ARKANSAS DEPARTMENT OF TRANSPORTATION

SUBSURFACE INVESTIGATION

STATE JOB NO. 040901

FEDERAL AID PROJECT NO. NHPP-1765(9) & 9030

HWY. 22 – GUN CLUB RD. (F)

STATE HIGHWAY 549 **SECTION** 6

IN CRAWFORD & SEBASTIAN **COUNTY**

The information contained herein was obtained by the Department for design and estimating purposes only. It is being furnished with the express understanding that said information does not constitute a part of the Proposal or Contract and represents only the best knowledge of the Department as to the location, character and depth of the materials encountered. The information is only included and made available so that bidders may have access to subsurface information obtained by the Department and is not intended to be a substitute for personal investigation, interpretation and judgment of the bidder. The bidder should be cognizant of the possibility that conditions affecting the cost and/or quantities of work to be performed may differ from those indicated herein.

GEOTECHNICAL DESIGN REPORT

I-49 Project from Hwy 22 to I-40
Crawford & Sebastian Counties, Arkansas

ARDOT Job No. 040901
HNTB Job No. 63136

Prepared For

Arkansas Department of Transportation

Prepared By

HNTB Corporation
Geotechnical Section

April 18, 2024

April 18, 2024

Attn: Mr. Steven Peyton
Assistant Division Head
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Re: Geotechnical Design Report – 040901 Phase Report
I-49 Project from Hwy 22 to I-40
Crawford & Sebastian Counties, Arkansas
HNTB Project Number: 63136

Dear Steven Peyton:

HNTB Corporation (HNTB) has completed the geotechnical engineering services for the 040901 Project. This report presents the findings of the subsurface exploration, laboratory testing, and provides geotechnical design along the alignment and for the bridge foundations.

We appreciate the opportunity to be of service to ARDOT on this project. Please contact either of the undersigned with any questions or if we may be of further service.

Sincerely,
HNTB Corporation

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No. 21612
MICHAEL JORDAN LEE DESTIGTER

04/17/2024

Michael J. L De Stigter, PE (AR, MO, SD)
Geotechnical Project Engineer

GEOTECHNICAL DESIGN REPORT – 040901 Phase Report
I-49 Project
Crawford & Sebastian Counties, Arkansas

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1. INTRODUCTION

The Arkansas Department of Transportation (ARDOT), in cooperation with the Federal Highway Administration (FHWA), is proceeding to construct a new segment of Interstate 49 (I-49) from Highway 22 in Sebastian County, Arkansas to Interstate 40 (I-40) in Crawford County, Arkansas (approximately 13.5 miles). This segment of Interstate was previously included in a larger corridor environmental study known as the "U.S. 71 Relocation". This study extended from Hwy 70 in DeQueen, Arkansas to I-40 near Alma, Arkansas, encompassing approximately 125 miles. The relocation of U.S. 71 in Arkansas is part of the Congressionally designated *High Priority Corridor 1*, which is a direct interstate connection between Shreveport, Louisiana, and Kansas City, Missouri.

At the time of this report, the Arkansas Department of Transportation (ARDOT) has divided the project into four sub-projects (approximately 3.5 miles for the 040901 project), listed in the anticipated order of the anticipated construction, as shown in the table below (Unless otherwise noted, all stations in this report are referenced to the baseline of I-49). Construction of all sections will include both northbound and southbound lanes.

Table 1: List Each Bridge in Relation to the Project Phase

ARDOT PROJECT NO.	STARTING STATION	TERMINATING STATION	ASSOCIATED BRIDGES*
040901	100+00	269+00	Bridge 1** & 16**
040904	595+00***	860+50	Bridge 6, 7A/B, 8A/B & 14
040902	269+00	595+00	Bridge 2A/B, 3, 5, 15, & 17
040903	595+00***	832+43.17	Bridge 9A/B, 10 & 10W, 11, 12, & 13

*Bridge 4 was replaced with a box culvert structure. Bridges 15, 16, and 17 were added after the completion of the preliminary design.
** Bridge 1 & Bridge 16 have been formally designated at Bridge 07684 and Bridge 07685, respectively, by ARDOT. All other phase bridges have not been assigned formal designations yet. For the purposes of this report, all references to Bridges 07684 and 07685 will be as Bridge 1 & 16 herein.
*** Project phases 40903 & 40904 include overlapping stationing. As a result of construction scheduling changes, the I-40/I-49 interchange bridges (9A\B thru 13) were grouped into the 40903 phase along with pavement and ITC structures within the project limits noted above. However, the interchange bridge connecting I-49 Southbound to I-40 Westbound, Bridge 14, is still needed to be installed sooner so it was grouped with Bridges 6 through 8A\B along with grading and pavement within the project limits listed.

This geotechnical report is for the 040901 project phase. All other phases will be addressed in their respective reports.

2. PROJECT DESCRIPTION

2.1 Purpose of Report

The purpose of this report is to present subsurface information, geotechnical analysis results, and recommendations for foundation-type alternatives for the project bridges, roadway embankment slopes, retaining structures, and support of culverts along the proposed I-49 alignment. Specifically, this report will cover the 040901 phase of the project with all other phases (040902 through 040904) covered in their respective reports.

An initial phase subsurface and laboratory investigation was completed to obtain preliminary information necessary to complete preliminary analyses, recommendations, and to set bridge span lengths based on safe end and side slopes. This preliminary data is presented in the *Preliminary Geotechnical Design Report, I-49 Project form Hwy 22 to*

I-40, Crawford & Sebastian Counties, Arkansas (ARDOT Job No. 040748, HNTB Job No. 63136), Prepared for Arkansas Department of Transportation; Prepared by HNTB Corporation Geotechnical Section, Dated July 29, 2022. This preliminary report includes soil stratification, depth to rock, shear strengths, unconfined compressive strengths of soil and rock, consolidation test data, sieve and hydrometers, unit weights, design soil parameters, organic contents, and corrosivity along all four (4) phase of this project.

This report contains the final subsurface investigation to finalize the above-referenced analysis and recommendations and references the relevant data obtained from the Preliminary Geotechnical Design Report. This report supersedes the information, analysis, and recommendations presented in the Preliminary Geotechnical Design Report for the 040901 phase of the Project.

2.2 Project Description

The I-49 project consists of a new four-lane divided roadway and 16 bridges as defined in the table below. The project alignment starts at the south end, connecting to the existing I-49 segment at Fort Street (AR 22) in Fort Smith, Arkansas, and terminates approximately 13.6 miles north at the existing I-40/I-49 interchange near Alma, Arkansas. The total project length is approximately 13.6 miles with approximately 3.2 miles of bridge length along the main alignment and 1.7 miles of bridge length off the main alignment (ramps and overpasses). Much of the project alignment will be built up with imported fill from borrowed sources to be determined. Typical bridge embankment heights are on the order of 15 feet to 20 feet with several embankments exceeding 25 feet up to a maximum height of 35 feet.

Table 2: List of Project Bridges in Relation to Project Phase and Alignment.

BRIDGE	STARTING STATION	TERMINATING STATION	BRIDGE LOCATION	ALIGNMENT
ARDOT PROJECT NUMBER 040901 (STATIONS 100+00 TO 269+00)				
1	163+71.83	216+04.17	Arkansas River Crossing	Main Alignment
16	240+71.92	258+94.08	Gun Club Rd Crossing	Main Alignment
ARDOT PROJECT NUMBER 040902 (STATIONS 269+00 TO 595+00)				
15	20+02.65	24+25.27	Westerville Rd Over I-49	Westerville Rd
2A & 2B	447+28.90	450+52.23	Mays Branch Crossing	Main Alignment
3	20+72.01	26+01.56	Thornhill Rd Over I-49	Thornhill Rd.
5	40+29	44+58	Clear Creek Rd. Over I-49	Clear Creek Rd
17	N/A[1]	N/A[1]	Rest Area Access Over I-49	Rest Area
ARDOT PROJECT NUMBER 040904 (STATIONS 595+00 TO 860+50)				
7A & 7B	612+60.80	619+59.95	I-49 Over Frog Bayou	Main Alignment
8A & 8B	682+91.22	687+76.78	I-49 Over S. Hwy 162 (Henry St.)	Main Alignment
6	41+09.00	43+90.30	Waterfront Rd. Over I-49	Waterfront Rd.
14	54+62.49	61+11.82	NW I-40 Interchange Over Frog Bayou	I49SB to I40WB
ARDOT PROJECT NUMBER 040903 (STATIONS 595+00 TO 832+43.17)				
9A & 9B	770+27.83	832+43.17	I-49 Over I-40	Main Alignment
10 & 10W	10+00	30+24.52	SW I-40/I-49 Interchange Over Frog Bayou	I40EB to I49SB
11	17+94.10	52+32.52	Alma Hwy (West)	I40WB to I49SB
12	16+63.13	25+36.30	Alma Hwy (East)	I49NB to I40EB
13	39+86.35	43+33.79	Over I-40/Under I-49	I49NB to I40WB

1. Rest Area Bridge stationing is unavailable at the time of this report. The anticipated bridge crosses the main alignment at approximately station 335+50.

This report covers the 040901 project phase commencing from station 100+00 to 269+00. This project connects the existing portion of I-49 starting at Arkansas Hwy 22 in Barling, Arkansas and ends just north of Gun Club Rd. A new embankment will be constructed from the Hwy 22 interchange to the southern abutment of Bridge 1 (located roughly ¼ mile north of H Street). From this new embankment Bridge 1 spans the Arkansas River followed by 2,468 ft of new embankment before Bridge 16 completes the 40901 phase by spanning the Crawford County Levee and making an interchange with Gun Club Rd.

3. SITE CONDITIONS

The 040901 project alignment is predominantly rural, spanning mostly land used for military and recreational purposes. Most of the alignment is relatively flat with the existing elevation ranging from approximately 390 feet near the Arkansas River to 400 feet at the proposed Gun Club Rd interchange.

South of the Arkansas River, the alignment crosses several paved and gravel roads used primarily by local agencies and the United States Army Corps of Engineers (USACE). This land is a relatively unmanaged forest with the Spring Hill Recreational Park open to the public. North of the river, before Gun Club Road, is a relatively unmanaged forested floodplain primarily only used by Fort Chaffee for military exercises and locally it is suspected to be a depository for dredged material from the river.

4. GEOTECHNICAL CONDITIONS

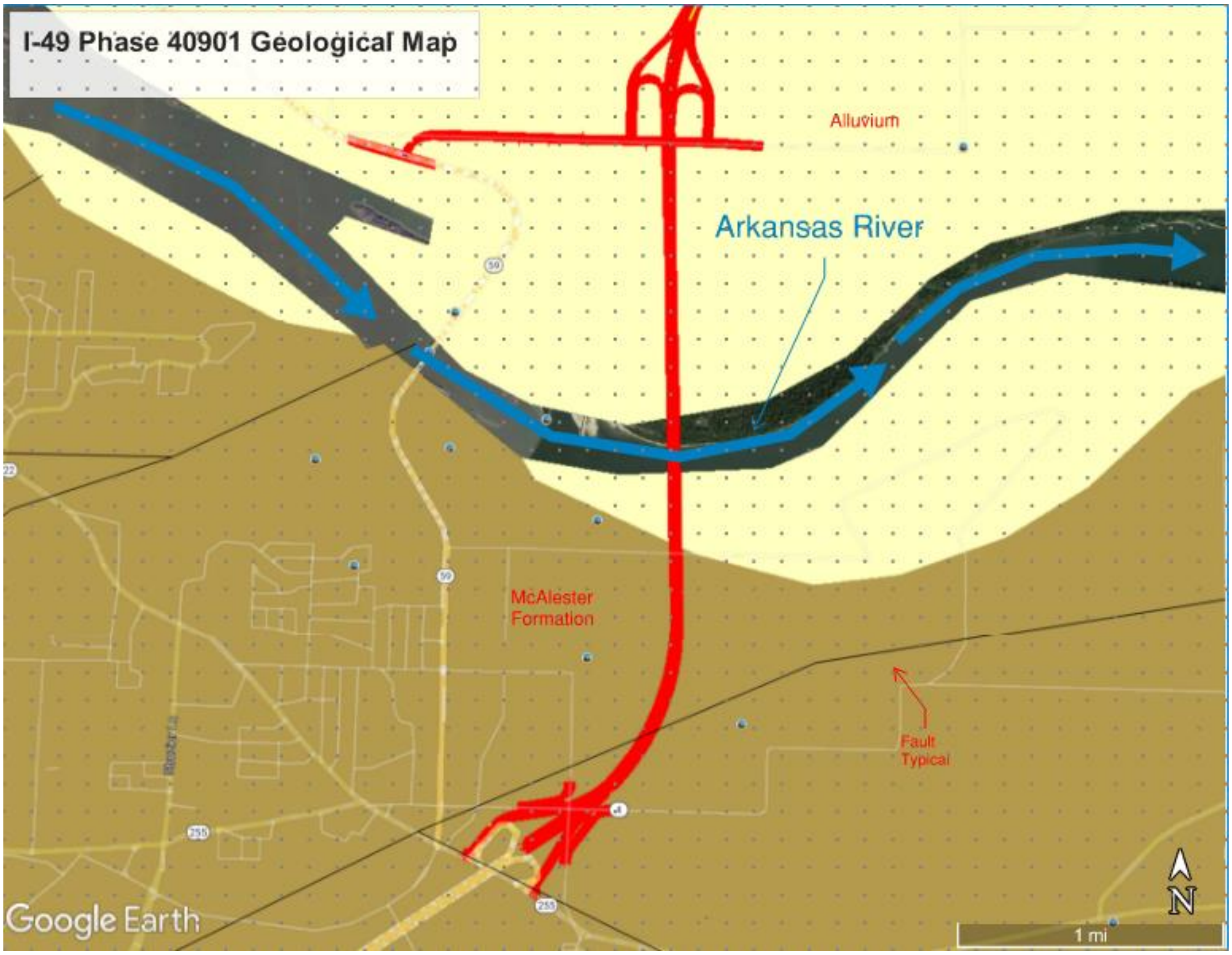
4.1 Geology

The study area geology is dominated by the alluvial plain of the Arkansas River. Landform-wise, the Arkansas River valley divides the interior highlands with the Boston Mountains on the north flank of the river and the Quachita Mountains on the south flank of the river.

The project alignment is primarily exposed to Holocene Alluvium and some areas of Pleistocene Terrace deposits. The river eroded the underlying bedrock as it meandered across the valley and subsequently deposited mostly granular material such as sand, silt, clay, and gravel. The alluvium has a maximum thickness of about 50 feet. Before the construction of dams and reservoirs, the Arkansas River was a shallow braided stream. Upland terrace deposits composed of similar types of materials were deposited during higher flows under Pleistocene glaciation.

Bedrock was primarily encountered at depths less than 30 feet below the ground surface south of the Arkansas River but ranged up to 52 feet between the north bank of the Arkansas River and Gun Club Rd. The rock located under these unconsolidated deposits is of the McAlester Formation. The Pennsylvanian Age McAlester Formation ranges from 500 to 2,300 feet in thickness and consists of in ascending order: several hundred feet of shale with thin sandstone and coal layers (the Lower Hartshorne Coal is just above the base), several hundred feet of shale with a few sandstone beds and coal (Upper Hartshorne Coal) and capped by several hundred feet of shale with a few coal beds. On rare occasions, the sandstones may contain rounded, coarse-grained, quartz sand. The beds at the base and top of the section are normally the thickest. At least six coal beds are present in the formation. The Savanna Formation is about 1,600 feet in thickness at its typical section, but the top several hundred feet of the sequence are usually absent in Arkansas.

Structurally, two trending fault trends are numerous in the study area, one northeast–southwest, and the other east–west. Although not indicated on the surficial geology maps, they are most likely to be found in the bedrock covered by the river alluvium.



4.2 Subsurface Exploration

A total of 24 borings were drilled for the initial phase investigation. These borings were completed by Grubbs, Hoskin, Barton & Wyatt, Inc. (Grubbs) between December 6, 2021, and April 5, 2022, and were drilled from 6 feet to 105 feet below the existing ground surface. No borings were drilled within the waterways during this phase. To supplement the initial phase borings, 94 final phase borings were completed by Grubbs between November 2022 to November 2023, and were drilled from 5.5 feet to 105 feet below existing grade (with shallower 5.5-10ft borings being conducted primarily for pavement evaluation of either existing or proposed roadways). For both phases, borings were planned by HNTB Corporation (HNTB) and staked utilizing GPS methods.

All drilling and sampling were conducted in accordance with EM 1110-1-1804, Geotechnical Investigations; ER 1110-1-1807, Drilling in Earth Embankment Levees; ASTM D1587-15, Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes, ASTM D1586-18, Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils, and ASTM D2113-14, Standard Practice for Sampling Rock for Site Exploration. Borings were drilled by Grubbs using either a CME Model 550 drill rig, a Simco 2800 drill rig, or a rubber-tired ATV rig. Borings were advanced through the alluvial and terrace overburden deposits using hollow stem augers. The borings were advanced using dry-auguring drilling procedures or a combination of dry-auger and rotary wash procedures. For boring intervals advanced with dry-auger methods, either 4.5-in diameter continuous flight augers or hollow stem augers were used. When boreholes could not remain open, holes were advanced by rotary wash methods utilizing a water and bentonite drilling fluid to flush cuttings and stabilize the borehole.

Standard Penetration Tests (SPT) were taken in all borings following AASHTO T 205 drilling procedures at generally 5-foot intervals to bedrock. The test involves driving a 2-inch outside diameter (O.D.), 1 3/8-inch inside diameter (I.D.), split barrel sampler 18 inches in length with a 140-pound hammer falling freely 30 inches after being lifted by an auto hammer. The blows for three six-inch increments were recorded, with the sum of the final two reported as the N-value. A portion of each sample was retained for possible laboratory testing. At selected intervals in cohesive soils, undisturbed samples were retrieved utilizing a 3-inch O.D., thin-walled, Shelby Tube sampler attached to the drill rods. The method involved pushing the tube 24 inches by employing drill rig hydraulics. Samples were capped and sealed in the field and extruded in the laboratory for evaluation.

At locations where rock sampling was required, an “NQ_{WL}” or “NQ2” sized core barrel with a 5-foot length was used in combination with a double tube coring system which allowed for coring continuously in 5-foot increments.

Borings were logged in the field using the Unified Soil Classification System by a Grubbs geologist. The drilling was observed, examined, and logged in the field. Items such as lithology, physical characteristics, drilling action, apparent groundwater table, and drilling fluid loss were noted and recorded.

The borings were backfilled with cuttings up to approximately 1 to 2 feet below the surrounding grade. Then a plastic spider plug was used to compress cutting before the hole was topped off with additional cutting to match the surrounding grade.

4.3 Site Stratigraphy

The boring investigation indicates that the overburdened soils and depth to bedrock vary widely. Borings indicate the following sitewide generalized subsurface profile: topsoil over 20 to 40 feet of alluvium, over predominately shale bedrock. However, given that the alignment is 3 miles this generalized subsurface profile varies significantly so the sitewide generalized profile is further divided into the following generalized profiles:

Table 3: Generalized Site Profiles

STARTING STATION	TERMINATING STATION	PROFILE DESCRIPTION
100+00	**160+00**	Topsoil over 7 to 25 feet of clayey silt and lean to fat clay, over shale
160+00	**181+50**	Topsoil over 7 to 25 feet of clayey silt and lean clay, over 12 to 20 feet of sand, over shale.
181+50	**193+00**	0-7ft of sand over shale
193+00	**260+00**	Topsoil over 30 to 50 feet of very loose to very dense sand, over sandstone and shale.
260+00	**269+00**	Topsoil over 22 to 32 feet of clayey silt and lean clay, over 15 to 25 feet of sand, over shale.

From the south project limit to Gun Club Road, the top of the rock varies from elevation 340 to 386 feet. Rock elevation peaks around station 158+50 but was generally between elevation 346 to 354 feet. Bedrock is predominantly shale described as slightly weathered and moderately hard. The uppermost unit of shale is typically described as low hardness and weathered before transitioning from slightly weathered to fresh and moderately hard. Unconfined compressive strength tests of the shale samples ranged from 640 psi to 8,340 psi with typical strengths ranging between 2,000 to 5,000 psi. Sandstone was also encountered, primarily between the Arkansas River and Gun Club Rd., between stations 216 and 258, respectively. The uppermost unit of sandstone is typically described as low hardness and weathered before transitioning from slightly weathered to fresh and moderately hard. Unconfined compressive strength test of the shale samples ranged from 550 psi to 11,780 psi with typical strengths ranging between 2,000 to 5,000 psi.

4.4 Groundwater Levels

Groundwater levels taken directly after drilling widely ranged from 3.3 feet to 35 feet below the existing ground surface observed by Grubbs (+/- Elevation 411ft to +/-Elevation 364ft), as noted in the boring logs in Appendix 1. Groundwater levels were collected directly after drilling between November 2022 to November 2023. Areas, where shallow groundwater was encountered, are considered to represent perched water conditions in overburdened soils, particularly alluvial units. The depth of groundwater is strongly influenced seasonally based on seasonal precipitation, surface runoff and infiltration, and stream level of nearby surface water features (such as the Arkansas River).

Seasonal variations in rainfall, changes to on-site conditions, and changes to off-site conditions can affect groundwater levels. Fluctuations in groundwater levels from those noted in logs should be anticipated during construction. Water levels observed and recorded by others reflect only those conditions that existed at the time of investigation and may vary from true phreatic groundwater levels. Fluctuations in water levels may occur over more prolonged periods of reading and can be influenced by various outside factors. It may take groundwater several days to reach hydrostatic levels in holes in cohesive soils.

4.5 Scour

Scour at bridge bents was evaluated by HNTB for the Arkansas River crossing. Scour results are included in Appendix 2. In summary, estimated scour depths are above the top of rock at all bents except Bents 14 and 15 located in the Arkansas River channel. The estimated long-term (abrasion) scour of the rock at these two bents is estimated down to elevation 340 based on anticipated stream flows at the bents, rock conditions, modified slake durability rock tests, and our engineering judgment.

5. ENGINEERING ANALYSIS AND RECOMMENDATIONS

The boring logs and laboratory data presented in Grubb's Data Report are provided in Appendix 1. This data report was reviewed and used to complete the final design geotechnical analyses for the following:

- Bridge subsurface conditions,
- Bridge foundation types and lengths,
- Settlement and global stability of embankments,
- Existing Utilities,
- Culverts,
- Seismic Considerations,
- Soil Corrosion, and
- Pavement.

5.1 Bridge Subsurface Conditions

The 040901 project phase originally consisted of a single bridge (Bridge 1) commencing south of the Arkansas River at approximately station 163+71.92 and terminating north of the Gun Club Road at station 258+94.08. However, over the course of the project, Bridge 1 was split into two bridges (Bridge 1 & Bridge 16) with embankments between them. The revised Bridge 1 & Bridge 16 stationing is 163+71.92 to 216+04.17 and 240+71.92 to 258+94.08; respectively. Based on preliminary and final phase bridge borings, the depth to rock, which is defined as shale or sandstone, ranges from 28 to 52 feet below the existing grade, with most borings encountering rock at depths greater than 40 feet.

<u>Bridge 1</u>

Bridge 1 is the proposed combined northbound and southbound I-49 crossing over the Arkansas River. The material encountered at the south approach close to bridge 1 includes soft clayey silt to silty clay, with loose silt and medium dense sand. Depth to rock gradually increases from approximately 10 feet to 15 feet towards Highway 22 to 30 feet to 40 feet near the Arkansas River. Bedrock consists primarily of moderately hard shales. North of the river, the foundation soils predominantly consist of loose silt over medium-dense sand over moderately hard shale. Depth to rock ranges from 40 feet to 45 feet below existing ground surface.

Bridge 16

Bridge 16 is the proposed combined northbound and southbound I-49 crossings over Flat Rock Creek, Crawford County Levee, and Gun Club Rd. Based on the boring log data, the south approach foundation soils consist of loose silt over loose to medium-dense sand. Depth to rock gradually increases from approximately 40 feet to 45 feet. Bedrock consists of moderately hard shales or sandstone. Around 5 feet thick coal was encountered at a depth of approximately 60 feet below ground. North of the Gun Club Rd, the foundation soils are alternate layers of loose silts and silty clay overlying sands over moderately hard shale. Depth to rock ranges from 48 feet to 50 feet below the existing ground surface. A handful of borings encountered coal seams at a considerable depth below the anticipated termination depth of the proposed foundations (approximately between elevations 307ft to 328ft).

5.2 Bridge Foundation Types

Based on a review of the available boring data, groundwater readings, and performance of the existing bridge foundations, HNTB recommends supporting the proposed bridges on deep foundations. Bridges 1 and 16 are both recommended to have the abutments supported by steel H-piles driven to rock and all interior bents supported by drilled shafts socketed into rock.

HNTB recommends designing and constructing driven pile foundations in accordance with the AASHTO LRFD Bridge Design Specification, 9th Edition; the July 2, 2020, ARDOT Bridge Division Policy Guidelines; and section 805.09 of the ARDOT Standard Specification for Highway Construction. To efficiently drive piles through the embankment and overburden to rock without damage and obtain the required capacities, HP12 and HP14 sections, or larger, are recommended. Pile tips are required for all piles driven to rock. Pre-bore is not anticipated to be required at the abutments for Bridges 1 and 16.

Drilled shafts are recommended at all substructure locations other than Bridge 1 & Bridge 16 abutments. Based on the evaluation of the subsurface conditions encountered, it is recommended that all shafts be constructed with permanent smooth steel casing seated into rock consisting of either shale or sandstone. In addition, all shafts shall be socketed a minimum of 2.0 diameters into competent rock. If shorter sockets are desired, a drilled shaft load test is recommended to be performed to evaluate possible reduction in the socket length. Verification borings at each drilled shaft location are recommended to confirm the shaft rock design conditions, especially since the presence of coal and weathered rock seams were encountered in a number of boring locations.

For driven piles at the abutments, the settlement of the foundation soils due to the embankment fill will impose downdrag forces on the piling unless the embankments are allowed to settle before driving the piles. Based on the planned construction schedule, the approach embankments are anticipated to have sufficient time to be constructed and allowed to settle prior to piling installation so downdrag was not considered in pile loading.

5.2.1 Driven Pile Foundation Recommendations

Following AASHTO LRFD Bridge Design Specification, 9th Edition and the July 2, 2020, ArDOT Bridge Division Policy Guidelines, the driven piles on Bridge 1 & Bridge 16 were designed as HP14x73 piles assuming no section loss or soil plugging. Due to the potentially corrosive nature of the soils, the piles were detailed as HP14 x 89 piles to account for corrosion loss. All piles are required to be driven to bearing on bedrock (shale or sandstone). Two bridge alternatives, a concrete superstructure option, and a steel superstructure option, for Bridge 1 & Bridge 16 will be put out for bid and will use a combination of vertical piles and battered piles (12V:4H) under the abutments and a single vertical pile supporting each of the wing walls. Both concrete and steel superstructure bridge alternatives were designed with center-to-center pile spacing greater than 3 pile widths and therefore group reduction factors for axial and lateral resistance were not required. Table 4 below summarizes the pile loads and estimated top of rock elevation for each bridge and design alternative:

Table 4: Bridge 1 & 16 Pile Loads and Estimated Top of Rock Elevation

Bridge	Bridge Alternative	Maximum Factored Pile Load-kips	Estimated Top of Rock Elevation
Bridge1	Concrete	264.5	357.8 Bent 1, 351.4 Bent 33
	Steel	177	357.8 Bent 1, 351.4 Bent 33
Bridge 16	Concrete	264.5	350.1 Bent 1, 350.0 Bent 16
	Steel	177	350.1 Bent 1, 350.0 Bent 16

The piles are recommended to be driven to the required nominal driving resistance using Method B – Wave Equation Analysis (WEAP). A driving resistance factor (Φ_{dyn}) of 0.65 is recommended by ARDOT for Method B to determine the pile nominal driving resistance. All piles are anticipated to be driven to bearing on rock.

Based on the subsurface conditions encountered and the pile driving criteria established, the nominal driving resistance (maximum factored pile load divided by the driving resistance factor per pile) of 407 kips for concrete alternate, and 272 kips for steel alternate is less than the structural nominal axial compressive resistance of 823.9 kips per pile. Recommended pile lengths for the plans should include an estimated 5 feet length below the top of rock elevations provided in Table 4.

5.2.2 Driven Pile Construction Recommendations

Per the ARDOT Bridge Division Guidelines, the piles at the end bents were evaluated for drivability using GRLWEAP 14 Version 14.1.20.1 by Pile Dynamics Inc. Wave Equation Analysis Program (WEAP). Analyses were performed using the smallest anticipated hammer, the Delmag D19-42 (although larger hammers are anticipated based on the contractor's hammer availability).

The WEAP analyses indicate that the required nominal driving resistance may be achieved using the Delmag D19-42, within the allowable limits for the maximum nominal driving stress and a practical 3-12 blows per inch driving criteria. Based on this evaluation it is estimated that the minimum rated hammer energy required to obtain the ultimate bearing capacity for all piles will be 40.0 ft-kips per blow. The Contractor awarded the job shall submit a proposed driving system per Subsection 805.07(c) for approval. The Engineer will perform a WEAP analysis with the proposed driving system and recommend approval or rejection. The approved driving system will include appropriate bearing graphs and tables with pump settings to be used during driving to verify piles are driven to the nominal driving resistance.

5.2.3 Drilled Shaft Foundation Recommendations

Drilled shafts are recommended for the land bents and the bents within the Arkansas River. It is recommended that all drilled shafts in this project be drilled using a shallow temporary casing. Drilling fluid to stabilize the excavation to advance the shaft excavation to bedrock will be required. Permanent smooth steel casing will then be installed and seated into rock. The uncased drilled shaft rock socket will be drilled using water or polymer drilling fluid that will not slicken the sidewalls of the exposed rock. Axial capacity is designed using side resistance and end bearing only in rock below the bottom of permanent casing using AASHTO methods and our experience. Lateral capacity is designed using soil and rock resistance. Soil and rock parameters were grouped based on foundation location, size, and proposed loading. Tables were generated for each group of shafts to determine the axial rock socket length and then compared with lateral analysis running the 3-D nonlinear finite element analysis program FB-MultiPier to analyze the bridge for soil-structure interactions under both static and dynamic loading conditions. Where design borings encountered coal and weathered rock seams within the side resistance and end-bearing design zones, adjustments to the rock socket lengths were made. The design of Bents 14 and 15 in the river disregarded estimated rock scour depths provided by HNTB Hydraulic Engineers. Recommended shaft lengths including the design rock socket depth are included in Appendix 3 of this report.

5.2.4 Drilled Shaft Construction Recommendations

Permanent smooth steel casing is recommended for all drilled shafts and shall be socketed into the bedrock at a sufficient depth to adequately seat the casing for any fractured/weathered rock at the overburden contact and provide a positive seal to stabilize the excavation. The estimated bottom of permanent casing elevations are provided in Appendix 3 and will be shown on the bridge plans.

Drilled shafts should be constructed and inspected in accordance with Bridge Division Guidelines, AASHTO LRFD Bridge Design Specification, 9th Edition, and the Drilled Shaft Foundations Special Provision. Drilled shaft concrete is required to have a minimum 28-day compressive strength indicated on the bridge plans.

The contractor will be required to drill one foundation test boring at the center of each drilled shaft for confirmation of shaft design and length unless a satisfactory boring was previously drilled at the shaft location for the preliminary or final geotechnical investigation. Test borings shall be drilled to the minimum depth of 2 times the shaft diameter below the planned bottom of the designed rock socket elevation. The Drilled Shaft Foundations Special Provision provides the requirements for drilling and furnishing the test boring information to the Engineer.

Cross-hole sonic logging (CSL) testing shall be performed on all drilled shafts as part of the shaft acceptance procedures. Thermal Integrity Profiling (TIP) testing shall also be performed on Bents 12 through 16 shafts of Bridge 1. Both tests shall be performed in accordance with the Nondestructive Testing (NDT) of Drilled Shaft Foundations Special Provision. NDT results for each shaft shall be furnished to the Engineer for approval within 72 hours of completion of all NDT tests on each shaft. Full-time inspection of drilled shaft construction by a qualified drilled shaft inspector is recommended with review and signoff by the Geotechnical Engineer.

5.3 Settlement and Global Stability of Embankments

Approach embankments to Bridge 1 and Bridge 16 were assessed for settlement and global stability in the 040901 phase. The approach embankments are named Bridge 1 South Approach Embankment, Bridge 1 North Approach Embankment, Bridge 16 South Approach Embankment, and Bridge 16 North Approach Embankment. Embankments beyond the bridge approaches were also evaluated for settlement and global stability.

The settlement and global stability analysis are discussed in the sections below.

5.4 Bridge Embankment Settlement Analysis

Settlement analyses were performed for each approach embankment using Settle3 version 5.022, by RocScience Inc. and the results of these analyses are included in Appendix 4. Based on the conditions encountered at the boring locations, along with the height of the embankment, the analysis results indicate the foundation soils may experience significant settlement under the proposed embankments. Bridge 1 requires approach embankments of 19 feet on the south and 23 feet on the north. Bridge 16 requires approach embankments of 23 feet on the south and 30 feet on the north. The total estimated settlement of the proposed embankments varies from 7 inches to 11 inches with estimated times for settlement to occur varying from approximately 7 to 19 months. Settlement mitigation options were considered to address potential downdrag on piles and settlement effects on drop inlets, outlet pipes, and paving. The current construction schedule for project 040901 has adequate time for constructing the embankments and monitoring the magnitude and rate of settlement with settlement plates to determine when piling and other construction within and on top of the embankment can be commenced.

It is recommended that the approach embankments for a minimum of 150 feet behind the end bents be constructed to subgrade level and required to meet settlement wait times prior to proceeding with pile driving, drop inlets, outlet pipes, and paving. Settlement plates are recommended to be installed at all four end bent approach embankment locations and monitored according to the plan notes and Settlement Monitoring Special Provision. Based on settlement plate readings collected during the wait periods after the construction of the embankments to subgrade level, the Engineer shall determine when pile driving may begin. The estimated wait periods vary from 6 to 10 months. Actual wait periods will be determined by the Engineer.

Roadway embankments constructed beyond 150 feet behind the four end bent locations are recommended to meet settlement wait times after construction to subgrade level based on the Engineer’s assessment of adjacent end bent embankment rate data prior to proceeding with construction of drop inlets, outlet pipes, and paving. Estimated wait periods are 5 months for embankment heights greater than 10 feet, and 3 months for embankment heights equal to and less than 10 feet. Actual wait periods will be determined by the Engineer.

5.5 Bridge Embankment Global Stability Analysis

Slope stability assessments were performed based on the proposed embankment slope's height, geometries, underlying soil conditions, and the required performance criteria of the structure. The engineering parameters used for the stability assessments are based on the results of the field and laboratory investigations. Parameters for suitable embankment fill were selected based on the initial assumption that most embankment fill would be lean clay (CL) or silty clay (CL-ML) material. A rock fill layer is recommended between the embankment fill and ground surface to provide satisfactory global stability factor of safety, reduce foundation soil settlement times, and provide overall embankment stability protection from the effects of water due to flooding events. Two types of rock fill materials are recommended in the approach embankments: rock fill -class 7 and rock fill – 24 inches maximum diameter. Rock fill – class 7 is recommended within the abutment limits where piles will be installed. Details of the rock fill are shown in Appendix 4. Values assumed for embankment fill and Rock Fill materials are shown in Table 5 below:

Table 5: Assumed Embankment Fill and Rock Fill Properties

MATERIAL	UNIT WT. (PCF)	UNDRAINED FRICTION ANGLE; Φ (DEG)	UNDRAINED COHESION; C (PSF)	DRAINED FRICTION ANGLE; Φ' (DEG)	DRAINED COHESION; C' (PSF)
ASSUMED EMBANKMENT FILL	125	0	800	26	160
ASSUMED ROCK FILL – CLASS 7	135	40	0	40	0
ASSUMED ROCK FILL – 24 INCHES DIA MAX	145	40	0	40	0

Undrained (total stress) soil strength parameters are assumed for short-term or "end of construction" conditions, while drained (effective stress) parameters were used to model long-term conditions where excess pore water pressures have dissipated.

Analyses were completed in general accordance with the current ARDOT Bridge Design Manual, AASHTO LFRD Bridge Design Specification, 9th Edition, and AASHTO Standard Specifications for Highway Bridges, 17th Edition. The limit equilibrium program, Slope/W, version 2023.1.2 by Geo-Slope International, Ltd., was used to analyze global stability. This program was used to model the geometry of critical sections of the proposed slopes to complete a robust search for critical slip surfaces. Factors of safety for global stability were calculated using Spencer's method. Global stability results are summarized in the following Tables 6 & 7, respectively:

Table 6: Summary of Global Stability Results – Bridge 1

Analysis Location Section	Assumed Conditions	Minimum Computed Factor of Safety	
		Long Term	Short Term
South Approach Embankment End Slope	3H:1V	1.55	1.45
South Approach Embankment Side Slope	3H:1V (left to right slip surface)	1.83	1.63
	3H:1V (right to left slip surface)	1.84	1.63
North Approach Embankment End Slope	2H:1V	3.72	4.00
North Approach Embankment Side Slope	3H:1V (left to right slip surface)	1.80	1.50
	3H:1V (right to left slip surface)	1.81	1.51

Table 7: Summary of Global Stability Results – Bridge 16

Analysis Location Section	Assumed Conditions	Minimum Computed Factor of Safety	
		Long Term	Short Term
South Approach Embankment End Slope	3H:1V	1.56	1.91
South Approach Embankment Side Slope	3H:1V (left to right slip surface)	1.88	2.06
	3H:1V (right to left slip surface)	1.86	2.05
North Approach Embankment End Slope	3H:1V	1.57	1.57
North Approach Embankment Side Slope	3H:1V (left to right slip surface)	1.72	1.42
	3H:1V (right to left slip surface)	1.73	1.45

End slopes were set at 3H:1V slope except at Bridge 1 north approach embankment. The 3H:1V slopes were required for global stability to meet the required 1.5 factor of safety against failure in the drained and 1.3 in the undrained conditions. Embankment side slopes were set at 3H:1V in accordance with ARDOT standards as they meet the required global stability Factors of Safety.

The results of the global stability assessments in the sections are summarized in Appendix 5 and are considered acceptable for achieving the required minimum factor of safety values.

6. EXISTING UTILITIES

Existing utilities include several natural gas production wells (both plugged and active wells), along with buried natural gas pipelines, overhead electric lines, and buried residential water and sewer systems. Existing natural gas utilities in potential conflict with proposed embankments are summarized from available information in Table 8 below.

Table 8: Summary of Known Existing Utilities

FEATURE	STATUS	APPROXIMATE STATION	APPROXIMATE FILL HEIGHT (FT)	CONFLICT WITH PROPOSED EMBANKMENT
ARDOT PROJECT NUMBER 040901 (STATIONS 100+00 TO 269+00)				
GAS PIPE	ACTIVE	124+00	5	Intersection of two gas pipes under the embankment.
GAS PIPE	ACTIVE	131+80	7	Pipe crosses under the embankment.
GAS PIPE	ACTIVE	145+80	4	Pipe crosses under embankment along H Street.
SEWER LINE	ACTIVE	148+50	5	Pipe crosses under the embankment.

7. CULVERTS

Several proposed and existing box culverts, and reinforced concrete pipes (RCP) cross through, connect to, or are adjacent to the project. Box Culverts and RCP with identified geotechnical concerns are described and discussed in the table in Appendix 6. Based on a review of the data available, geotechnical assessments are provided in the subsections below. Vibrations from anticipated pile-driving activities are not a concern for the culverts and RCP, as these structures are located at least 100 feet away from pile-driving activities.

7.1 Culvert Settlement

The settlement was evaluated at select culvert locations based on a screening of the anticipated amount of fill above the culverts along with the subsurface stratigraphy expected at each location. The total new fill above the proposed culverts ranges from 0 feet to approximately 13 feet above each culvert section. Rocscience Settle3 Version 5.022 was used to model the embankment and culvert geometry. Consolidation parameters for soil layers were derived from consolidation tests taken from representative soil samples within the 040901 project phase. The majority of the proposed culverts will be founded on soft to stiff clays and silts (CH, CL, and ML). Multiple sand lenses were identified in the soil borings allowing for the potential for double drainage of the foundation soils.

Based on the subsurface conditions encountered and estimated settlement values, ground improvement is recommended at the following proposed culvert locations:

- 2-8’ x 4’ multiple box culvert at Station 106+60
- 36” RCP at Station 106+60
- 4’ x 4’ single box culvert at Station 129+65
- 24” double RCP at Station 145+98
- 24” single RCP at Station 218+50
- 24” double RCP at Station 221+18
- 24” single RCP at Station 225+00

Ground improvement is recommended to mitigate total and differential settlement and improve the bearing support of the foundation soils beneath the culverts. Undercut is recommended for the full length of the box culverts from below the bottom slab structural excavation level to a depth of 4 feet and backfill with "Stone Backfill" according to Standard Drawing RCB-2 and Specification Sections 207 Stone Backfill and 801.10. Undercut is recommended for the full length of the RCPs from below the structural bedding bottom of excavation level to a depth of 4 feet and replace with Selected Pipe Bedding according to Standard Drawing PCC-1 and Specification Section 606 Pipe Culverts.

7.2 Culvert Bearing Resistance

The culvert locations along the project alignment include a few critical cases for bearing resistance calculations. Undrained and drained bearing resistances of shallow foundations were calculated per AASHTO LRFD 9th Edition. It was assumed that multiple box culverts have one footing only. Nominal and factored bearing resistances were calculated for undrained and drained conditions.

AASHTO LRFD Bridge Design Specifications (2020) were used to determine a bearing resistance factor, appropriate bearing capacity factors, and shape correction factors using Tables 10.5.5.2.2-1, 10.6.3.1.2a-1 and 10.6.3.1.2a-3, respectively. The bearing resistance of the soil was determined from equation 10.6.3.1.1-1.

All culverts were evaluated bearing on clay soils. Culverts across the project alignment will have varying bearing soil conditions. Based on this analysis a maximum factored bearing resistance (q_R) of 2,000 psf is recommended for the design of box culvert foundations provided the ground improvements discussed in Section 7.1 are followed.

8. SEISMIC CONSIDERATIONS

Geotechnology, LLC prepared a site-specific ground motion analysis (SSGMRA) for the 040901 project phase by developing shear wave velocity profiles on each side of the Arkansas River.

Geotechnology conducted two Multichannel Analyses of Surface Waves (MASW) surveys, on each side of the Arkansas River, on April 18th and April 19th, 2023 in accordance with Section 3.10.3.1 of AASHTO LRFD Bridge Design Specifications. The surveys consisted of collecting active and passive data with a linear array of 24 geophones and data processing software ParkSEIS. A summary of Geotechnology's recommended Site-Specific Response is listed below in Table 9.

Table 9: Summary of Site-Specific Response Results

Period	North Side of Arkansas River	South Side of Arkansas River
A_s (g) (Site-Adjusted PGA)	0.124	0.147
S_{DS} (g) (0.2sec)	0.302	0.386
S_{D1} (g) (1 Sec)	0.115	0.115
Seismic Performance zone	1	1

Additional analysis and commentary can be viewed in Geotechnology's SSGMRA report included in Appendix 7.

9. CORROSION

The potential impact of corrosion on foundation elements was evaluated based on available data, which included three corrosivity test results and is summarized in Table 10 below.

Table 10: Summary of Corrosion Testing

Boring No.	Sample Depth, ft	Sulfate Content, ppm (AASHTO T290)	Chloride Content, ppm (AASHTO T291)	Soil pH (ASTM G51)	Soil Resistivity, ohm-cm (AASHTO T288)
FB-45	9-10	22	<10	8.80	18,450
FB-46	4.5-5.5	24	<10	8.80	18,450
FB-66	2.5-3.5	48	<10	8.10	2475

Resistivity results are generally consistent with non-aggressive soil (greater than 5000 ohm-cm), except for one result between 2000 and 5000 ohm-cm (FB-66); which, when considered in combination with the corresponding sulfate content results and pH indicates a non-aggressive to slightly corrosive steel elements and non-corrosive to concrete elements.

HNTB recommends that the design of concrete foundations exposed to site soils in this project (such as uncased drilled shafts, shallow foundations, or culverts), should consider the potential for attack by sulfate-reducing bacteria in requirements for cement type, concrete mix design, and clear cover. For concrete spread footings on bedrock, sulfate attack is not a concern, provided the completed footing is backfilled with a material having a sulfate content of less than 200 ppm.

HNTB recommends that the design of steel pile foundations (such as H-piles), should be based on slightly aggressive soils. A conservative estimate of the corrosion rate is 0.0005 inches per year on each surface in contact with the soil. This translates to total corrosion losses (per surface) of 0.0375 inches for a 75-year design life and 0.050 inches for a 100-year design life.

Accordingly, HNTB recommends either galvanizing all H-piles from the top of the pile to a depth of at least 20 feet below grade or increasing the pile size to account for the estimated corrosion loss for the design life. Alternatively, a permanent corrosion protection system (such as impressed current, cathodic protection, or similar) can be installed and maintained at each substructure where steel pile foundations are used.

10. PAVEMENT

Pavement will be designed by others based on testing performed for this investigation. A total of five (5) California Bearing Ratio (CBR) tests and nine (9) proctors were collected for the 040901 phase. The results of these tests are included in the 040901 Geotechnical Data Report (GDR) included in Appendix 1. The results of the CBRs were converted to Resilient Modulus values based on correlation found in Table 5-34 of the Federal Highway Administration's Geotechnical Aspect of Pavement Reference Manual (US DOT Publication No. NHI-05-37; 2006).

Table 11: Recommended Resilient Modulus (Mr) Values and R-Values

Applicable Zone	Boring	Recommended M_r	Recommended R-Value
100+00 to 182 + 00	FB-1	2375	5.2
	FB-2	3630	15.8
	FB-3	2440	5.3
	FB-8	2320	4.6
	FB-10	2520	6.6
215+00 to 269+00 and Along Gun Club Rd	FB-80	2610	6.8

11. LIMITATIONS

The recommendations presented in this report are based on a limited number of subsurface samples obtained from widely spaced boring locations. The samples may not fully indicate the nature and extent of the variations that exist between sampling locations. Engineering judgment was used in interpreting the subsurface conditions between borings and determining design parameters. If variations or other latent conditions become evident during construction, it may be necessary for HNTB to review these conditions and possibly modify the recommendations provided in this report.

Recommendations presented in this report should not be applied if the nature, design, or location of the facilities is changed. If changes are contemplated, HNTB should be retained to review them to assess their impact on this report's applicability. This report was prepared and is intended for HNTB design and estimation proposes. Interpretations made by others are the responsibility of the user.

FIGURES

Figure 1: Site Vicinity Map

Figure 1 – Site Vicinity Map

Figure 2: Boring Plan Key

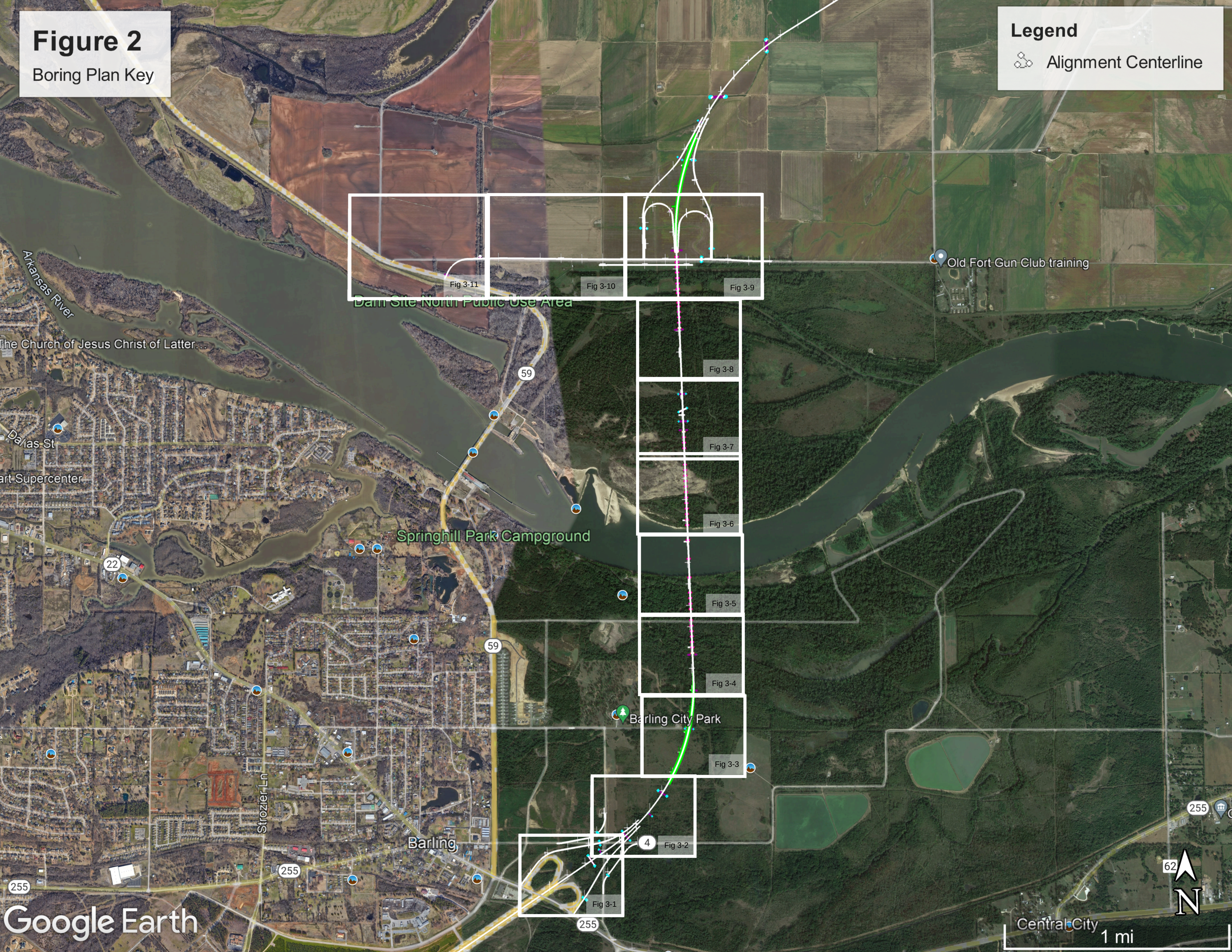


Figure 2
Boring Plan Key

Figure 3: Boring Location Plans

Figure 3-1

Boring Location Plan

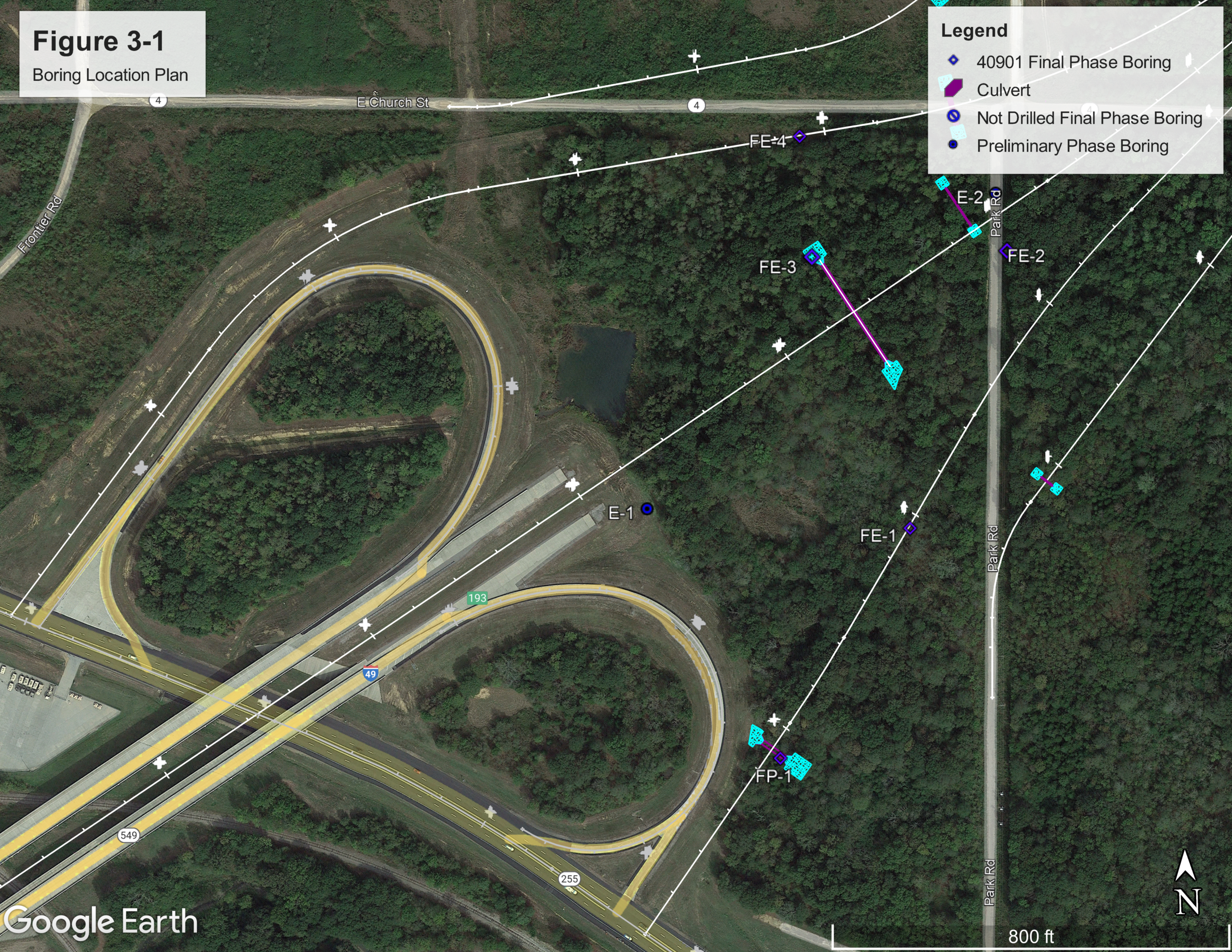


Figure 3-2

Boring Location Plan

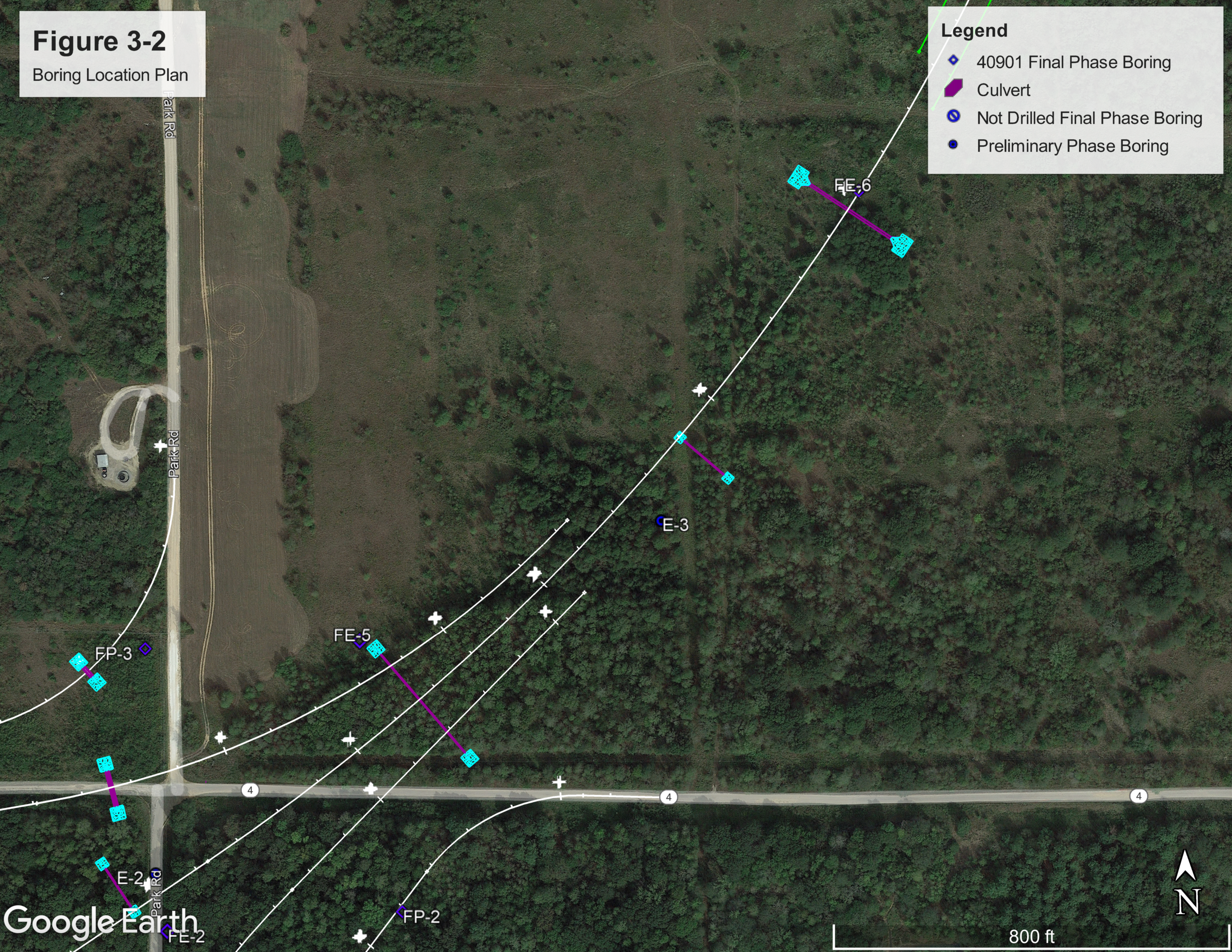


Figure 3-3
Boring Location Plan

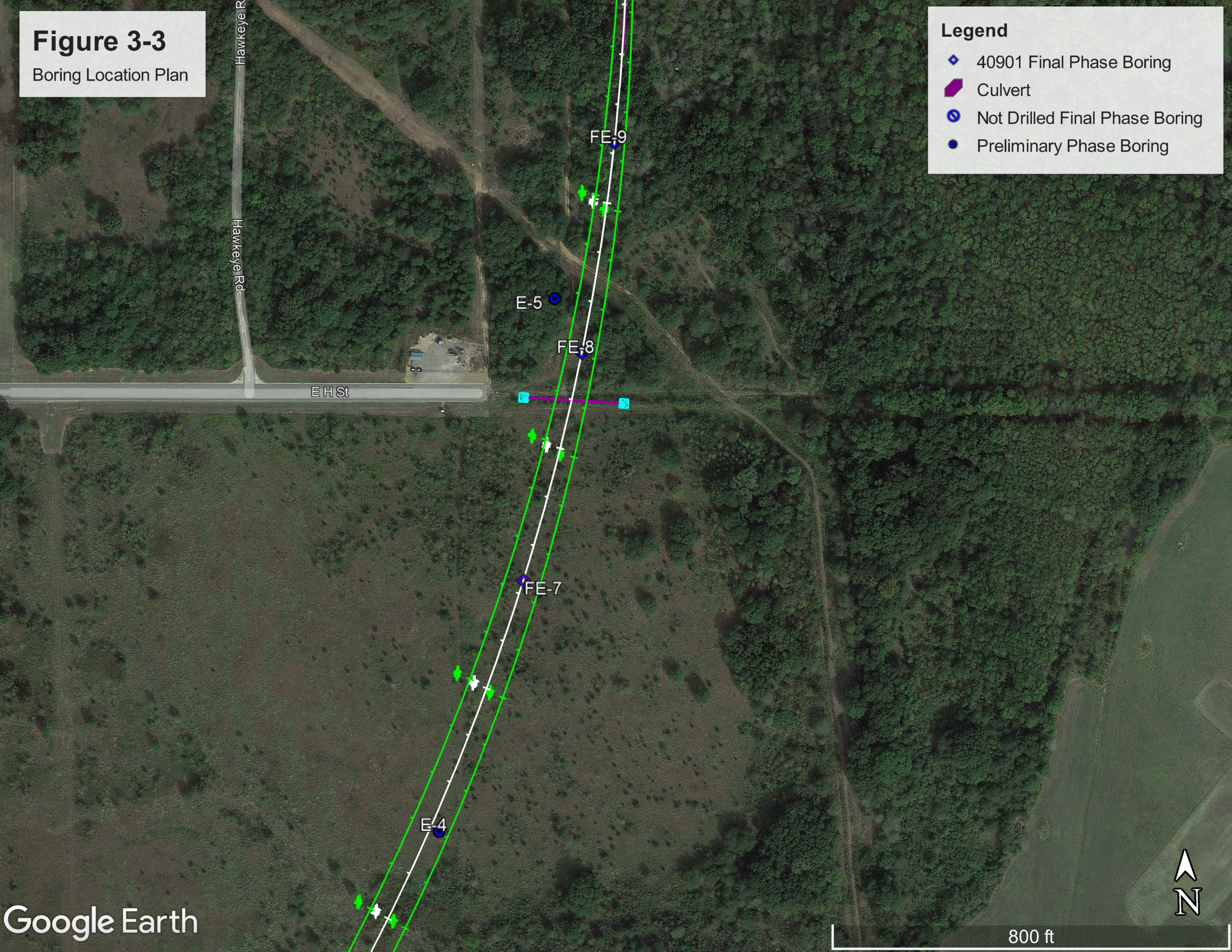


Figure 3-4

Boring Location Plan

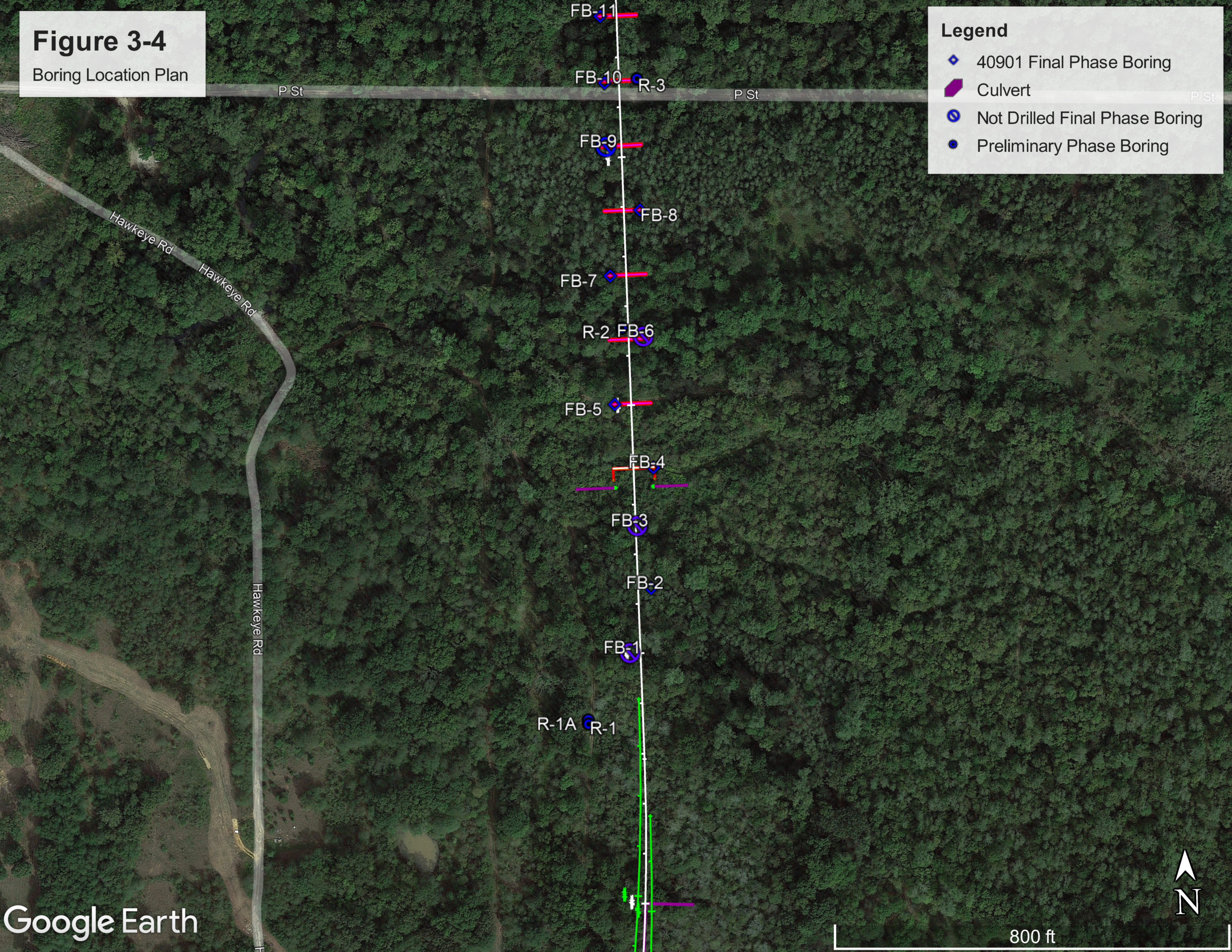


Figure 3-5
Boring Location Plan

Figure 3-6

Boring Location Plan

Figure 3-7

Boring Location Plan

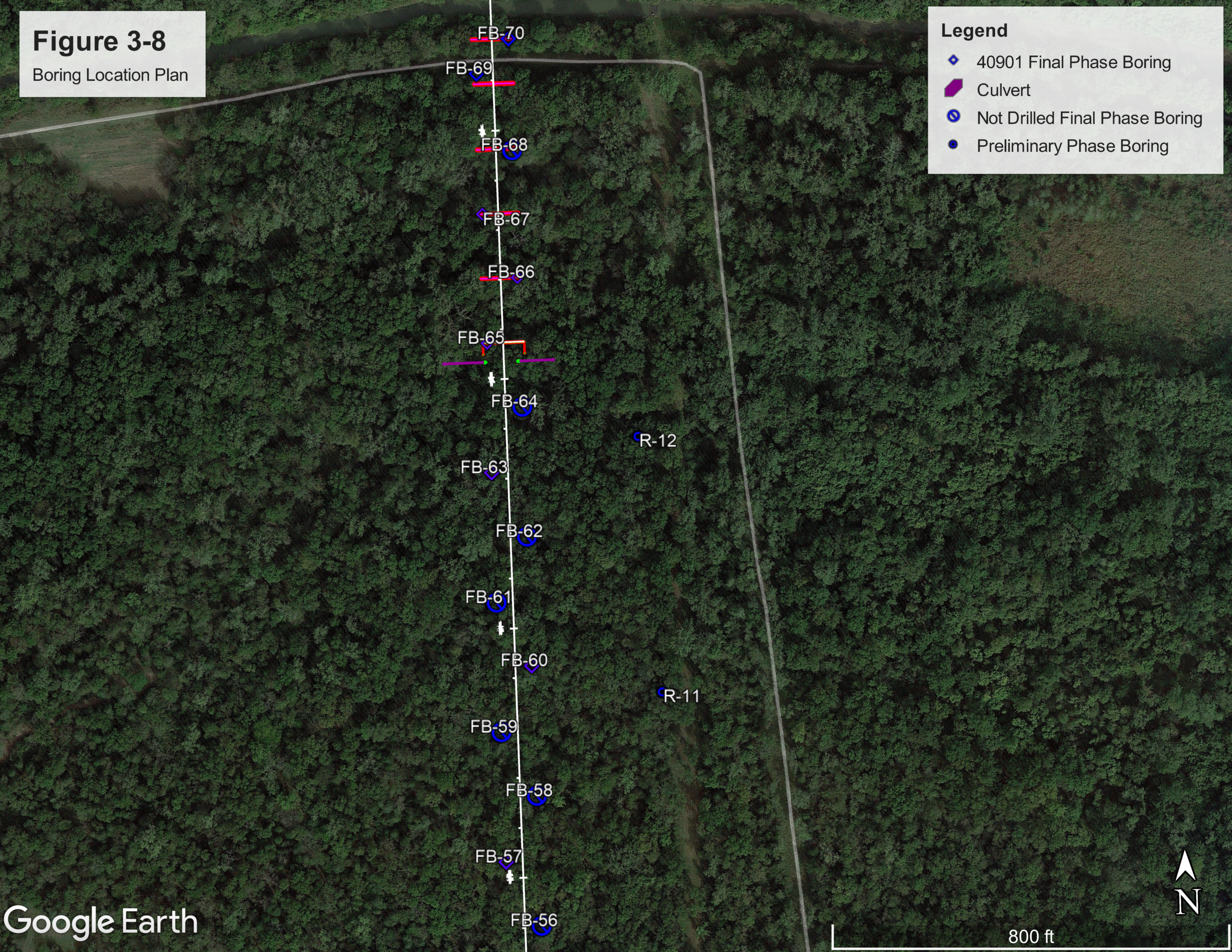


Figure 3-8
Boring Location Plan
Legend
40901 Final Phase Boring
Culvert
Not Drilled Final Phase Boring
Preliminary Phase Boring
FB-70
FB-69
FB-68
FB-67
FB-66
FB-65
FB-64
R-12
FB-63
FB-62
FB-61
FB-60
R-11
FB-59
FB-58
FB-57
FB-56
Google Earth
800 ft
N

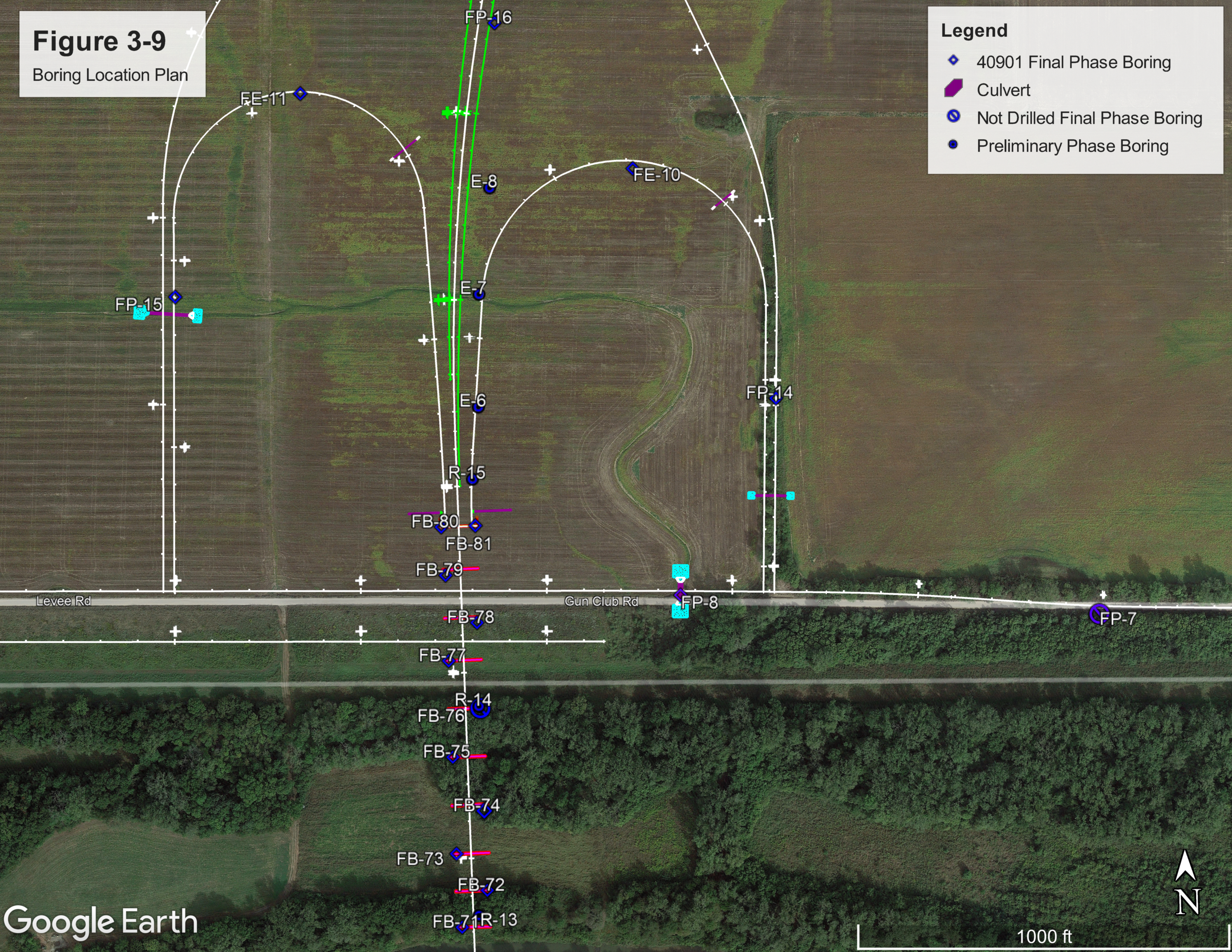


Figure 3-9
Boring Location Plan
Legend
40901 Final Phase Boring
Culvert
Not Drilled Final Phase Boring
Preliminary Phase Boring
FP-16
FE-11
FE-10
E-8
E-7
E-6
FP-15
FP-14
R-15
FB-80
FB-81
FB-79
Levee Rd
Gun Club Rd
FP-8
FP-7
FB-78
FB-77
R-14
FB-76
FB-75
FB-74
FB-73
FB-72
FB-71
R-13
Google Earth
1000 ft
N

Figure 3-10
Boring Location Plan

Figure 3-11

Boring Location Plan

APPENDICES

Appendix 1: Section 40901 Geotechnical Data Report

January 4, 2024
GHBW Project No. 21-071

HNTB Corporation
5800 Evergreen Drive, Suite A
Little Rock, Arkansas 72205

Attn: Mr. Michael J. De Stigter, P.E.
Project Geotechnical Task Manager

SECTION 901 GEOTECHNICAL DATA REPORT
JOB No. 040748: HWY. 22 - I-40 (ARKANSAS RIVER) (F)
CRAWFORD and SEBASTIAN COUNTIES, ARKANSAS

INTRODUCTION

Submitted herein is the geotechnical data report for the Section 901 geotechnical study performed for ARDOT Job No. 040748: Hwy. 22 - I-40 (Arkansas River) (F) in Crawford and Sebastian Counties, Arkansas**.** These services were authorized by the Subconsultant Agreement for On-Call Design Services (2017-2020 extended to 2021) with HNTB Corporation and acknowledged on May 25, 2021. This study has been performed in general accordance with the outlined scope in that agreement and in discussions throughout the project. Preliminary results of this study were submitted as data were developed throughout the course of this study phase.

The ARDOT Job No040748 future I-49 alignment extends between Highway 22 and Interstate 40, approximately 13.7 miles. The new I-49 alignment will connect Highway 22 in Sebastian County to the Interstate 40 and Interstate 49 interchange in Crawford County. The southern end of the alignment will extend over the Arkansas River to Hwy. 22 in Barling, Sebastian County, Arkansas. The project will consist of bridges and roadways designed and constructed to interstate standards.

The purposes of this Phase II geotechnical investigation has been to perform the final exploration of subsurface conditions in the alignment, drilling borings at representative locations selected by the Engineer (HNTB) and obtaining samples for laboratory testing. This report is limited to the results developed from the study performed for Section 901. The geotechnical data discussed herein are intended for use in design and construction planning for Section 901. The results of the field and laboratory studies are presented in the following report sections.

SUBSURFACE EXPLORATION

Subsurface conditions in the Section 901 portion of the interstate alignment were explored by drilling 93 borings at or near the locations selected by the Engineer (HNTB). The site vicinity is shown on Plate 1. The exploration program is summarized on Plates 2a through 2c. Logs of the borings drilled for this Phase II section 901 study, presenting descriptions of the soil and rock strata encountered in the borings and the results of field and laboratory tests, are included as Plates 3 through 200. The surveyed ground surface elevation, as provided by the Surveyor (Crafton Tull) or the Engineer, is also shown on the logs. Where survey data was not available, the surface elevation was inferred from the available topographic information. It must be recognized that the elevations shown are approximate and actual elevations may vary. The latitude and longitude, obtained from survey data or a hand-portable GPS unit, is also shown on the logs. Keys to the terms and symbols used on the logs are presented as Plates 201 and 202.

The borings were drilled using a truck-mounted SIMCO 2800 rotary-drilling rig, a rubber-tired ATV CME-550, and track-mounted Diedrich D-50 and CME-55 rotary-drilling rigs. The drill rig utilized for the particular boring is noted on the appropriate boring log. The borings were advanced using dry-auger drilling procedures or a combination of dry-auger and rotary-wash procedures. For boring intervals advanced with dry-auger methods, either 4.5-in.-diameter continuous flight augers or hollow stem augers were used.

Samples of the overburden soils and weathered rock were typically obtained using a 2-in.-diameter split-barrel sampler driven into the strata by blows of a 140-lb automatic hammer with 30-in. drop in accordance with Standard Penetration Test (SPT) procedures (AASHTO T 206). The number of blows required to drive the standard split-barrel sampler the final 12 in. of an 18-in. total drive, or a portion thereof, is defined as the Standard Penetration Number (N). Recorded N-values are shown on the boring logs in the "Blows Per Ft" column. Where rock hardness precluded obtaining samples via the SPT, cuttings were obtained for use in visual classification. The SPT auto hammer calibration reports are provided in Appendix A.

Representative undisturbed samples of cohesive soils were obtained using a 3-in.-diameter thin-walled tube hydraulically advanced into the soil (AASHTO T 207). Undrained shear strength of the cohesive soils was estimated in the field using a calibrated hand penetrometer. The estimated shear strength value was determined, in tons per sq ft, by dividing the penetrometer value by 3, as per Grubbs Engineers/McClelland Engineers standard procedure. Estimated shear strength values are plotted on the log forms, in tons per sq ft, as circles enclosing an "x".

Competent shale and sandstone were cored using 5-ft-long NQ_{WL}- or NQ2-size double-tube core barrel with a diamond bit (AASHTO T 225). For each core run, the percent recovery was determined as the ratio of recovery to total length of core run. Rock Quality Designation (RQD) was also determined for each core run as the sum of intact, sound rock core greater than 4-in. length divided by the total length of the run and expressed in percent. For the purposes of determining RQD, mechanical core breaks were not deleted from sound rock intervals. Both these values are presented in the right-hand columns of the log forms, opposite the corresponding core run.

Photographs of the recovered rock cores are provided in Appendix B. It should be noted that the very poor to poor rock quality of some interbedded shale and sandstone units limited core recovery. Where rock was not coreable, cuttings were collected for use in visual classification.

All samples were removed from sampling tools in the field, examined and visually classified by the field geologist or geotechnical engineer. Samples were then placed in appropriate containers to prevent moisture loss and/or change in condition during transfer to our laboratory for further examination by a geotechnical engineer and testing. Rock cores were placed in waxed cardboard boxes.

The borings were advanced using dry-auger drilling procedures to the extent possible to facilitate evaluation of shallow groundwater conditions. Observations regarding groundwater are noted in the lower-right portion of each log and are discussed in subsequent sections of this report. All boreholes were backfilled with cuttings after obtaining the final water level readings. At directed locations, bulk samples were obtained for Moisture-Density Relationship (Proctor) and California Bearing Ratio (CBR) tests.

LABORATORY TESTING

To evaluate pertinent physical and engineering characteristics of the overburden soils and rock, laboratory tests were performed on selected representative soil and rock core samples. Laboratory testing was assigned by the Engineer. In some cases, assigned sample intervals were adjusted with respect to sample recovery and suitability of selected samples.

The laboratory testing program included the following.

- Natural water content determinations (AASHTO T 265)
- Liquid and plastic (Atterberg) limit determinations (AASHTO T 89 and T 90)
- Grain size analysis through No. 200 sieve (AASHTO T 88)
- Grain size analysis through No. 200 sieve with hydrometer (AASHTO T 88)

- Soil compression tests
  - Unconfined compression tests of soil (AASHTO T 208)
  - Unconsolidated-undrained triaxial compression, single-stage (AASHTO T 296)
- Soil shear strength tests
  - Consolidated-drained direct shear (AASHTO T 236)
- Consolidation tests (AASHTO T 216)
- Hydraulic conductivity measurement (ASTM D5084)
- Analytical tests of soil
  - Water-Soluble Sulfate Ion Content in Soil (AASHTO T 290)
  - Water-Soluble Chloride Ion Content in Soil (AASHTO T 291)
  - Soil pH (ASTM G51)
  - Minimum Laboratory Soil Resistivity (AASHTO T 288)
- Uniaxial compression on rock (ASTM D7012)
- Slake Durability Tests
  - Determination of Slake Durability Index (ASTM D4644)
  - Modified determination of Slake Durability Index (Keaton and Mishra, NCHRP Project No. 24-29)

Water content results are plotted on the boring log forms in accordance with the scale and symbols shown in the legend located in the upper-right corner of the logs. The Atterberg limits are plotted on the logs as small pluses inter-connected with a dashed line using the water content scale. The percent of soil passing the No. 200 sieve is noted in the "- No. 200%" column on the log forms. Classification test results, as well as soil classification by the Unified Soil Classification System (ASTM D2487) and the AASHTO Classification System (AASHTO M 145), are summarized in Appendix C.

Grain-size distribution curves are provided in Appendix D. The results of hydrometer analyses are provided in Appendix E.

Laboratory soil strength testing included unconfined compression tests and unconsolidated-undrained triaxial compression tests. Undrained shear strength (cohesion) determined from the results of the compression tests is plotted at the appropriate depth, in tons per sq ft, as an open circle or open triangle, for unconfined compression and unconsolidated-undrained triaxial compression tests, respectively. Unit dry weight and natural water content were also determined as a part of each strength test. These data are also shown on the logs. The results of soil compression tests are summarized in Appendix F.

Soil shear strength was also evaluated by performing consolidated-drained direct shear tests and a consolidated-drained triaxial compression test with pore pressure measurement. These test results are presented graphically in Appendix G.

Consolidation tests were performed on selected samples as directed by the Engineer. Tests typically included loading in increments up to 16 tons per sq foot. The consolidation test results are shown in Appendix H. The consolidation test results were utilized to develop square root of time curves and determine coefficient of consolidation values. These results are presented graphically in Appendix I.

Hydraulic conductivity (permeability) of selected on-site soils was evaluated by flexible wall permeability tests. Tests were performed on undisturbed samples, using flexible wall permeameter methods. Permeability test results are provided in Appendix J.

Laboratory testing included measurement of water-soluble chlorides and sulfates, soil pH, and soil resistivity. Analytical test results are summarized in Appendix K.

Unconfined compressive strength of representative core samples of shale, sandstone, and shale with interbedded sandstone were evaluated by performing uniaxial compression tests. Results of the laboratory compression tests are shown in lbs per sq in. at the appropriate depth on the boring logs. The total unit weight of intact cores was also measured, and these data are also shown on the logs. The compression test results are summarized in the Summary of Rock Compression Test Results provided in Appendix L. The summary includes the boring number, sample depth, water content (if available), total unit weight, measured compressive strength, a description of the failure mode, and a rock description.

Modified slake durability tests were performed on selected rock cores to evaluate rock durability. The slake durability test results are tabulated in Appendix M. Jar slake durability tests were performed on selected rock cores. These test results are displayed in Appendix N.

Moisture-Density Relationship (Proctor) tests were performed on nine (9) representative bulk samples. These tests were performed in accordance with AASHTO T 99 methods. Pavement subgrade support properties were evaluated at the Boring FB-1, FB-2, FB-3, FB-8, FB-10, and FB-80, locations by performing six (6) California Bearing Ratio (CBR) tests (AASHTO T 193), with one (1) test performed for each bulk sample obtained from the test pits. For the CBR tests, the specimens were molded at approximately the optimum water content and 95 percent of the maximum dry density as determined by the corresponding laboratory Proctor tests. A 20-lb surcharge was used for each CBR test. Proctor and CBR test results are presented graphically in Appendix O.

