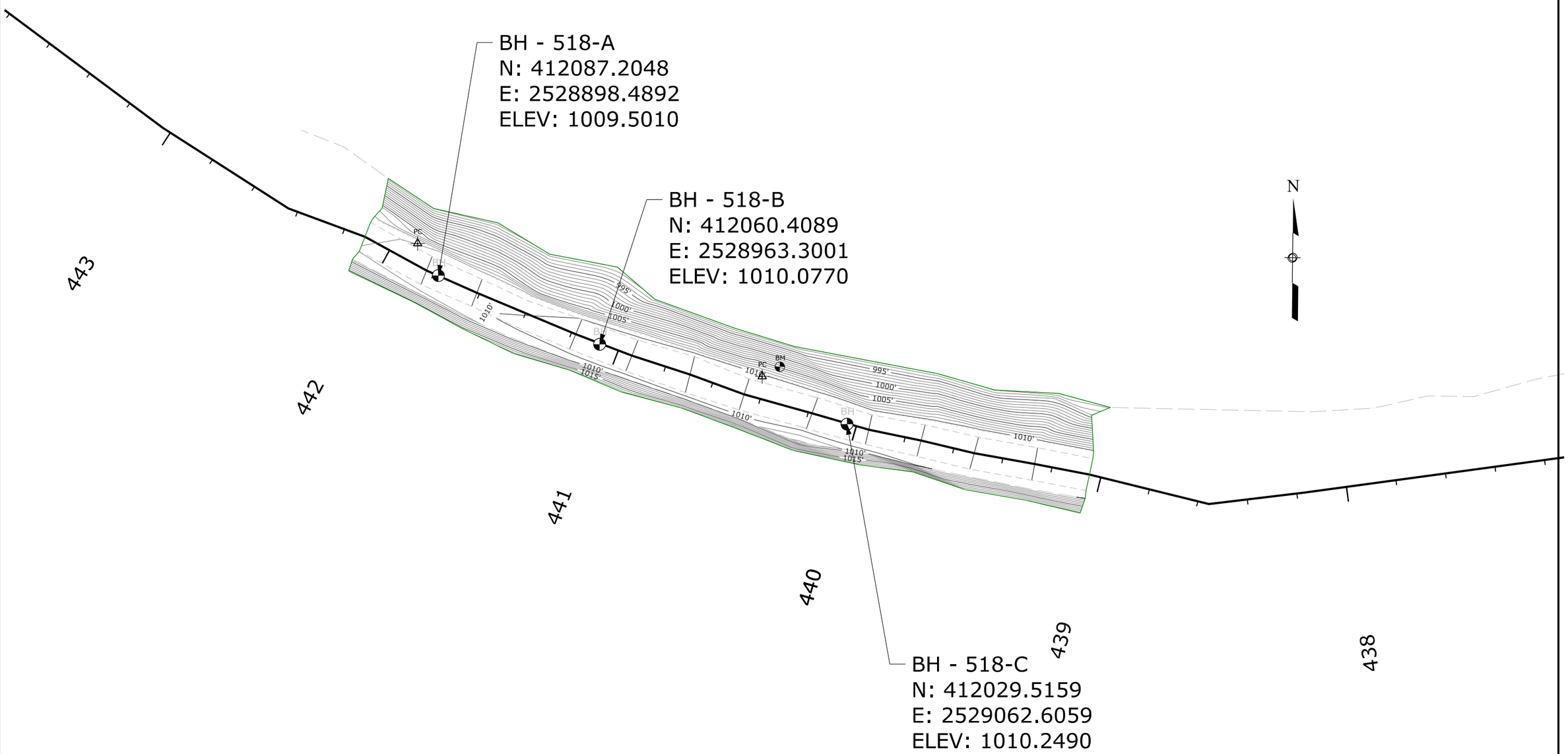

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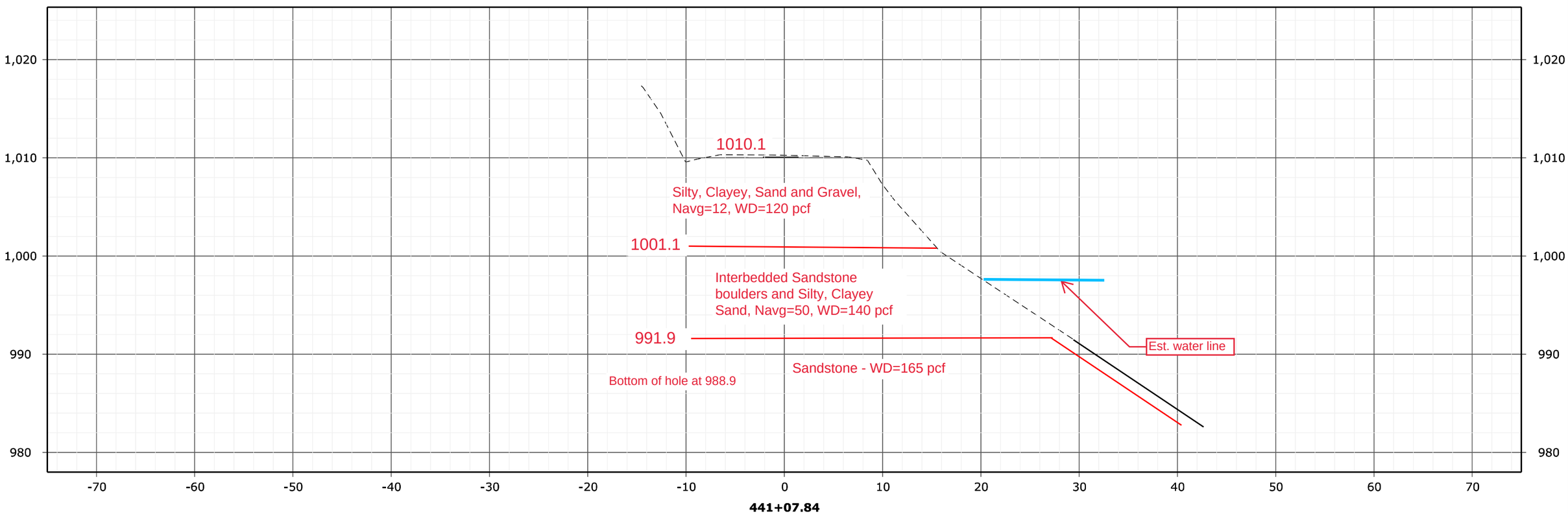

FHWA, Office of Federal Lands Highway

BH 518-B

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PROJECT	SHEET NUMBER
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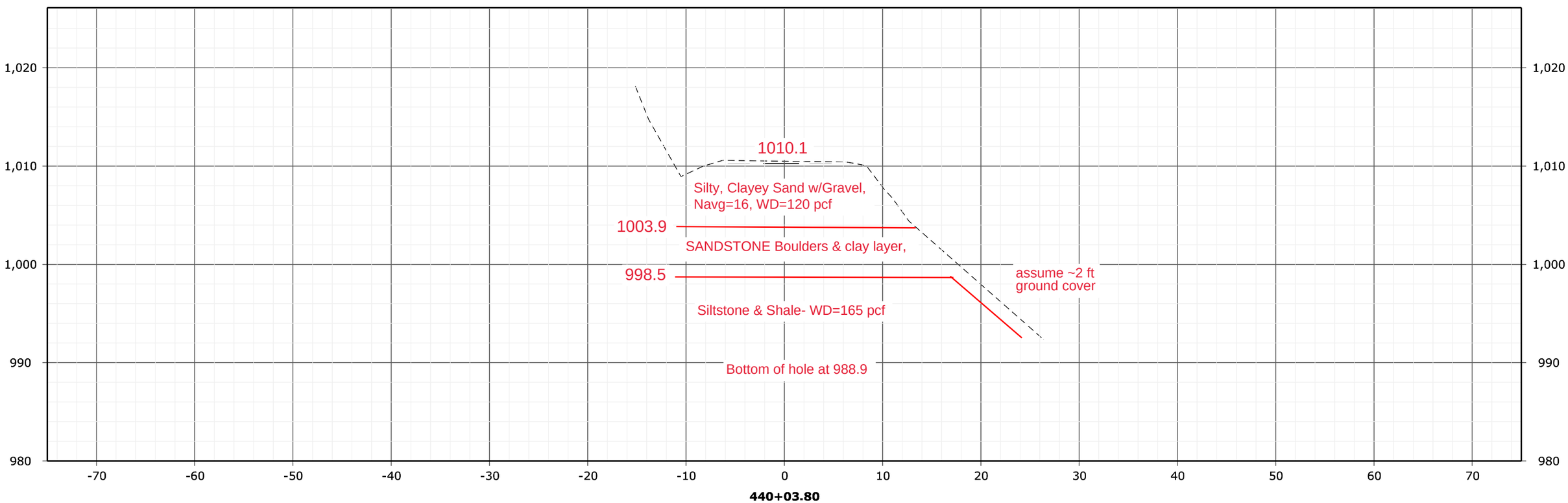

FHWA, Office of Federal Lands Highway

BH 518-C

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21 August 2024 4:00 PM

Stantec

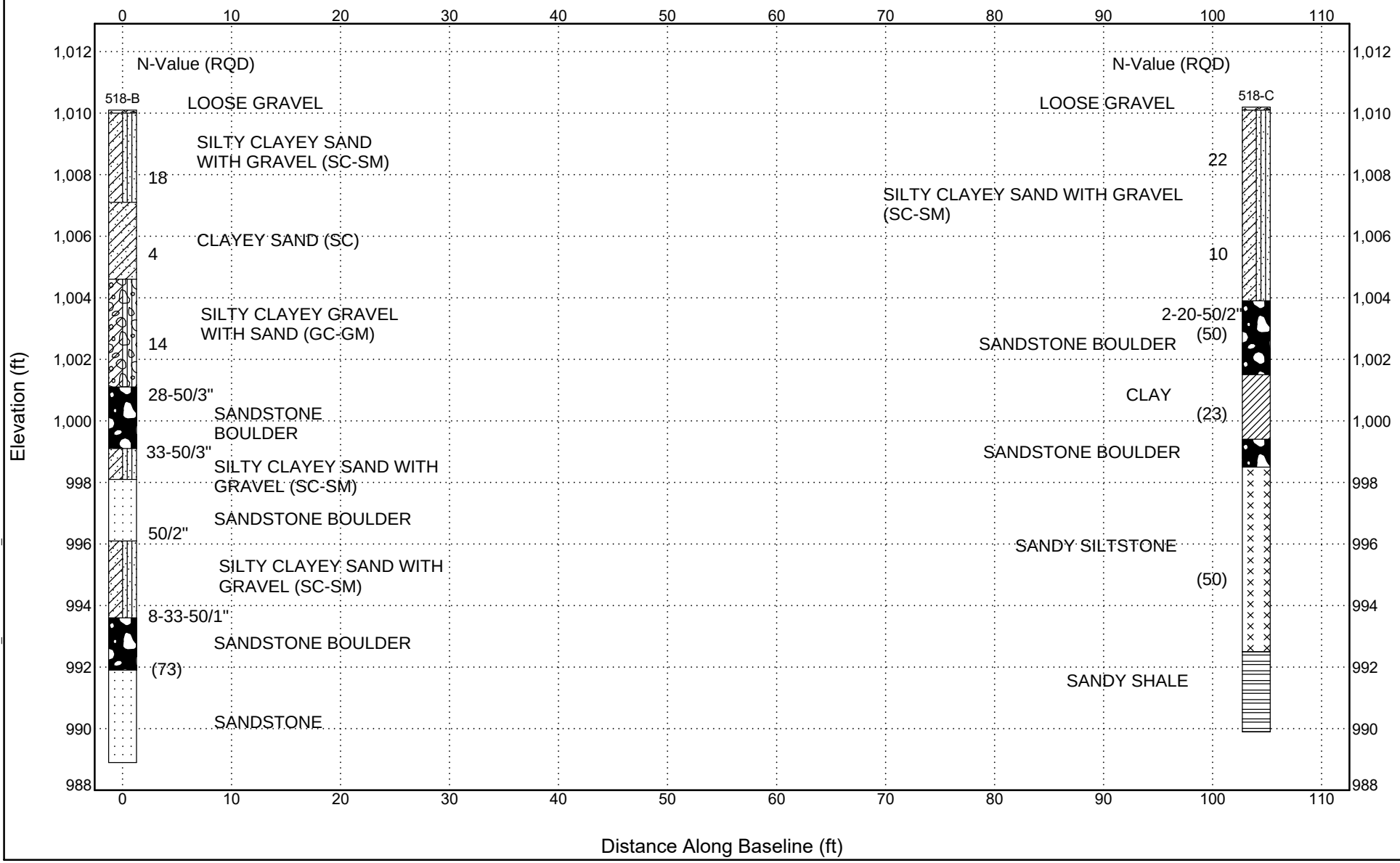
SUBSURFACE DIAGRAM
Boring 518B & C

CLIENT FHWA

PROJECT NUMBER 2026252404

PROJECT NAME TN ERFO FS CHRKE804 2020-2(5)

PROJECT LOCATION Cherokee National Forest, TN



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APPENDIX F
Slope Stability Analyses

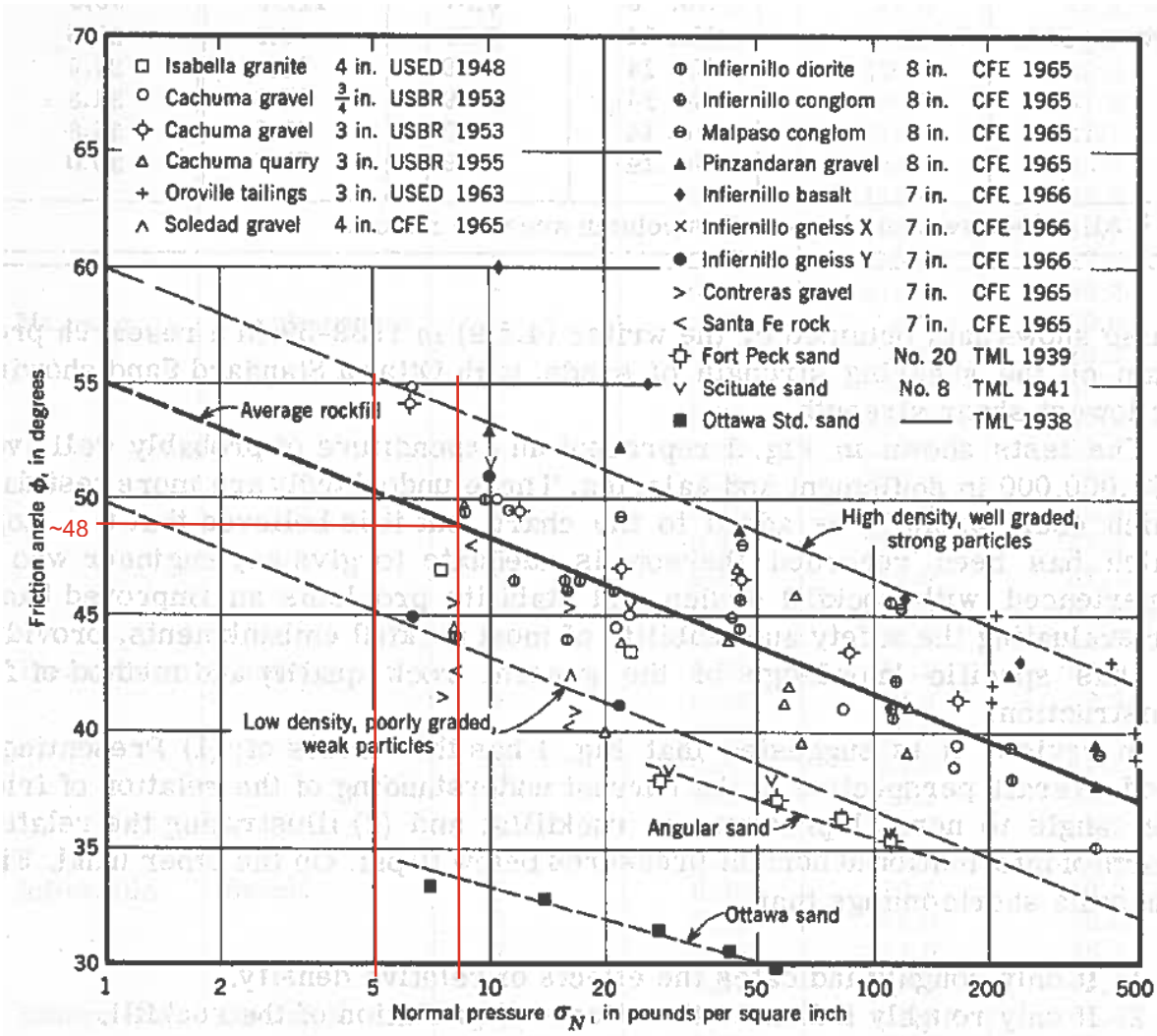

Figure 2. Shearing Strength of Rockfill from Large-scale Triaxial Tests (from Leps 1970)

For Normal Pressures ranging from 5 to 8 psi (750 to 1125 psf - 6 to 9 ft of rock fill).