Based on the results of CBR tests and correlation with the AASHTO classification of the anticipated subgrade soils, subgrade support is expected to be very poor to poor for these fine-grained, low-plasticity soils. In light of the correlation with laboratory test data and factoring for environmental and serviceability criteria, the following parameters have been developed for each CBR test.

Boring FB-1

- Resilient Modulus (M_R): 2375 lbs per sq in.
- R value: 5.2

Boring FB-2

- Resilient Modulus (M_R): 3630 lbs per sq in.
- R value: 15.8

Boring FB-3

- Resilient Modulus (M_R): 2440 lbs per sq in.
- R value: 5.3

Boring FB-8

- Resilient Modulus (M_R): 2320 lbs per sq in.
- R value: 4.6

Boring FB-10

- Resilient Modulus (M_R): 2520 lbs per sq in.
- R value: 6.6

Boring FB-80

- Resilient Modulus (M_R): 2610 lbs per sq in.
- R value: 6.8

SITE and SUBSURFACE CONDITIONS

Site Conditions

The 040748 I-49 Section 901 portion of the alignment extends generally south form just on the north side of Gun Club Road in mainly farm fields which consist primarily of low-lying areas with a few scattered small trees with thick underbrush and unimproved roads. Several low-lying areas in this section are poorly drained and prone to flooding during periods of heavy rain months.

The alignment crosses the Arkansas River about 5600 ft downstream of the Hwy. 59 crossing and the existing James W. Trimble Lock and Dam. The alignment enters Crawford County on the north side of the Arkansas River, extending through a relatively flat and generally low-lying area. This portion of the alignment extending from the riverbank to an existing flood control levee is a partially wooded area. There are some localized areas of surficial sand with sparse vegetation, apparently alluvial deposits from the nearby river. This area evidently experiences flooding during periods of high river levels.

From the existing flood control levee, just south of Gun Club Road, the alignment extends north across areas of farmland with scattered residences. The alignment crosses Hwy. 64 about 2000 ft south of the I-40 alignment, approximately 1 mile west of Alma. The alignment expanse between Gun Club Road and I-40 primarily has flat to undulating terrain with variable very poor to fair surface drainage. The alignment crosses numerous drainage features, both natural and excavated agricultural features.

Site Geology

Mapping shown on the Geologic Map of Arkansas[1] indicates that the project alignment is primarily mapped in exposures of Holocene Alluvium and a few areas of the Pleistocene Terrace deposits. The alluvium and terrace deposits are variable flood-plain deposits typically comprised of terraces of gravel, sand, silt, and clay and mixtures of these clastic materials. The alluvial deposits characteristically consist of an upper zone of fine-grained clay and/or silt units underlain by sand and gravel units. The alluvial deposits are variable deposits of small streams, over bank deposits of major streams, or older meander belt deposits of major streams. Locally, the alluvial units are a result of channel fill, natural levee and backswamp activity. The terrace deposits are comprised of a complex sequence of unconsolidated gravel, sand, silt and clay. Individual Terrace deposits are often lenticular and discontinuous. The thickness of the terrace and alluvial deposits is variable.

In areas of higher terrain, and below the alluvial and terrace deposits, are Paleozoic bedrock units of the Pennsylvanian Period McAlester Formation and the Hartshorne Sandstone. The McAlester Formation consists of several hundred feet of shale with thin sandstone and coal beds, several hundred feet of shale with a few sandstone beds and coal and is capped by several hundred feet of shale with occasional coal beds. The McAlester Formation rests conformably on the Hartshorne Sandstone and the Lower Hartshorne Coal is just above the base of the McAlester. The McAlester Formation is about 500 to 2300 feet thick.

The Hartshorne Sandstone is generally comprised of medium-grained sandstone which is massive and frequently cross-bedded. This formation is the first continuous sandstone underlying the Lower Hartshorne Coal. The formation rests with minor unconformity on the Atoka Formation. The thickness of the Hartshorne Sandstone is reported to range from about 10 to 300 feet.

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[1] Geologic Map of Arkansas, Arkansas Geological Commission and U.S. Geological Survey; 1993

Subsurface Conditions

The results of the borings indicate that the overburden soils and the depth to bedrock varies widely along the alignment. The variable overburden soils range from 1 to 52 ft below existing grades, and the overburden averages about 30-ft thick. The overburden soils in areas or higher terrain and/or overlying shallow rock tend to be residual soil units of clayey silt, silty clay, and/or clay derived from the underlying shale and sandstone units of the Paleozoic rock. In the areas of lower terrain, particularly around major streams like the Arkansas River, the overburden soils tend to be a widely-variable mixture of fine-grained silt and clay units overlying granular soil units of sand and gravel and mixtures of these soils.

The rock units encountered in the Phase II borings are predominantly comprised of shale and sandstone. These rock units are frequently interbedded, with shale generally predominant. Weathered shale or weathered sandstone units are often overlying the predominant slightly weathered shale to fresh shale strata. The weathered rock zone, where present, varies from 1 ft, or less, to 22 ft thick at the boring locations. The weathered zone typically consists of highly weathered to moderately weathered shale with subordinate units of weathered sandstone. Fractures and ferrous stains are common in the weathered rock zones.

The basal bedrock consists primarily of moderately hard to hard gray and dark gray shale with subordinate units of moderately hard to hard gray fine-grained sandstone. In some areas, the shale has interbedded, very thin close to very close, gray fine-grained sandstone partings, seams, and layers. Where sandstone is predominant in the stratigraphy, the sandstone will sometimes contain very thin interbedded close to very close dark gray shale inclusions, laminations, and seams. The shale and sandstone are generally flat bedded. The shale is generally silty, but some shale units are arenaceous or carbonaceous. Rare clayey shale units are also present. Localized and discontinuous inclusions, seams, and layers of coal are present in the shale.

Groundwater Conditions

Groundwater was encountered at widely variable depths of 1.5 to 23 ft (±El 390 to ±El 371) at the time of drilling in November 2022 to November 2023. The shallow groundwater depths are considered to represent shallow perched water in the overburden soils, particularly in alluvial units. The depth of groundwater in soil units in proximity to major streams like the Arkansas River and Frog Bayou will be strongly influenced by surface water levels in those streams. Normal pool of the Arkansas River at the alignment location is reported to be El 389. Groundwater levels will vary with seasonal precipitation, surface runoff and infiltration, and stream levels in nearby surface water features.

CLOSING

The data and conclusions provided herein have been developed based on the results of this study phase. The interpretation of soil, rock, and groundwater conditions has been based on our knowledge of site geology, the results of the borings performed for this study phase, observations made during the subsurface investigation, and our understanding of the project. Although consideration has been given to minor variations in subsurface conditions, the results and conclusions of this report may not be appropriate for localized, but potentially significant, variations in subsurface conditions. Variations from the conditions shown on the boring logs could be encountered.

The following attachments are included and complete this submittal of the Phase II geotechnical data report.

Plate 1	Site Vicinity
Plate 2a through 2c	Summary of Phase II Exploration Program
Plates 3 through 169	Logs – Bridge (“FB”) Borings
Plates 170 through 184	Logs – Embankment (“FE”) Borings
Plates 185 through 200	Logs – Pavement (“FP”) Borings
Plates 201 and 202	Keys to Terms and Symbols
Appendix A	SPT Auto Hammer Calibration
Appendix B	Rock Core Photographs
Appendix C	Summary of Classification Test Results
Appendix D	Grain-Size Distribution Curves
Appendix E	Hydrometer Analyses Particle-Size Distribution Curves
Appendix F	Soil Compression Test Results (U and UU Tests)
Appendix G	Soil Shear Strength Test Results (Direct Shear Tests)
Appendix H	Consolidation Test Results
Appendix I	Summary of Coefficients of Consolidation
Appendix J	Permeability Test Results
Appendix K	Analytical Test Results
Appendix L	Rock Compression Test Results
Appendix M	Modified Slake Durability Test Results
Appendix N	Jar Slake Durability Test Results
Appendix O	Proctor and CBR Test Results

* * * * *

We appreciate the opportunity to be of service to you on this project phase. Should you have any questions regarding this report, or when we may be of assistance during final design and construction, please call on us.

Sincerely,

GRUBBS, HOSKYN,
BARTON & WYATT, LLC

Justin Ferguson
Project Geologist

Mark E. Wyatt, P.E.
President

STATE OF ARKANSAS REGISTERED PROFESSIONAL ENGINEER No. 7791 MARK E. WYATT

JKB/JDF/MEW:jw

Copies submitted: HNTB Corporation
Attn: Mr. Michael J. De Stigter, P.E. (1-electronic)
Attn: Mr. Wayne Duryee, P.E. (1-electronic)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

SITE VICINITY MAP
040748 Hwy 22 to I-40
Sebastian & Crawford Counties, Arkansas

Job No. 21-071

Plate 1

SUMMARY of PHASE II, SECTION 901 EXPLORATION PROGRAM

PROJECT: Job. No. 040748: Hwy 22 - I-40 (I-49)
LOCATION: Crawford and Sebastian Counties, Arkansas
GHBW JOB No.: 21-071

Boring No.	Project Facet	GPS Coordinates		Approx Surf El, ft	Boring Depth, ft
		Latitude	Longitude		
FB-2	I-49 -Bridge Embankment	35.33631	-94.28038	391.0	30
FB-4	I-49 -Bridge Embankment	35.33698	-94.28035	392.9	87
FB-5	I-49 -Bridge Embankment	35.33733	-94.28059	393.5	87
FB-7	I-49-Bridge	35.33805	-94.28060	385.9	80
FB-8	I-49-Bridge	35.33841	-94.28040	385.5	79
FB-10	Bridge 1	35.33912	-94.28062	388.3	95
FB-11	Bridge 1	35.33948	-94.28062	388.5	100
FB-12	Bridge 1	35.33984	-94.28043	390.6	85
FB-13	Bridge 1	35.34019	-94.28063	391.7	85
FB-14	Bridge 1	35.34055	-94.28044	392.0	86
FB-15	Bridge 1	35.34091	-94.28065	394.3	88.5
FB-16	Bridge 1	35.34091	-94.28054	394.9	90.5
FB-17	Bridge 1	35.34091	-94.28044	394.6	91
FB-18	Bridge 1	35.34180	-94.28067	391.4	101
FB-19	Bridge 1	35.34180	-94.28056	390.7	100.5
FB-20	Bridge 1	35.34180	-94.28045	390.4	95
FB-21	Bridge over Arkansas River	35.34310	-94.28070	354.0	72.5
FB-22	Bridge over Arkansas River	35.34310	-94.28094	355.0	80
FB-23	Bridge over Arkansas River	35.34309	-94.28058	351.0	74
FB-24	Bridge over Arkansas River	35.34430	-94.28073	359.0	71
FB-25	Bridge over Arkansas River	35.34430	-94.28058	359.0	74
FB-26	Bridge over River	35.34430	-94.28046	359.0	84
FB-27	Bridge 1	35.34527	-94.28072	388.0	95
FB-28	Bridge 1	35.34527	-94.28061	387.4	100
FB-29	Bridge 1	35.34528	-94.28051	387.3	100
FB-30	Bridge 1	35.34563	-94.28052	385.7	90
FB-31	Bridge 1	35.34599	-94.28073	386.7	90
FB-32	Bridge 1	35.34635	-94.28053	389.0	85
FB-33	Bridge 1	35.34657	-94.28074	388.8	85
FB-34	Bridge 1	35.34709	-94.28054	389.6	85
FB-35	Bridge 1	35.34742	-94.28075	399.1	96
FB-36	Bridge 1	35.34778	-94.28055	398.8	95
FB-37	Bridge 1	35.34813	-94.28076	400.2	98
FB-38	Bridge 1	35.34849	-94.28057	399.3	97
FB-39	Bridge 1	35.34884	-94.28077	400.0	97
FB-40	Bridge 1	35.34920	-94.28058	400.6	99
FB-41	Bridge 1	35.34956	-94.28078	400.4	99
FB-42	Bridge 1	35.34992	-94.28059	400.1	96

SUMMARY of PHASE II, SECTION 901 EXPLORATION PROGRAM

PROJECT: Job. No. 040748: Hwy 22 - I-40 (I-49)
LOCATION: Crawford and Sebastian Counties, Arkansas
GHBW JOB No.: 21-071

Boring No.	Project Facet	GPS Coordinates		Approx Surf El, ft	Boring Depth, ft
		Latitude	Longitude		
FB-43	Bridge 1	35.35027	-94.28080	396.1	92
FB-44	Bridge 1	35.35063	-94.28060	392.1	89
FB-45	Bridge 1	35.35099	-94.28081	393.5	90
FB-46	Bridge 1	35.35134	-94.28060	393.4	94
FB-48	Embankment/Soil Plug	35.35206	-94.28061	390.2	39
FB-50	Embankment/Soil Plug	35.35277	-94.28062	390.4	39
FB-53	Embankment/Soil Plug	35.35384	-94.28086	391.7	40
FB-57	Embankment/Soil Plug	35.35527	-94.28089	398.3	49
FB-60	Embankment/Soil Plug	35.35635	-94.28068	398.4	49
FB-63	Embankment/Soil Plug	35.35741	-94.28092	395.2	47
FB-65	Embankment/Soil Plug	35.35813	-94.28093	391.1	92
FB-66	Bridge 16	35.35849	-94.28072	389.0	90
FB-67	Bridge 16	35.35884	-94.28094	390.8	95
FB-69	Bridge 16	35.35961	-94.28096	389.7	90
FB-70	Bridge 16	35.35981	-94.28074	386.9	90
FB-71	Bridge 16	35.36016	-94.28097	387.3	90
FB-72	Bridge 16	35.36044	-94.28072	393.9	95
FB-73	Bridge 16	35.36071	-94.28100	392.8	95
FB-74	Bridge 16	35.36102	-94.28074	393.0	95
FB-75	Bridge 16	35.36142	-94.28101	392.2	96
FB-77	Bridge 16	35.36214	-94.28102	400.2	100
FB-78	Bridge 16	35.36242	-94.28075	400.7	105
FB-79	Bridge 16	35.36277	-94.28103	398.9	100
FB-80	Bridge 16	35.36313	-94.28106	400.0	60
FB-81	Bridge 16	35.36313	-94.28075	399.5	60
FE-1	Hwy 22 Ramp 2-Embankment	35.32270	-94.28854	405.3	24
FE-2	I-49 RS-Embankment/Culvert	35.32360	-94.28867	407.8	13
FE-3	I-49 LS	35.32427	-94.28783	410.3	20
FE-4	Hwy 22 Ramp 3-Embankment	35.32486	-94.28922	418.5	16
FE-5	I-49-Embankment	35.32573	-94.28640	414.6	15
FE-6	I-49 RS-Embankment/Culvert	35.32817	-94.28308	412.0	23
FE-7	I-49-Embankment	35.33115	-94.28127	419.1	30
FE-8	I-49-Embankment	35.33239	-94.28084	412.7	30
FE-9	I-49-Embankment	35.33355	-94.28059	401.9	30
FE-10	Embankment Gun Club ramps	35.36573	-94.27925	400.0	40
FE-11	Embankment Gun Club ramps	35.36634	-94.28223	401.2	40
FE-12	Embankment Gun Club ramps	35.36747	-94.27903	398.8	40
FE-13	Embankment Gun Club ramps	35.36764	-94.28228	399.4	40
FE-14	I-49-Embankment	35.36917	-94.27985	394.1	40

SUMMARY of PHASE II, SECTION 901 EXPLORATION PROGRAM

PROJECT: Job. No. 040748: Hwy 22 - I-40 (I-49)

LOCATION: Crawford and Sebastian Counties, Arkansas

GHBW JOB No.: 21-071

Boring No.	Project Facet	GPS Coordinates		Approx Surf El, ft	Boring Depth, ft
		Latitude	Longitude		
FP-1	Hwy 22 Ramp 2-PVT	35.32146	-94.28945	406.4	10
FP-2	SE Service RD-PVT	35.32428	-94.28627	406.5	10
FP-3	NW Service RD-Pvt	35.32576	-94.28794	422.9	7
FP-4	HWY 59-PVT	35.36145	-94.29793	400.4	10
FP-5	HWY 59-PVT	35.36228	-94.30140	397.6	10
FP-6	Gun Club RD PVT	35.36244	-94.29917	396.0	10
FP-7	Gun Club RD PVT	35.36237	-94.27513	395.6	10
FP-8	Gun Club RD PVT	35.36258	-94.27891	396.4	10
FP-9	Gun Club RD PVT	35.36275	-94.28686	402.7	10
FP-10	Gun Club RD PVT	35.36284	-94.29022	402.1	10
FP-11	Gun Club RD PVT	35.36292	-94.29359	402±	10
FP-12	Gun Club RD PVT	35.36297	-94.29703	399.2	10
FP-13	Gun Club RD PVT	35.36316	-94.29641	401±	10
FP-14	Gun Club RD ramp-PVT	35.36401	-94.27801	399.0	5.5
FP-15	Gun Club RD ramp-PVT	35.36487	-94.28341	400.0	5.5
FP-16	I-49-PVT	35.36682	-94.28047	400.7	5.5

Notes: 1. Lat/long coordinates provided by Surveyor (B&F) or obtained with a hand-portable GPS unit.
2. Surface elevations are as provided by the Surveyor or the Engineer. Elevations are approximate and actual surface elevation may vary.
3. The following Borings were not drilled due to access issues, wetlands, and too close to a PH I boring; FB-1, FB-3, FB-6, FB-9, FB-47, FB-49, FB-51, FB-52, FB-54, FB-55, FB-56, FB-58, FB-59, FB-61, FB-62, FB-64, FB-68, FB-76.

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-2

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA to 5 ft /Wash-CME-55 LOCATION: 35.336313°N, -94.280381°E

SURF. EL: 390.9

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %
0–8	Soft brown clay (CL), slightly blocky	5			
	- with rootlets to 2 ft			0.25 (cohesion)	
	- firm at 4 to 6 ft	7			
	- soft with occasional silt seams below 6 ft	6			
8–18	Loose reddish tan silt (ML)	5			
	- water at 9.5 ft				
	- very loose below 12 ft	4			
18–22	Loose tan fine sand w/trace silt (SP)	9			
22–28	Medium dense reddish tan fine sandy silt (ML)	13			
28–30	Dense to very dense grayish tan silty fine sand (SM)	50/10"			

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by BR.
NOTE 3: Logged by DJM.

COMPLETION DEPTH: 30.0 ft
DATE: 3-10-23

DEPTH TO WATER IN BORING: 9.5 ft
DATE: 3/10/2023

LGBNEW 21-071 FB LOGS.GPJ 3-15-23

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-4

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 25 ft /Wash 37 ft /NQ Core-Diedrich D-50

LOCATION: 35.336983°N, -94.280346°E

SURF. EL: 392.8

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Soft brown clayey silt (CL-ML)	5	80			
	- very soft below 2 ft	4				
5	Firm brown silty clay w/silt seams (CL)		89			
	Loose reddish tan silt (ML), slightly sandy	5				
10		6				
	Medium dense reddish tan silty fine sand (SM)	12				
15	- water at 16.4 ft					
20	Loose reddish tan fine to medium sand (SP), slightly silty	7				
25	- medium dense below 24 ft	17				
30	Medium dense tan fine sand (SP)	25		1		
		19				

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

COMPLETION DEPTH: 87.0 ft
DATE: 2-18-23

DEPTH TO WATER IN BORING: 16.4 ft

DATE: 2/17/2023

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-4

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 25 ft /Wash 37 ft /NQ Core-Diedrich D-50

LOCATION: 35.336983°N, -94.280346°E

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	Remarks	- No. 200 %	% Recovery	% RQD
	Moderately hard dark gray weathered shale	50/2"					
	Moderately hard dark gray shale w/occasional gray fine-grained sandstone partings, horizontal bedding			q_u= 3000 psi, TUW= 160 pcf		98	88
40						90	90
45				q_u= 2160 psi, TUW= 152 pcf		100	100
50				q_u= 2220 psi, TUW= 160 pcf		100	100
55				q_u= 1570 psi, TUW= TUW=160 pcf			
	Moderately hard dark gray shale w/interbedded very close, very thin gray fine-grained sandstone partings, horizontal bedding					100	100
60						100	100
65	Moderately hard dark gray shale, horizontal bedding					95	95

COMPLETION DEPTH: 87.0 ft
DATE: 2-18-23

DEPTH TO WATER IN BORING: 16.4 ft

DATE: 2/17/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-21-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-4

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 25 ft /Wash 37 ft /NQ Core-Diedrich D-50

LOCATION: 35.336983°N, -94.280346°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
								100	100
75			Moderately hard light gray fine-grained sandstone w/interbedded very close, very thin, dark gray shale partings, horizontal bedding					98	98
80						q_u= 5170 psi, TUW= 162 pcf		100	100
85								96	96
90			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by DT. NOTE 3: Logged by DRM.						
95									
100									

COMPLETION DEPTH: 87.0 ft
DATE: 2-18-23

DEPTH TO WATER
IN BORING: 16.4 ft

DATE: 2/17/2023

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-5

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in HSA to 20 ft /Wash to 37 ft /NQ2 Core-Diedrich D-50 LOCATION: 35.33737°N, -94.28060°E

SURF. EL: 393.55

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4) / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT (10–70)	- No. 200 %
	Soft reddish brown clayey silt (ML)	4			
		6			96
5	Firm reddish brown silty clay (CL) w/silt seams	7			
10	Loose reddish tan fine sandy silt (ML)	9			
15		5			
20	Medium dense tan fine sand (SP)	15			2
25		22			
30	- dense with some fine to coarse gravel below 28 ft	37			
	Medium dense brown silt (ML), slightly sandy	10		NON-PLASTIC-	

COMPLETION DEPTH: 87.0 ft
DATE: 2-17-23

DEPTH TO WATER
IN BORING: 18.9 ft

DATE: 2/17/2023

LGBNEW 21-071 FB LOGS.GPJ 1-2-24

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-5

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in HSA to 20 ft /Wash to 37 ft /NQ2 Core-Diedrich D-50

LOCATION: 35.33737°N, -94.28060°E

DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL (continued) | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4) / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10, 20, 30, 40, 50, 60, 70) | - No. 200 %

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %
		50/1"			98
	Moderately hard dark gray shale w/some gray fine-grained sandstone partings, horizontal bedding			q_u= 2440 psi, TUW= 165 pcf q_u= 1300 psi, TUW= 165 pcf	
40					100
				q_u= 2180 psi, TUW= 166	
45					93
50					100
	- with high-angle shear at 51.5 ft			q_u= 1430 psi, TUW= 162 pcf	
55					100
				q_u= 2080 psi, TUW= 165 pcf	
60					98
65	- with less sandstone partings below 64 ft				100

COMPLETION DEPTH: 87.0 ft
DATE: 2-17-23

DEPTH TO WATER
IN BORING: 18.9 ft

DATE: 2/17/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-5

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in HSA to 20 ft /Wash to 37 ft /NQ2 Core-Diedrich D-50
LOCATION: 35.33737°N, -94.28060°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %
							98
75			Moderately hard light gray sandstone w/interbedded very close, very thin dark gray shale partings, horizontal bedding				100
80							98
85							100
90			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by D.T. NOTE 3: Logged by DRM.				
95							
100							

COMPLETION DEPTH: 87.0 ft
DATE: 2-17-23

DEPTH TO WATER
IN BORING: 18.9 ft
DATE: 2/17/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-7

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 30 ft /NQ Core-Diedrich D-50 LOCATION: 35.338048°N, -94.280059°E

SURF. EL: 386.3

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT	- No. 200 %	% Recovery	% RQD
	Very loose brown clayey silt (CL-ML)	0/WOH			95		
		0/WOH			99		
5	- with silty clay seams below 4 ft	0/WOH					
	Very soft brown clay (CH)	4					
10	- with silt seams below 9 ft	4					
15		0/WOH			98		
20	Very loose brown fine sandy silt (ML)	2					
25	Very loose gray silty fine to medium sand (SM) w/a little fine to coarse gravel	6					
	Gray fine to coarse sand (SP)	13					
30	Moderately hard dark gray shale w/occasional gray fine-coarse sandstone partings, horizontal bedding					90	70
35	- with vertical fractures at 35 to 35.1 ft and 38.2 to 38.6 ft					100	90
40	- with highly weathered seams at 40 to 43.5 ft			q_u= 1550 psi, TUW= 162 pcf		100	100

COMPLETION DEPTH: 80.0 ft
DATE: 2-16-23

DEPTH TO WATER IN BORING: 14.9 ft

DATE: 2/15/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-7

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 30 ft /NQ Core-Diedrich D-50 LOCATION: 35.338048°N, -94.280059°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
45–50				q_u= 970 psi, TUW= 163 pcf		100	100
50–55	- with more sandstone partings and inclusions below 50 ft					100	100
55–60				q_u= 1570 psi, TUW= 161 pcf		100	93
60–65	- with vertical fractures at 62.1 to 62.5 ft					100	88
65–70	Moderately hard dark gray shale w/interbedded very close, very thin, gray fine-grained sandstone partings, horizontal bedding					100	100
70–75						98	98
75–80	- sandstone partings close below 75 ft					100	100
80–85	NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by J.T NOTE 3: Logged by DRM.						

COMPLETION DEPTH: 80.0 ft
DATE: 2-16-23

DEPTH TO WATER IN BORING: 14.9 ft

DATE: 2/15/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

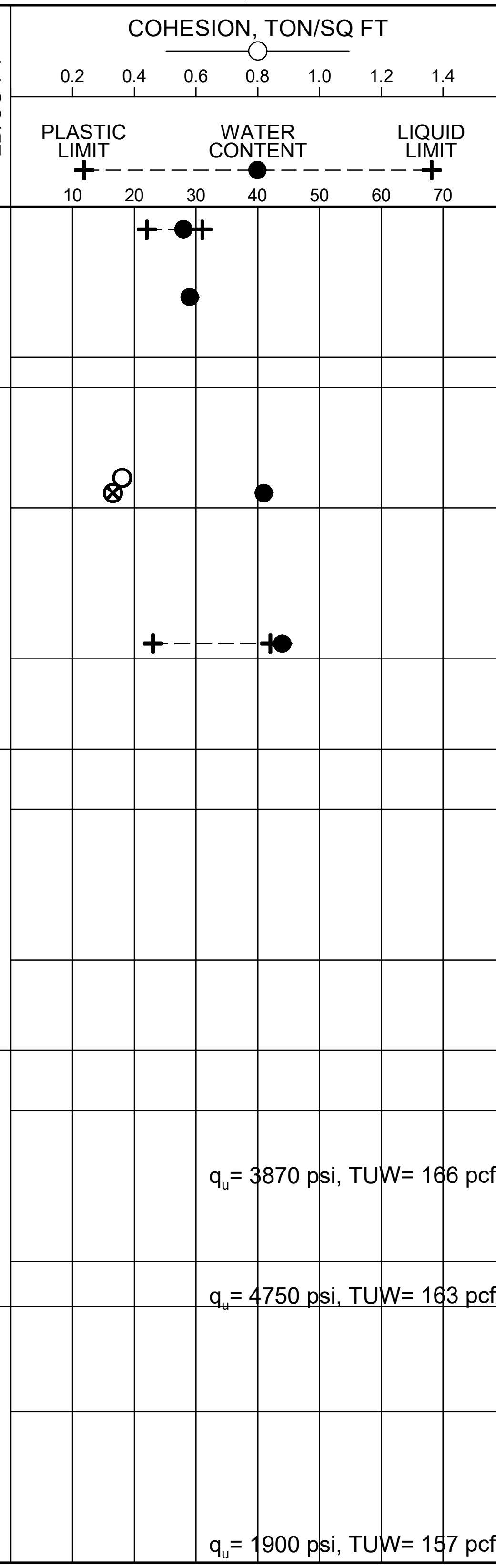
LOG OF BORING NO. FB-8

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in HSA to 29 ft /NQ Core-Diedrich D-50 LOCATION: 35.338408°N, -94.280403°E

SURF. EL: 385.5

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0–6	Very soft brown silty clay w/silt seams (CL)	0/WOH		98		
		0/WOH		97		
5		3				
6–18	Very soft brown silty clay (CL)	4				
10	- water at 8.5 ft		82			
15		2		100		
18–28	Medium dense tan silty fine sand (SM)	11				
20–25	- very loose with less silt below 22 ft	3		28		
28–36.5	Moderately hard dark gray shale w/some gray fine-grained sandstone partings and inclusions, horizontal bedding	50/4"			100	90
35					100	100
36.5–45	Moderately hard dark gray shale w/very close, very thin fine-grained sandstone partings, horizontal bedding				90	90



COMPLETION DEPTH: 79.0 ft
DATE: 2-7-23

DEPTH TO WATER
IN BORING: 8.5 ft

DATE: 2/7/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-8

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in HSA to 29 ft /NQ Core-Diedrich D-50 LOCATION: 35.338408°N, -94.280403°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %	% Recovery	% RQD
			- more mechanical breaks from 45 to 49 ft					100	90
50						q_u= 2090 psi, TUW= 159 pcf		95	87
55			- high angle shear at 54 to 54.4 ft					98	98
60								100	100
65						q_u= 8340 psi, TUW= 164 pcf		98	98
70								98	98
75								100	100
80			NOTE 1: Backfilled with cuttings. 2: Drilled by JT. 3: Logged by DRM.						
85									

COMPLETION DEPTH: 79.0 ft
DATE: 2-7-23

DEPTH TO WATER
IN BORING: 8.5 ft

DATE: 2/7/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-10

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in HSA 45 ft /NQ Core-CME-55

LOCATION: 35.339121°N, -94.280617°E

SURF. EL: 388.3

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Very loose brown clayey silt (ML)	2				
	Very loose tan silty fine sand (SM)					
	Loose brown silt (ML)	6		99		
5	- with some clayey silt seams below 4 ft	4				
	Soft brown clayey silt w/some fine sandy silt seams (CL-ML)	6				
10		7				
15		5				
20		19		75		
	- water at 20 ft - with more fine sandy silt seams below 20 ft					
25		23				
	Medium dense tan and gray fine to medium sand (SP)					
30	- dense below 29 ft	58				
		40				

COMPLETION DEPTH: 95.0 ft
DATE: 2-16-23

DEPTH TO WATER IN BORING: 20 ft

DATE: 2/16/2023

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Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-10

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in HSA 45 ft /NQ Core-CME-55

LOCATION: 35.339121°N, -94.280617°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT	- No. 200 %	% Recovery	% RQD
37–45	Dense tan and gray silty fine sand (SM-SP)	44					
45	Low hardness dark gray weathered shale - with some gray fine-grained sandstone partings below 45 ft	50/10"			12		
				q_u= 1790 psi, TUW= 162 pcf		72	50
						100	90
55	Moderately hard dark gray shale w/some clayey shale seams w/occasional gray fine-grained sandstone partings					87	50
						100	63
66	Moderately hard dark gray shale w/interbedded, very thin, gray fine-grained sandstone partings, horizontal bedding			q_u= 1730 psi, TUW= 158 pcf		97	97

COMPLETION DEPTH: 95.0 ft
DATE: 2-16-23

DEPTH TO WATER
IN BORING: 20 ft

DATE: 2/16/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-10

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in HSA 45 ft /NQ Core-CME-55

LOCATION: 35.339121°N, -94.280617°E

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	Cohesion / Water content	- No. 200 %	% Recovery	% RQD
70–75								100	80
75			- with numerous clayey shale seams from 74 to 75 ft						
75–80								98	98
80–85								97	97
85			Moderately hard dark gray shale w/occasional gray fine-grained sandstone partings						
85–90						q_u= 2970 psi, TUW= 164 pcf		100	100
90–95						q_u= 2370 psi, TUW= 160 pcf		100	100
91.5			Moderately hard gray fine-grained sandstone w/interbedded very close, very thin, dark gray shale partings, horizontal bedding						
95			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by CL. NOTE 3: Logged by IJM.						
100									

COMPLETION DEPTH: 95.0 ft
DATE: 2-16-23

DEPTH TO WATER IN BORING: 20 ft

DATE: 2/16/2023

Form 108-6(74) Job No. 21-071

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Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-11

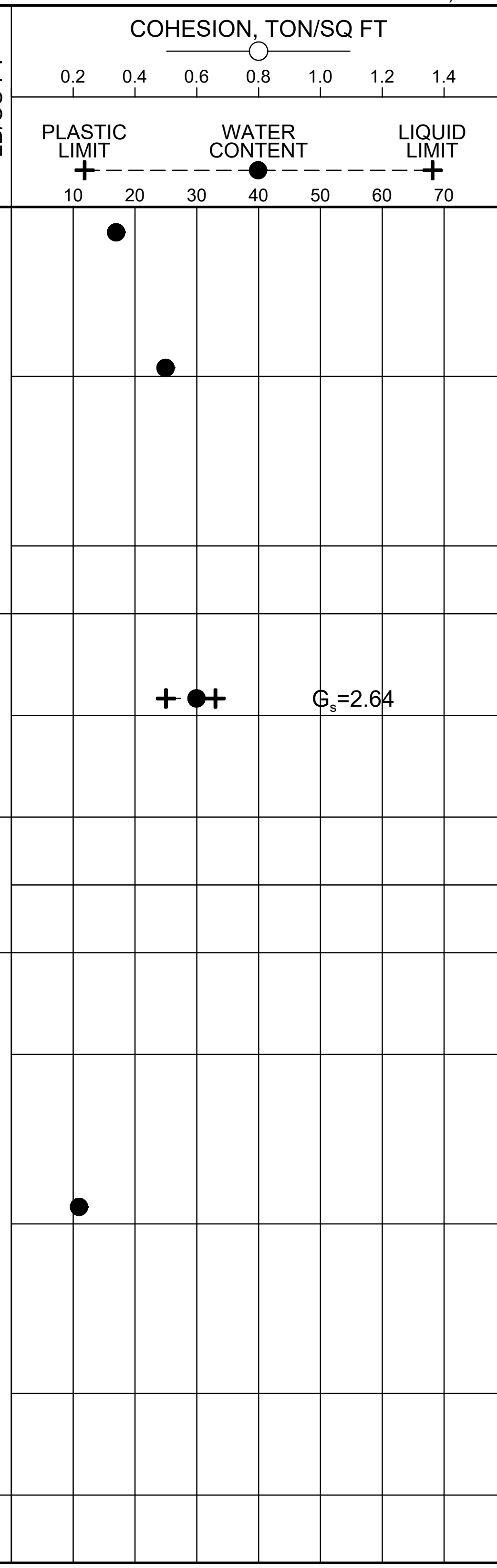
040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 45 ft /Wash 50 ft /NQ Core - CME-550

LOCATION: 35.339477°N, -94.280621°E

SURF. EL: 388.3

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0	Loose tan fine sandy silt (ML)	7		74		
		7				
5	- very loose at 4 to 6 ft	2				
	- loose below 6 ft - slightly sandy with occasional clay seams and layers at 6 to 12 ft	8				
10		5				
12	Very loose brown silty clay (CL)					
15		4		99		
18	Medium dense brown fine sandy silt w/trace clay (ML)	11				
22	Dense to very dense tan fine to coarse sand w/occasional fine to coarse gravel (SW)					
25		50/10"				
30	- dense at 28 to 32 ft - with more gravel below 28 ft	32		3		
	- dense to very dense below 32 ft					
35		50/11"				
38	Dense to very dense brown and tan silty fine to medium	50/6"		26		



COMPLETION DEPTH: 100.0 ft
DATE: 1-24-23

DEPTH TO WATER
IN BORING: 23.8 ft

DATE: 1/24/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-21-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. FB-11

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 45 ft /Wash 50 ft /NQ Core - CME-550

LOCATION: 35.339477°N, -94.280621°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 – 1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 – 70)	- No. 200 %	% Recovery	% RQD
			sand (SM)						
45				50/3"					
			Moderately hard dark gray shale w/interbedded very close very thin gray fine-grained sandstone partings, horizontal bedding	50/2"					
50									
								95	78
55									
								88	67
60									
								73	17
65									
								40	0
70									
								80	60
75									
								95	95

COMPLETION DEPTH: 100.0 ft
DATE: 1-24-23

DEPTH TO WATER
IN BORING: 23.8 ft

DATE: 1/24/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-11

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 45 ft /Wash 50 ft /NQ Core - CME-550

LOCATION: 35.339477°N, -94.280621°E

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
			- with multiple mechanical breaks below 80 ft				92	68
85							100	75
90			- predominately sandstone from 92 to 95.5 ft				80	70
95							92	72
100			NOTE 1: Backfilled with cuttings NOTE 2: Drilled by CS. NOTE 3: Logged by IJM.					
105								
110								
115								

COMPLETION DEPTH: 100.0 ft
DATE: 1-24-23

DEPTH TO WATER
IN BORING: 23.8 ft

DATE: 1/24/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-12

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 20 ft /Wash 35 ft /NQ Core-Diedrich D-50

LOCATION: 35.339837°N, -94.280426°E

SURF. EL: 390.6

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	REMARKS	- No. 200 %
	Very loose reddish tan fine sandy silt (ML)	3			
		3		-NON-PLASTIC-	
5	- slightly clayey below 4.5 ft	3			
	Very loose reddish brown silt w/clay seams and layers	6			
10	- loose below 9 ft	8			
	Loose reddish tan silty fine sand (SM)				
15		6			
	- wash at 18 ft				
20	- very loose below 18 ft	3			
	Medium dense tan and gray silty fine to medium sand (SM)				
25		12		-NON-PLASTIC-	
30	Medium dense tan and gray fine to coarse sand (SW) w/occasional fine gravel	11			
	Moderately hard dark gray weathered shale	50/5"			
35	Moderately hard dark gray shale w/occasional gray fine-grained sandstone partings, horizontal bedding				100
				q_u= 1030 psi, TUW= 163 pcf	
40					96
				q_u= 2100 psi, TUW= 162 pcf	

COMPLETION DEPTH: 85.0 ft
DATE: 2-21-23

DEPTH TO WATER IN BORING: 18 ft
DATE: 2/20/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-12

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 20 ft /Wash 35 ft /NQ Core-Diedrich D-50 LOCATION: 35.339837°N, -94.280426°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %
			- with more sandstone partings below 45 ft			q_u= 1240 psi, TUW= 162 pcf	100
50							97
			Moderately hard dark gray shale, horizontal bedding				
55			- with pyrite inclusions at 55 to 56.5 ft				93
						q_u= 2720 psi, TUW= 162 pcf	
60							100
			Moderately hard dark gray shale w/interbedded very close, very thin gray fine-grained sandstone partings, horizontal bedding				
65							100
70							100
						q_u= 1590 psi, TUW= 164 pcf	
75							98
80							98
85							

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by D.T.
NOTE 3: Logged by DRM.

COMPLETION DEPTH: 85.0 ft
DATE: 2-21-23

DEPTH TO WATER IN BORING: 18 ft

DATE: 2/20/2023

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-13

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 25 ft /Wash 35 ft /NQ Core-Diedrich D-50 LOCATION: 35.340192°N, -94.280633°E

SURF. EL: 391.7

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	WATER CONTENT / NOTES	- No. 200 %	% Recovery	% RQD
0–3.5	Very loose tan and brown fine sandy silt (ML)	2		-NON-PLASTIC-	72		
		2					
3.5–12	Very loose tan and brown silt, slightly sandy (ML)	2			94		
	- loose to medium dense from 6 to 8 ft	10	84		97		
	- loose below 8.5 ft	6					
12–18	Loose brown silty fine sand (SM)	6					
18–28	Very loose brown fine to medium sand (SP)	2					
		7					
28–35	Loose gray and brown fine to coarse sand w/fine to coarse gravel	9					
	- dense below 34 ft	42					

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

COMPLETION DEPTH: 85.0 ft
DATE: 2-20-23

DEPTH TO WATER IN BORING: 18.3 ft

DATE: 2/6/2023

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Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-13

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 25 ft /Wash 35 ft /NQ Core-Diedrich D-50

LOCATION: 35.340192°N, -94.280633°E

Columns: DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL (continued) | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4) / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10, 20, 30, 40, 50, 60, 70) | - No. 200 % | % Recovery | % RQD

DEPTH, FT	DESCRIPTION OF MATERIAL	Test Results	% Recovery	% RQD
35–57	Moderately hard dark gray shale w/occasional gray fine-grained sandstone partings, horizontal bedding	q_u= 2420 psi, TUW= 167 pcf q_u= 1520 psi, TUW= 166 pcf	90	67
		q_u= 1450 psi, TUW= 164 pcf	100	93
45			100	94
50		q_u= 1740 psi, TUW= 169 pcf	95	95
55		q_u= 2310 psi, TUW= 162 pcf	100	93
57–67+	Moderately hard gray fine-grained sandstone w/interbedded, very close, very thin dark gray shale partings, horizontal bedding	q_u= 4470 psi, TUW= 166 pcf	95	95
65			100	98

COMPLETION DEPTH: 85.0 ft
DATE: 2-20-23

DEPTH TO WATER
IN BORING: 18.3 ft

DATE: 2/6/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-13

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 25 ft /Wash 35 ft /NQ Core-Diedrich D-50

LOCATION: 35.340192°N, -94.280633°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT; PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
						q_u= 3300 psi, TUW= 161 pcf		98	98
75						q_u= 3190 psi, TUW= 161 pcf		100	95
			Moderately hard dark gray shale w/some very thin gray fine-grained sandstone partings, horizontal bedding						
80								98	98
			- with more sandstone partings below 84 ft						
85			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by JT. NOTE 3: Logged by DJM.						
90									
95									
100									

COMPLETION DEPTH: 85.0 ft
DATE: 2-20-23

DEPTH TO WATER
IN BORING: 18.3 ft

DATE: 2/6/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-14

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 35 ft /NQ Core - Dietrich D-50   LOCATION: 35.34055°N, -94.28042°E

SURF. EL: 392.0

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	WATER CONTENT (%)	- No. 200 %	% Recovery	% RQD
0–8	Very loose brown and tan fine sandy silt (ML), slightly clayey - with less clay below 6 ft - loose below 6.5 ft	2					
		4		~20	78		
		3					
		7					
8–18	Loose brown and tan silt (ML)	6	86	~19	98		
		5					
18–22	Loose brown silty fine sand (SM), damp	5		~33	45		
22–28	Medium dense tan and brown fine to medium sand (SP)	14		~19	3		
28–35	Medium dense tan fine to coarse sand (SP) w/some fine gravel (GP)	28					
		13					
35–	Moderately hard dark gray shale w/close to very close, very thin gray fine-grained sandstone partings, horizontal bedding	50/1"				92	87

q_u= 3210 psi, TUW= 163 pcf

COMPLETION DEPTH: 86.0 ft
DATE: 2-5-23

DEPTH TO WATER IN BORING: 21.5 ft

DATE: 2/5/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-20-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-14

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 35 ft /NQ Core - Dietrich D-50 LOCATION: 35.34055°N, -94.28042°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
41-46						100	100
46-51	- with little to no sandstone partings below 48 ft			q_u= 2200 psi, TUW= 160 pcf		93	90
51-56				q_u= 3060 psi, TUW= 163 pcf		100	100
56-61	- pyrite inclusion at 56.1 ft Moderately hard dark gray shale w/interbedded very close, very thin gray fine-grained sandstone partings, horizontal bedding					100	100
61-66				q_u= 1770 psi, TUW= 165 pcf		100	100
66-71						98	98
71-76				q_u= 3590 psi, TUW= 164 pcf		92	92
76-80						92	92

COMPLETION DEPTH: 86.0 ft
DATE: 2-5-23

DEPTH TO WATER IN BORING: 21.5 ft

DATE: 2/5/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-20-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-14

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 35 ft /NQ Core - Dietrich D-50 LOCATION: 35.34055°N, -94.28042°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
								100	100
85			Moderately hard light gray fine-grained sandstone w/interbedded very close, very thin shale laminations			q_u= 4300 psi, TUW= 164 pcf			
			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by JT. NOTE 3: Logged by DJM.						
90									
95									
100									
105									
110									
115									

COMPLETION DEPTH: 86.0 ft
DATE: 2-5-23

DEPTH TO WATER IN BORING: 21.5 ft

DATE: 2/5/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-15

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 39 ft /NQ2 Core - Diedrich D-50 LOCATION: 35.340906°N, -94.280650°E

SURF. EL: 394.3

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	WATER CONTENT	- No. 200 %	% Recovery	% RQD
0–8	Very loose tan and brown silty fine sand (SM)	4					
		4	91	●	62		
5		3					
	- loose below 6.5 ft	6					
8–12	Loose tan and brown fine sandy silt (ML), slightly clayey	6		●			
10							
12–22	Loose tannish brown silt (ML) w/occasional clayey silt seams	6	84	●	100		
15							
20		6					
22–	Loose to medium dense dark gray and gray fine to medium sand (SM-SP)	10			7		
25							
30	- loose from 29 to 30 ft	8					
		15					

COMPLETION DEPTH: 88.5 ft
DATE: 2-3-23

DEPTH TO WATER IN BORING: 20 ft

DATE: 2/3/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-15

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 39 ft /NQ2 Core - Diedrich D-50   LOCATION: 35.340906°N, -94.280650°E

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / WATER CONTENT	- No. 200 %	% Recovery	% RQD
37-39	Moderately hard dark gray shale, horizontal bedding w/some fine-grained very thin sandstone partings and occasional sandstone inclusions	50/4"				78	10
40-45				q_u= 3620 psi, TUW= 162 pcf		98	98
45-50				q_u= 1830 psi, TUW= 162 pcf		97	97
50-55				q_u= 2120 psi, TUW= 162 pcf		97	97
56-60	Moderately hard dark gray shale, horizontal bedding w/interbedded very close, very thin, gray fine-grained sandstone partings			q_u= 4090 psi, TUW= 161 pcf		100	100
60-65						100	100
65-70	- with more sandstone partings from 65 to 68 ft			q_u= 8870 psi, TUW= 165 pcf		100	100

COMPLETION DEPTH: 88.5 ft
DATE: 2-3-23

DEPTH TO WATER IN BORING: 20 ft

DATE: 2/3/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-15

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 39 ft /NQ2 Core - Diedrich D-50 LOCATION: 35.340906°N, -94.280650°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
								97	97
75								97	97
80								98	98
			Moderately hard light gray fine-grained sandstone, flat bedded w/interbedded very close, very thin dark gray shale laminations						
85						q_u= 7910 psi, TUW= 160 pcf		100	100
90			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by J.T. NOTE 3: Logged by IJM and DJM.						
95									
100									

COMPLETION DEPTH: 88.5 ft
DATE: 2-3-23

DEPTH TO WATER IN BORING: 20 ft

DATE: 2/3/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 8-24-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-16

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 38.5 ft /NQ Core - CME-550

LOCATION: 35.340907°N, -94.280544°E

SURF. EL: 394.9

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
	Very loose brown fine sandy silt (ML)	4		-NON-PLASTIC-			
	Soft brown clayey silt (CL-ML), sandy	7					
5		6	89		51		
		6					
	Loose to medium dense brown and tan silt	10	88		99		
10							
		8					
15	- loose with some clay seams from 14.5 to 15 ft						
	Medium dense tan fine sand w/occasional clay seams (SP)	18					
20							
	Medium dense gray fine to medium sand (SP) w/trace silt	15			4		
25							
	- loose at 28 to 32 ft						
30		6					
	- a little fine to coarse below 33 ft - with a little fine gravel at 33 ft	12					

COMPLETION DEPTH: 90.5 ft
DATE: 1-29-23

DEPTH TO WATER
IN BORING: 23 ft

DATE: 1/28/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-16

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 38.5 ft /NQ Core - CME-550

LOCATION: 35.340907°N, -94.280544°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT	- No. 200 %	% Recovery	% RQD
	Moderately hard dark gray shale, horizontal bedding	50/2"					
40						89	89
						100	95
45				q_u= 1600 psi, TUW= 159 pcf		100	98
50				q_u= 1300 psi, TUW= 157 pcf		100	98
55	Moderately hard fine-grained sandstone, horizontal bedding w/interbedded very close, very thin dark gray shale partings			q_u=3900 psi, TUW= 161 pcf		100	100
60	- with very close clayey shale seams below 62 ft			q_u= 4610 psi, TUW= 164 pcf		100	100
65	Moderately hard dark gray shale w/interbedded very close, very thin gray fine-grained sandstone partings					100	97

COMPLETION DEPTH: 90.5 ft
DATE: 1-29-23

DEPTH TO WATER IN BORING: 23 ft

DATE: 1/28/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-16

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 38.5 ft /NQ Core - CME-550

LOCATION: 35.340907°N, -94.280544°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
			- with close sandstone partings below 73 ft					100	97
75								98	98
80						q_u= 3580 psi, TUW= 162 pcf			
			Moderately hard gray fine-grained sandstone, horizontal bedding w/very close, very thin dark gray shale laminations			q_u= 4500 psi, TUW= 161 pcf		100	100
85								98	98
90									
			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by C.S. NOTE 3: Logged by IJM.						
95									
100									

COMPLETION DEPTH: 90.5 ft
DATE: 1-29-23

DEPTH TO WATER
IN BORING: 23 ft

DATE: 1/28/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-17

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 39 ft /NQ Core - CME-550 LOCATION: 35.340909°N, -94.280436°E

SURF. EL: 394.6

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT + — WATER CONTENT ● — LIQUID LIMIT +: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Very Loose tan and brown silty fine sand (SM)	3				
		6				
5		6		48		
		4				
		7				
10						
	Loose brown and tan silt (ML)					
15	- with some clay seams below 14 ft	8	91	100		
	- loose to medium dense below 18 ft - water at 19 ft	10				
20						
	Medium dense tan and gray fine to coarse sand (SP)	13				
25						
	- with some fine to coarse gravel below 28.5 ft	12				
30						
	- with more coarse sand below	18				

COMPLETION DEPTH: 91.0 ft
DATE: 1-28-23

DEPTH TO WATER
IN BORING: 19 ft

DATE: 1/27/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 8-24-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-17

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 39 ft /NQ Core - CME-550

LOCATION: 35.340909°N, -94.280436°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
	33.5 ft						
	Moderately hard dark gray shale, horizontal bedding	50/3"					
40	Moderately hard dark gray shale, flat bedded w/close very thin, gray fine-grained sandstone partings					92	50
						97	92
45							
						91	43
50				q_u= 1290 psi, TUW= 157 pcf			
						100	100
55							
	Moderately hard gray fine-grained sandstone, flat bedded w/interbedded very close, very thin dark gray shale laminations					100	100
60				q_u= 2990 psi, TUW= 162 pcf			
						91	91
65							
						100	100

COMPLETION DEPTH: 91.0 ft
DATE: 1-28-23

DEPTH TO WATER
IN BORING: 19 ft

DATE: 1/27/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-17

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 39 ft /NQ Core - CME-550

LOCATION: 35.340909°N, -94.280436°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
72–83	Moderately hard dark gray shale w/some very thin gray fine-grained sandstone partings, horizontal bedding					91	91
				q_u= 1840 psi, TUW= 165 pcf		100	80
83–91	Moderately hard gray fine-grained sandstone w/interbedded, very close, very thin dark gray shale partings, horizontal bedding			q_u= 5250, TUW= 161 pcf		100	100
						100	100

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by C.S.
NOTE 3: Logged by IJM.

Depth scale: 75, 80, 85, 90, 95, 100

COMPLETION DEPTH: 91.0 ft
DATE: 1-28-23

DEPTH TO WATER
IN BORING: 19 ft

DATE: 1/27/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-18

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 39 ft /NQ Core - CME-550

LOCATION: 35.341799°N, -94.280665°E

SURF. EL: 391.4

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	WATER CONTENT (approx.)	- No. 200 %	% Recovery	% RQD
0–6	Very loose tan and brown silty fine sand (SM)	2					
		2		~14	31		
5		3					
6–13	Loose to medium dense tan fine to medium sand (SP) w/a little fine gravel	9					
10		11					
13–	Medium dense tan fine to coarse sand (SW) w/some fine to coarse gravel	10		~2	2		
15							
	- very loose below 18 ft - water at 19 ft	3					
20							
25	- medium dense, gray and tan at 23.5 to 28 ft	17					
	- loose at 28 to 33 ft						
30		9					
	- medium dense with occasional clay seams below	25					

COMPLETION DEPTH: 101.0 ft
DATE: 1-27-23

DEPTH TO WATER IN BORING: 19 ft

DATE: 1/24/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 4-26-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-18

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 39 ft /NQ Core - CME-550

LOCATION: 35.341799°N, -94.280665°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
			33.5 ft						
			Moderately hard dark gray shale, flat bedded w/occasional clayey shale seams, horizontal bedding	50/2"					
40								75	25
								92	33
45									
								100	83
50			Moderately hard dark gray shale, horizontal bedding w/interbedded very close, very thin, gray fine-grained sandstone partings						
						q_u= 3820 psi, TUW= 161 pcf			
								100	93
55									
						q_u= 4050 psi, TUW= 161 pcf		100	60
60									
						q_u= 3810 psi, TUW= 160 pcf			
								100	100
65									
								100	100

COMPLETION DEPTH: 101.0 ft
DATE: 1-27-23

DEPTH TO WATER
IN BORING: 19 ft

DATE: 1/24/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-18

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 39 ft /NQ Core - CME-550

LOCATION: 35.341799°N, -94.280665°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
72–76						100	100
76–81	Moderately hard gray fine-grained sandstone, horizontal bedding w/interbedded very close, very thin, dark gray shale laminations			q_u= 5500, TUW= 161 pcf		100	100
81–86				q_u= 4500 psi, TUW= 161 pcf		100	100
86–91						100	100
91–96						100	100
96–101						98	98

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by C.S.
NOTE 3: Logged by IJM.

COMPLETION DEPTH: 101.0 ft
DATE: 1-27-23

DEPTH TO WATER IN BORING: 19 ft

DATE: 1/24/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-19

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 38 ft /NQ2 Core - CME-550

LOCATION: 35.341801°N, -94.280558°E

SURF. EL: 390.7

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	WATER CONTENT (%)	- No. 200 %	% Recovery	% RQD
0–8	Very loose tan silty fine sand (SM)	3					
	- loose below 2 ft	4					
5		4			22		
	- fine to medium with less silt below 6.5 ft	7					
8–18	Medium dense tan and brown fine to coarse sand (SW) w/some fine to coarse gravel	13					
	- loose below 13 ft	9			2		
18–32	Very loose tan silty fine sand (SM-SP) w/a little fine to coarse gravel, slightly silty	3					
25		4			5		
30		2					
32–38	Medium dense tan and gray fine to coarse sand (SW) w/a little fine to coarse gravel	18					
38–41	Moderately hard dark gray w/tan slightly weathered shale, horizontal bedding	50/2"					
41–45	Moderately hard dark gray shale, horizontal bedding w/occasional clayey shale seams					78	23

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

COMPLETION DEPTH: 100.5 ft
DATE: 1-26-23

DEPTH TO WATER
IN BORING: 18 ft

DATE: 1/25/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 7-5-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-19

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 38 ft /NQ2 Core - CME-550

LOCATION: 35.341801°N, -94.280558°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
45–50						q_u= 830 psi, TUW= 157 pcf		100	92
50–55			Moderately hard dark gray shale, flat bedded w/interbedded, very close, very thin gray fine-grained sandstone partings					95	92
55–60								100	75
60–65								97	33
65–70								100	97
70–75								100	100
75–80			- with frequent mechanical breaks below 75 ft Moderately hard gray fine-grained sandstone, flat bedded w/interbedded, very close, very thin dark gray shale laminations					100	75
80–85								100	60
85–90								100	45

COMPLETION DEPTH: 100.5 ft
DATE: 1-26-23

DEPTH TO WATER
IN BORING: 18 ft

DATE: 1/25/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-19

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 38 ft /NQ2 Core - CME-550

LOCATION: 35.341801°N, -94.280558°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
						q_u= 4730 psi, TUW= 161 pcf		100	100
95			Moderately hard dark gray shale, flat bedded w/interbedded very close, very thin, gray fine-grained sandstone partings					100	100
100			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by CS. NOTE 3: Logged by IJM.						
105									
110									
115									
120									
125									
130									

COMPLETION DEPTH: 100.5 ft
DATE: 1-26-23

DEPTH TO WATER
IN BORING: 18 ft

DATE: 1/25/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-20

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 38 ft /NQ2 Core-CME-550

LOCATION: 35.341800°N, -94.280450°E

SURF. EL: 390.4

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0–7	Very loose tan and brown fine sandy silt (ML)	2				
		2	94	56		
	- loose below 4 ft	6				
7–27		5				
	Medium dense tan fine to medium sand (SP) - with a little fine gravel below 8.5 ft	22				
	- loose at 13 to 18 ft	6				
	- water at 18 ft - very loose at 18 to 23 ft	2				
	- loose below 23 ft	6				
27–37	Loose tan and gray fine to coarse sand (SP) w/some fine to coarse gravel	7				
	- medium dense below 34 ft	15				
37–40	Moderately hard dark gray shale slightly weathered shale, horizontal bedding	50/4"			94	0
40–	Moderately hard dark gray shale, horizontal bedding				80	42
					89	67

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

COMPLETION DEPTH: 95.0 ft
DATE: 1-25-23

DEPTH TO WATER IN BORING: 18 ft

DATE: 1/23/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-20

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 38 ft /NQ2 Core-CME-550

LOCATION: 35.341800°N, -94.280450°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	COHESION / TEST RESULTS	% Recovery	% RQD
		q_u= 3740 psi, TUW= 160 pcf	83	73
50	Moderately hard dark gray shale, horizontal bedding w/interbedded very close, very thin fine-grained sandstone partings			
		q_u= 4640 psi, TUW= 162 pcf	85	40
55		q_u= 3770 psi, TUW= 163 pcf	98	80
60		q_u= 4380 psi, TUW= 163 pcf	98	68
65		q_u= 5040 psi, TUW= 169 pcf	95	83
		q_u= 1680 psi, TUW= 161 pcf		
70	Moderately hard dark gray shale, horizontal bedding w/close fine-grained sandstone partings		100	90
75	Moderately hard dark gray shale, horizontal bedding w/interbedded very close, very thin fine-grained sandstone partings	q_u= 4590 psi, TUW= 160 pcf	100	43
80			100	30
85		q_u= 5640 psi, TUW= 163 pcf	100	90

COMPLETION DEPTH: 95.0 ft
DATE: 1-25-23

DEPTH TO WATER IN BORING: 18 ft

DATE: 1/23/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-20

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 38 ft /NQ2 Core-CME-550

LOCATION: 35.341800°N, -94.280450°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
			- with very close calcite veins at 89.5 to 95 ft					100	100
95									
			NOTE 1: Backfilled with cuttings NOTE 2: Drilled by CS. NOTE 3: Logged by IJM.						
100									
105									
110									
115									
120									
125									
130									

COMPLETION DEPTH: 95.0 ft
DATE: 1-25-23

DEPTH TO WATER
IN BORING: 18 ft

DATE: 1/23/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-21

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 4 in. Casing to 3 ft /NQ2 Core - CME-550 LOCATION: 35.343095°N, -94.280701°E

SURF. EL: 354±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
0–12.5	Low hardness to moderately hard dark gray slightly weathered shale, horizontal bedded, fractured w/some very thin, very close gray fine-grained sandstone partings to 3 ft	50/8"					
						83	0
						90	42
12.5–35	Moderately hard dark gray shale, horizontal bedded w/interbedded very thin, very close gray fine-grained sandstone partings - sandstone layer at 12.9 to 13.2 ft - with multiple mechanical breaks below 14 ft					92	58
						97	67
						100	65
						95	63
				q_u= 2130 psi, TUW= 167 pcf		100	43
35–	Moderately hard gray fine-grained sandstone, horizontal bedded w/close dark gray shale laminations and multiple mechanical breaks along bedding planes					90	57
						93	38

COMPLETION DEPTH: 72.5 ft
DATE: 11-10-22

DEPTH TO WATER IN BORING: NA

DATE: 11/10/2022

RECRQDN200-2 21-071_FB LOGS.GPJ 1-10-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-21

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 4 in. Casing to 3 ft /NQ2 Core - CME-550 LOCATION: 35.343095°N, -94.280701°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
			- with interbedded very close, very thin shale laminations below 45 ft					83	43
50								100	33
55								100	63
60			Moderately hard dark gray shale, horizontal bedded w/very close, very thin gray fine-grained sandstone partings and seams and multiple mechanical breaks along bedding planes					100	60
65								97	33
70								100	30
75			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by CS. NOTE 3: Logged by DJM.						
80									
85									

COMPLETION DEPTH: 72.5 ft
DATE: 11-10-22

DEPTH TO WATER IN BORING: NA

DATE: 11/10/2022

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-22

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 4 in. Casing to 2 ft /HQ Casing to 5 ft /NQ2 Core - CME-550

LOCATION: 35.343095°N, 94.280942°E

SURF. EL: 355.0

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
Medium dense to dense gray and brown fine to coarse sand w/some fine to coarse gravel	85/9"						
Moderately hard dark gray shale, carbonaceous, flat bedded	50/1"					67	0
						62	10
						98	37
Hard gray fine-grained sandstone							
Moderately hard dark gray shale, flat bedded w/very close, very thin fine-grained sandstone partings and seams						95	70
						95	42
						100	17
						100	27
						87	7
						93	70

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4. Water content scale: 10, 20, 30, 40, 50, 60, 70.

Depth, ft: 5, 10, 15, 20, 25, 30, 35, 40

COMPLETION DEPTH: 80.0 ft
DATE: 11-10-22

DEPTH TO WATER IN BORING: NA

DATE: 11/10/2022

RECRQDN200-2 21-071_FB LOGS.GPJ 11-21-23

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-22

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 4 in. Casing to 2 ft /HQ Casing to 5 ft /NQ2 Core - CME-550

LOCATION: 35.343095°N, 94.280942°E

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
45–50					82	38
50–55					85	23
55–60					100	35
60–65	- calcite inclusion at 63 ft				97	15
65–70	- decreased sandstone partings and seams below 65 ft - with close highly weathered shale seams below 65 ft				92	0
70–75					72	0
75–80	- with very close sandstone seams below 78 ft				75	0
80	NOTE 1: Water depth 17.1 ft NOTE 2: Backfilled with cuttings and fall in. NOTE 3: Drilled by CS. NOTE 4: Logged by DJM.					

RECRQDN200-2 21-071_FB LOGS.GPJ 11-21-23

COMPLETION DEPTH: 80.0 ft
DATE: 11-10-22

DEPTH TO WATER
IN BORING: NA

DATE: 11/10/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-23

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 4 in. Casing to 2 ft /NQ2 Core - CME-550

LOCATION: 35.343091°N, -94.280583°E

SURF. EL: 351±

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0–2	Medium dense to dense tan and brown fine to medium sand w/some coarse sand	72/6" 50/1"		3		
2–14	Moderately hard dark gray shale, carbonaceous, flat bedded				100	21
					78	10
					98	25
14–44+	Moderately hard dark gray shale, flat bedded w/very close, very thin fine-grained sandstone partings, seams, and layers - sandstone layer at 14.1 to 14.8 ft				100	78
					97	35
	q_u= 3900 psi, TUW= 163 pcf				97	62
					98	40
					100	53
					97	8

COMPLETION DEPTH: 74.0 ft
DATE: 11-11-22

DEPTH TO WATER IN BORING: NA

DATE: 11/11/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-23

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 4 in. Casing to 2 ft /NQ2 Core - CME-550 LOCATION: 35.343091°N, -94.280583°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
								77	0
50								83	10
55								87	22
60						q_u= 3000 psi, TUW= 158 pcf		100	55
65								100	18
70			Moderately hard dark gray shale, flat bedded					100	92
75			NOTE 1: Water depth 19.0 to 19.5 ft NOTE 2: Backfilled with cuttings and fall in. NOTE 3: Drilled by CS. NOTE 4: Logged by DJM.						
80									
85									

COMPLETION DEPTH: 74.0 ft
DATE: 11-11-22

DEPTH TO WATER IN BORING: NA

DATE: 11/11/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-24

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 4 in. Casing to 5 ft /NQ2 Core - CME-550

LOCATION: 35.344299°N, -94.280732°E

SURF. EL: 359±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
0–5.5	Very loose tan and brown fine to medium sand w/some coarse sand and fine gravel	2					
5.5–8	Moderately hard dark gray shale, flat bedded w/interbedded very close, very thin light gray fine-grained sandstone partings and seams	50/0.5"				87	32
8–17	Hard gray and dark gray fine-grained sandstone w/interbedded, very close, very thin dark gray shale laminations			q_u= 3040 psi, TUW= 161 pcf		93	93
17–	Moderately hard to hard dark gray shale w/interbedded, very close, very thin fine-grained sandstone partings, flat bedded					100	72
						93	58
27–29	- with very close calcite veins at 27 to 29 ft					100	85
				q_u= 4980 psi, TUW= 162 pcf		100	18
						100	57
						100	52

COMPLETION DEPTH: 71.0 ft
DATE: 11-12-22

DEPTH TO WATER IN BORING: NA

DATE: 11/11/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-24

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 4 in. Casing to 5 ft /NQ2 Core - CME-550

LOCATION: 35.344299°N, -94.280732°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %
					98
50	- with very close calcite veins at 49 to 50.5 ft				88
55	Hard gray and dark gray fine-grained sandstone w/occasional dark gray shale laminations and inclusions, flat bedded			q_u= 10,170 psi, TUW= 154 pcf	
	Moderately hard dark gray shale w/interbedded very close, very thin fine-grained sandstone partings and seams, flat bedded				100
60					100
65	- with more sandstone partings below 66 ft				83
70					

NOTE 1: Water depth ±12 ft
NOTE 2: Backfilled with cuttings and fall in.
NOTE 3: Drilled by CS.
NOTE 4: Logged by DJM/IM.

COMPLETION DEPTH: 71.0 ft
DATE: 11-12-22

DEPTH TO WATER
IN BORING: NA

DATE: 11/11/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-25

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 4 in. Casing to 3 ft /NQ2 Core - CME-550

LOCATION: 35.344303°N, -94.280584°E

SURF. EL: 359.0

Column headings: DEPTH, FT; SYMBOL; SAMPLES; DESCRIPTION OF MATERIAL; BLOWS PER FT; UNIT DRY WT LB/CU FT; COHESION, TON/SQ FT (0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10, 20, 30, 40, 50, 60, 70); - No. 200 %; % Recovery; % RQD

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %	% Recovery	% RQD
0	Very loose to loose brown fine to coarse sand (SW) w/fine to coarse gravel	4	1		
4.5	Moderately hard dark gray shale, flat bedded w/interbedded very close, very thin light gray fine-grained sandstone partings, seams, and layers	50/4"	17		
5				98	25
9				100	90
14				95	67
19	q_u= 2660 psi, TUW= 159 pcf			100	95
23	- sandstone seams more frequent below 23 ft				
24	q_u= 4090 psi, TUW= 160 pcf			100	92
29				100	63

COMPLETION DEPTH: 74.0 ft
DATE: 11-13-22

DEPTH TO WATER
IN BORING: NA

DATE: 11/12/2022

RECRQDN200-2 21-071_FB LOGS.GPJ 10-16-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-25

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 4 in. Casing to 3 ft /NQ2 Core - CME-550

LOCATION: 35.344303°N, -94.280584°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
								98	78
40								98	83
45								95	63
50			Hard gray and dark gray fine-grained sandstone w/occasional dark gray shale laminations, flat bedded			q_u= 8590 psi, TUW= 155 pcf		100	77
55			- with more shale laminations below 55.5 ft			q_u= 11,780 psi, TUW= 157 pcf		87	23
			Moderately hard dark gray shale, flat bedded w/very close light gray fine-grained sandstone partings and seams						
60								93	13
65								100	42

COMPLETION DEPTH: 74.0 ft
DATE: 11-13-22

DEPTH TO WATER
IN BORING: NA

DATE: 11/12/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-25

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 4 in. Casing to 3 ft /NQ2 Core - CME-550

LOCATION: 35.344303°N, -94.280584°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
								100	67
75			NOTE 1: Water depth 12.2 ft NOTE 2: Backfilled with cuttings and fall in. NOTE 3: Drilled by CS. NOTE 4: Logged by IM.						
80									
85									
90									
95									
100									

COMPLETION DEPTH: 74.0 ft
DATE: 11-13-22

DEPTH TO WATER IN BORING: NA

DATE: 11/12/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-26

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 4 in. Casing to 4.5 ft /NQ2 Core - CME-550 LOCATION: 35.344303°N, -94.280460°E

SURF. EL: 359.0

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	WATER CONTENT (%)	- No. 200 %	% Recovery	% RQD
0–4.5	Very loose tan and brown sandy fine to coarse gravel (GW)	2		≈12	2		
4.5		50/2"					
4.5–23.5	Moderately hard dark gray shale, flat bedded w/interbedded very thin, very close fine-grained sandstone partings and occasional seams and inclusions					100	50
						73	0
	- sandstone layer at 17.1 to 17.3 ft					100	88
	- with more sandstone below 19 ft					100	90
23.5–36.5	Moderately hard light gray fine-grained sandstone, flat bedded w/interbedded very close shale laminations					98	95
	q_u= 2870 psi, TUW= 159 pcf					100	90
						100	77
36.5–	Moderately hard dark gray shale, flat bedded w/interbedded very close, very thin fine-grained sandstone partings and seams					100	58

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

COMPLETION DEPTH: 84.0 ft
DATE: 11-14-22

DEPTH TO WATER IN BORING: NA

DATE: 11/14/2022

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-26

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 4 in. Casing to 4.5 ft /NQ2 Core - CME-550

LOCATION: 35.344303°N, -94.280460°E

DESCRIPTION OF MATERIAL (continued)

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
45–50	- with more sandstone at 44.9 to 45.7 ft					100	81
50–55	Moderately hard light gray fine-grained sandstone, flat bedded w/interbedded very close shale laminations and seams			q_u= 8640 psi, TUW= 148 pcf		98	83
55–60						100	23
60–65	Moderately hard dark gray shale, flat bedded w/interbedded very close fine-grained sandstone partings and occasional seams and inclusions			q_u= 2730 psi, TUW= 159 pcf		100	48
65–70						100	47
70–75	- with less sandstone below 71.5 ft					100	37
75–80				q_u= 2870 psi, TUW= 161 pcf		100	0
80–84						100	47

NOTE 1: Water depth 13.3 ft
NOTE 2: Backfilled with cuttings and fall in.
NOTE 3: Drilled by CS.
NOTE 4: Logged by IM.

COMPLETION DEPTH: 84.0 ft
DATE: 11-14-22

DEPTH TO WATER IN BORING: NA

DATE: 11/14/2022

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-27

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 35 ft /NQ 2 Core-CME-55

LOCATION: 35.345273°N, -94.280721°E

SURF. EL: 387.9

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	WATER CONTENT	- No. 200 %	% Recovery	% RQD
0–6	Very loose tan silty fine sand (SM) w/silty clay seams to 2 ft	2			● (~16)	28		
		3			G_s=2.69			
5	- very loose to loose, silty at 4 to 6 ft	4						
6–13	Loose reddish tan and tan fine sand (SP), slightly silty	7						
10		9				4		
13–28	Medium dense tan fine to medium sand (SP)	13						
20		16						
25	- slightly silty below 24 ft	22				5		
28–34	Loose to medium dense tan fine to coarse sand w/trace fine gravel (SW)	10						
34	Moderately hard dark gray	50/6"						

COMPLETION DEPTH: 95.0 ft
DATE: 4-14-23

DEPTH TO WATER IN BORING: 17.7 ft

DATE: 4/8/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-27

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 35 ft /NQ 2 Core-CME-55

LOCATION: 35.345273°N, -94.280721°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
35–40			shale w/interbedded very close, very thin gray fine-grained sandstone partings, horizontal bedding			q_u= 6670 psi, TUW= 160 pcf		80	80
40–45						q_u= 5510 psi, TUW= 162 pcf; q_u= 2930 psi, TUW= 164 pcf		100	100
45–50						q_u= 6550 psi, TUW= 164 pcf		100	100
50–55								100	100
55–60						q_u= 2800 psi, TUW= 164 pcf		100	100
60–65								100	100
65–70								98	98

COMPLETION DEPTH: 95.0 ft
DATE: 4-14-23

DEPTH TO WATER
IN BORING: 17.7 ft

DATE: 4/8/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-27

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 35 ft /NQ 2 Core-CME-55

LOCATION: 35.345273°N, -94.280721°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
			- sandstone seams at 72 to 72.3 ft, 73.5 to 73.6 ft and 74 to 74.3 ft			q_u= 4110 psi, TUW= 162 pcf		100	100
75			- fewer sandstone partings at 76 to 78.4 ft					100	100
80								100	100
			- with close sandstone partings below 83 ft						
85						q_u= 3070 psi, TUW= 163 pcf		98	98
90								100	100
95			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by JSW. NOTE 3: Logged by DJM/JKB.						
100									

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4; Water content scale: 10, 20, 30, 40, 50, 60, 70

COMPLETION DEPTH: 95.0 ft
DATE: 4-14-23

DEPTH TO WATER
IN BORING: 17.7 ft

DATE: 4/8/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. FB-28

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 40 ft /NQ 2 Core-CME-55 LOCATION: 35.345275°N, -94.280614°E

SURF. EL: 387.3

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	WATER CONTENT (approx. from plot)	- No. 200 %
0–6	Very loose tan and brown fine to medium sandy silt w/ occassional silty clay seams and layers (ML)	3		●	57
		4			
5		3		●	
6–14	Loose to medium dense tan fine sand, slightly silty (SM-SP)	10			
	- loose with occasional clay pockets below 8 ft	9		●	
14–28	Medium dense tan fine to medium sand, slightly silty (SM-SP)	11			
	- with occasional clay pockets below 18 ft	13		●	
25		16			
28–34	Loose to medium dense tan sandy fine to coarse gravel, slightly silty w/fine to coarse sand (GM-GW)	10		●	
34–	Moderately hard to hard dark gray				

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

COMPLETION DEPTH: 100.0 ft
DATE: 4-16-23

DEPTH TO WATER
IN BORING: 16.5 ft

DATE: 4/15/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-28

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 40 ft /NQ 2 Core-CME-55

LOCATION: 35.345275°N, -94.280614°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %
	shale w/interbedded very close, very thin gray fine-grained sandstone partings, horizontal bedding				
40				q_u= 5840 psi, TUW= 164 pcf	90
45					100
50				q_u= 2810 psi, TUW= 164 pcf	97
55					100
60					100
65	- with fewer sandstone partings at 65.6 to 65.9 ft, 66.5 to 67.2 ft and 95 to 98.3 ft			q_u= 3690 psi, TUW= 161 pcf	100

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4. Water content scale: 10, 20, 30, 40, 50, 60, 70.

COMPLETION DEPTH: 100.0 ft
DATE: 4-16-23

DEPTH TO WATER
IN BORING: 16.5 ft

DATE: 4/15/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-28

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 40 ft /NQ 2 Core-CME-55

LOCATION: 35.345275°N, -94.280614°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %
							100
75			- with close sandstone partings at 75 to 77.3 ft				100
80						q_u= 5390 psi, TUW= 161 pcf	100
85							100
90			- with close sandstone partings below 90 ft - fine-grained sandstone seams at 72 to 72.2 ft, 92.7 to 92.9 ft and 93.8 to 94 ft			q_u= 5520 psi, TUW= 162 pcf	100
95							95
100			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by JSW. NOTE 3: Logged JKB.				

COMPLETION DEPTH: 100.0 ft
DATE: 4-16-23

DEPTH TO WATER
IN BORING: 16.5 ft

DATE: 4/15/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-29

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 40 ft/NQ 2 Core-CME-55

LOCATION: 35.345276°N, -94.280507°E

SURF. EL: 387.3

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	WATER CONTENT / PLASTICITY	- No. 200 %	% Recovery	% RQD
0–6	Very loose brown and tan fine sandy silt (ML) w/occasional silty clay seams	4		~20; -NON-PLASTIC-			
		3					
5		4		~8; -NON-PLASTIC-			
6–12	Loose tan fine sandy silt (ML)	9					
	- with fine sand seams and layers below 8 ft	8		~18	64		
12–28	Medium dense tan fine to medium sand (SP)	11					
	- with trace fine gravel below 18 ft	16		~9	2		
	- with less medium sand below 22 ft - loose below 22 ft	8					
28–34	Medium dense grayish tan fine to coarse sand w/fine to coarse gravel (SW)	12			3		
34–	Moderately hard gray sandstone w/interbedded very close, very thin shale partings, horizontal bedding	50/2"					
40–				q_u= 5250 psi, TUW= 165 pcf		68	63

COMPLETION DEPTH: 100.0 ft
DATE: 4-19-23

DEPTH TO WATER IN BORING: 14.3 ft

DATE: 4/18/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-29

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 40 ft/NQ 2 Core-CME-55

LOCATION: 35.345276°N, -94.280507°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
45–50						q_u= 7410 psi, TUW= 161 pcf		100	100
50–55						q_u= 4200 psi, TUW= 160 pcf		100	100
55–60								98	98
60–65						q_u= 5250 psi, TUW= 162 pcf		100	100
65–70								100	100
70–75								98	98
75–80			- with shale seams below 75 ft			q_u= 3330 psi, TUW= 160 pcf		100	100
80–85								100	100
85–90								98	98

COMPLETION DEPTH: 100.0 ft
DATE: 4-19-23

DEPTH TO WATER
IN BORING: 14.3 ft

DATE: 4/18/2023

Form 108-6(74) Job No. 21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-29

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 40 ft/NQ 2 Core-CME-55

LOCATION: 35.345276°N, -94.280507°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
90–95								100	100
95–100			Moderately hard dark gray shale w/sandstone partings, horizontal bedding			q_u= 2640 psi, TUW= 166 pcf		98	98
100			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by JSW. NOTE 3: Logged JKB.						

Depth scale: 95, 100, 105, 110, 115, 120, 125, 130

COMPLETION DEPTH: 100.0 ft
DATE: 4-19-23

DEPTH TO WATER
IN BORING: 14.3 ft

DATE: 4/18/2023

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21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-30

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 20 ft /Wash 40 ft /NQ 2 Core-CME-55

LOCATION: 35.345633° N, -94.280519°E

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

SURF. EL: 387.7

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0–4	Very loose reddish brown fine sandy silt (ML) w/silty clay seams and layers (-NON-PLASTIC-)	2, 5				
4–23	Medium dense reddish tan fine to medium sand w/trace silt (SP) - with trace fine to coarse gravel below 6 ft - loose at 18 to 22 ft - medium dense below 22 ft	10, 17, 12, 11, 6				
23–33	Medium dense reddish tan fine to coarse sand w/some fine to coarse gravel	14, 14				
33–37	Moderately hard dark gray weathered shale w/some gray fine-grained sandstone partings	50/2"				
37–	Moderately hard dark gray shale w/interbedded, very close, very thin gray fine-grained sandstone					

COMPLETION DEPTH: 90.0 ft
DATE: 4-21-23

DEPTH TO WATER IN BORING: 12.5 ft

DATE: 4/20/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-30

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 20 ft /Wash 40 ft /NQ 2 Core-CME-55

LOCATION: 35.345633° N, -94.280519°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
			partings, horizontal bedding			q_u= 2700 psi, TUW= 162 pcf		98	98
45						q_u= 3360 psi, TUW= 164 pcf		95	95
50						q_u= 4150 psi, TUW= 164 pcf		100	100
55								100	100
60									
			Moderately hard to hard gray fine-grained sandstone w/interbedded, very close, very thin dark gray shale partings, horizontal bedding			q_u= 2680 psi, TUW= 164 pcf		100	100
65								100	100
70						q_u= 3170 psi, TUW= 162 pcf			
			- with shale seams at 72 to 80 ft					100	100
75								100	100

COMPLETION DEPTH: 90.0 ft
DATE: 4-21-23

DEPTH TO WATER
IN BORING: 12.5 ft

DATE: 4/20/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-30

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 20 ft /Wash 40 ft /NQ 2 Core-CME-55

LOCATION: 35.345633° N, -94.280519°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
80–85						q_u= 2900 psi, TUW= 164 pcf		100	100
85–90			Moderately hard dark gray shale w/sandstone partings					95	95

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by JSW.
NOTE 3: Logged by DRM.

COMPLETION DEPTH: 90.0 ft
DATE: 4-21-23

DEPTH TO WATER
IN BORING: 12.5 ft

DATE: 4/20/2023

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Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-31

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 40 ft/NQ2 Core-CME 55

LOCATION: 35.345987°N, -94.280726°E

SURF. EL: 386.6

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT	- No. 200 %
0	Loose brown fine to medium sand (SP)	7			
		9			
5		10			2
	- medium dense at 6 to 12 ft	16			
		16			
10					
	- loose at 12 to 17 ft				
15		5			
	- medium dense at 17 to 22 ft				
20		11			
	- loose below 22 ft				
25		6			
27	Tan sandy gravel (GP)				
30		4			
33	Moderately hard dark gray shale				
35		50/2"			
40	Moderately hard gray fine-grained sandstone w/interbedded very close, very thin dark gray shale partings, horizontal bedding			q_u= 3960 psi, TUW= 163 pcf	100

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

COMPLETION DEPTH: 90.0 ft
DATE: 5-16-23

DEPTH TO WATER IN BORING: 14 ft
DATE: 4/22/2023

LGBNEW 21-071 FB LOGS.GPJ 1-2-24

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-31

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 40 ft/NQ2 Core-CME 55

LOCATION: 35.345987°N, -94.280726°E

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / WATER CONTENT	- No. 200 %
45						q_u= 4980 psi, TUW= 161 pcf	98
50			- with some clayey shale seams at 50 and 50.3 ft				98
55						q_u= 3430 psi, TUW= 163 pcf	100
60							100
65						q_u= 8170 psi, TUW= 158 pcf	98
70							98
75						q_u= 3220 psi, TUW= 159 pcf	100
80							100
85			- with shale seams at 86 to 89.7 ft				97

COMPLETION DEPTH: 90.0 ft
DATE: 5-16-23

DEPTH TO WATER
IN BORING: 14 ft

DATE: 4/22/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-31

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 40 ft/NQ2 Core-CME 55

LOCATION: 35.345987°N, -94.280726°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by C.S. NOTE 3: Logged by DRM.				
95							
100							
105							
110							
115							
120							
125							
130							

COMPLETION DEPTH: 90.0 ft
DATE: 5-16-23

DEPTH TO WATER
IN BORING: 14 ft

DATE: 4/22/2023

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Form 108-6(74) Job No. 21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-32

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 20 ft /Wash 34 ft /NQ2 Core-CME-55

LOCATION: 35.346347°N, -94.280531°E

SURF. EL: 389.0

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT	- No. 200 %	% Recovery	% RQD
0–12	Very loose tan fine sand (SP) (possible fill)	2					
	- loose at 2 to 8 ft	7					
5		9		● (water content)			
	- silt layer at 7 ft	6					
10	- medium dense at 8 to 18 ft	18					
12–28	Medium dense brown and tan silty fine sand (SM)						
15	- water at 15 ft	15					
20	- with some fine to coarse gravel from 18 to 22 ft	3					
25	- medium dense with a little medium sand below 22 ft	10					
28–34	Loose gray brown fine to coarse sand, slightly silt w/some fine to coarse gravel and decayed organics (SW)	7		● (water content)			
34–40	Moderately hard gray fine-grained sandstone w/interbedded very close, very thin, dark gray shale partings, horizontal bedding	50/1"		q_u= 3620 psi, TUW= 162 pcf		100	90

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

COMPLETION DEPTH: 85.0 ft
DATE: 5-17-23

DEPTH TO WATER
IN BORING: 15 ft

DATE: 5/17/2023

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Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-32

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 20 ft /Wash 34 ft /NQ2 Core-CME-55

LOCATION: 35.346347°N, -94.280531°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4) / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
40–45						q_u= 3740 psi, TUW= 162 pcf		100	100
45–50								100	100
50–55						q_u= 2780 psi, TUW= 167 pcf		100	100
55–60						q_u= 3600 psi, TUW= 163 pcf		98	98
60–65								100	100
65–70			- with coal seam at 69.5 ft			q_u= 5170 psi, TUW= 161 pcf		100	98
70–75						q_u= 2150 psi, TUW= 160 pcf		100	100
75–80			- with shale seams below 78 ft					100	100

COMPLETION DEPTH: 85.0 ft
DATE: 5-17-23

DEPTH TO WATER
IN BORING: 15 ft

DATE: 5/17/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-32

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 20 ft /Wash 34 ft /NQ2 Core-CME-55

LOCATION: 35.346347°N, -94.280531°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
80–85								98	98
85			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by C.S. NOTE 3: Logged by DRM.						
90									
95									
100									
105									
110									
115									

COMPLETION DEPTH: 85.0 ft
DATE: 5-17-23

DEPTH TO WATER IN BORING: 15 ft

DATE: 5/17/2023

Form 108-6(74) Job No. 21-071

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Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-33

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 20 ft /Wash 35 ft /NQ2 Core-CME-55

LOCATION: 35.346569°N, -94.280742°E

SURF. EL: 388.8

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT	- No. 200 %	% Recovery	% RQD
0–13	Very loose tan sand (SP) (possible fill) - loose at 2 to 6 ft - with silt layers at 4 to 8 ft - medium dense below 6 ft	2, 8, 5, 13, 17					
13–22	Medium dense tan silty fine sand (SM) - water at 13.8 ft	18, 8					
22–28	Dense gray and tan fine sand (SP)	34					
28–34.5	Medium dense grayish brown fine to medium sand w/fine to coarse gravel (SP)	11, 50/2"					
34.5–	Moderately hard gray fine-grained sandstone w/interbedded very close, very thin dark gray shale partings, horizontal bedding			q_u= 5920 psi, TUW= 161 pcf		100	100
				q_u= 7910 psi, TUW= 163 pcf		100	100

Chart scales: Cohesion, ton/sq ft: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4. Plastic Limit / Water Content / Liquid Limit: 10, 20, 30, 40, 50, 60, 70.