NPS PMIS No. xxxxxx NPS Drwg No. xxxxxx

PROJECT	SHEET NUMBER
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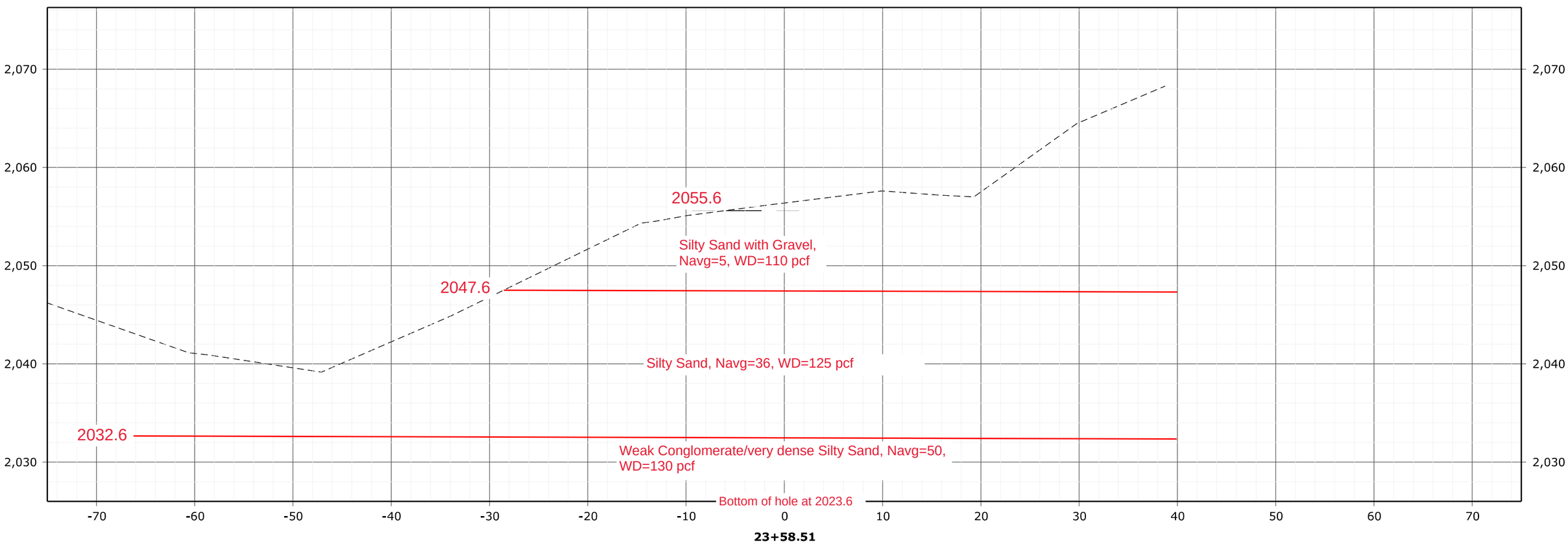

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21 August 2024 3:32 PM

FHWA, Office of Federal Lands Highway

BH 466-B

Reinforced Soil Slope Analysis:

Description: The slope at MP 466 is approximately 15 feet high from the crest at the edge of the road. The subsurface profile consists of about 8 to 10 feet of very loose to loose silty sand with gravel over 11 to 15 feet of medium dense to dense silty sand. The overburden is underlain by weak highly weathered conglomerate and sandstone. Based on the cross sections at Boring 466-A and B the slopes are currently at 2H:1V of flatter. Slope stability analyses for existing conditions, repaired with rip rap, and repaired with rip rap and reinforced with geogrid are summarized in the table below.

Summary of Preliminary Slope Stability Analyses – MP 466-B

Conditions	Resulting FOS	Remarks
Existing	1.28	Shallow failure occurs in the upper loose silty sand
Existing - Seismic	0.78	Failure occurs in the upper loose silty sand
Repaired w/ Rip Rap	1.30	Approx. 12-in layer applied to slope face
Repaired w/ Rip Rap -Seismic	0.79	Approx. 12-in layer applied to slope face

Min Static FOS = 1.3, Seismic FOS = 1.1

The results of the preliminary slope stability analyses indicate that the repaired slope with a rip rap cover meets the required factor of safety (FOS) of 1.3. However, when a seismic load is applied the FOS for the repaired slope drops to 0.79 which is less than the required 1.1. From AASHTO 11.6.5.2.2, a wall that is capable of displacement of 1 to 2 inches or more during the design seismic event, k_h may be reduced to $0.5k_{h0}$ without conducting a deformation analysis. This applies to reinforced soil slopes as well. Using a conservative Site Class analysis for Citico Creek the resulting A_s is equal to 0.23. Therefore, the reduced $k_h = 0.5\ A_s = 0.12$ for the reinforced slope stability analysis. The k_h ($k_h = A_s$) for the existing and repaired slopes without reinforcement is 0.23**.**

Stantec utilized the slope stability software GeoSlope to analyze the existing and proposed conditions. GeoSlope has the ability to analyze reinforced slopes and the reinforcement for adequacy of design. Based on FHWA GEC-11, November 2009, Chapter 9, the tensile capacity of a reinforcement layer is taken as the minimum of its allowable pullout resistance behind the potential failure surface or its long-term allowable design strength. The slope stability factor of safety is taken from the critical surface requiring the maximum amount of reinforcement. Final design is performed by distributing the reinforcement over the height of the slope and evaluating the external stability of the reinforced section.

Analysis:

Define slope and soil parameters.

Slope height, H = 15 ft
Slope angle, $\theta = 26.6°$ (2H:1V)
Traffic Surcharge = 250 psf
Upper silty sand w/ gravel – $c_u = 0$, $\phi = 30°$, $\gamma = 110$ pcf
Lower silty sand – $c_u = 0$, $\phi = 35°$, $\gamma = 120$ pcf
Conglomerate - $c_u = 0$, $\phi = 38°$, $\gamma = 130$ pcf
Groundwater at 19 ft.

Assumed geogrid/soil interface friction angle = 25°

Performance Requirements:

External Stability

- Overall Stability, Static – FOS>1.3
- Dynamic Loading – FOS>1.1
- Internal Slope Stability – FOS>1.3
- Bearing Failure (lateral squeeze) – FOS>1.3

Soil Parameters:

Stantec proposes to reuse the existing excavated soil from the proposed reinforced zone. According to GEC-11, Vol 1, Table 3-2, granular reinforced fill should meet the following requirements.

Table 3-2. RSS Granular Reinforced Fill Requirements.

Gradation: (AASHTO T-27)	U.S. Sieve Size	Percent Passing
	4 in. (102 mm)[a,b] ¾-inch (20 mm)[a]	100
	No. 4 (4.76 mm)	100 – 20
	No. 40 (0.425 mm)	0-60
	No. 200 (0.075 mm)	0 – 50
Plasticity Index, PI (AASHTO T-90)	PI ≤ 20	
Soundness: (AASHTO T-104)	Magnesium sulfate soundness loss less than 30% after 4 cycles, based on AASHTO T-104 or equivalent sodium sulfate soundness of less than 15 percent after 5 cycles.	

Note:
(a) To apply default F* values, C_u, should be greater than or equal to 4.
(b) As a result of recent research on construction survivability of geosynthetics and epoxy coated reinforcements, it is recommended that the maximum particle size for these materials be reduced to ¾-in. (19 mm) for geosynthetics, and epoxy and PVC coated steel reinforcements unless construction damage assessment tests are or have been performed on the reinforcement combination with the specific or similarly graded large size granular fill. Prequalification tests on reinforcements using standard agency fill materials should be considered.

Based on soil classification test performed on samples from Borings 466-A and B, the existing soils within the proposed reinforced zone are classified as Silty Sand with gravel and generally meets the gradation recommendations above. For reinforced soil slopes the design soil strength, due to higher fines content, are typically equal to 28 to 30 degrees. In the analysis of this reinforced slope a friction angle of 30 degrees was used, which is likely lower than that of the compacted in-place fill. For geosynthetic reinforcements the limits for the electrochemical criteria will vary depending on the polymer type. Stantec tested the upper Silty Sand with gravel from both borings and the resulting pH values were 4.5 and 6.3. Both values exceed the minimum pH criteria of 3 based on GEC-11, Table 3-4.

Design Parameters for Reinforcement:

Allowable Geogrid Strength T_{al} = ultimate strength (Tult) / reduction factors (RF) for creep, installation damage, and durability

For granular reinforced fill meeting the recommended gradation and electrochemical properties cited above, RF values typically ranges between 1 to 3 based on review or several manufacturer's reduction factors. Stantec used an RF value of 3 for preliminary design. Depending on the actual geogrid reinforcement used and confirmatory tests performed, the RF could be lower. Based on review of various geogrid manufacturers, a geogrid with an ultimate strength of 2000 lbs/ft was used for preliminary design.

Therefore, the allowable tensile strength for the geogrid is:

T_{al} = 2000 / 3 = 666 lbs/ft

Using GeoSlope, with a vertical grid spacing of 1.5 feet, that extends approximately 6 inches into the denser underlying silty sand layer, results in a 6-layer reinforced soil slope system. Slope stability analyses with geogrid reinforcement are summarized in the table below.

Summary of Reinforced Slope Stability Analyses – MP 466-B

Conditions	Resulting FOS	Remarks
Repaired and reinforced - Static	1.62	Failure occurs below/around the reinforced zone
Repaired and reinforced - Seismic	1.24	Failure occurs below/around the reinforced zone

Min Static FOS = 1.3, Seismic FOS = 1.1

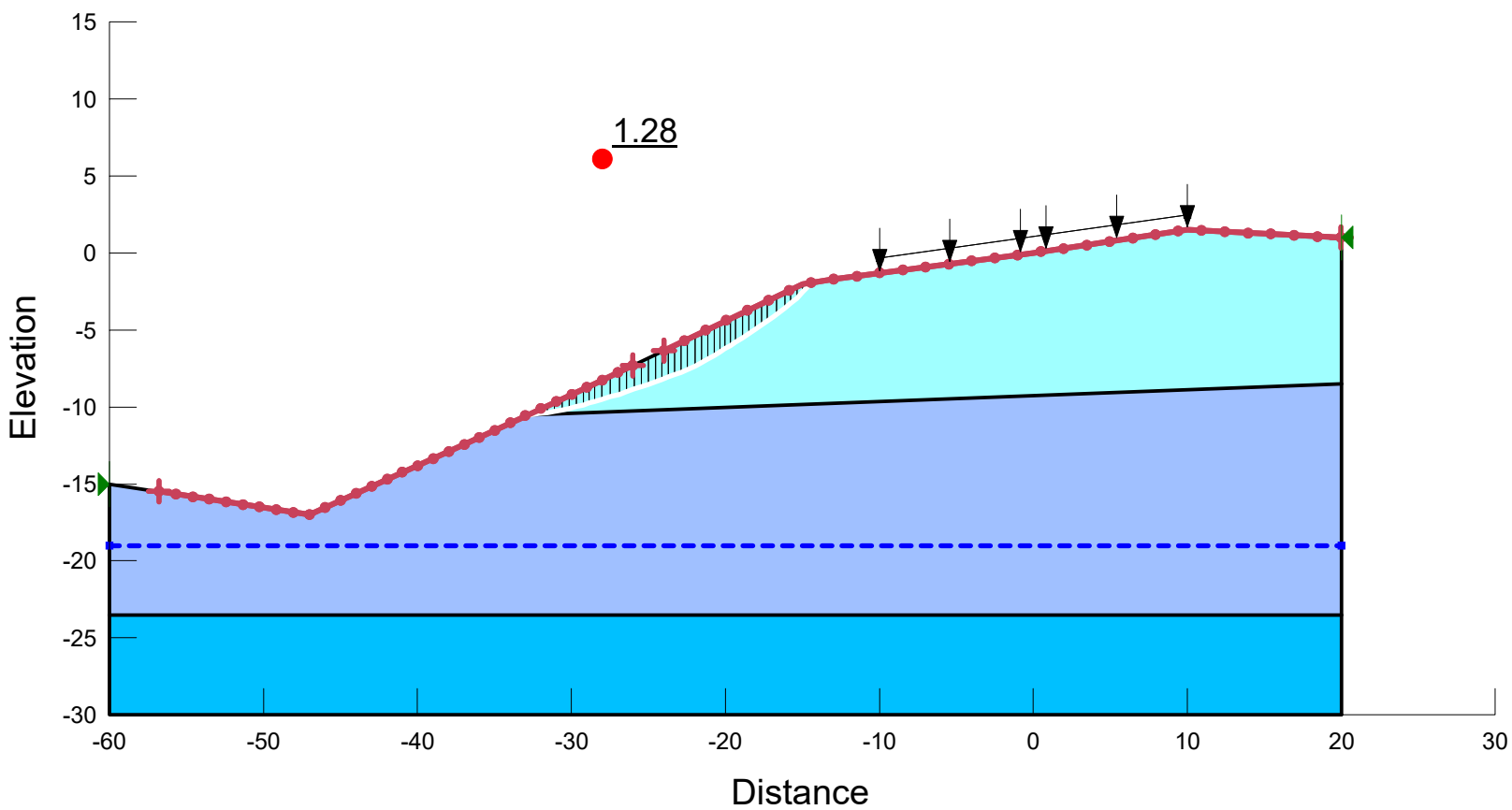
Note, the lowest factor of safety occurs below/around the reinforced zone. Failure surfaces intersecting the geogrid or passing between geogrid layers have a higher factor of safety.

TN ERFO FS CHRKE804 2020-2(5)
Global Stability Analysis
Existing Conditions - 2H:1V Slope
MP466-B

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Conglomerate	130	0	38
	Silty Sand	120	0	35
	Silty Sand w/Gravel	110	0	30

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability of a 2H:1V Slope

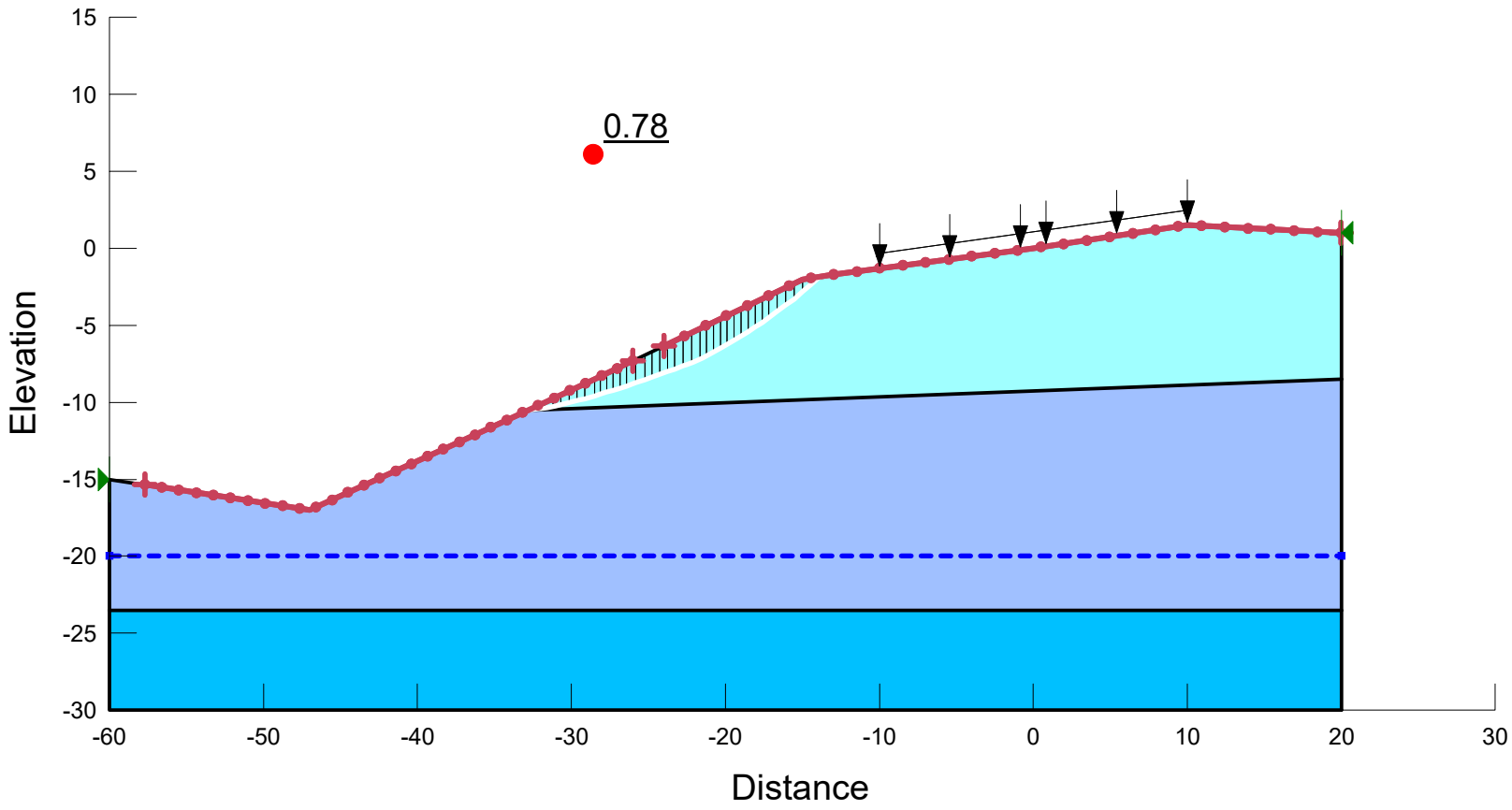


TN ERFO FS CHRKE804 2020-2(5)
Global Stability Analysis
Existing Conditions - 2H:1V Slope
MP466-B

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Conglomerate	130	0	38
	Silty Sand	120	0	35
	Silty Sand w/Gravel	110	0	30

Global Stability - Seismic

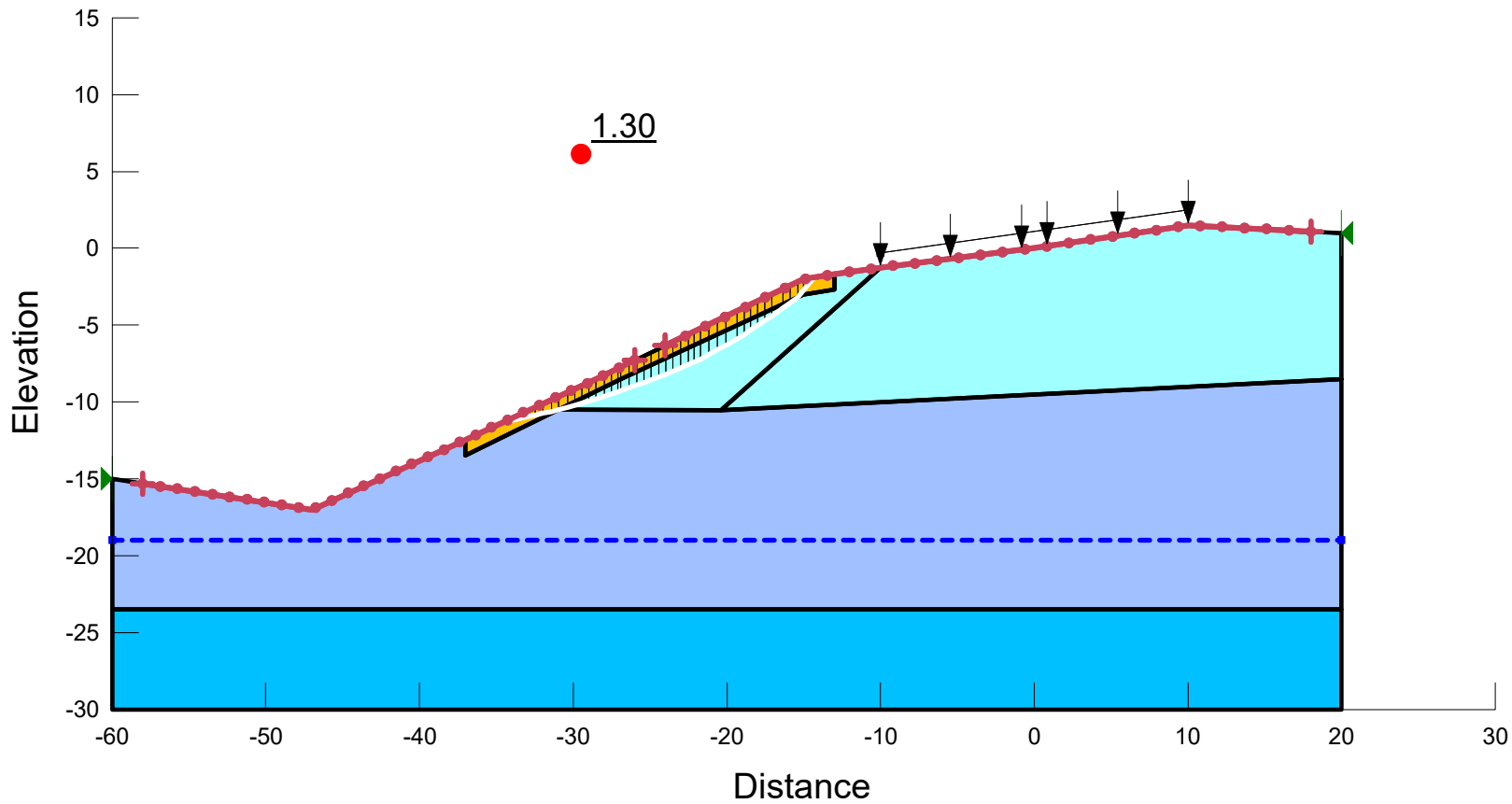


TN ERFO FS CHRKE804 2020-2(5)
Global Stability Analysis
Existing Conditions - 2H:1V Slope
MP466-B

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability of a 2H:1V Slope - With Rip Rap Slope.