COMPLETION DEPTH: 85.0 ft
DATE: 5-18-23

DEPTH TO WATER IN BORING: 13.9 ft

DATE: 5/18/2023

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Form 108-6(74) Job No. 21-071

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Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-33

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 20 ft /Wash 35 ft /NQ2 Core-CME-55

LOCATION: 35.346569°N, -94.280742°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
45–50								100	100
50–55						q_u= 5310 psi, TUW= 164 pcf		97	97
55–60								100	100
60–65						q_u= 8330 psi, TUW= 162 pcf		100	100
65–70								100	100
70–75			- with less shale partings from 70 to 71.5 ft			q_u= 2870 psi, TUW= 157 pcf		100	100
75–80								100	100
80–85								100	100
85			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by C.S. NOTE 3: Logged by DRM.						

COMPLETION DEPTH: 85.0 ft
DATE: 5-18-23

DEPTH TO WATER IN BORING: 13.9 ft

DATE: 5/18/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-21-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-34

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 15 ft /Wash 30 ft /NQ2 Core-CME-55 LOCATION: 35.34709°N, -94.28054°E

SURF. EL: 389.5

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
0–6	Very loose brown fine to medium sand (SP) - loose below 4 ft	2 4 8			1		
6–8	Loose brown fine sandy silt (ML)	5		-NON-PLASTIC-			
8–18	Medium dense tan fine sand, slightly silty (SP) - loose below 12 ft - water at 13.8 ft	17 8			5		
18–22	Medium dense tan silty fine sand (SM)	13			15		
22–28	Medium dense tan fine to medium sand w/a little coarse and and some gravel (SW)	12					
28–34.5	Medium dense brownish gray fine to coarse sand w/fine to coarse gravel	16 50/4"					
34.5–	Moderately hard gray fine-grained sandstone w/interbedded very close, very thin dark gray shale laminations, horizontal bedding			q_u= 6300 psi, TUW= 161 pcf		100 100	100 100

COMPLETION DEPTH: 85.0 ft
DATE: 5-22-23

DEPTH TO WATER
IN BORING: 13.8 ft

DATE: 5/22/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-34

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 15 ft /Wash 30 ft /NQ2 Core-CME-55 LOCATION: 35.34709°N, -94.28054°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
45–50						q_u= 4610 psi, TUW= 158 pcf		100	100
50–55								97	97
55–60						q_u= 4220 psi, TUW= 162 pcf		100	90
60–65								100	100
65–70						q_u= 5490 psi, TUW= 165 pcf		98	98
70–75			- slightly weathered zone from 70.5 to 73 ft			q_u= 2970 psi, TUW= 162 pcf		98	50
75–80								100	90
80–85								97	97
85			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by C.S NOTE 3: Logged by DRM.						

COMPLETION DEPTH: 85.0 ft
DATE: 5-22-23

DEPTH TO WATER IN BORING: 13.8 ft

DATE: 5/22/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-34

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 15 ft /Wash 30 ft /NQ2 Core-CME-55

LOCATION: 35.34709°N, -94.28054°E

SURF. EL: 389.5

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0–6	Very loose brown fine to medium sand (SP)	2				
		4		1		
	- loose below 4 ft	8				
6–8	Loose brown fine sandy silt (ML)	5				
8–18	Medium dense tan fine sand, slightly silty (SP)	17		5		
	- loose below 12 ft					
	- water at 13.8 ft	8				
18–22	Medium dense tan silty fine sand (SM)	13		15		
22–28	Medium dense tan fine to medium sand w/a little coarse and and some gravel (SW)	12				
28–34.5	Medium dense brownish gray fine to coarse sand w/fine to coarse gravel	16				
		50/4"				
34.5–	Moderately hard gray fine-grained sandstone w/interbedded very close, very thin dark gray shale laminations, horizontal bedding				100	100
					100	100

Cohesion, ton/sq ft scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

Plastic limit, water content and liquid limit scale: 10, 20, 30, 40, 50, 60, 70

At 7 ft: -NON-PLASTIC-

At about 41 ft: q_u= 6300 psi, TUW= 161 pcf

COMPLETION DEPTH: 85.0 ft	DEPTH TO WATER IN BORING: 13.8 ft
DATE: 5-22-23	DATE: 5/22/2023

21-071

Form 108-6(74) Job No. 21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-34

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 15 ft /Wash 30 ft /NQ2 Core-CME-55

LOCATION: 35.34709°N, -94.28054°E

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	Test results	% Recovery	% RQD
45–50		q_u= 4610 psi, TUW= 158 pcf	100	100
50–55			97	97
55–60		q_u= 4220 psi, TUW= 162 pcf	100	90
60–65			100	100
65–70		q_u= 5490 psi, TUW= 165 pcf	98	98
70–75	- slightly weathered zone from 70.5 to 73 ft	q_u= 2970 psi, TUW= 162 pcf	98	50
75–80			100	90
80–85			97	97

Column headings: DEPTH, FT; SYMBOL; SAMPLES; DESCRIPTION OF MATERIAL; BLOWS PER FT; UNIT DRY WT LB/CU FT; - No. 200 %; % Recovery; % RQD

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by C.S
NOTE 3: Logged by DRM.

COMPLETION DEPTH: 85.0 ft
DATE: 5-22-23

DEPTH TO WATER IN BORING: 13.8 ft

DATE: 5/22/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-21-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-35

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 30 ft /Wash 46 ft /NQ2 Core-CME-55

LOCATION: 35.347416°N, -92.280749°E

SURF. EL: 399.1

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Medium dense reddish tan silty fine to medium sand w/some fine gravel (SM) (fill)	22				
	- with crushed shale and sandstone cobbles at 2 to 6 ft	47		19		
5		18				
	- loose at 6 to 8 ft	6				
10		20				
	Loose tan silty fine sand (SM)					
15		8		19		
	- medium dense below 18 to 23 ft					
20		15				
	- loose below 23 ft					
25		7				
	Medium dense tan fine to medium sand w/a little fine to coarse gravel (SP)	13				
30						
	Medium dense tan fine to coarse sand w/fine to coarse gravel and occasional cobbles					

COMPLETION DEPTH: 96.0 ft
DATE: 5-2-23

DEPTH TO WATER
IN BORING: 23 ft

DATE: 5/1/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-35

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 30 ft /Wash 46 ft /NQ2 Core-CME-55

LOCATION: 35.347416°N, -92.280749°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
	(SW)						
40		12					
45	Low hardness dark gray weathered shale	24					
	Moderately hard dark gray shale w/interbedded very close, very thin gray fine-grained sandstone partings, horizontal bedding					98	70
50				q_u= 5420 psi, TUW= 166 pcf			
				q_u= 3050 psi, TUW= 162 pcf		100	0
55							
						97	97
60							
				q_u= 2420 psi, TUW= 161 pcf		97	83
65	- clayey shale seam at 64 ft						
						98	92

COMPLETION DEPTH: 96.0 ft
DATE: 5-2-23

DEPTH TO WATER
IN BORING: 23 ft

DATE: 5/1/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-35

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 30 ft /Wash 46 ft /NQ2 Core-CME-55

LOCATION: 35.347416°N, -92.280749°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
72–75				q_u= 3490 psi, TUW= 163 pcf		100	100
77–80						98	98
81–85	Moderately hard gray fine-grained sandstone w/interbedded very close dark gray shale laminations, horizontal bedding			q_u= 2760 psi, TUW= 169 pcf		100	100
85–91	- thicker sandstone layers below 85 ft					100	85
91–96						100	100

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by CS.
NOTE 3: Logged by DRM.

COMPLETION DEPTH: 96.0 ft
DATE: 5-2-23

DEPTH TO WATER IN BORING: 23 ft

DATE: 5/1/2023

21-071

Form 108-6(74) Job No. 21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-36

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 45 /NQ 2 Core-CME-55

LOCATION: 35.347776°N, -94.280554°E

SURF. EL: 398.8

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Loose tan fine to coarse sand w/a little fine to coarse gravel (SW) (possible fill)	7				
- medium dense below 2 ft	16		2		
	17				
	17				
- with more fine sand below 8 ft	12				
Medium dense tan fine sand (SP)	12		3		
	11				
	10				
	13				
	19				

DEPTH, FT: 5, 10, 15, 20, 25, 30

COMPLETION DEPTH: 95.0 ft
DATE: 5-3-23

DEPTH TO WATER IN BORING: 23.3 ft

DATE: 5/2/2023

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Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-36

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 45 /NQ 2 Core-CME-55

LOCATION: 35.347776°N, -94.280554°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
40	Medium dense gray and tan fine to coarse sand (SP) w/trace fine gravel	26					
45	Moderately hard dark gray fine-grained sandstone w/very close, very thin dark gray shale partings, horizontal bedding	50/3"					
						100	100
				q_u= 9310 psi, TUW= 164 pcf			
50							
						100	100
				q_u= 3360 psi, TUW= 164 pcf			
55				q_u= 4350 psi, TUW= 163 pcf			
						98	98
60							
						100	100
65	- with shale seams and layers at 65 to 70 ft						
						100	100

COMPLETION DEPTH: 95.0 ft
DATE: 5-3-23

DEPTH TO WATER IN BORING: 23.3 ft

DATE: 5/2/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-36

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 45 /NQ 2 Core-CME-55

LOCATION: 35.347776°N, -94.280554°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
						q_u= 3460 psi, TUW= 165 pcf		100	100
75								98	98
80								100	100
85						q_u= 4810 psi, TUW= 165 pcf		100	100
90								100	100
95			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by CS. NOTE 3: Logged by DRM.						
100									

COHESION, TON/SQ FT scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT scale: 10, 20, 30, 40, 50, 60, 70

COMPLETION DEPTH: 95.0 ft
DATE: 5-3-23

DEPTH TO WATER
IN BORING: 23.3 ft

DATE: 5/2/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-37

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 30 ft /Wash 47 ft /NQ 2 Core-CME-55

LOCATION: 35.348130°N, -94.280761°E

SURF. EL: 400.2

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	WATER CONTENT (approx.)	- No. 200 %	% Recovery	% RQD
0–8	Loose tan fine to coarse sand w/a little fine gravel (SP) (possible fill) - medium dense at 2 to 6 ft - with more fine gravel below 4 ft - loose below 6 ft	6					
		18		●	2		
		15					
		7					
8–23	Loose tan fine sand (SP) - medium dense below 12 ft	9					
		11		●	1		
		18					
23–33	Medium dense tan fine to medium sand (SP) - loose below 29 ft	16					
		5					
33–40	Medium dense gray and tan fine to coarse sand w/fine to coarse gravel (SW)	12					
		23			3		

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

COMPLETION DEPTH: 98.0 ft
DATE: 5-6-23

DEPTH TO WATER IN BORING: 23.7 ft

DATE: 5/5/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-37

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 30 ft /Wash 47 ft /NQ 2 Core-CME-55

LOCATION: 35.348130°N, -94.280761°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
45		10					
	Moderately hard dark gray shale w/gray fine-grained sandstone partings, horizontal bedding	50/3"		q_u= 2130 psi, TUW= 167 pcf		98	64
50	Moderately hard gray fine-grained sandstone w/interbedded very thin shale partings, horizontal bedding			q_u= 5110 psi, TUW= 163 pcf		100	90
55–60						100	98
60–65				q_u= 2270psi, TUW= 161 pcf		10	100
65–70				q_u= 3060 psi, TUW= 160 pcf		100	100
70–75						97	95
75–				q_u= 3940 psi, TUW= 171 pcf		100	100

COMPLETION DEPTH: 98.0 ft
DATE: 5-6-23

DEPTH TO WATER
IN BORING: 23.7 ft

DATE: 5/5/2023

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-37

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 30 ft /Wash 47 ft /NQ 2 Core-CME-55

LOCATION: 35.348130°N, -94.280761°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
								100	100
85									
								100	100
90									
						q_u= 550 psi, TUW= 160 pcf			
								100	100
95									
								92	92
100			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by CS. NOTE 3: Logged by DRM.						
105									
110									
115									

COMPLETION DEPTH: 98.0 ft
DATE: 5-6-23

DEPTH TO WATER
IN BORING: 23.7 ft

DATE: 5/5/2023

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21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-38

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 47 ft /NQ 2 Core-CME-55

LOCATION: 35.348490°N, -94.280565°

SURF. EL: 399.3

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Loose tan fine to coarse sand w/some fine gravel (SP) (possible fill)	7				
- medium dense below 2 ft	16		2		
	19				
	11				
Very loose gray silty clay (CL)	2				
Loose tan fine sand (SP)	7				
- medium dense below 17 ft	16		3		
- water at 22.8 ft - with some fine to coarse gravel below 24 ft	10				
Loose tan fine to medium sand (SP)	6		2		
- medium dense below 33 ft	11				
- with more fine to coarse	12				

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

COMPLETION DEPTH: 97.0 ft
DATE: 5-6-23

DEPTH TO WATER IN BORING: 22.8 ft

DATE: 5/6/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-38

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 47 ft /NQ 2 Core-CME-55

LOCATION: 35.348490°N, -94.280565°

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
	gravel below 39 ft						
45		21					
	Moderately hard dark gray weathered shale w/occasional sandstone partings, horizontal bedding					67	0
50	Moderately hard dark gray shale w/some gray fine-grained sandstone partings, horizontal bedding			q_u= 4200 psi, TUW 168 pcf		100	100
	Moderately hard dark gray shale w/interbedded very close, very thin, gray fine-grained sandstone partings, horizontal bedding						
55				q_u= 5310 psi, TUW= 160 pcf		100	100
	Moderately hard gray fine-grained sandstone w/interbedded very close, very thin dark gray shale partings, horizontal bedding						
60						100	100
65				q_u= 2640 psi, TUW= 164 pcf		100	100
70						100	100
75	Moderately hard dark gray shale w/interbedded very close, very thin gray fine-grained sandstone partings, horizontal bedding			q_u= 5180 psi, TUW= 165 pcf		100	100

COMPLETION DEPTH: 97.0 ft
DATE: 5-6-23

DEPTH TO WATER
IN BORING: 22.8 ft

DATE: 5/6/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-38

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 47 ft /NQ 2 Core-CME-55 LOCATION: 35.348490°N, -94.280565°

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
80–85								100	100
85–90						q_u= 3190 psi, TUW= 163 pcf		100	100
90–95			- with calcium carbonate veins at 93.5 to 96.6 ft					97	97
95–97								98	98

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by CS.
NOTE 3: Logged by DRM.

Depth scale: 85, 90, 95, 100, 105, 110, 115

COMPLETION DEPTH: 97.0 ft
DATE: 5-6-23

DEPTH TO WATER
IN BORING: 22.8 ft

DATE: 5/6/2023

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-39

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 47 ft /NQ 2 Core-CME-55

LOCATION: 35.348845°N, -94.280772°E

SURF. EL: 399.9

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0–12	Very loose tan fine to medium sand w/some coarse sand and trace fine gravel (SP) (possible fill) - medium dense at 2 to 8 ft - loose below 8 ft	2, 14, 15, 8, 6		17		
12–28	Medium dense tan fine sand (SP) - water at 23 ft	10, 16, 15		3		
28–40	Loose tan fine to coarse sand (SP) - with some fine to coarse gravel below 32 ft - medium dense below 34 ft	6, 21, 24				

COMPLETION DEPTH: 97.0 ft
DATE: 5-6-23

DEPTH TO WATER IN BORING: 23 ft

DATE: 5/6/2023

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Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-39

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 47 ft /NQ 2 Core-CME-55

LOCATION: 35.348845°N, -94.280772°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
45				16					
50			Moderately hard fine-grained sandstone w/interbedded very close, very thin dark gray shale partings, horizontal bedding			q_u= 1710 psi, TUW= 162 pcf		100	75
55						q_u= 3380 psi, TUW= 169 pcf		98	98
60								100	100
65						q_u= 4630 psi, TUW= 162 pcf		100	90
			- clayey shale partings from 64.5 ft to 65 ft						
70						q_u= 2830 psi, TUW= 163 pcf		98	98
75								93	93
								100	97

Scale: Cohesion 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4; Water content 10, 20, 30, 40, 50, 60, 70

COMPLETION DEPTH: 97.0 ft
DATE: 5-6-23

DEPTH TO WATER IN BORING: 23 ft

DATE: 5/6/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-39

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 47 ft /NQ 2 Core-CME-55

LOCATION: 35.348845°N, -94.280772°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
80–85								98	98
85–90			- with rehealed vertical fracture at 85.4 to 87 ft - with shale partings from 87 to 88ft					100	100
90–95						q_u= 1890 psi, TUW= 162 pcf		100	100
95–97								100	100
97			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by CS. NOTE 3: Logged by DRM.						

Depth scale: 85, 90, 95, 100, 105, 110, 115

COMPLETION DEPTH: 97.0 ft
DATE: 5-6-23

DEPTH TO WATER
IN BORING: 23 ft

DATE: 5/6/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-40

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: HSA 25 ft /Wash 49 ft /Core

LOCATION: 35.349204°N, -94.280577°E

SURF. EL: 400.5

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Loose tan fine to medium sand w/a little coarse sand (SP) (possible fill)	5		1		
	- medium dense with a little fine gravel below 2 ft	14				
5		13				
	Medium dense tan fine sand (SP)	13				
	- loose at 8 to 17 ft					
10	- loose below 9 ft	7		1		
15		8				
	- medium dense at 17 to 22 ft					
20		11				
	- loose below 22 ft					
	- water at 23.2 ft					
25		6				
	Very loose tan fine to medium sand w/trace coarse sand and fine gravel (SP)	4		2		
30						
	- medium dense with more coarse sand and fine gravel below 32 ft					
35		14				
		12				

COMPLETION DEPTH: 99.0 ft
DATE: 5-7-23

DEPTH TO WATER IN BORING: 23.2 ft

DATE: 5/7/2023

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Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-40

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: HSA 25 ft /Wash 49 ft /Core

LOCATION: 35.349204°N, -94.280577°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
45		15					
50	Moderately hard gray fine-grained sandstone w/interbedded very close, very thin dark gray shale partings, horizontal bedding	50/1"				96	92
				q_u= 5560 psi, TUW 165 pcf		98	97
55				q_u= 6350 psi, TUW= 163 pcf		98	85
60	- with near vertical fracture at 60.3 to 61.8 ft			q_u= 1560 psi, TUW= 164 pcf		100	68
65						100	98
70	- with less shale partings at 71 to 76.3 ft			q_u= 1750 psi, TUW= 153 pcf		98	98
75	- with some shale seams below 76 ft			q_u= 4750 psi, TUW= 164 pcf		100	100

COMPLETION DEPTH: 99.0 ft
DATE: 5-7-23

DEPTH TO WATER
IN BORING: 23.2 ft

DATE: 5/7/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 7-11-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-40

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: HSA 25 ft /Wash 49 ft /Core

LOCATION: 35.349204°N, -94.280577°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
85								100	100
						q_u= 4110 psi, TUW= 161 pcf		95	95
90			- with calcium carbonate veins at 91 to 94.8 ft, 96.1 ft and 97.3 to 98 ft					100	100
95								94	94
100			NOTE 1: Backfilled with cuttings.. NOTE 2: Drilled by CS. NOTE 3: Logged by DRM.						
105									
110									
115									

COMPLETION DEPTH: 99.0 ft
DATE: 5-7-23

DEPTH TO WATER IN BORING: 23.2 ft

DATE: 5/7/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-41

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 25 ft /Wash 49 ft /NQ 2 Core

LOCATION: 35.349559°N, -94.280784°E

SURF. EL: 400.3

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0–6	Loose tan fine to medium sand w/some coarse sand and trace fine gravel (SW) (possible fill) - medium dense below 2 ft	7, 20, 14		3		
6–22	Medium dense tan fine to coarse sand w/occasional fine to coarse gravel (SW) - loose at 8 to 12 ft - medium dense at 12 to 22 ft	10, 9, 10, 22		4		
22–28	Loose brown fine to medium sand (SP)	9		3		
28–45	Medium dense tan fine to medium sand w/trace coarse sand and a little fine to coarse gravel (SW) - loose at 32 to 38 ft - medium dense below 38 ft	13, 9, 25, 21				

COMPLETION DEPTH: 99.0 ft
DATE: 5-16-23

DEPTH TO WATER IN BORING: 23.5 ft

DATE: 5/16/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-41

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 25 ft /Wash 49 ft /NQ 2 Core   LOCATION: 35.349559°N, -94.280784°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
		21					
49–99	Moderately hard gray fine-grained sandstone w/interbedded very close, very thin dark gray shale partings, horizontal bedding						
50				q_u= 3130 psi, TUW= 163 pcf		83	37
						98	98
55				q_u= 850 psi, TUW= 162 pcf		100	93
60						100	85
65				q_u= 6030 psi, TUW= 163 pcf		98	90
70	- with shale seams at 72 to 86 ft - with more shale seams at 72.3 to 74.3 ft			q_u= 1980 psi, TUW 155 pcf		98	98
75				q_u= 3710 psi, TUW= 161 pcf		98	97
80						100	100
85				q_u= 5130 psi, TUW= 163 pcf		98	98

COMPLETION DEPTH: 99.0 ft
DATE: 5-16-23

DEPTH TO WATER
IN BORING: 23.5 ft

DATE: 5/16/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 10-20-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-41

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 25 ft /Wash 49 ft /NQ 2 Core LOCATION: 35.349559°N, -94.280784°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4 / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT 10 20 30 40 50 60 70	- No. 200 %	% Recovery	% RQD
								100	100
95									
								100	100
100			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by C.S NOTE 3: Logged by DRM.						
105									
110									
115									
120									
125									
130									

COMPLETION DEPTH: 99.0 ft
DATE: 5-16-23

DEPTH TO WATER IN BORING: 23.5 ft

DATE: 5/16/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 10-20-23

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-42

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 25 ft/Wash 25 ft /NQ2 Core-CME-55

LOCATION: 35.349918°N, -94.280588°E

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

SURF. EL: 400.0

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	WATER CONTENT (%)	- No. 200 %	% Recovery	% RQD
0–4	Very loose tan fine to coarse sand w/fine to coarse gravel (SW) (possible fill) - medium dense with less coarse sand below 2 ft	2					
		10		●	1		
4–6	Loose tan silty fine sand (SM)	8					
6–18	Medium dense tan fine sand (SP)	10					
	- loose at 8 to 12 ft	9		●	4		
	- medium dense below 12 ft	13					
18–22	Loose reddish tan fine sandy silt (ML)	9					
22–	Medium dense tan fine to medium sand (SP-SW) w/a little fine to coarse gravel - water at 22.8 ft	10					
		12			2		
	- with grayish brown below 32 ft	19					

COMPLETION DEPTH: 96.0 ft
DATE: 5-20-23

DEPTH TO WATER
IN BORING: 22.8 ft

DATE: 5/20/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-21-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-42

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 25 ft/Wash 25 ft /NQ2 Core-CME-55

LOCATION: 35.349918°N, -94.280588°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
39–40		12					
44–45		29					
46–51	Moderately hard gray fine-grained sandstone w/interbedded, very close, very thin dark gray shale laminations, horizontal bedding			q_u= 3030 psi, TUW= 163 pcf		85	70
51–56						98	98
56–61				q_u= 2160 psi, TUW= 165 pcf		100	100
61–66						92	92
66–70				q_u= 3540 psi, TUW= 163 pcf		100	100

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4. Water content scale: 10, 20, 30, 40, 50, 60, 70.

COMPLETION DEPTH: 96.0 ft
DATE: 5-20-23

DEPTH TO WATER
IN BORING: 22.8 ft

DATE: 5/20/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-42

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 25 ft/Wash 25 ft /NQ2 Core-CME-55

LOCATION: 35.349918°N, -94.280588°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT	- No. 200 %	% Recovery	% RQD
72–75						94	94
75–80	- with shale seams at 76 to 93.4 ft			q_u= 2970 psi, TUW= 168 pcf		100	100
80–85						100	100
85–90						100	100
90–96						100	100
96	NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by C.S. NOTE 3: Logged by DRM.						

COMPLETION DEPTH: 96.0 ft
DATE: 5-20-23

DEPTH TO WATER
IN BORING: 22.8 ft

DATE: 5/20/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-43

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 42 ft /NQ2-Core-CME-55 LOCATION: 35.350273°N, -94.280795°E

SURF. EL: 396.1

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	WATER CONTENT, % (approx.)	- No. 200 %	% Recovery	% RQD
	Very loose tan fine to medium sand w/some coarse sand and fine gravel (SW) (possible fill)	3					
	Very loose brown fine sandy silt, slightly clayey (SM)	2		~23; -NON-PLASTIC-			
5	Loose tan fine sand (SP)	8		~12			
	- medium dense at 6 to 8 ft	10		~12	1		
	- loose at 8 to 12 ft	8					
10							
	- medium dense, slightly silty below 12 ft						
15		11					
	Medium dense brownish tan fine to medium sand w/a little coarse sand and fine gravel (SW)	14					
20							
	- loose at 22 to 27 ft						
25		5					
	- medium dense at 27 to 32 ft						
30		23		~10	3		
	- loose at 32 to 37 ft - with grayish brown and more coarse sand below 32 ft						
35		9					
		14					

COMPLETION DEPTH: 92.0 ft
DATE: 5-21-23

DEPTH TO WATER IN BORING: 18.1 ft

DATE: 5/21/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-43

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 42 ft /NQ2-Core-CME-55

LOCATION: 35.350273°N, -94.280795°E

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / WATER CONTENT	- No. 200 %	% Recovery	% RQD
45			Moderately hard gray fine-grained sandstone w/interbedded very close, very thin shale partings, horizontal bedding			q_u= 2840 psi, TUW= 1644 pcf		82	62
50						q_u= 6600 psi, TUW= 165 pcf		95	95
55								100	100
60			Moderately hard gray shale w/very close sandstone partings, horizontal bedding - high-angle fracture at 59 to 59.3 ft			q_u= 3830 psi, TUW= 160 pcf		98	95
65								98	98
70						q_u= 2780 psi, TUW= 164 pcf		100	95
75			Moderately hard gray fine-grained sandstone w/interbedded very close, very thin shale partings, horizontal bedding					98	100
						q_u= 5520 psi, TUW= 164 pcf		100	98

COMPLETION DEPTH: 92.0 ft
DATE: 5-21-23

DEPTH TO WATER
IN BORING: 18.1 ft

DATE: 5/21/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-43

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 42 ft /NQ2-Core-CME-55

LOCATION: 35.350273°N, -94.280795°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %	% Recovery	% RQD
85								100	100
			- with multiple calcium carbonate veins at 86.1 to 91.8 ft						
90								95	95
95			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by CS. NOTE 3: Logged by DRM.						
100									
105									
110									
115									

COMPLETION DEPTH: 92.0 ft
DATE: 5-21-23

DEPTH TO WATER
IN BORING: 18.1 ft

DATE: 5/21/2023

Form 108-6(74) Job No. 21-071

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Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-44

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 39 ft/NQ 2 Core-CME-55

LOCATION: 35.350632°N, -94.280599°E

SURF. EL: 392.1

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT	- No. 200 %	% Recovery	% RQD
	Loose tan fine sand, slightly silty (SP)	6					
		9		●			
5	- medium dense, w/less silt below 4 ft	10		●	2		
		15					
10		11					
	Medium dense tan fine to coarse sand w/a little fine to coarse gravel (SW)						
15		14		●			
	- loose at 18 to 22 ft - with less coarse sand at 18 to 32 ft						
20		6					
	- medium dense at 22 to 32 ft						
25		19			2		
	- with grayish brown below 28 ft						
30		21					
	- loose below 32 ft						
35		8					
	Moderately hard gray	50/1"					

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4. Plastic Limit – Water Content – Liquid Limit scale: 10, 20, 30, 40, 50, 60, 70.

COMPLETION DEPTH: 89.0 ft
DATE: 5-23-23

DEPTH TO WATER IN BORING: 16.5 ft

DATE: 5/22/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-21-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-44

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 39 ft/NQ 2 Core-CME-55

LOCATION: 35.350632°N, -94.280599°E

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	Test results	% Recovery	% RQD
41–46	fine-grained sandstone w/interbedded very close, very thin dark gray shale partings, horizontal bedding; - clayey shale partings at 44.5 ft	q_u= 5740 psi, TUW= 161 pcf; q_u= 5230 psi, TUW= 159 pcf	100	100
46–51		q_u= 3840 psi, TUW= 164 pcf	100	100
51–56			100	100
56–61	- with some sandstone seams below 56 ft		98	98
61–66		q_u= 4590 psi, TUW= 165 pcf	98	98
66–71			95	95
71–76	- hydro carbons producing bubbles at 74 ft ±, bubbles lasted 5 minutes.	q_u= 4250 psi, TUW= 162 pcf	100	100
76–80		q_u= 4420 psi, TUW= 162 pcf	100	100

COMPLETION DEPTH: 89.0 ft
DATE: 5-23-23

DEPTH TO WATER IN BORING: 16.5 ft

DATE: 5/22/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-44

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 39 ft/NQ 2 Core-CME-55

LOCATION: 35.350632°N, -94.280599°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
								100	100
85								100	100
90			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by C.S. NOTE 3: Logged by DRM/JDF.						
95									
100									
105									
110									
115									

COMPLETION DEPTH: 89.0 ft
DATE: 5-23-23

DEPTH TO WATER
IN BORING: 16.5 ft

DATE: 5/22/2023

Form 108-6(74) Job No. 21-071

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Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-45

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 39 ft /NQ2 Core-CME55

LOCATION: 35.350987°N, -94.280806°E

SURF. EL: 393.5

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0	Very loose tan fine sand, slightly silty (SM-SP)	3		11		
2	- loose below 2 ft	7				
5		7				
6	Loose tan silty fine sand (SM)	8		33		
8	Medium dense tan fine sand, slightly silty (SM-SP)	21				
12	- with less silt below 12 ft					
13.8	- water at 13.8 ft	15				
19	- very loose below 19 ft	4				
22	Loose tan and gray fine to medium sand w/some coarse sand and fine gravel (SP)	9		2		
27	- medium dense below 27 ft	14				
34		21				

COMPLETION DEPTH: 90.0 ft
DATE: 5-22-23

DEPTH TO WATER IN BORING: 13.8 ft

DATE: 5/22/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-22-23

Form 108-6(74) Job No. 21-071

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Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-45

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 39 ft /NQ2 Core-CME55

LOCATION: 35.350987°N, -94.280806°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
40			Low hardness gray fine-grained weathered sandstone w/interbedded very close, very thin shale partings, horizontal bedding - with clayey shale layer at 43.5 ft	50/2"				65	0
45			Moderately hard dark gray shale w/various plant fossils and occasional sandstone partings, horizontal bedding			q_u= 1820 psi, TUW= 163 pcf		82	62
50								100	100
55						q_u= 2540 psi, TUW= 159		100	100
60			Moderately hard gray fine-grained sandstone w/interbedded very close, very thin shale partings, horizontal bedding			q_u= 6250 psi, TUW= 164 pcf		100	100
65								98	98

COMPLETION DEPTH: 90.0 ft
DATE: 5-22-23

DEPTH TO WATER
IN BORING: 13.8 ft

DATE: 5/22/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-22-23

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Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-45

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 39 ft /NQ2 Core-CME55

LOCATION: 35.350987°N, -94.280806°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %	% Recovery	% RQD
						q_u= 5150 psi, TUW= 159 pcf			
								100	100
75			- with rehealed near-vertical fractures at 73.5 to 73.8 ft						
								100	100
80						q_u= 7490 psi, TUW= 158 pcf			
								100	100
85									
								100	100
90			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by CS. NOTE 3: Logged by DRM.						
95									
100									

COMPLETION DEPTH: 90.0 ft
DATE: 5-22-23

DEPTH TO WATER
IN BORING: 13.8 ft

DATE: 5/22/2023

21-071

Form 108-6(74) Job No. 21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-46

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 43 ft /NQ2 Core-CME-55

LOCATION: 35.351344° N, -94.280601°E

SURF. EL: 393.4

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Very loose reddish tan silty fine sand (SM)	3				
		3		47		
	- loose below 4 ft					
5		6				
		8				
		7				
10						
	Medium dense tan fine sand (SP)	18				
15						
	- water at 16.7 ft					
		8				
20						
	Loose tan fine to coarse sand w/trace fine gravel (SP)					
		9		4		
25						
		9				
30						
	- with fine to coarse gravel below 33 ft	11				

COMPLETION DEPTH: 94.0 ft
DATE: 5-23-23

DEPTH TO WATER IN BORING: 16.7 ft

DATE: 5/23/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-22-23

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-46

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 43 ft /NQ2 Core-CME-55

LOCATION: 35.351344° N, -94.280601°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
40		10					
42–43	Dense dark gray weathered shale	50/3"					
43–50	Low to moderately hard dark gray shale w/interbedded very close, very thin gray fine-grained sandstone partings, horizontal bedding			q_u= 7340 psi, TUW= 162 pcf		92	92
50–51	- with some clayey shale partings below 50 ft						
51–55	Moderately hard dark gray shale w/occasional gray fine-grained sandstone partings, horizontal bedding			q_u= 860 psi, TUW= 151 pcf		100	60
55–60				q_u= 3040 psi, TUW= 162 pcf		100	58
60–65	Moderately hard dark gray shale w/interbedded very close, very thin gray fine-grained sandstone partings, horizontal bedding					98	98
65–70				q_u= 4080 psi, TUW= 167 pcf		100	100

COMPLETION DEPTH: 94.0 ft
DATE: 5-23-23

DEPTH TO WATER
IN BORING: 16.7 ft

DATE: 5/23/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-22-23

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-46

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 43 ft /NQ2 Core-CME-55

LOCATION: 35.351344° N, -94.280601°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
70–75						100	100
75–80				q_u= 6210 psi, TUW= 164 pcf		100	100
80–85						100	100
85–90	Moderately hard gray fine-grained sandstone w/some dark gray shale laminations, horizontal bedding			q_u= 2810 psi, TUW= 153 pcf		100	100
90–94						95	95

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by DT.
NOTE 3: Logged by IJM.

COHESION, TON/SQ FT scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4; PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT scale: 10, 20, 30, 40, 50, 60, 70

Depth markers: 75, 80, 85, 90, 95, 100

COMPLETION DEPTH: 94.0 ft
DATE: 5-23-23

DEPTH TO WATER
IN BORING: 16.7 ft

DATE: 5/23/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-48

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 HSA ft /15 ft /Wash

LOCATION: 35.352061°N, -94.280613°E

SURF. EL: 390.2

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	WATER CONTENT (plotted)	- No. 200 %	% Recovery	% RQD
0–2	Very loose reddish brown fine sandy silt, slightly clayey (ML)	3		●	84		
2–7	Loose reddish fine sandy silt (ML)	5		●			
		5					
7–12	Loose tan fine sand (SP)	7					
		9		●			
12–22	Loose tan fine to medium sand w/occasional fine gravel (SP) - water at 12.6 ft	6					
		7					
22–38	Medium dense tan fine to coarse sand w/some fine to coarse gravel	11		●			
		15					
		11					
38–39	Low hardness dark gray shale	50/3"					

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by DT.
NOTE 3: Logged by IJM.

COMPLETION DEPTH: 39.0 ft
DATE: 5-24-23

DEPTH TO WATER IN BORING: 12.6 ft

DATE: 5/24/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 8-28-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-50

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 15 ft /Wash

LOCATION: 35.352775°N, -94.280624°E

SURF. EL: 390.4

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT	- No. 200 %	% Recovery	% RQD
0–1.5	Very soft reddish fine sandy silt (ML)	3		-NON-PLASTIC-			
1.5–23	Loose reddish tan and tan silty fine sand (SM)	5					
5	- with occasional clayey silt seams below 4 ft	8					
	- dense brown below 6 ft	7		G_s=2.66			
10	- medium dense from 9 to 10 ft	16					
15		5					
20		11					
23–38	Medium dense tan fine to coarse sand w/some fine to coarse gravel (SW)	11					
30		15			3		
35		15					
38–39	Moderately hard dark gray shale	50/6"					

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by DT.
NOTE 3: Logged by IJM.

COMPLETION DEPTH: 39.0 ft
DATE: 5-24-23

DEPTH TO WATER IN BORING: 12 ft

DATE: 5/24/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-15-23

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-53

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash

LOCATION: 35.353843°N, -94.280863°E

SURF. EL: 391.7

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Loose dark brown and tan fine sand (SP)	6				
	- with organics from 2 to 3 ft	4				
5		7		3		
	- medium dense below 6.5 ft	10				
10		13				
	Loose tan fine to medium sand (SP)	9				
15						
20		11				
25		22		3		
	Loose tan and gray fine to coarse sand w/fine to coarse gravel (SW)	8				
30						
		15				

G_s=2.7

COMPLETION DEPTH: 40.0 ft
DATE: 5-25-23

DEPTH TO WATER IN BORING: 15.8 ft

DATE: 5/25/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-15-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-53

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash

LOCATION: 35.353843°N, -94.280863°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
			- with more gravel below 38 ft						
40			Moderately hard dark gray shale	50/2"					
			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by DT. NOTE 3: Logged by IJM.						
45									
50									
55									
60									
65									

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
Water content scale: 10, 20, 30, 40, 50, 60, 70

COMPLETION DEPTH: 40.0 ft
DATE: 5-25-23

DEPTH TO WATER
IN BORING: 15.8 ft

DATE: 5/25/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-57

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 25 ft /Wash

LOCATION: 35.355272°N, -94.280886°E

SURF. EL: 398.3

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Very loose reddish tan fine sandy silt (ML)	2		67		
	3				
Loose reddish tan silty fine sand (SM) - loose with more sand below 4.5 ft	5				
	4		39		
	7				
Very loose to loose tan silty fine sand (SM)	4				
- medium dense below 19 ft	11				
Medium dense gray and tan fine sand, slightly silty (SP)	27				
	15				
	18				
Moderately hard tan and gray fine to coarse sand (SW) w/occasional fine to coarse gravel	14				
	11				
Moderately hard dark gray shale	50/6"				

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by DT.
NOTE 3: Logged by IJM.

COMPLETION DEPTH: 49.0 ft
DATE: 5-25-23

DEPTH TO WATER
IN BORING: 21.1 ft

DATE: 5/25/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 8-28-23

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-60

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 25 ft /Wash

LOCATION: 35.356346°E, -94.280681°E

SURF. EL: 398.4

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
	Very loose reddish brown fine sandy silt (ML)	2		-NON-PLASTIC-			
		2					
5		4					
	- loose below 6.5 ft	5					
	Loose brown and tan fine sand (SP)	9					
10							
15		9			2		
20		10					
	- water at 22 ft						
25		22					
	Medium dense tan fine to coarse sand w/some fine to coarse gravel (SP)	14					
30							
35	- loose from 34 to 35 ft	8					
		12					

COMPLETION DEPTH: 49.0 ft
DATE: 5-25-23

DEPTH TO WATER IN BORING: 22 ft

DATE: 5/25/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 8-28-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-60

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 25 ft /Wash

LOCATION: 35.356346°E, -94.280681°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
45		X		18					
		X	Moderately hard dark gray shale						
50			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by DT. NOTE 3: Logged by IJM.						
55									
60									
65									
70									
75									

COMPLETION DEPTH: 49.0 ft
DATE: 5-25-23

DEPTH TO WATER
IN BORING: 22 ft

DATE: 5/25/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 8-28-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-63

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 25 ft /Wash — LOCATION: 35.357415°N, -94.280919°E

SURF. EL: 395.2

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	WATER CONTENT / PLASTIC LIMIT / LIQUID LIMIT	- No. 200 %
0–4	Very loose reddish brown fine sandy silt (ML)	2 3		-NON-PLASTIC-	
4–8.5	Loose silty fine sand (SP)	7 7			
8.5–10	Very loose reddish brown silt (ML)	5			97
10–17	Medium dense tan fine sand (SP)	17			
17–27	Loose brown silty fine sand (SM) - water at 20.5 ft	9 16			
27–33	Medium dense tan and gray fine sand (SP)	17			
33–44	Medium dense tan and gray fine to coarse sand (SW)	11 13			
44–47	Low hardness dark gray shale	39 50/5"			

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by DT.
NOTE 3: Logged by IJM.

COMPLETION DEPTH: 47.0 ft
DATE: 5-26-23

DEPTH TO WATER IN BORING: 20.5 ft

DATE: 5/26/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-65

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 42 ft/NQ2 Core-CME-55

LOCATION: 35.358129°N, -94.280931°E

SURF. EL: 391.1

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
0–2	Very loose brown silt, slightly clayey (ML)	33					
2–18	Very loose tan silty fine sand (SM)	3					
5		3			39		
	- with silt seams below 6 ft	3					
10		3		G_s=2.7			
15		3					
	- water at 17.6 ft						
18–32	Medium dense tan and gray fine sand, slightly silty (SM-SP)	12					
20	- gray below 22 ft - with occasional decayed organics at 22 to 26 ft						
25		12			6		
30		25					
32–	Medium dense grayish tan fine to coarse sand w/a little fine to coarse gravel (SW)	10					

COMPLETION DEPTH: 92.0 ft
DATE: 5-31-23

DEPTH TO WATER IN BORING: 17.6 ft

DATE: 5/31/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-65

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 42 ft/NQ2 Core-CME-55

LOCATION: 35.358129°N, -94.280931°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 – 1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 – 70)	- No. 200 %	% Recovery	% RQD
40				19					
			Moderately hard dark gray shale, slightly weathered w/some fractures, horizontal bedding	50/2"					
								100	83
45						q_u= 1460 psi, TUW= 163 pcf			
								100	83
50			- high-angle fracture at 50.5 to 51.5 ft			q_u= 1000 psi, TUW= 163 pcf			
								95	78
55			- with multiple fractures from 55 to 60 ft						
								100	48
						q_u= 1500 psi, TUW= 154 pcf			
60			- with coal bed at 61 to 62.7 ft						
								97	55
65									
			Moderately hard gray fine-grained sandstone w/interbedded very close, very thin shale partings, horizontal bedding			q_u= 4310 psi, TUW= 166 pcf		100	88

COMPLETION DEPTH: 92.0 ft
DATE: 5-31-23

DEPTH TO WATER
IN BORING: 17.6 ft

DATE: 5/31/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-65

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 in. HSA 20 ft /Wash 42 ft/NQ2 Core-CME-55

LOCATION: 35.358129°N, -94.280931°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
						100	100
75				q_u= 5130 psi, TUW= 166 pcf		100	100
80				q_u= 3740 psi, TUW= 162 pcf		100	100
85	Moderately hard gray shale w/occasional sandstone partings					100	100
90						100	75
95	NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by DT. NOTE 3: Logged by DRM.						
100							

COMPLETION DEPTH: 92.0 ft
DATE: 5-31-23

DEPTH TO WATER
IN BORING: 17.6 ft

DATE: 5/31/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-66

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 20 ft /NQ 2 Core-CME-55
LOCATION: 35.358489°N, -94.280716°E

SURF. EL: 388.9

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Soft reddish brown silty clay (CL)	6				
	Loose reddish brown silt (ML)	6				
5	Soft reddish brown silty clay (CL) w/some silt seams		89	99		
	Loose reddish tan fine sandy silt w/occasional clay seams (ML)	7		64		
10		10				
	Loose brown tan fine sandy silt (ML)					
15		8		71		
20	- medium dense below 19 ft	10				
25		12				
30	Medium dense tan fine to coarse sand w/some fine to coarse gravel (SP)	15		4		
35		22				
	Moderately hard dark gray shale, horizontal bedding	50/1"				

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

COMPLETION DEPTH: 90.0 ft
DATE: 4-6-23

DEPTH TO WATER IN BORING: 14.2 ft

DATE: 4/5/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 8-17-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-66

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 20 ft /NQ 2 Core-CME-55

LOCATION: 35.358489°N, -94.280716°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
40–45	- with occasional gray fine-grained sandstone partings below 40 ft			q_u= 1760 psi, TUW= 159 pcf		75	47
45–50				q_u= 2330 psi, TUW= 160 pcf		100	90
50–55	- with some fractures and 100% water loss 52 ft			q_u= 1290 psi, TUW= 164 pcf		98	42
55–60				q_u= 1300 psi, TUW= 160 pcf		95	87
61–66	Low hardness black coal					67	0
66–70	Moderately hard gray fine-grained sandstone w/interbedded very close, very thin dark gray shale partings, horizontal bedding			q_u= 1590 psi, TUW= 172 pcf		100	100
70–75				q_u= 6080 psi, TUW= 165 pcf		100	100
75–80						98	98

COMPLETION DEPTH: 90.0 ft
DATE: 4-6-23

DEPTH TO WATER IN BORING: 14.2 ft

DATE: 4/5/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 8-17-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-66

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 20 ft /NQ 2 Core-CME-55

LOCATION: 35.358489°N, -94.280716°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %	% Recovery	% RQD
								100	100
85								100	100
90			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by JSW. NOTE 3: Logged by DRM.						
95									
100									
105									
110									
115									

COMPLETION DEPTH: 90.0 ft
DATE: 4-6-23

DEPTH TO WATER
IN BORING: 14.2 ft

DATE: 4/5/2023

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-67

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 45 ft /NQ 2 Core-CME-55

LOCATION: 35.358844°N, -94.280940°E

SURF. EL: 390.8

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
0	Very loose to loose reddish tan fine sandy silt w/silty clay seams (ML)	4						
	- loose below 2 ft	7						
5	- with more fine sand below 4 ft	6						
6	Medium dense tan silty fine sand (SM)	12						
	- loose below 8 ft	8						
12	Loose reddish tan fine sandy silt (ML)	7						
		5						
19.5	Loose tan silty fine sand (SML) w/some silt seams							
	- very loose below 24 ft	2						
	- medium dense below 29 ft	11						
32	Medium dense tan fine to medium sand w/fine to coarse gravel (SW)	25						

COMPLETION DEPTH: 95.0 ft
DATE: 4-8-23

DEPTH TO WATER
IN BORING: 13.5 ft

DATE: 4/7/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-29-23

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-67

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 45 ft /NQ 2 Core-CME-55 LOCATION: 35.358844°N, -94.280940°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4) / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
			- with coarse sand below 38 ft	26					
40									
			Moderately hard dark gray shale, horizontal bedding	50/1"					
45								73	73
50			- with numerous fractures and occasional highly weathered seams and layers at 50 to 55 ft			q_u= 1220 psi, TUW= 161 pcf		100	53
55						q_u= 1150 psi, TUW= 160 pcf		100	82
60			- with highly weathered layer at 58.8 to 59 ft					100	92
65						q_u= 1800 psi, TUW= 164 pcf			
			Low hardness black coal					100	40
			Moderately hard dark gray shale, horizontal bedding						

COMPLETION DEPTH: 95.0 ft
DATE: 4-8-23

DEPTH TO WATER
IN BORING: 13.5 ft

DATE: 4/7/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-29-23

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-67

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 45 ft /NQ 2 Core-CME-55

LOCATION: 35.358844°N, -94.280940°E

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / WATER CONTENT	- No. 200 %	% Recovery	% RQD
71–95			Moderately hard gray fine-grained sandstone w/interbedded very close, very thin dark gray shale partings, horizontal bedding					100	100
75–80						q_u= 4290 psi, TUW= 164 pcf		100	100
80–85								98	98
85–90						q_u= 5030 psi, TUW= 166 pcf		100	100
90–95								100	100
95			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by JSW. NOTE 3: Logged by DRM.						

COMPLETION DEPTH: 95.0 ft
DATE: 4-8-23

DEPTH TO WATER IN BORING: 13.5 ft

DATE: 4/7/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-29-23

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-69

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 40 ft /NQ2 Core-CME-55 LOCATION: 35.961375°N, -94.280958°E

SURF. EL: 389.7

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Very loose brown clayey silt, slightly sandy (ML-CL)	4				
	Very loose tan silty fine sand (SM)					
5	Loose dark brown silt, slightly clayey w/clay pockets (ML)	5				
	Loose reddish brown silty fine sand (SM) -NON-PLASTIC-			46 45		
10	- medium dense below 9 ft	10				
15	- dark brown below 14 ft	24				
	Loose dark gray fine to medium sand (SP)					
20		5				
	Loose dark gray fine to medium sand (SP)					
25		6				
30		8				
	Medium dense tan and gray fine to coarse sand w/some fine to coarse gravel (SP)	13				

COMPLETION DEPTH: 90.0 ft
DATE: 3-23-23

DEPTH TO WATER IN BORING: 7.7 ft

DATE: 3/23/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-69

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 40 ft /NQ2 Core-CME-55

LOCATION: 35.961375°N, -94.280958°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
40			Moderately hard dark gray shale, horizontal bedding	50/3"				37	0
						q_u= 2320 psi, TUW= 158 pcf		86	81
45						q_u= 4370 psi, TUW= 174 pcf		100	87
50			- with near vertical fracture at 48 to 48.2 ft - clayey shale seams at 49 to 49.1 ft					93	90
55			- with clayey shale seams at 54 to 54.1 ft and 72.9 to 73.5 ft - with multiple fractures from 55 to 60 ft and 65 to 70 ft					95	7
60						q_u= 1350, TUW= 161 pcf		93	77
65								100	67

COMPLETION DEPTH: 90.0 ft
DATE: 3-23-23

DEPTH TO WATER
IN BORING: 7.7 ft

DATE: 3/23/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-69

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 40 ft /NQ2 Core-CME-55

LOCATION: 35.961375°N, -94.280958°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	Remarks	% Recovery	% RQD
70–75	- coal bed at 71.5 to 72.7 ft	q_u= 2770 psi, TUW= 164 pcf; q_u= 1130 psi, TUW= 164 pcf	100	100
75–80	Moderately hard dark gray shale w/interbedded gray fine-grained sandstone partings, horizontal bedding	q_u= 4220 psi, TUW= 166 pcf	100	100
80–85	Moderately hard gray fine-grained sandstone w/interbedded, very close, very thin dark gray shale partings, horizontal bedding	q_u= 2110 psi, TUW= 163 pcf; q_u= 6880 psi, TUW= 167 pcf	100	100
85–90			100	100

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by JSW.
NOTE 3: Logged by DRM.

Column headings: BLOWS PER FT; UNIT DRY WT LB/CU FT; COHESION, TON/SQ FT (0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10, 20, 30, 40, 50, 60, 70); - No. 200 %; % Recovery; % RQD

COMPLETION DEPTH: 90.0 ft
DATE: 3-23-23

DEPTH TO WATER IN BORING: 7.7 ft

DATE: 3/23/2023

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-70

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 40 ft /NQ 2 Core-CME-55

LOCATION: 35.359807°N, -94.280741°E

SURF. EL: 386.9

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
0–13	Very loose reddish tan silty fine sand (SM)	5					
	- medium dense, brown with occasional silt seams at 2 to 6 ft	12					
5	- tan below 4.5 ft	13					
		9					
10		6					
13–18	Loose brown brown fine sandy silt (ML)	6					
18–32	Loose tan silty fine sand (SM)	9					
	- medium dense below 22 ft						
25		16					
30		11					
32–	Medium dense tan and brown fine to coarse sand w/a little fine to coarse gravel (SM)	11					

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4 — Water content scale: 10, 20, 30, 40, 50, 60, 70

COMPLETION DEPTH: 90.0 ft
DATE: 4-11-23

DEPTH TO WATER IN BORING: 13.1 ft

DATE: 4/10/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-29-23

Form 108-6(74) Job No. 21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-70

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 40 ft /NQ 2 Core-CME-55

LOCATION: 35.359807°N, -94.280741°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
			Moderately hard dark gray shale, horizontal bedding						
40			- with highly weathered layer at 40 to 40.2 ft			q_u= 2470 psi, TUW= 161 pcf			
						q_u= 1060 psi, TUW= 161 pcf		80	30
45								100	52
50						q_u= 1180 psi, TUW= 164 pcf		98	80
55						q_u= 3300 psi, TUW= 161 pcf		100	52
60								98	98
65								92	40

COMPLETION DEPTH: 90.0 ft
DATE: 4-11-23

DEPTH TO WATER IN BORING: 13.1 ft

DATE: 4/10/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-29-23

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-70

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 40 ft /NQ 2 Core-CME-55

LOCATION: 35.359807°N, -94.280741°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
70–75			- with coal bed at 69.6 to 71.3 ft - with multiple clayey shale seams below 70 ft			q_u= 1070 psi, TUW= 164 pcf		100	33
75–80			Moderately hard gray fine-grained sandstone w/interbedded very close, very thin dark gray shale partings, horizontal bedding					100	100
80–85						q_u= 2460 psi, TUW= 165 pcf		100	100
85–90								100	100
90			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by EB. NOTE 3: Logged by DRM.						

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
Water content scale: 10, 20, 30, 40, 50, 60, 70

Depth scale: 75, 80, 85, 90, 95, 100

COMPLETION DEPTH: 90.0 ft
DATE: 4-11-23

DEPTH TO WATER IN BORING: 13.1 ft

DATE: 4/10/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-71

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 10 ft /Wash 40 ft /NQ 2-Core-CME-55

LOCATION: 35.360162°N, 94.280965°E

SURF. EL: 387.2

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	Atterberg / remarks	- No. 200 %	% Recovery	% RQD
	Very loose reddish tan silty fine sand (SM)	4					
	- loose with silt seams and layers below 2 ft	5			21		
5	Very loose to loose reddish brown clayey silt (CL-ML), moist w/occasional decayed organics	4					
	- loose below 6 ft	6		-NON-PLASTIC-			
10	Very loose reddish tan fine to coarse sand (SP) w/some fine gravel	4		-NON-PLASTIC- G_s= 2.68			
15		4					
20	- medium dense below 19 ft	12					
25		11			4		
30	Medium dense reddish tan fine to medium sand (SP)	15					
35	Medium dense tan fine to coarse sand w/some fine gravel (SW)	14					
	Moderately hard dark gray shale, slightly weathered	50/2"					

COMPLETION DEPTH: 90.0 ft
DATE: 4-4-23

DEPTH TO WATER
IN BORING: 8.3 ft

DATE: 3/28/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-71

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 10 ft /Wash 40 ft /NQ 2-Core-CME-55

LOCATION: 35.360162°N, 94.280965°E

DESCRIPTION OF MATERIAL (continued)

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
	Moderately hard dark gray shale w/occasional gray fine-grained sandstone partings, horizontal bedding			q_u= 2200 psi, TUW= 162 pcf; q_u= 2420 psi, TUW= 161 pcf		82	82
45				q_u= 441 psi, TUW= 163 pcf		100	100
50				q_u= 1840 psi, TUW= 168 pcf		93	93
55				q_u= 2260 psi, TUW= 164 pcf		100	96
60						100	98
65	- with more sandstone partings and small inclusions at 68.5 to 69.4 ft					98	98
70	- with coal bed at 72.5 to 74.2 ft					98	45
75				q_u= 1730 psi, TUW= 161 pcf			
	Moderately hard gray fine-grained sandstone w/interbedded very close, very thin dark gray shale partings,			q_u= 3730 psi, TUW= 169 pcf		100	100

COMPLETION DEPTH: 90.0 ft
DATE: 4-4-23

DEPTH TO WATER IN BORING: 8.3 ft

DATE: 3/28/2023

Form 108-6(74) Job No. 21-071

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Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-71

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 10 ft /Wash 40 ft /NQ 2-Core-CME-55 LOCATION: 35.360162°N, 94.280965°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
			horizontal bedding					100	100
85								98	98
90			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by JSW. NOTE 3: Logged by DRM.						
95									
100									
105									
110									
115									

COMPLETION DEPTH: 90.0 ft
DATE: 4-4-23

DEPTH TO WATER
IN BORING: 8.3 ft

DATE: 3/28/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-29-23

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-72

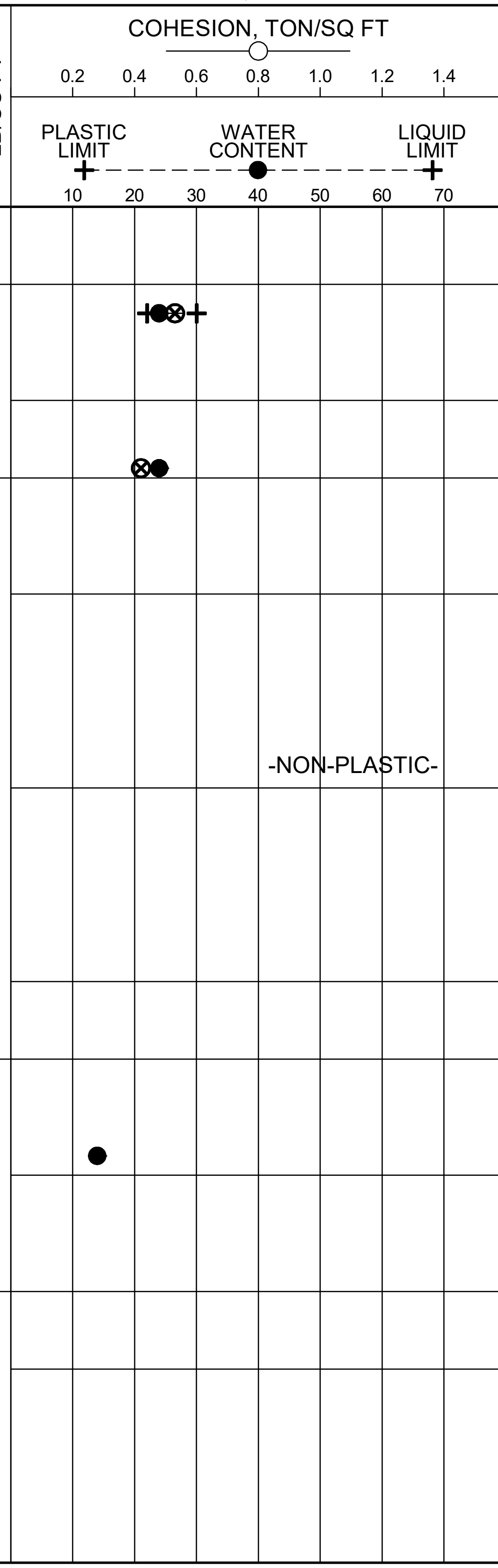
040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 45 ft /NQ 2 Core-CME-55

LOCATION: 35.360440°N, -94.280723°E

SURF. EL: 393.9

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0–2	Loose reddish brown silt w/trace clay (ML)	6				
2–7	Soft reddish brown silty clay (CL)		89			
		6				
7–22	Medium dense reddish tan fine sandy silt (ML)	10				
		6				
	- brown with less sand below 18 ft	4				
22–28	Medium dense brown fine to coarse sand w/some fine to coarse gravel (SW)	14		4		
28–	Loose brown fine sandy silt (ML)	6				



COMPLETION DEPTH: 95.0 ft
DATE: 3-26-23

DEPTH TO WATER IN BORING: 13.9 ft

DATE: 3/26/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 8-23-23

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-72

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 45 ft /NQ 2 Core-CME-55

LOCATION: 35.360440°N, -94.280723°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
40							
42	Moderately hard dark gray shale, horizontal bedding						
45–50				q_u= 540 psi, TUW= 161 pcf		75	75
50–55						97	92
55–60				q_u= 1080 psi, TUW= 160 pcf		97	92
60–65				q_u= 2210 psi, TUW= 160 pcf		100	100
65–70						100	100

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4; Water content scale: 10, 20, 30, 40, 50, 60, 70

COMPLETION DEPTH: 95.0 ft
DATE: 3-26-23

DEPTH TO WATER
IN BORING: 13.9 ft

DATE: 3/26/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 8-23-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-72

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 45 ft /NQ 2 Core-CME-55

LOCATION: 35.360440°N, -94.280723°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
70–75						97	88
75–80	- with coal bed at 78.2 to 80 ft			q_u= 1050 psi, TUW= 165 pcf		88	60
80–85						97	97
85–90	Moderately hard gray fine-grained sandstone w/interbedded very close, very thin shale partings, horizontal bedding			q_u= 4690 psi, TUW= 167 pcf		97	97
90–95				q_u= 4310 psi, TUW= 159 pcf		98	98

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by JSW.
NOTE 3: Logged by DRM.

COMPLETION DEPTH: 95.0 ft
DATE: 3-26-23

DEPTH TO WATER
IN BORING: 13.9 ft

DATE: 3/26/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 8-23-23

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-73

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 15 ft /Wash 45 ft /NQ2 Core-CME-55

LOCATION: 35.360711°N, -94.280999°E

SURF. EL: 392.7

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT + — WATER CONTENT ● — LIQUID LIMIT +: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	Chart notes	- No. 200 %	% Recovery	% RQD
0	Soft brown clayey silt (ML)						
2	Soft brown clay (CH) w/some silt pockets	7	79				
5	- very soft below 4.5 ft	3					
6.5			100				
9	- firm to stiff below 9 ft	11					
9.5	Medium dense reddish brown silt (ML)						
14	- loose below 14 ft	6		-NON-PLASTIC-			
18.5	- very loose below 18.5 ft - slightly clayey below 19 ft	3		G_s= 2.56	98		
23	Medium dense tan silty fine sand (SM)	21					
29	- very loose below 29 ft	4					
34		5					
37	Medium dense tan fine to coarse sand w/some fine to coarse gravel (SP)	13					
42.5	Moderately hard dark gray shale, slightly weathered	50/1"					

COMPLETION DEPTH: 95.0 ft
DATE: 3-21-23

DEPTH TO WATER
IN BORING: 14 ft

DATE: 3/20/2023

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-73

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 15 ft /Wash 45 ft /NQ2 Core-CME-55

LOCATION: 35.360711°N, -94.280999°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
45–50	Moderately hard dark gray shale w/occasional gray fine-grained sandstone partings, horizontal bedding			q_u= 1140 psi, TUW= 167 pcf		88	77
50–55				q_u= 3590 psi, TUW= 160 pcf		100	83
55–60				q_u= 1960 psi, TUW= 164 pcf		100	100
60–65	- with occasional clayey shale partings below 60 ft			q_u= 620 psi, TUW= 159 pcf		97	93
65–70						100	93
70–75				q_u= 1550 psi, TUW= 163 pcf		100	100
75–80						100	95
76–78	Moderately hard black coal						
78–85	Hard dark gray shale w/occasional gray fine-grained sandstone partings, horizontal bedding - with occasional pyrite inclusions below 80 ft					100	100
85–90	Moderately hard dark gray shale w/interbedded very close, very thin gray fine-grained sandstone partings, horizontal bedding					100	100

COMPLETION DEPTH: 95.0 ft
DATE: 3-21-23

DEPTH TO WATER IN BORING: 14 ft

DATE: 3/20/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-22-23

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-73

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 15 ft /Wash 45 ft /NQ2 Core-CME-55

LOCATION: 35.360711°N, -94.280999°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
								90	90
95			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by JSW. NOTE 3: Logged by IJM.						
100									
105									
110									
115									
120									
125									
130									

COMPLETION DEPTH: 95.0 ft
DATE: 3-21-23

DEPTH TO WATER
IN BORING: 14 ft

DATE: 3/20/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-74

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 45 ft /NQ 2-CORE-CME-55 LOCATION: 35.361023°N, -94280739°E

SURF. EL: 392.9

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0–4	Soft reddish brown silty clay w/rootlets (CL)	5		89 90 91		
4–28	Medium dense reddish brown and reddish tan fine sandy silt (ML) - loose at 6 to 8 ft - very loose at 8 to 22 ft - water at 13 ft - loose, dark brown below 22 ft	11 7 4 4 2 7				
28–32	Very loose brown fine sand (SM-SP), slightly silty	3		6		
32–37	Very loose brown and tan fine to medium sand, slightly silty (SP)	2				
37–40	Dense tan and brown fine to coarse sand w/some fine to coarse gravel (SM)	32				

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

-NONPLASTIC-

COMPLETION DEPTH: 95.0 ft
DATE: 3-27-23

DEPTH TO WATER IN BORING: 13 ft

DATE: 3/27/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-10-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-74

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 45 ft /NQ 2-CORE-CME-55 LOCATION: 35.361023°N, -94280739°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
	Moderately hard dark gray shale, horizontal bedding	50/3"					
45	- with occasional gray sandstone partings below 45 ft - with more fractures from 45 to 50 ft					60	22
50				q_u= 1800 psi, TUW= 158 pcf		90	70
55	- with near vertical fractures at 55.8 to 56.1 ft					100	83
60				q_u= 1270 psi, TUW= 161 pcf		100	100
65				q_u= 960 psi, TUW= 158 pcf		98	98
70						98	98
75	- with some sandstone partings below 75 ft - with coal bed at 78 to 80 ft					83	60

COMPLETION DEPTH: 95.0 ft
DATE: 3-27-23

DEPTH TO WATER
IN BORING: 13 ft

DATE: 3/27/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-10-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-74

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 45 ft /NQ 2-CORE-CME-55

LOCATION: 35.361023°N, -94280739°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
						q_u= 2750 psi, TUW= 167 pcf		100	60
85			Moderately hard gray fine-grained sandstone w/interbedded very close, very thin dark gray shale partings, horizontal bedding					98	98
90								100	100
95			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by JSW. NOTE 3: Logged by DRM.						
100									
105									
110									
115									

COMPLETION DEPTH: 95.0 ft
DATE: 3-27-23

DEPTH TO WATER
IN BORING: 13 ft

DATE: 3/27/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-75

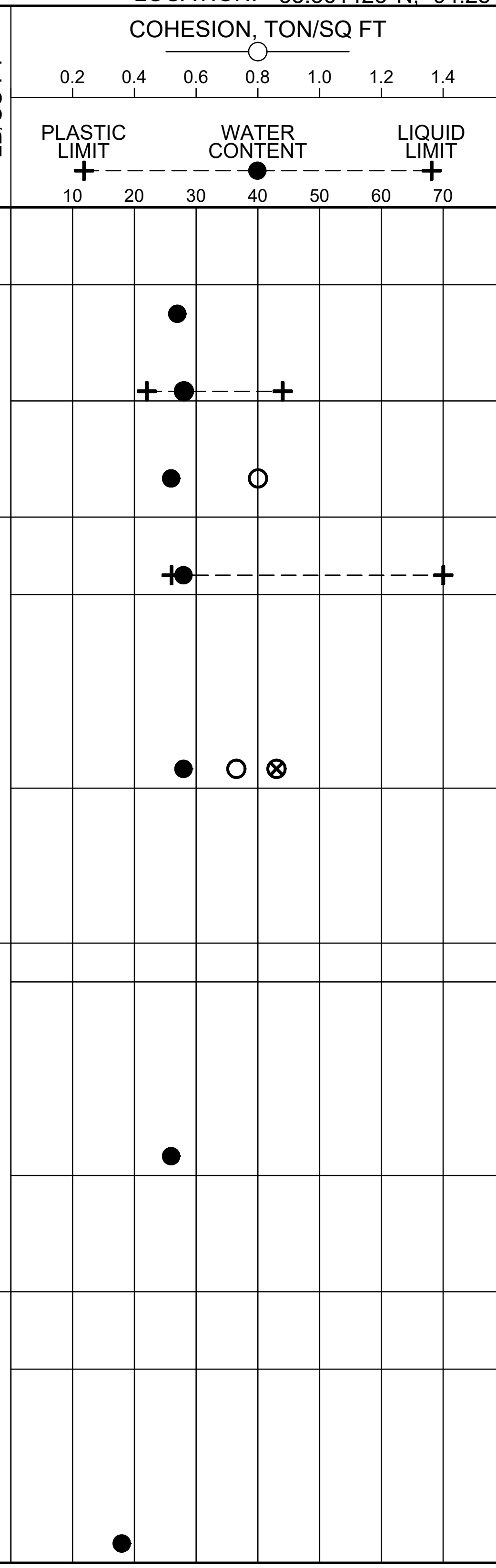
040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in HSA 25 ft /Wash 46 ft /NQ Core-CME-55

LOCATION: 35.361425°N, -94.281011°E

SURF. EL: 392.1

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0–2	Firm reddish brown silty clay(CL) w/rootlets and decayed organics	7				
2–8	Soft reddish brown silty clay (CL)	6				
5			96	99		
	- with silt pockets and partings below 6 ft	5				
8–19	Stiff brown and gray clay (CH), blocky w/ferrous stains	11	81			
15			90			
19–28	Very loose to loose reddish tan fine sand, slightly silty (SP-SM)	4				
	- loose below 22 ft - water at 22.5 ft					
25		9		6		
28–	Medium dense tan fine to medium sand (SP)	18				
		16		2		



COMPLETION DEPTH: 96.0 ft
DATE: 3-14-23

DEPTH TO WATER IN BORING: 22.5 ft

DATE: 3/14/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-75

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in HSA 25 ft /Wash 46 ft /NQ Core-CME-55

LOCATION: 35.361425°N, -94.281011°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
40		17					
45		50/8"					
45	Moderately hard dark gray shale, slightly weathered w/occasional very thin gray fine-grained sandstone partings and ferrous stains, horizontal bedding	25/0"					
46–51						95	82
51–56				q_u= 1420 psi, TUW= 159 pcf		97	85
55	- with some clayey shale partings and seams and fractures from 55 to 80 ft						
56–61						100	78
61–66				q_u= 1040 psi, TUW= 158 pcf		88	58
66–70						92	20

COMPLETION DEPTH: 96.0 ft
DATE: 3-14-23

DEPTH TO WATER IN BORING: 22.5 ft

DATE: 3/14/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-75

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in HSA 25 ft /Wash 46 ft /NQ Core-CME-55

LOCATION: 35.361425°N, -94.281011°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
71–76						98	30
76–81	- coal seams and layers from 77 to 79 ft - with pyrite inclusions at 77.6 to 77.9 ft					100	25
81–86				q_u= 2170 psi, TUW= 166 pcf q_u= 2650 psi, TUW= 163 pcf		98	98
86–91	Moderately hard dark gray shale w/interbedded very close, very thin gray fine-grained sandstone partings, horizontal bedding					98	98
91–96						100	98
96–	NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by CL. NOTE 3: Logged by DJM.						

COMPLETION DEPTH: 96.0 ft
DATE: 3-14-23

DEPTH TO WATER
IN BORING: 22.5 ft

DATE: 3/14/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-77

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 50 ft/ NQ 2 Core-CME-55

LOCATION: 35.362140°N, -94.281022°E

SURF. EL: 400.2

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0–3	Soft dark brown clayey silt (CL-ML)	6				
3–13	Soft dark brown silty clay w/some silt seams (CL)	6 6	98 99 97	98		
13–18	Loose tan and reddish tan fine sandy silt (ML)	8				
18–28	Medium dense tan silty fine sand (SM) - very loose below 23 ft	22 3		18		
28–40	Medium dense tan fine to medium sand, slightly silty, w/ocassional fine gravel (SP-SM)	11 10 26		7		

COMPLETION DEPTH: 100.0 ft
DATE: 3-17-23

DEPTH TO WATER
IN BORING: 23 ft

DATE: 3/14/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-77

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 50 ft/ NQ 2 Core-CME-55

LOCATION: 35.362140°N, -94.281022°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
44–49.5	- with some fine to coarse gravel below 44 ft	15					
49.5		50/4"					
50–55	Moderately hard dark gray shale, horizontal bedding			q_u= 1190 psi, TUW= 160 pcf		85	85
55–60				q_u= 1410 psi, TUW= 156 pcf		100	80
60–65						100	100
65–70	- close shale partings at 68.5, 68.7, 71.8, 72.5 and 72.6 ft			q_u= 1610 psi, TUW= 158 pcf		93	90
70–75	- with occasional gray fine-grained sandstone partings below 70 ft			q_u= 1340 pcf, TUW= 158 pcf		100	78
75–80						100	63

COHESION, TON/SQ FT scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4; WATER CONTENT scale: 10, 20, 30, 40, 50, 60, 70

COMPLETION DEPTH: 100.0 ft
DATE: 3-17-23

DEPTH TO WATER
IN BORING: 23 ft

DATE: 3/14/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-77

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft /Wash 50 ft/ NQ 2 Core-CME-55

LOCATION: 35.362140°N, -94.281022°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
80–85				q_u= 640 psi, TUW= 163 pcf		100	100
85–90	- coal seam at 85 ft and 94 ft					95	95
90–95	- with some pyrite inclusions below 92 ft					78	75
95–100	Hard gray fine-grained sandstone w/some dark gray shale partings, horizontal bedding			q_u= 4750 psi, TUW= 161 pcf		100	100

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by JSW.
NOTE 3: Logged by IJM.

COMPLETION DEPTH: 100.0 ft
DATE: 3-17-23

DEPTH TO WATER
IN BORING: 23 ft

DATE: 3/14/2023

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-78

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in HSA 25 ft /Wash 55 ft /NQ 2 Core-CME-55

LOCATION: 35.362417°N, -94.280755°E

SURF. EL: 400.7

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0	Soft dark brown clayey silt (CL-ML)	5	101 101	94 94		
5	Firm to stiff dark brown silty clay (CL) w/silt pockets	10				
	Firm to stiff dark brown clay (CH)	6	104 108			
10	Loose reddish brown fine sandy silt, slightly clayey (ML)					
15	Loose reddish brown silty fine sand (SM)	7		43		
20	- medium dense from 19 to 22 ft	35				
25		9				
30	Medium dense tan fine to medium sand (SP)	10				
35		10				
40	- with some fine to coarse gravel below 39 ft	25				
	Medium dense tan fine to coarse sand w/fine to coarse gravel (SP)	14				

2.08

COMPLETION DEPTH: 105.0 ft
DATE: 3-19-23

DEPTH TO WATER
IN BORING: 21 ft

DATE: 3/14/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 11-22-23

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-78

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in HSA 25 ft /Wash 55 ft /NQ 2 Core-CME-55 LOCATION: 35.362417°N, -94.280755°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
50				25					
			Low hardness dark gray shale, slightly weathered						
55				50/1"					
			- with some clayey shale seams below 55.5 ft						
			Moderately hard dark gray shale, horizontal bedding			q_u= 1400 psi, TUW= 162 pcf		80	50
60								96	96
65								100	87
						q_u= 940 psi, TUW= 167 pcf			
70								100	98
						q_u= 2490 psi, TUW= 162 pcf			
75								96	87
80						q_u= 1820 psi, TUW= 160 pcf		96	77
85								96	96

Cohesion scale: 0.2 0.4 0.6 0.8 1.0 1.2 1.4; Water content scale: 10 20 30 40 50 60 70

COMPLETION DEPTH: 105.0 ft
DATE: 3-19-23

DEPTH TO WATER
IN BORING: 21 ft

DATE: 3/14/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-78

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in HSA 25 ft /Wash 55 ft /NQ 2 Core-CME-55

LOCATION: 35.362417°N, -94.280755°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
			Moderately hard dark gray shale w/interbedded very close, very thin gray fine-grained sandstone partings, horizontal bedding			q_u= 2760 psi, TUW= 165 pcf		100	67
95			Low hardness black coal						
			Hard dark gray shale w/some clayey shale seams, horizontal bedding					100	80
100			Moderately dark gray shale w/interbedded very close, very thin gray fine-grained sandstone partings, horizontal bedding					100	100
105									
			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by JSW. NOTE 3: Logged by IJM.						
110									
115									
120									
125									
130									

COMPLETION DEPTH: 105.0 ft
DATE: 3-19-23

DEPTH TO WATER
IN BORING: 21 ft

DATE: 3/14/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-79

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 48.5 ft /NQ 2 Core-CME-55

LOCATION: 35.362772°N, -94.281032°E

SURF. EL: 398.9

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / WATER CONTENT	- No. 200 %	% Recovery	% RQD
	Loose brown silt (ML)						
	Loose brown silt, slightly clayey (ML)		104				
		7					
5	Firm to stiff brown clayey silt (CL-ML)	10			90		
	- soft below 6 ft	6					
10		6					
	- with some fine sand seams below 13.5 ft						
15	Medium dense reddish brown fine sandy silt (ML)		100	-NON-PLASTIC-	54		
20	Medium dense tan silty fine sand (SM)	16			12		
25	Loose reddish brown fine sandy silt (ML)	8		-NON-PLASTIC-			
30	Medium dense tan fine to medium sand, slightly silt (SM-SP)	25					
		28					

COMPLETION DEPTH: 100.0 ft
DATE: 2-26-23

DEPTH TO WATER IN BORING: 20 ft

DATE: 2/24/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-79

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 48.5 ft /NQ 2 Core-CME-55

LOCATION: 35.362772°N, -94.281032°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
39–40		28					
44–45		19		Water content ≈ 17			
48.5	Moderately hard dark gray shale, horizontal bedding					75	67
50–55				q_u= 1260 psi, TUW= 163 pcf		100	100
55–60				q_u= 1440 psi, TUW= 161 pcf		92	92
60–65				q_u= 1950 psi, TUW= 164 pcf		100	100
65–70				q_u= 3150 psi, TUW= 164 pcf		95	95

COMPLETION DEPTH: 100.0 ft
DATE: 2-26-23

DEPTH TO WATER
IN BORING: 20 ft

DATE: 2/24/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-79

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 48.5 ft /NQ 2 Core-CME-55 | LOCATION: 35.362772°N, -94.281032°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
						q_u= 2750 psi, TUW= 164 pcf		100	100
75						q_u= 2210 psi, TUW= 162 pcf		95	95
80						q_u= 2550 psi, TUW= 160 pcf		100	100
85			- with some very thin fine-grained sandstone partings below 85 ft			q_u= 2760 psi, TUW= 164 pcf		97	97
90			- coal layer at 91.6 to 93 ft - close coal seams at 93 to 94 ft			q_u= 3790 psi, TUW= 165 pcf		100	53
95			Moderately hard to hard dark gray shale w/interbedded, very close, very thin gray fine-grained sandstone partings, horizontal bedding			q_u= 5260 psi, TUW= 163 pcf		100	100
100			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by JSW. NOTE 3: Logged by IJM/JKB.						

COMPLETION DEPTH: 100.0 ft
DATE: 2-26-23

DEPTH TO WATER IN BORING: 20 ft

DATE: 2/24/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-80

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 48.5 ft /NQ 2 Core-CME-55   LOCATION: 35.363128°N, -94.281058°E

SURF. EL: 400.0

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	Cohesion / Water content notes	- No. 200 %	% Recovery	% RQD
0	Loose brown silt (ML)	5		-NON-PLASTIC-			
2	Firm brown silty clay (CL) - stiff below 3.5 ft	7	102 104 108 109	2.25 1.73	97		
8	Firm brown clayey silt, sandy (CL)	7					
13	Loose to medium dense tan silty fine sand w/fine sandy silt seams and layers (SM) - with fewer fine sandy silt seams and layers below 18 ft - medium dense at 18 to 23 ft - loose at 23 to 28 ft	10 15 9			44		
27	Dense reddish tan fine sand, slightly silty (SM-SP) - loose below 33 ft	37 9			10		
38	Medium dense tan fine to medium sand, slightly silty (SM-SP) - dense below 43 ft	14 31					

COMPLETION DEPTH: 60.0 ft
DATE: 2-26-23

DEPTH TO WATER IN BORING: 22 ft

DATE: 2/26/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-80

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 48.5 ft /NQ 2 Core-CME-55

LOCATION: 35.363128°N, -94.281058°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
48.5–50			Moderately hard dark gray shale, horizontal bedding	50/4"					
50–55						q_u= 2000 psi, TUW= 158 pcf		92	87
55–60						q_u= 1410 psi, TUW= 164 pcf		98	98
60			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by JSW. NOTE 3: Logged by JKB.						

Depth scale: 50, 55, 60, 65, 70, 75, 80, 85

COMPLETION DEPTH: 60.0 ft
DATE: 2-26-23

DEPTH TO WATER
IN BORING: 22 ft

DATE: 2/26/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-81

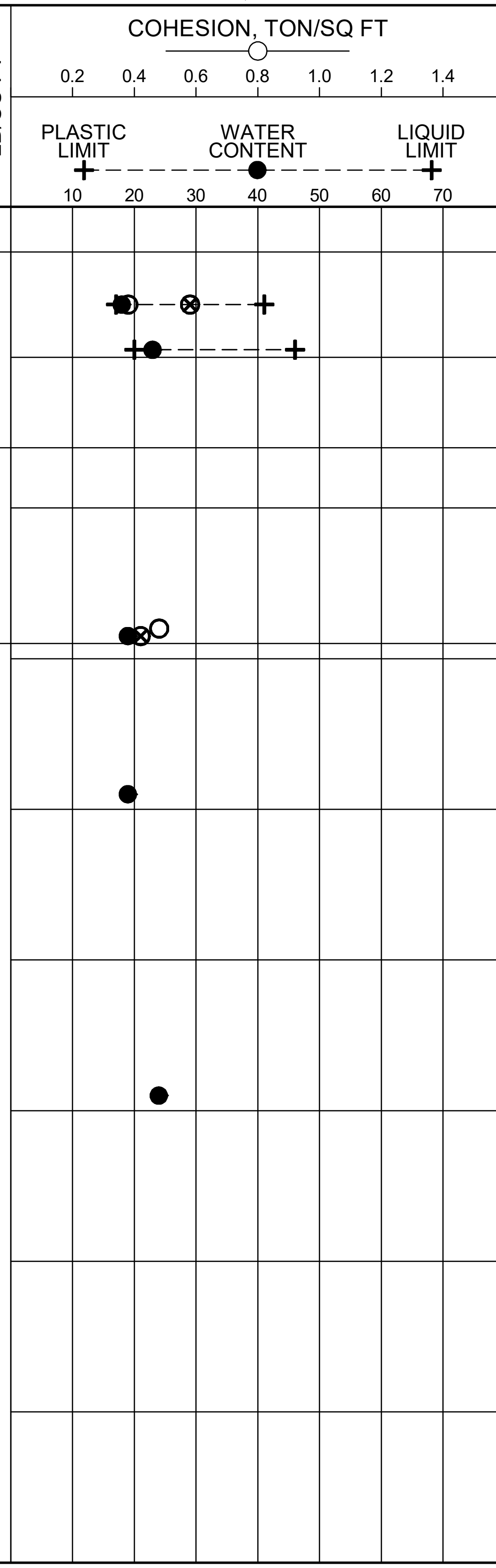
040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 48.5 ft /NQ 2 Core-CME-55

LOCATION: 35.363132°N, -94.280751°E

SURF. EL: 399.5

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0	Loose brown silt, sandy (ML)	5				
	Firm brown silty clay (CL)		106			
5		9				
	- firm to stiff below 6 ft	10				
10	Soft reddish brown clayey silt (CML-ML)	5				
			108			
15	Loose to medium dense tan silty fine sand w/fine sandy silt seams and layers (SM-SP)					
20		10		7		
	- loose at 23 to 38 ft - with fewer fine sandy silt seams and layers below 23 ft					
25		8				
30		5		10		
35		7				
	- dense below 38 ft					
40		31				
		35				



COMPLETION DEPTH: 60.0 ft
DATE: 2-27-23

DEPTH TO WATER IN BORING: 21.6 ft

DATE: 2/26/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-81

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 48.5 ft /NQ 2 Core-CME-55 LOCATION: 35.363132°N, -94.280751°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
50			Moderately hard dark gray shale, horizontal bedding	50/3"					
						q_u= 1780 psi, TUW= 166 pcf		85	73
55									
						q_u= 2130 psi, TUW= 161 pcf		100	100
60									

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4. Water content scale: 10, 20, 30, 40, 50, 60, 70.