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Conglomerate	130	0	38
	Rip Rap	120	0	35
	Silty Sand	120	0	35
	Silty Sand w/Gravel	110	0	30

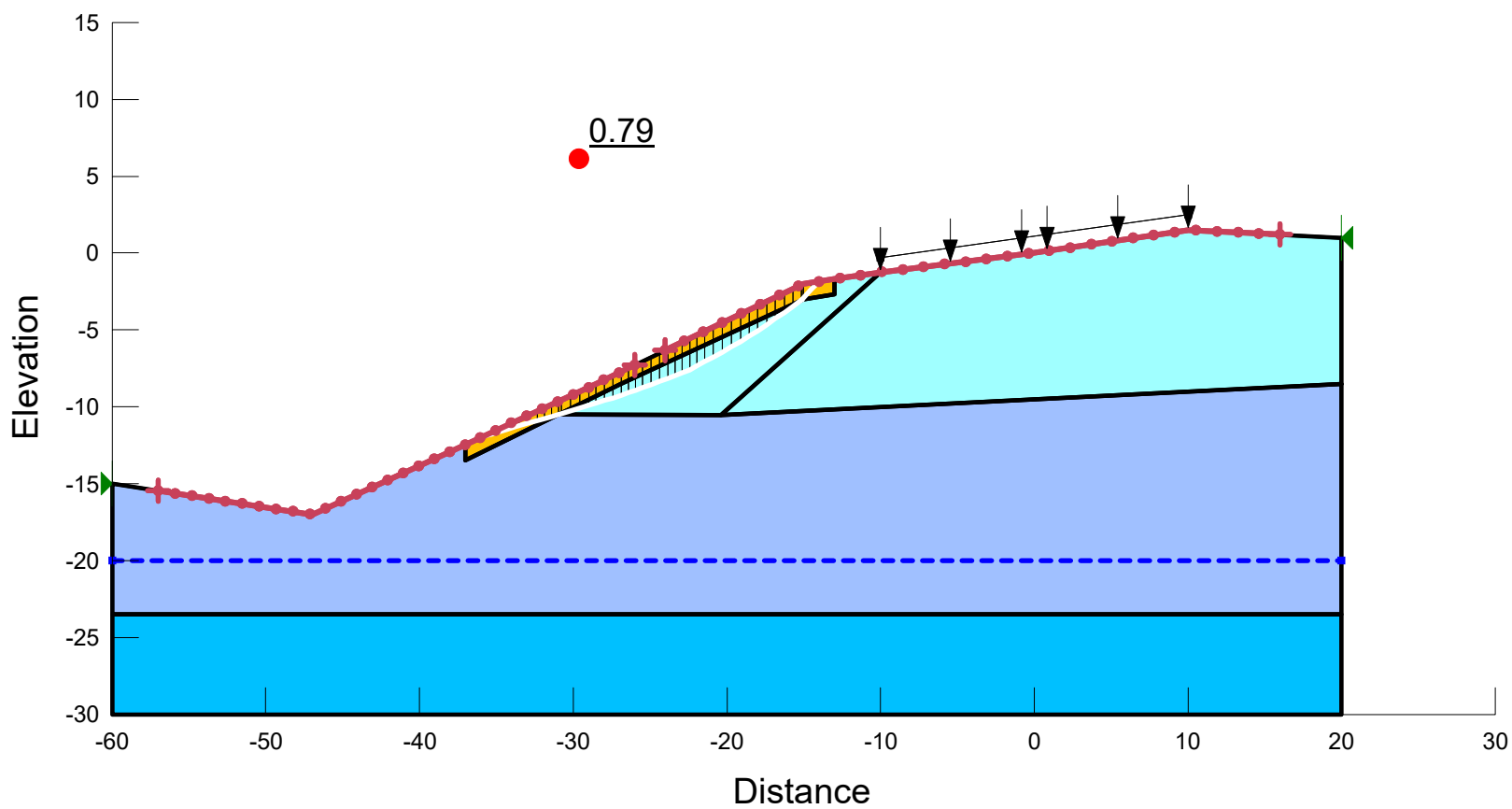


TN ERFO FS CHRKE804 2020-2(5)
Global Stability Analysis
Existing Conditions - 2H:1V Slope
MP466-B

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Conglomerate	130	0	38
	Rip Rap	120	0	35
	Silty Sand	120	0	35
	Silty Sand w/Gravel	110	0	30

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Seismic - With Rip Rap slope.

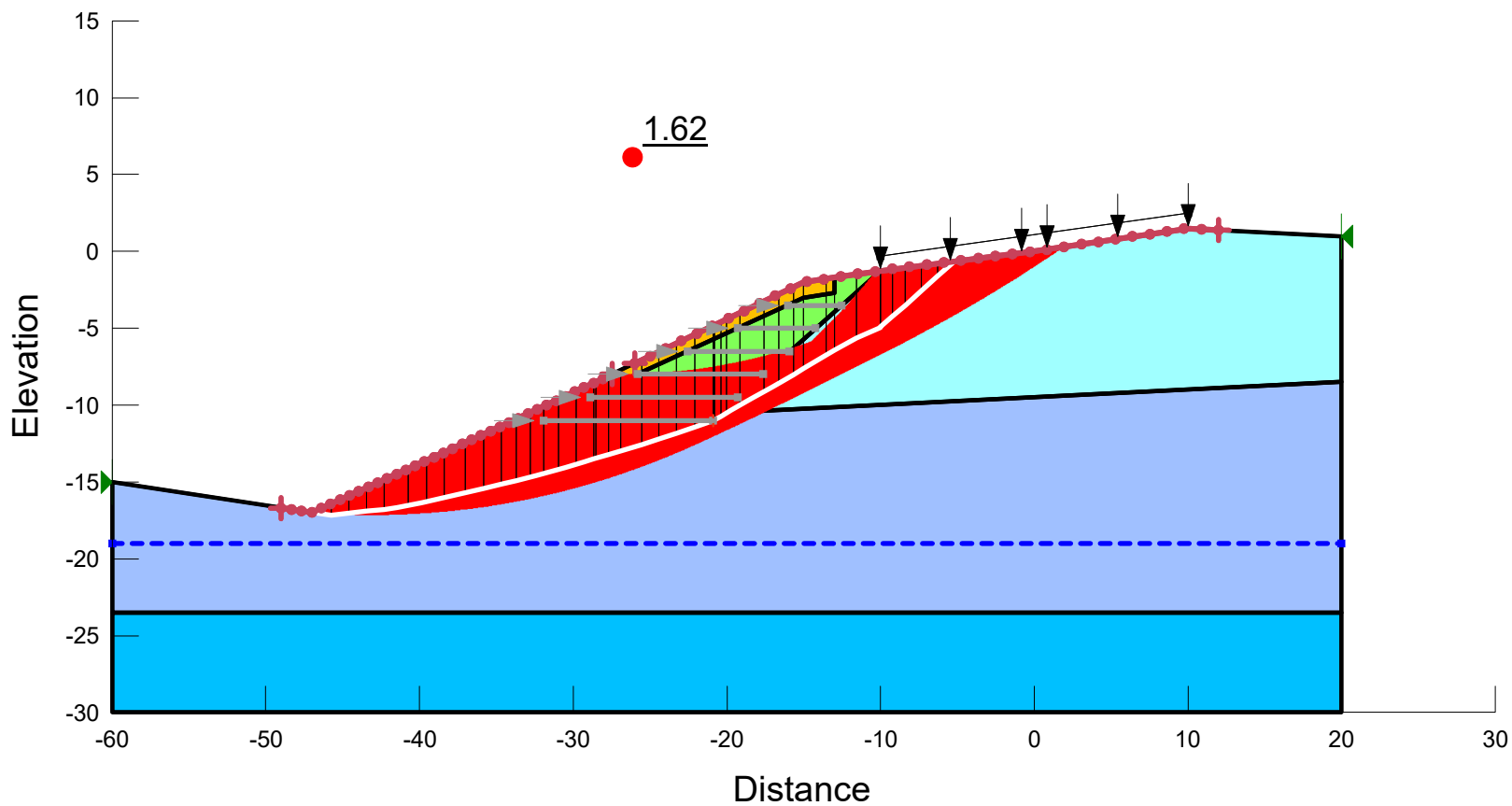


TN ERFO FS CHRKE804 2020-2(5)
Global Stability Analysis
Reinforced Conditions - 2H:1V Slope
MP466-B

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Conglomerate	130	0	38
	Rip Rap	120	0	35
	Silty Sand	120	0	35
	Silty Sand w/Gravel	110	0	30
	Silty Sand w/Gravel - Comp.	115	0	30

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability of a 2H:1V Slope - Reinforced

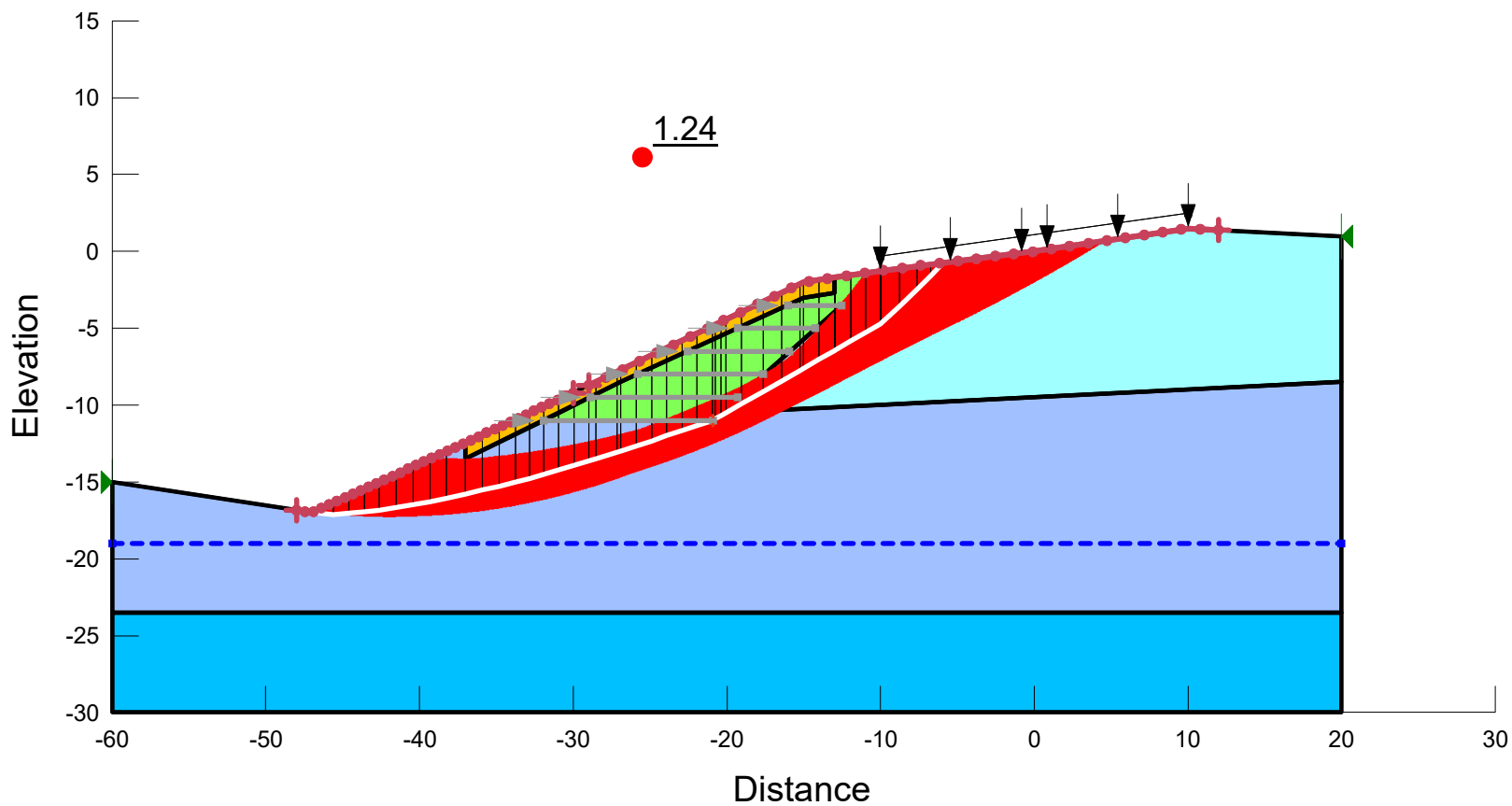


TN ERFO FS CHRKE804 2020-2(5)
Global Stability Analysis
Reinforced Conditions - 2H:1V Slope
MP466-B

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Conglomerate	130	0	38
	Rip Rap	120	0	35
	Silty Sand	120	0	35
	Silty Sand w/Gravel	110	0	30
	Silty Sand w/Gravel - Comp.	115	0	30

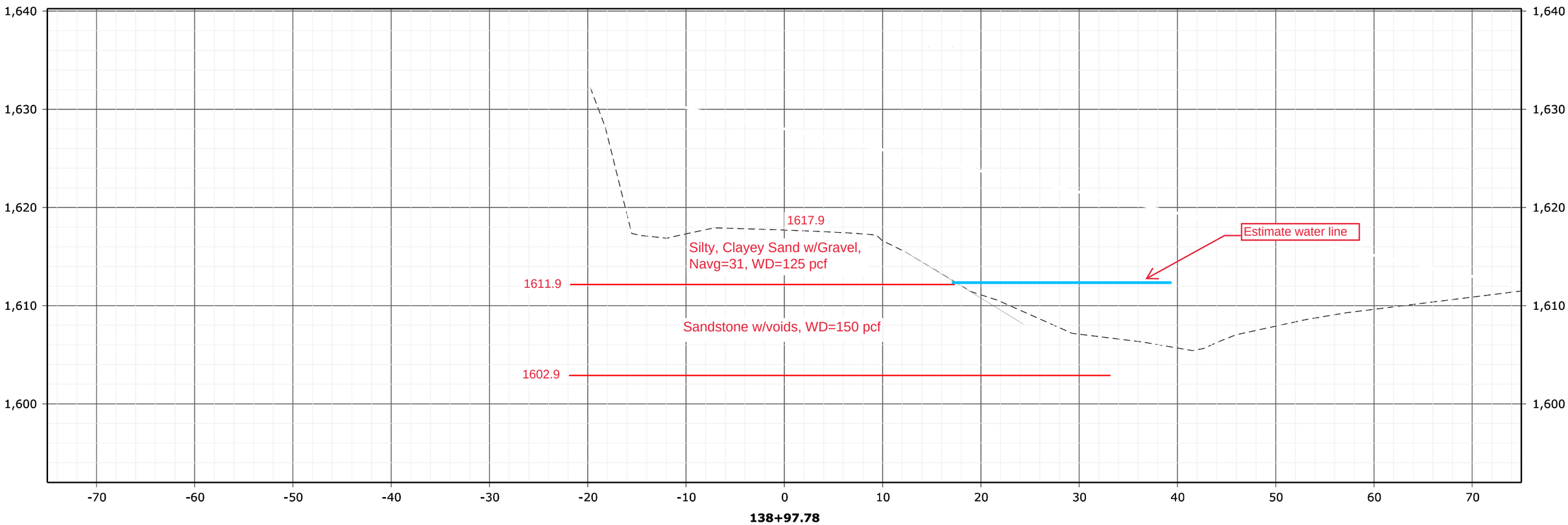
Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Seismic - Reinforced