Depth scale: 50, 55, 60, 65, 70, 75, 80, 85

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by JSW.
NOTE 3: Logged by JKB.

COMPLETION DEPTH: 60.0 ft
DATE: 2-27-23

DEPTH TO WATER IN BORING: 21.6 ft

DATE: 2/26/2023

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FE-1

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 HSA 14 ft /NQ2 Core-CME-55LC

LOCATION: 35.322702°N, -94.288538°E

SURF. EL: 405.3

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
0	Very soft gray, brown and reddish brown silty clay (CL)	3					
2.5	- stiff below 2.5 ft	18					
6.5	Very soft to soft tan and brown clay (CH)	5					
13.5	Low hardness to moderately hard dark gray weathered shale, horizontal bedding	50/4"					
15	Moderately hard dark gray shale w/occassional gray fine grained sandstone partings, horizontal bedding			q_u= 2740 psi, TUW= 169 pcf		100	90
19				q_u= 2300 psi, TUW= 164 pcf		98	80

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by RR.
NOTE 3: Logged by TRS.

COMPLETION DEPTH: 24.0 ft
DATE: 11-2-23

DEPTH TO WATER
IN BORING: Dry to 14 ft

DATE: 11/2/2023

RECRQDN200-2 21-071_FE LOGS.GPJ 1-3-24

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FE-2

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55

LOCATION: 35.324274°N, -94.287826°E

SURF. EL: 407.8

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %
0–2	Very loose brown silt, slightly clayey (CL-ML), w/organics	2			
2–12	Stiff tan and brown clayey silt with ferrous nodules (CL-ML)	17			
		13			
		13			
	- w/more ferrous nodules and some shale fragments below 8.5 ft	28			
12–13	Low hardness to moderately hard dark gray weathered shale	25/0			

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by CL.
NOTE 3: Logged by IJM.

COMPLETION DEPTH: 13.0 ft
DATE: 11-21-23

DEPTH TO WATER IN BORING: Dry
DATE: 11/21/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FE-3

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 HSA 9 ft /NQ2 Core-CME-55LC

LOCATION: 35.323604°N, -94.288670°E

SURF. EL: 410.3

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT	- No. 200 %	% Recovery	% RQD
0–2	Very soft brown and gray clayey silt (CL-ML)	4					
2–4	Soft gray and tan silty clay (CL)	6					
4–8.5	Stiff grray and tan clay (CH)	20					
8.5–10	Low hardness dark gray shale, slightly weathered, horizontal bedding	50/1"				75	65
10–15	Moderately hard dark gray shale w/interbeded very close, thin to very thin gray fine-grained sandstone partings and inclusions, horizontal bedding			q_u= 5590 psi, TUW= 160 pcf		100	92
15–19	Moderately hard to hard Tan and gray fine grained sandstone with some interbeded dark gray shale laminations, horizontal bedding			q_u= 11360 psi, TUW= 160 pcf		100	90

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by RR.
NOTE 3: Logged by TRS.

COMPLETION DEPTH: 19.0 ft
DATE: 11-2-23

DEPTH TO WATER
IN BORING: Dry to 9 ft

DATE: 11/2/2023

21-071

Form 108-6(74) Job No. 21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FE-4

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 HSA 6 ft /NQ2 Core-CME-55LC

LOCATION: 35.324858°N, -94.289223°E

SURF. EL: 418.5

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
0–6	Very loose brown fine sandy silt (ML), slightly clayey	3					
		3					
5	- dense below 4.5 ft	32					
6–8	Low hardness to moderately hard tan and brown fine-grained sandstone w/ferrous stains, slightly weathered, horizontal bedding			q_u= 10400 psi, TUW= 154 pcf		100	80
8–11	Moderately hard dark gray shale w/some gray fine-grained sandstone partings, horizontal bedding						
11–16	Moderately hard dark gray shale w/interbeded very close, thin to very thin gray fine-grained sandstone partings, horizontal bedding			q_u= 2900 psi, TUW= 155 pcf		97	85
15						98	98

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by RR.
NOTE 3: Logged by TRS.

COMPLETION DEPTH: 16.0 ft
DATE: 11-1-23

DEPTH TO WATER
IN BORING: Dry to 6 ft

DATE: 11/1/2023

RECRQDN200-2 21-071_FE LOGS.GPJ 1-3-24

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FE-5

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 HSA 5 ft /NQ2 Core-CME-55LC

LOCATION: 35.325727°N, -94.286399°E

SURF. EL: 414.6

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	WATER CONTENT (%) (plotted)	- No. 200 %	% Recovery	% RQD
0–4.5	Very soft tan and brown clayey silt, sandy (CL-ML)	3		~25			
	- firm below 2.5 ft	8		~18			
4.5–9.5	Low hardness to moderately hard tan and brown fine-grained sandstone w/ferrous stains, slightly weathered, horizontal bedding	50/10"				83	70
9.5–15	Moderately hard dark gray shale w/interbeded very close, thin to very thin gray fine-grained sandstone partings and some inclusions, horizontal bedding					90	65

Chart scales: COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4; PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

Depth marks: 5, 10, 15, 20, 25

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by RR.
NOTE 3: Logged by TRS.

COMPLETION DEPTH: 15.0 ft
DATE: 11-1-23

DEPTH TO WATER
IN BORING: Dry to 5 ft

DATE: 11/1/2023

Form 108-6(74) Job No. 21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FE-6

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 HSA 13 ft /NQ2 Core-CME-55LC

LOCATION: 35.328170°N, -94.283084°E

SURF. EL: 412.0

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / WATER CONTENT	- No. 200 %	% Recovery	% RQD
0–2	Medium dense brown silt (ML) (fill)	12					
2–8	Stiff gray and reddish tan silty clay (CL)	10					
5				⊗			
		10					
8–13	Stiff brown clayey silt with ferrous nodules and shale fragments (CL-ML)	18					
	- firm from 12-12.5 ft	7 50/3"					
13–15	Moderately hard tan and brown fine-grained sandstone, slightly weathered with ferrous stains, horizontal bedding					92	92
15–16.5	Moderately hard dark gray shale, slightly weathered, horizontal bedding						
16.5–23	Moderately hard dark gray shale w/interbeded very close, thin to very thin gray fine-grained sandstone partings and some inclusions, horizontal bedding			q_u= 2100 psi, TUW= 168 pcf		92	67
20				q_u= 3360 psi, TUW= 166 pcf			
						98	98

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by RR.
NOTE 3: Logged by DRM.

COMPLETION DEPTH: 23.0 ft
DATE: 10-31-23

DEPTH TO WATER IN BORING: Dry to 13 ft

DATE: 10/31/2023

RECRQDN200-2 21-071_FE LOGS.GPJ 1-3-24

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FE-7

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.75 HSA-CME-55LC

LOCATION: 35.331154°N, -94.281265°E

SURF. EL: 419.1

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %
0–2	Very loose brown silt (ML) (fill)	3			
2	Firm gray and tan silty clay (CL)	7			
4.5	- stiff below 4.5 ft	10			
10		17			
12	- w/moore silt and calcareous nodules below 12 ft				
15		13			
18	Soft tan silty clay (CL)	6			
24	-stiff w/occassional shale fragments below 24 ft	15			
30		14			

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by RR.
NOTE 3: Logged by DRM.

COMPLETION DEPTH: 30.0 ft
DATE: 10-30-23

DEPTH TO WATER
IN BORING: Dry

DATE: 10/30/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FE-8

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55

LOCATION: 35.332394°N, -94.280841°E

SURF. EL: 412.7

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT	- No. 200 %
0–2	Medium dense dark brown silty fine sand w/numerous crushed stone (fill) GM)	16				
2–22	Firm tan clay (CH)	7				
	- stiff with reddish tan ferrous stains below 6 ft	13				
	- with calcium carbonate nodules at 8 to 18 ft	18				
		20				
		23				
22–30	Stiff tan silty clay w/shale fragments (CL)	22				
		17				

NOTE 1: Backfilled with cuttings.

NOTE 2: Drilled by CL.

NOTE 3: Logged by DJM.

COMPLETION DEPTH: 30.0 ft
DATE: 3-14-23

DEPTH TO WATER
IN BORING: Dry

DATE: 3/14/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

L O G O F B O R I N G N O. FE-9

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55

LOCATION: 35.333546°N, -94.280587°E

SURF. EL: 401.9

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT + / WATER CONTENT ● / LIQUID LIMIT + (10–70)	- No. 200 %
0–2	Very loose brown silt, slightly clayey, moist (ML)	2			
2–6	Stiff grayish brown clay w/silt pockets and ferrous stains and nodules (CH)	20			
6–12	Stiff gray and brown silty clay (CL)	19			
	- with yellowish tan and tan below 8 ft	15			
12–15	Medium dense reddish tan clayey silt (ML-CL)				
	- water at 15 ft	19			
15–18	Medium dense tan fine sand (SP)				
18–22	Moderately hard gray and tan weathered shale w/ferrous stains	50/9"			
22–28	Moderately hard dark gray slightly weathered shale	50/5"			
28–30	Moderately hard dark gray shale	50/3"			

NOTE 1: Backfilled with cuttings.

NOTE 2: Drilled by CL.

NOTE 3: Logged by DJM.

COMPLETION DEPTH: 30.0 ft
DATE: 3-13-23

DEPTH TO WATER
IN BORING: 15 ft

DATE: 3/13/2023

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FE-10

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 25 ft/Wash-CME-55 LOCATION: 35.365729°N, -94.279250°E

SURF. EL: 400.0

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT	- No. 200 %
0	Loose brown fine sandy silt (ML)	4			
2	Soft dark brown silty clay (CL) w/silt pockets			-NON-PLASTIC-	78
3			104	-NON-PLASTIC- G_s= 2.67	80
5	- stiff with more silt pockets below 4.5 ft	15	102	-NON-PLASTIC-	
7		10			
9.5		10	99		
13	Medium dense reddish brown and tan clayey fine sand (SC)	10			24
18	Loose reddish tan and brown silty fine sand (SM) - water at 20 ft	8			
25		8			
30		5			
35	- medium dense with less silt below 34 ft	13			
39	Medium dense tan fine to coarse sand (SP)	30			

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by JSW.
NOTE 3: Logged by IJM.

COMPLETION DEPTH: 40.0 ft
DATE: 1-23-23

DEPTH TO WATER IN BORING: 20 ft

DATE: 1/23/2023

LGBNEW 21-071 FE LOGS.GPJ 1-3-24

Form 108-6(74) Job No. 21-071

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FE-11

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in HSA 25 ft /Wash-CME-55

LOCATION: 35.366338°N, -94.282233°E

SURF. EL: 401.2

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
0–2	Soft brown clayey silt (ML)	5		
2–8	Very soft dark brown silty clay (CL)	3	104	
	- firm below 4 ft	7		
			102	93
8–30	Soft reddish tan and brown silty clay (CL)	6		
	- with silt seams below 14 ft	6		
		7		
			104	92
		4		
30–40	Very loose tan silty fine sand (SM)	3		
	- fine to medium sand below 34 ft - loose below 34 ft	9		
		9		

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

G_s = 2.65

-NON-PLASTIC-

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by JSW.
NOTE 3: Logged by IJM.

COMPLETION DEPTH: 40.0 ft
DATE: 2-21-23

DEPTH TO WATER IN BORING: 24 ft

DATE: 2/21/2023

LGBNEW 21-071_FE LOGS.GPJ 1-3-24

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FE-12

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 20 ft /Wash-CME-55

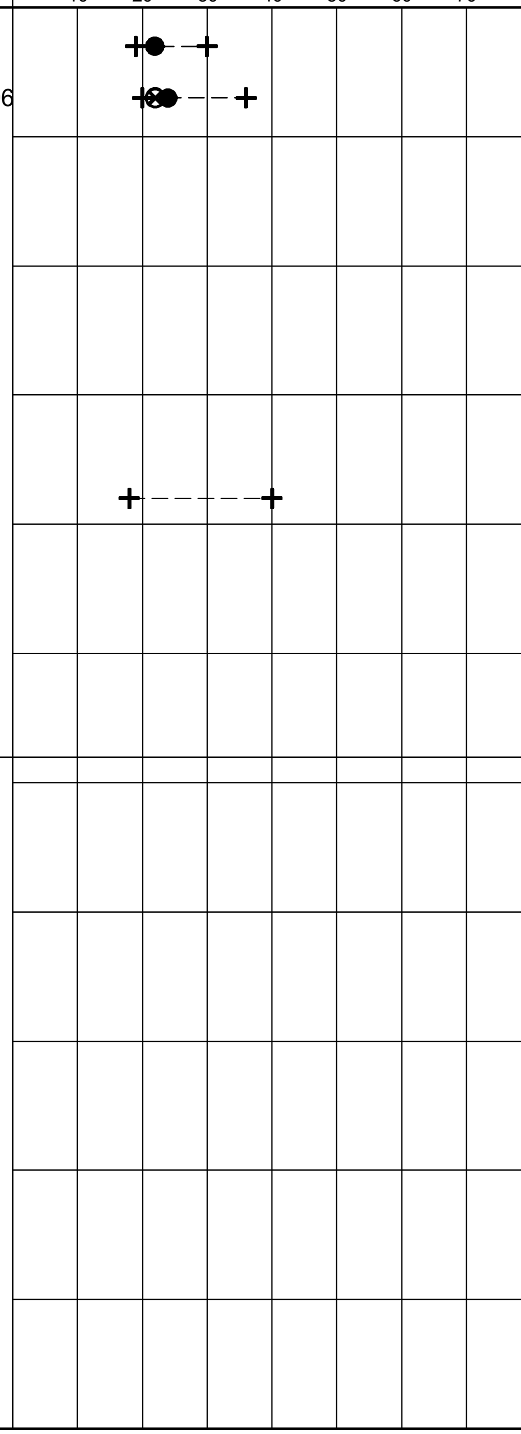
LOCATION: 35.367468°N, -94.279034°E

SURF. EL: 398.8

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
0	Soft dark brown and tan silty clay (CL)			
			96	95
		7		
5	- stiff with silt pockets from 4.5 to 6 ft	10		
		8		
10		8		
		14		
15	Medium dense tan silty fine sand (SM)			
20	- loose from 19 to 20 ft - water at 19 ft	9		
25		8		

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70



COMPLETION DEPTH: 40.0 ft
DATE: 2-23-23

DEPTH TO WATER IN BORING: 19 ft

DATE: 2/23/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FE-12

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 20 ft /Wash-CME-55 LOCATION: 35.367468°N, -94.279034°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %
29–30		X	- very loose below 29 ft	2			
34–35		X		2			
38–40		X	Medium dense tan fine to coarse sand	16			

NOTE 1: Backfilled with cuttings.

NOTE 2: Drilled by JSW.

NOTE 3: Logged by IJM.

COMPLETION DEPTH: 40.0 ft
DATE: 2-23-23

DEPTH TO WATER
IN BORING: 19 ft
DATE: 2/23/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FE-13

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: HSA 35 ft /Wash-CME-55 LOCATION: 35.367638°N, -94.282276°E

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL: 399.4)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %
	Soft dark brown clayey silt (ML)	6			
	Soft brown clay (CH)				75
5	Firm reddish brown clayey silt (ML)	8			
	Soft reddish brown silty clay (CL) w/silt partings and seams	6			71
10	Soft reddish brown clayey silt (ML)				
15	- soft to firm below 14 ft	7			
	Loose to medium dense tan silty fine sand (SM)				
20		10			16
25	- very loose from 24 to 25 ft	4			5
30		5			
35	- medium dense from 34 to 35 ft	13			
40		7			

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by JSW.
NOTE 3: Logged by TJM.

COMPLETION DEPTH: 40.0 ft
DATE: 2-21-23

DEPTH TO WATER IN BORING: 20 ft

DATE: 2/21/2023

LGBNEW 21-071 FE LOGS.GPJ 4-4-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FE-14

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA 20 ft /Wash-CME-55

LOCATION: 35.369175°N, -94.279853°E

SURF. EL: 394.1

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0–3.5	Loose brown silt (ML) -NON-PLASTIC-	6, 6				
3.5–13	Soft to firm reddish brown silty clay (CL) w/some silt pockets (G_s = 2.65)	10, 5	103, 94	84, 98		
13–19	Very soft brown clay (CH), w/some silt pockets	4				
19–34	Very loose brown fine sandy silt (ML) - water at 19 ft	4, 2, 3		57		
34–38	Loose tan fine to coarse sand (SM-SP), slightly silty	7		7		
38–40	Loose tan fine to coarse sand w/fine to coarse gravel (SM-SW)	7		7		

Chart headings: COHESION, TON/SQ FT (0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4); PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10, 20, 30, 40, 50, 60, 70)

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by JSW.
NOTE 3: Logged by IJM.

COMPLETION DEPTH: 40.0 ft
DATE: 2-13-23

DEPTH TO WATER
IN BORING: Dry

DATE: 2/13/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-1

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55

LOCATION: 35.321456°N, -94.289449°E

SURF. EL: 406.4

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %
0–4	Soft brown and dark brown clayey silt w/some fine sand, ferrous nodules and stains (CL-ML)	4			
	- stiff with more ferrous nodules below 2.5 ft	19			
4–7	Very stiff gray and brown silty clay w/occassional shale fragments (CL)	31			
	- water at 6ft	45			
7–10	Low hardness dark gray weathered shale w/occassional silty clay laminations and ferrous stains	50/7"			

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by CL.
NOTE 3: Logged by IJM.

COMPLETION DEPTH: 10.0 ft
DATE: 11-21-23

DEPTH TO WATER
IN BORING: 6 ft

DATE: 11/21/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-2

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55

LOCATION: 35.324282°N, -94.286267°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 406.5	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			Very soft dark brown and tan silty clay (CL)	3			
			- soft from 2.5 to 6.5 ft	6			
5				6			
				3			
			Stiff tan and gray silty clay with weathered shale seams (CL)	19			
10			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by CL. NOTE 3: Logged by IJM.				
15							
20							
25							

COMPLETION DEPTH: 10.0 ft
DATE: 11-21-23

DEPTH TO WATER
IN BORING: Dry

DATE: 11/21/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-3

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55

LOCATION: 35.325758°N, -94.287810°E

SURF. EL: 422.9

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4) / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10–70)	- No. 200 %
0	Loose brown silt w/organics (ML)				
	Medium dense reddish brown, gray and yellowish tan clayey fine sand (SC)	20			
		34			
4	Low hardness to moderately hard tan and brown weathered shale	25/0			
	- auger refusal at 7 ft	25/0			

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by CL.
NOTE 3: Logged by IJM.

COMPLETION DEPTH: 7.0 ft
DATE: 11-21-23

DEPTH TO WATER
IN BORING: Dry

DATE: 11/21/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-4

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55 LOCATION: 35.361448°N, -94.297930°E

SURF. EL: 400.4

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %
0	7.5 inches of Asphalt Cement Concrete				
	5.5 inches of Crushed Stone Base				
	Stiff brown silty clay (CL) w/some silt partings - soft from 2.5 to 4.5 ft	11			
		6			
5		11			
		10			
	Medium dense reddish brown silt, slightly clayey (CL-ML)				
		12			
10					

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by CL.
NOTE 3: Logged by IJM.

COMPLETION DEPTH: 10.0 ft
DATE: 11-22-23

DEPTH TO WATER IN BORING: Dry
DATE: 11/22/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-5

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55 LOCATION: 35.362277°N, -94.301399°E

SURF. EL: 397.6

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %
0	4.5 inches of Asphalt Cement Concrete				
	6 inches of Crushed Stone Base	18			
	Stiff brown silty clay w/some fine sandy silt partings (CL)	17			
5		14			
	- firm below 6.5 ft	7			
		5			
10					

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by CL.
NOTE 3: Logged by IJM.

COMPLETION DEPTH: 10.0 ft
DATE: 11-22-23

DEPTH TO WATER
IN BORING: Dry

DATE: 11/22/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-6

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55 LOCATION: 35.362442°N, -94.299173°E

SURF. EL: 396.0

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT	- No. 200 %
0–4	Soft brown silty clay w/some fine sandy silt partings (CL)	6				
		5				
4–8.5	Loose redish brown fine sandy silt (ML)	6				
		4				
8.5–10	Stiff brown silty clay (CL)	11				

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by CL.
NOTE 3: Logged by IJM.

COHESION, TON/SQ FT scale: 0.2 0.4 0.6 0.8 1.0 1.2 1.4
WATER CONTENT scale: 10 20 30 40 50 60 70

COMPLETION DEPTH: 10.0 ft
DATE: 11-22-23

DEPTH TO WATER IN BORING: Dry

DATE: 11/22/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-7

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55LC

LOCATION: 35.36243°N, -94.27515°E

SURF. EL: 395.6

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT	- No. 200 %
	Dense crushed stone (fill)					
	Stiff brown silty clay (CL)	14				
	- very soft below 2 ft	9				
5	Loose reddish brown silt (ML), w/some silty clay seams	6				
		7				
	Loose tan silty fine sand (SM)	9				
10						

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4. Plastic limit / water content / liquid limit scale: 10, 20, 30, 40, 50, 60, 70. Depth scale: 5, 10, 15, 20, 25.

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by RR.
NOTE 3: Logged by DRM.

COMPLETION DEPTH: 10.0 ft
DATE: 10-30-23

DEPTH TO WATER
IN BORING: Dry

DATE: 10/30/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-8

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55LC

LOCATION: 35.36255°N, -94.27892°E

SURF. EL: 396.4

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %
0	Dense crushed stone (fill)				
	Stiff reddish brown silty clay (CL)	14			
	- firm bel 2 ft	9			
4	Soft brown clayey silt (CL-ML)	6			
6	Loose reddish tan fine sandy silt (ML)	7			
8	Loose tan silty fine sand (SM)	9			
10					

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by RR.
NOTE 3: Logged by DRM.

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4; water content scale: 10, 20, 30, 40, 50, 60, 70

Depth scale: 5, 10, 15, 20, 25

COMPLETION DEPTH: 10.0 ft
DATE: 10-30-23

DEPTH TO WATER
IN BORING: Dry

DATE: 10/30/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-9

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55LC

LOCATION: 35.36270°N, -94.28678°E

SURF. EL: 402.7

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %
0	Dense crushed stone (fill)				
	Medium dense brown silt (ML)	12			
		8			
5		8			
	Soft reddish brown silty clay (CL)	5			
	Very loose reddish brown fine sandy silt, slightly clayey (ML)	4			
10					

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by RR.
NOTE 3: Logged by DRM.

COMPLETION DEPTH: 10.0 ft
DATE: 10-30-23

DEPTH TO WATER
IN BORING: Dry

DATE: 10/30/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-10

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55LC

LOCATION: 35.36281°N, -94.29025°E

SURF. EL: 402.1

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %
0	Dense crushed stone (fill)				
	Medium dense brown silt, slightly clayey (CL-ML)	13			
		7			
5	Loose reddigh brown fine sandy silt (ML)	8			
	- very loose below 2.5 ft	3			
	Very loose reddish tan silt, slightly clayey (CL-ML)	3			
10					

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by RR.
NOTE 3: Logged by DRM.

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

COMPLETION DEPTH: 10.0 ft
DATE: 10-30-23

DEPTH TO WATER
IN BORING: Dry

DATE: 10/30/2023

LGBNEW 21-071 FP LOGS.GPJ 11-17-23

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-11

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55LC

LOCATION: 35.362918°N, -94.293591°E

SURF. EL: 402±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
0	Dense crushed stone (fill)						
	Medium dense reddish tan silt, slightly clayey (CL-ML)	14					
	- loose below 2.5 ft	7					
4	Loose reddish tan silt (ML)						
5		5					
		4					
		3					
10	NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by RR. NOTE 3: Logged by DRM.						

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4; Water content scale: 10, 20, 30, 40, 50, 60, 70

COMPLETION DEPTH: 10.0 ft
DATE: 10-27-23

DEPTH TO WATER IN BORING: Dry

DATE: 10/27/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-12

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55LC

LOCATION: 35.36294°N, -94.29705°E

SURF. EL: 399.2

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %
0	Dense crushed stone (fill)				
	Dense brown silt, slightly clayey (CL-ML)	18			
	Medium dense reddish tan fine sandy silt (ML)	12			
5	- very loose to loose below 4.5 ft	5			
		7			
		5			
10					

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by RR.
NOTE 3: Logged by DRM.

COHESION, TON/SQ FT scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT scale: 10, 20, 30, 40, 50, 60, 70

Depth scale: 5, 10, 15, 20, 25

COMPLETION DEPTH: 10.0 ft
DATE: 10-27-23

DEPTH TO WATER
IN BORING: Dry

DATE: 10/27/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-13

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55LC

LOCATION: 35.36320°N, -94.29630°E

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL: 401±)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %
0	Dense crushed stone (fill)				
	Medium dense brown clayey silt (CL-ML)	13			
		12			
4	Firm reddish brown silty clay (CL)	7			
6	Loose reddish tan fine sandy silt (ML)	9			
		8			
10					

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by RR.
NOTE 3: Logged by DRM.

COMPLETION DEPTH: 10.0 ft
DATE: 10-27-23

DEPTH TO WATER
IN BORING: Dry

DATE: 10/27/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-14

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55

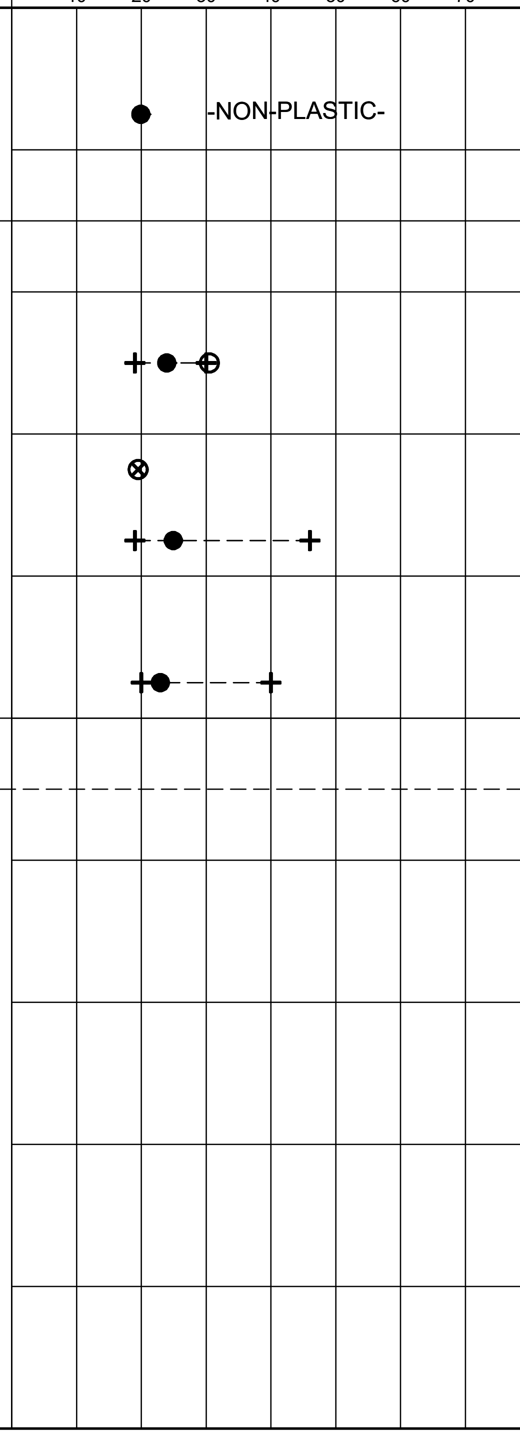
LOCATION: 35.364014°N, -94.278009°E

SURF. EL: 399.0

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
0 – 1.5	Very soft brown clayey silt (ML)	4		
1.5 – 5.0	Soft brown silty clay (CL)		108	
			100	84
				97
			100	
5.0 – 5.5	Firm to stiff brown clayey silt (ML)	10		

COHESION, TON/SQ FT (0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4)

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10, 20, 30, 40, 50, 60, 70)



NOTE 1: Backfilled with cuttings.

NOTE 2: Drilled by JSW.

NOTE 3: Logged by IJM.

COMPLETION DEPTH: 5.5 ft
DATE: 2-23-23

DEPTH TO WATER
IN BORING: Dry

DATE: 2/23/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-15

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55

LOCATION: 35.364867°N, -94.283406°E

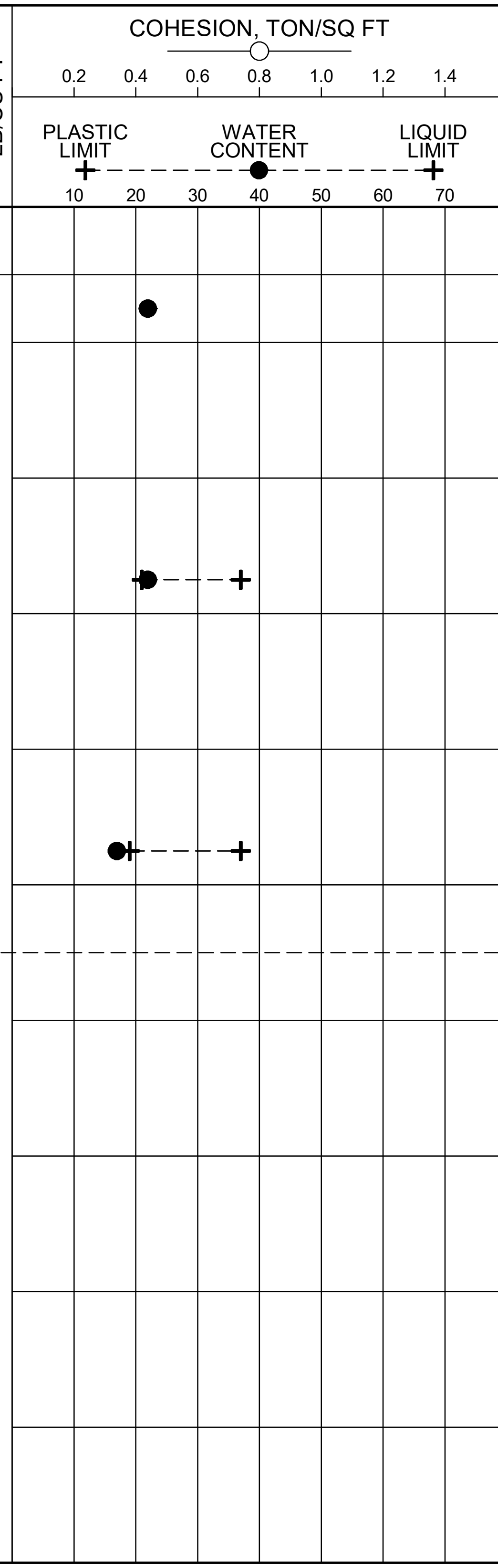
SURF. EL: 400.0

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
0	Soft brown clayey silt (ML)		
0.5	Firm brown silty clay (CL)		
1		8	
2.75			98
3		7	
4.5	- stiff below 4.5 ft		
4.75			100
5		13	

NOTE 1: Backfilled with cuttings.

NOTE 2: Drilled by JSW.

NOTE 3: Logged by IJM.



- No. 200 %

COMPLETION DEPTH: 5.5 ft
DATE: 2-21-23

DEPTH TO WATER IN BORING: Dry

DATE: 2/21/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FP-16

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: CFA-CME-55

LOCATION: 35.366823°N, -94.280465°E

SURF. EL: 400.7

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	WATER CONTENT (approx., %)	- No. 200 %
0–2	Very soft dark brown clayey silt (ML)	4		~18	
2–5.5	Soft to firm dark brown silty clay (CL)	7		~13	
	- with silt seams below 4 ft	11		~13	

NOTE 1: Backfilled with cuttings.

NOTE 2: Drilled by JSW.

NOTE 3: Logged by IJM.

COMPLETION DEPTH: 5.5 ft
DATE: 2-21-23

DEPTH TO WATER
IN BORING: Dry

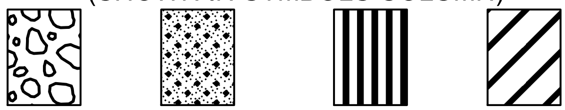
DATE: 2/21/2023

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

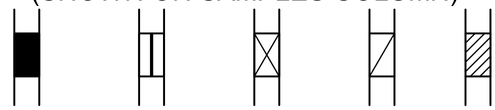
(SHOWN IN SYMBOLS COLUMN)



Gravel Sand Silt Clay
Predominant type shown heavy

SAMPLER TYPES

(SHOWN ON SAMPLES COLUMN)



Shelby Tube, Rock Core, Split Spoon, No Recovery, Cutting

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (I) Clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	N-VALUE	RELATIVE DENSITY
VERY LOOSE	0-4	0-15%
LOOSE	4-10	15-35%
MEDIUM DENSE	10-30	35-65%
DENSE	30-50	65-85%
VERY DENSE	50 and above	85-100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) Inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ. FT.
VERY SOFT	Less than 0.25
SOFT	0.25-0.50
FIRM	0.50-1.00
STIFF	1.00-2.00
VERY STIFF	2.00-4.00
HARD	4.00 and higher

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance.
FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
LAMINATED - composed of thin layers of varying color and texture.
INTERBEDDED - composed of alternate layers of different soil types.
CALCAREOUS - containing appreciable quantities of calcium carbonate.
WELL GRADED - having a wide range in grain sizes and substantial amounts of all intermediate particle sizes.
POORLY GRADED - predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.

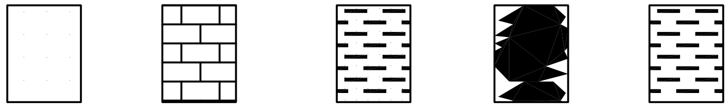
Terms used on this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No.3-357, Waterways Experiment Station, March 1953

KEY 5-27-22

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

BORING LOG TERMS – ROCK

ROCK TYPES
(SHOWN IN SYMBOLS COLUMN)



Sandstone Limestone Siltstone Coal Shale

Joint Characteristics –

Spacing	
Very Close	0.75 to 2.5 in.
Close	2.5 to 8 in.
Moderately Close	8 to 24 in.
Wide	2 to 6 ft
Very Wide	More than 6 ft

Bedding Characteristics –

Very Thin	0.75 to 2.5 in.
Thin	2.5 to 8 in.
Medium	8 to 24 in.
Thick	2 to 6 ft
Massive	More than 6 ft

Lithologic Characteristics –

Clayey
Shaly
Calcareous (limy)
Siliceous
Sandy (Arenaceous)
Silty
Plastic Seams

Parting –	Less than 1/16 inch
Seam –	1/16 to 1/2 inch
Layer –	1/2 to 12 inches
Stratum –	Greater than 12 inches

Hardness–

Soft (S) – Reserved for plastic material alone.

Friable (F) – Easily crumbled by hand, pulverized or reduced to powder and is too soft to be cut with a pocket knife.

Low Hardness (LH) – Can be gouged deeply or carved with a pocket knife.

Moderately Hard (MH) – Can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and scratch is readily visible after the powder has been blown away.

Hard (H) – Can be scratched with difficulty; scratch produces little powder and is often faintly visible; traces of the knife steel may be visible.

Very hard (VH) – Cannot be scratched with a pocket knife. Knife steel marks left on surface.

Texture –

Fine – Barely seen with naked eye
Medium – Barely seen up to 1/8 in.
Coarse – 1/8 in. to 1/4 in.

Structure –

Bedding
- Flat – 0° – 5°
- Gently Dipping – 5° – 35°
- Moderately Dipping – 55° – 85°
- Steeply Dipping – 55° – 85°

Fractures, scattered
- Open
- Cemented or Tight

Fractures, closely spaced
- Open
- Cemented or Tight

Brecciated (Sheared and Fragmented)
- Open
- Cemented or Tight

Joints
- Faulted
- Slickensides

Degree of Weathering –

Fresh – No visible signs of decomposition or discoloration. Rings under hammer impact.

Slighty Weathered – Slight discoloration inwards from open fractures, otherwise similar to fresh.

Moderately Weathered – Discoloration throughout. Weaker minerals such as feldspar decomposed. Strength somewhat less than fresh rock, but cores cannot be broken by hand or scraped by knife. Texture preserved.

Highly Weathered – Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becoming indistinct but fabric

Completely Weathered – Minerals decomposed to soil but fabric and structure preserved (Saprolite). Specimens easily crumbled or penetrated.

Residual Soil – Advanced state of decomposition resulting in plastic soils. Rock fabric and structure completely destroyed. Large volume change.

Solution and Void Conditions –

Solid, contains no voids
Vuggy (pitted)
Vesicular (igneous)
Porous
Cavities
Cavernous

Swelling Properties –

Nonswelling
Swelling

Slaking Properties –

Nonslaking
Slakes slowly on exposure
Slakes readily on exposure

Rock Quality Designation (RQD) –

RQD (Percent)	Diagnostic Description
Greater than 90	Excellent
75 – 90	Good
50 – 75	Fair
25 – 50	Poor
Less than 25	Very Poor

KEYROCK FHWA 3-2-12

APPENDIX A

FOUNDATION TESTING & CONSULTING, LLC
Knowledge To Build On®

16500 Lucille St. Overland Park, KS 66221
phone 913-626-8499
fax 913-439-1703

September 2, 2022

Mr. Justin Ferguson, Project Geologist/Operations Manager
Grubbs, Hoskyn, Barton & Wyatt, Inc.
11200 Baseline Road
Little Rock, Arkansas 72209

Subject: SPT Hammer Calibrations
FTC Project Number 059-2022

Dear Mr. Ferguson,

Foundation Testing and Consulting, LLC (FTC) is pleased to submit the results of our SPT hammer calibrations to you. The field work associated with the hammer calibration was performed by us on August 29, 2022. The energy efficiency rating for the hammers on 2 of your drill rigs was determined by us.

Hammer blow rates, average maximum compressive forces, average maximum velocities, average energy transfer and average transfer ratio were computed for each sample interval from data collected using a PAX 8 model pile driving analyzer (PDA) unit manufactured by Pile Dynamics Incorporated with upgraded software to comply with ASTM D4633. The PDA unit was connected to an instrumented AWJ rod. The primary objective of the calibration testing was to determine the average energy transfer efficiency for the hammer system. The testing procedure and detailed test results are presented below.

Procedure

The field work was performed at your project site located in Springdale, Arkansas. SPT sample depths ranged from the surface to 21.5 feet below the ground surface. Data collected during the last the sample intervals for each rig were used in my analysis.

Energy measurements were taken over the full 18 inches of sample drive for each sample interval.

Drill Rig Truck Number	Serial Number	Average Efficiency	Energy Correction Factor
CME 55	300905	85.0%	1.42
Simco 2800	092147	71.3%	1.19

These calibration results are presented graphically in the attached plots for the SPT data sets collected in the borings.

Please note that per ASTM D4633, hammer energy measurements (calibrations) should be performed at least annually and following major repair or refurbishment of the hammer system components.

It was our pleasure to provide these calibration services to you. Please contact me with any questions or future needs.

Sincerely,

William C. Jones, P.E*, P.G.** – President, FTC

*Professional Engineer in Kansas, Missouri, Iowa, Tennessee, Illinois, Arkansas, Texas, and Oklahoma
**Professional Geologist in Kansas and Missouri

Enclosure: SPT Data Plots

Table 1
CME55 Rig, (Serial Number 300905)– Grubbs, Hoskyn, Barton & Wyatt, Inc.
Hammer Calibration Performed August 29, 2022

Rod Length (ft)	Beginning Depth (ft)	Final Depth (ft)	Blows per 6-inch interval	N	N_{60}	BPM	Avg. Max. Compressive Force (kips)	Avg. Max. Velocity (ft/sec)	Avg. Transferred Energy (lb-ft)	**Average Transfer Ratio (%)**
18	10.0	11.5	**15-16-22**	**50+**	**50+**	49	22	17	298	**85**
24	15.0	16.5	**7-13-12**	**37**	**50+**	48	17	13	287	**82**
27	20.0	21.5	**18-15-23**	**50+**	**50+**	48	22	16	308	**88**

	BPM	Avg. Max. Compressive Force (kips)	Avg. Max. Velocity (ft/sec)	Avg. Transferred Energy (lb-ft)	Average Transfer Ratio (%)
Overall Average	48.3	20.3	15.3	297.7	85.0
Standard Deviation	0.5	2.4	1.7	8.6	2.4

Overall Calibration Factor for N_{60} = 85.0/60 = 1.42

To compute N_{60} values for this rig multiply recorded N-value by 1.42*

* Calibration factor should be recomputed annually or sooner if changes are made to rig and/or hammer

Table 2
Simco 2800 Rig, (Serial Number 092147) – Grubbs, Hoskyn, Barton & Wyatt, Inc.
Hammer Calibration Performed August 29, 2022

Rod Length (ft)	Beginning Depth (ft)	Final Depth (ft)	Blows per 6-inch interval	N	N_{60}	BPM	Avg. Max. Compressive Force (kips)	Avg. Max. Velocity (ft/sec)	Avg. Transferred Energy (lb-ft)	**Average Transfer Ratio (%)**
14	5.0	6.5	**15-50-40**	**50+**	**50+**	39	17	10	249	**71**
20	15.0	16.5	**5-6-21**	**27**	**32**	41	22	15	252	**72**
25	20.0	21.5	**16-25-31**	**37**	**44**	41	20	16	249	**71**

Overall Average	40.3	19.7	13.7	250.0	71.3
Standard Deviation	0.9	2.1	2.6	1.4	0.5

Overall Calibration Factor for N_{60} = 71.3/60 = 1.19

To compute N_{60} values for this rig multiply recorded N-value by 1.19*

* Calibration factor should be recomputed annually or sooner if changes are made to rig and/or hammer

Geotechnology Automatic Hammer Efficiency Summary

Office Location	Drill Rig	Serial Number	Energy Transfer Ratio (%) 2023		Energy Transfer Ratio (%) 2022		Energy Transfer Ratio (%) 2021		Energy Transfer Ratio (%) 2020		Energy Transfer Ratio (%) 2019		Energy Transfer Ratio (%) 2018		Energy Transfer Ratio (%) 2017		Energy Transfer Ratio (%) 2015/2016	
			Average	Std Dev	Average	Std Dev	Average	Std Dev	Average	Std Dev	Average	Std Dev	Average	Std Dev	Average	Std Dev	Average	Std Dev
St. Louis	CME 55HTX	314225	80	2.9	-	-	77	2.0	81	2.7	91	2.7	85	2.2	76	2.4	87	2.7
	CME 55 LC	390755	-	-	84	2.2	93	1.7	92	2.7	85	1.2	96	1.4	92	2.4	92	2.1
	CME 550X	343063	91	2.1	80	2.9	84	1.7	75	3.7	82	2.4	87	3.8	86	1.5	88	1.9
	CME 750Y	404788	95	2.0	92	1.8	90	2.5	98	1.6	91	1.2	96	2.1	Rig Purchased May 2018			
	CME 85	254746	89	2.6	-	-	73	2.1	87	3.1	87	2.1	80	2.8	87	2.4	89	1.6
	Geoprobe	3230DT1810011	91	3.1	89	3.0	98	3.5	98	3.4	97	2.5	Rig Purchased March 2019					
	CME 75 (Rental)	229417	Rig Rental Sept. 22		88	2.0	Rig Rental September 2022 (PDP)											
Overland Park	CME 55LC	424035	89	2.0	Rig Purchased Spring 2023													
	CME 550	357883	-	-	82	1.5	-	-	89	1.9	-	-	87	1.9	-	-	80	1.6
	TD-2 CME 55	325345	88	1.8	-	-	88	1.8	-	-	88	1.3	88	2.2	-	-	86	2.6
	Diedrich D-50	D50-245			-	-	86	2.2	85	2.3	-	-	87	3.2	-	-	88	3.4
Memphis	Geoprobe	7822T4V3191015	98	2.7	-	-	-	-	Rig Purchased 2021									
	CME 550X	382933	-	-	88	1.9	88	2.1	94	2.0	92	2.4	-	-	92	1.8	92	1.7
	CME 750X	303608	-	-	81	2.1	-	-	84	2.1	90	2.6	81	2.0	85	2.0	83	3.8
	CME 75	183277	-	-	-	-		Previous Data in Erlanger Row										
	Diedrich D-50	D50-308	-	-	-	-	93	3.2	-	-	97	3.2	Rig Purchased Fall 2019					
Erlanger	Sonic-2	TS-1263			86	2.6	Rig Purchased 2022											
	BD-1(L) CME 550X	359083	-	-	73	5.6	-	-	80	2.4	-	-	77	1.5	-	-	90	1.9
	TD-4(L) CME 850	377922	-	-	-	-	100*	2.9	97	2.1	-	-	91	2.5	-	-	90	2.3
	TD-5(L) CME 55	388255	-	-	-	-	88	2.0	93	1.4	95	1.5	89	2.7	-	-	92	2.1
	TD-6 CME 55LC	401375	-	-	-	-	94	1.8	88	1.8	95	2.5	-	-	95	2.6	Purchased 2017	
	CME 75	183277	-	-	Rig Moved to Memphis Office		-	-	80	2.2	-	-	-	-	87	2.1	94	1.9
			-	-			-	-	83	1.5								
Sold	CME 55 Track	294795	-	-	-	-	88	2.6	-	-	85	1.8	83	2.4	91	1.9	88	1.8
	CME 55	204395	-	-	-	-	-	-	-	-	92	1.6	-	-	90	2.2	89	1.8
	CME 45 Track	304214	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	2.3
	Diedrich D-50 (Old)	74960	-	-	-	-	-	-	-	-	80	4.1	-	-	79	6.1	83	5.5
	CME 55HT	253335	-	-	-	-	-	-	-	-	-	-	-	-	87	1.7	78	2.9

*SPT Hammer was observed to have a stroke greater than 30 inches.

APPENDIX B

FB-4: Run 1 (36-40 ft), Run 2 (40-45 ft)

FB-4: Run 3 (45-50 ft), Run 4 (50-55 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

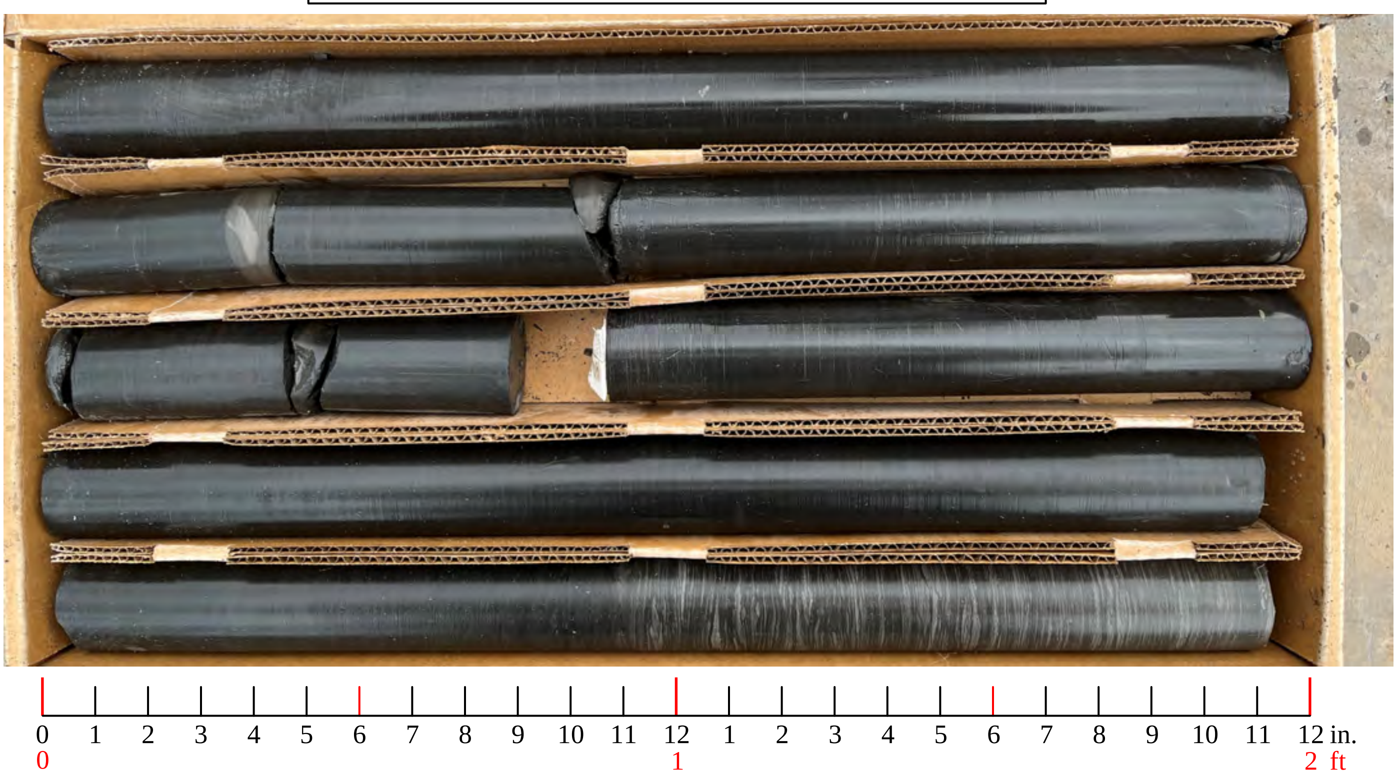
ROCK CORE PHOTOS
040748 Hwy 22 to I-40
Crawford & Sebastian Counties, Arkansas

Job No. 21-071

Plate

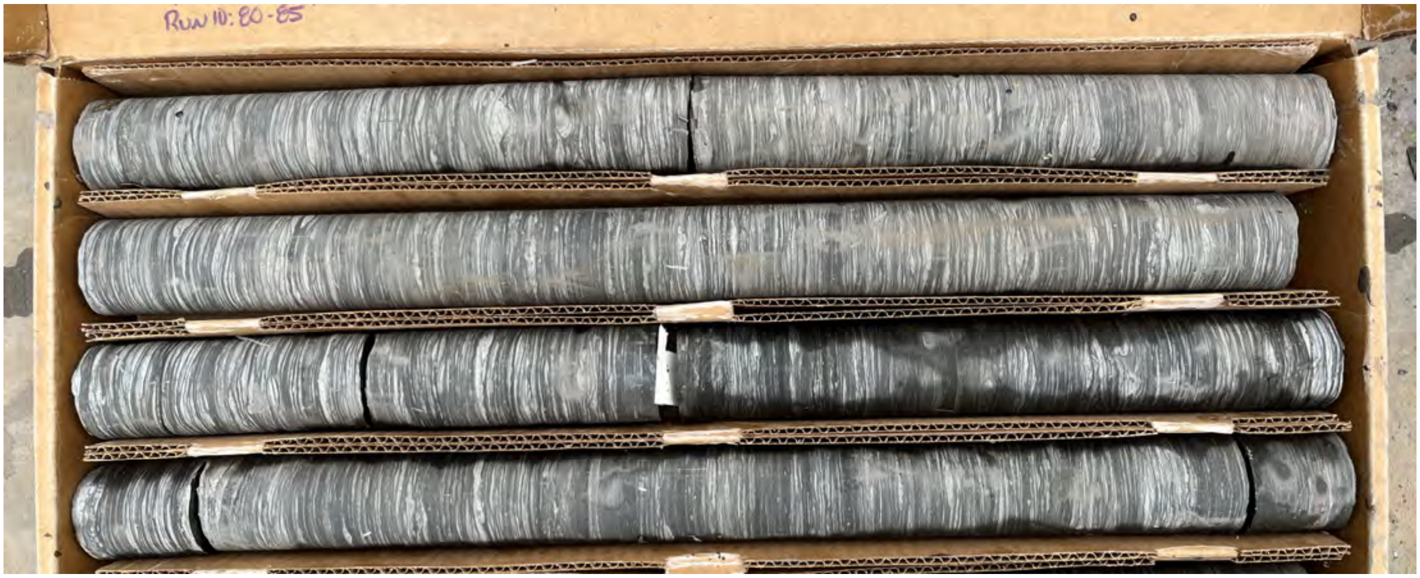
FB-4: Run 5 (55-60 ft), Run 6 (60-65 ft)

FB-4: Run 7 (65-70 ft), Run 8 (70-75 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-4: Run 9 (75-80 ft), Run 10 (80-85 ft)



0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-4: Run 11 (85-87 ft))

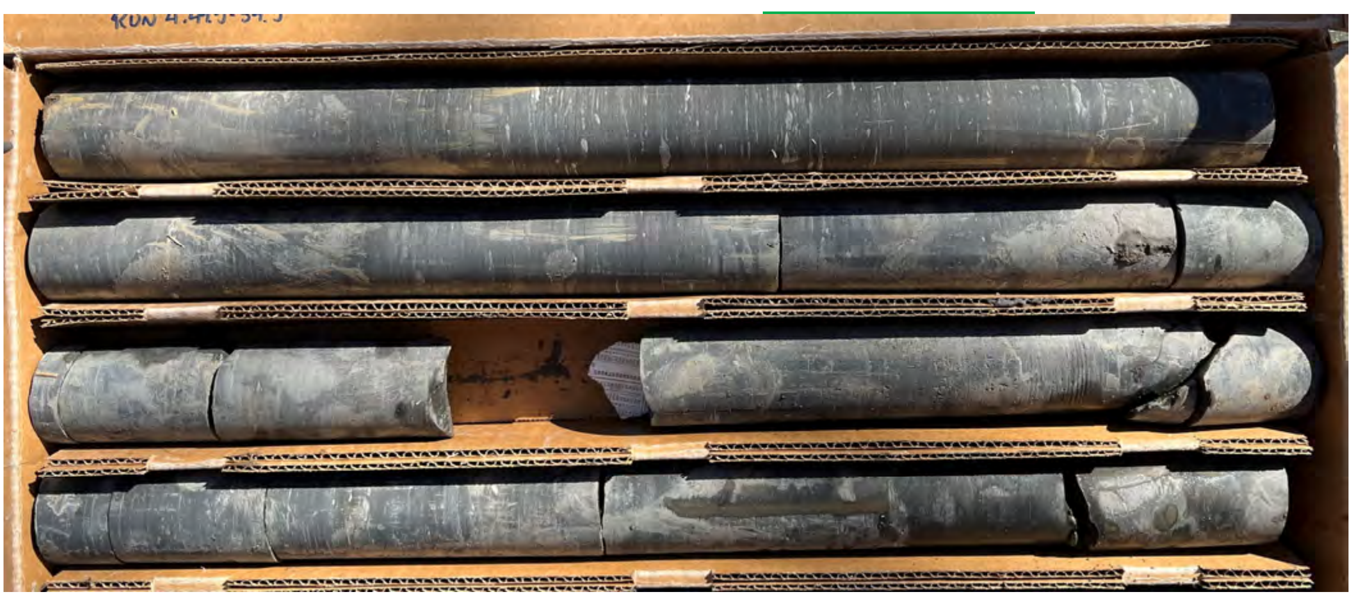
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-5: Run 1 (37-39.5 ft), Run 2 (39.5-44.5 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

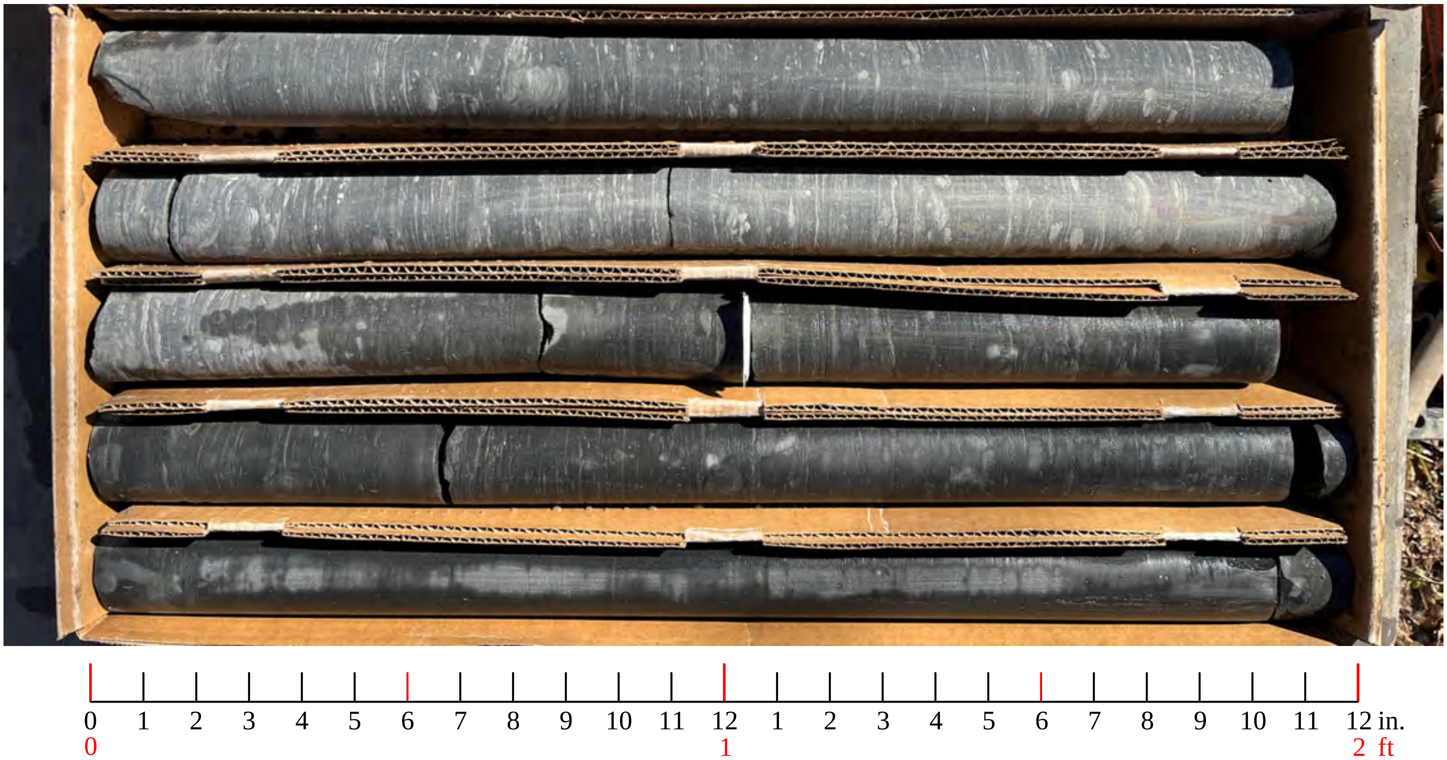
FB-5: Run 3 (44.5-49.5 ft), Run 4 (49.5-54.5 ft)



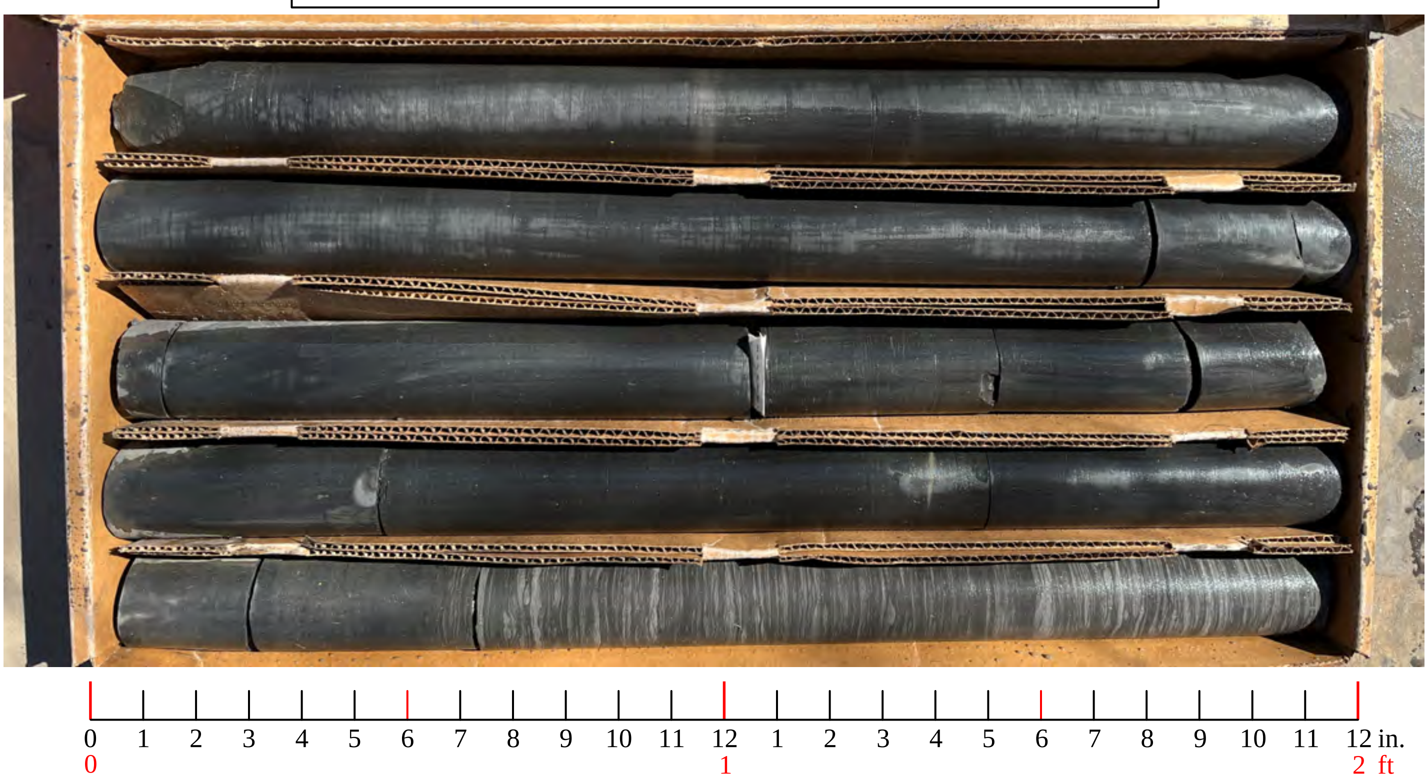
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-5: Run 5 (54.5-59.5 ft), Run 6 (59.5-64.5 ft)



FB-5: Run 7 (64.5-69.5 ft), Run 8 (69.5-74.5 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-5: Run 9 (74.5-79.5 ft), Run 10 (79.5-84.5 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

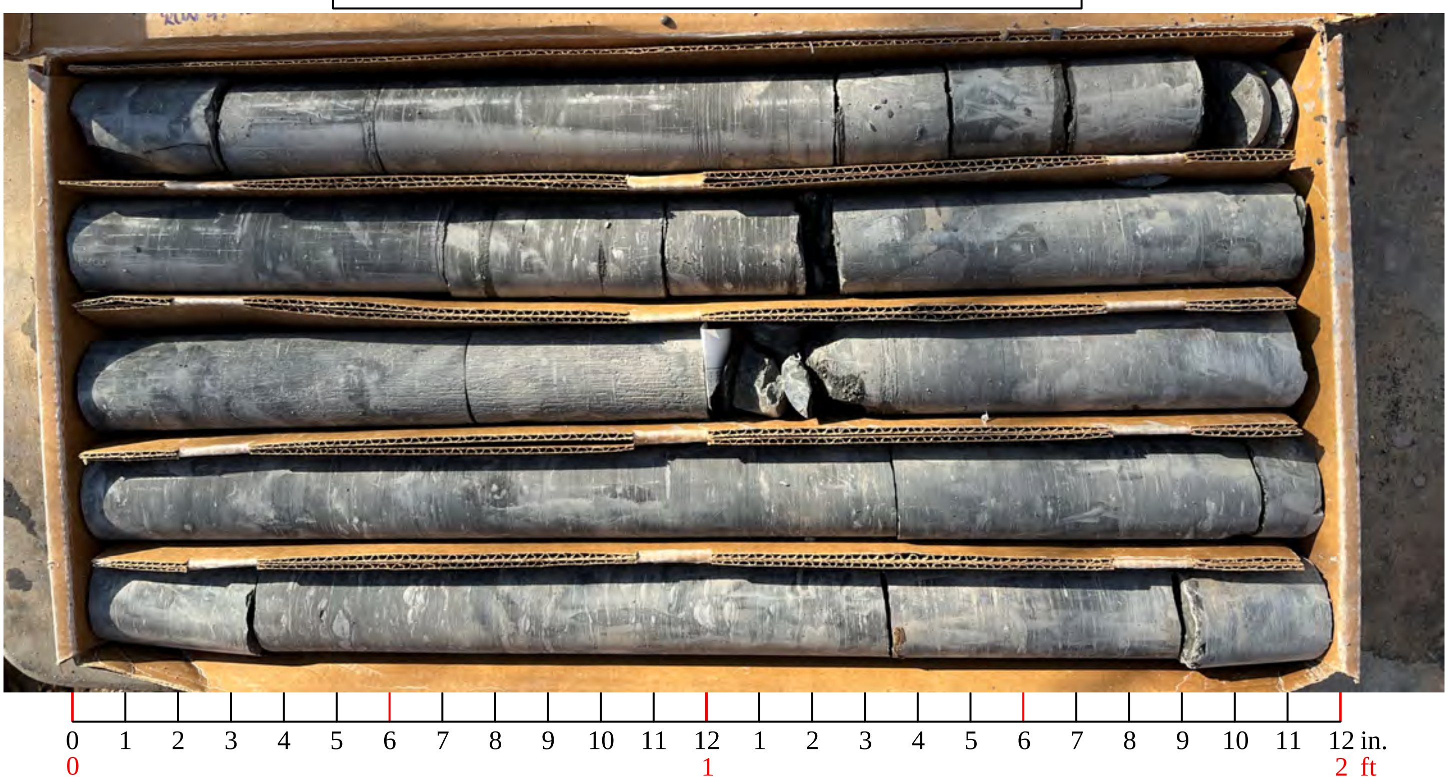
FB-5: Run 11 (84.5-87.5 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	**Job No. 21-071**
		Plate

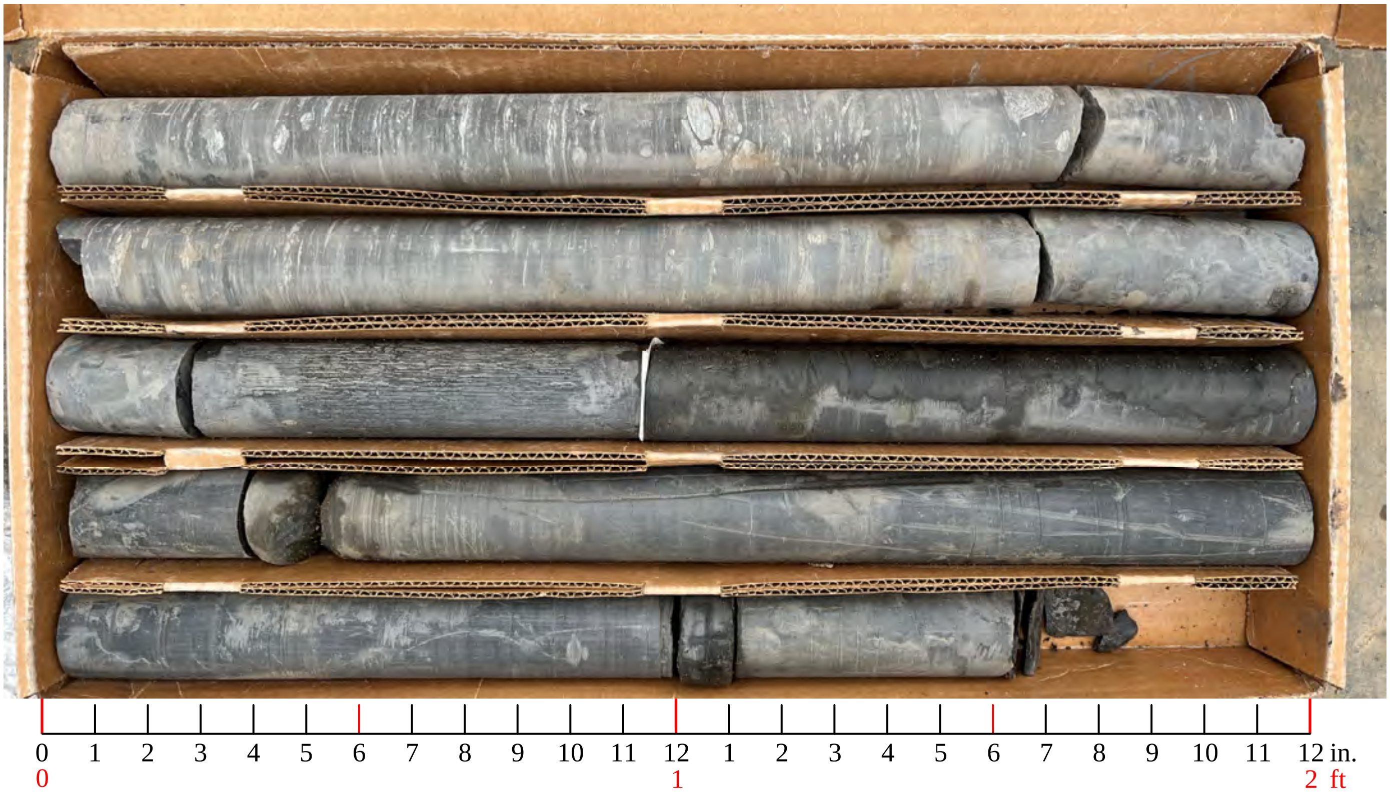
FB-7: Run 1 (30-35 ft), Run 2 (35-40 ft)

FB-7: Run 3 (40-45 ft), Run 4 (45-50 ft)

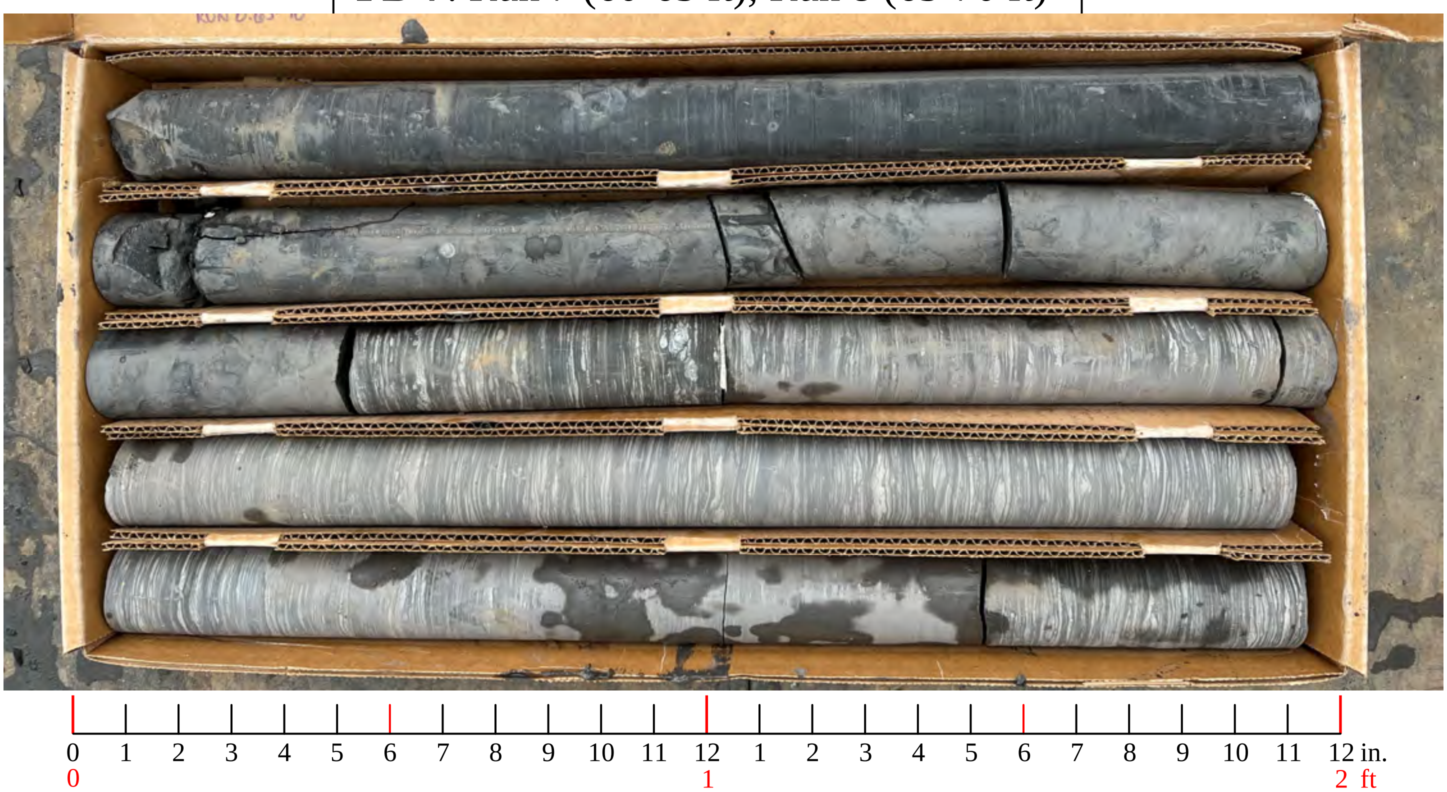


Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-7: Run 5 (50-55 ft), Run 6 (55-60 ft)



FB-7: Run 7 (60-65 ft), Run 8 (65-70 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-7: Run 9 (70-75 ft), Run 10 (75-80 ft)

0	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12 in.
0												1												2 ft

FB-8: Run 1 (29-34 ft), Run 2 (34-39 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-8: Run 3 (39-44 ft), Run 4 (44-49 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-8: Run 5 (49-54 ft), Run 6 (54-59 ft)

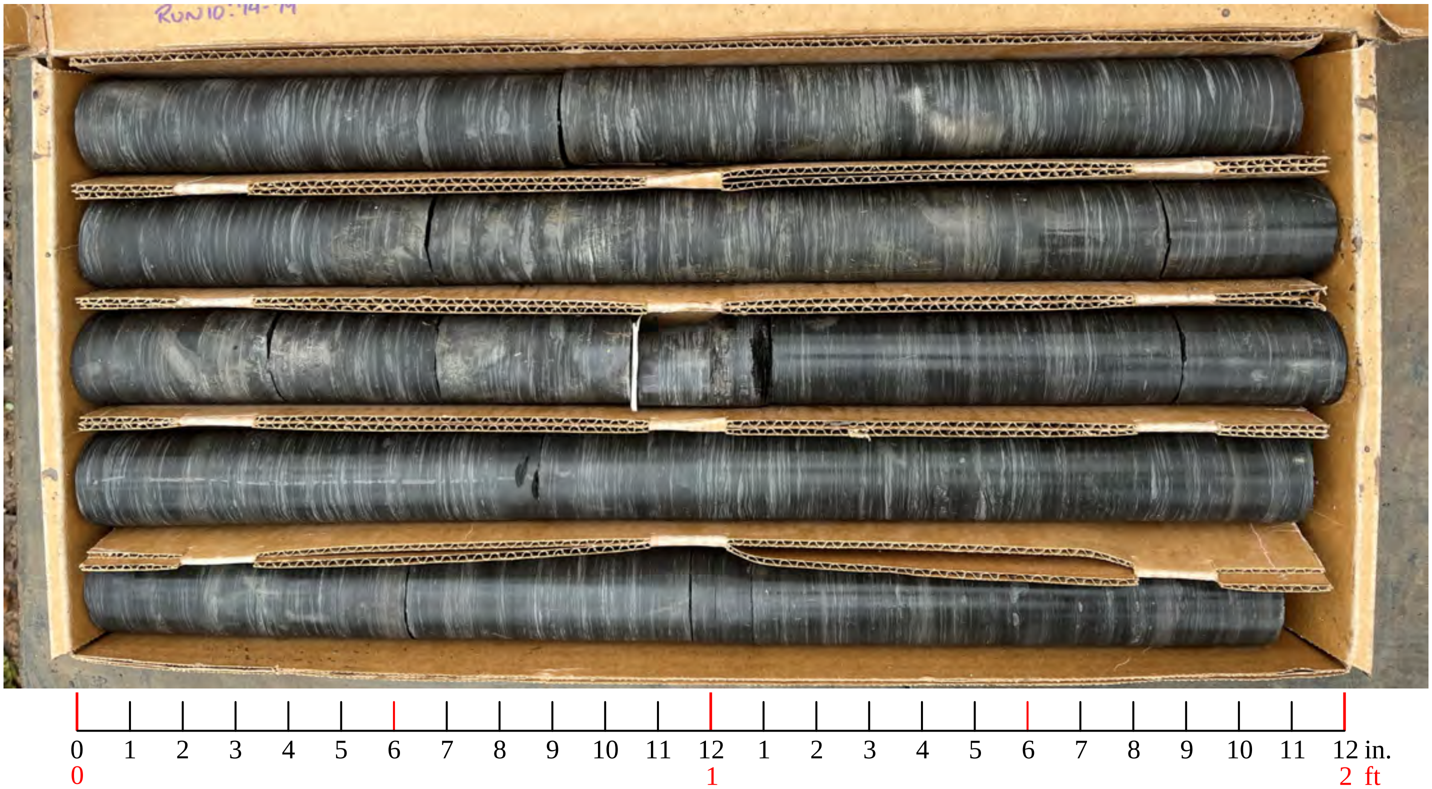
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-8: Run 7 (59-64 ft), Run 8 (64-69 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-8: Run 9 (69-74 ft), Run 10 (74-79 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-10: Run 1 (45-50 ft), Run 2 (50-55 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-10: Run 3 (55-60 ft), Run 4 (60-65 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071**
		Plate

FB-10: Run 5 (65-70 ft), Run 6 (70-75 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-10: Run 7 (75-80 ft), Run 8 (80-85 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-10: Run 9 (85-90 ft), Run 10 (90-95 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

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Crawford & Sebastian Counties, Arkansas

Job No. 21-071

Plate

FB-11: Run 1 (50-55 ft), Run 2 (55-60 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-11: Run 3 (60-65 ft), Run 4 (65-70 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>ROCK CORE PHOTOS</u> 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	**Job No. 21-071** **Plate**

FB-11: Run 5 (70-75 ft), Run 6 (75-80 ft)

FB-11: Run 7 (80-85 ft), Run 8 (85-90 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-11: Run 9 (90-95 ft), Run 10 (95-100 ft)

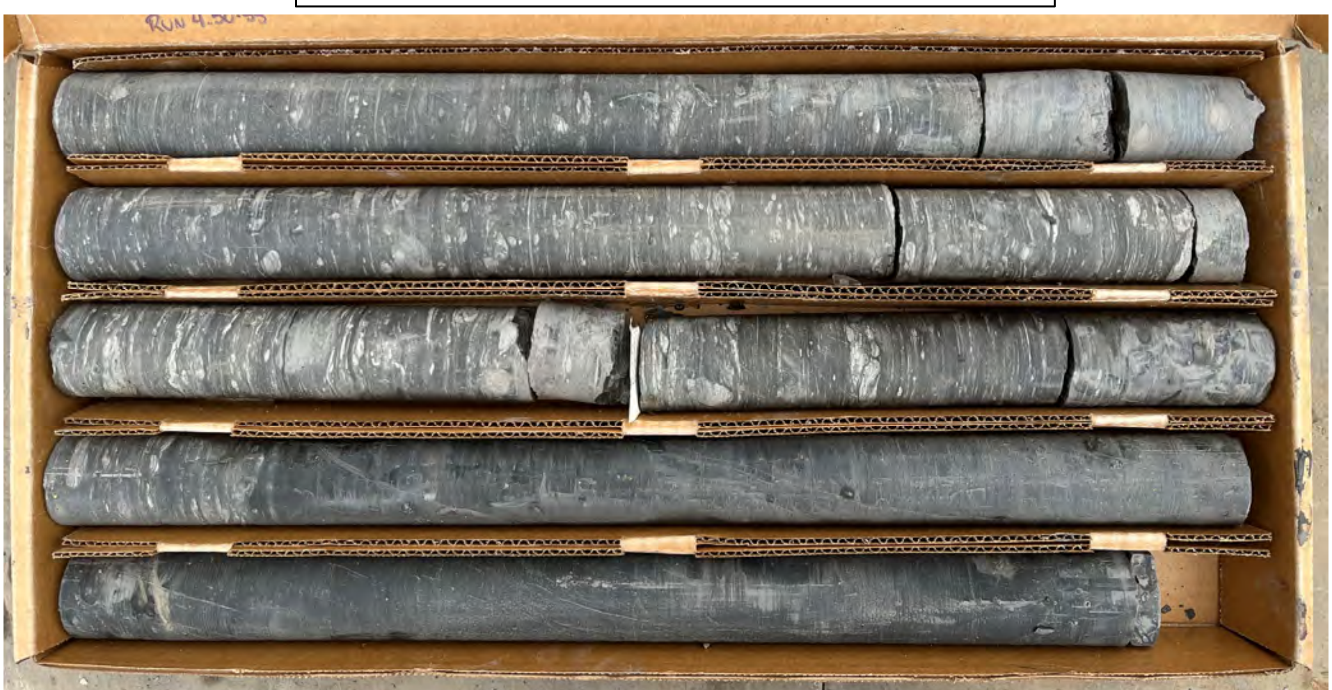
0	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12 in.
0												1												2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>ROCK CORE PHOTOS</u> 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	**Job No. 21-071** **Plate**

FB-12: Run 1 (35-40 ft), Run 2 (40-45 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

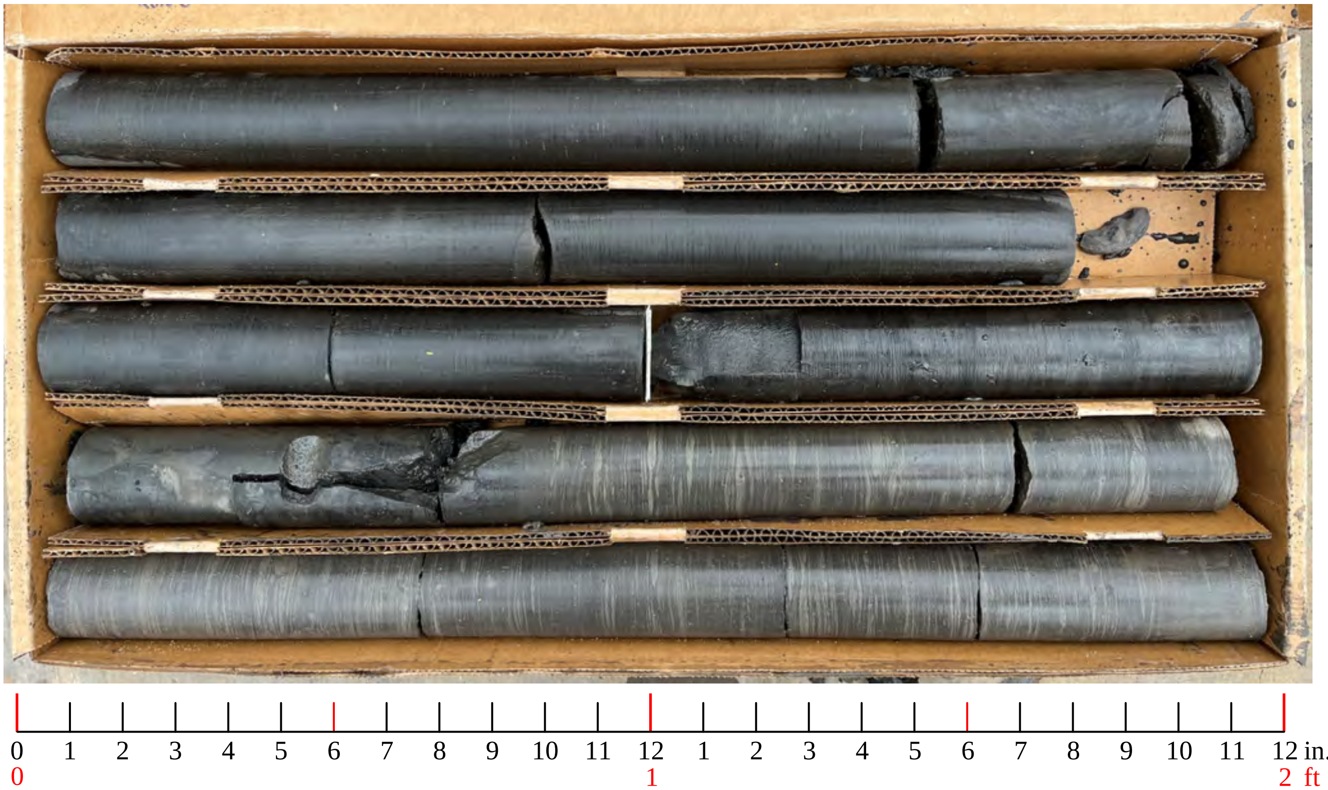
FB-12: Run 3 (45-50 ft), Run 4 (50-55 ft)



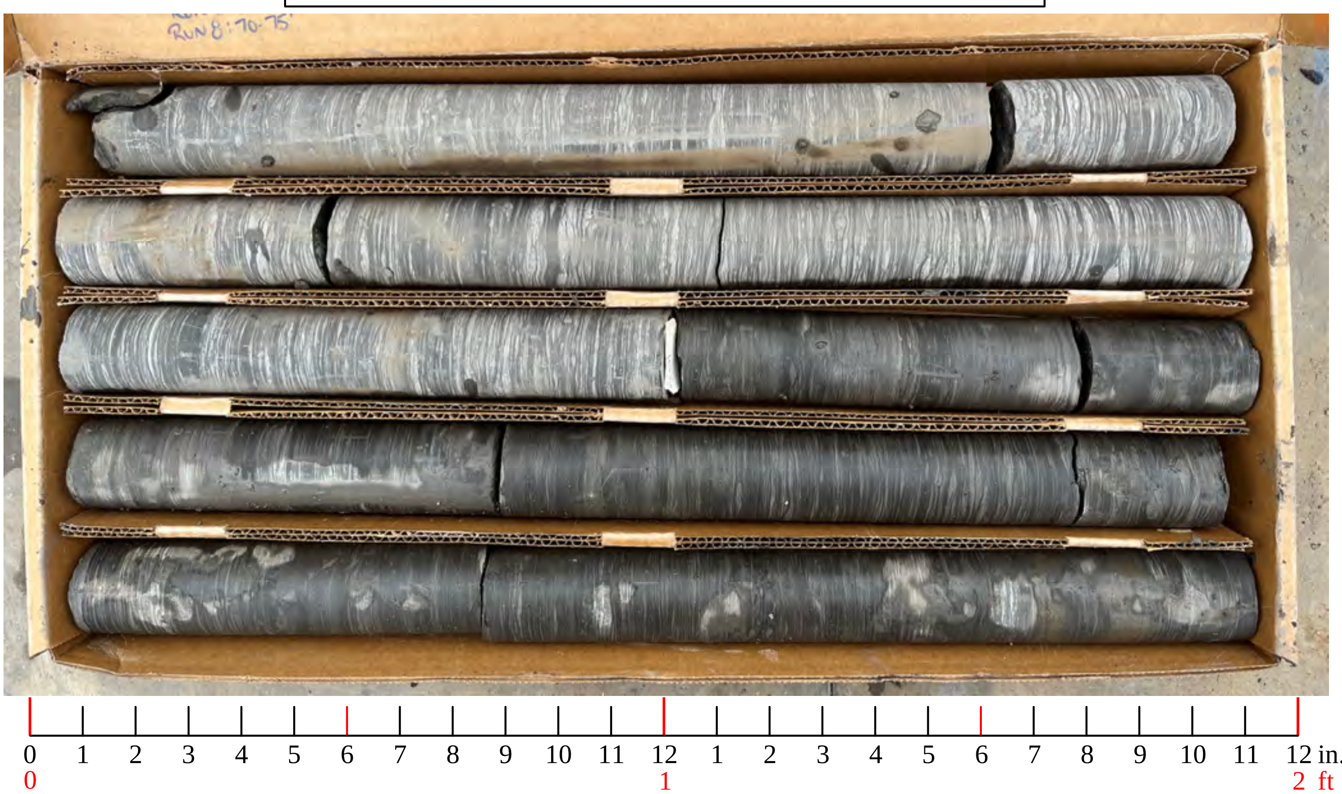
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-12: Run 5 (55-60 ft), Run 6 (60-65 ft)

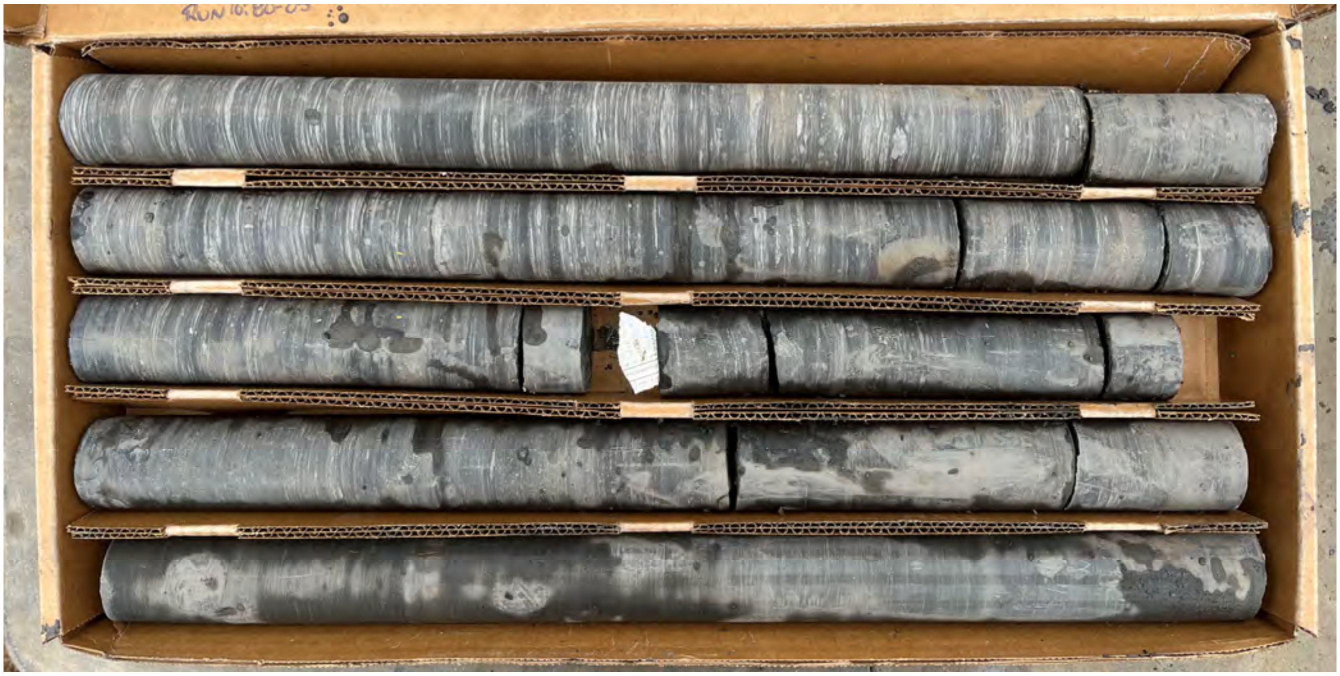


FB-12: Run 7 (65-70 ft), Run 8 (70-75 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-12: Run 9 (75-80 ft), Run 10 (80-80-85 ft)



0	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12 in.
0												1												2 ft

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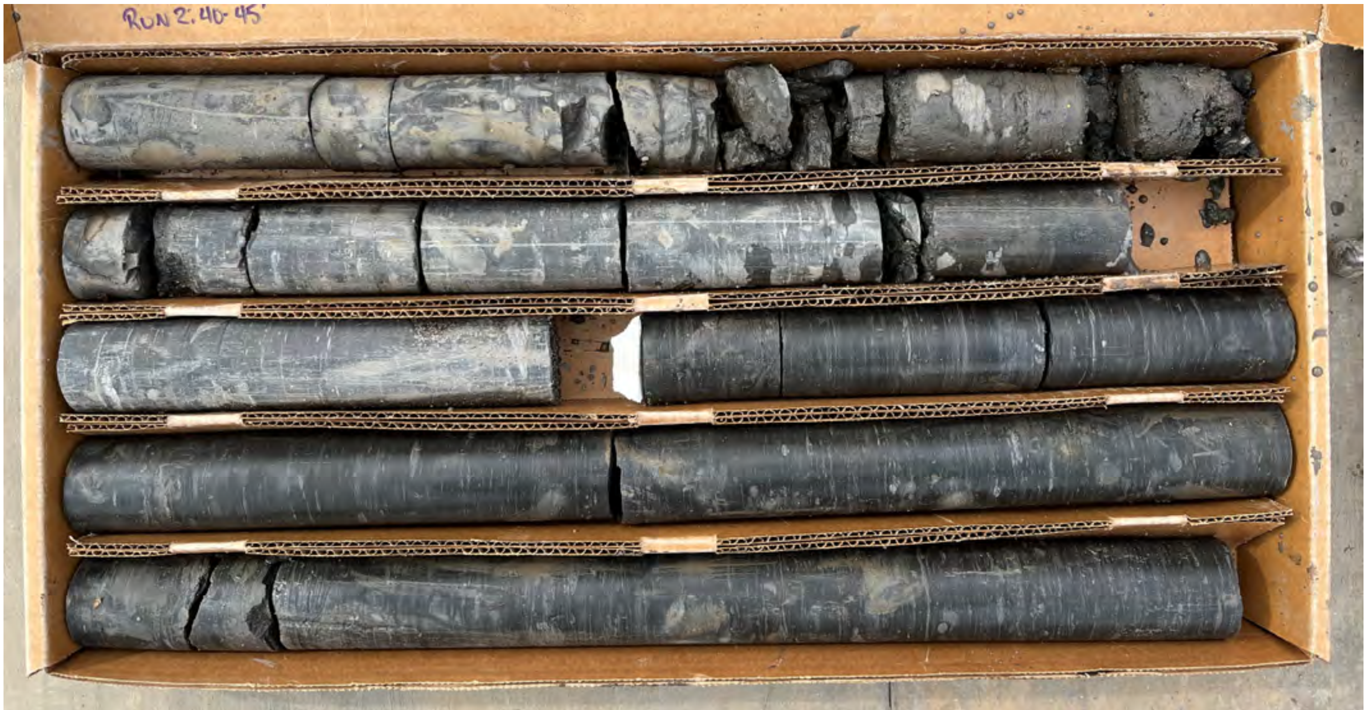
ROCK CORE PHOTOS
040748 Hwy 22 to I-40
Crawford & Sebastian Counties, Arkansas

Job No. 21-071

Plate

FB-13: Run 1 (35-40 ft), Run 2 (40-45 ft)



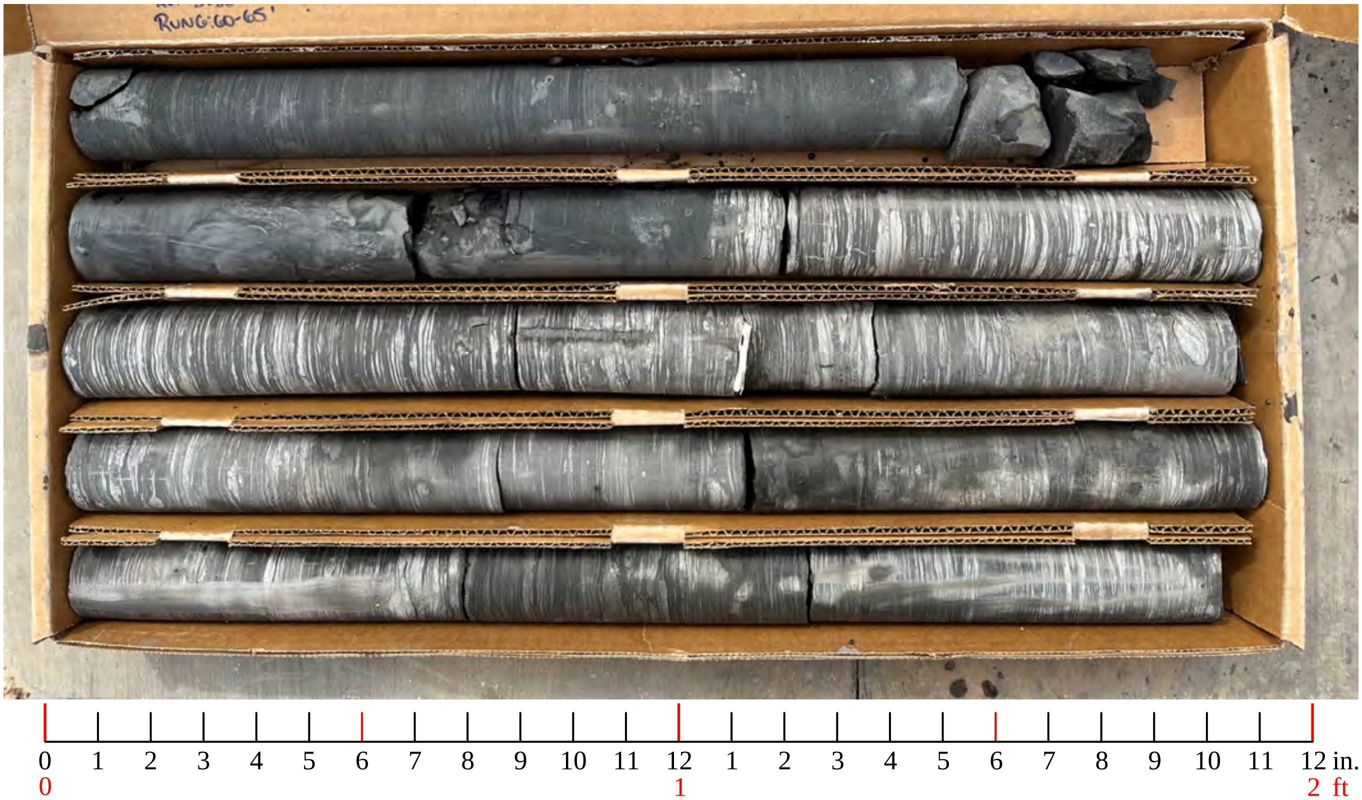
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-13: Run 3 (45-50 ft), Run 4 (50-55 ft)

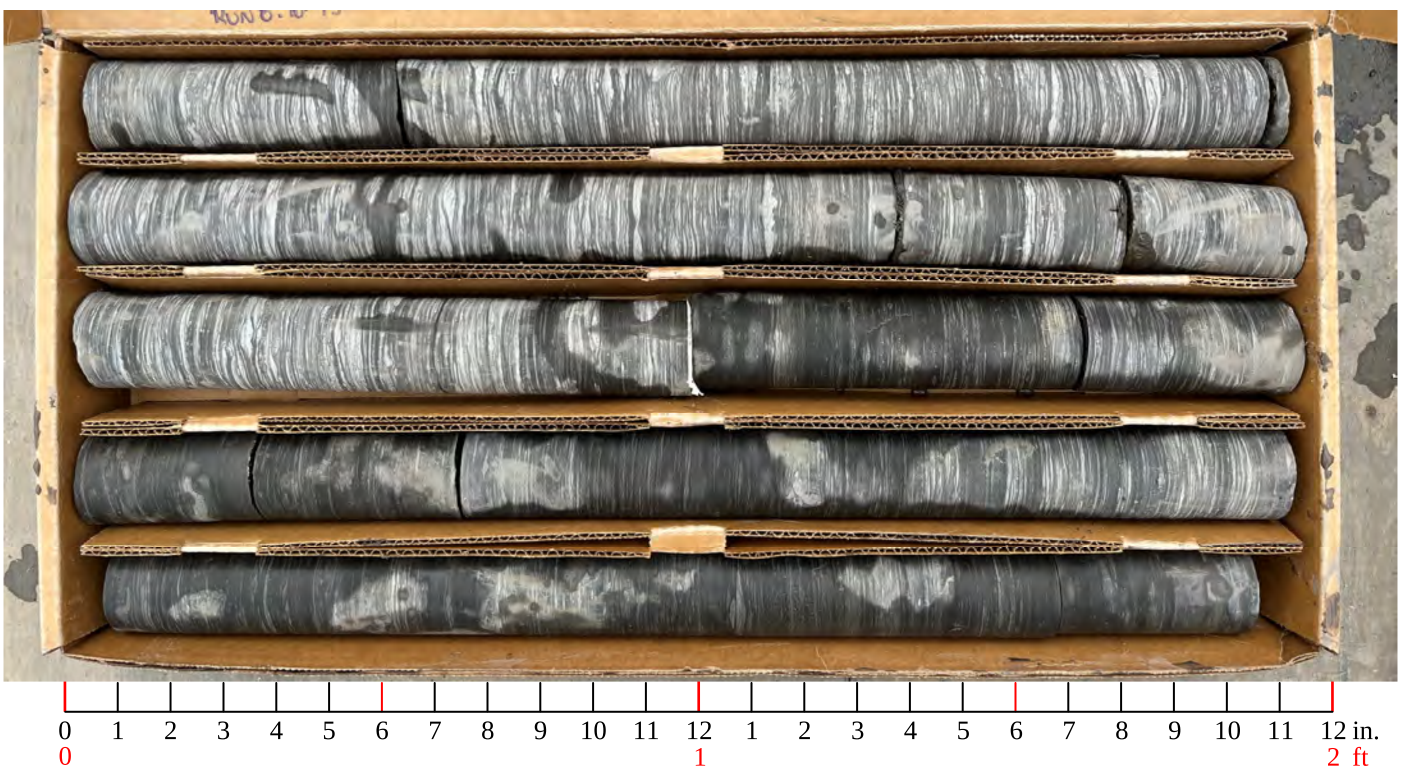
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-13: Run 5 (55-60 ft), Run 6 (60-65 ft)

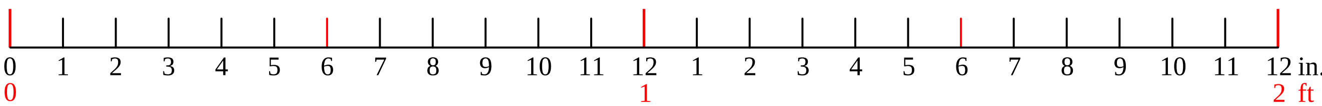


FB-13: Run 7 (65-70 ft), Run 8 (70-75 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-13: Run 9 (75-80 ft), Run 10 (80-85 ft)



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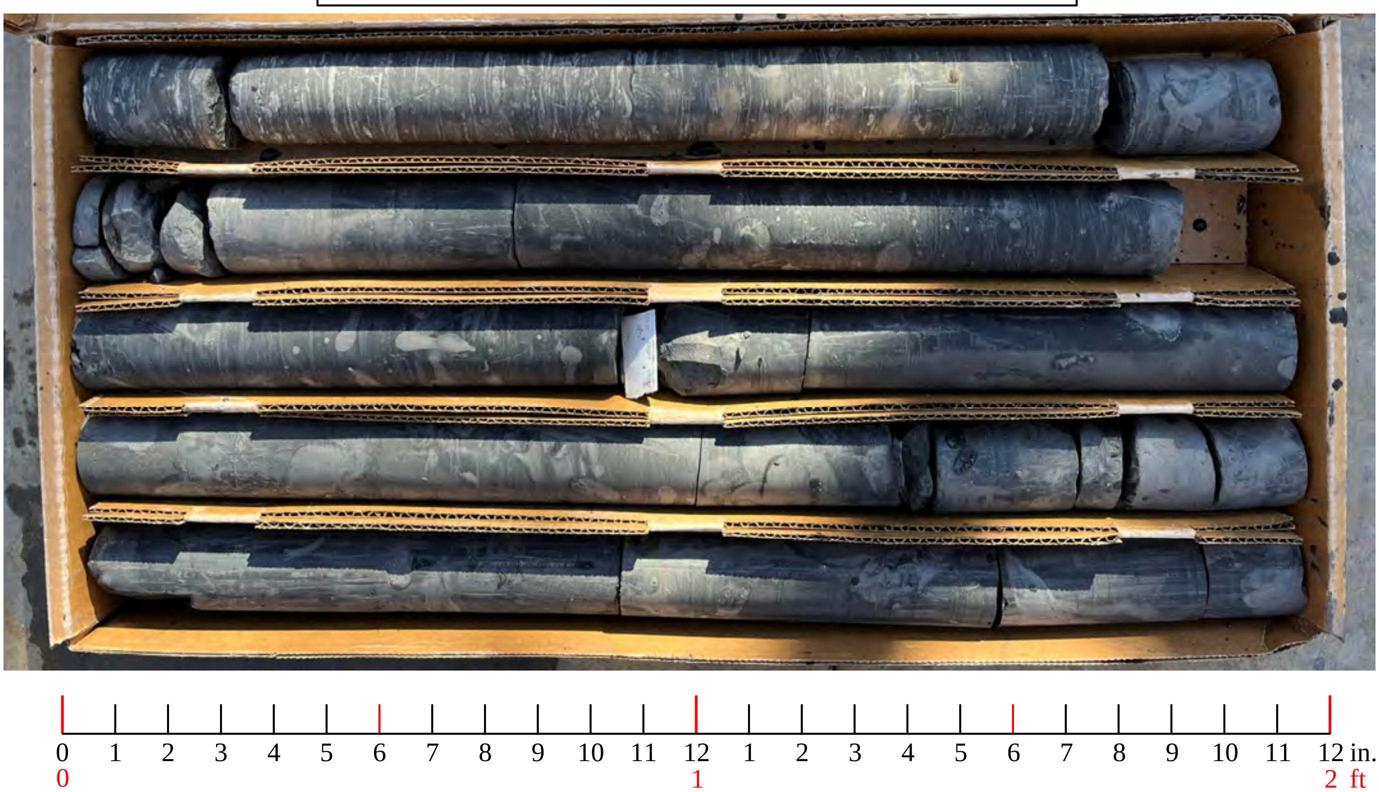
040748 Hwy 22 to I-40
Crawford & Sebastian Counties, Arkansas

Job No. 21-071

Plate

FB-14: Run 1 (36-41 ft), Run 2 (41-46 ft)

FB-14: Run 3 (46-51 ft), Run 4 (51-56 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>ROCK CORE PHOTOS</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-14: Run 5 (56-61 ft), Run 6 (61-66 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-14: Run 7 (66-71 ft), Run 8 71-76 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>ROCK CORE PHOTOS</u> 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	Job No. 21-071 Plate

FB-14: Run 9 (76-81 ft), Run 10 (81-86 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-15: Run 1 (38.5-40 ft), Run 2 (40-45 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-15: Run 3 (45-50 ft), Run 4 (50-55 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-15: Run 5 (55-60 ft), Run 6 (60-65 ft)

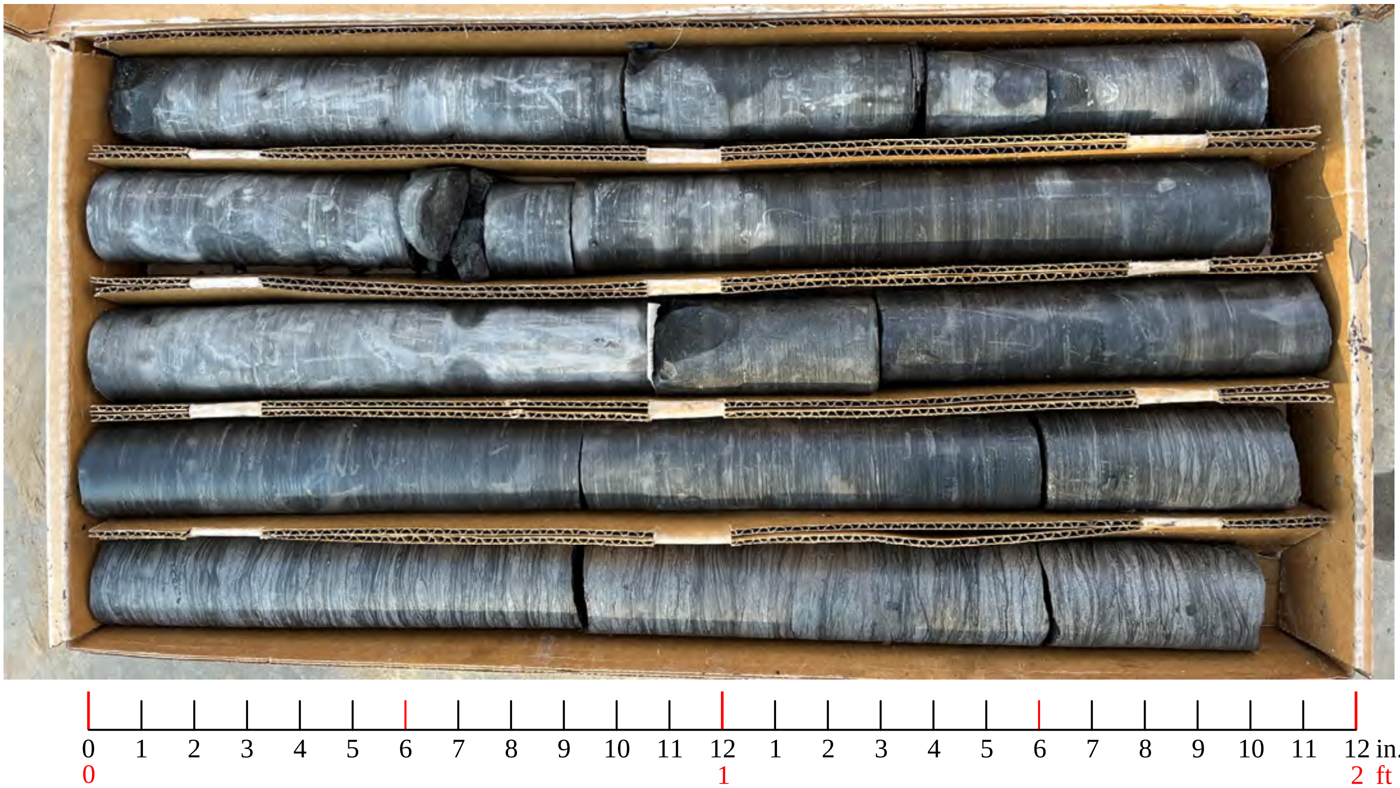
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-15: Run 7 (65-70 ft), Run 8 (70-75 ft)

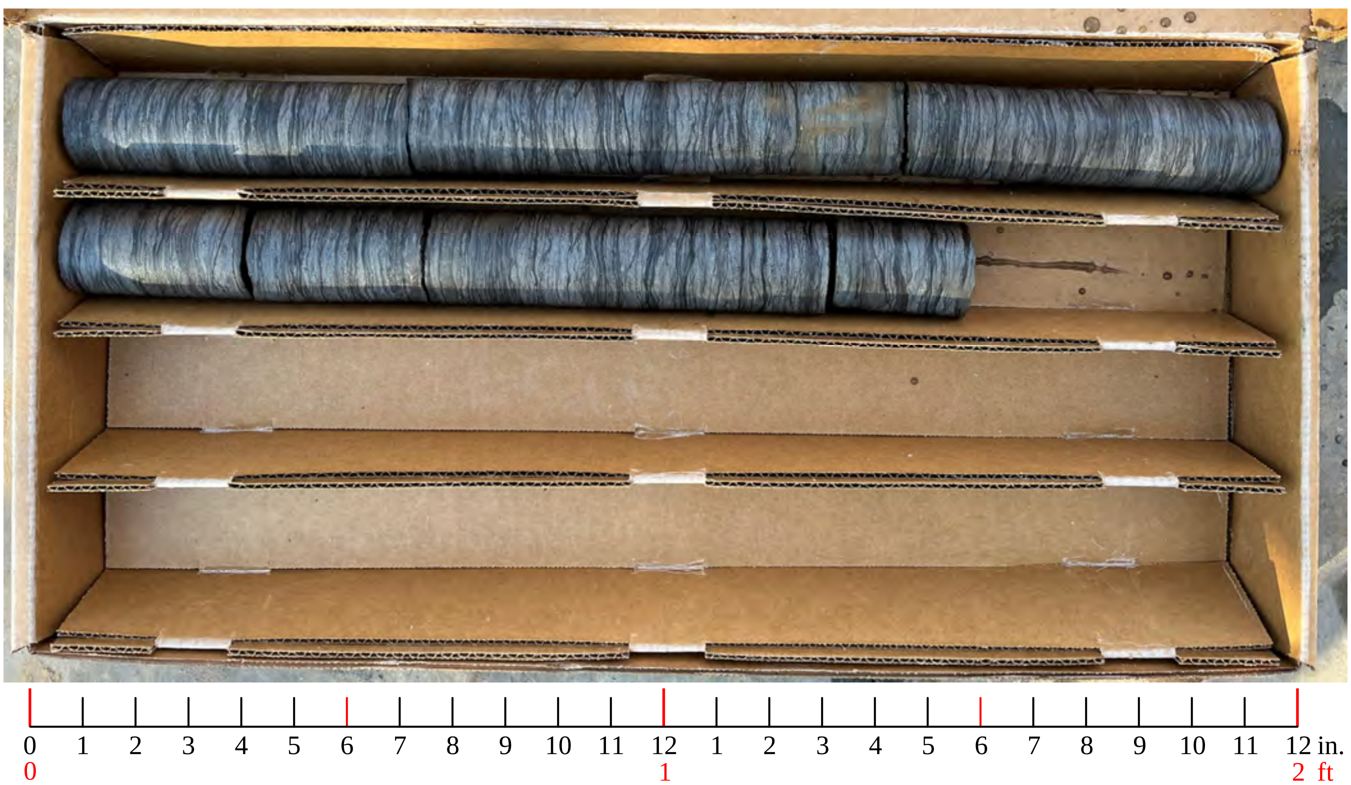
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-15: Run 9 (75-80 ft), Run 10 (80-85 ft)



FB-15: Run 11 (85-88.5 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-16: Run 1 (39-40.5 ft), Run 2 (40.5-45.5 ft)

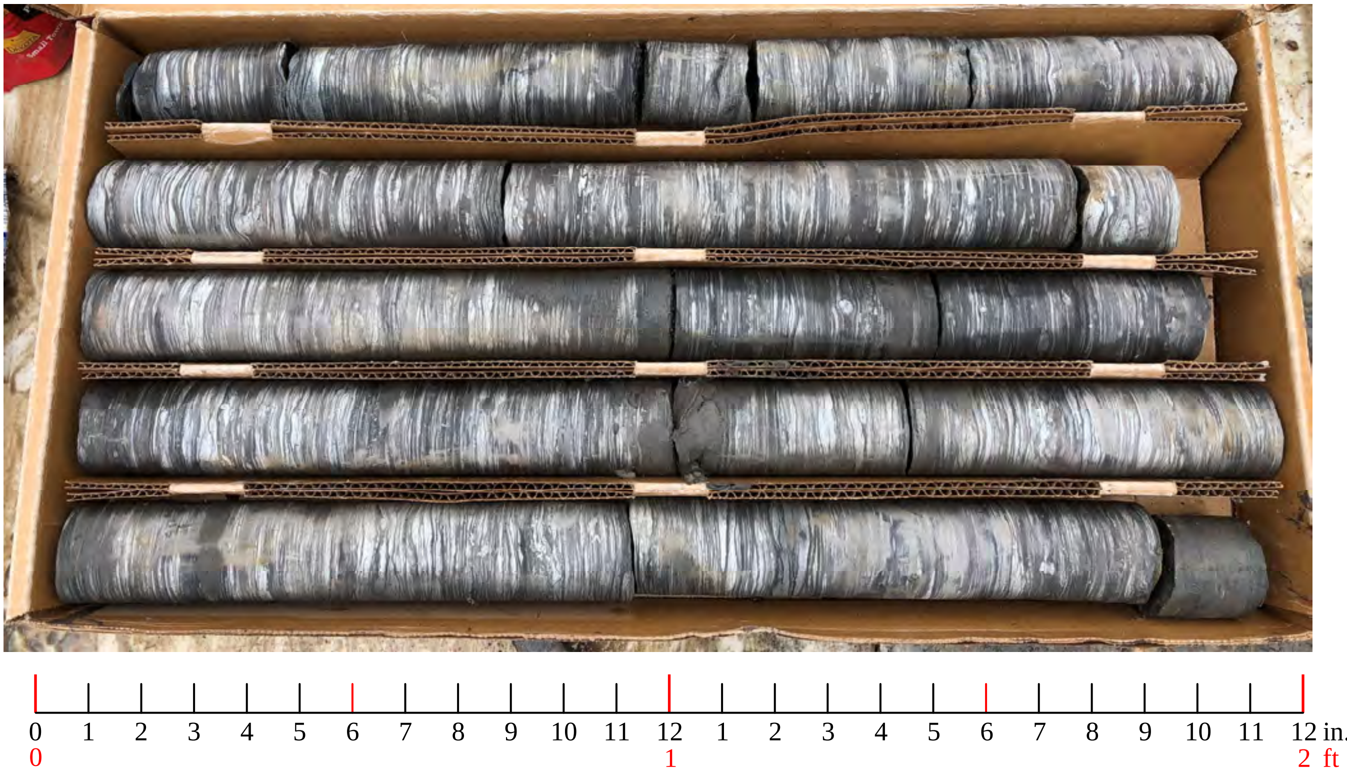
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-16: Run 3 (45.5-50.5 ft), Run 4 (50.5-55.5 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

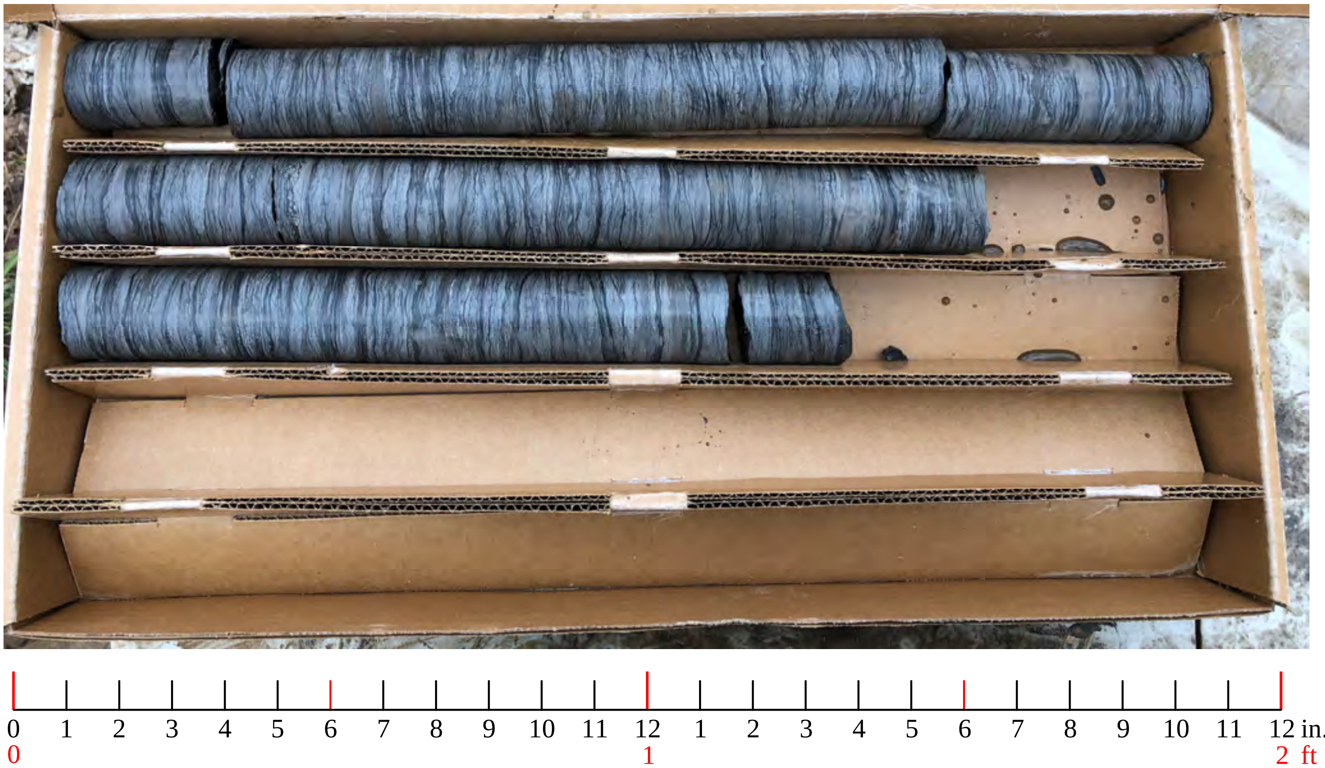
FB-16: Run 5 (55.5-60.5 ft), Run 6 (60.5-65.5 ft)



FB-16: Run 7 (75.5-80.5 ft), Run 8 (80.5-85.5 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>ROCK CORE PHOTOS</u> 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	Job No. 21-071 Plate

FB-16: Run 9 (85.5-90.5 ft)



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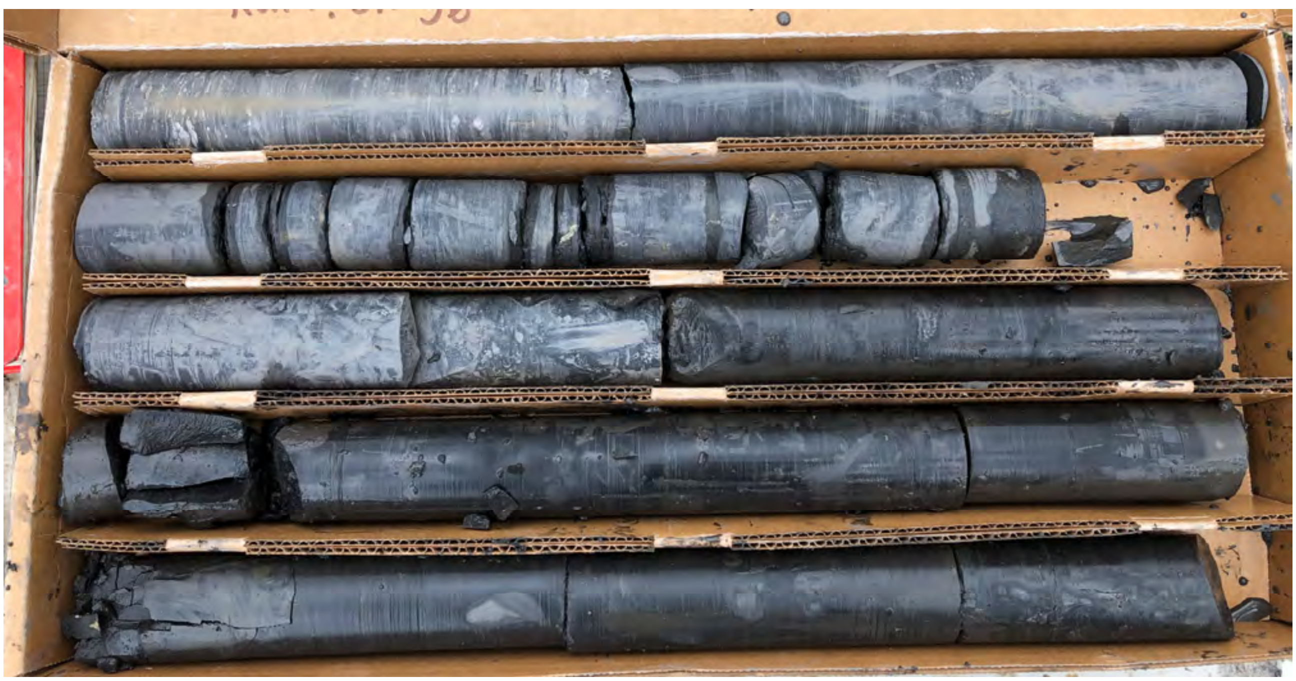
FB-17: Run 1 (39-41 ft), Run 2 (41-46 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-17: Run 3 (46-51 ft), Run 4 (51-56 ft)



0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-17: Run 5 (56-61 ft), Run 6 (61-66 ft)

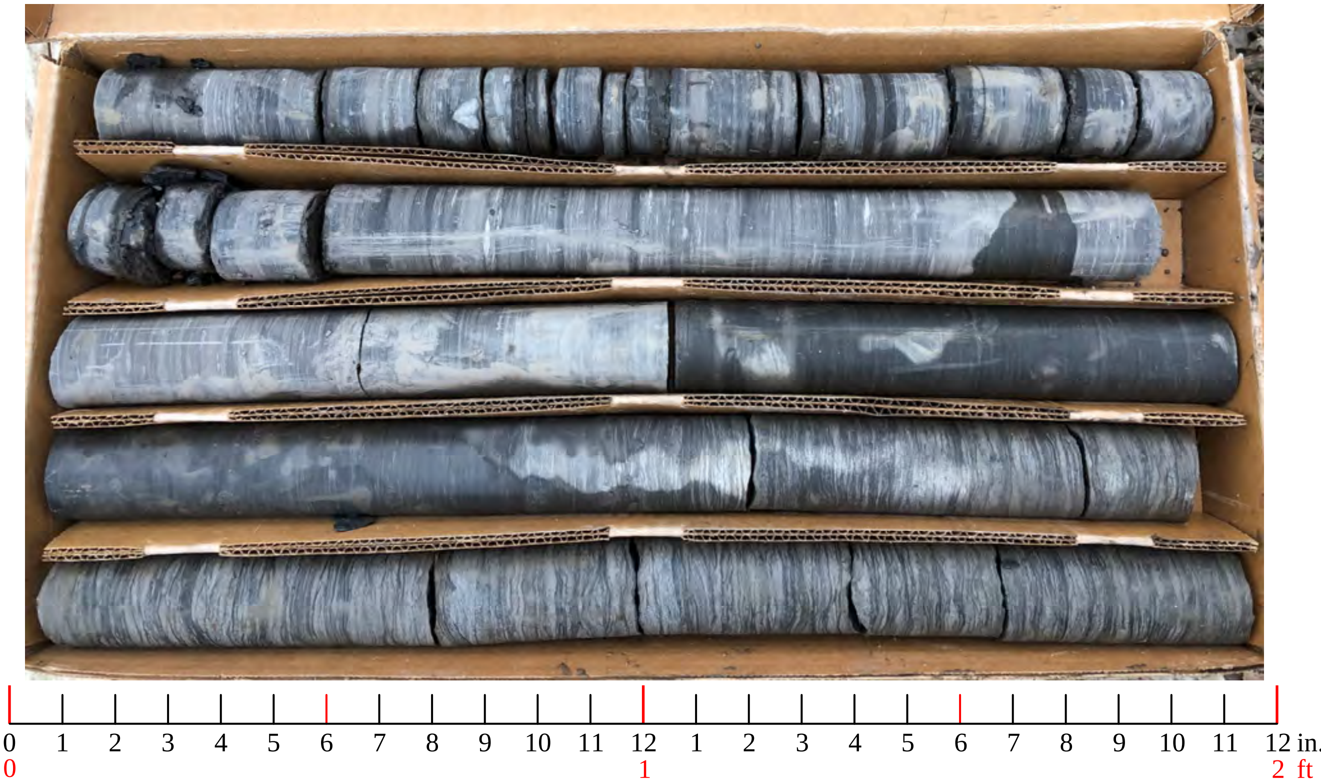
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-17: Run 7 (66-71 ft), Run 8 (71-76 ft)

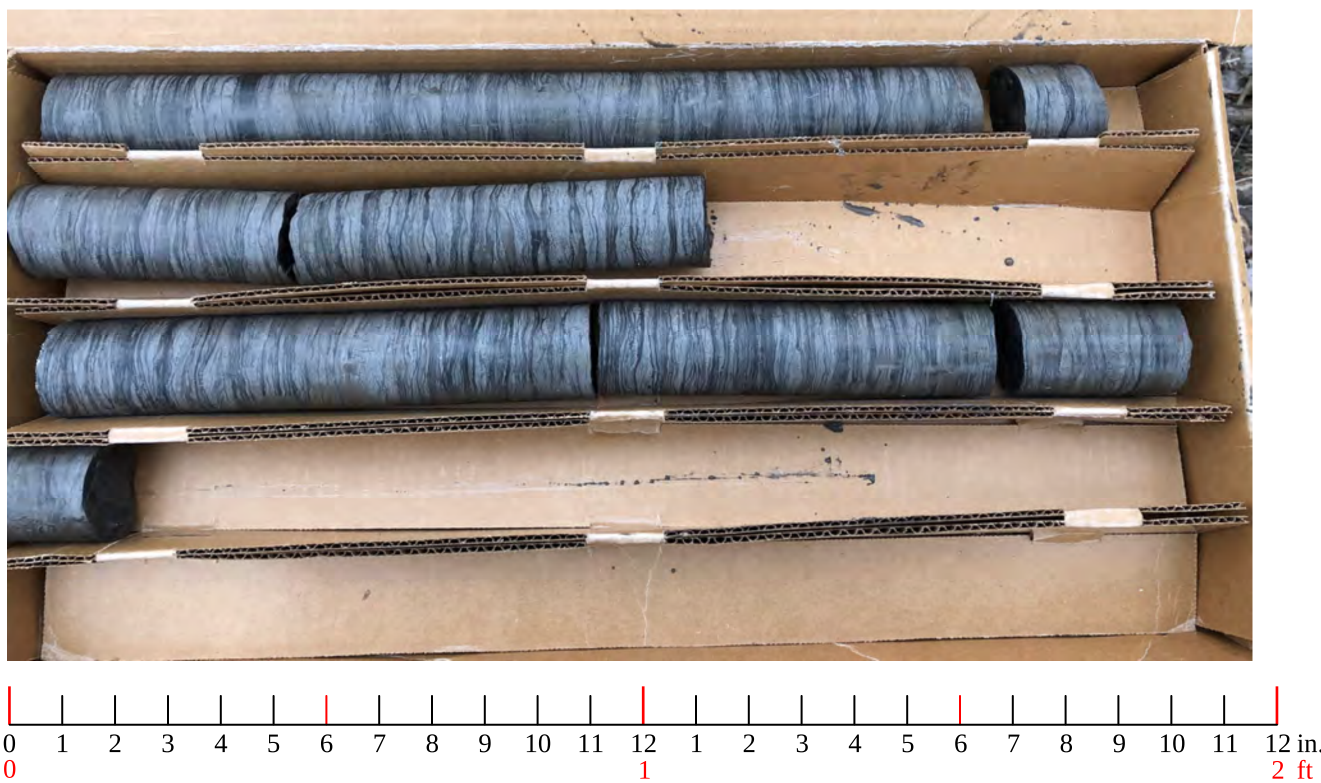
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-17: Run 9 (76-81 ft), Run 10 (81-86 ft)

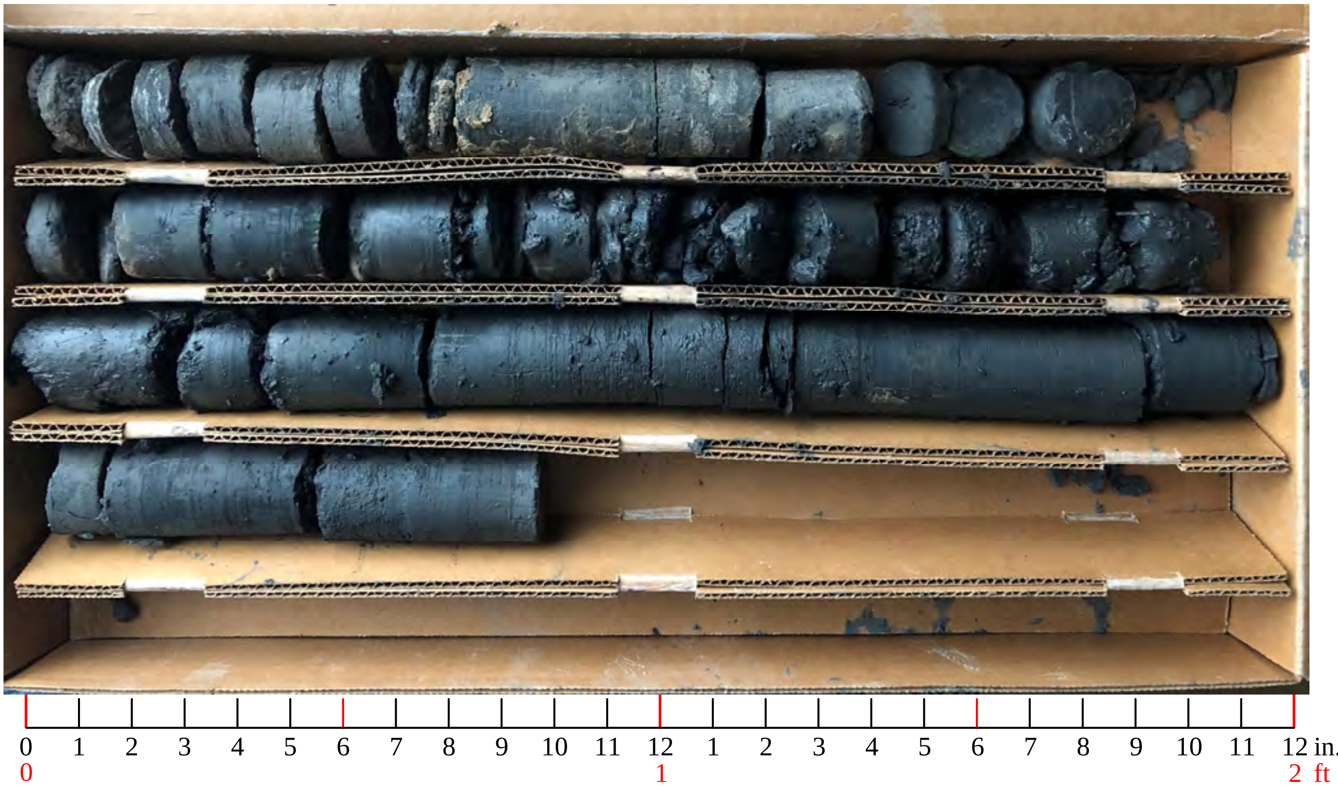


FB-17: Run 11 (86-91 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	**Job No. 21-071**
		Plate

FB-18: Run 1 (39-41 ft), Run 2 (41-46 ft)



FB-18: Run 3 (46-51 ft), Run 4 (51-56 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-18: Run 5 (56-61 ft), Run 6 (61-66 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-18: Run 7 (66-71 ft), Run 8 (71-76 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

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ROCK CORE PHOTOS
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FB-18: Run 9 (76-81 ft), Run 10 (81-86 ft)

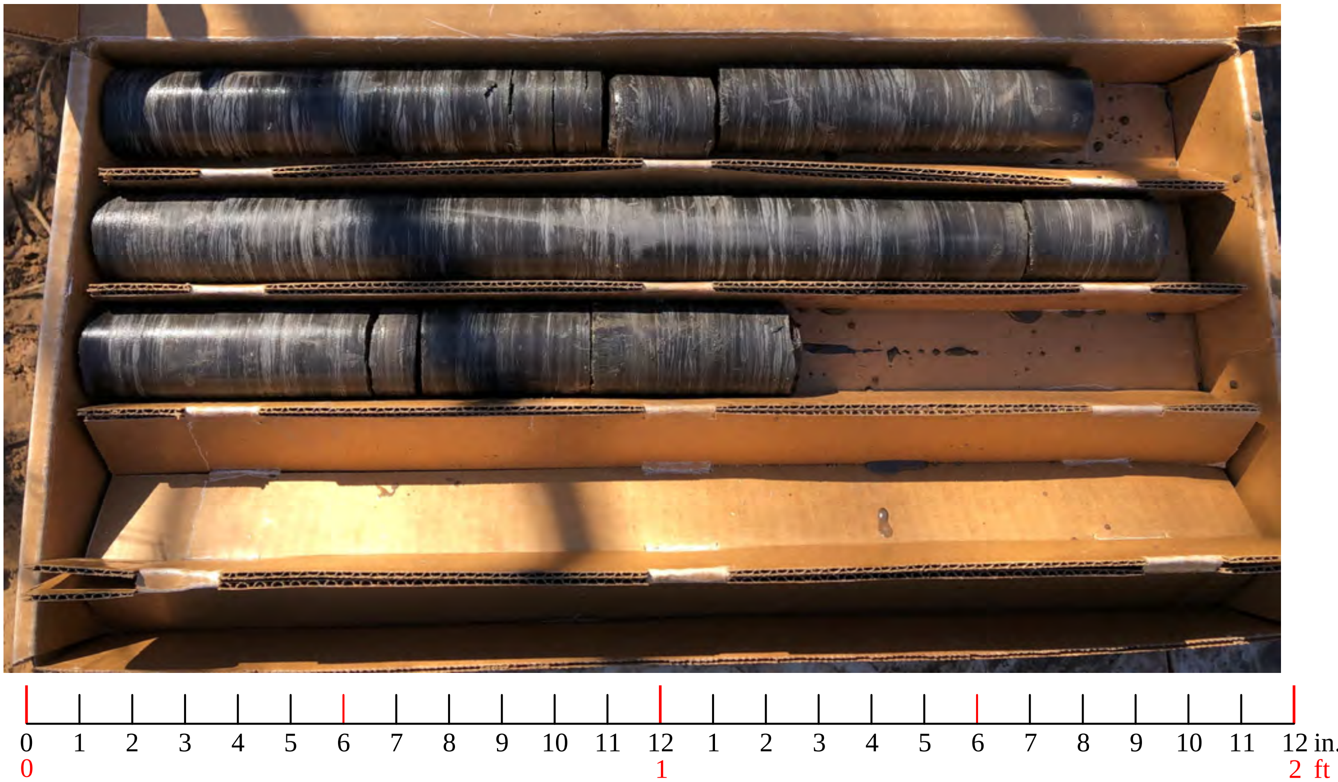
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-18: Run 11 (86-91 ft), Run 12 (91-96 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-18: Run 13 (96-101 ft)



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	ROCK CORE PHOTOS **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071**
		Plate

FB-19: Run 1 (39-41 ft), Run 2 (41-45.5 ft)

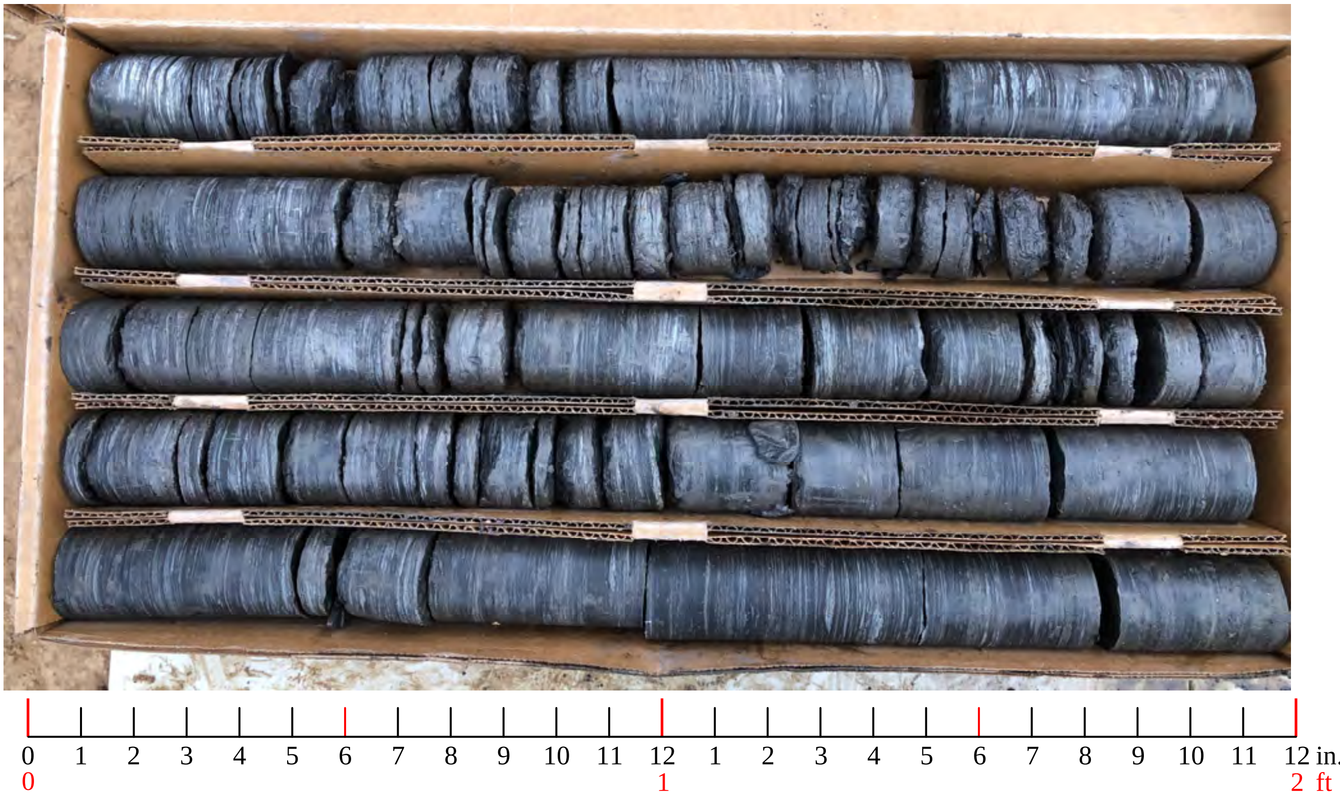
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-19: Run 3 (45.5-50.5 ft), Run 4 (50.5-55.5 ft)

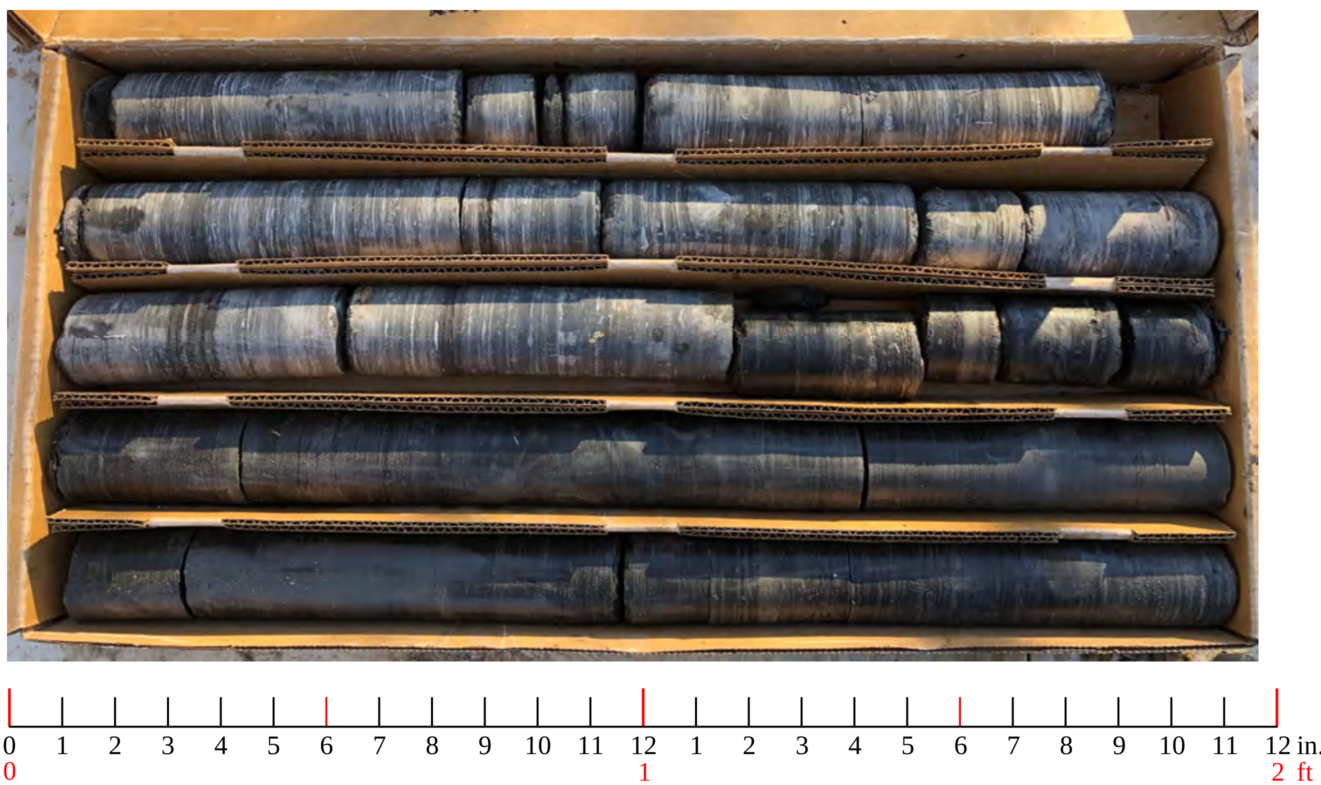
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>**ROCK CORE PHOTOS**</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-19: Run 5 (55.5-60.5 ft), Run 6 (60.5-65.5 ft)

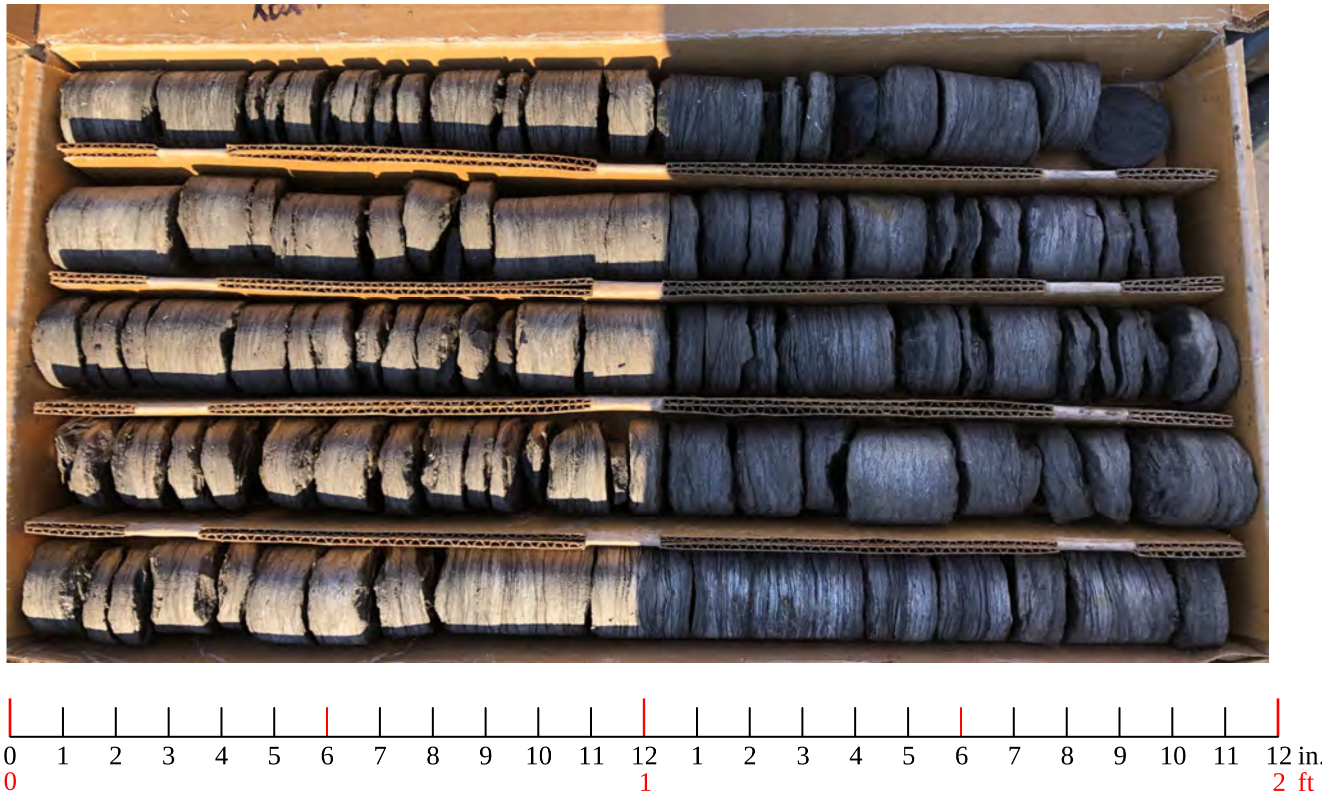


FB-19: Run 7 (65.5-70.5 ft), Run 8 (70.5-75.5 ft)



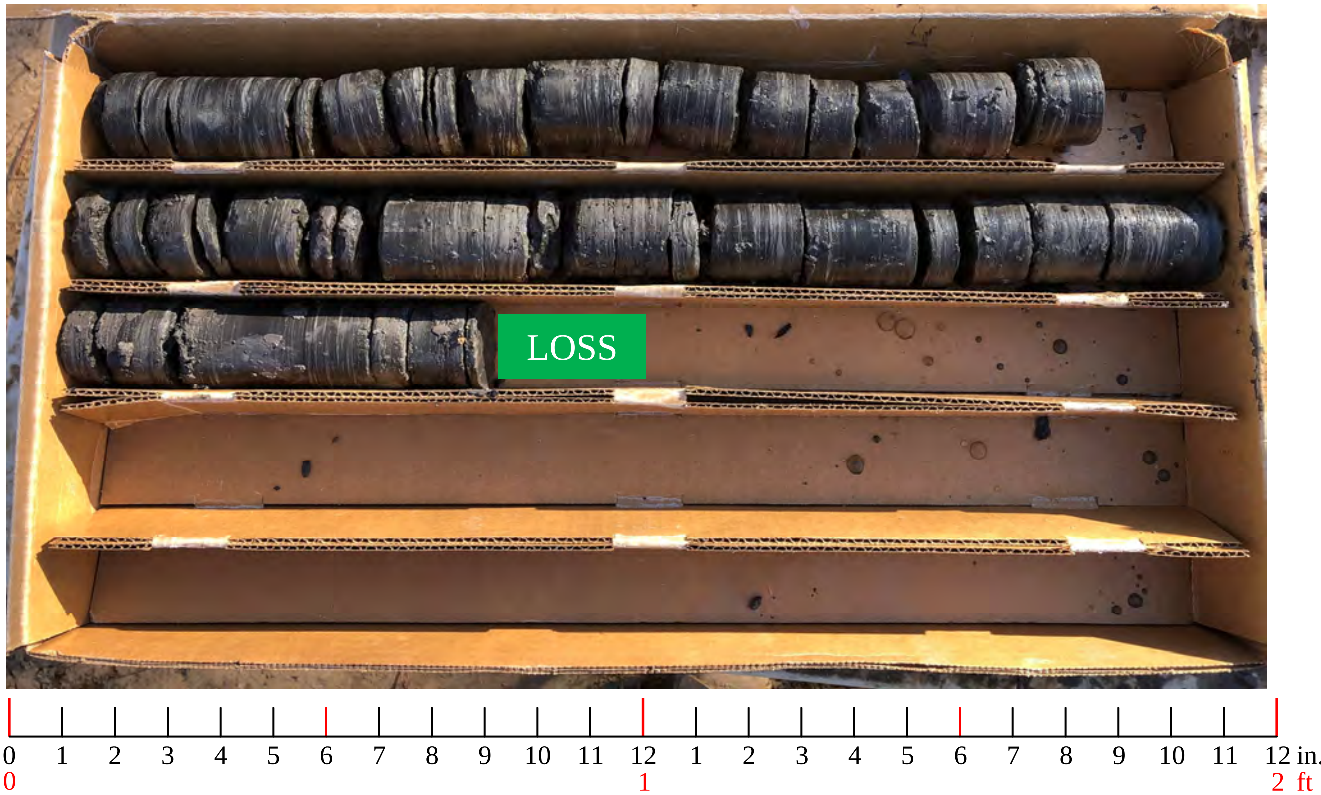
Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>**ROCK CORE PHOTOS**</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-19: Run 9 (75.5-80.5 ft), Run 10 (80.5-85.5 ft)



FB-19: Run 11 (85.5-90.5 ft), Run 12 (90.5-95.5 ft)

FB-19: Run 13 (95.5-100.5 ft)



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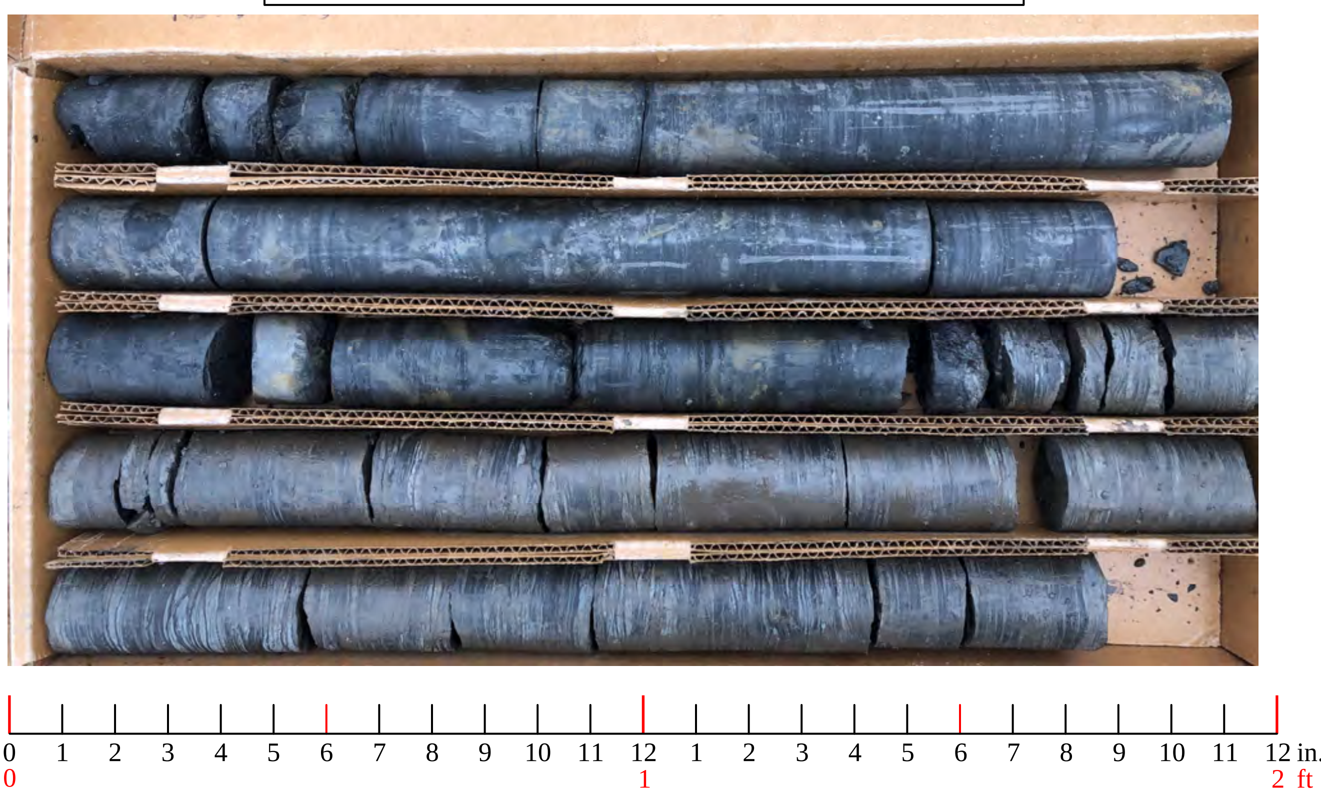
FB-20: Run 1 (37.5-40 ft), Run 2 (40-45 ft)

FB-20: Run 3 (45-50 ft), Run 4 (50-55 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-20: Run 5 (55-60 ft), Run 6 (60-65 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-20: Run 7 (65-70 ft), Run 8 (70-75 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-20: Run 9 (75-80 ft), Run 10 (80-85 ft)

FB-20: Run 11 (85-90 ft), Run 12 (90-95 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>ROCK CORE PHOTOS</u> 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	Job No. 21-071 Plate

FB-21: Run 1 (3-5 ft), Run 2 (5-10 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-21: Run 3 (10-15 ft), Run 4 (15-20 ft

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-21: Run 5 (20-25 ft), Run 6 (25-30 ft)

FB-21: Run 7 (30-35 ft), Run 8 (35-40 ft

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FB-21: Run 9 (40-45 ft), Run 10 (45-47.5 ft), Run 11 (47.5-50 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-21: Run 11 (50-52.5 ft), Run 12 (52.5-57.5 ft

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-21: Run 13 (59.5-65.5 ft), Run 14 (65.5-69.5 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-21: Run 15 (69.5-72.5 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

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FB-22: Run 1 (3-5 ft), Run 2 (5-10 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-22: Run 3 (10-15 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-22: Run 4 (15-20 ft), Run 5 (20-25 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-22: Run 6 (25-30 ft), Run 7 (30-35 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-22: Run 8 (35-40 ft), Run 9 (40-45 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-22: Run 10 (45-50 ft), Run 11 (50-55 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

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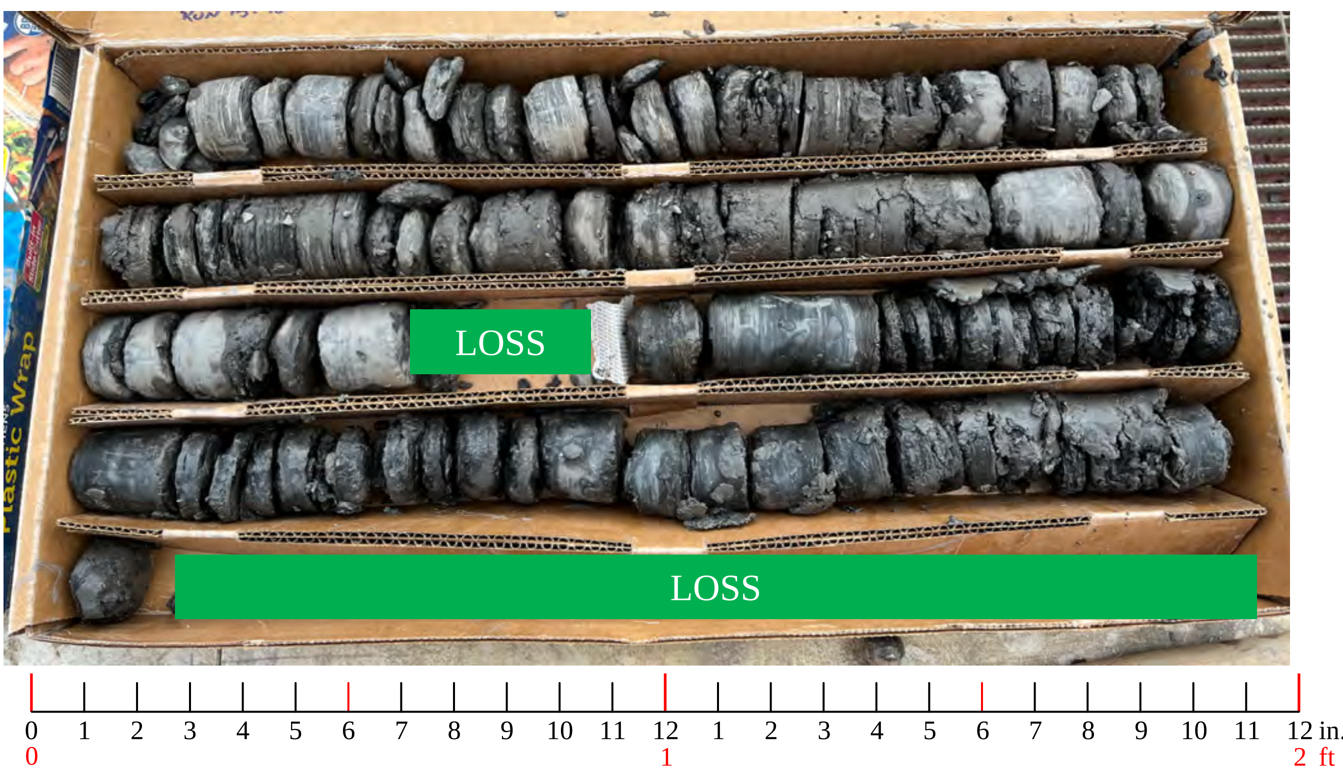
		Plate

FB-22: Run 12 (55-60 ft), Run 13 (60-65 ft)

FB-22: Run 14 (65-70 ft), Run 15 (70-75 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071**
		Plate

FB-22: Run 16 (75-80 ft)

0	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	in.
0												1												2	ft

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ROCK CORE PHOTOS 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	Job No. 21-071
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FB-23: Run 1 (2-4 ft), Run 2 (4-9 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-23: Run 3 (9-14 ft), Run 4 (14-19 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

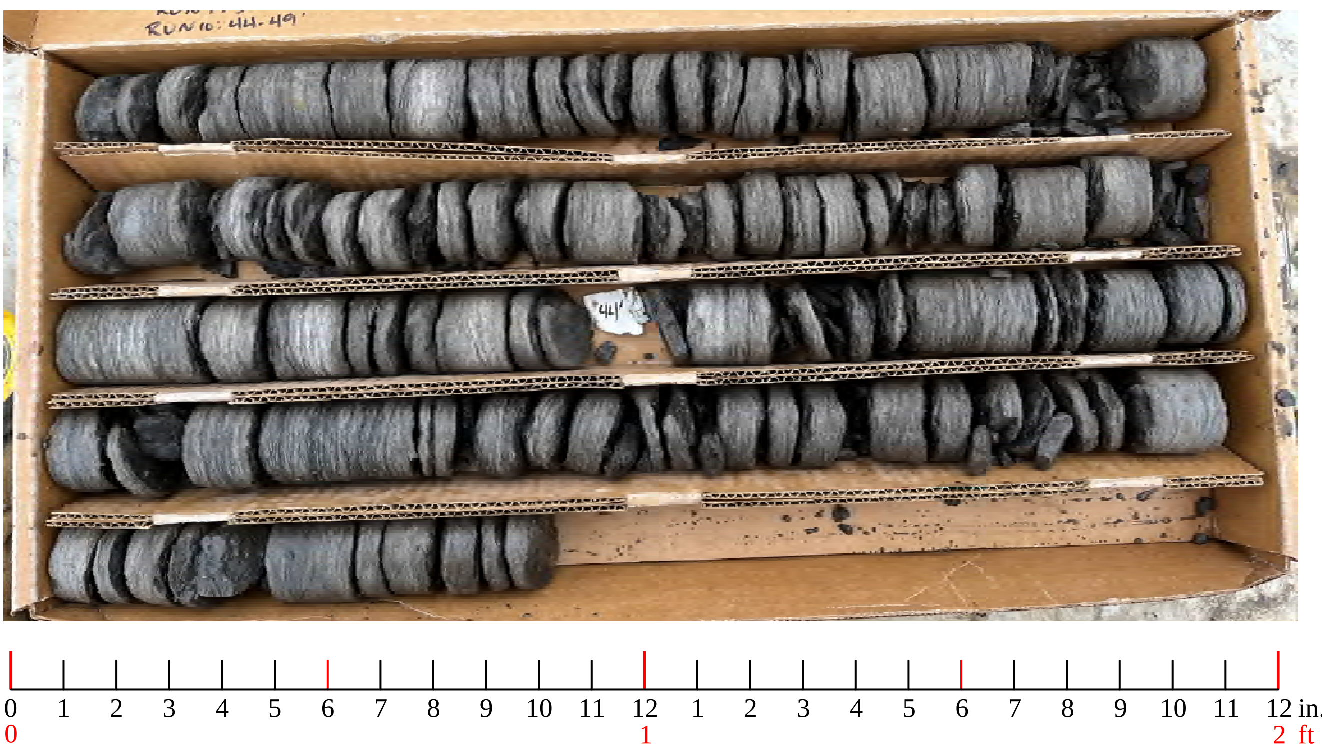
FB-23: Run 5 (19-24 ft), Run 6 (24-29 ft)

FB-23: Run 7 (29-24 ft), Run 8 (24-29 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>**ROCK CORE PHOTOS**</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-23: Run 9 (29-34 ft), Run 10 (34-39 ft)

FB-23: Run 11 (39-44 ft), Run 12 (44-49) ft



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-23: Run 13 (49-54 ft), Run 14 (54-59 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-23: Run 15 (59-64 ft), Run 16 (64-69 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-23: Run 17 (69-74 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-24: Run 1 (6-11 ft), Run 2 (11-16 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-24: Run 3 (16-21 ft), Run 4 (21-26 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>ROCK CORE PHOTOS</u> 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	Job No. 21-071 Plate

FB-24: Run 5 (26-31 ft), Run 6 (31-36 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-24: Run 7 (36-41 ft), Run 8 (41-46 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	ROCK CORE PHOTOS 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	Job No. 21-071 Plate

FB-24: Run 9 (46-51 ft), Run 10 (51-56 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

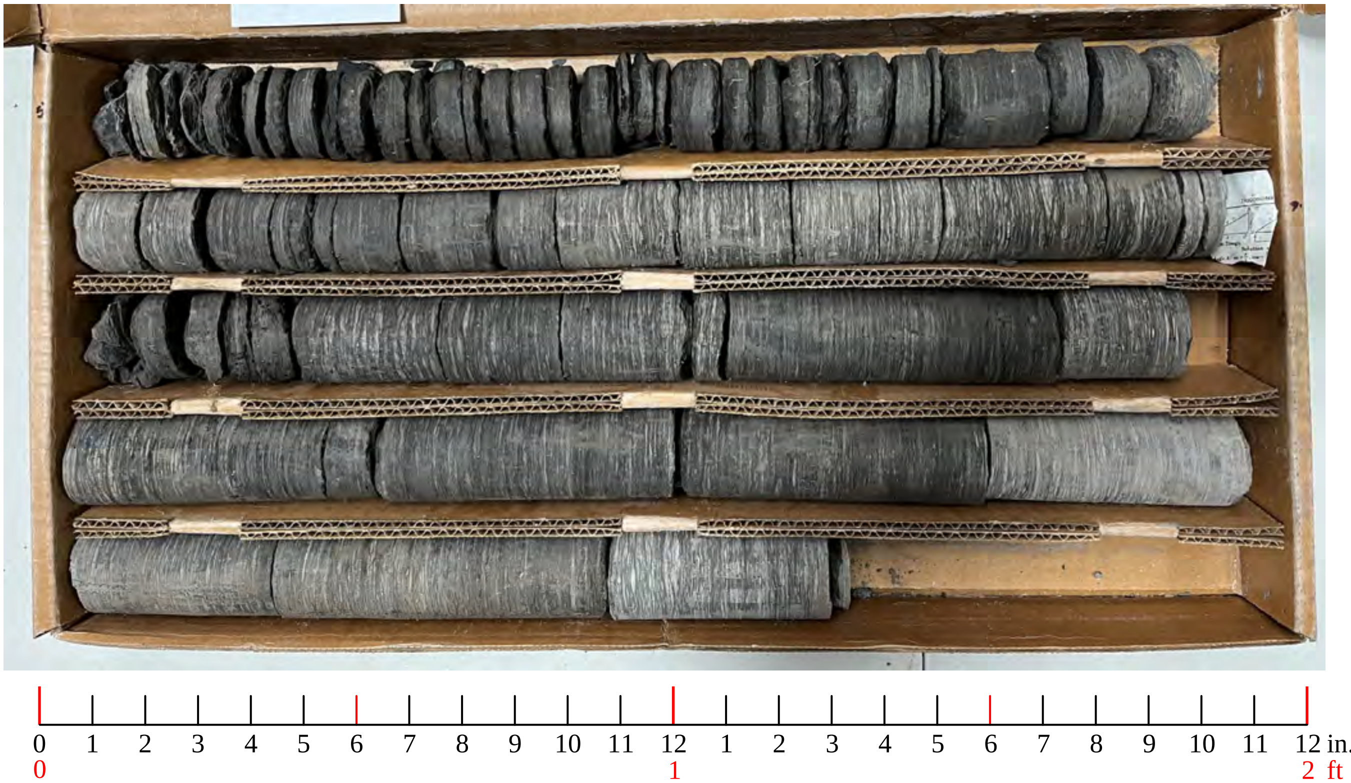
FB-24: Run 11 (56-61 ft), Run 12 (61-66 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-24: Run 13 (66-71 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-25: Run 1 (5-9 ft), Run 2 (9-14 ft)