NPS PMIS No. xxxxxx NPS Drwg No. xxxxxx

PROJECT	SHEET NUMBER
	A001



FHWA, Office of Federal Lands Highway

BH 481-A

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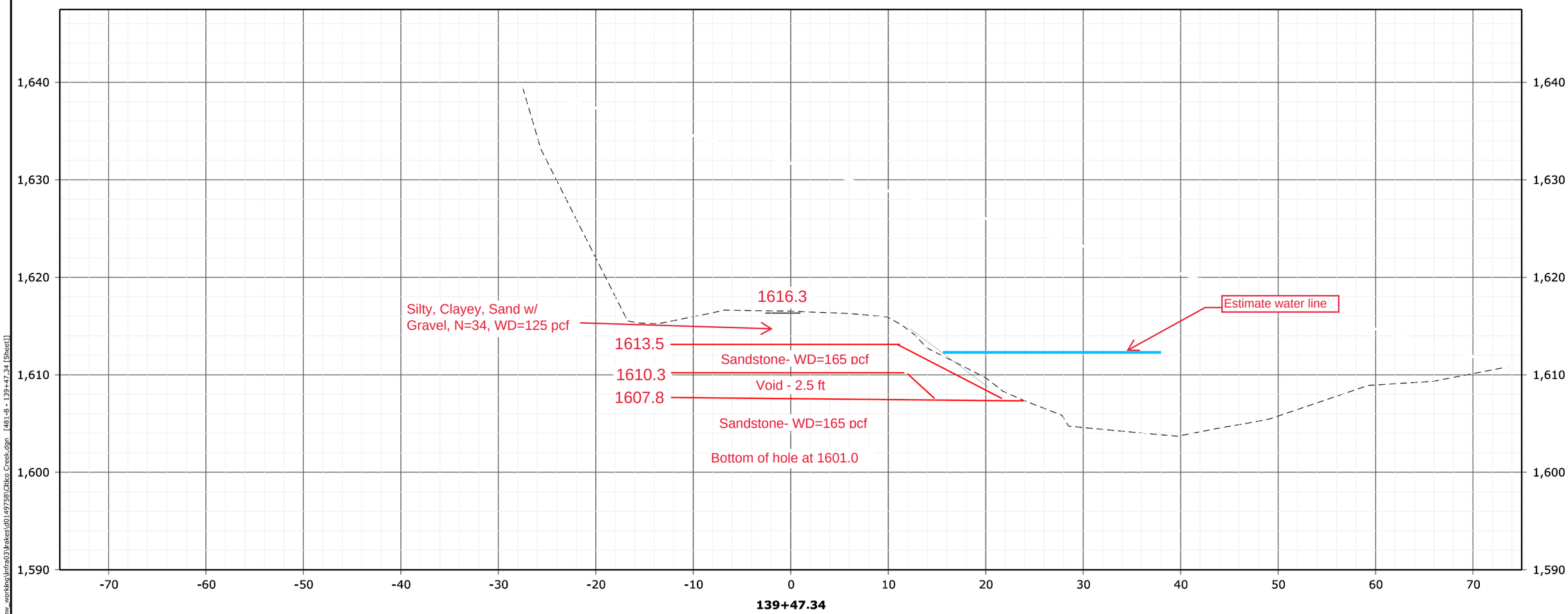
21 August 2024 3:57 PM

NPS PMIS No. xxxxxx NPS Drwg No. xxxxxx

PROJECT	SHEET NUMBER
	A001



FHWA, Office of Federal Lands Highway

BH 481-B

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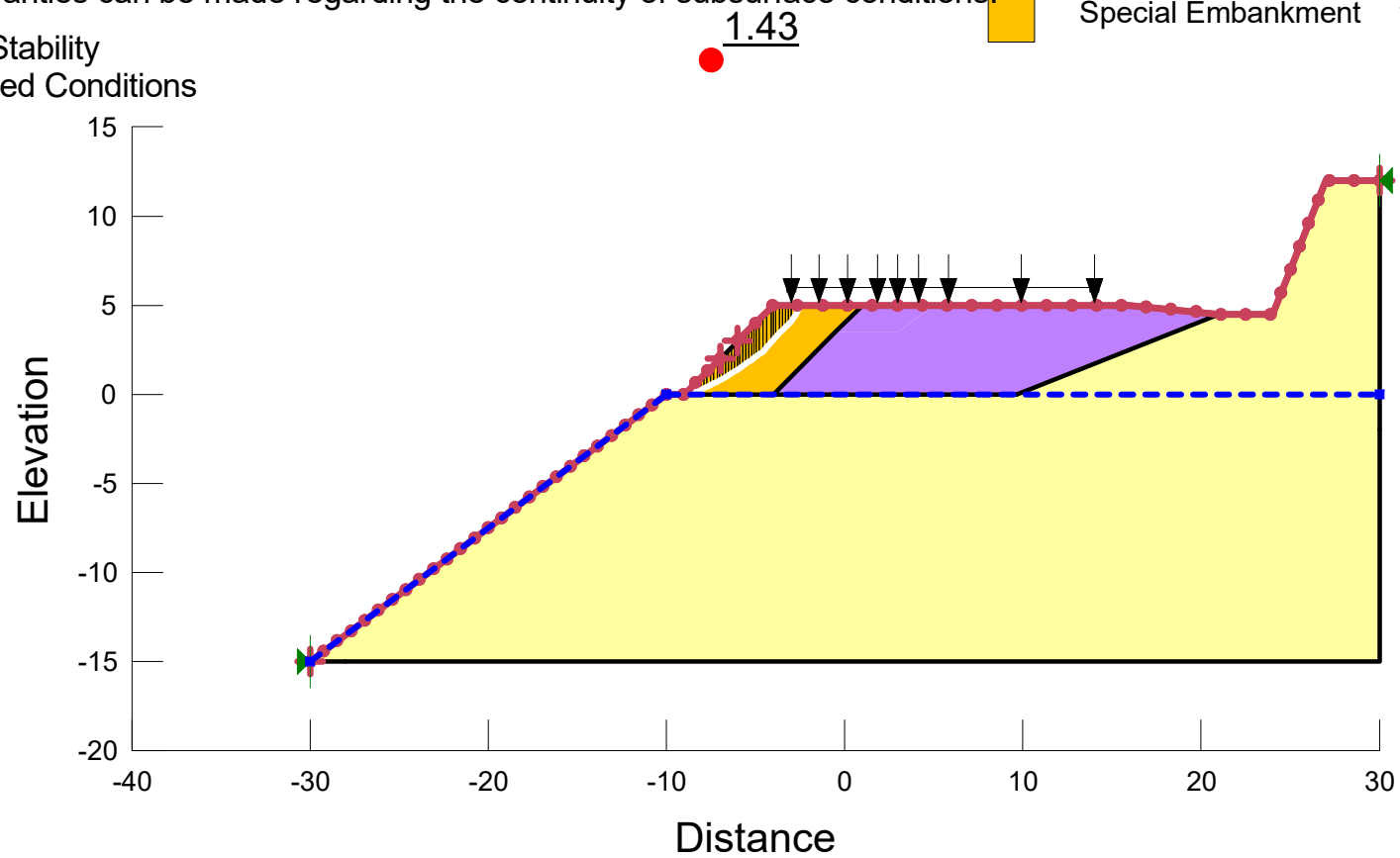
21 August 2024 3:57 PM

TN ERFO FS CHRKE804 2020-2(5)
Special Embankment
Global Stability Analysis
MP481

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Gravel w/Clay & Sand	120	0	34
	Sandstone Bedrock	160	5,000	0
	Special Embankment	125	0	48

Global Stability
Undrained Conditions



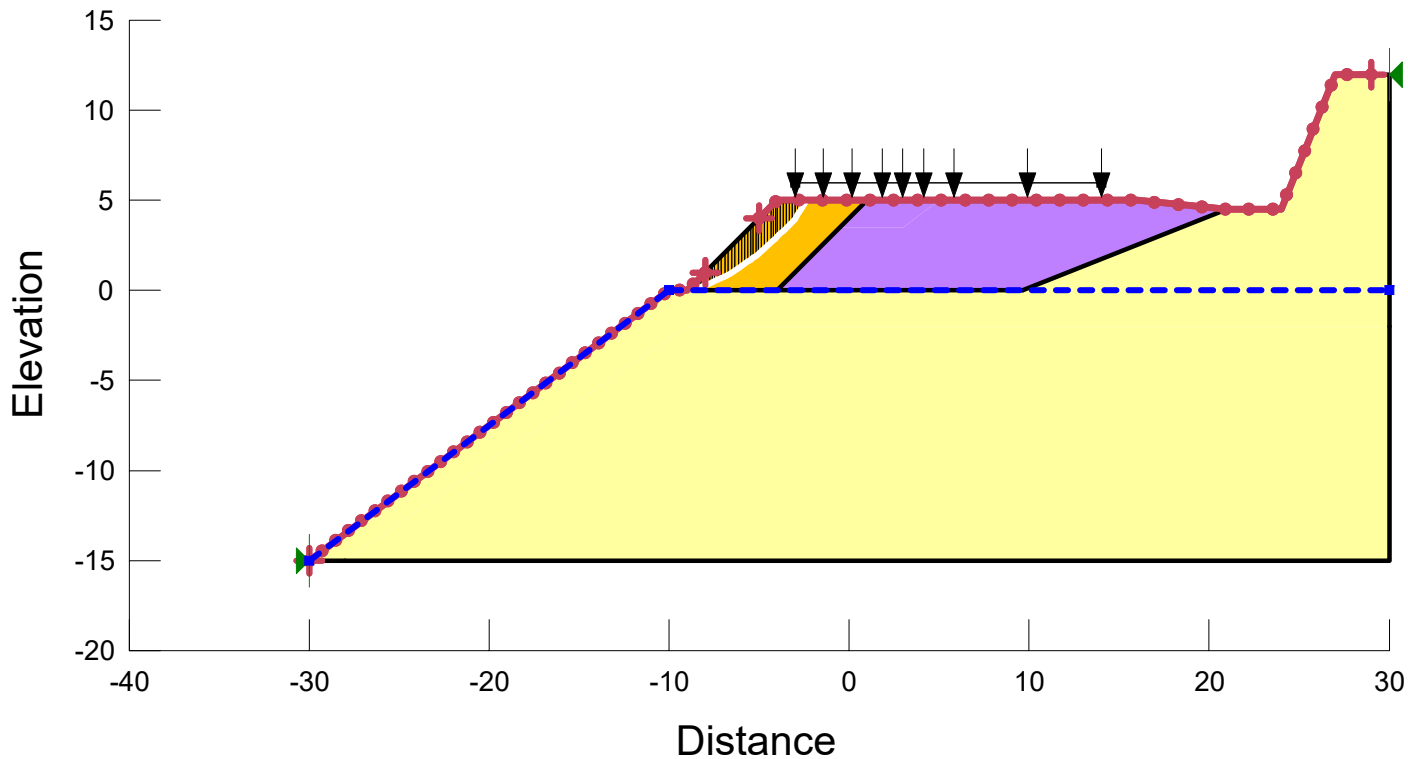
TN ERFO FS CHRKE804 2020-2(5)
Special Embankment
Global Stability Analysis
MP481

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Gravel w/Clay & Sand	120	0	34
	Sandstone Bedrock	160	5,000	0
	Special Embankment	125	0	48

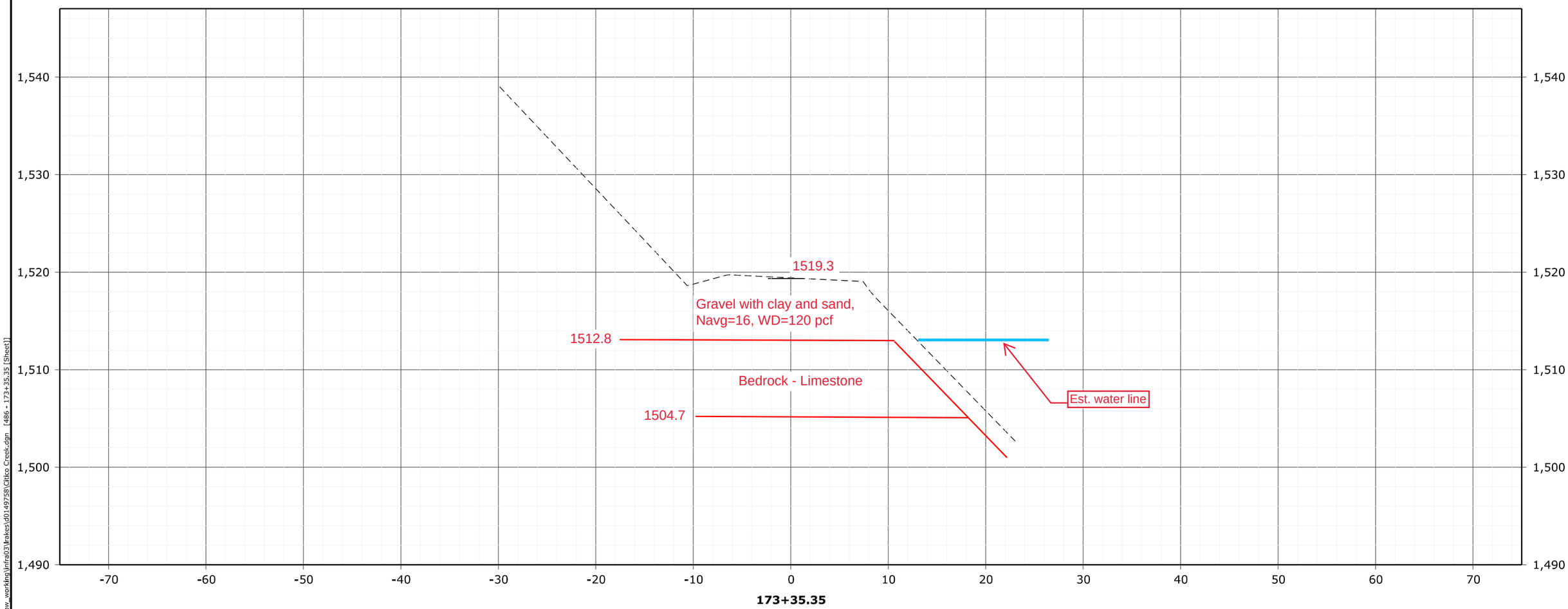
Global Stability - Seismic Analysis

1.18



NPS PMIS No. xxxxxx NPS Drwg No. xxxxxx

PROJECT	SHEET NUMBER
	A001



FHWA, Office of Federal Lands Highway

BH 486

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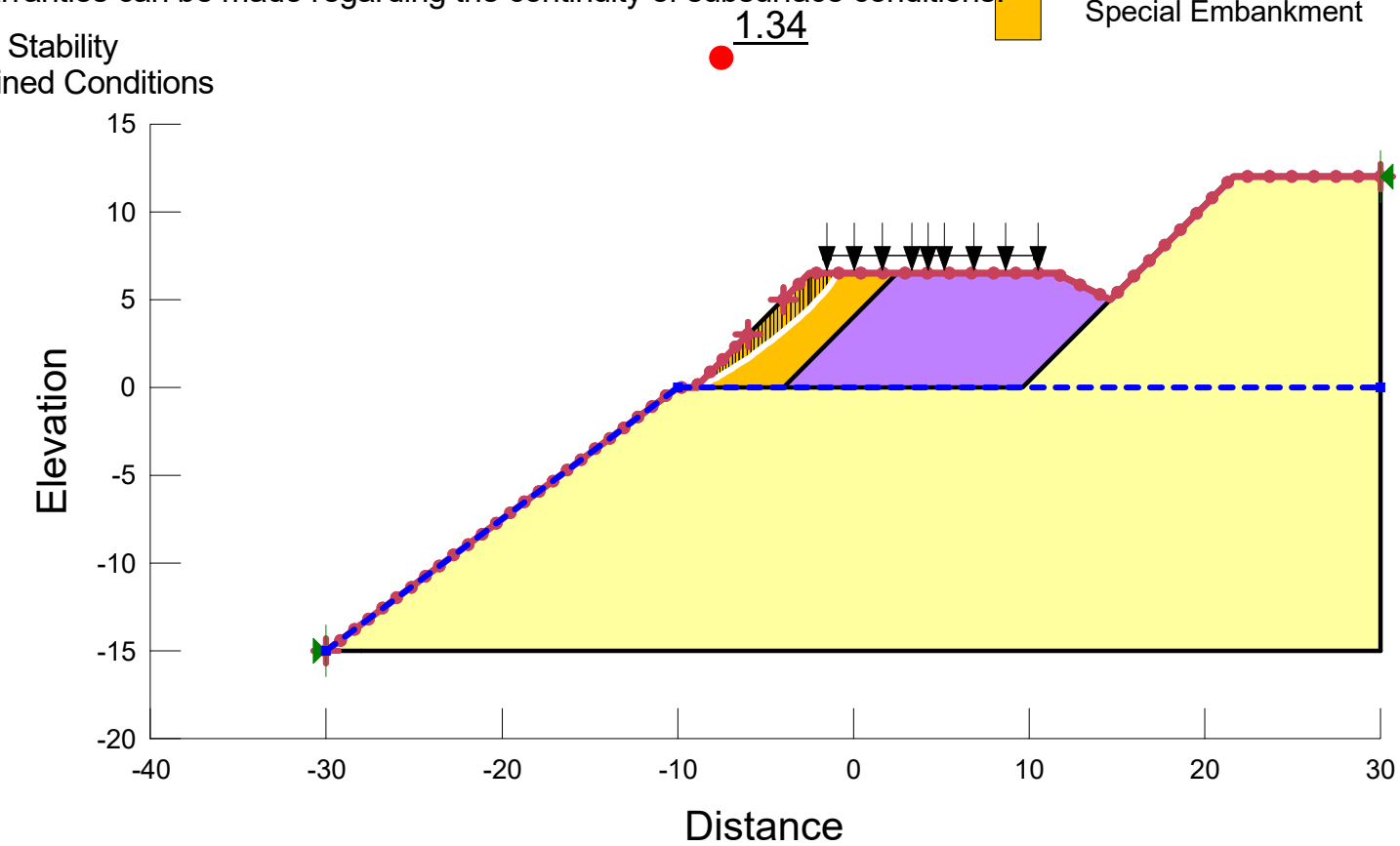
9 September 2024 3:50 PM

TN ERFO FS CHRKE804 2020-2(5)
Special Embankment
Global Stability Analysis
MP486

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Ph (°)
	Gravel w/Clay & Sand	120	0	34
	Limestone Bedrock	160	5,000	0
	Special Embankment	125	0	48

Global Stability
Undrained Conditions



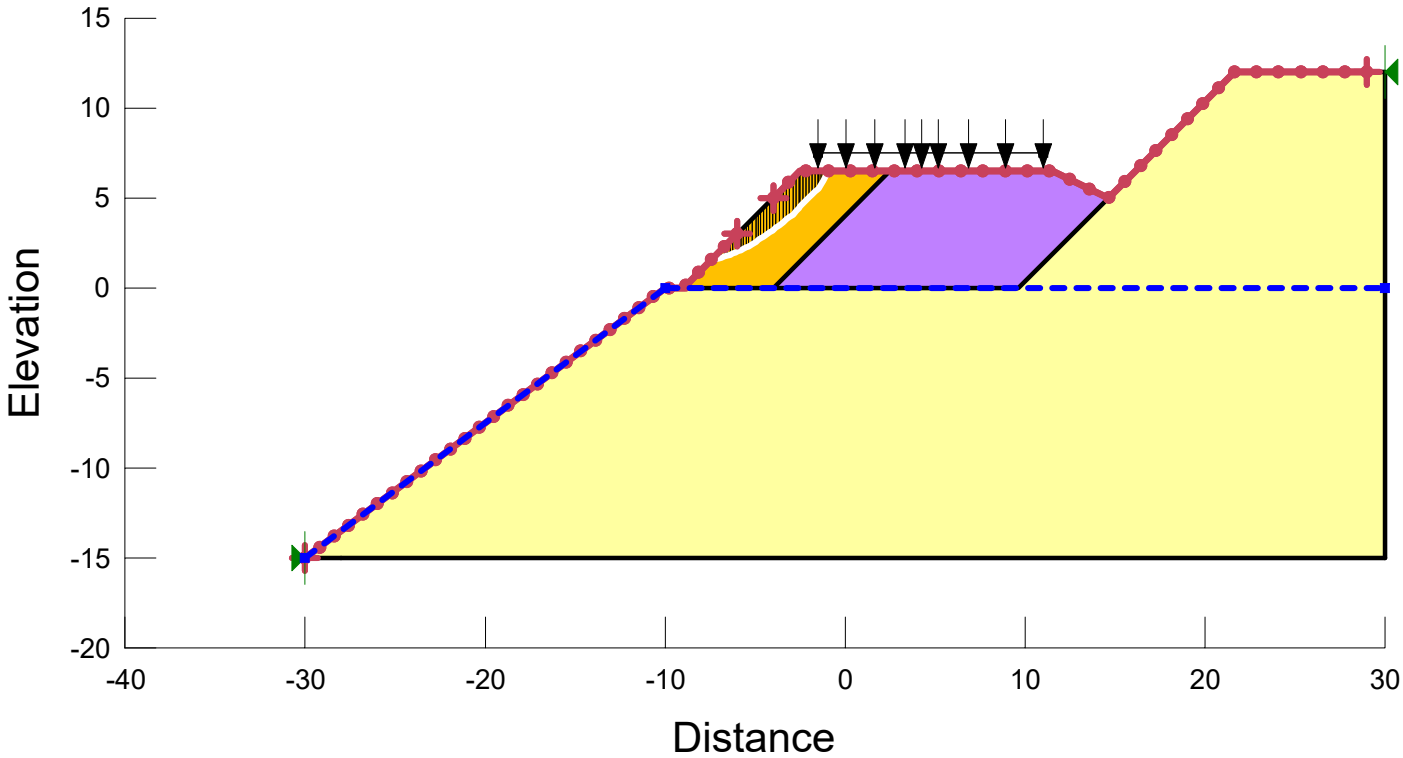
TN ERFO FS CHRKE804 2020-2(5)
Special Embankment
Global Stability Analysis
MP486

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Ph (°)
	Gravel w/Clay & Sand	120	0	34
	Limestone Bedrock	160	5,000	0
	Special Embankment	125	0	48

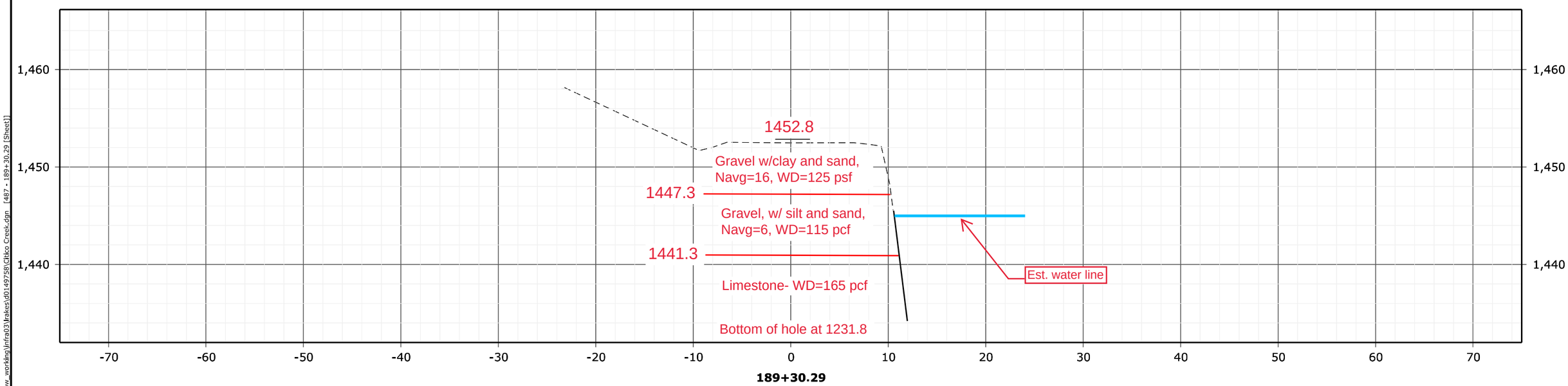
Global Stability - Seismic Analysis

1.18



NPS PMIS No. xxxxxx NPS Drwg No. xxxxxx

PROJECT	SHEET NUMBER
	A001



FHWA, Office of Federal Lands Highway

BH 487

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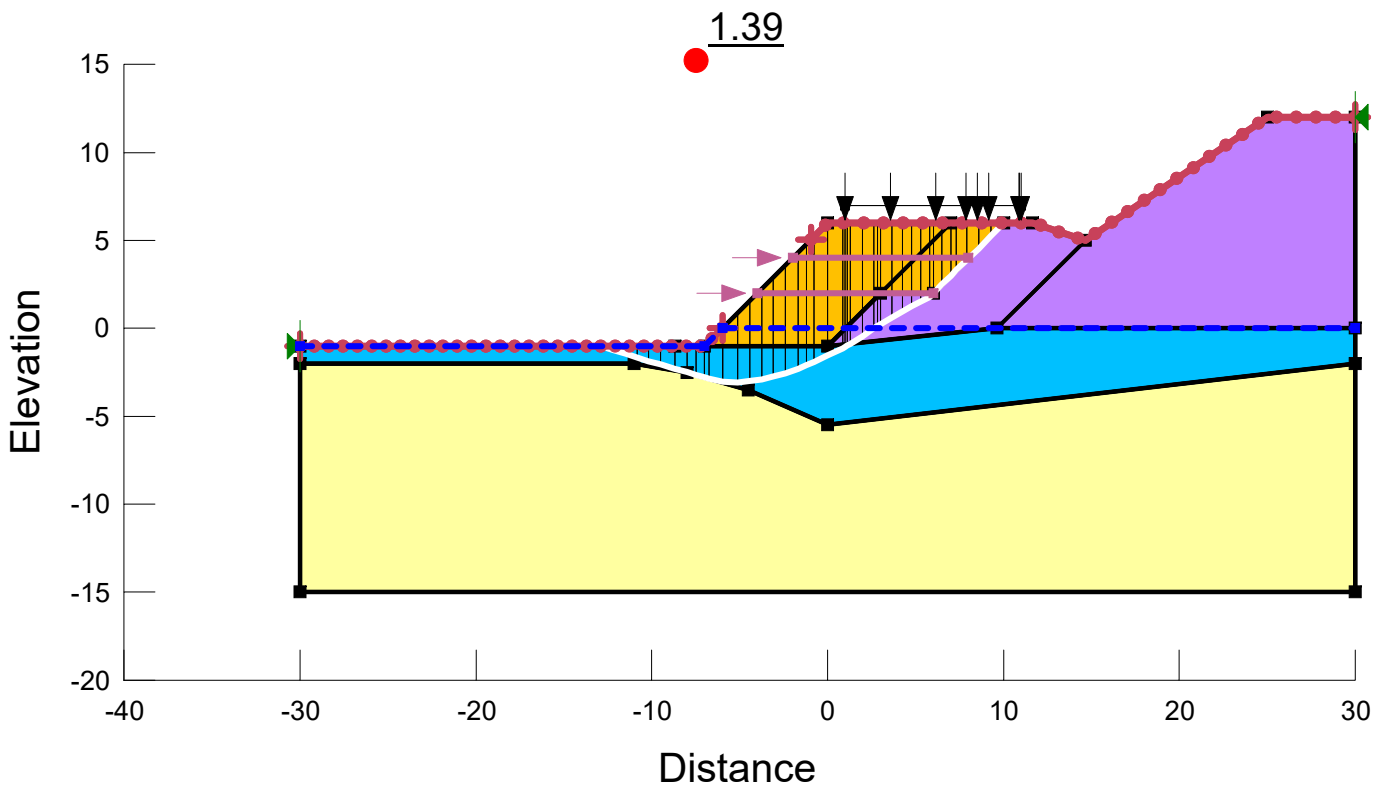
21 August 2024 3:57 PM

TN ERFO FS CHRKE804 2020-2(5)
Special Embankment
Global Stability Analysis
MP487

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability
Undrained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Ph (°)
	Gravel w/Clay & Sand	120	0	34
	Gravel w/Silt & Sand	118	0	33
	Limestone Bedrock	160	5,000	0
	Special Embankment	125	0	48

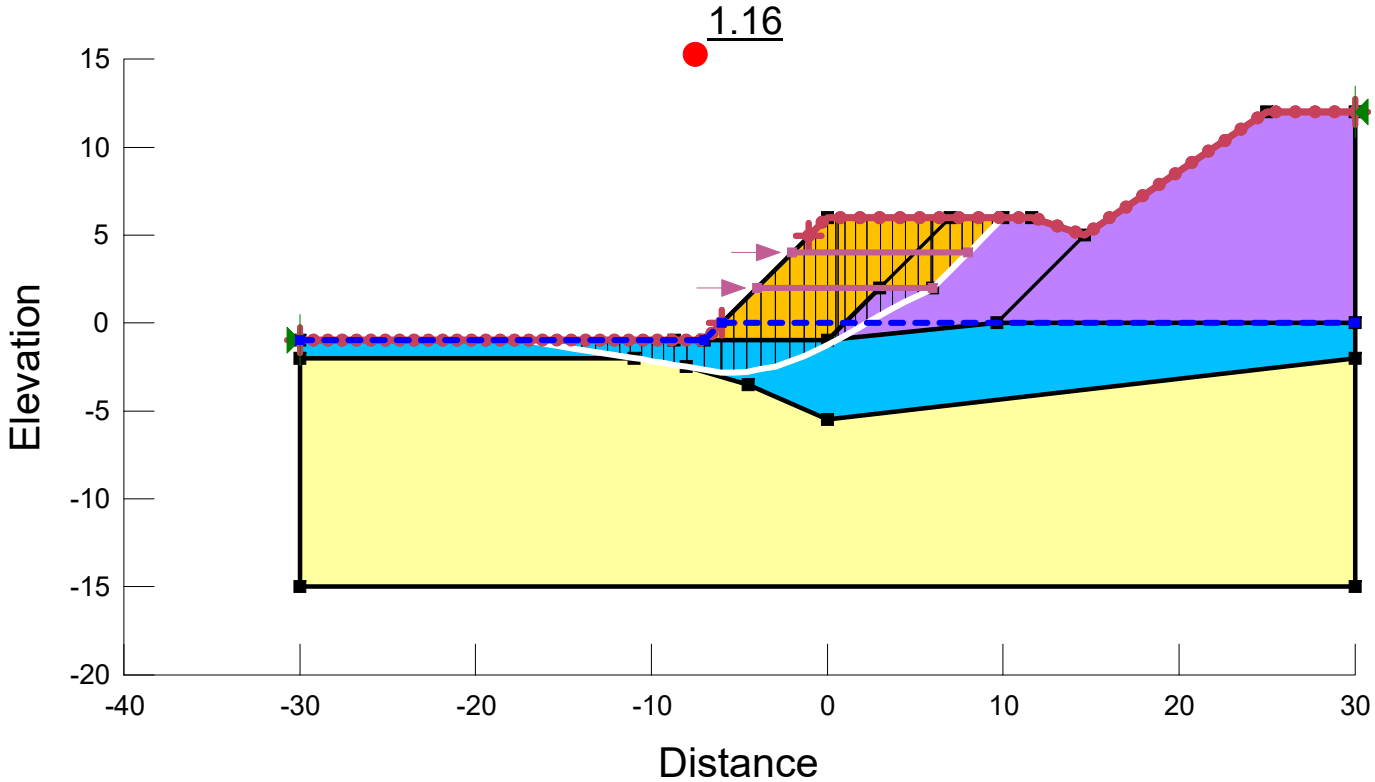


TN ERFO FS CHRKE804 2020-2(5)
Special Embankment
Global Stability Analysis
MP487

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

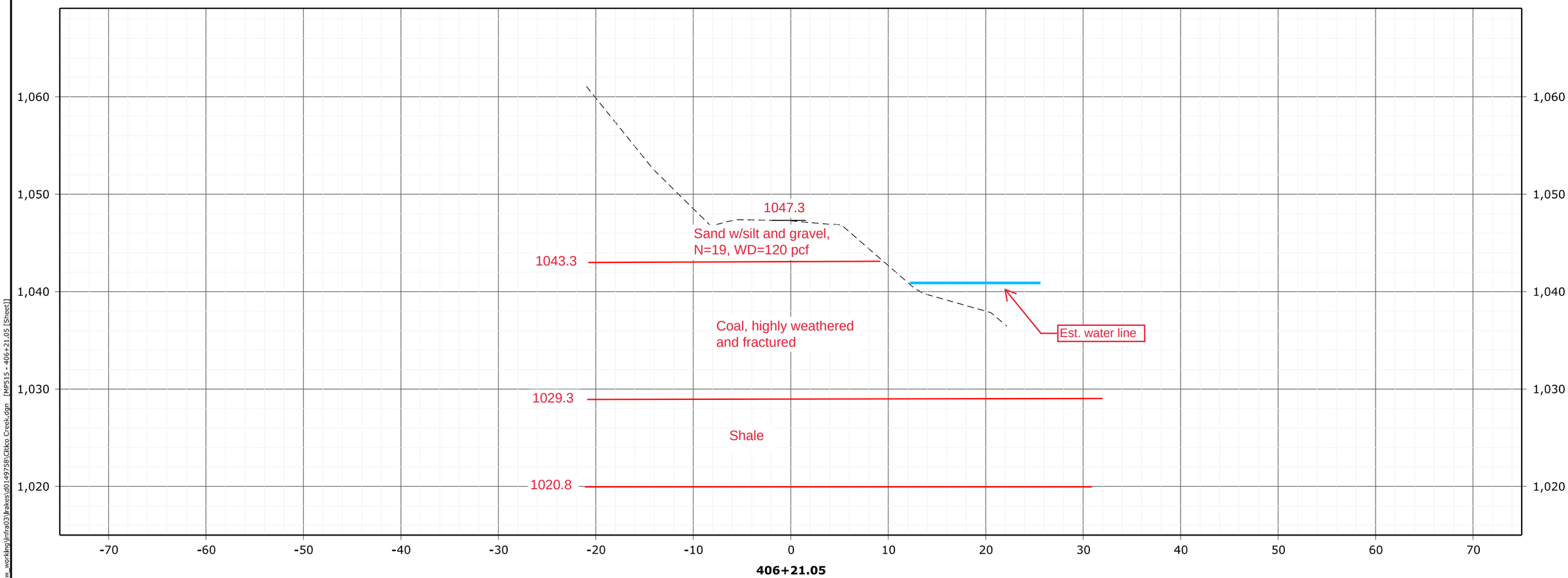
Global Stability - Seismic Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Gravel w/Clay & Sand	120	0	34
	Gravel w/Silt & Sand	118	0	33
	Limestone Bedrock	160	5,000	0
	Special Embankment	125	0	48



NPS PMIS No. xxxxxx NPS Drwg No. xxxxxx

PROJECT	SHEET NUMBER
	A001



FHWA, Office of Federal Lands Highway

BH 515

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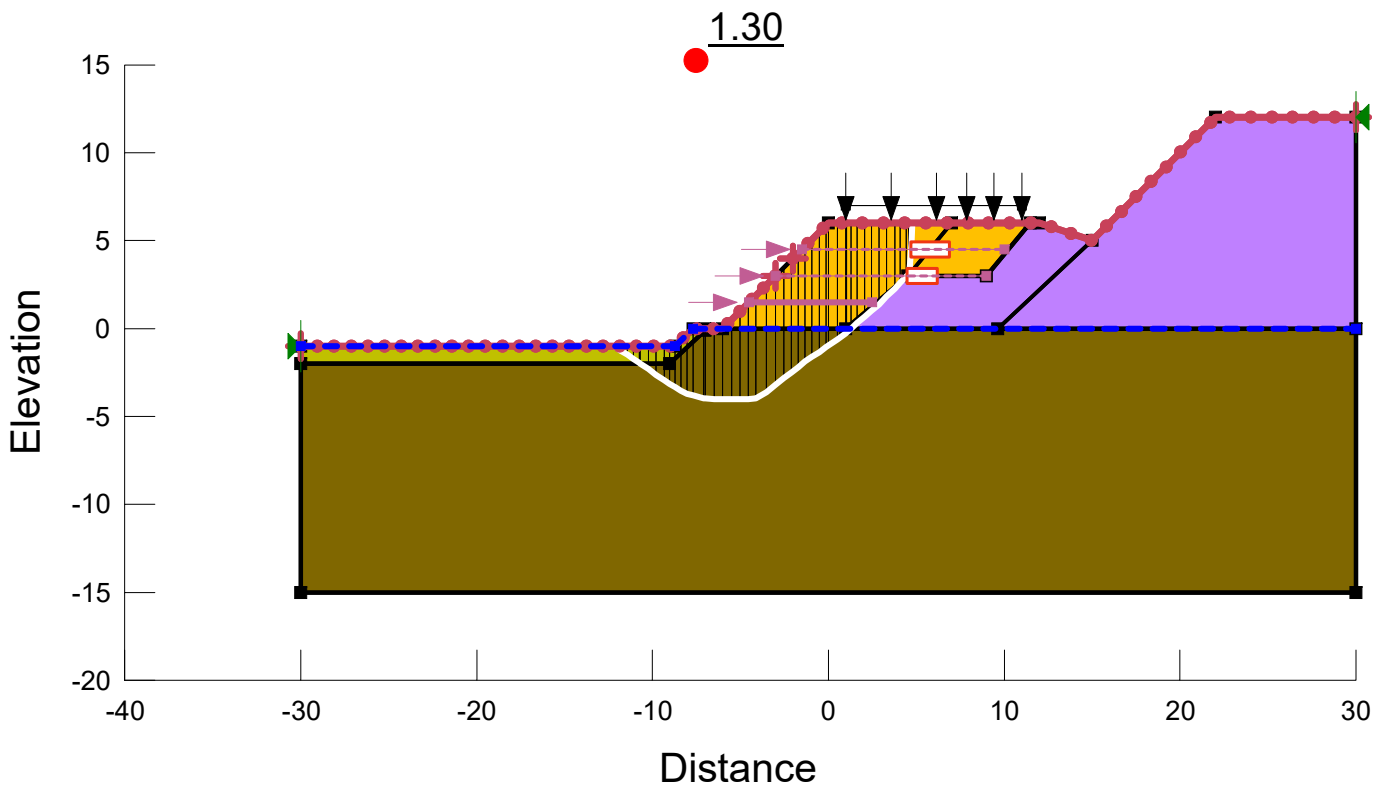
9 September 2024 3:50 PM