FB-25: Run 3 (14-19 ft), Run 4 (19-24 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-25: Run 5 (24-29 ft), Run 6 (29-34 ft)

FB-25: Run 7 (34-39 ft), Run 8 (39-44 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-25: Run 9 (44-49 ft), Run 10 (49-54 ft)

FB-24: Run 11 (54-59 ft), Run 12 (59-64 ft)

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FB-25: Run 13 (64-69 ft), Run 14 (69-74 ft)

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FB-26: Run 1 (5-9 ft), Run 2 (9-14 ft)

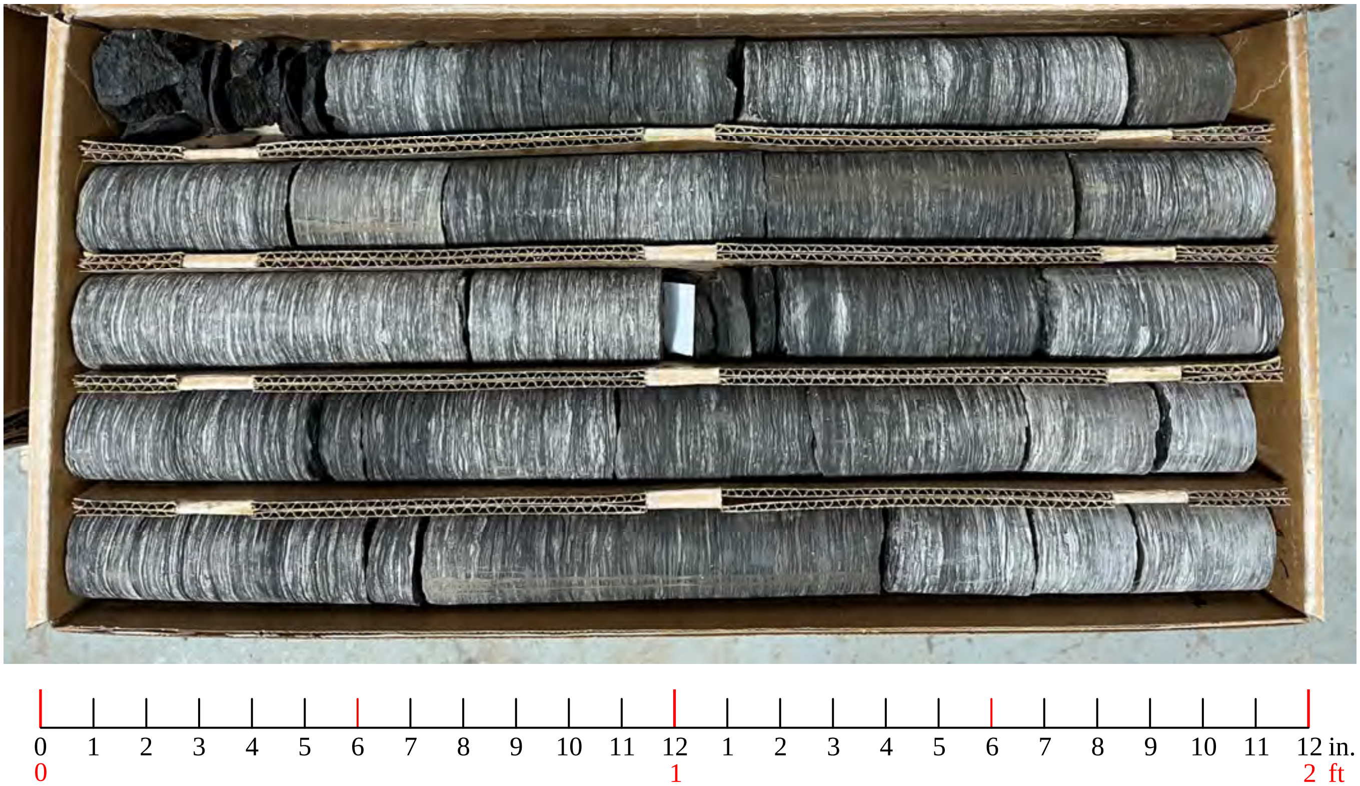
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-26: Run 3 (14-19 ft), Run 4 (19-24 ft)

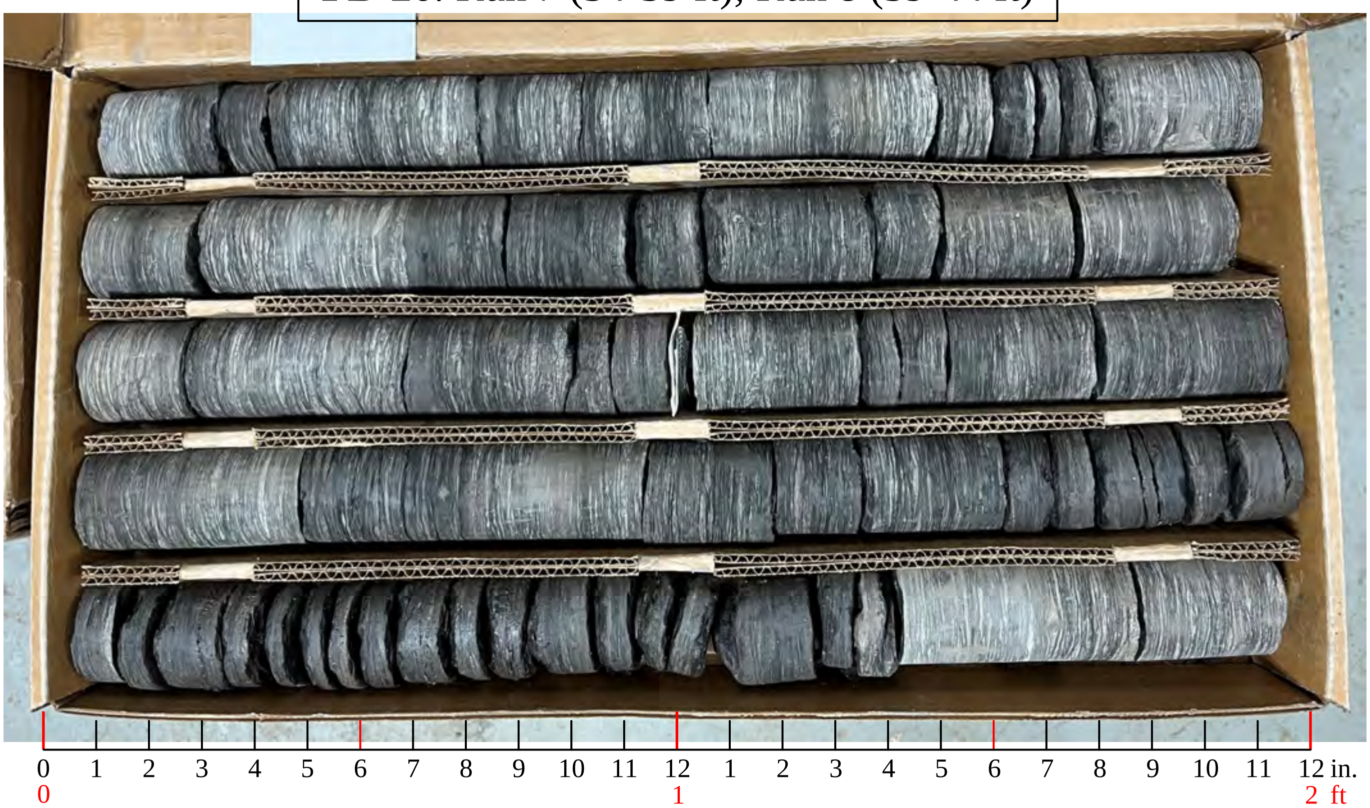
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-26: Run 5 (24-29 ft), Run 6 (29-34 ft)



FB-26: Run 7 (34-39 ft), Run 8 (39-44 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-26: Run 9 (44-49 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-26: Run 10 (49-54 ft), Run 11 (54-59 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-26: Run 12 (59-64 ft), Run 13 (64-69 ft)

FB-26: Run 14 (69-74 ft), Run 15 (74-79 ft)

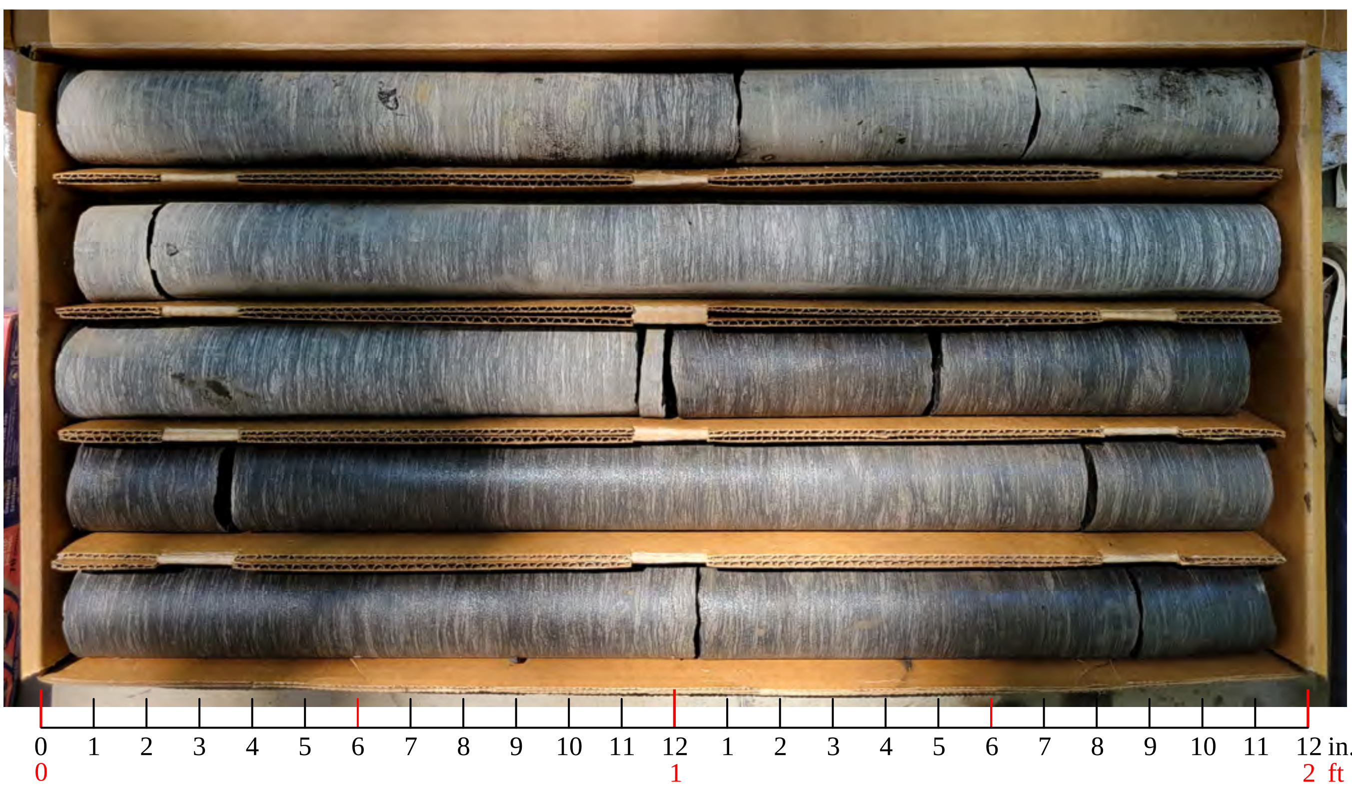
Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>**ROCK CORE PHOTOS**</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-26: Run 16 (79-84 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-27: Run 1 (35-40 ft), Run 2 (40-45 ft)

FB-27: Run 3 (45-50 ft), Run 4 (50-55 ft)



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ROCK CORE PHOTOS
040748 Hwy 22 to I-40
Crawford & Sebastian Counties, Arkansas

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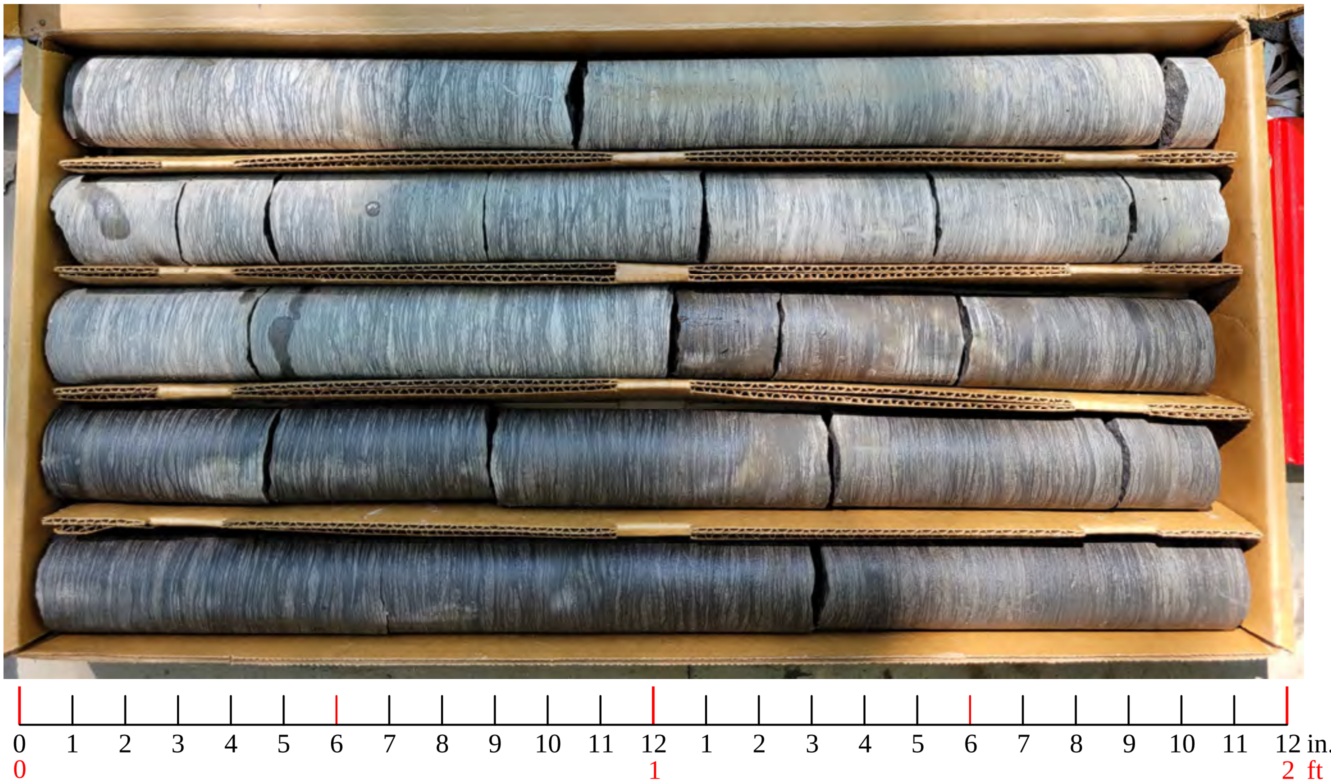
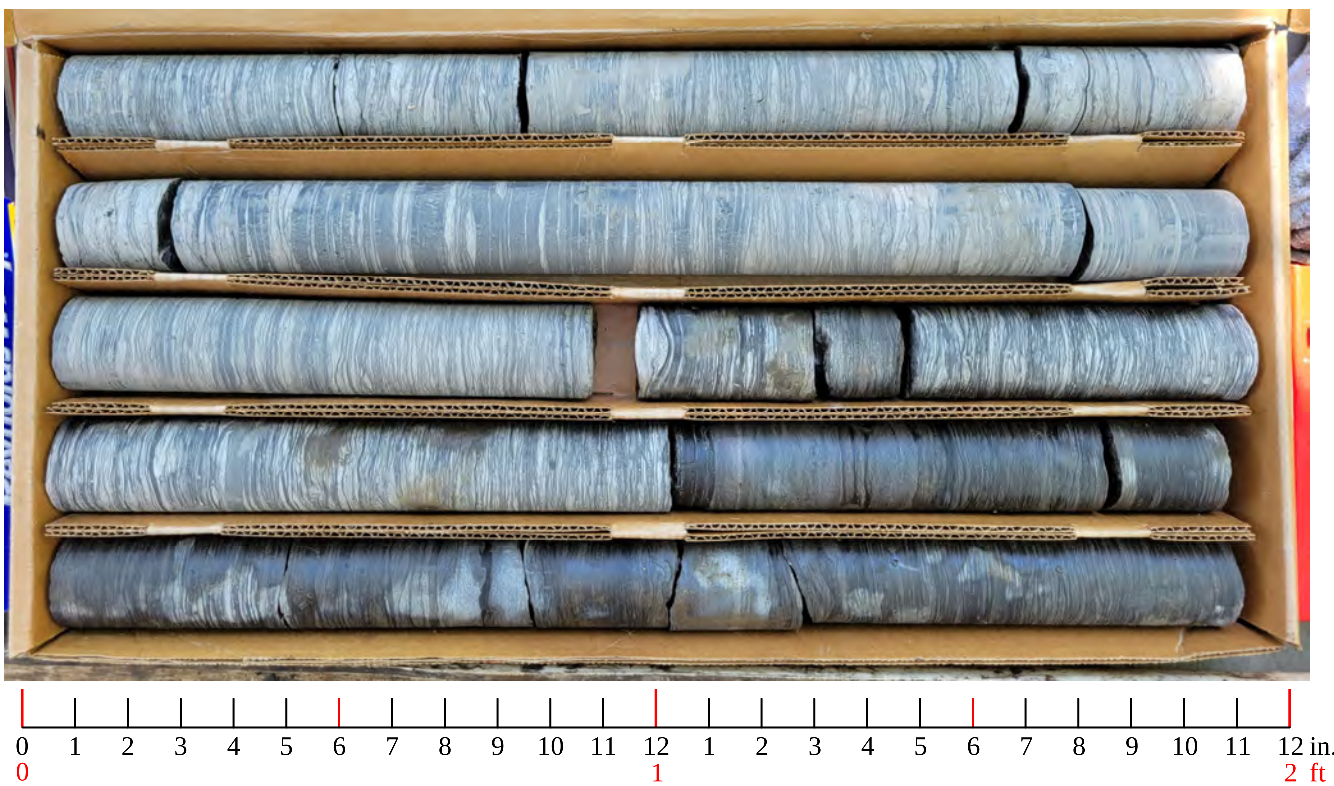
Plate	

FB-27: Run 5 (55-60 ft), Run 6 (60-65 ft)



FB-27: Run 7 (65-70 ft), Run 8 (70-75 ft)



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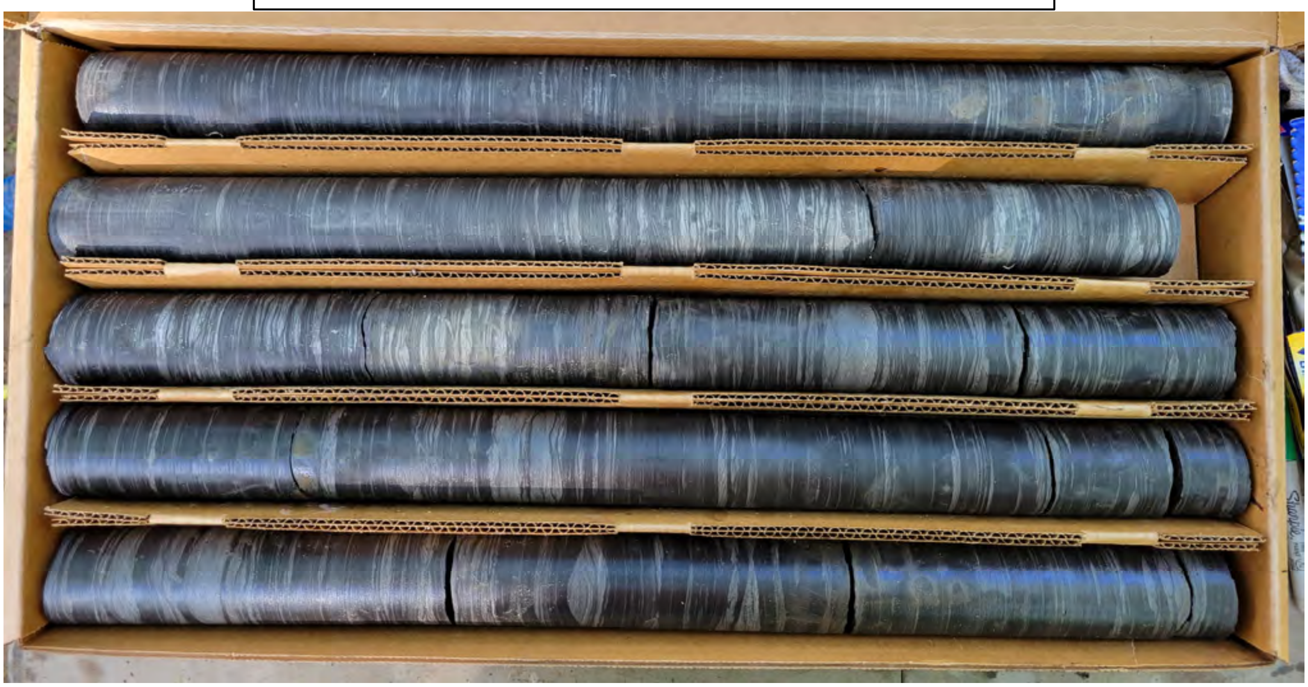
FB-27: Run 9 (75-80 ft), Run 10 (80-85 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

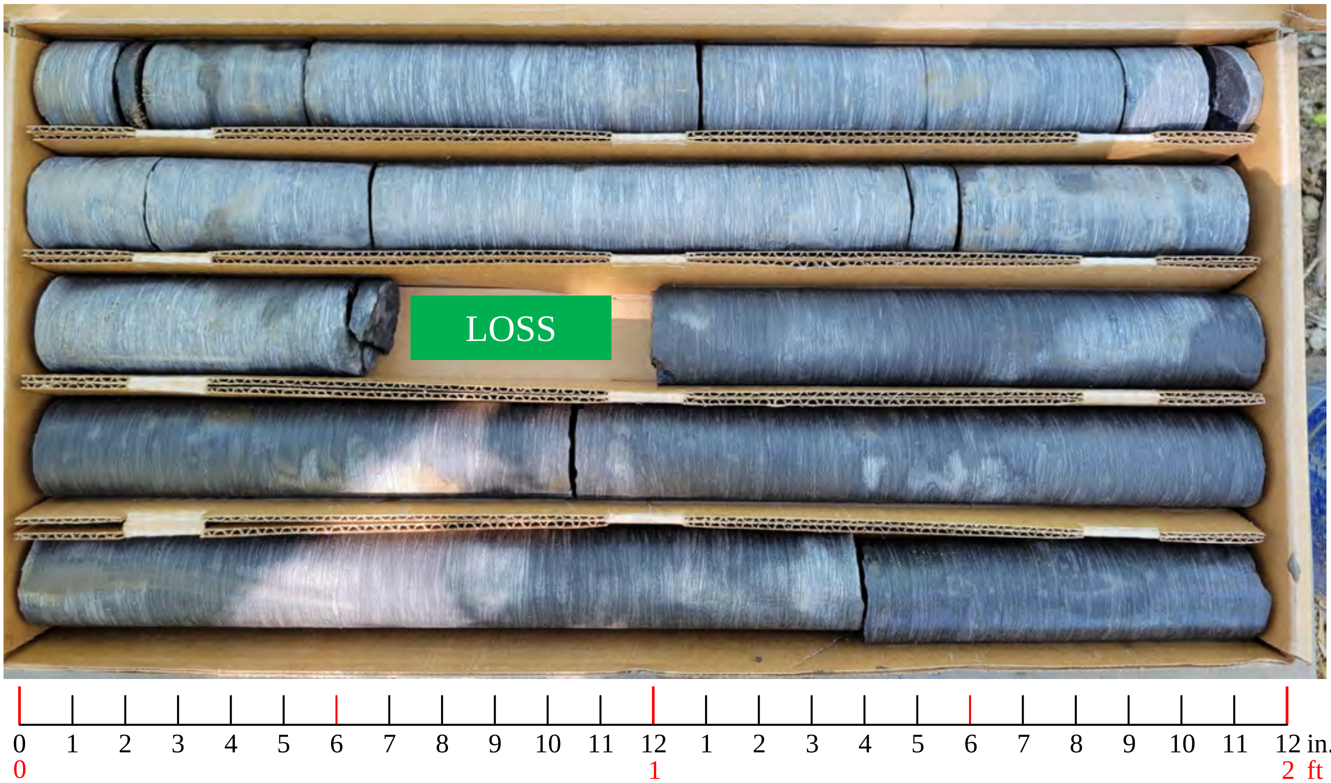
FB-27: Run 11 (85-90 ft), Run 12 (90-95 ft)



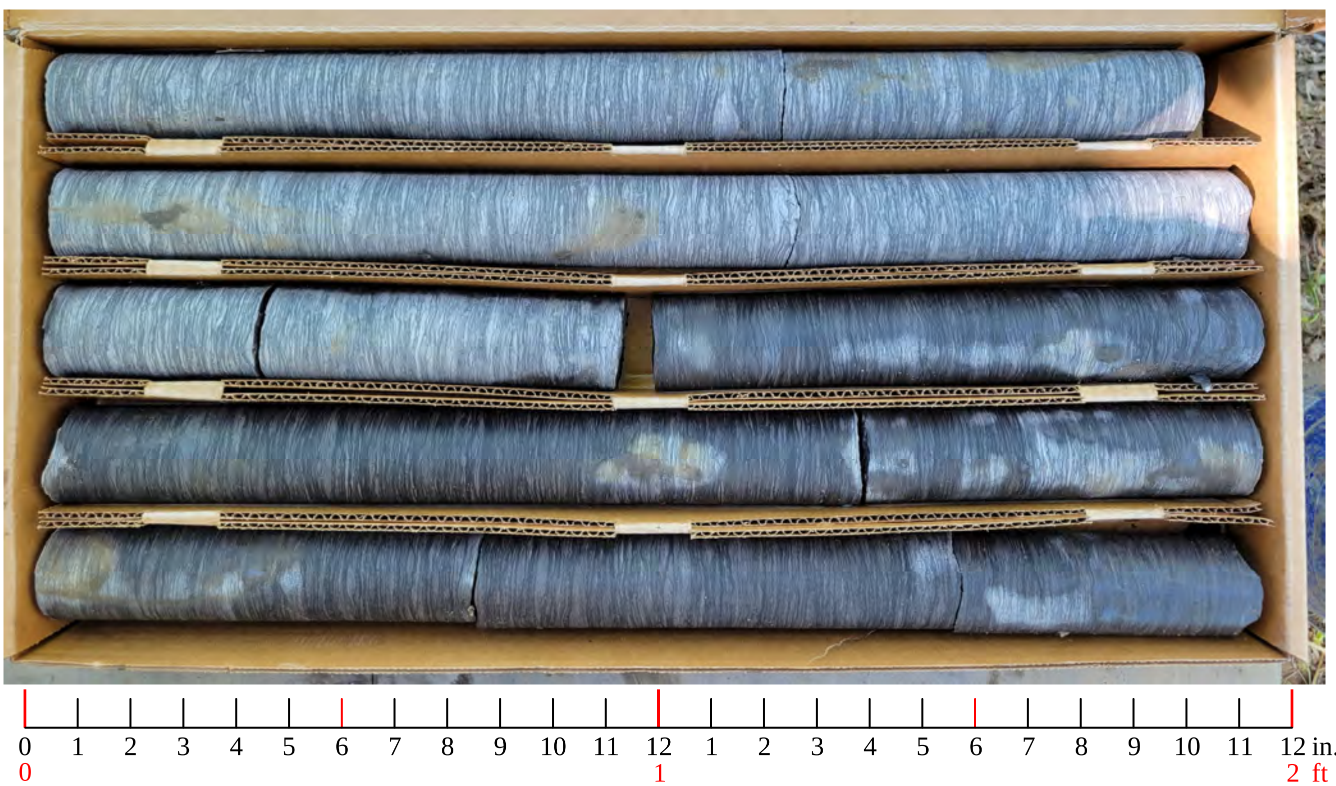
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-28: Run 1 (40-45 ft), Run 2 (45-50 ft)

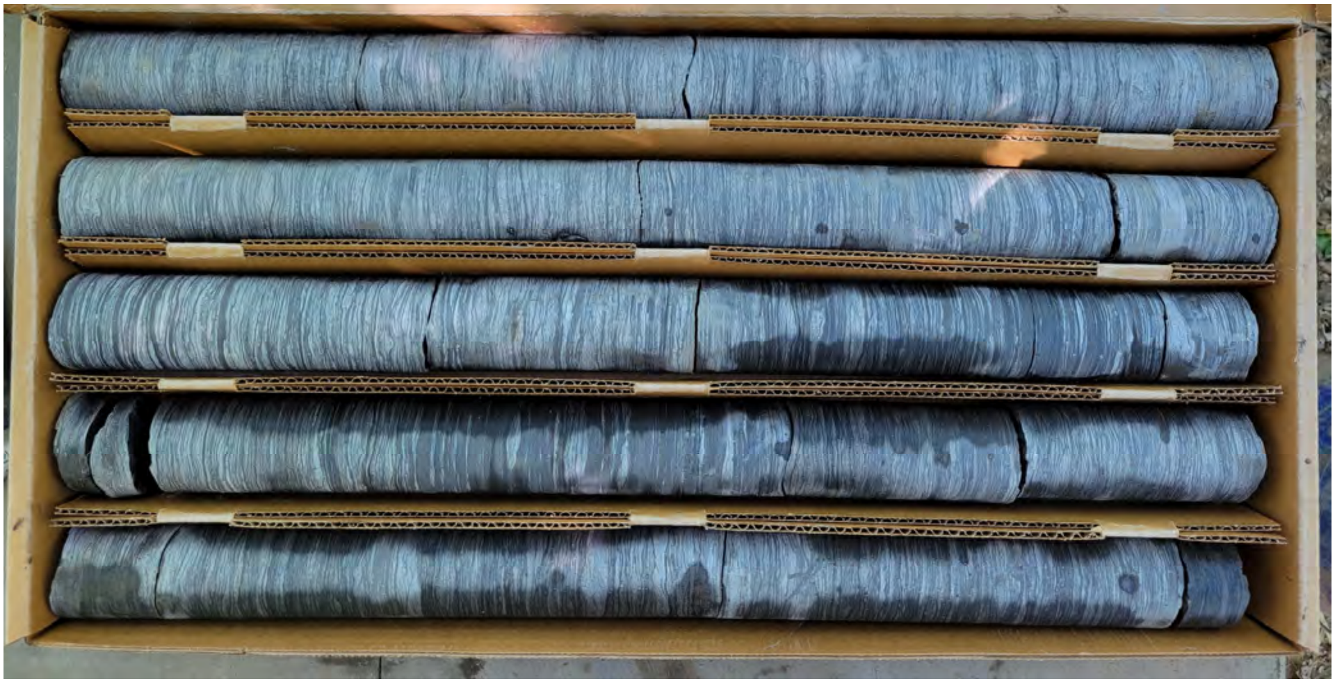


FB-28: Run 3 (50-55 ft), Run 4 (55-60 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>ROCK CORE PHOTOS</u> 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	Job No. 21-071 Plate

FB-28: Run 5 (60-65 ft), Run 6 (65-70 ft)



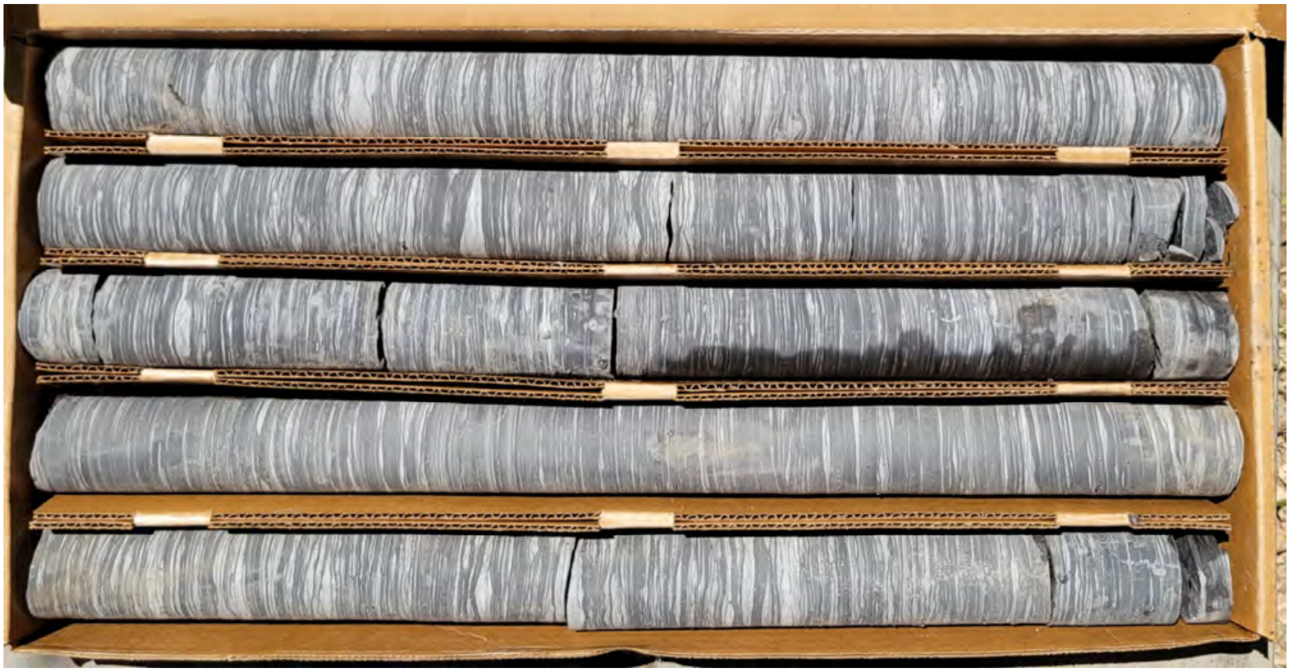
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-28: Run 7 (70-75 ft), Run 8 (75-80 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	ROCK CORE PHOTOS 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	Job No. 21-071 Plate

FB-28: Run 9 (80-85 ft), Run 10 (85-90 ft)



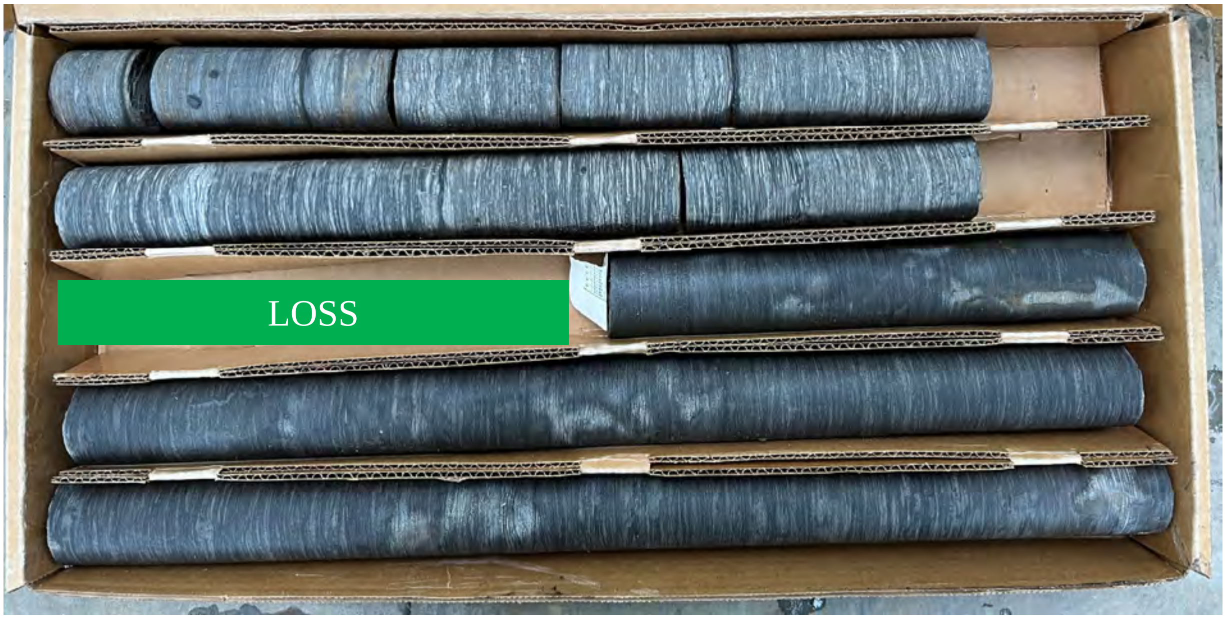
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-28: Run 11 (90-95 ft), Run 12 (95-100 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

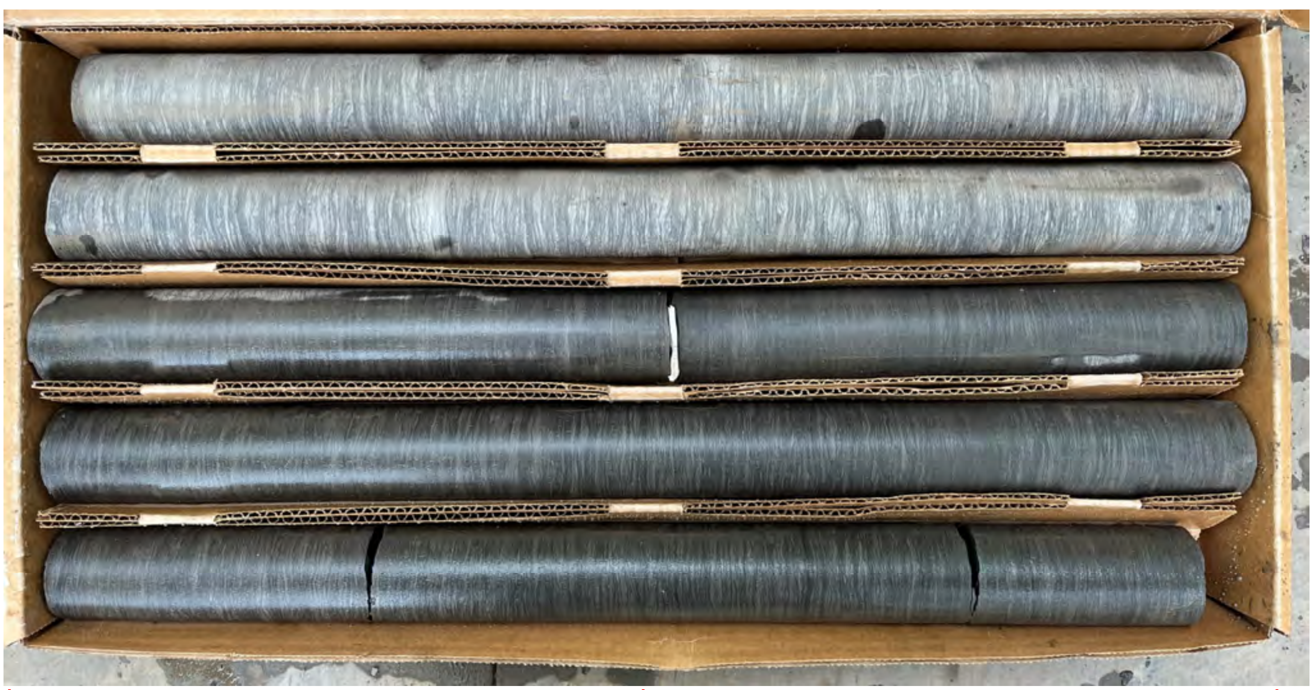
Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>ROCK CORE PHOTOS</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-29: Run 1 (40-45 ft), Run 2 (45-50 ft)



0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-29: Run 3 (50-55 ft), Run 4 (55-60 ft)



0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

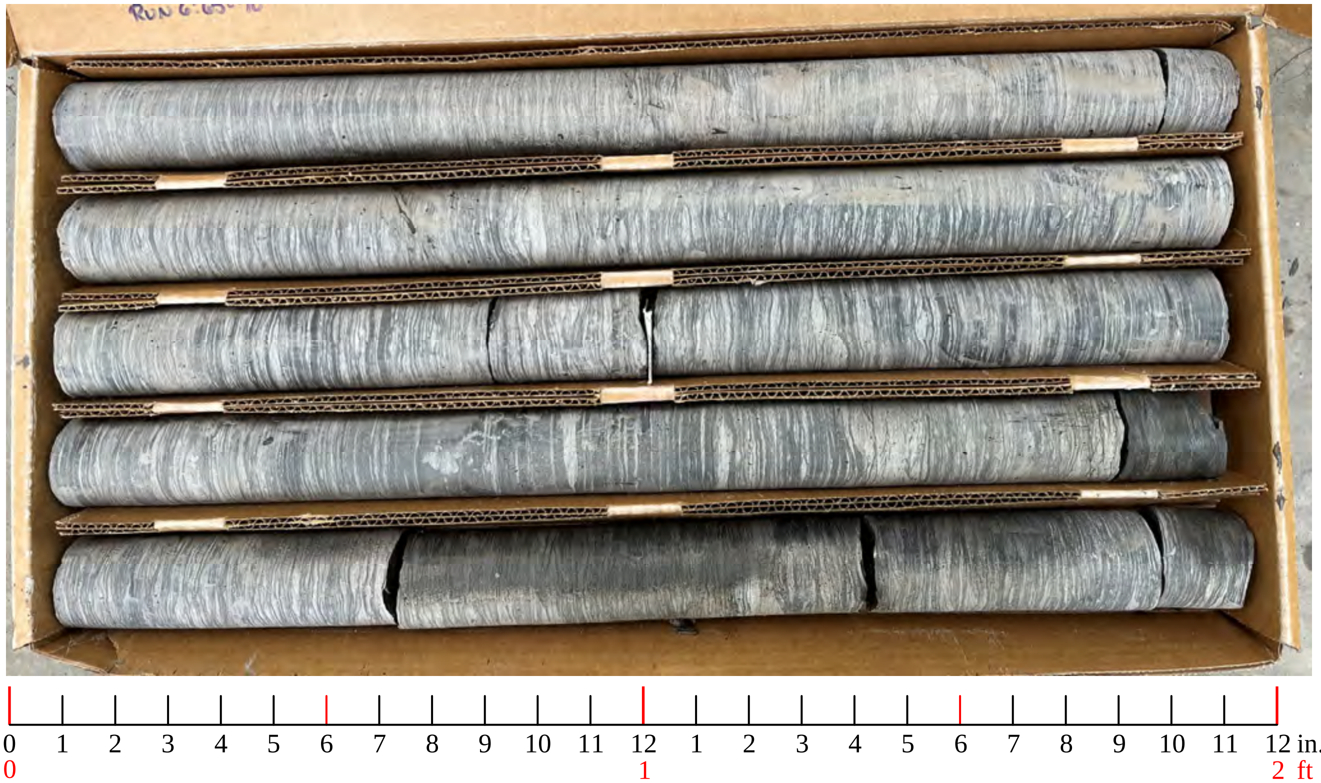
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

<u>ROCK CORE PHOTOS</u>
040748 Hwy 22 to I-40
Crawford & Sebastian Counties, Arkansas

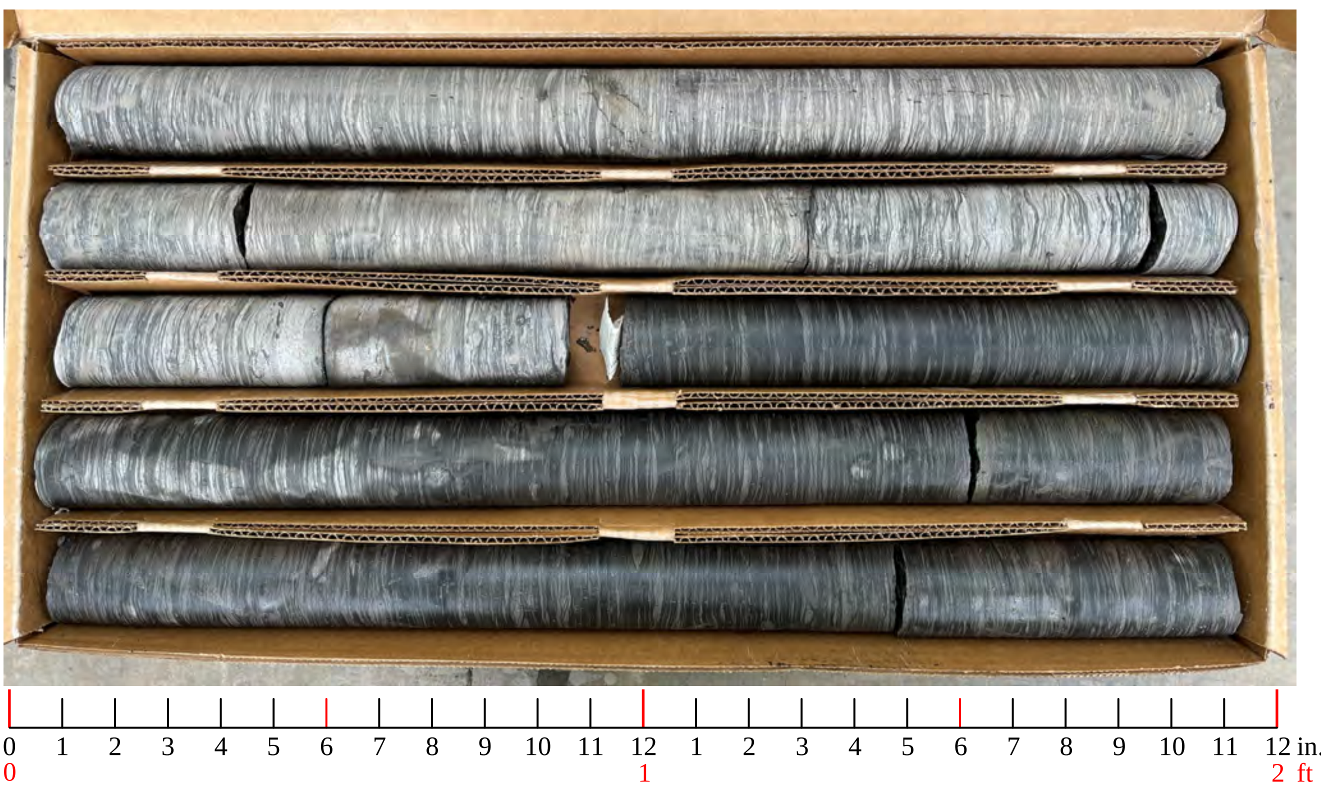
Job No. 21-071

Plate

FB-29: Run 5 (60-65 ft), Run 6 (65-70 ft)



FB-29: Run 7 (70-75 ft), Run 8 (75-80 ft)

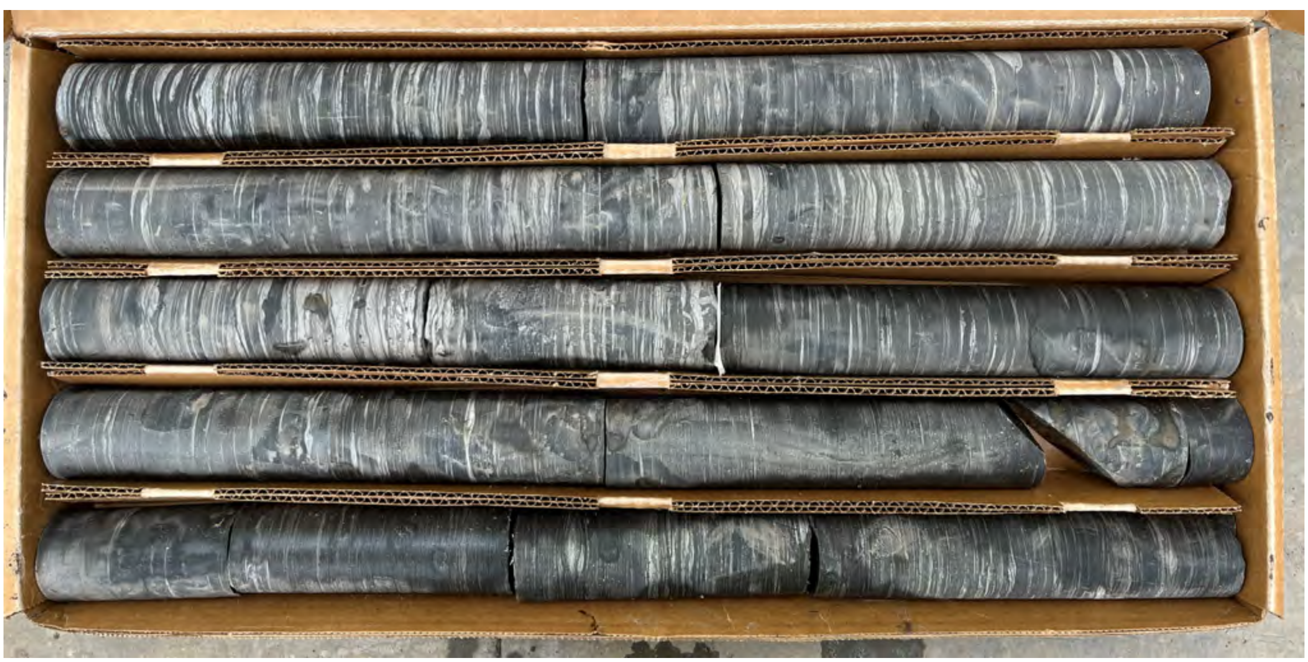


Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**<u>ROCK CORE PHOTOS</u>** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-29: Run 9 (80-85 ft), Run 10 (85-90 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

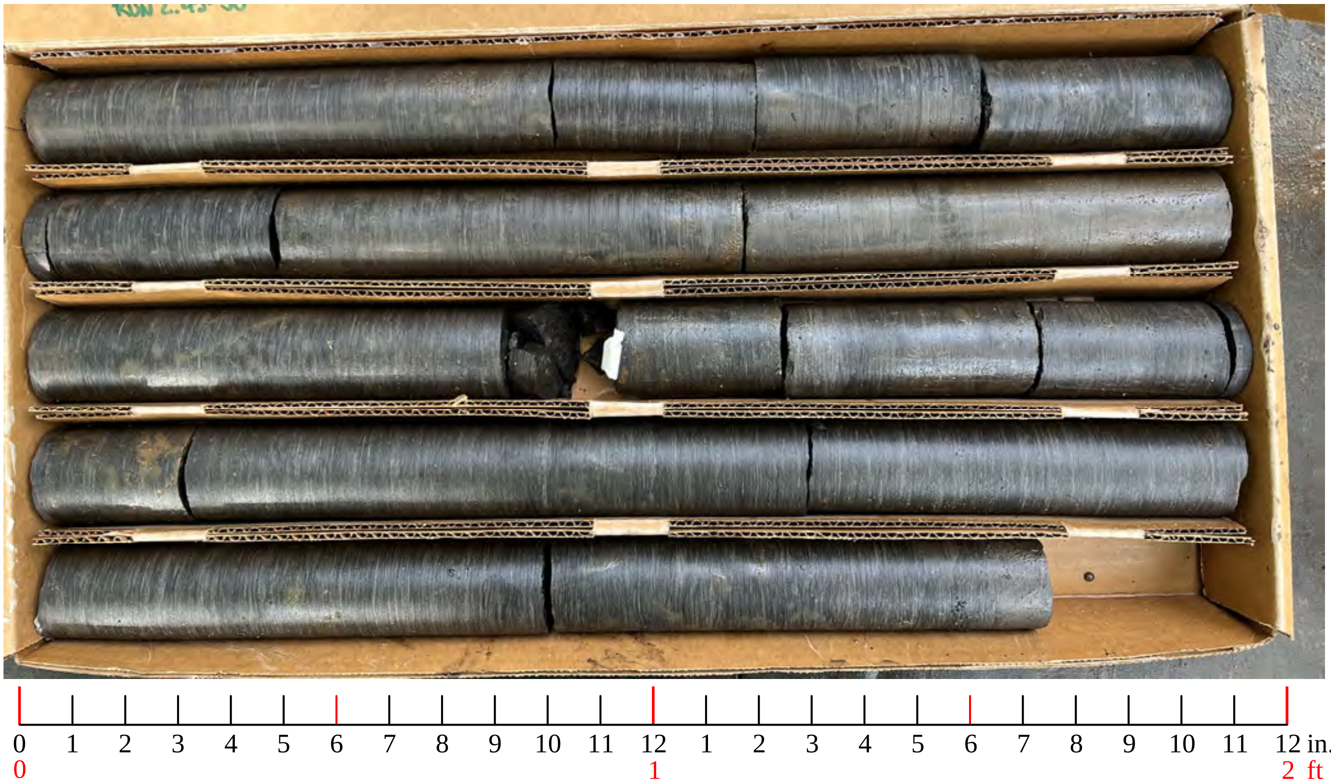
FB-29: Run 11 (90-95 ft), Run 12 (95-100 ft)



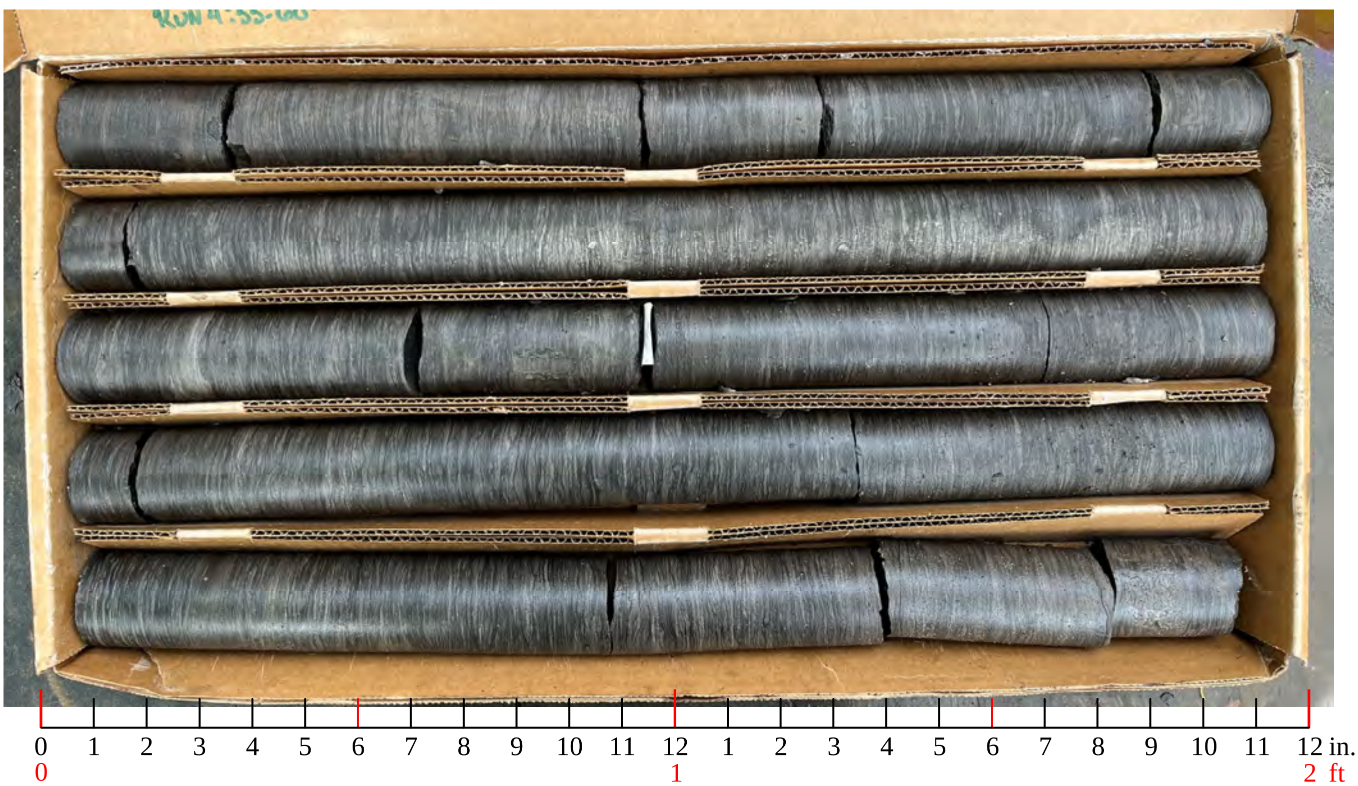
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-30: Run 1 (40-45 ft), Run 2 (45-50 ft)

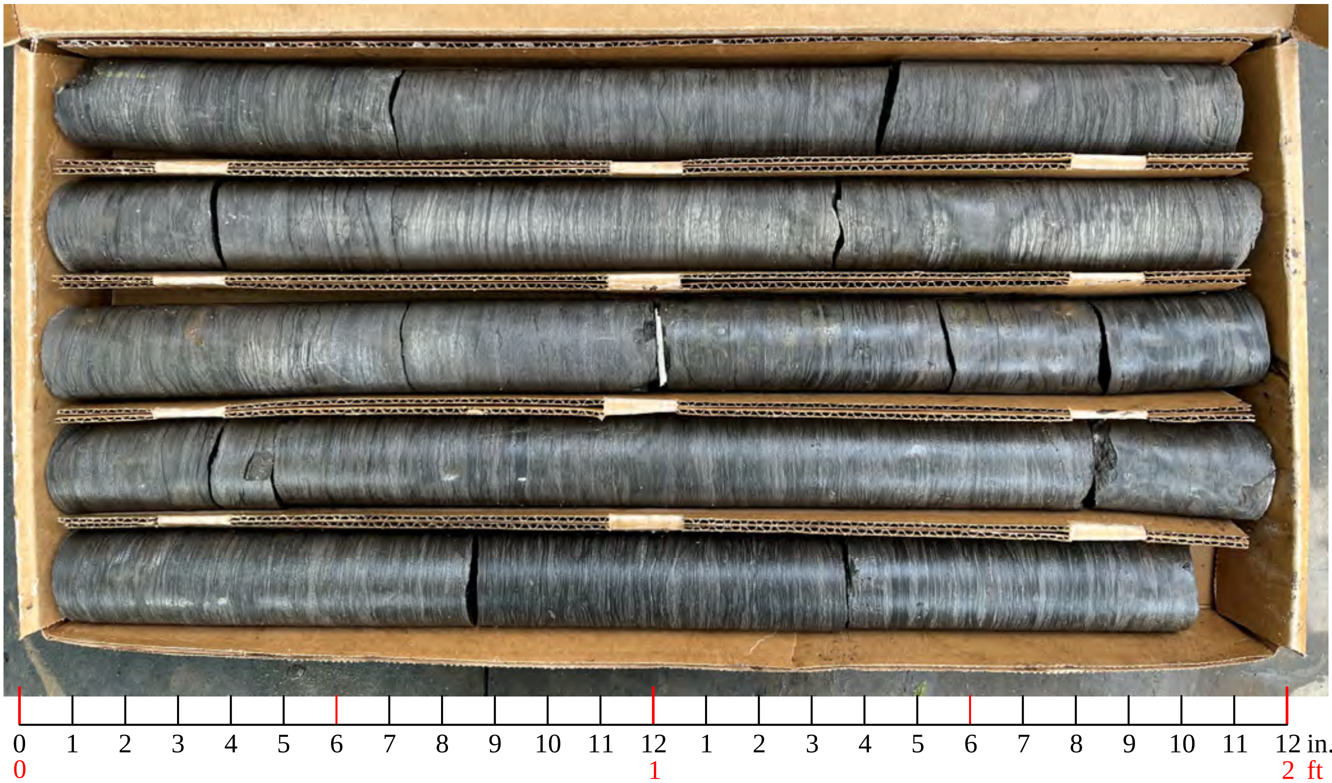


FB-30: Run 3 (50-55 ft), Run 4 (55-60 ft)

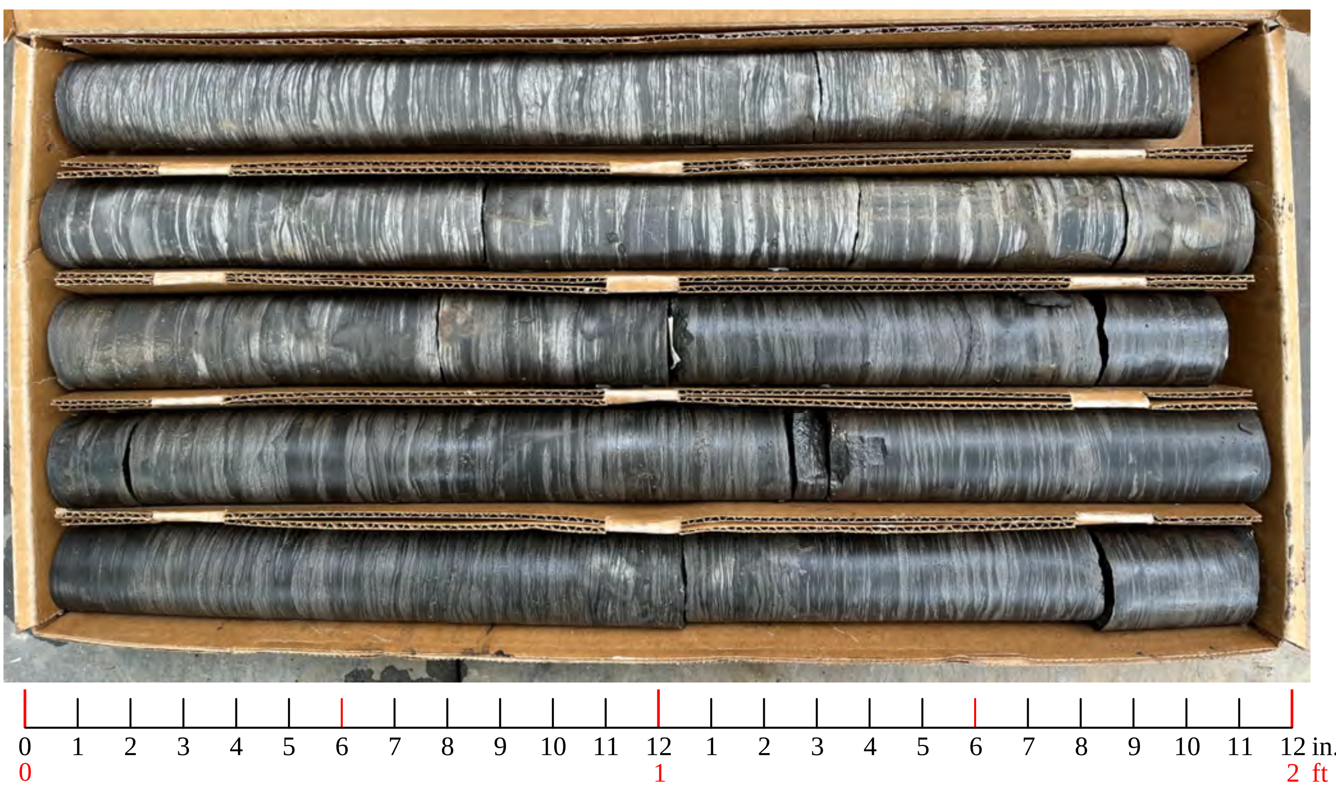


Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-30: Run 5 (60-65 ft), Run 6 (65-70 ft)



FB-30: Run 7 (70-75 ft), Run 8 (75-80 ft)



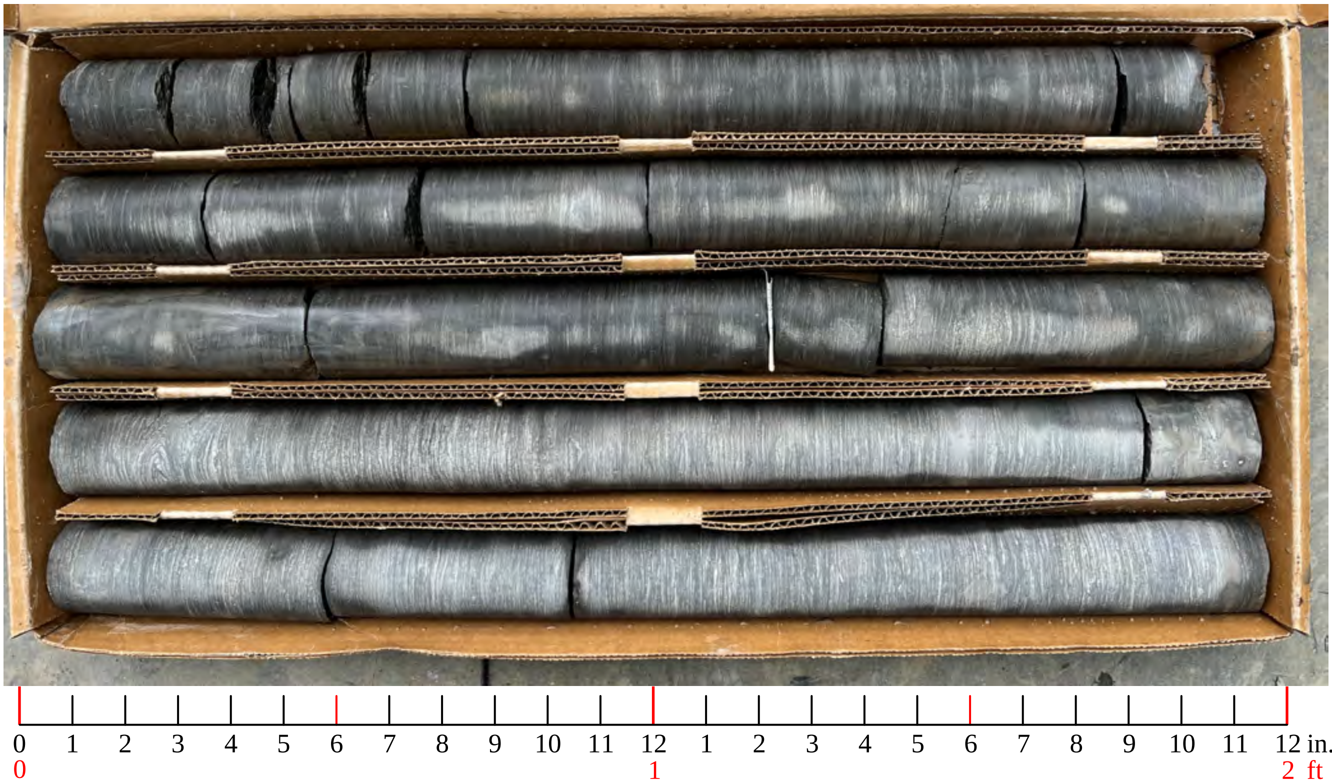
Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-30: Run 9 (80-85 ft), Run 10 (85-90 ft)

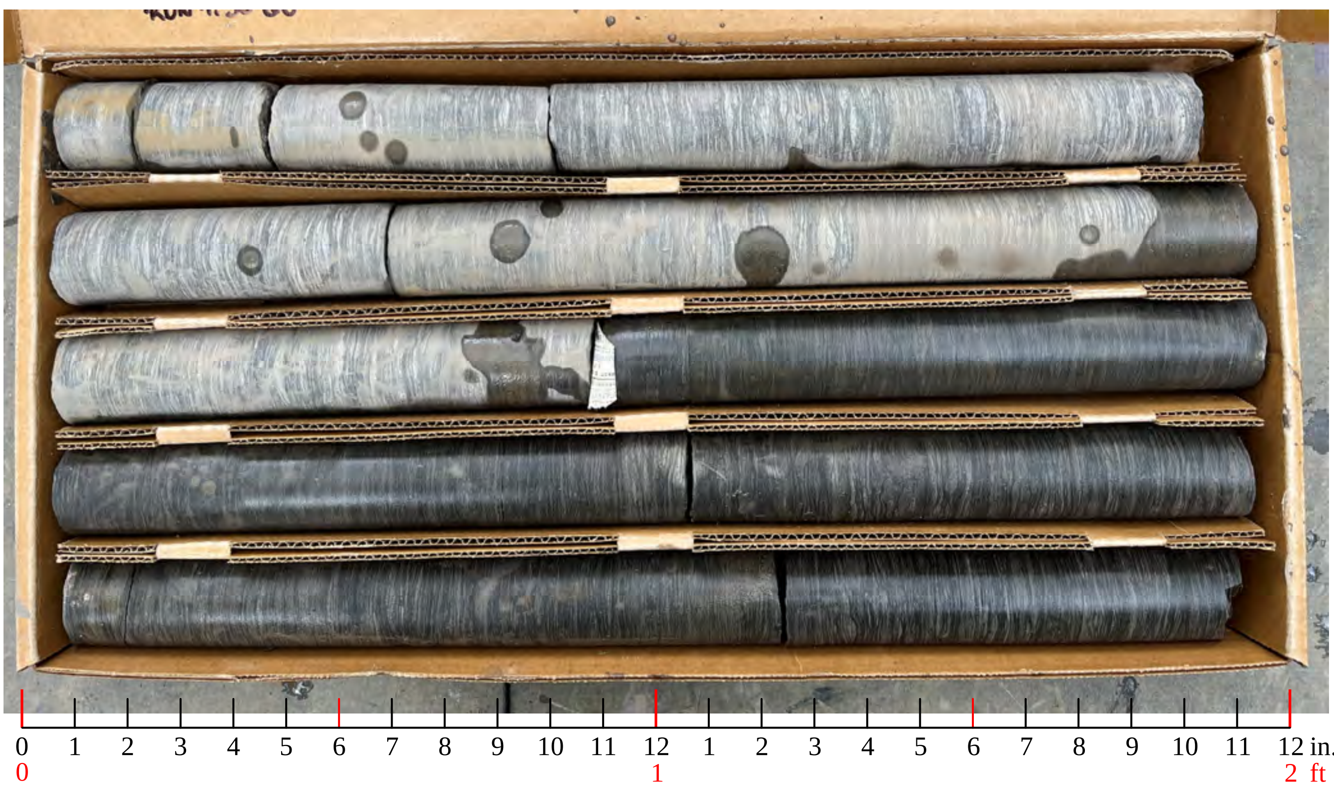
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	ROCK CORE PHOTOS 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	Job No. 21-071 Plate

FB-31: Run 1 (40-45 ft), Run 2 (45-50 ft)



FB-31: Run 3 (50-55 ft), Run 4 (55-60 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-31: Run 5 (60-65 ft), Run 6 (65-70 ft)

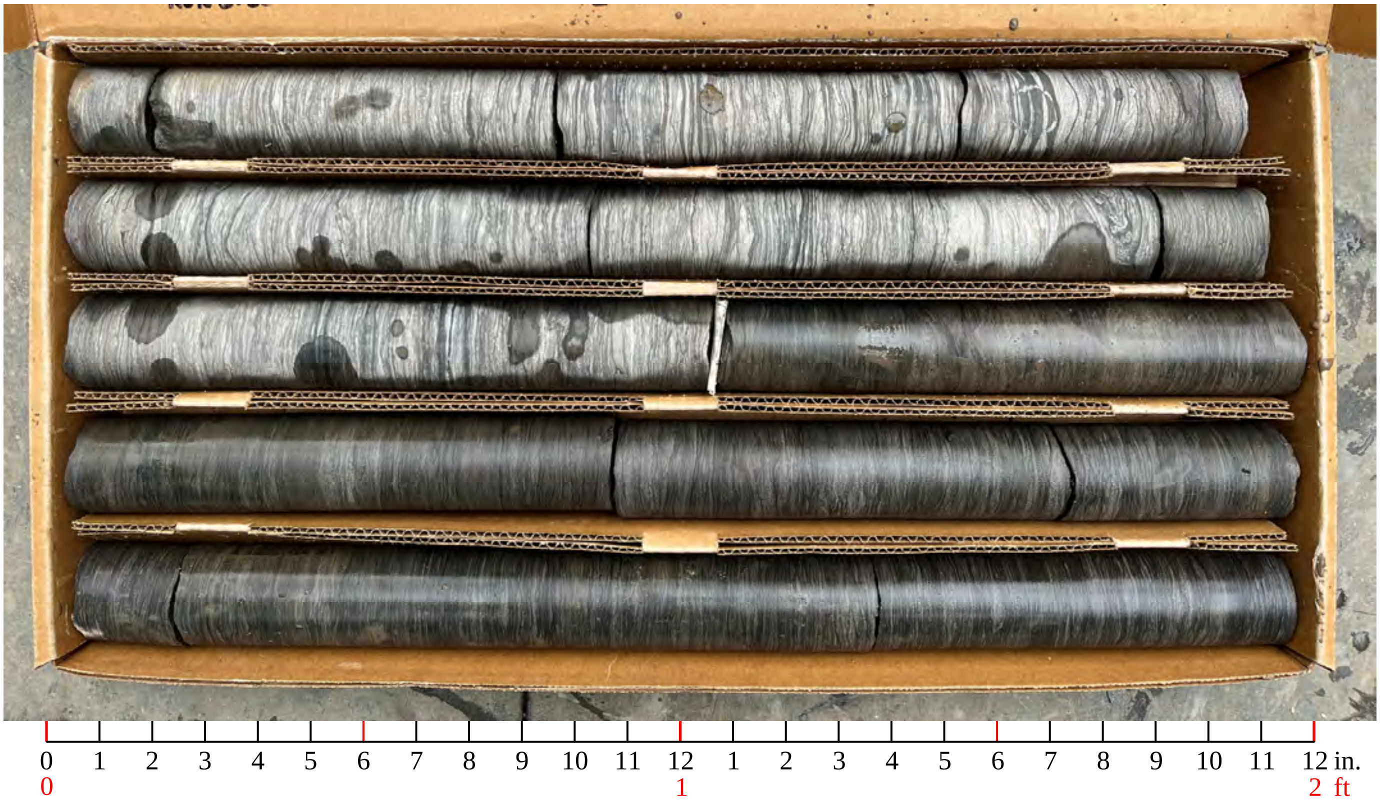
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-31: Run 7 (70-75 ft), Run 8 (75-80 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

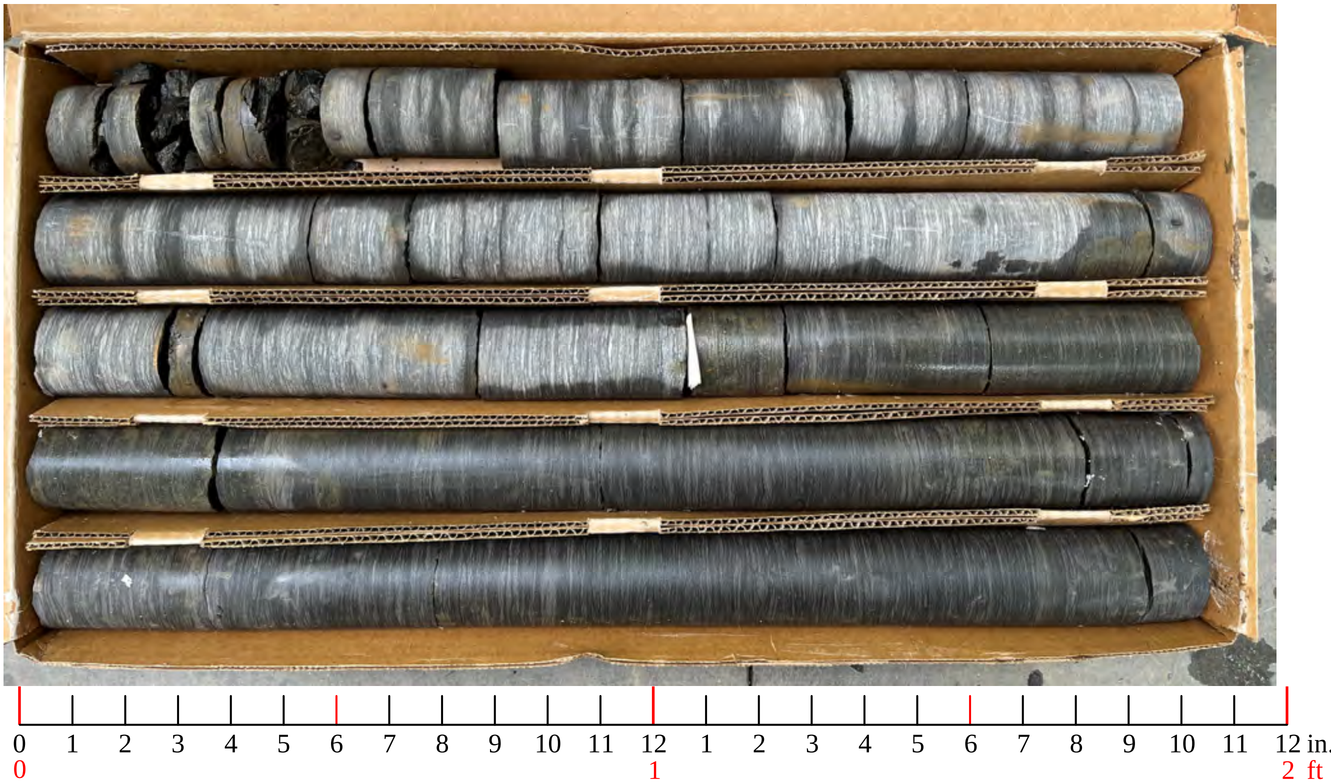
Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-31: Run 9 (80-85 ft), Run 10 (85-90 ft)

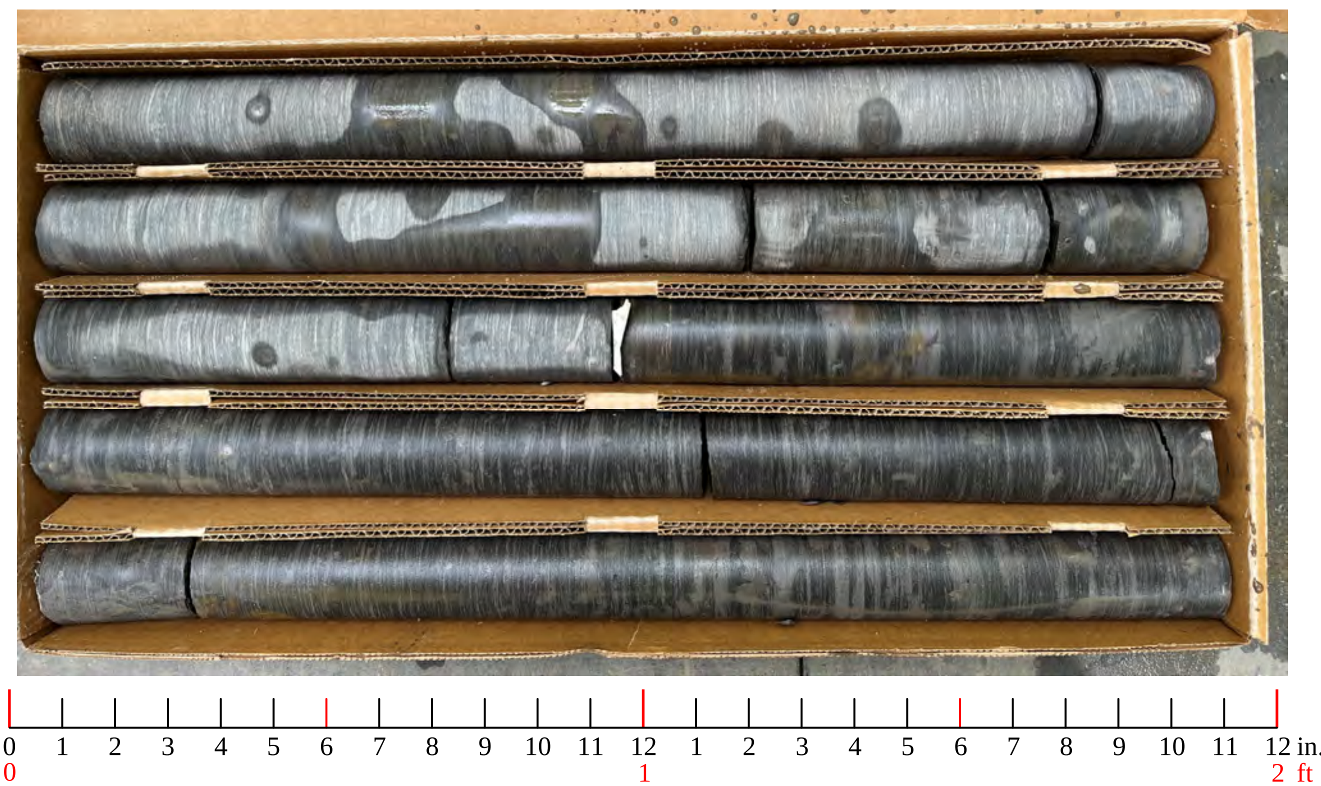


Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-32: Run 1 (35-40 ft), Run 2 (40-45 ft)



FB-32: Run 3 (45-50 ft), Run 4 (50-55 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-32: Run 5 (55-60 ft), Run 6 (60-65 ft)

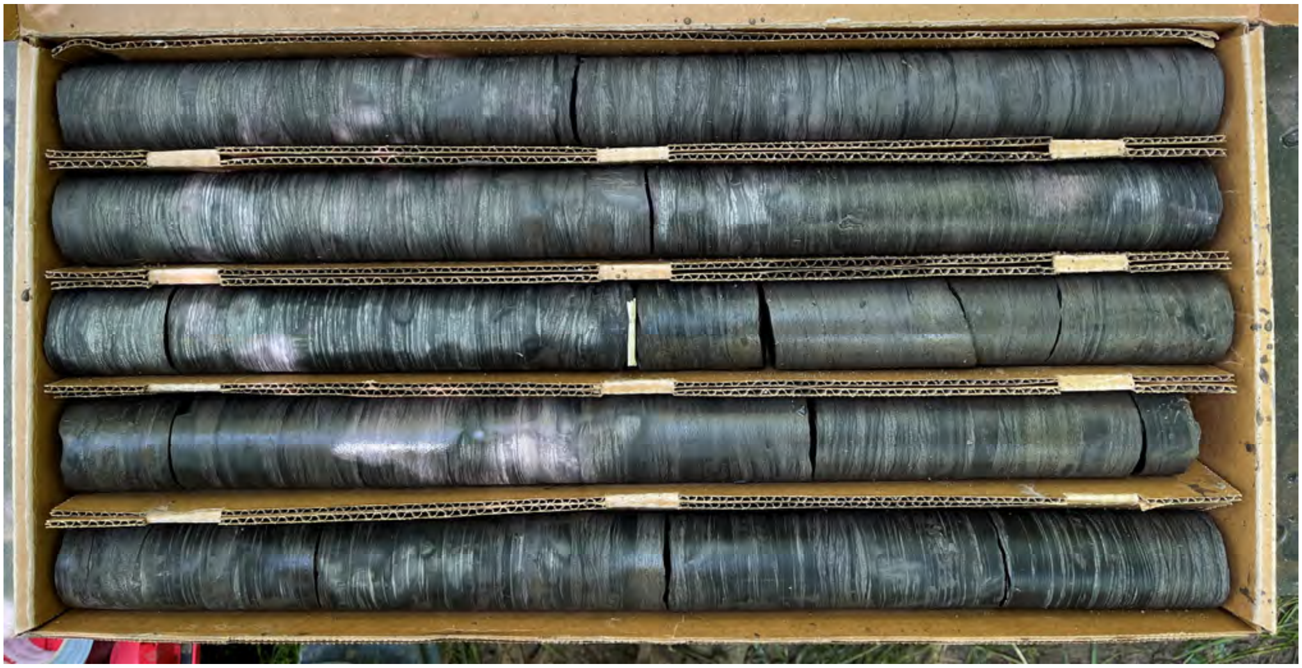
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-32: Run 7 (65-70 ft), Run 8 (70-75 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>ROCK CORE PHOTOS</u> 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	Job No. 21-071 Plate

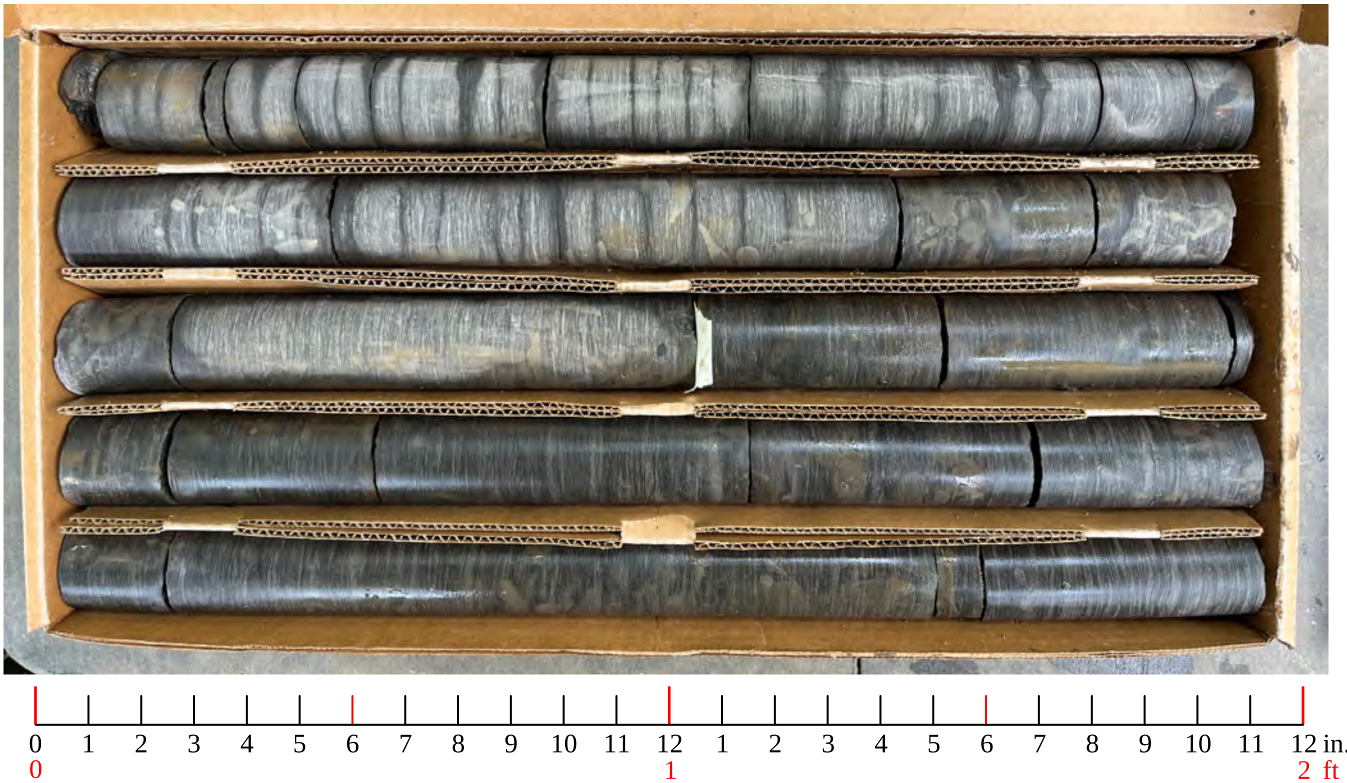
FB-32: Run 9 (75-80 ft), Run 10 (80-85 ft)



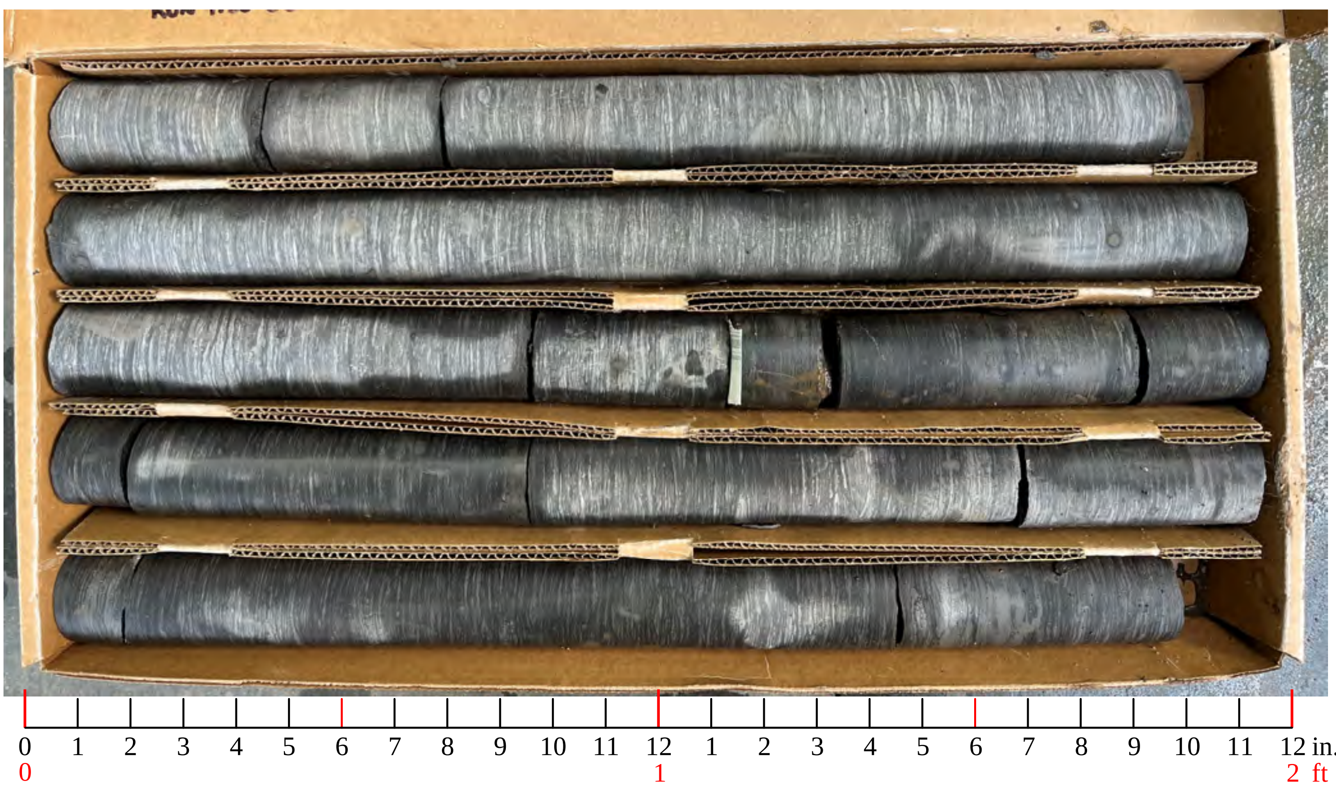
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-33: Run 1 (35-40 ft), Run 2 (40-45 ft)



FB-33: Run 3 (45-50 ft), Run 4 (50-55 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-33: Run 5 (55-60 ft), Run 6 (60-65 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-33: Run 7 (65-70 ft), Run 8 (70-75 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	ROCK CORE PHOTOS 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	Job No. 21-071 Plate

FB-33: Run 9 (75-80 ft), Run 10 (80-85 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC
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ROCK CORE PHOTOS
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Crawford & Sebastian Counties, Arkansas

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FB-34: Run 1 (35-40 ft), Run 2 (40-45 ft)

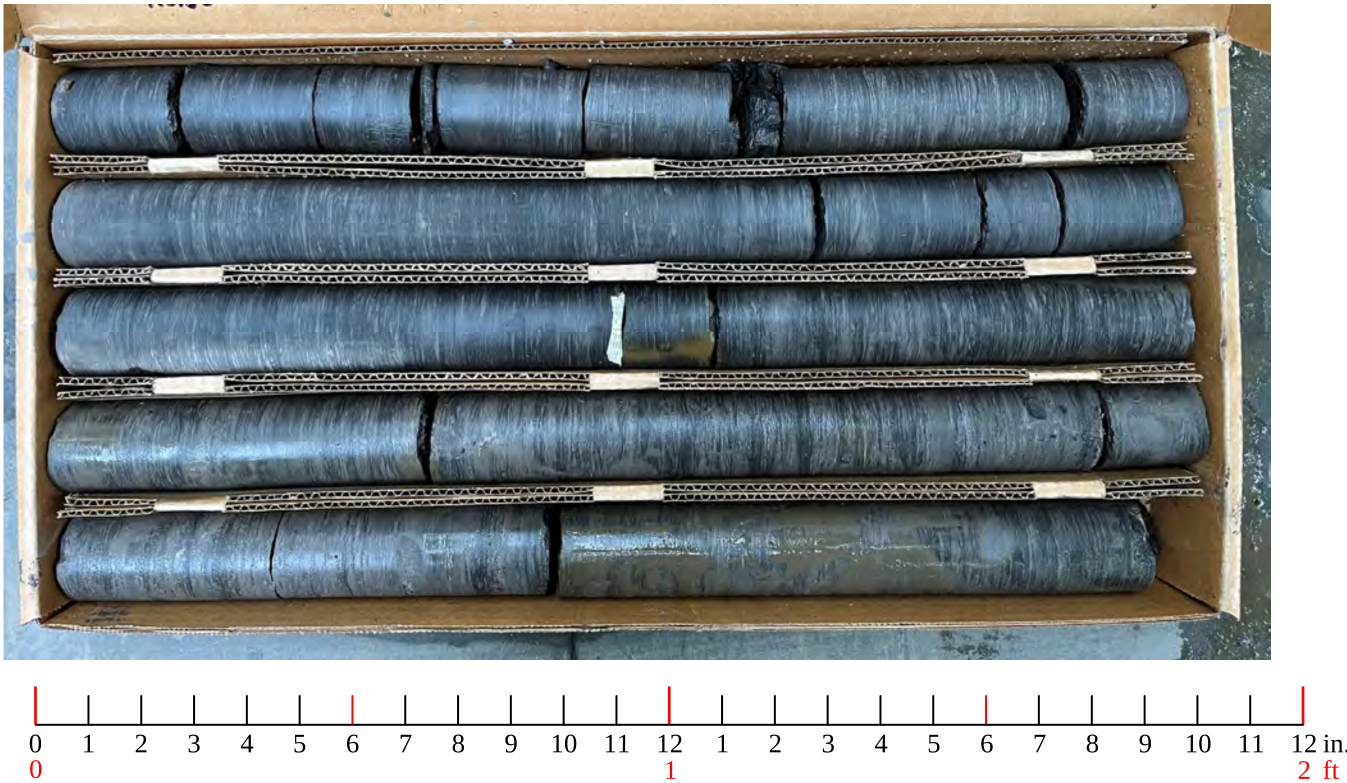
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-34: Run 3 (45-50 ft), Run 4 (50-55 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-34: Run 5 (55-60 ft), Run 6 (60-65 ft)



FB-34: Run 7 (65-70 ft), Run 8 (70-75 ft)

FB-34: Run 9 (75-80 ft), Run 10 (80-85 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
040748 Hwy 22 to I-40
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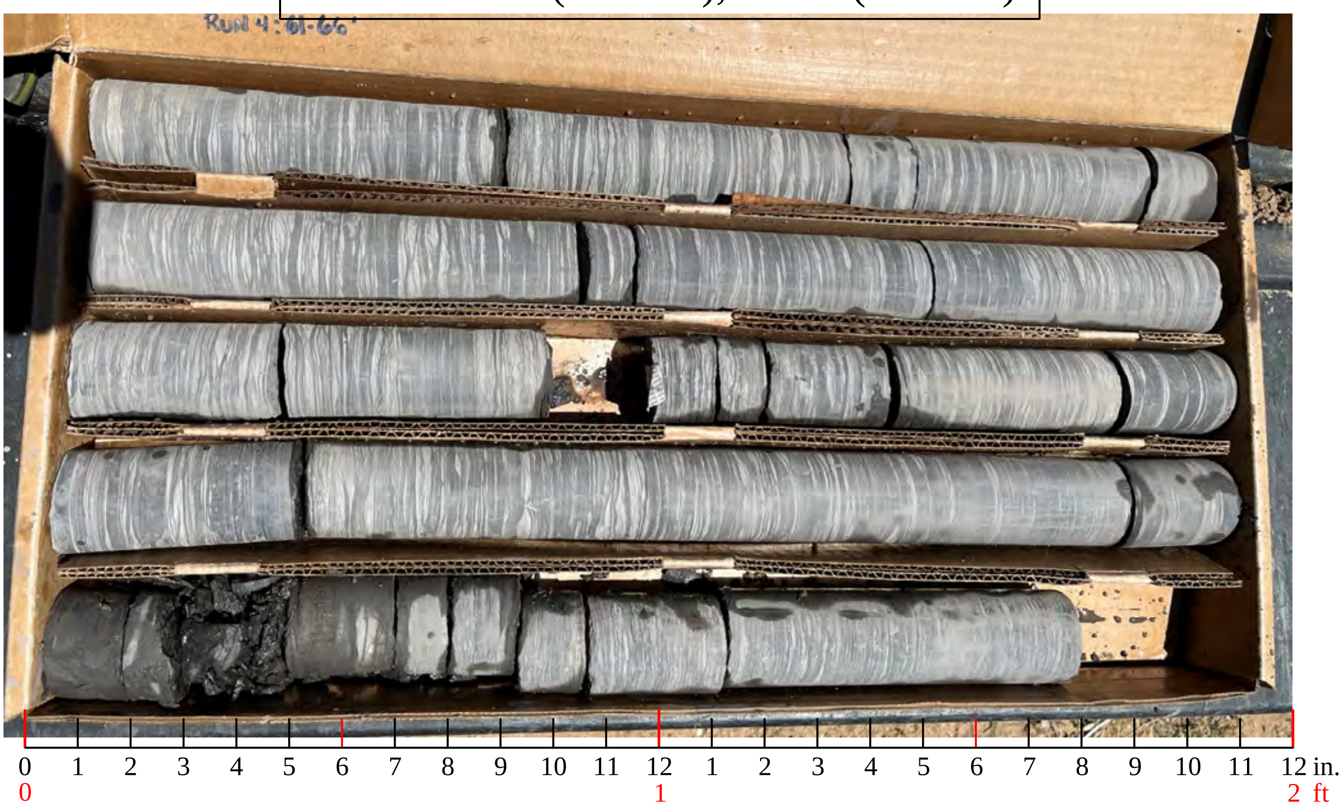
Plate

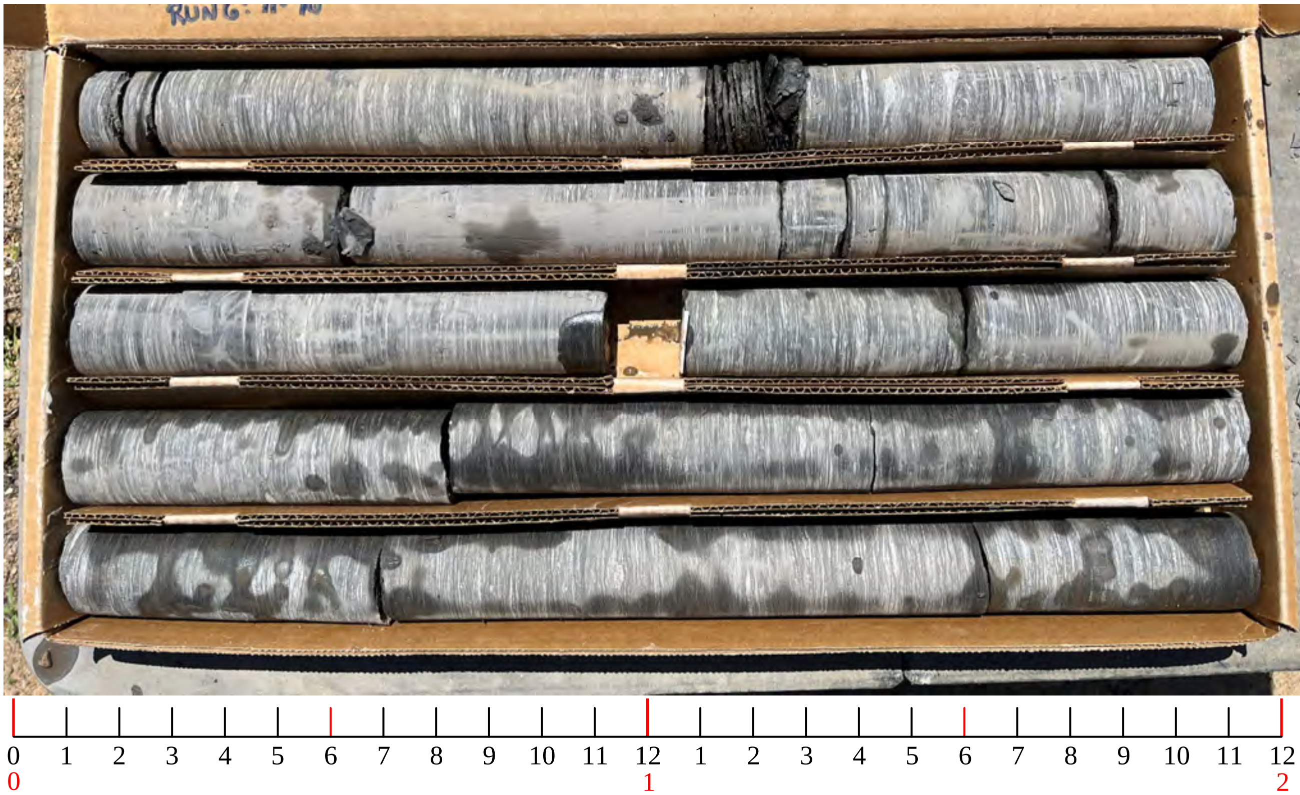
FB-35: Run 1 (46-51 ft), Run 2 (51-56 ft)

FB-35: Run 3 (56-61 ft), Run 4 (61-66 ft)

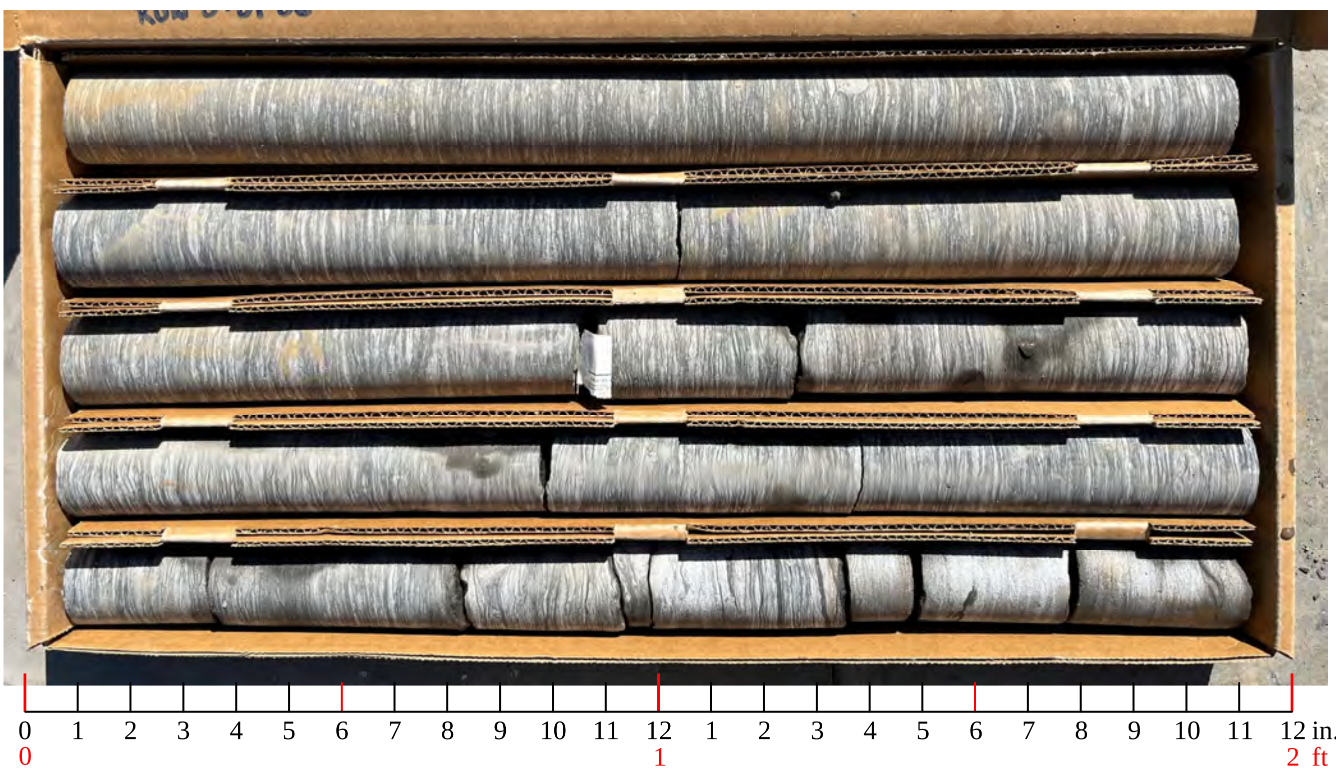


Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>**ROCK CORE PHOTOS**</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-35: Run 5 (66-71 ft), Run 6 (71-76 ft)

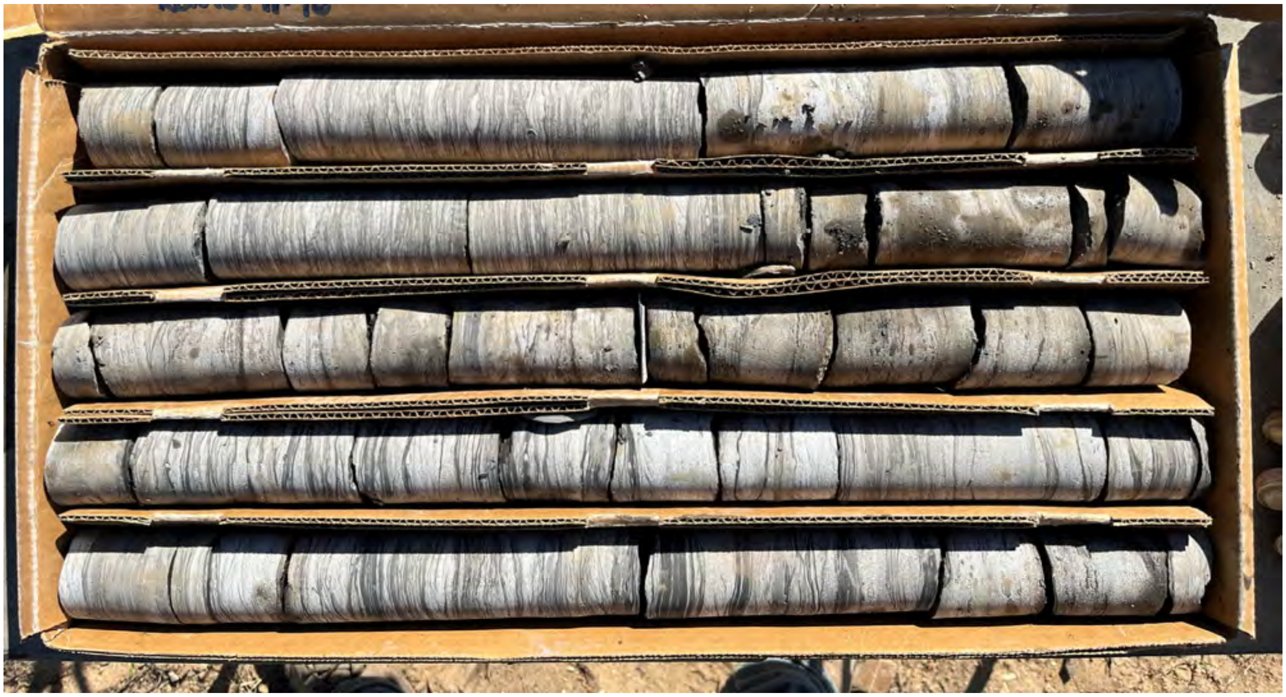


FB-35: Run 7 (76-81 ft), Run 8 (81-86 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-35: Run 9 (86-91 ft), Run 10 (91-96 ft)



0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	Job No. 21-071
	Plate

FB-36: Run 1 (45-50 ft), Run 2 (50-55 ft)

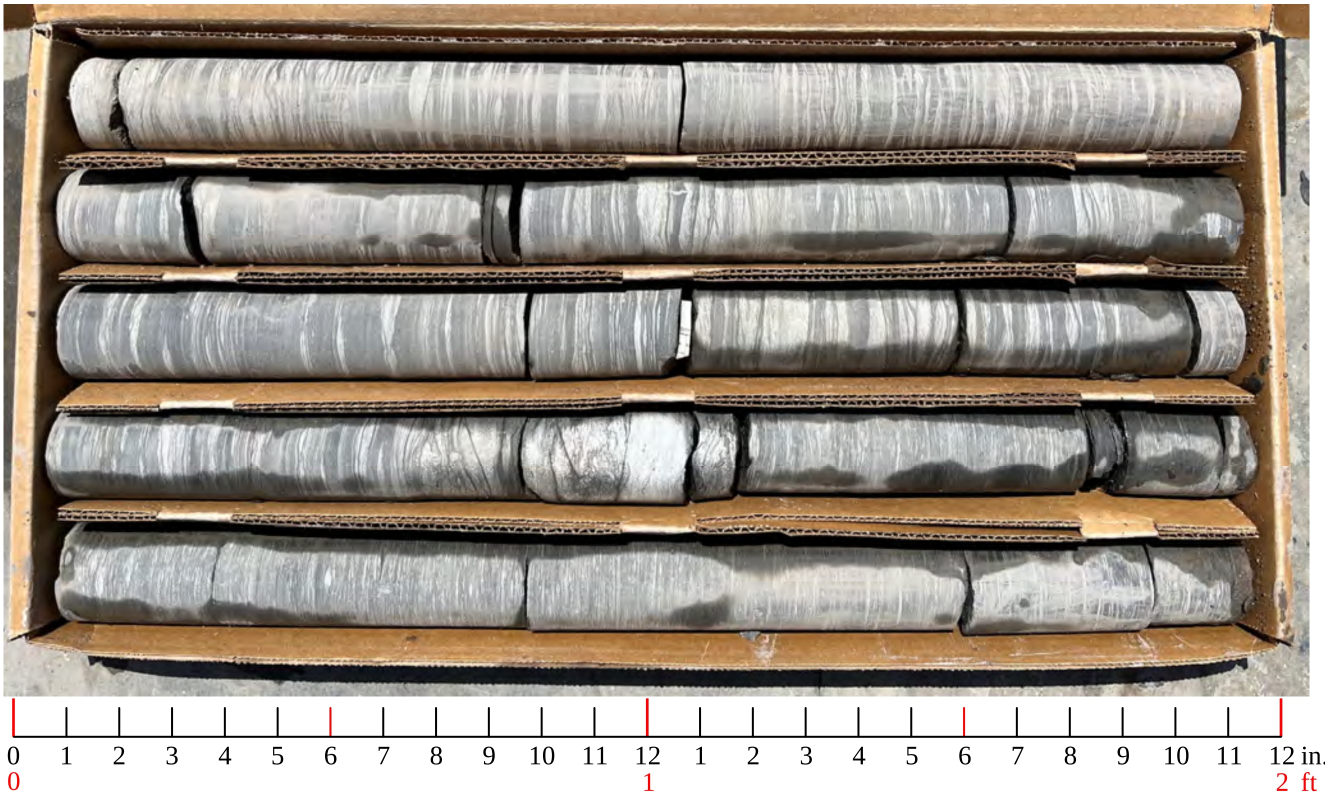
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-36: Run 3 (55-60 ft), Run 4 (60-65 ft)

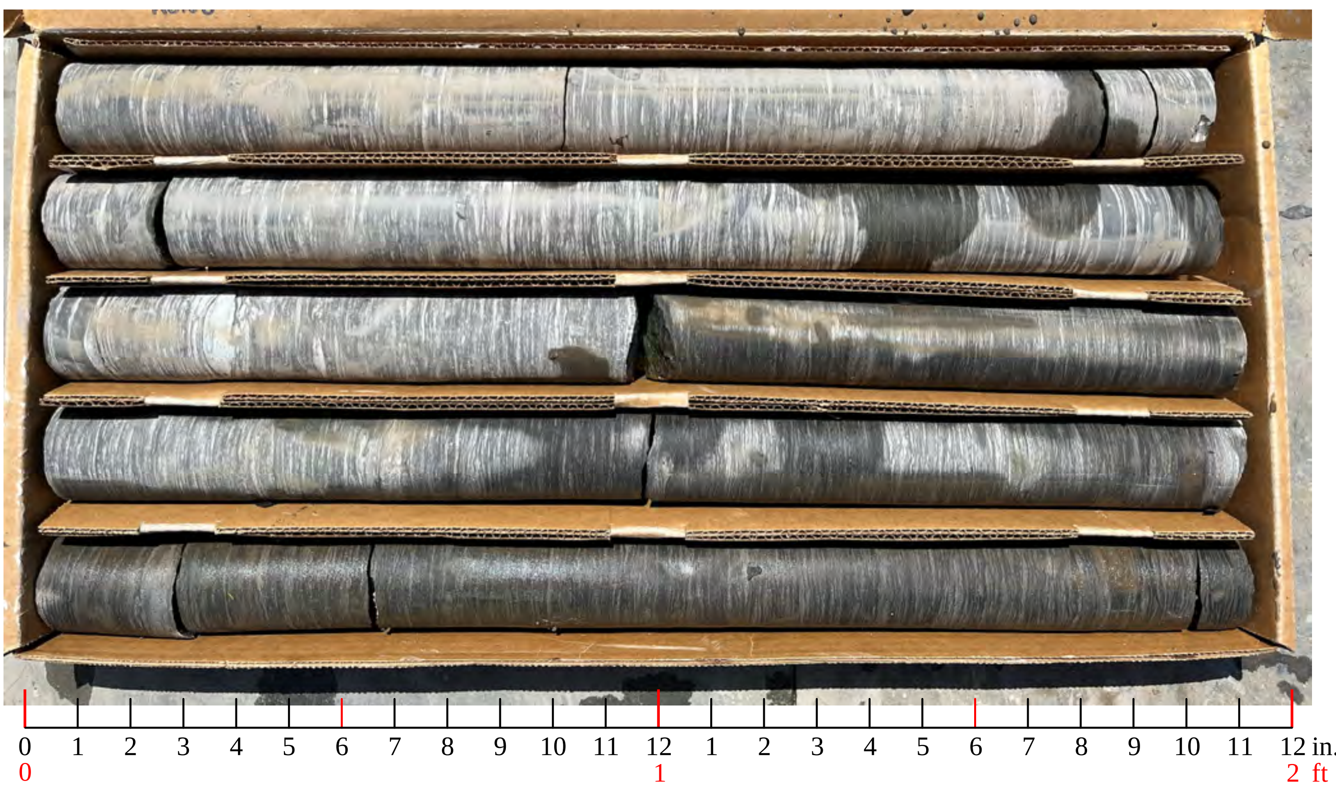
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-36: Run 5 (65-70 ft), Run 6 (70-75 ft)



FB-36: Run 7 (75-80 ft), Run 8 (80-85 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>**ROCK CORE PHOTOS**</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-36: Run 9 (85-90 ft), Run 10 (90-95 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-37: Run 1 (48-51 ft), Run 2 (51-56 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-37: Run 3 (56-61 ft), Run 4 (61-66 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**<u>ROCK CORE PHOTOS</u>** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-37: Run 5 (66-71 ft), Run 6 (71-76 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-37: Run 7 (76-81 ft), Run 8 (81-86 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**<u>ROCK CORE PHOTOS</u>** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-37: Run 9 (86-91 ft), Run 10 (91-96 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-37: Run 11 (96-98 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-38: Run 1 (47-50 ft), Run 2 (50-55 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-38: Run 3 (55-60 ft), Run 4 (60-65 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071**
		Plate

FB-38: Run 5 (65-70 ft), Run 6 (70-75 ft)

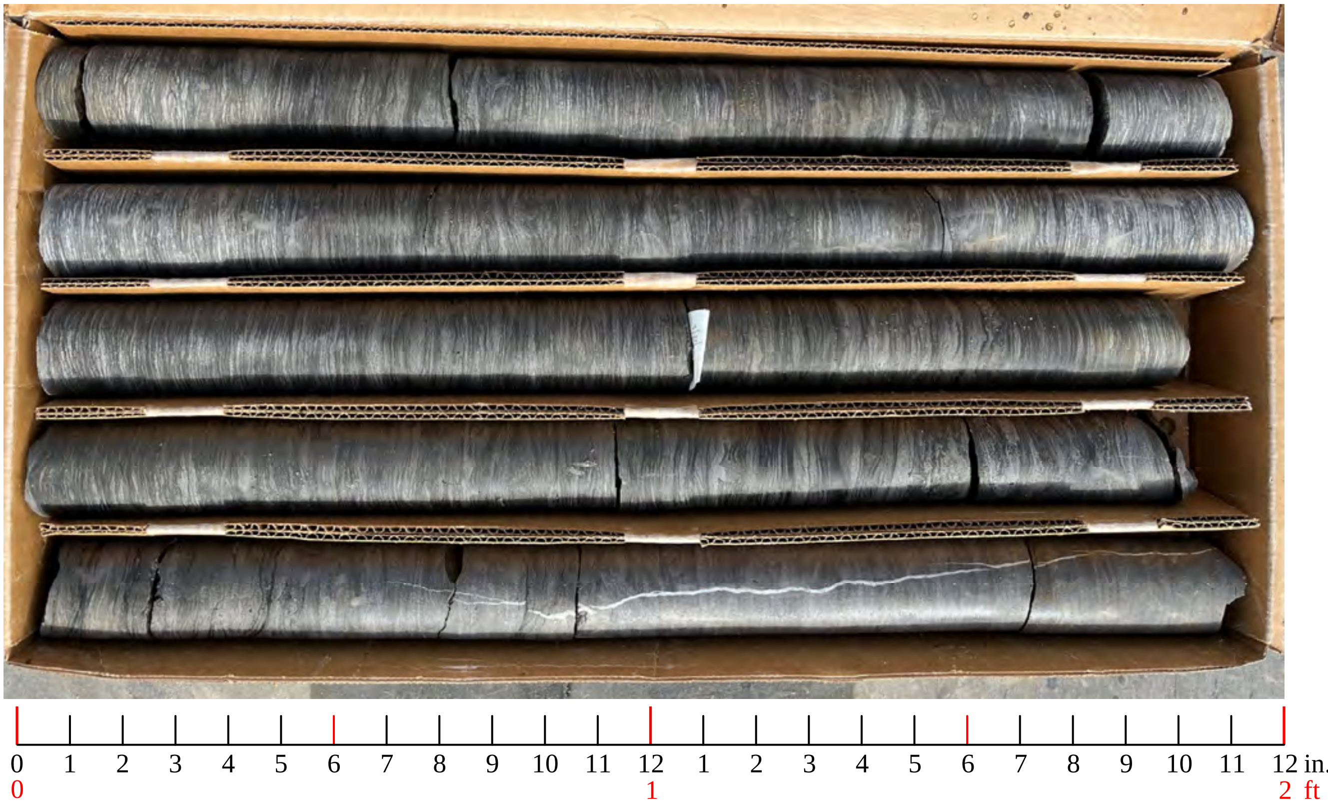
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-38: Run 7 (75-80 ft), Run 8 (80-85 ft)

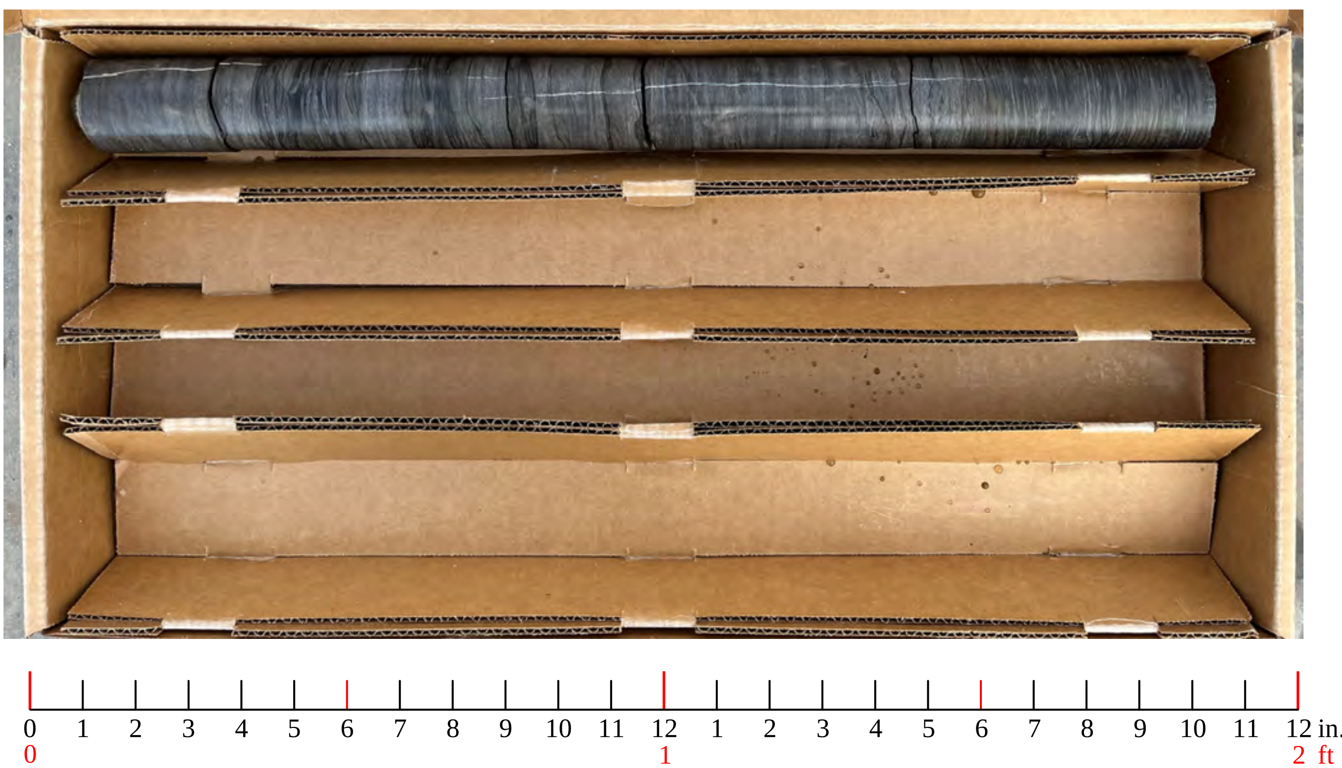
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>**ROCK CORE PHOTOS**</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-38: Run 9 (85-90 ft), Run 10 (90-95 ft)



FB-38: Run 11 (95-97 ft)

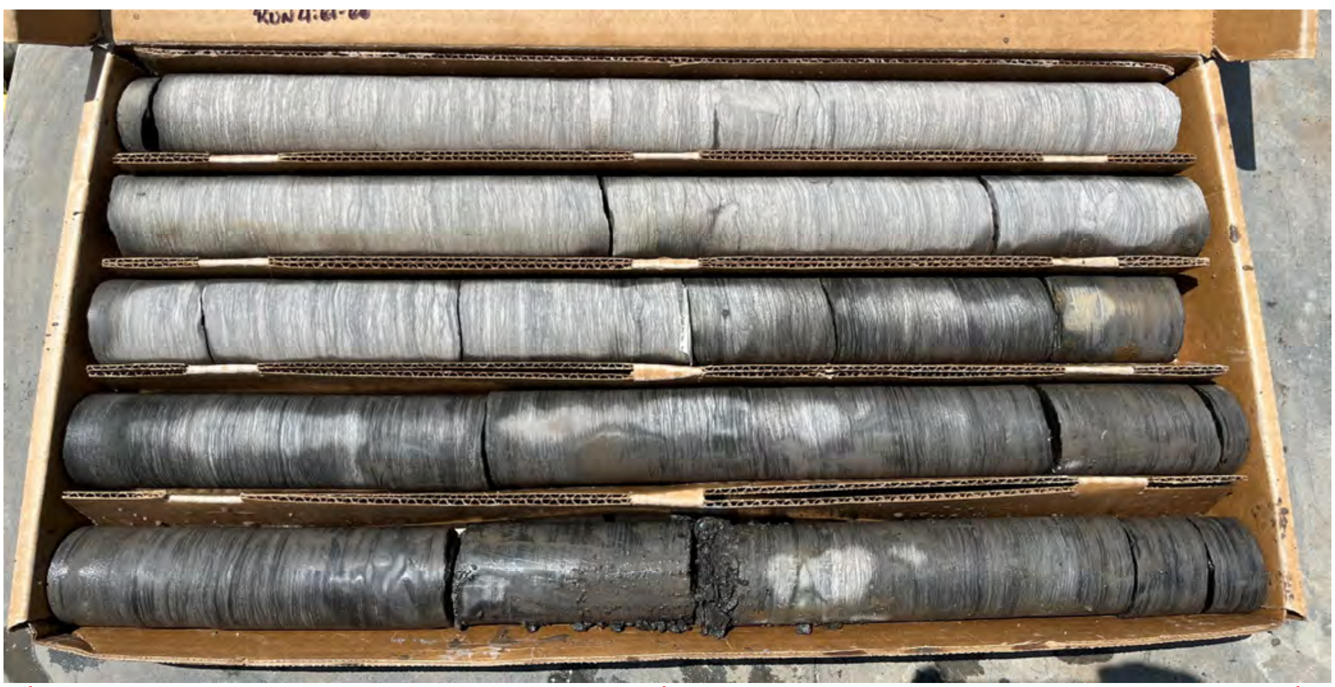


Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-39: Run 1 (47-51 ft), Run 2 (51-56 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-39: Run 3 (56-61 ft), Run 4 (61-66 ft)



0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-39: Run 5 (66-71 ft), Run 6 (71-76 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-39: Run 7 (76-81 ft), Run 8 (81-86 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-39: Run 9 (86-91 ft), Run 10 (91-96 ft)

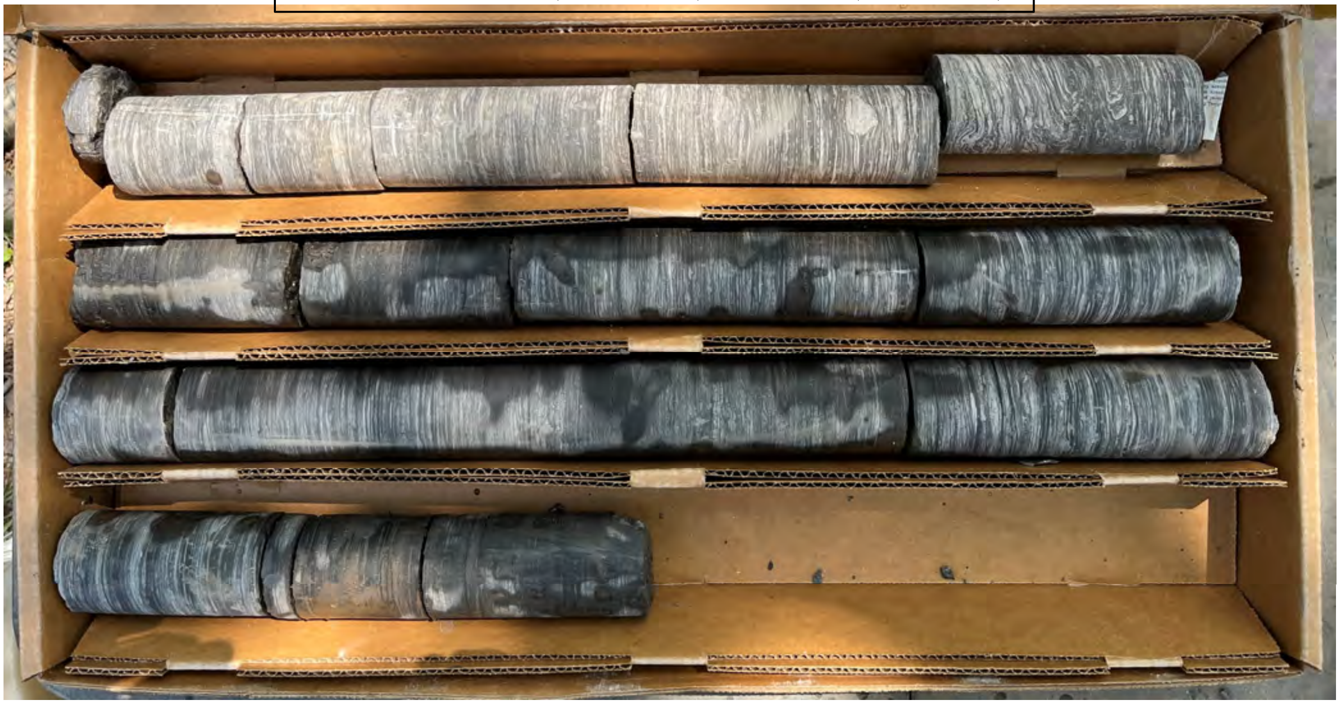
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-39: Run 11 (96-97 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-40: Run 1 (49-51 ft), Run 2 (51-56 ft)



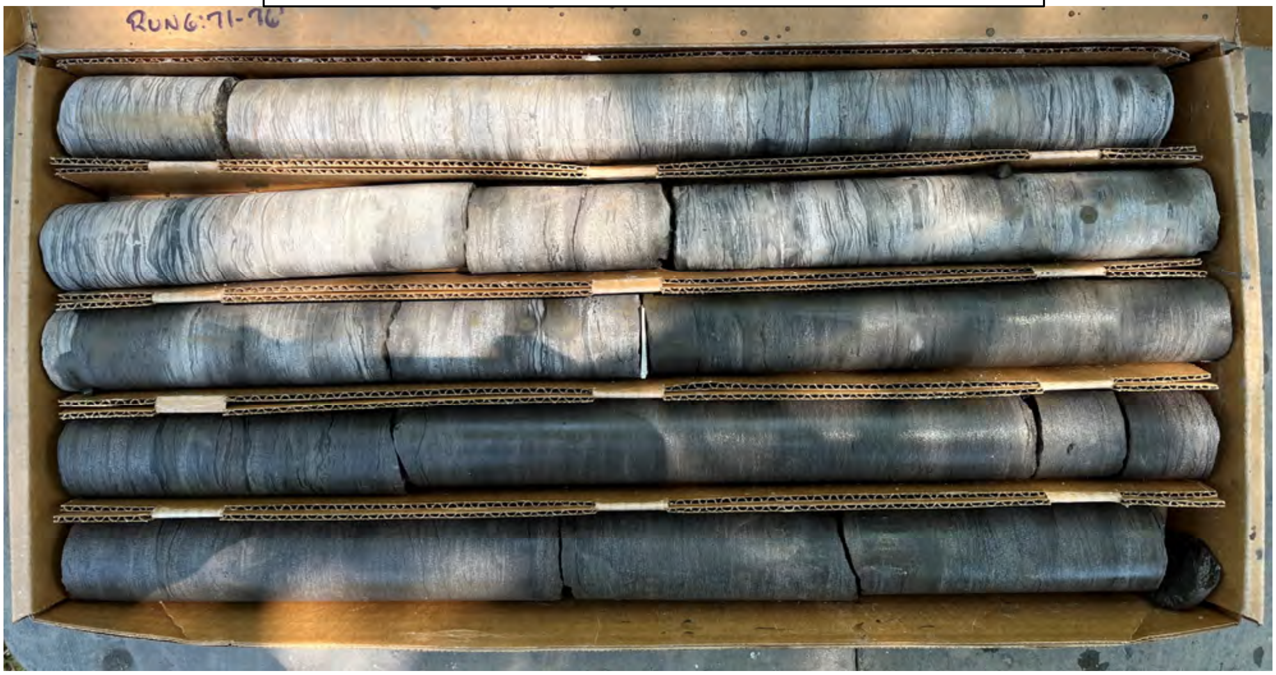
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-40: Run 3 (56-61 ft), Run 4 (61-66 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**<u>ROCK CORE PHOTOS</u>** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-40: Run 5 (66-71 ft), Run 6 (71-76 ft)



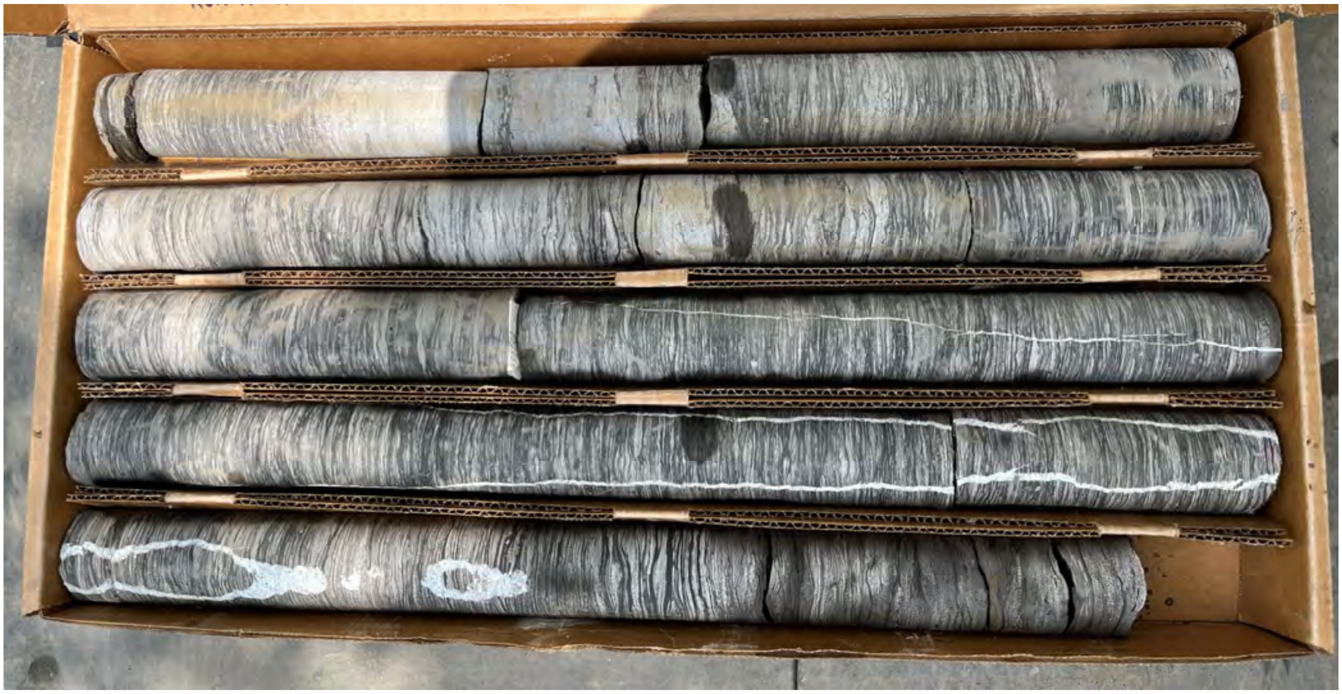
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-40: Run 7 (76-81 ft), Run 8 (81-86 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-40: Run 9 (86-91 ft), Run 10 (91-96 ft)



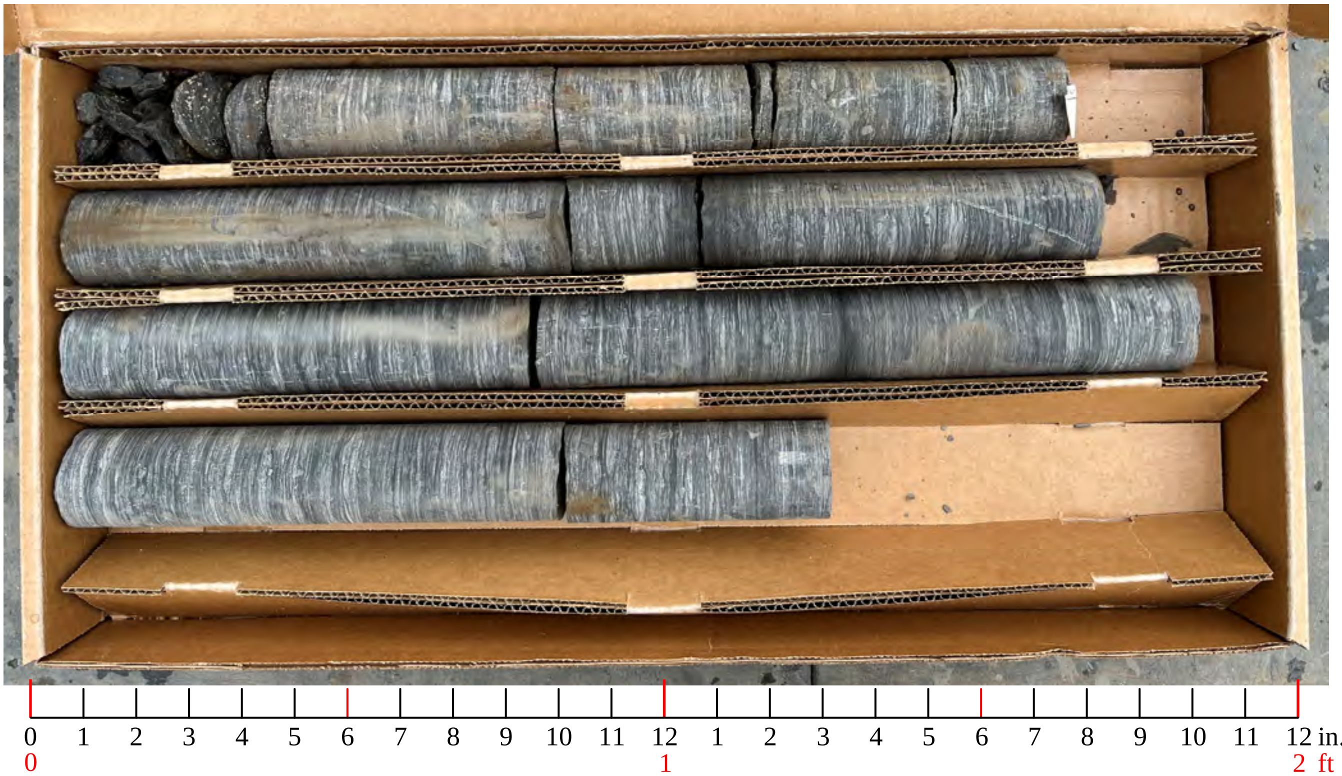
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-40: Run 11 (96-99 ft)

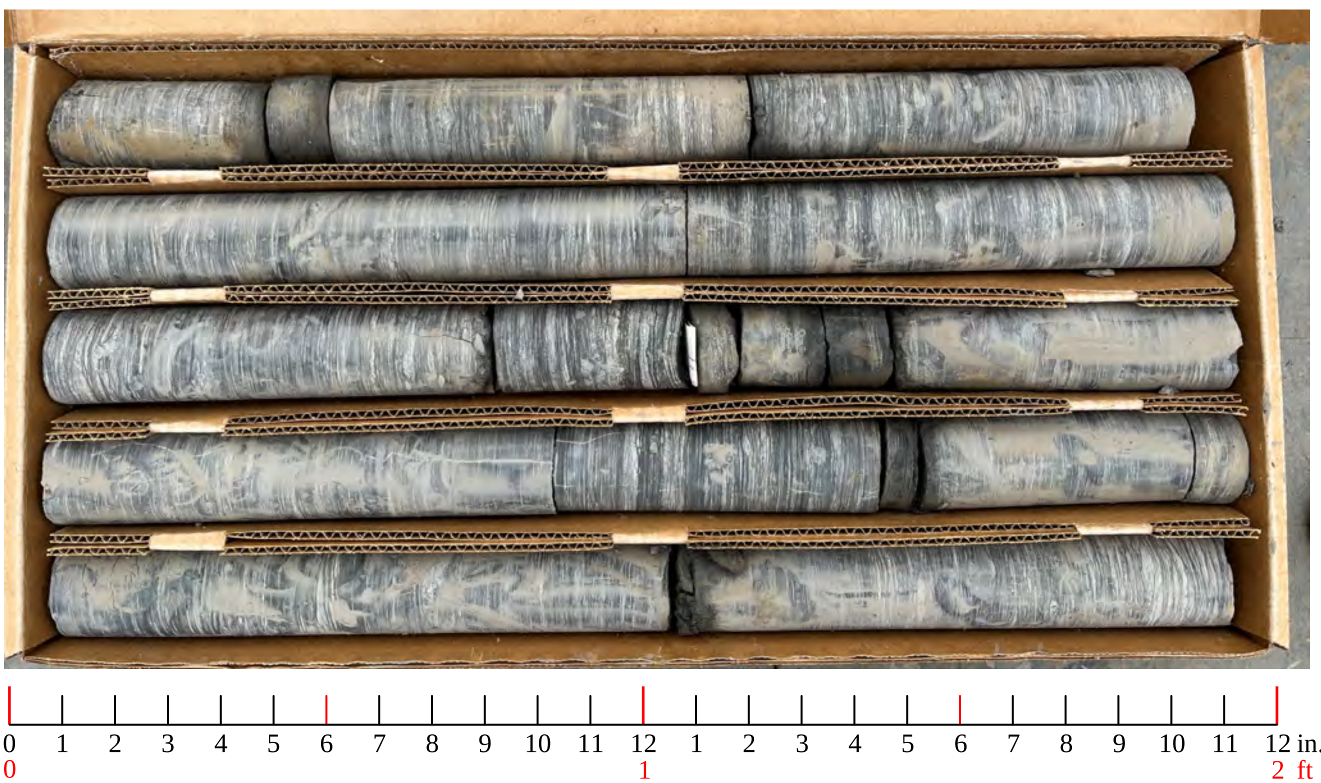
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-41: Run 1 (49-51 ft), Run 2 (51-56 ft)

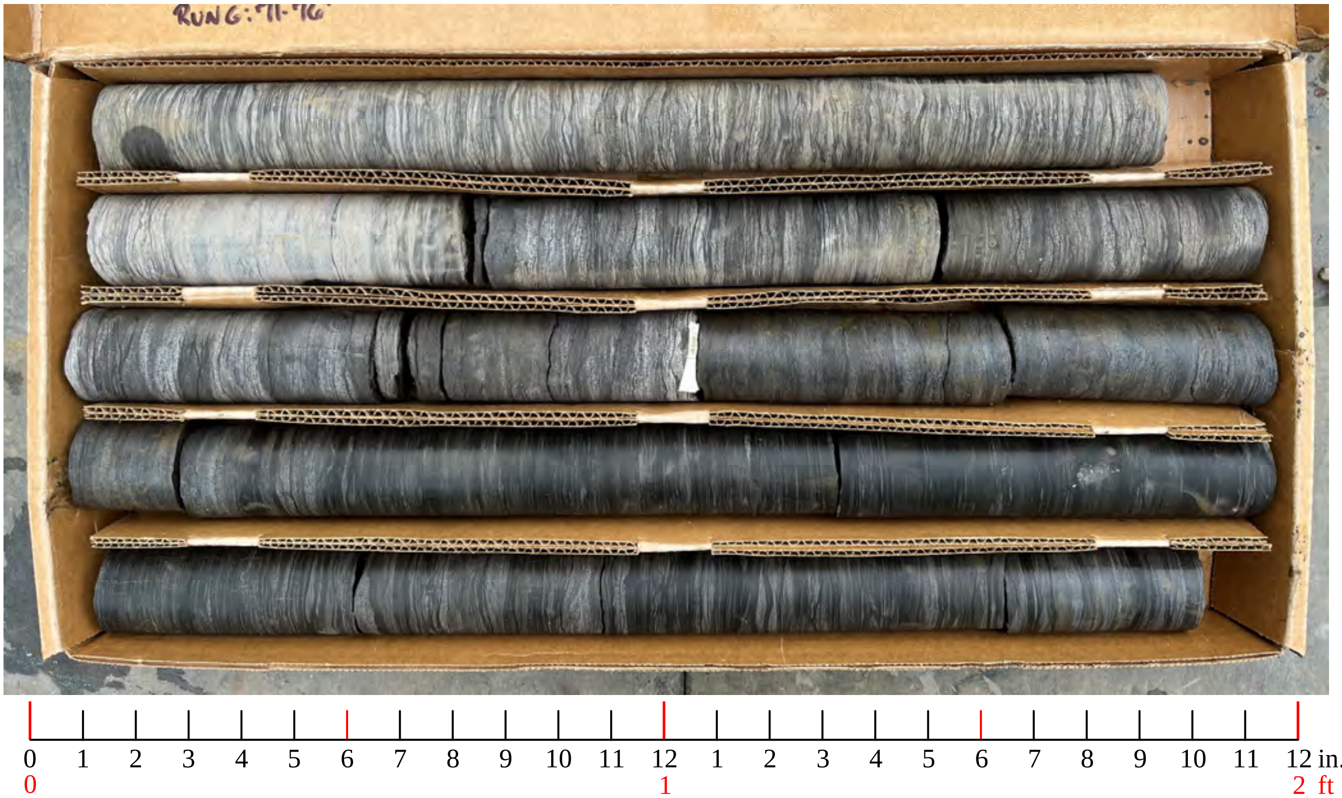


FB-41: Run 3 (56-61 ft), Run 4 (61-66 ft)

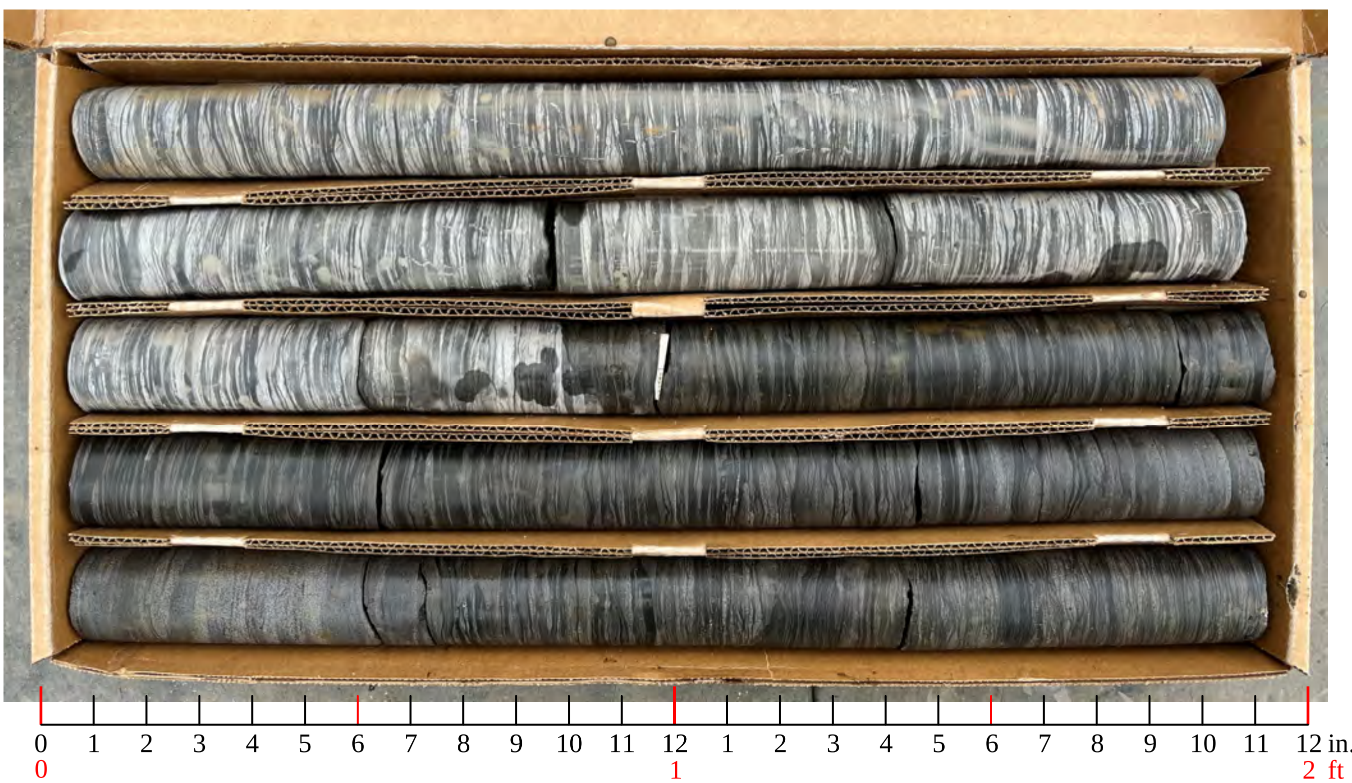


Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-41: Run 5 (66-71 ft), Run 6 (71-76 ft)

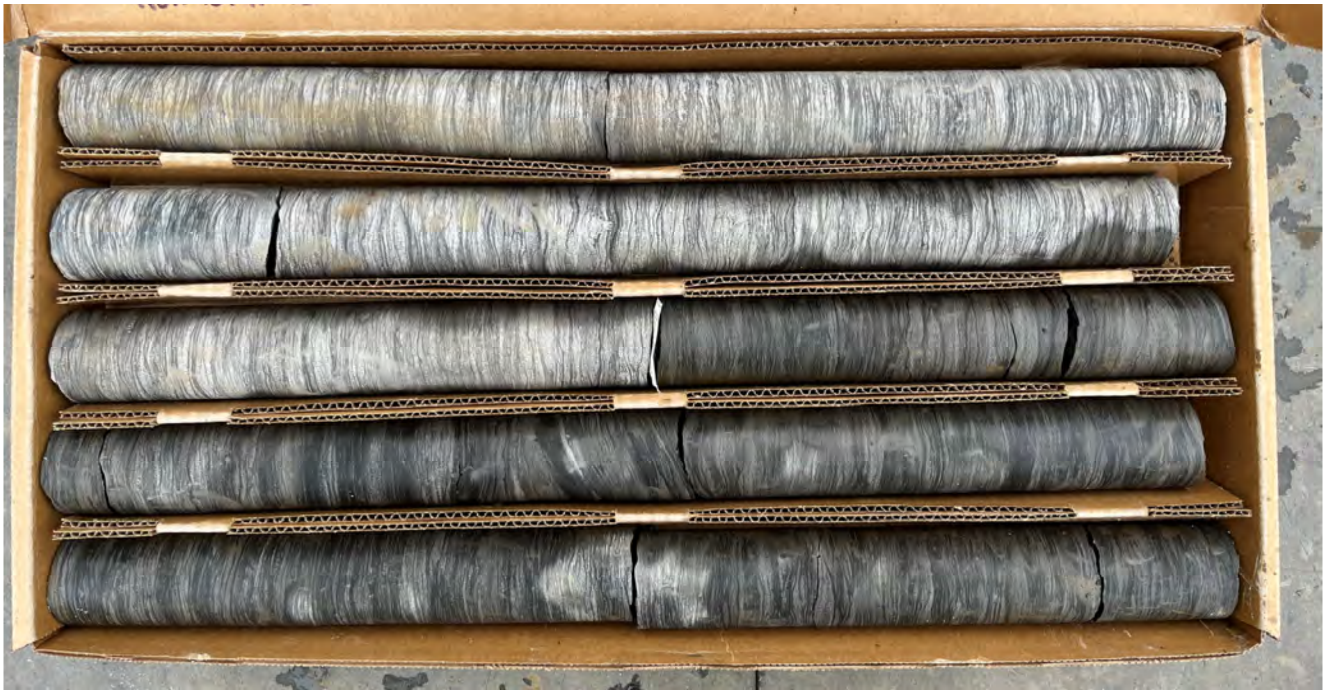


FB-41: Run 7 (76-81 ft), Run 8 (81-86 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-41: Run 9 (86-91 ft), Run 10 (91-96 ft)



0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

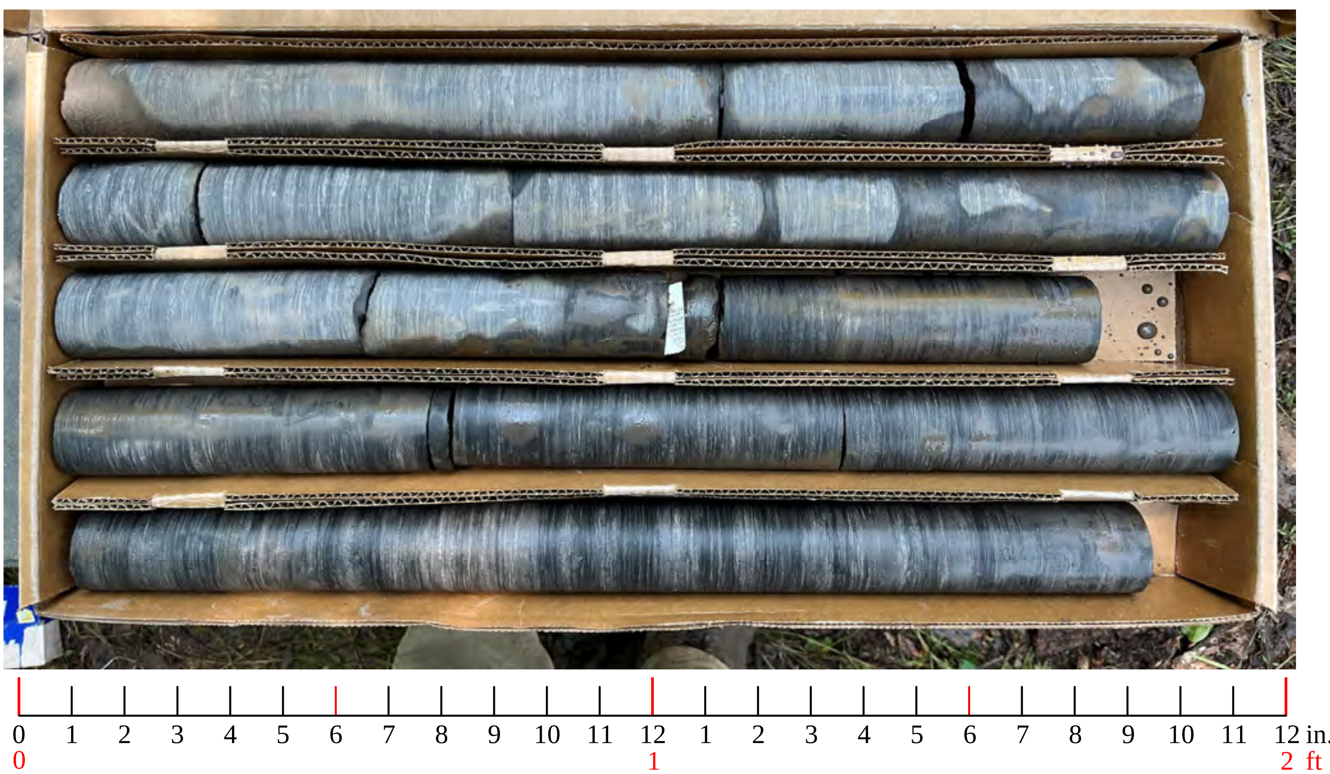
FB-41: Run 11 (96-99 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-42: Run 1 (46-51 ft), Run 2 (51-56 ft)

FB-42: Run 3 (56-61 ft), Run 4 (61-66 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-42: Run 5 (66-71 ft), Run 6 (71-76 ft)

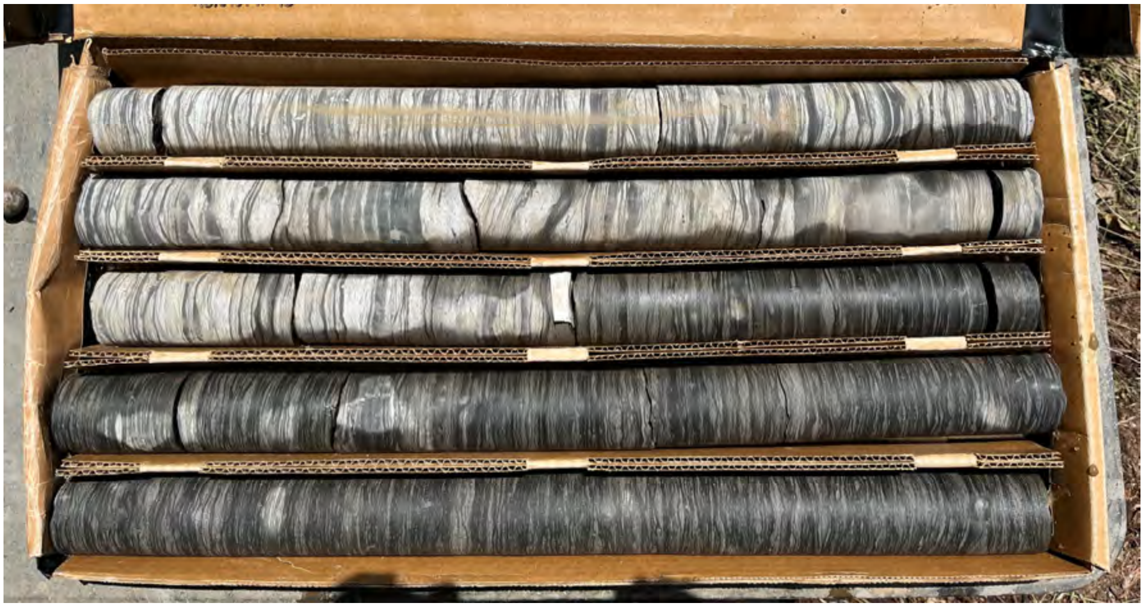
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-42: Run 7 (76-81 ft), Run 8 (81-86 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-42: Run 9 (86-91 ft), Run 10 (91-96 ft)



0	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12 in.
0												1												2 ft

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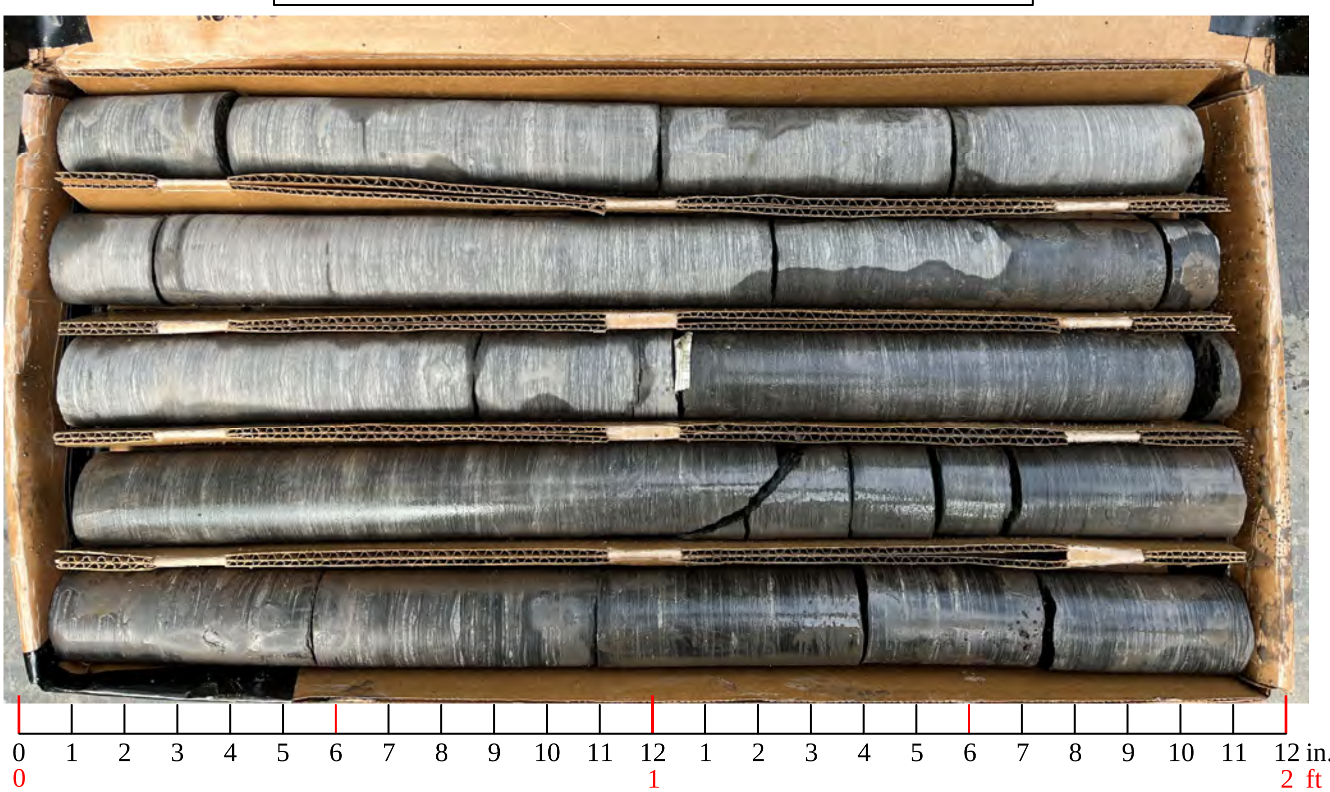
FB-43: Run 1 (42-46 ft), Run 2 (46-52 ft)

FB-43: Run 3 (52-57 ft), Run 4 (57-62 ft)



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FB-43: Run 5 (62-66 ft), Run 6 (66-72 ft)

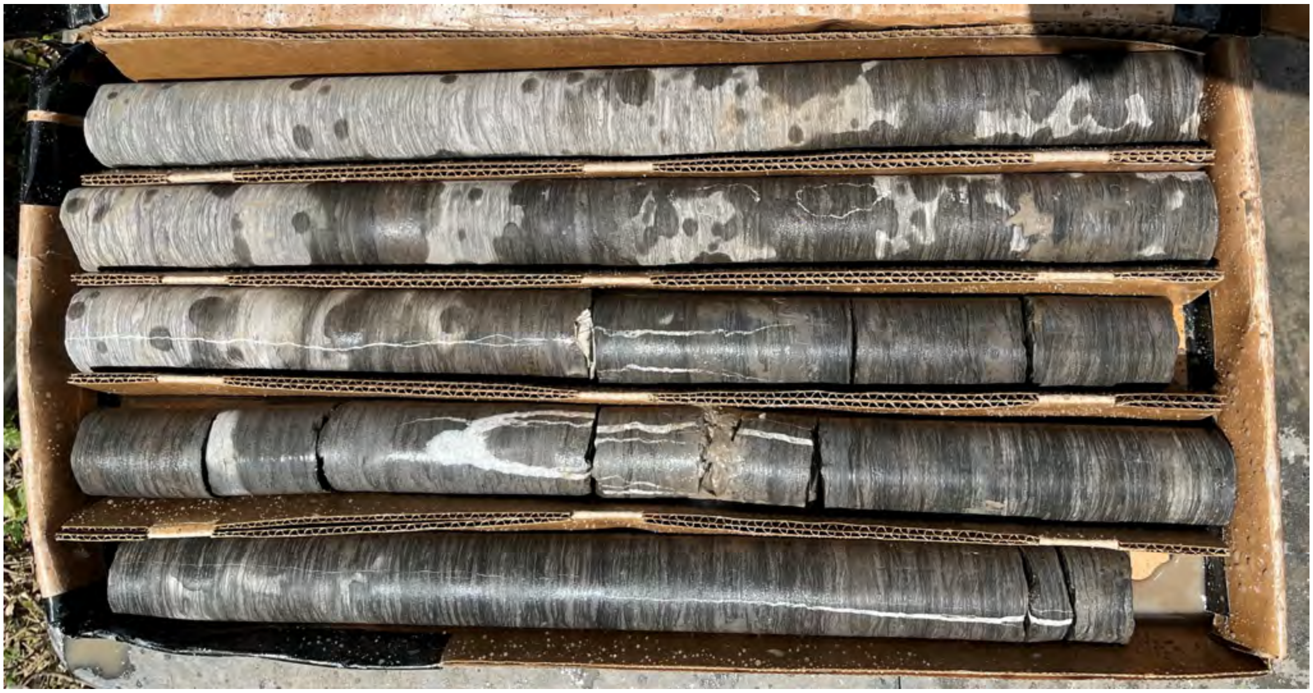
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-43: Run 7 (72-77 ft), Run 8 (77-82 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-43: Run 9 (82-86 ft), Run 10 (86-92 ft)



0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-44: Run 1 (39-41 ft), Run 2 (41-46 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-44: Run 3 (46-51 ft), Run 4 (51-56 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-44: Run 5 (56-61 ft), Run 6 (61-66 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-44: Run 7 (66-71 ft), Run 8 (71-76 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-44: Run 9 (76-81 ft), Run 10 (81-86 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-44: Run 11 (86-89 ft)

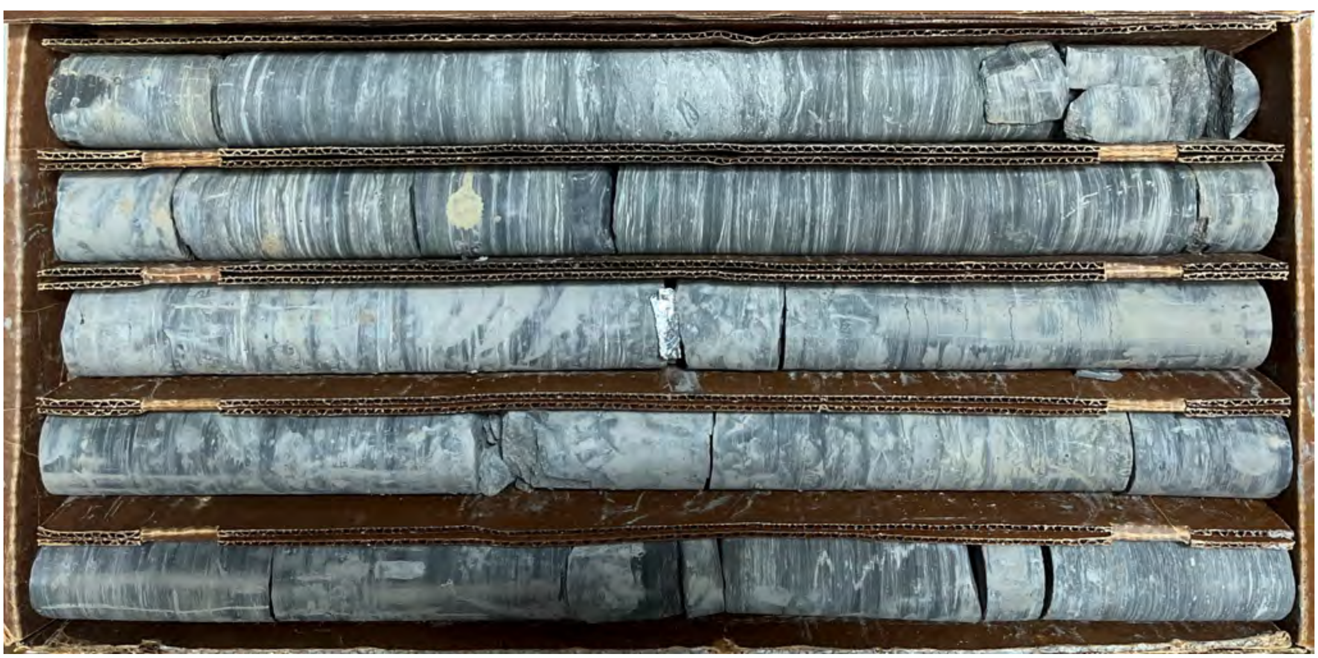
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>**ROCK CORE PHOTOS**</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-45: Run 1 (40-45 ft), Run 2 (45-50 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