TN ERFO FS CHRKE804 2020-2(5)
Special Embankment
Global Stability Analysis
MP515

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability
Undrained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Coal	90	0	35
	Gravel w/Silt & Sand	118	0	32
	Sand w/Silt & Gravel	120	0	34
	Special Embankment	125	0	48

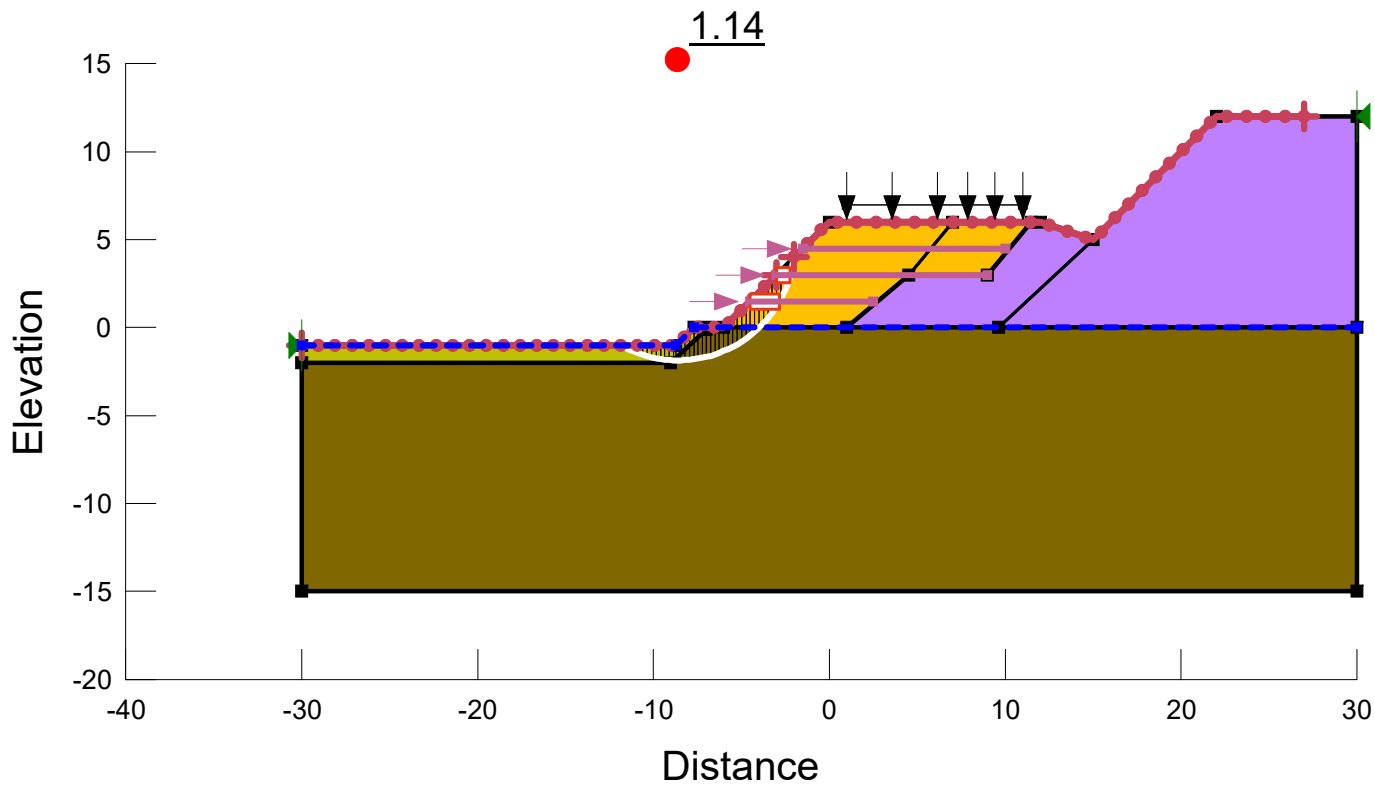


TN ERFO FS CHRKE804 2020-2(5)
Special Embankment
Global Stability Analysis
MP515

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

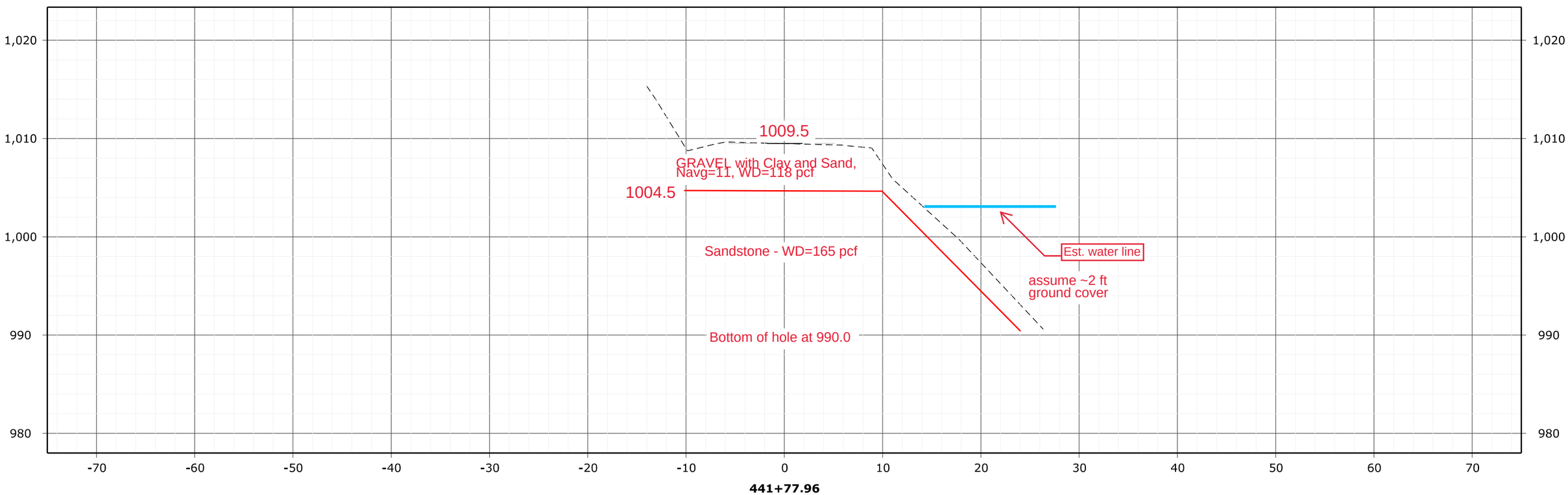
Global Stability - Seismic Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Coal	90	0	35
	Gravel w/Silt & Sand	118	0	32
	Sand w/Silt & Gravel	120	0	34
	Special Embankment	125	0	48



NPS PMIS No. xxxxxx NPS Drwg No. xxxxxx

PROJECT	SHEET NUMBER
	A001



FHWA, Office of Federal Lands Highway

BH 518-A

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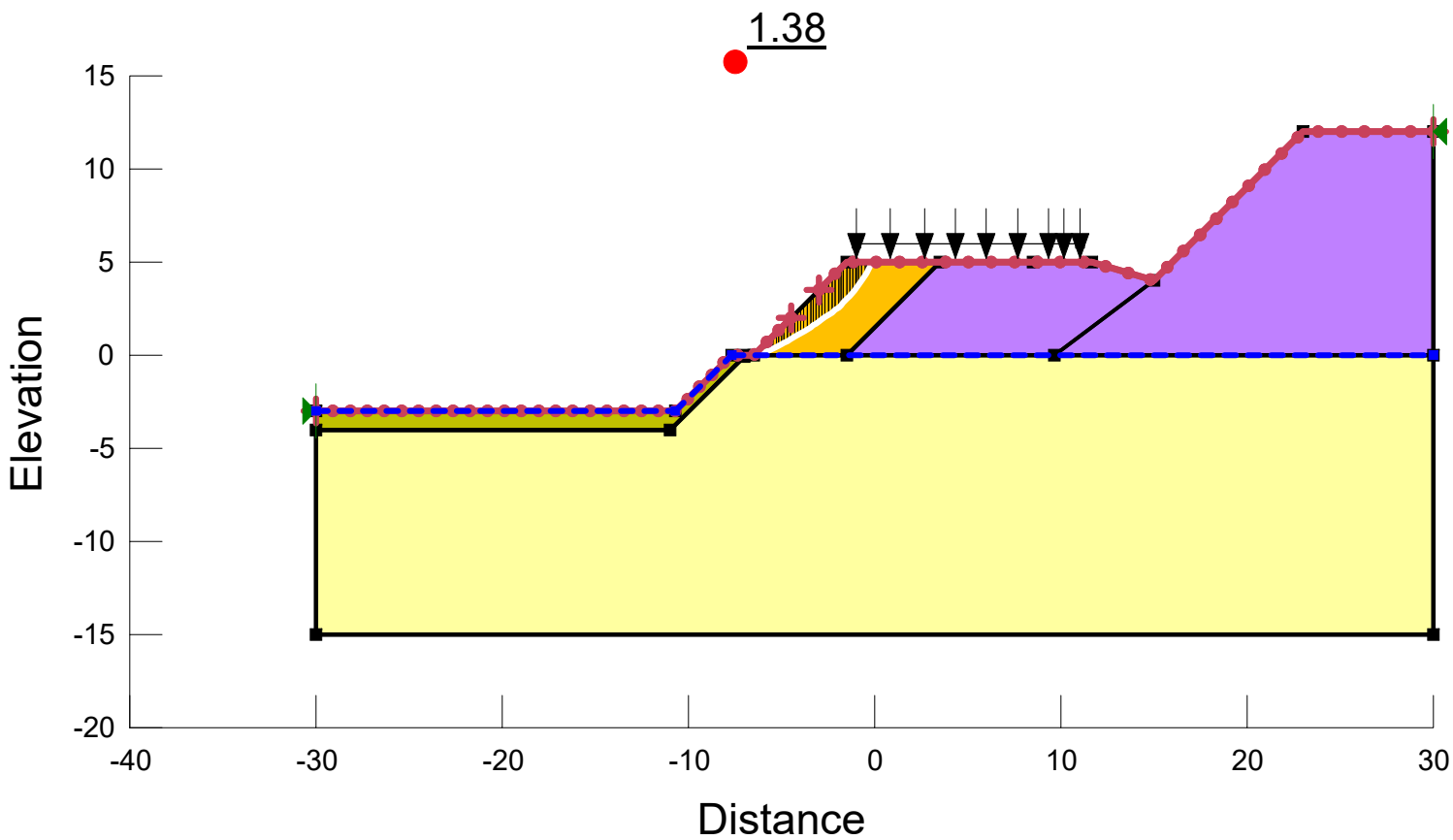
21 August 2024 4:01 PM

TN ERFO FS CHRKE804 2020-2(5)
Special Embankment
Global Stability Analysis
MP 518A

Color	Name	Unit Weight (pcf)	Cohesion' (psf)
	Gravel w/ Clay & Sand	120	0
	Gravel w/Silt & Sand	118	0
	Sandstone	165	5,000
	Special Embankment	125	0

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability
Undrained Conditions

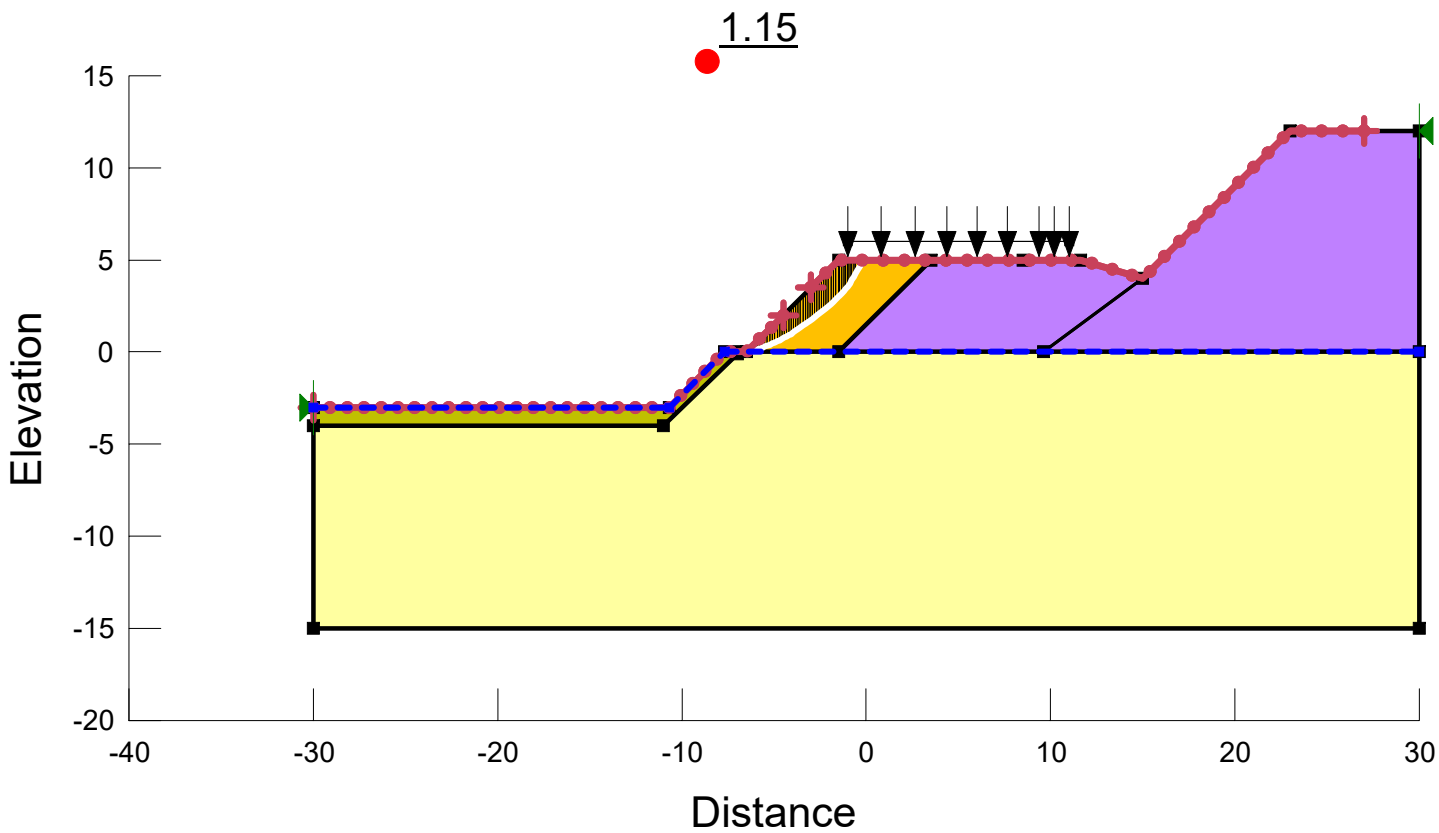


TN ERFO FS CHRKE804 2020-2(5)
Special Embankment
Global Stability Analysis
MP 518A

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

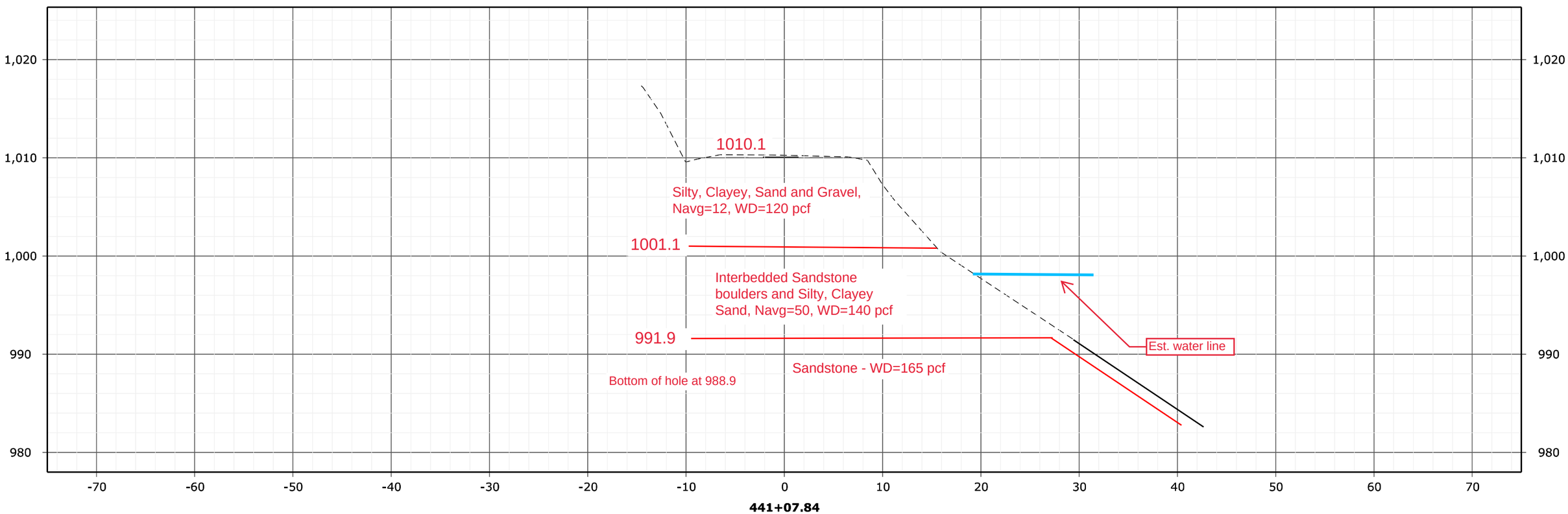
Global Stability - Seismic Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Gravel w/ Clay & Sand	120	0	33
	Gravel w/Silt & Sand	118	0	32
	Sandstone	165	5,000	0
	Special Embankment	125	0	48



NPS PMIS No. xxxxxx NPS Drwg No. xxxxxx

PROJECT	SHEET NUMBER
	A001



FHWA, Office of Federal Lands Highway

BH 518-B

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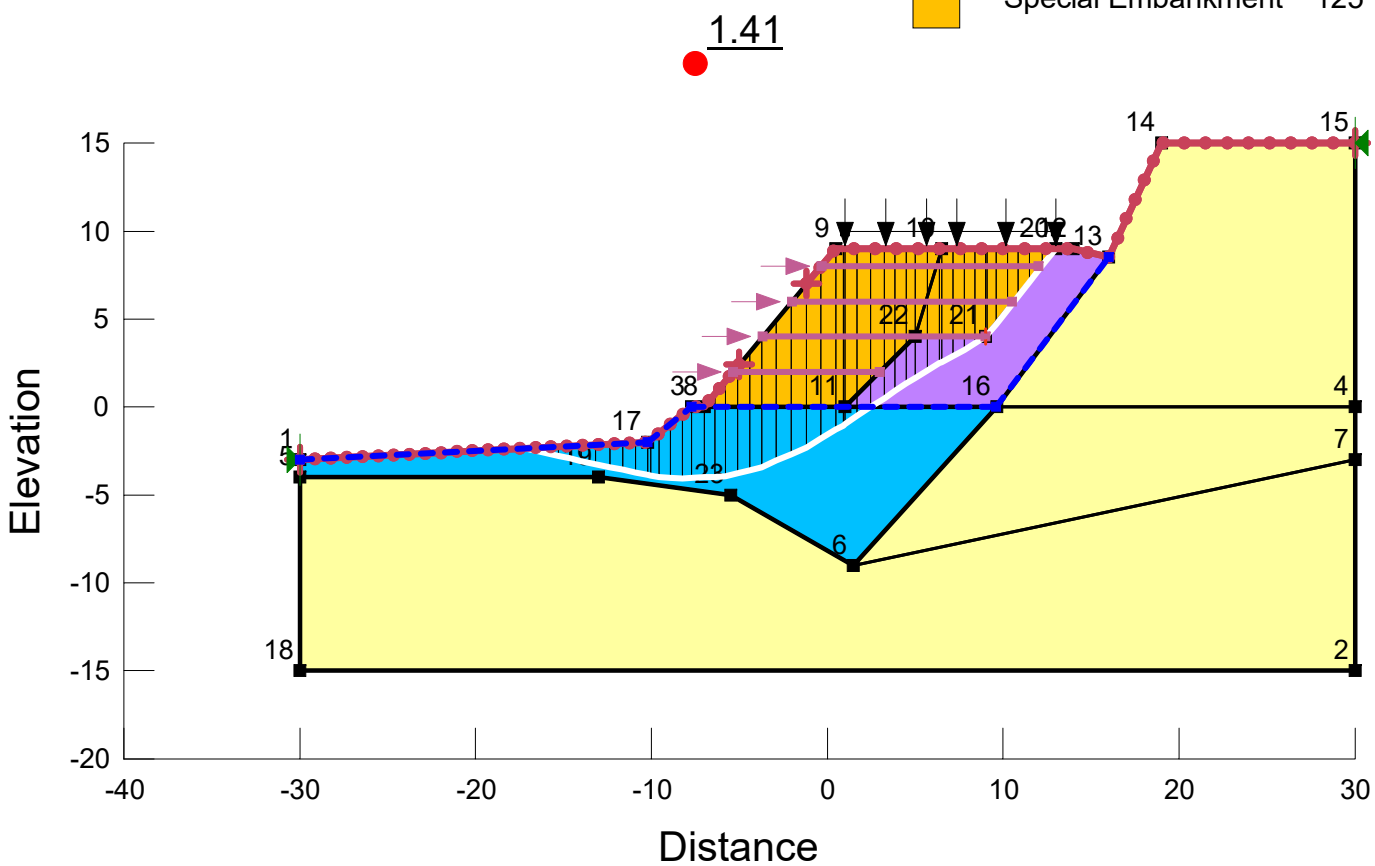
21 August 2024 4:01 PM

TN ERFO FS CHRKE804 2020-2(5)
Special Embankment
Global Stability Analysis
MP 518B

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability
Undrained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Sandstone Bedrock	165	5,000	0
	Sandstone Boulders	135	0	38
	Silty Sand and Gravel	120	0	34
	Special Embankment	125	0	48

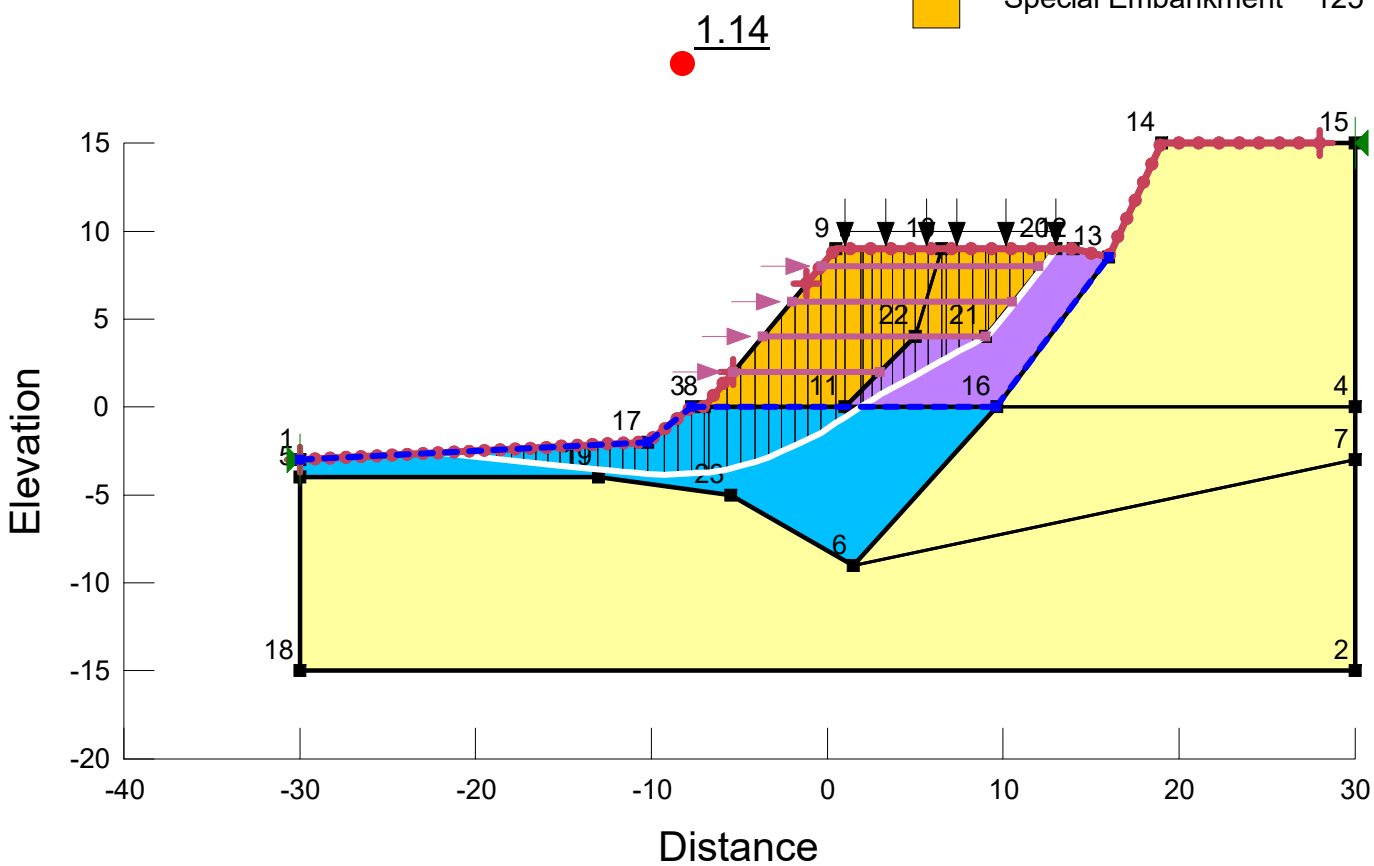


TN ERFO FS CHRKE804 2020-2(5)
Special Embankment
Global Stability Analysis
MP 518B

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

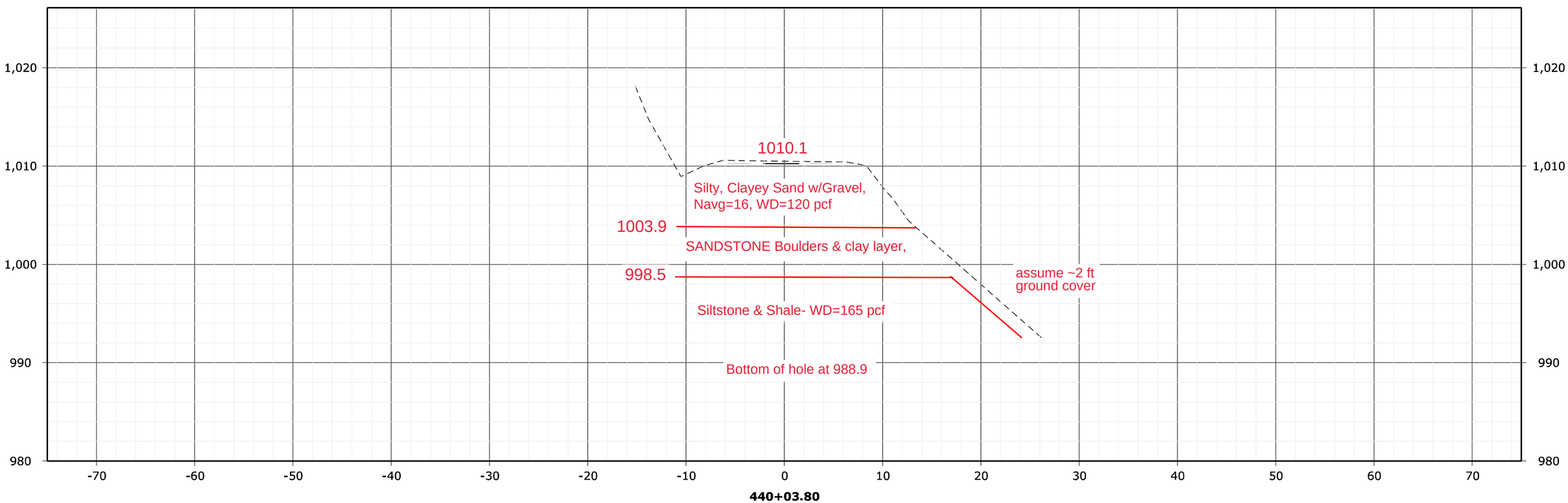
Global Stability - Seismic Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Sandstone Bedrock	165	5,000	0
	Sandstone Boulders	135	0	38
	Silty Sand and Gravel	120	0	34
	Special Embankment	125	0	48



NPS PMIS No. xxxxxx NPS Drwg No. xxxxxx

PROJECT	SHEET NUMBER
	A001



FHWA, Office of Federal Lands Highway

BH 518-C

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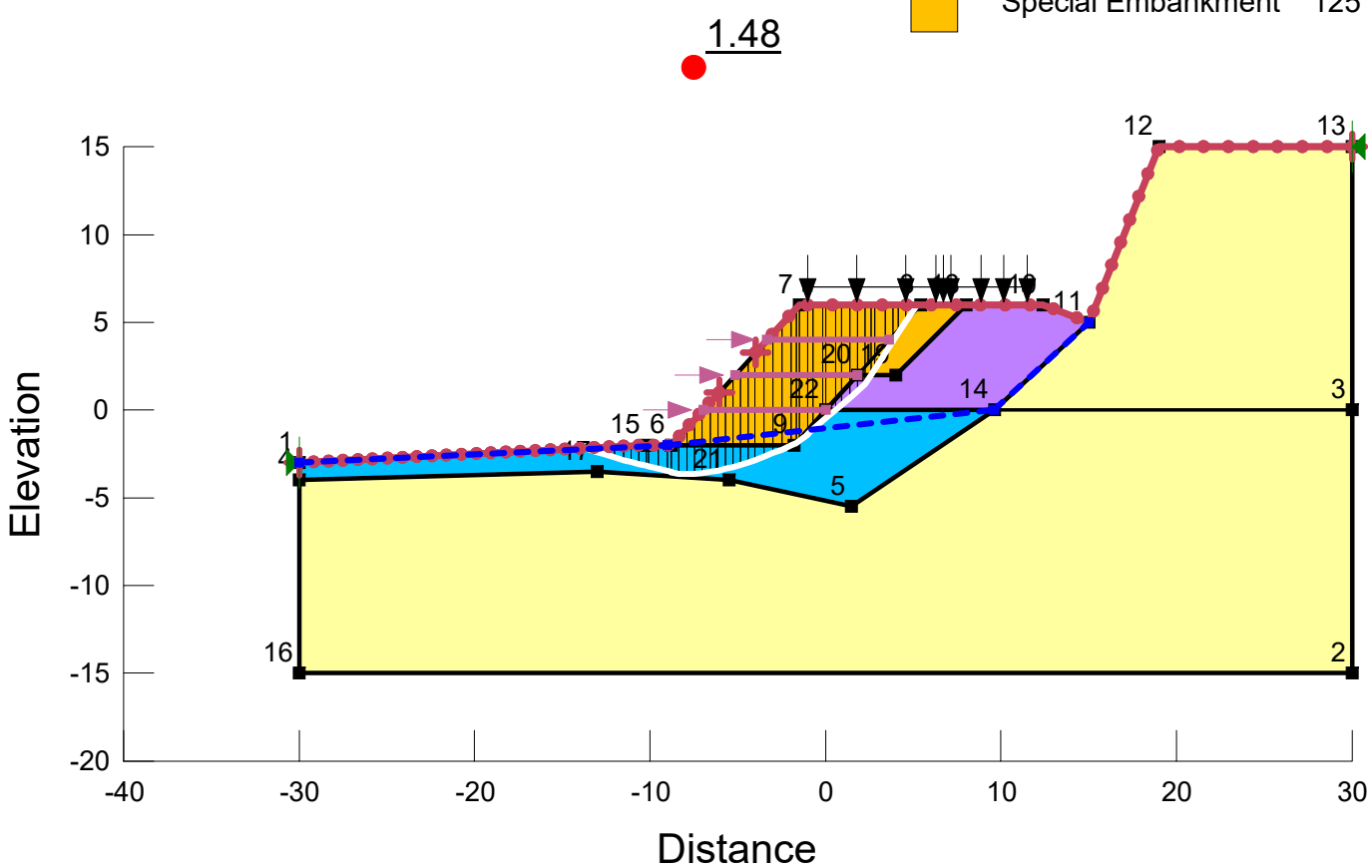
21 August 2024 4:00 PM

TN ERFO FS CHRKE804 2020-2(5)
Special Embankment
Global Stability Analysis
MP 518C

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability
Undrained Conditions

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Sandstone Bedrock	165	5,000	0
	Sandstone Boulders	135	0	38
	Silty Sand and Gravel	120	0	34
	Special Embankment	125	0	48

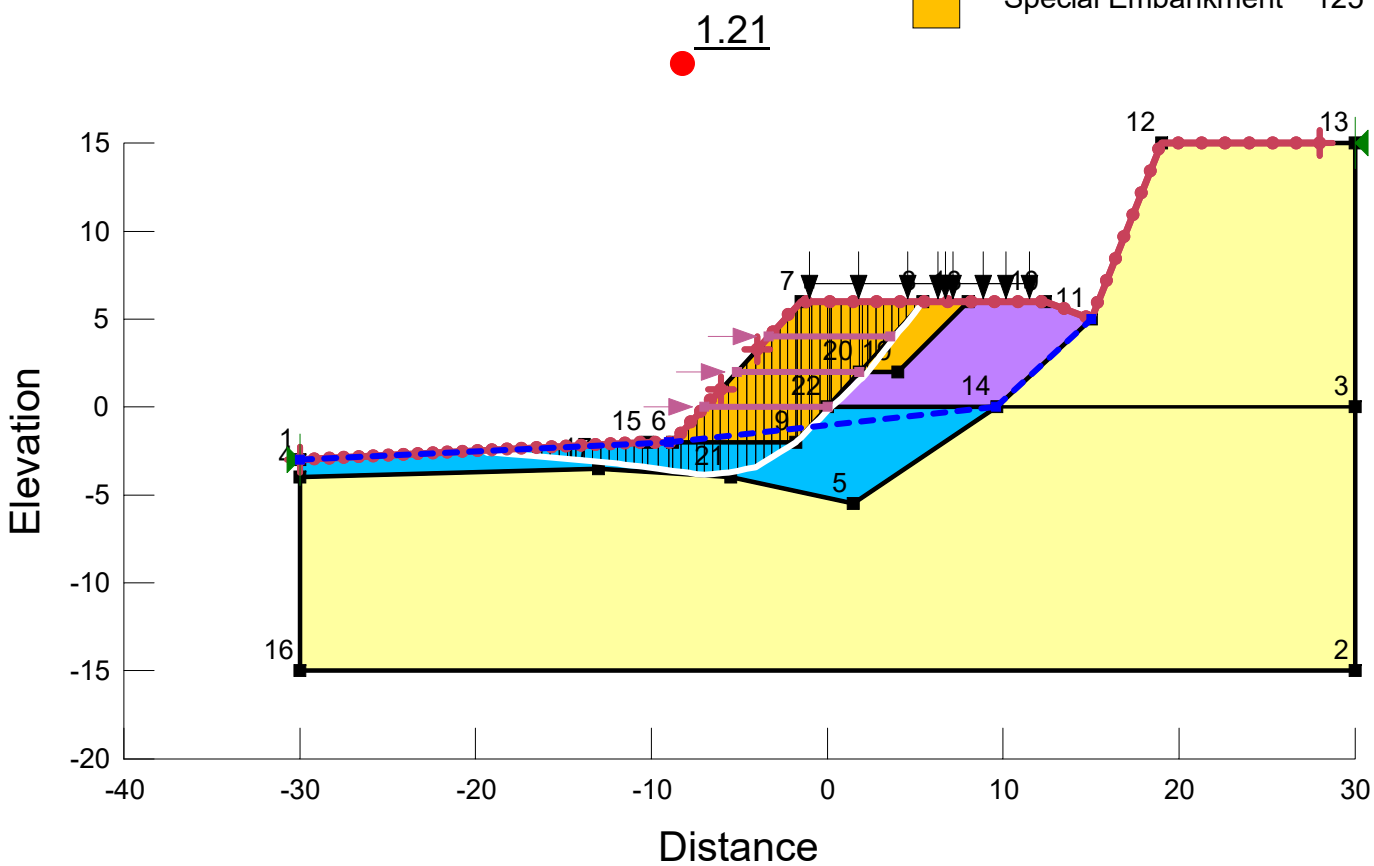


TN ERFO FS CHRKE804 2020-2(5)
Special Embankment
Global Stability Analysis
MP 518C

Note: The results of the analysis shown here are based on available subsurface information, soil properties, and profile information.
The drawing depicts approximate subsurface conditions based on provided drawing information and specific borings at the time of analysis.
No warranties can be made regarding the continuity of subsurface conditions.

Global Stability - Seismic Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Sandstone Bedrock	165	5,000	0
	Sandstone Boulders	135	0	38
	Silty Sand and Gravel	120	0	34
	Special Embankment	125	0	48



APPENDIX G
Geocell Information

BASELOK™

510 O'Neal Ln Baton Rouge, LA 70819 • (713) 641- 9797 • www.baselok.com

INSTALLATION PROCEDURES - SLOPE REINFORCEMENT

1| Consult with design engineer to determine specific anchoring method.

2| Stakes are typically used on slope less than or equal to 3H:1V. Tendon systems or twist anchors are usually used on slopes steeper than 3H:1V.

3| Installation can typically be carried out with five (5) laborers and one (1) supervisor.

4| Create a smooth and unvarying surface before application of the GeoCell. Some applications might require a non-woven fabric based on project parameters.

5| Panels are joined with a pneumatic stapler and galvanized staples or with our one-piece BaseLok™ Cable Locks.

6| Panels will need to be either precut or joined depending on the length of the slope. Prepare precut or pre-connect panels at the top of the slope.

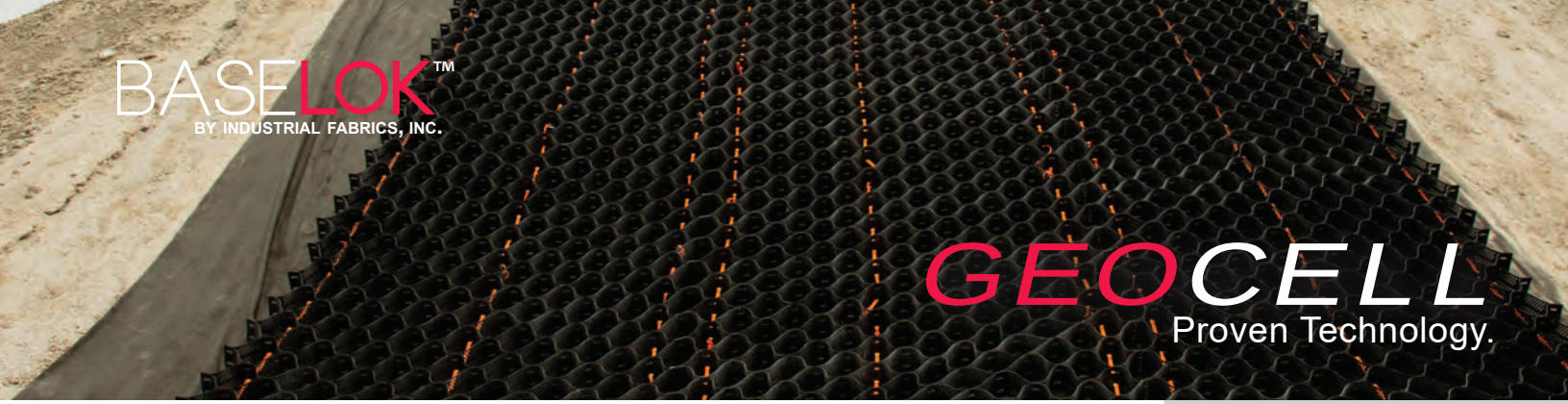
7| If the project design requires tendons, feed the tendons through the collapsed panel and attach one end to the dead man anchor in the anchor trench. Pull the tendons down the slope to the toe of the slope.

8| Place a minimum of one cell inside the anchor trench and stake every other cell inside the anchor trench. Stretch the panel(s) down the slope and stake every other cell at the bottom.

9| With the tendons through the panel, tie the tendon to the cell wall or to a load displacement washer every 3-6 cells depending on project requirement. Pre-threaded panels that are already tied to load displacement washers can also be purchased.

10| Proceed joining and expanding adjacent panels.

11| Backfill the anchor trench each day after the day's final panel is secured. Panels can be filled once the anchor trench is thoroughly backfilled. When filling the cells, work from the top down. Do not drop fill material more than 3' (1 m) from GeoCell panel.



Slope
INTRODUCTION

GeoCells were invented in the early 80's and patented by the United States Army Corps of Engineers to stabilized soft soils and construct roads for heavy load applications. Since their inception they are now used for various civil applications such as slope and channel protection and retaining walls.

On slope applications the BaseLok™ GeoCells can be filled with angular rock, concrete or with soil and vegetated, angular rock or concrete. The GeoCells confine the infill material creating a stable layer protecting the slope or channel from sheet flow. The GeoCells can be installed on slopes as steep as 60 degrees and on channels with flow velocities greater than 25 fps depending on infill material. BaseLok™ GeoCells is a flexible system that will contour to the sub-grade of a slope or channel reducing preparation time. When filled with soil and vegetated or rock the system is permeable reducing water runoff.

The BaseLok™ Geocell is the perfect system to protect impervious and fragile geomembrane liners. It can be installed directly over the liner without the use of stakes and filled with concrete for impact and puncture protection or filled with soil and APPLICATIONS vegetated to create a natural landscape.

APPLICATIONS

- **Slopes/ Embankments**
- **Pond Slopes**
- **Containment Berms**
- **Geomembrane Protection**
- **Shoreline Protection**
- **Landfill Caps**
- **Complete design review.**
- **On site installation assistance.**

KEYPOINTS

- **Complete design review.**
- **On site installation assistance.**
- **Value engineered designs that are project specific and reviewed by experienced professional geotechnical engineers.**
- **Construction possible on slopes greater than 1:1.**
- **On channel applications our GeoCells can be filled with rock for velocities up to 10 fps, vegetated soil up to 20 fps and concrete for velocities greater that 20 fps.**
- **For shore protection the GeoCell allows for the use of a smaller aggregate vs costly rip rap.**
- **On a concrete application the individual blocks become a flexible system that can conform to sub-grade settlement.**

TEAM SUPPORT

- 39 years as a leader in the Geosynthetic Industry
- 25 years of experience with geocells
- Design assistance
- Complete project evaluation
- Project specific value engineered designs reviewed by professional geotechnical engineers
- On site installation and site assessment assistance

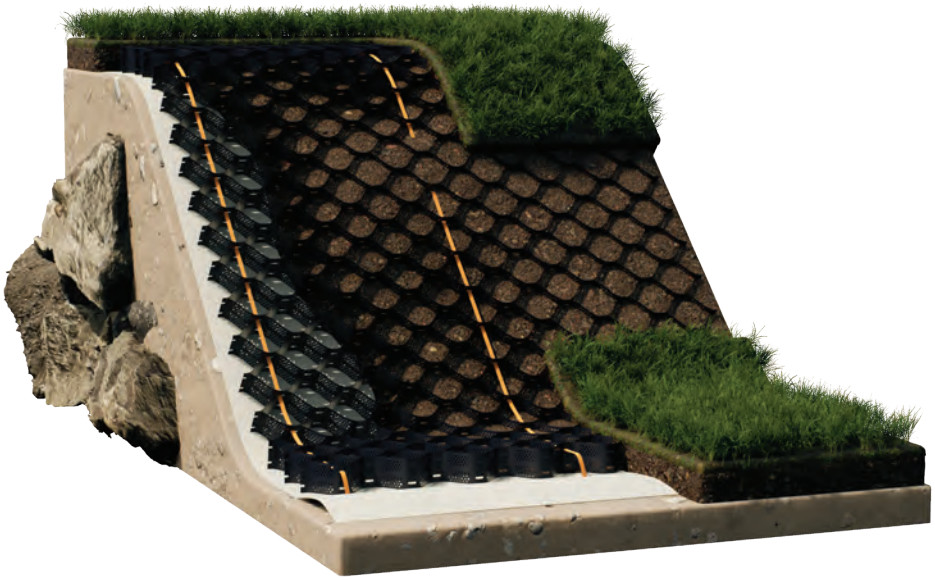
BENEFITS

- 100% manufactured in the USA
- Complete installation accessories
- Meets or exceeds industry standards

> **BaseLok™ GeoCell is a confinement system that can be used on slopes creating a stabilized and permeable layer. We offer an engineered system complete with anchoring components.**

CUSTOMIZATION

- BaseLok™ GeoCell panels can be manufactured to cover the length of the slope or width of the channel to be protected. Evaluation of the soil conditions and geometry of the slope or channel will determine appropriate cell depth for the application as well as anchoring requirements. BaseLok™ GeoCell can be manufactured with depths of 3", 4", 6", or 8" to meet specific project needs.



EXPERT TECHNICAL SUPPORT

- The superior effectiveness of GeoCell is made even better thanks to our BaseLok™ team's proficiency and technical support. We believe a solution is more than just a product we manufacture or sell; you deserve an attentive and knowledgeable team of professionals working alongside you every step of the way. Our experienced engineers and sales team are fully equipped to cater to your every need, no matter the project.

INDUSTRIAL FABRICS, INC.

Industrial Fabrics, Inc.
510 O'Neal Lane Ext
Baton Rouge LA 70819
800 848 4500
www.baselok.com

BASELOK™ GEOCELL may change product specifications without notice. The **BASELOK™ GEOCELL** system is suitable for use in the application described in our literature and on our website, provided proper installation and engineering principles are followed. Professional engineering should be consulted before installation of **BASELOK™ GEOCELL** units to assure proper design. ALL EXPRESSED OR IMPLIED WARRANTIES, INCLUDING THOSE OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. **BASELOK™** is a trademark of Industrial Fabrics, Inc.

**For an updated manufacturer compliance status throughout the audit cycle, SCAN the code with your mobile device.

AASHTO PRODUCT EVALUATION & AUDIT SOLUTIONS
DATAMINE
COMPLIANT

COMPLIANCE AUTHENTICATION

AASHTO

This authenticates:

Industrial Fabrics, Houston, TX, US

successfully complies with the AASHTO Product Evaluation & Audit Solutions

Subgrade Stabilization Geosynthetics

Work Plan

October 2023
Date of Administration

December 31, 2024
Date of Expiration

Jim Tymon
AASHTO Executive Director

CAT
CAT

APPENDIX H
Site and Rock Core Photographs

Photograph 1 – Spring Creek: Boring Location 406

Photograph 2 – Spring Creek: Boring Location 411

Photograph 3 – Spring Creek: Boring Location 428-A

Photograph 4 – Spring Creek: Boring Location 428-B

Photograph 5 – Spring Creek: Boring Location 431

Photograph 6 – Spring Creek: Boring Location 433

Photograph 7 – Spring Creek: Boring Location 452

Photograph 8 – Citico: Boring Location 466-A

Photograph 9 – Citico: Boring Location 466-B

Photograph 10 – Citico: Boring Location 469

Photograph 11 – Citico: Boring Location 481-A

Photograph 12 – Citico: Boring Location 481-B

Photograph 13 – Citico: Boring Location 485

Photograph 14 – Citico: Boring Location 486

Photograph 15 – Citico: Boring Location 487

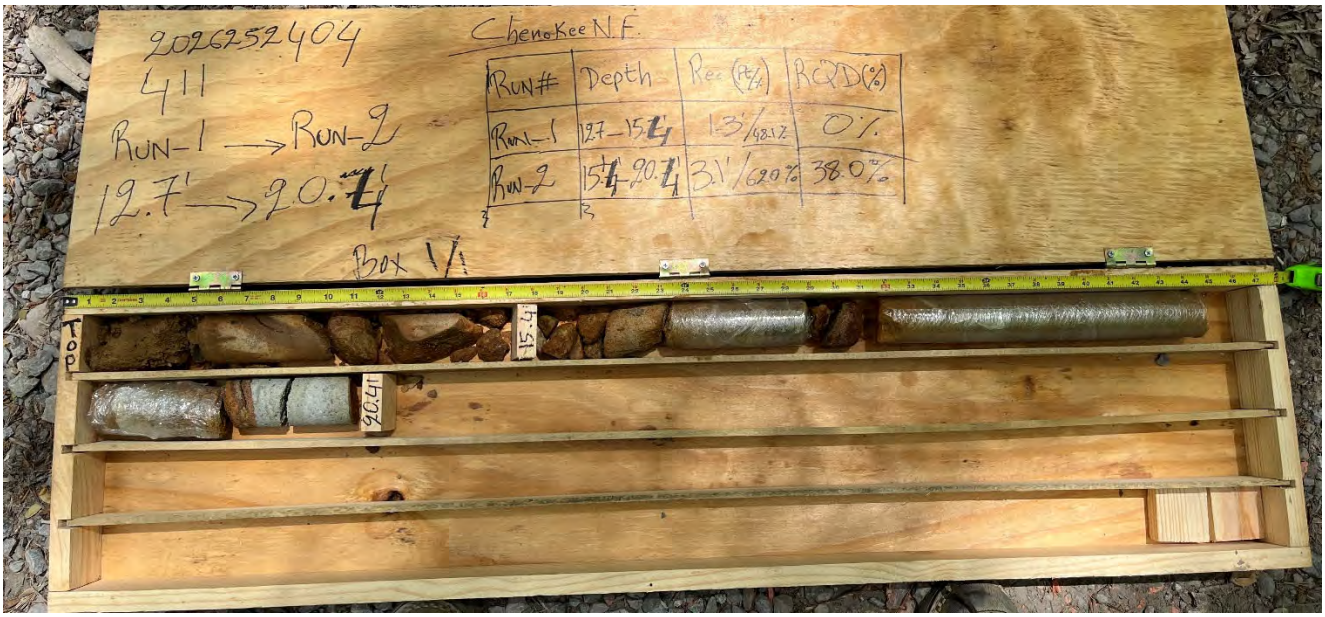
Photograph 16 – Citico: Boring Location 508

Photograph 17 – Citico: Boring Location 515

Photograph 18 – Citico: Boring Location 518-A

Photograph 19 – Citico: Boring Location 518-B

Photograph 20 – Citico: Boring Location 518-C



Photograph 1 – Spring Creek: Boring Location 411

Photograph 2 – Spring Creek: Boring Location 428-B

Photograph 3 – Spring Creek: Boring Location 431

Photograph 4 – Spring Creek: Boring Location 433

Photograph 5 – Spring Creek: Boring Location 452

Photograph 6 – Citico: Boring Location 466-A

Photograph 7 – Citico: Boring Location 466-B

Photograph 8 – Citico: Boring Location 469

Photograph 9 – Citico: Boring Location 481-A

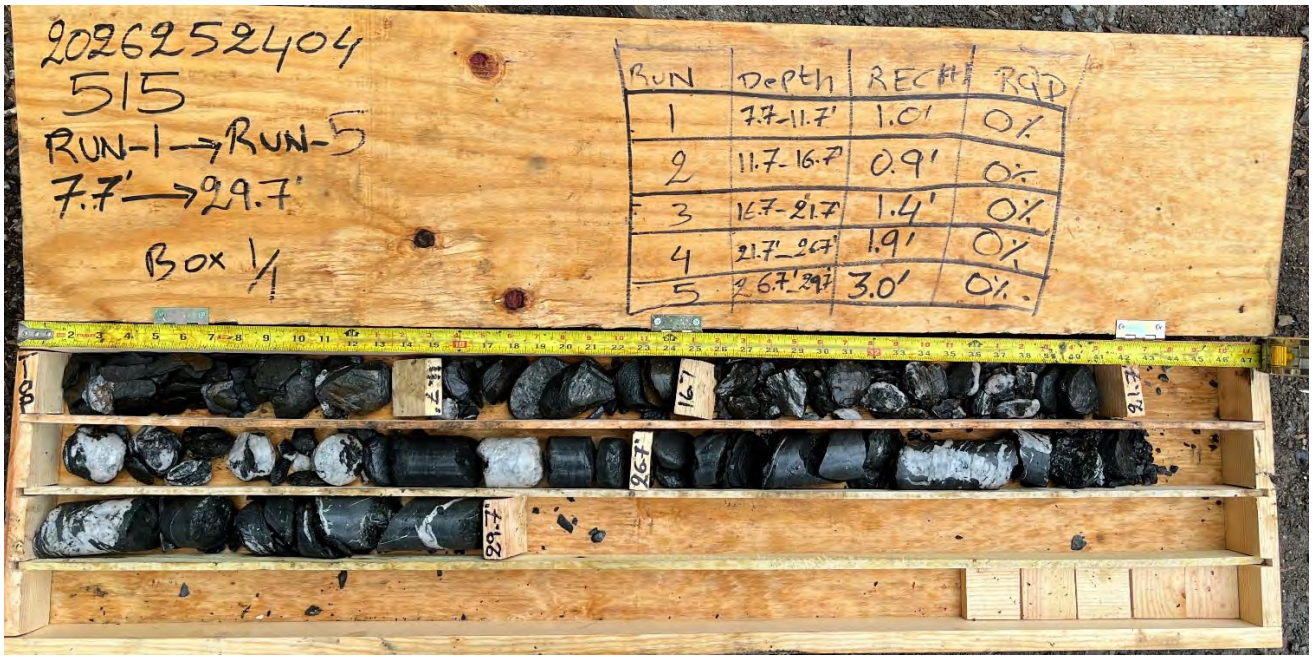
Photograph 10 – Citico: Boring Location 481-B

Photograph 11 – Citico: Boring Location 485

Photograph 12 – Citico: Boring Location 486

Photograph 13 – Citico: Boring Location 487

Photograph 14 – Citico: Boring Location 508



Photograph 15 – Citico: Boring Location 515

Photograph 16 – Citico: Boring Location 518-A

Photograph 17 – Citico: Boring Location 518-B

Photograph 18 – Citico: Boring Location 518-C