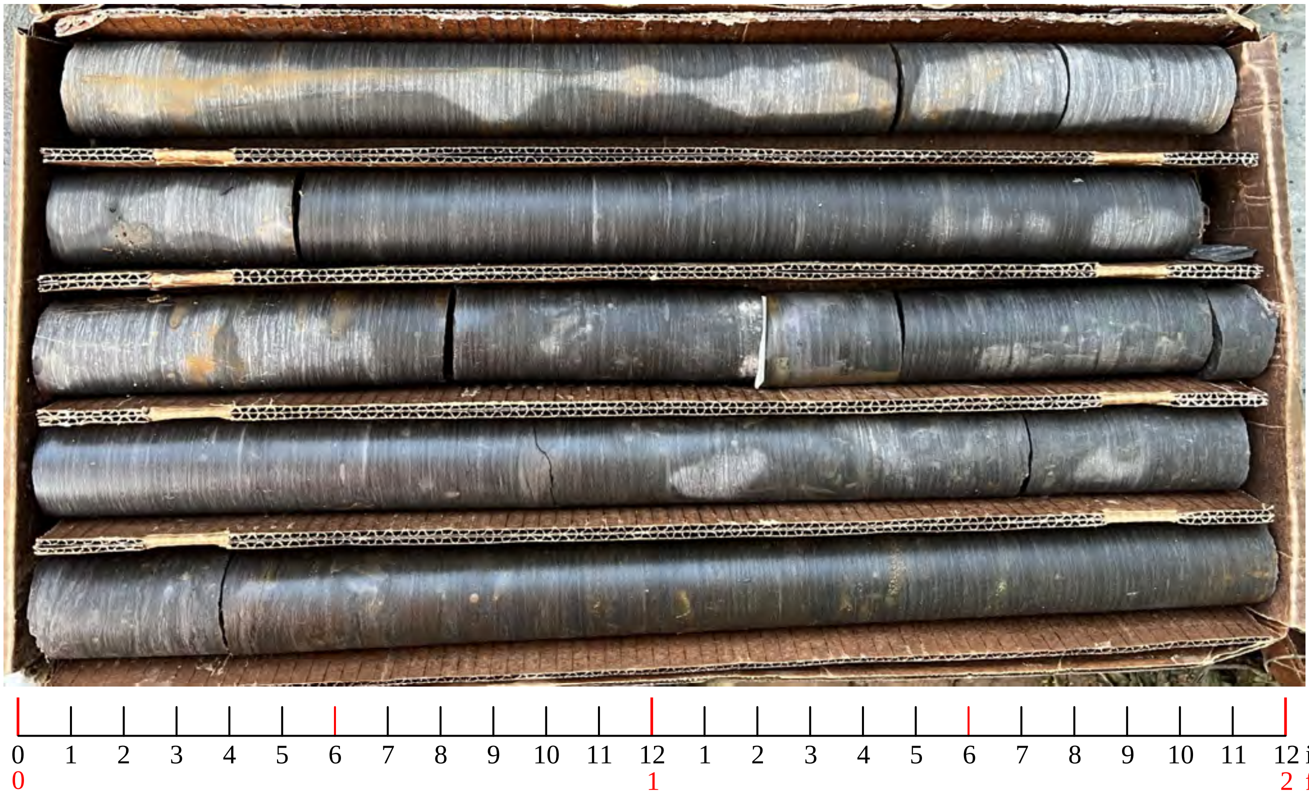
FB-45: Run 3 (50-55 ft), Run 4 (55-60 ft)



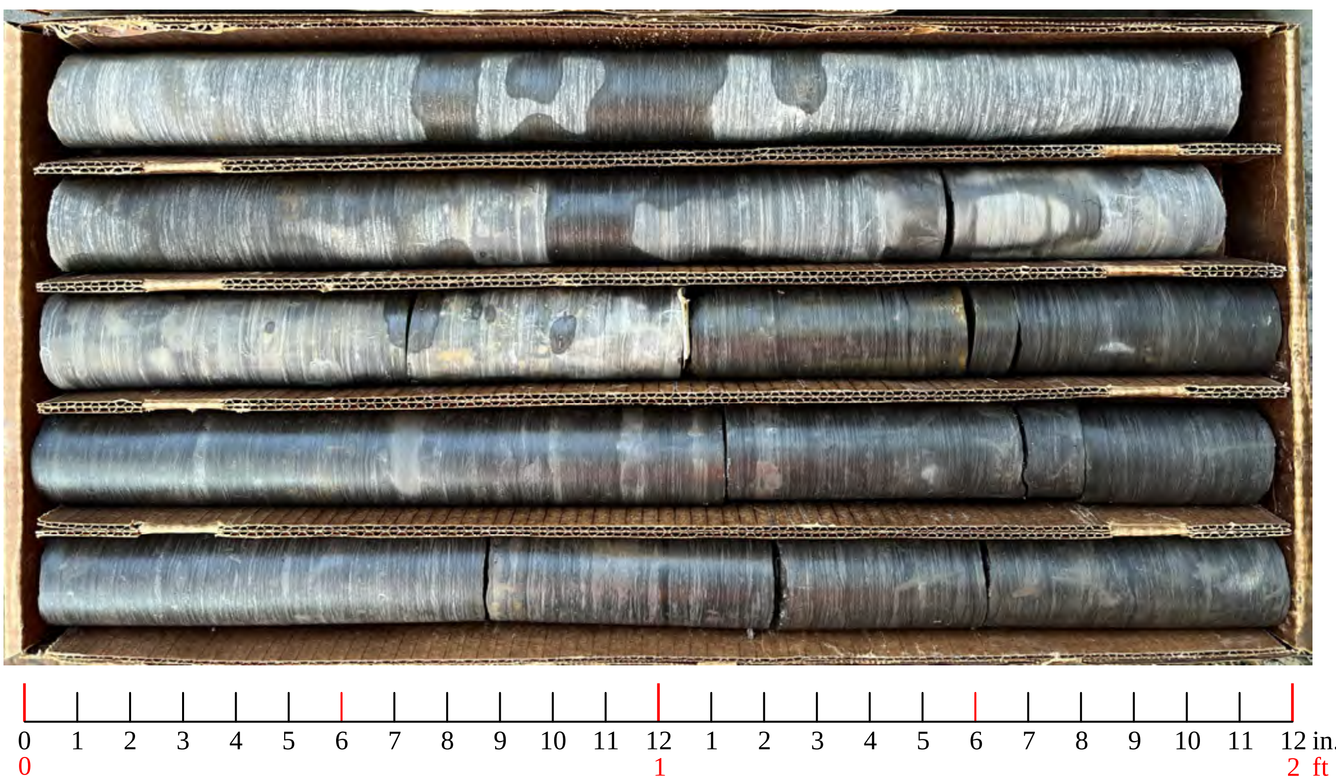
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-45: Run 5 (60-65 ft), Run 6 (65-70 ft)



FB-45: Run 7 (70-75 ft), Run 8 (75-80 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-45: Run 9 (80-85 ft), Run 10 (85-90 ft)

0	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	in.
0												1												2	ft

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040748 Hwy 22 to I-40
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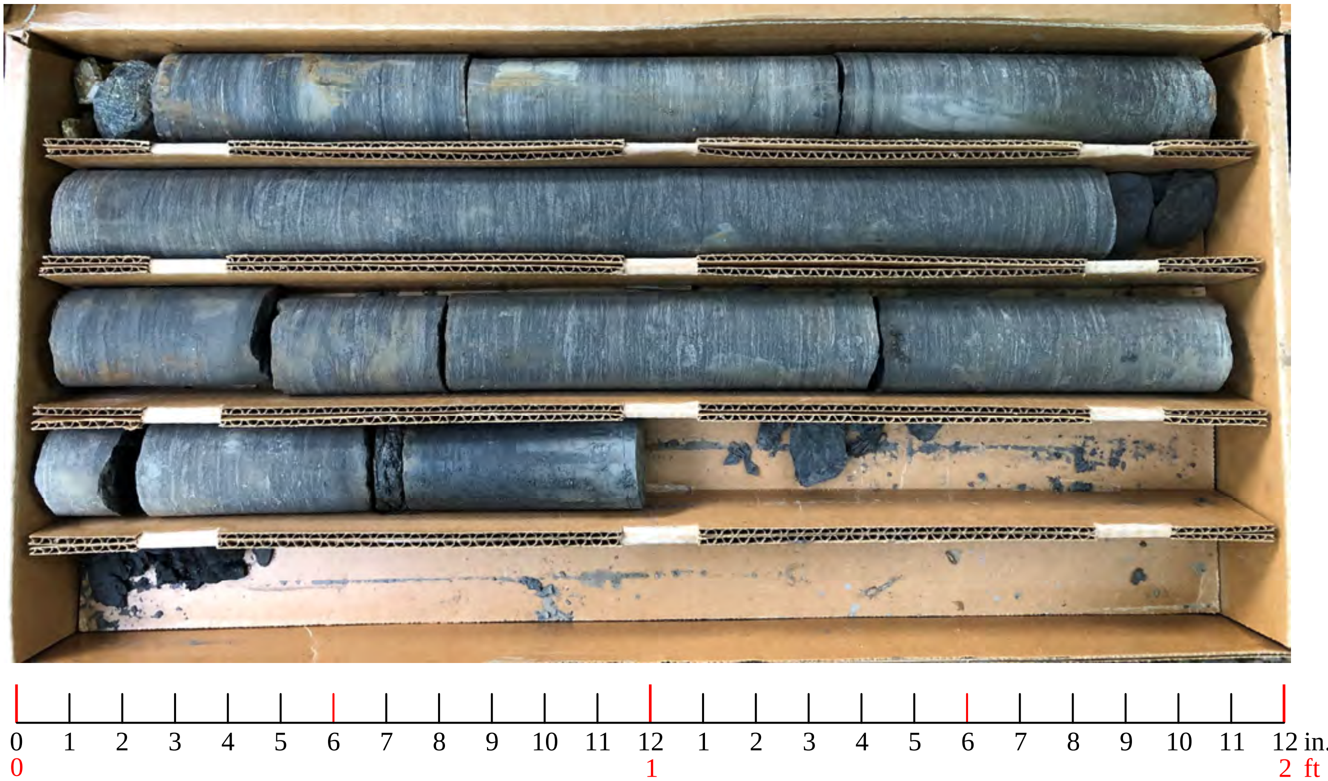
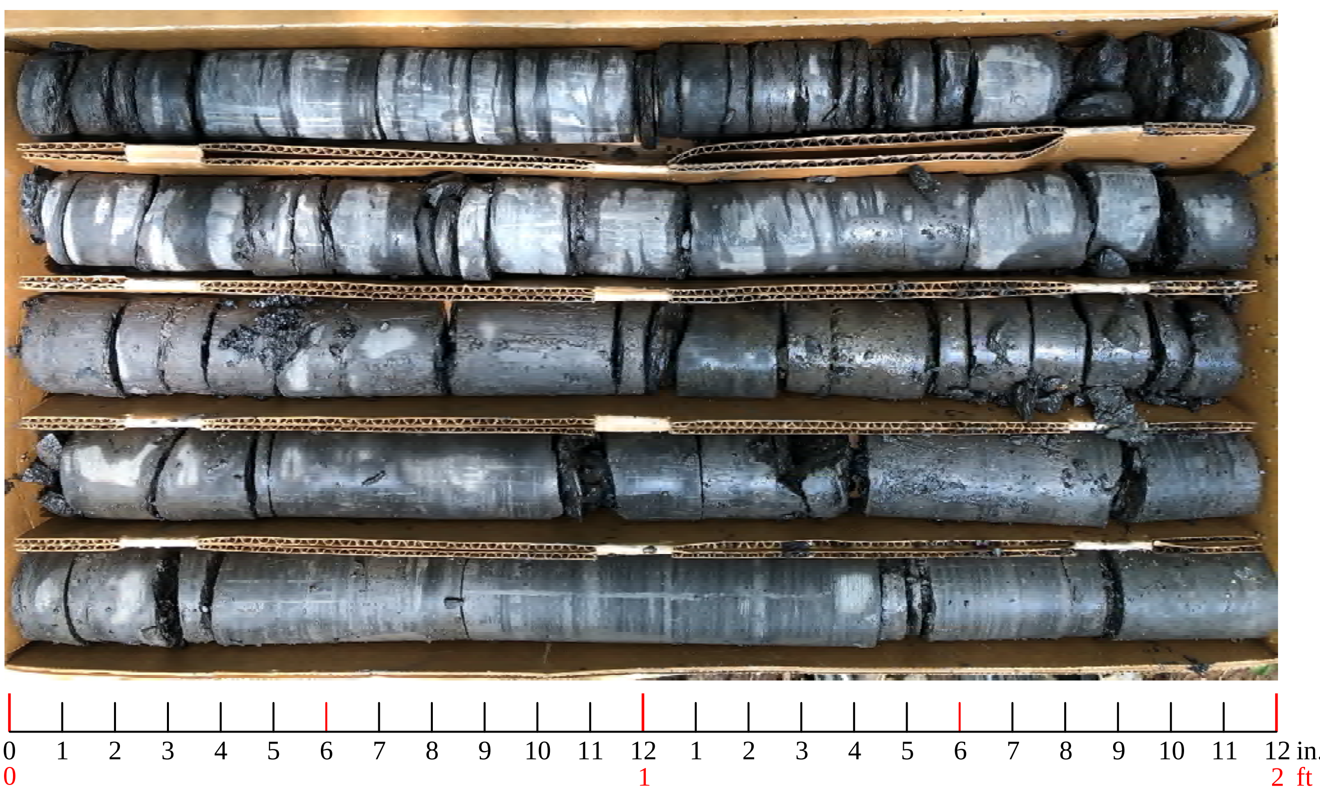
FB-46: Run 1 (43-45 ft), Run 2 (45-50 ft)

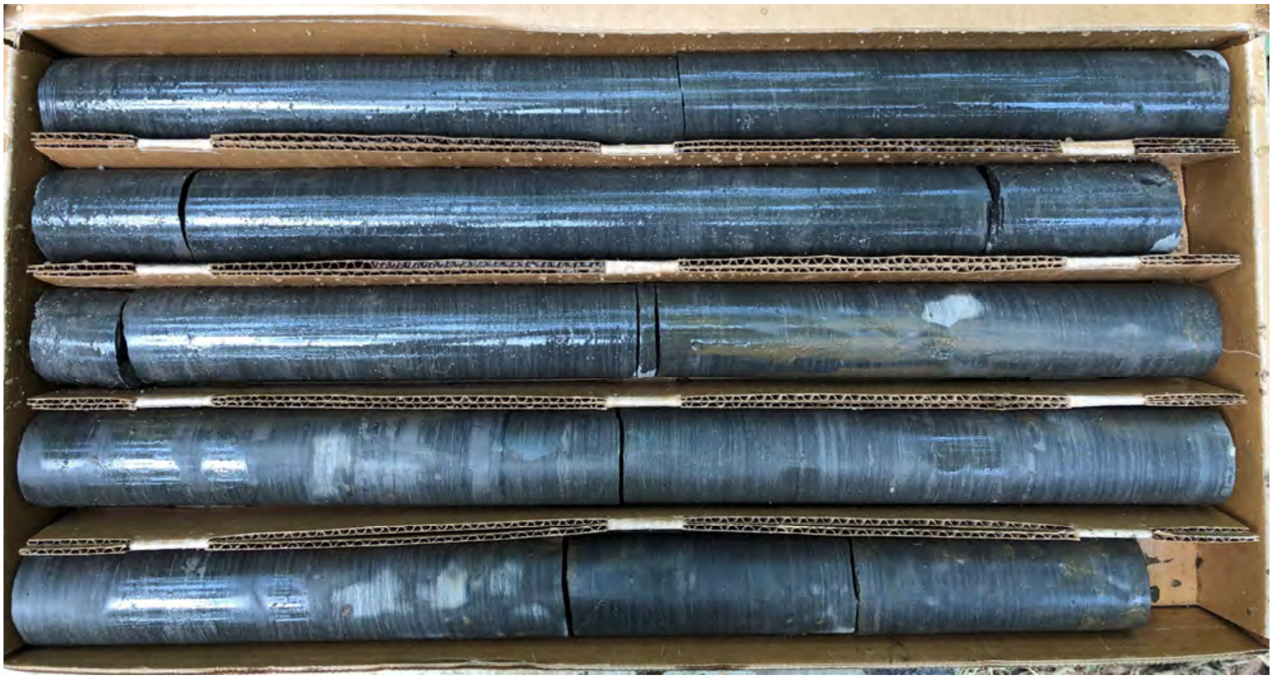


FB-46: Run 3 (50-55 ft), Run 4 (55-60 ft)



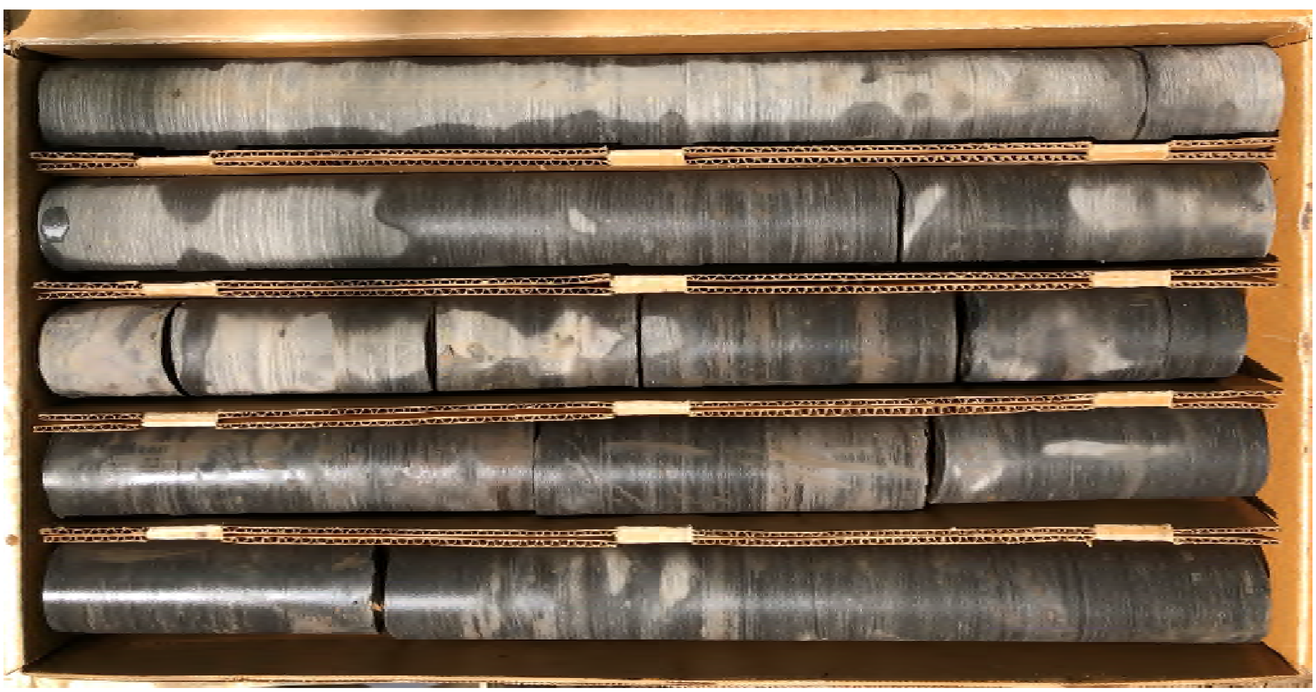
Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**<u>ROCK CORE PHOTOS</u>** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-46: Run 5 (60-65 ft), Run 6 (65-70 ft)



0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-46: Run 7 (70-75 ft), Run 8 (75-80 ft)



0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>**ROCK CORE PHOTOS**</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-46: Run 9 (80-85 ft), Run 10 (85-90 ft)

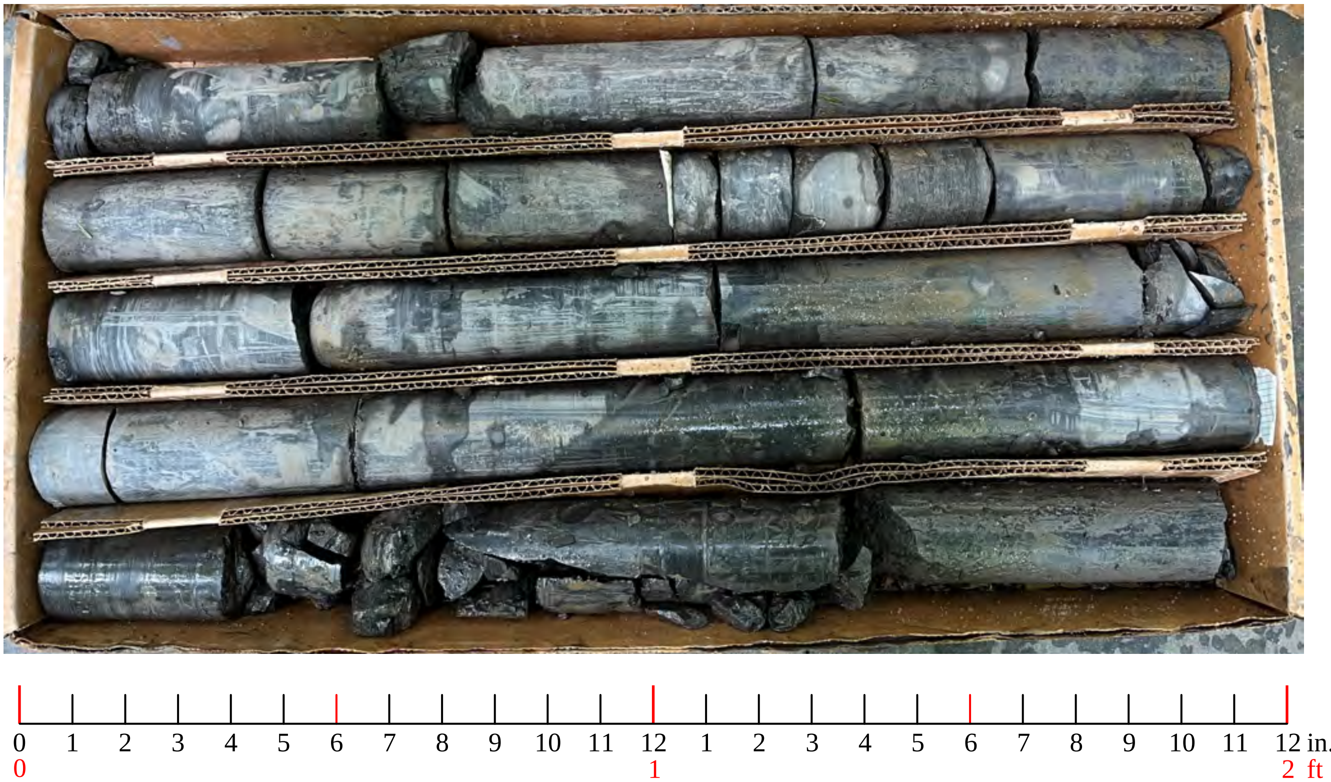
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-46: Run 11 (90-93 ft)

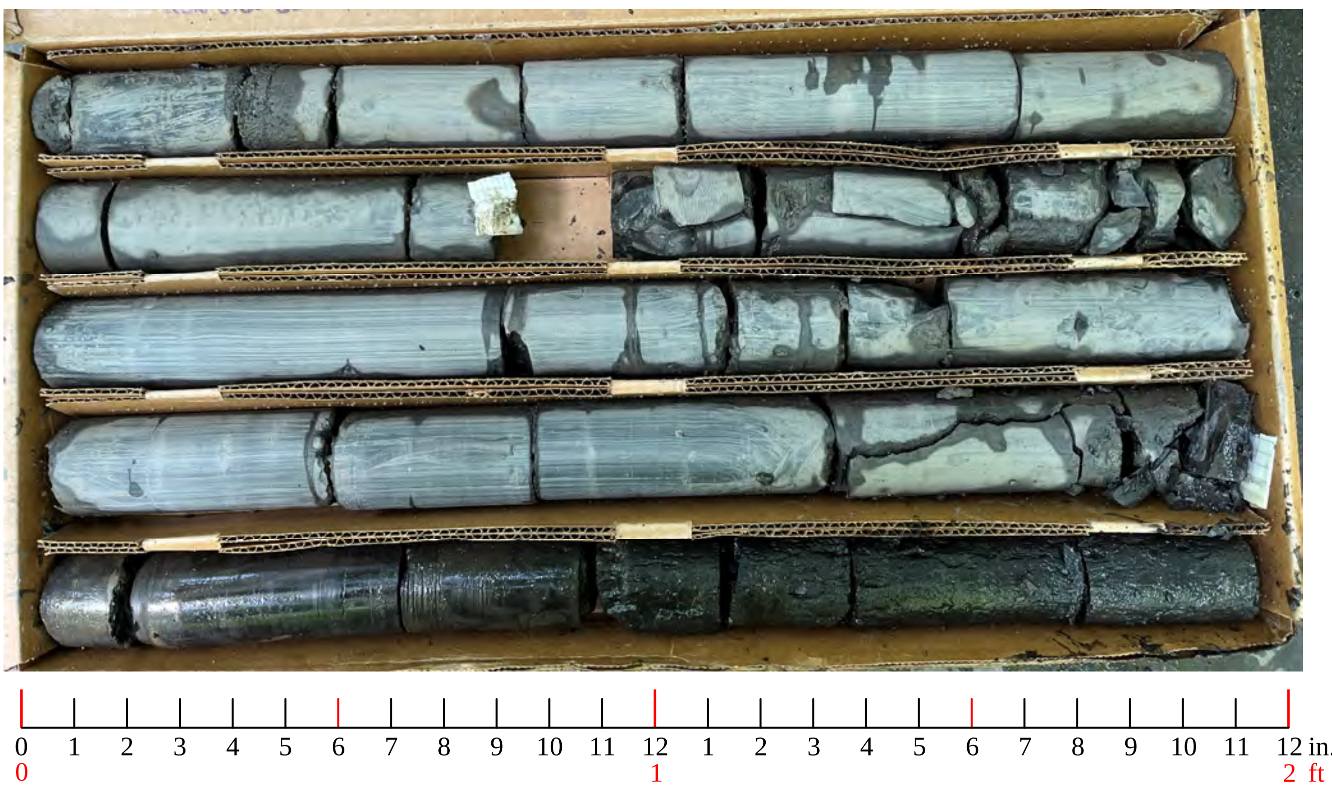
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-65: Run 1 (42-45 ft), Run 2 (45-50 ft), Run 3 (50-52 ft)

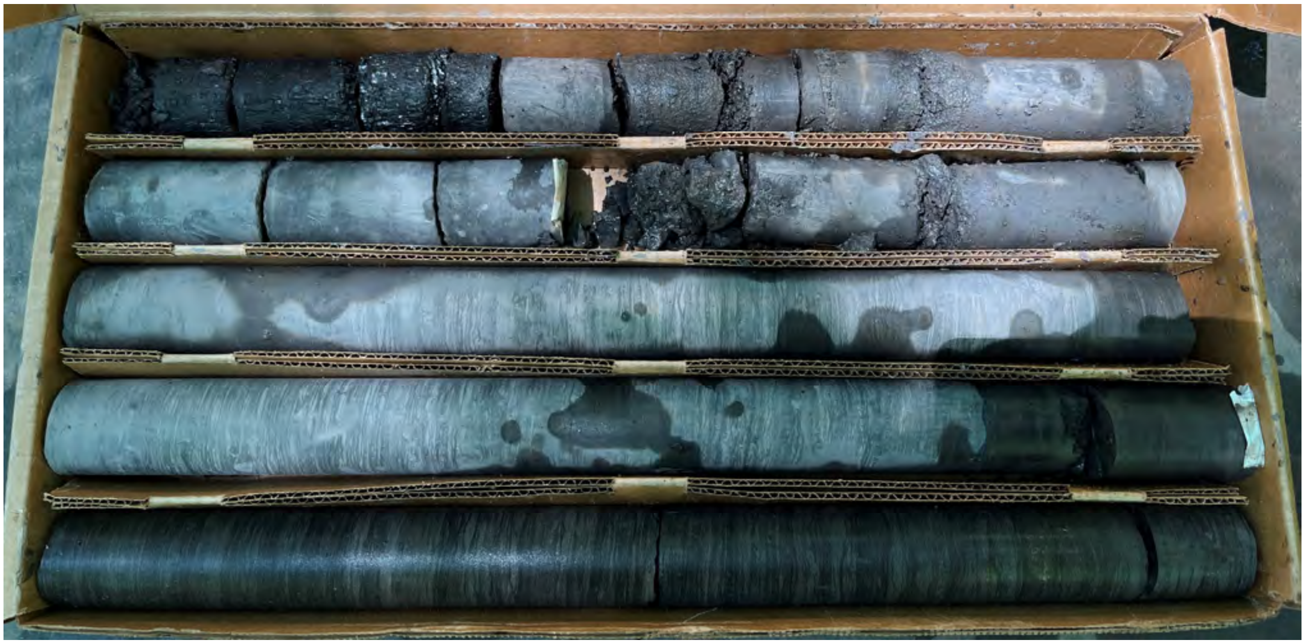


FB-65: Run 3 (52-55 ft), Run 4 (55-60 ft), Run 5 (60-62 ft)



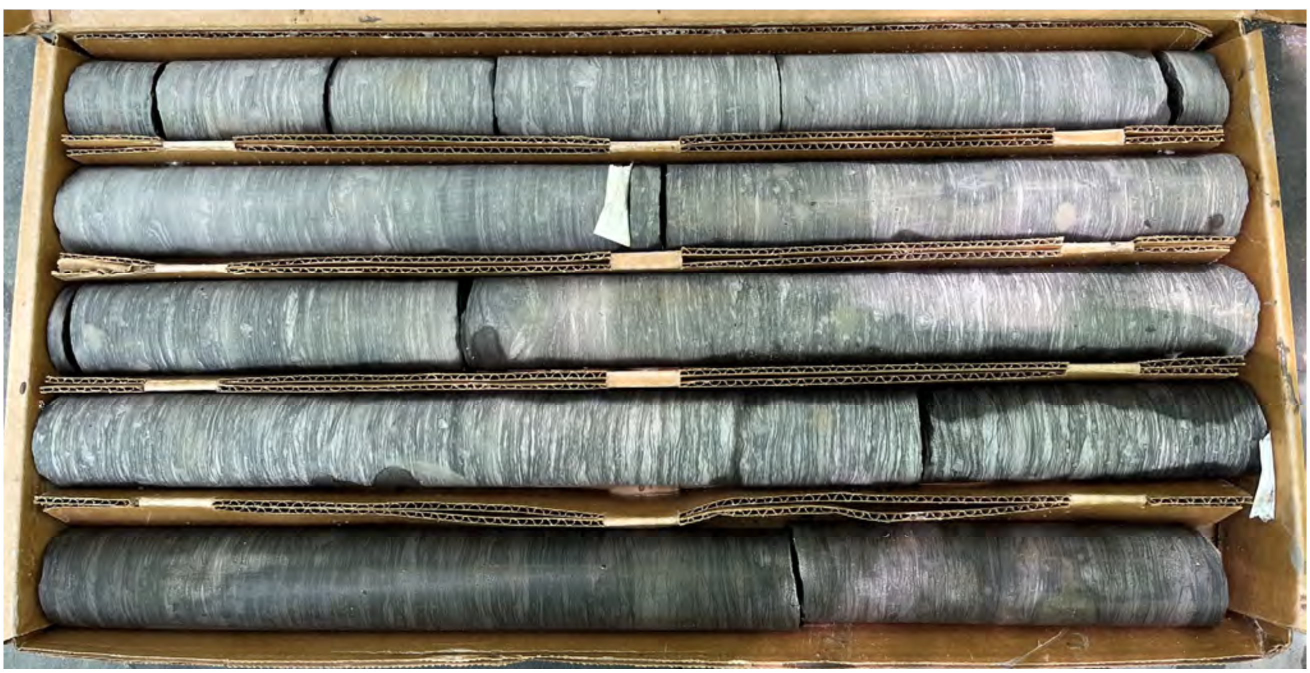
Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>ROCK CORE PHOTOS</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-65: Run 5 (62-65 ft), Run 6 (65-70 ft), Run 7 (70-72 ft)



0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-65: Run 7 (72-75 ft), Run 8 (75-80 ft), Run 9 (80-82 ft)



0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

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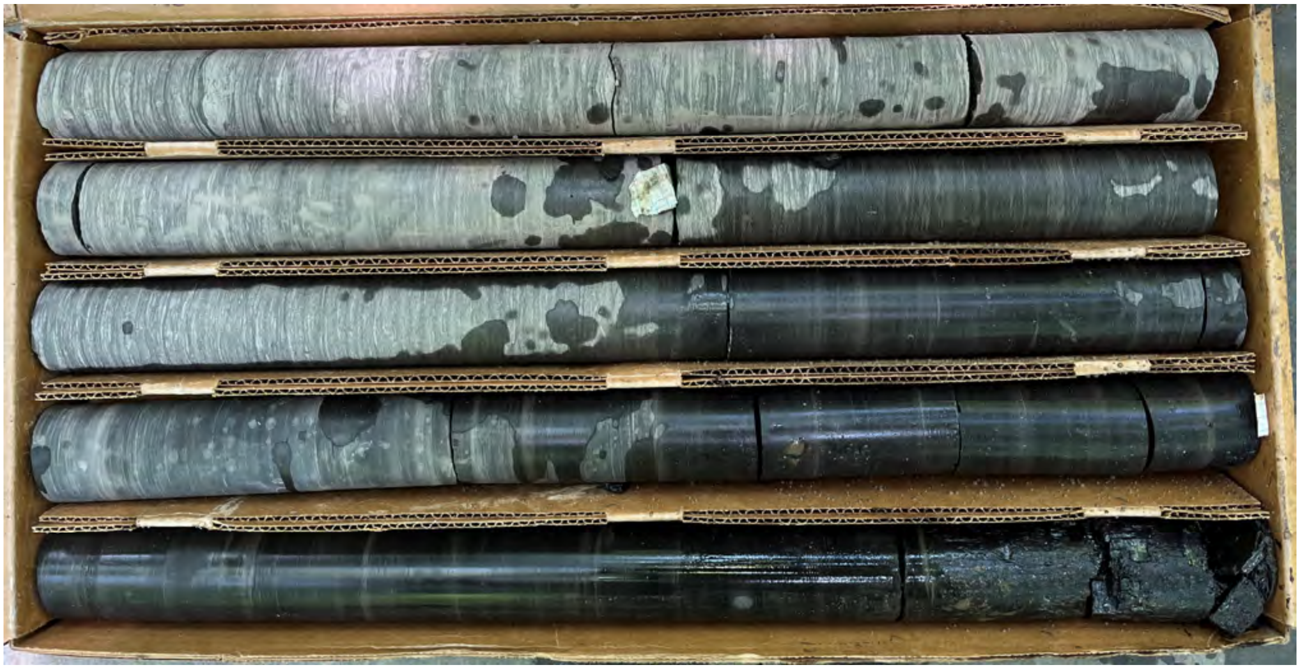
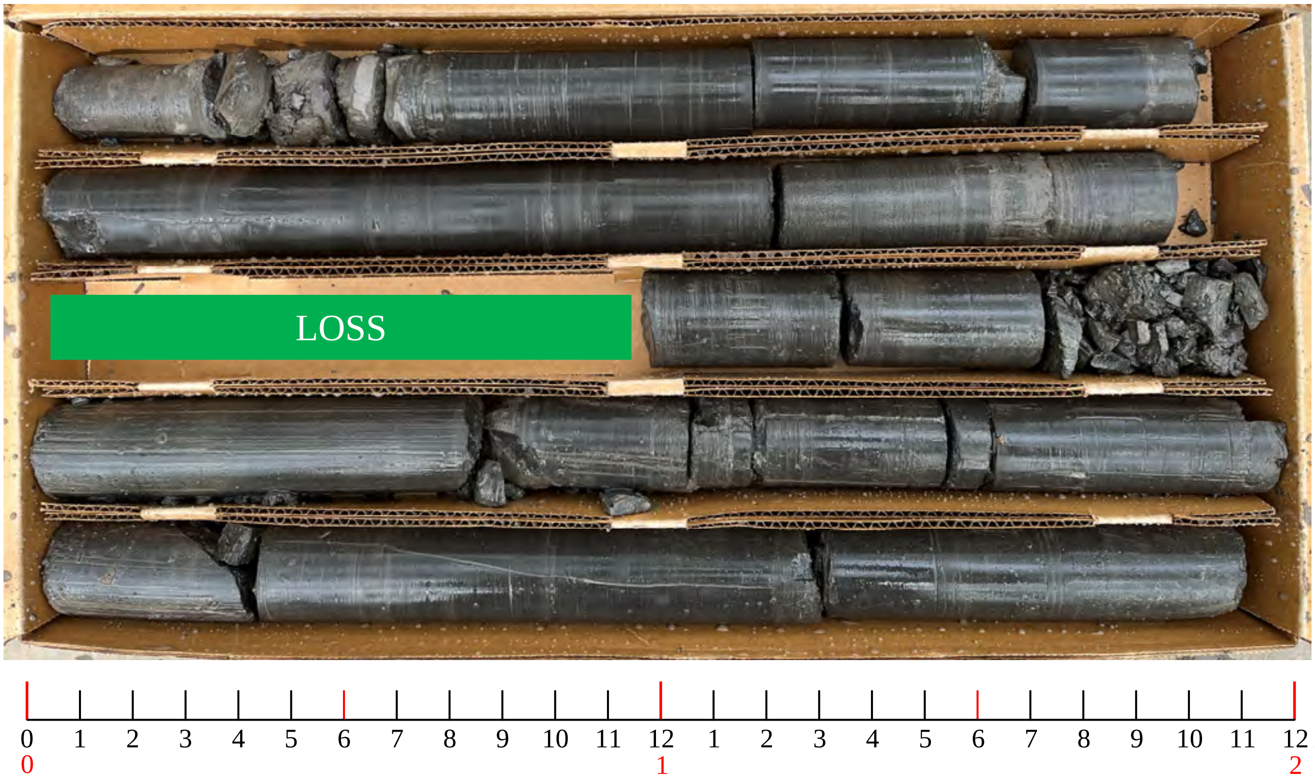
FB-65: Run 9 (82-85 ft), Run 10 (85-90 ft), Run 11 (90-92 ft)



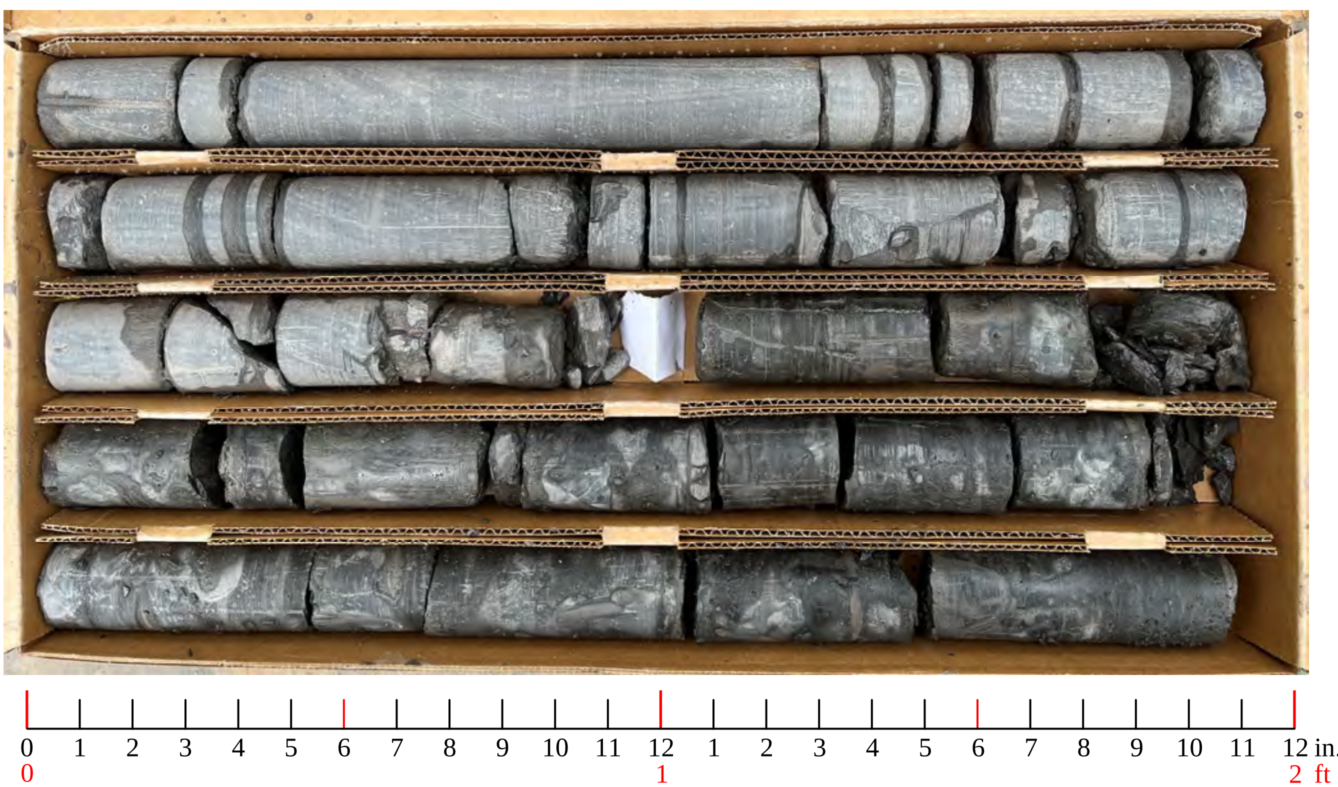
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-66: Run 1 (40-45 ft), Run 2 (45-50 ft)



FB-66: Run 3 (50-55 ft), Run 4 (55-60 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-66: Run 5 (60-65 ft), Run 6 (65-70 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-66: Run 7 (70-75 ft), Run 8 (75-80 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

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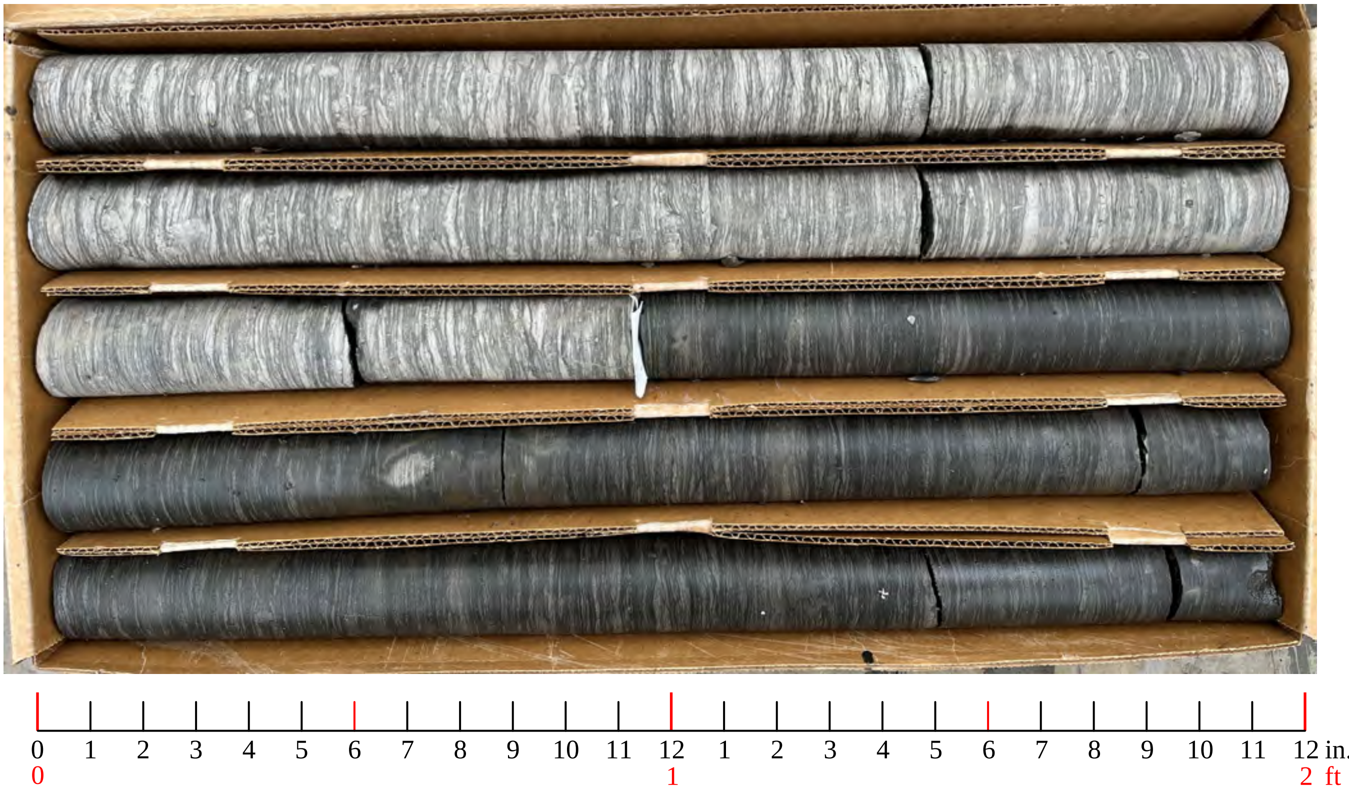
FB-66: Run 9 (80-85 ft), Run 10 (85-90 ft)



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FB-67: Run 1 (45-50 ft), Run 2 (50-55 ft)

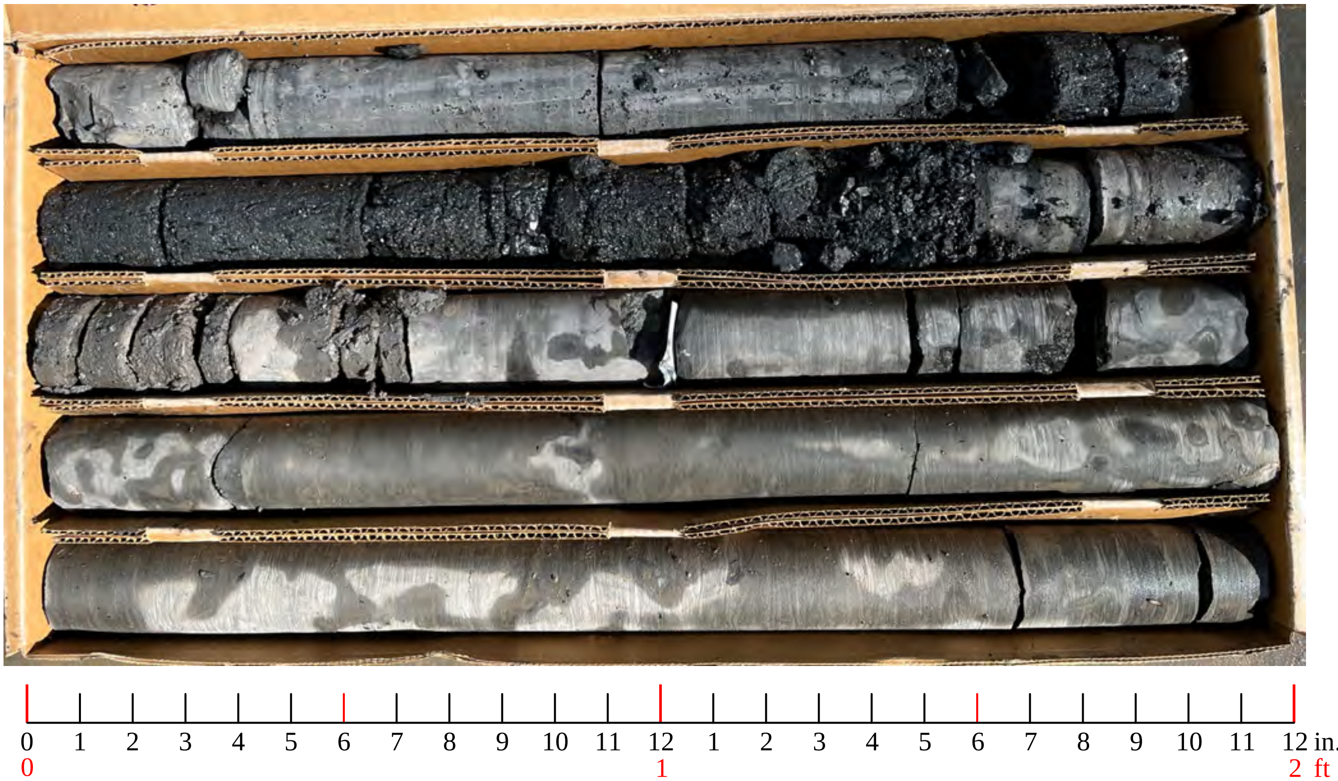
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-67: Run 3 (55-60 ft), Run 4 (60-65 ft)

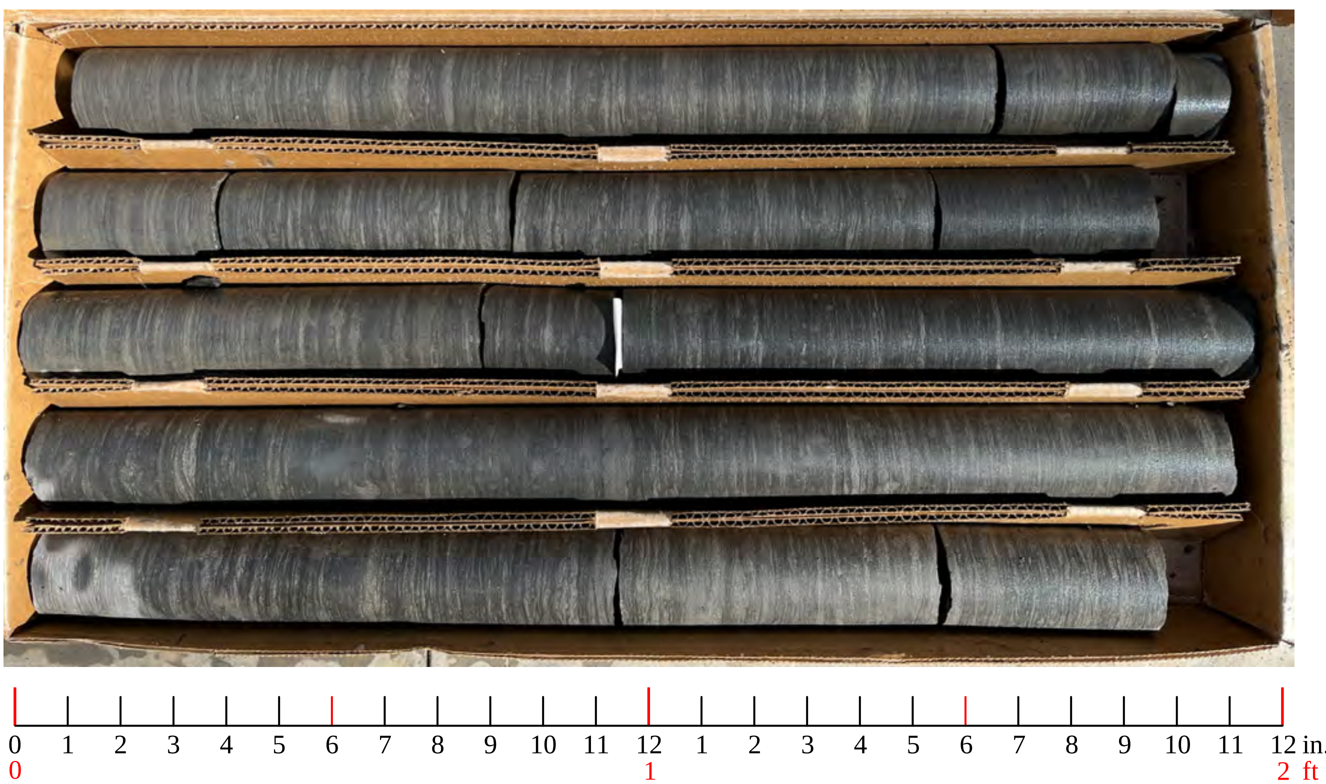
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-67: Run 5 (65-70 ft), Run 6 (70-75 ft)



FB-67: Run 7 (75-80 ft), Run 4 (80-85 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-67: Run 9 (85-90 ft), Run 10 (90-95 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-69: Run 1 (40-42 ft), Run 2 (42-45 ft), Run 3 (45-50 ft)

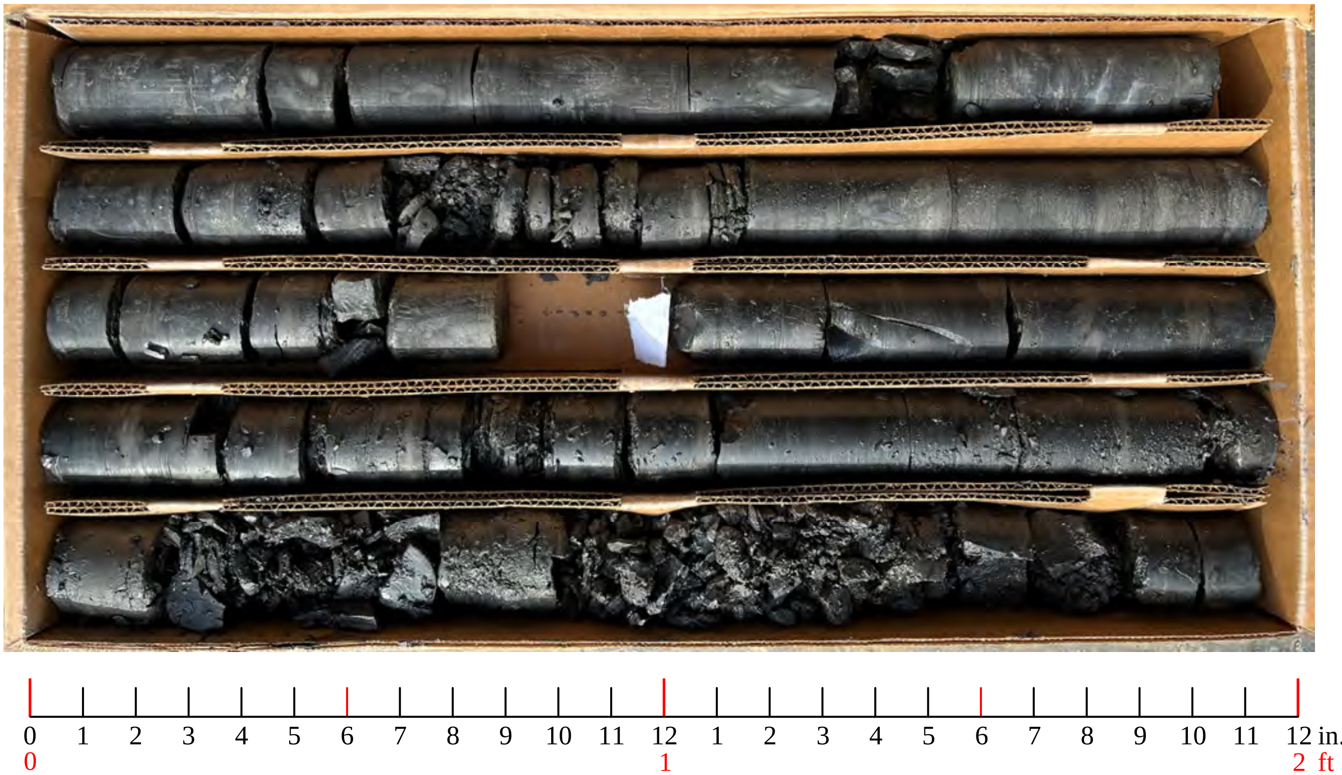
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-69: Run 4 (50-55 ft), Run 6 (55-60 ft)

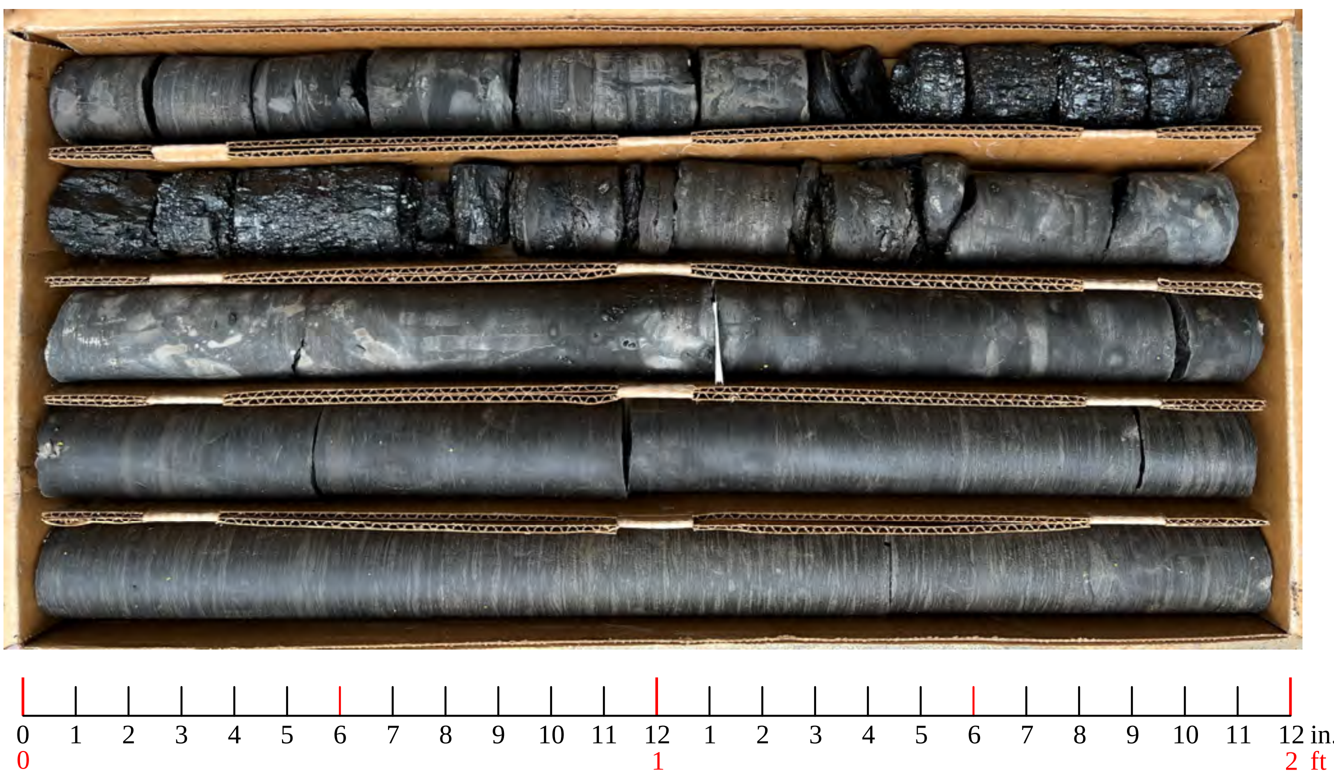
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>**ROCK CORE PHOTOS**</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-69: Run 6 (60-65 ft), Run 7 (65-70 ft)



FB-69: Run 8 (70-75 ft), Run 9 (75-80 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-69: Run 10 (80-85 ft), Run 11 (85-90 ft)

0	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12 in.
0												1												2 ft

FB-70: Run 1 (40-45 ft), Run 2 (45-50 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-70: Run 3 (50-55 ft), Run 4 (55-60 ft)

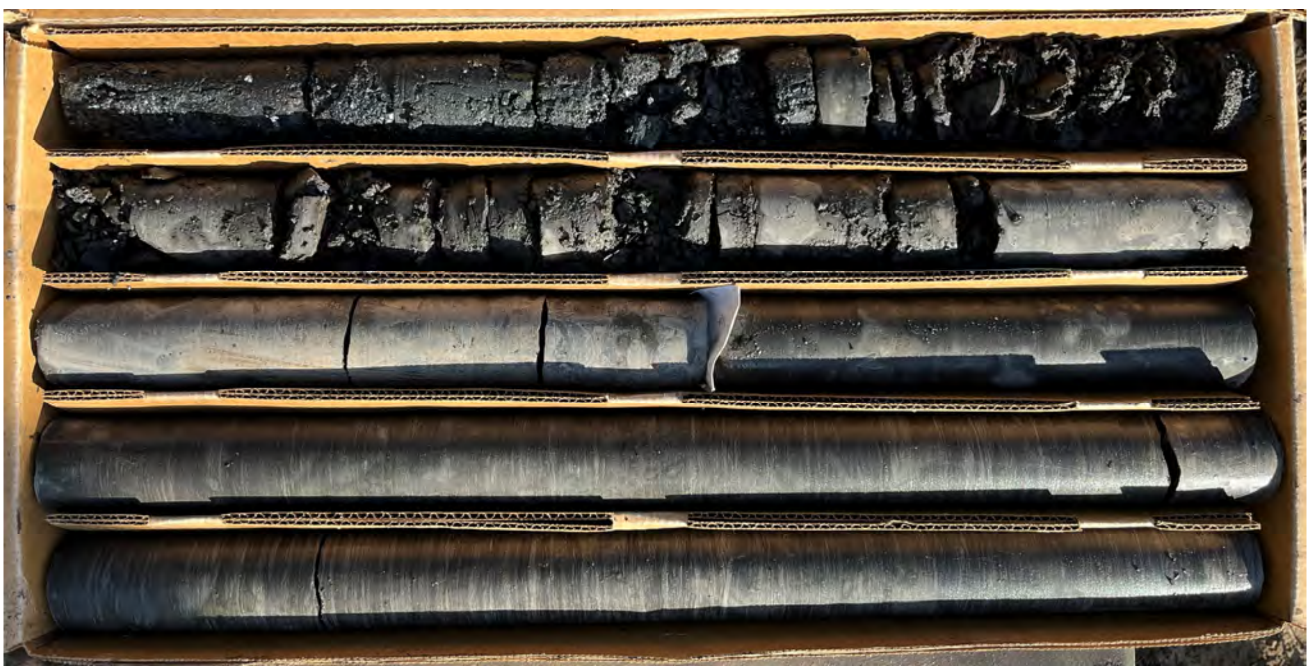
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-70: Run 5 (60-65 ft), Run 6 (65-70 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

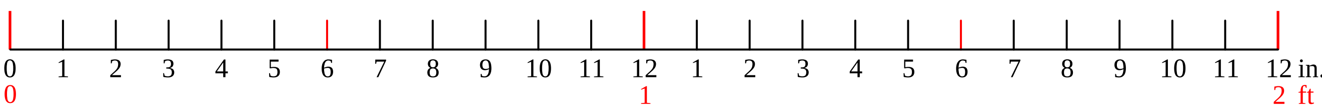
FB-70: Run 7 (70-75 ft), Run 8 (75-80 ft)



0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-70: Run 9 (80-85 ft), Run 10 (85-90 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>ROCK CORE PHOTOS</u> 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	Job No. 21-071 Plate

FB-71: Run 1 (40-45 ft), Run 2 (45-50 ft)

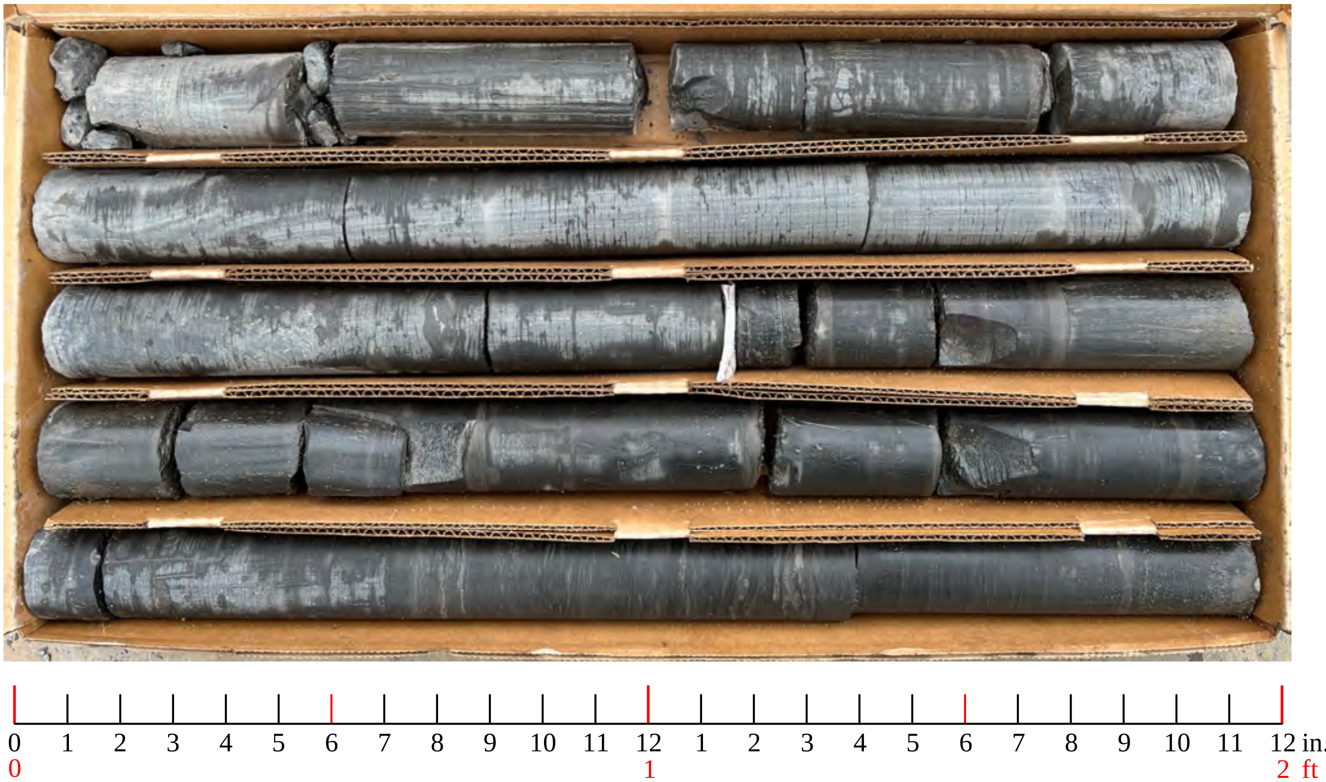
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-71: Run 3 (50-55 ft), Run 4 (55-60 ft)

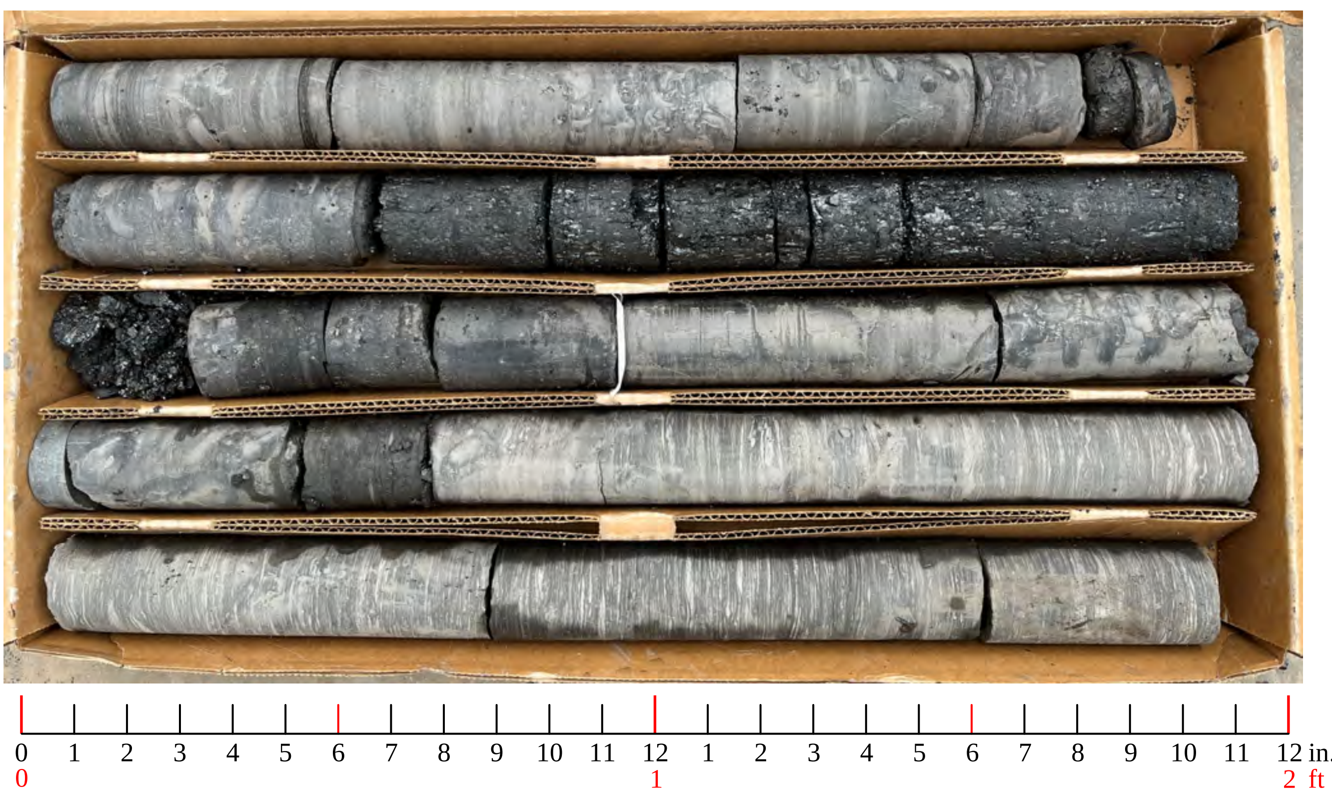
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-71: Run 5 (60-65 ft), Run 6 (65-70 ft)



FB-71: Run 7 (70-75 ft), Run 8 (75-80 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**<u>ROCK CORE PHOTOS</u>** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-71: Run 9 (80-85 ft), Run 10 (85-90 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

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FB-72: Run 1 (45-50 ft), Run 2 (50-55 ft)

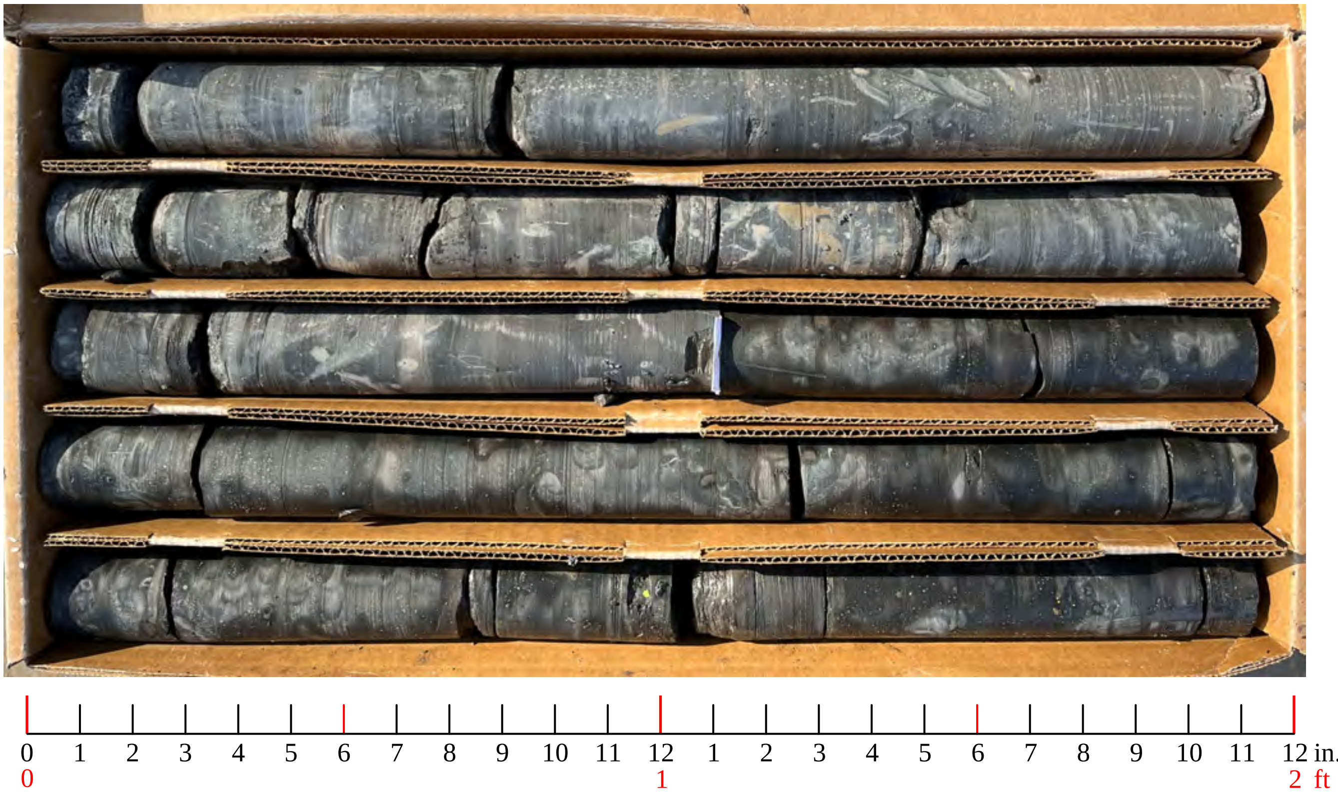
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-72: Run 3 (55-60 ft), Run 4 (60-65 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

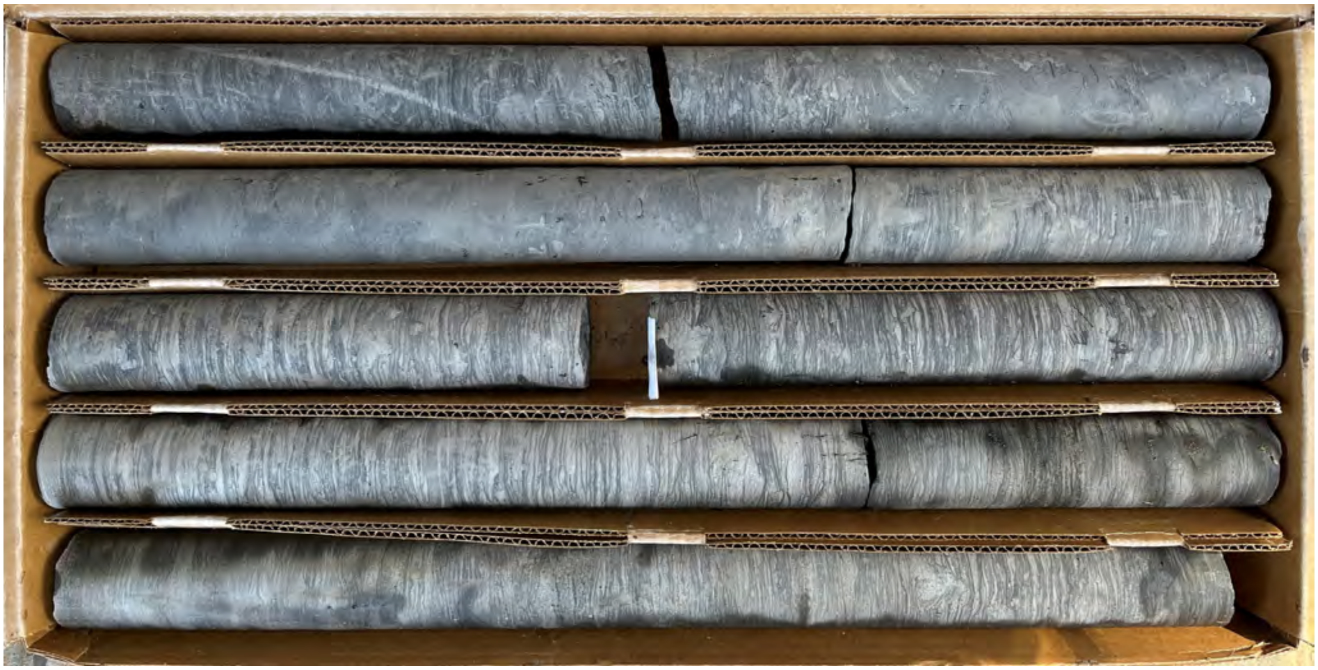
FB-72: Run 5 (65-70 ft), Run 6 (70-75 ft)



FB-72: Run 7 (75-80 ft), Run 8 (80-85 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

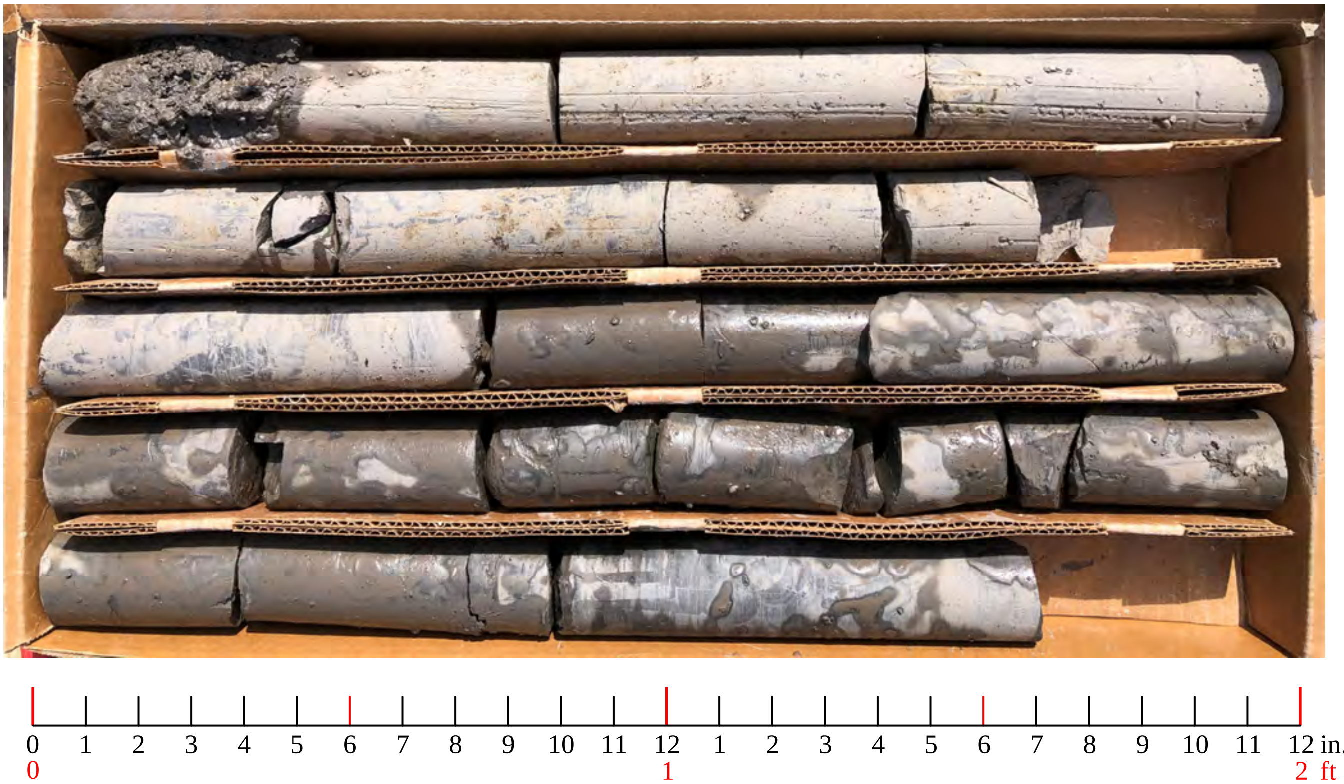
FB-72: Run 9 (85-90 ft), Run 10 (90-95 ft)



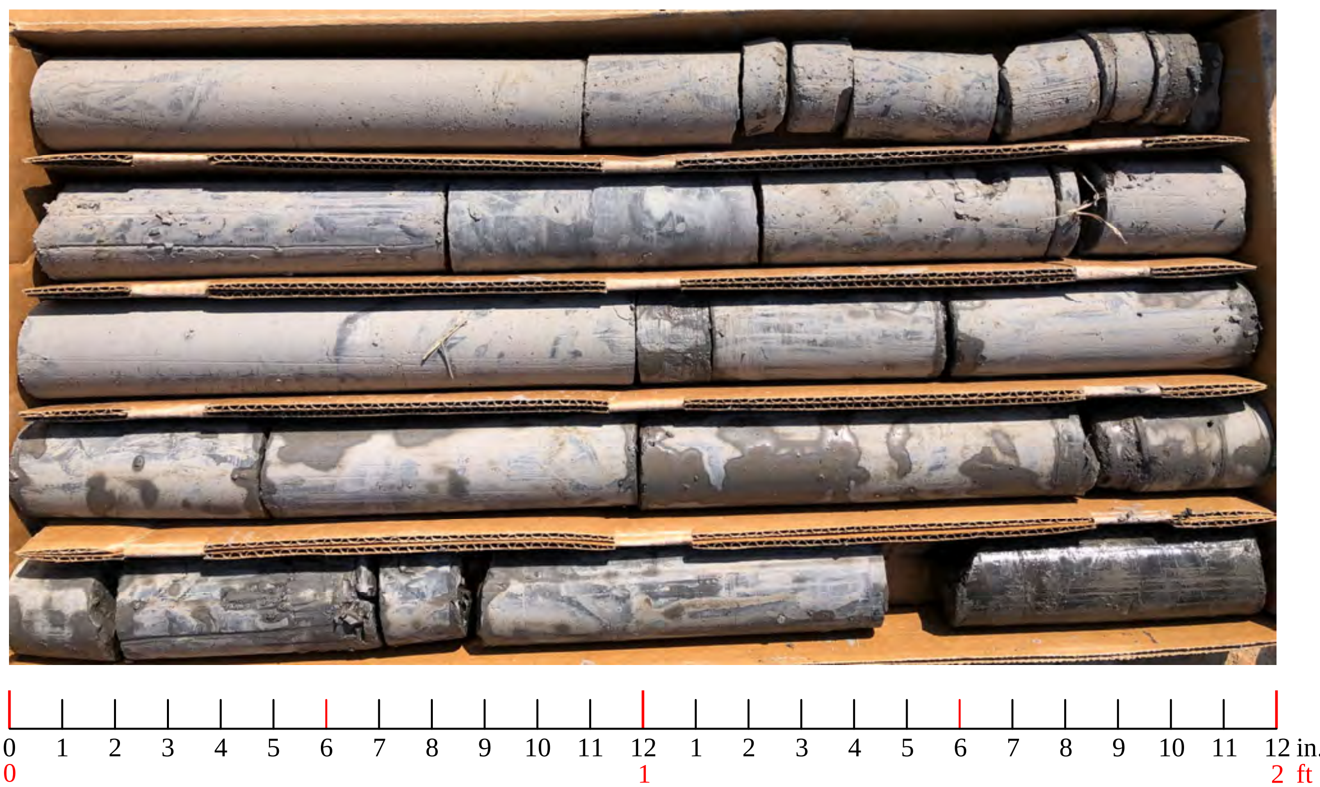
0	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12 in.
0												1												2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-73: Run 1 (45-50 ft), Run 2 (50-55 ft)

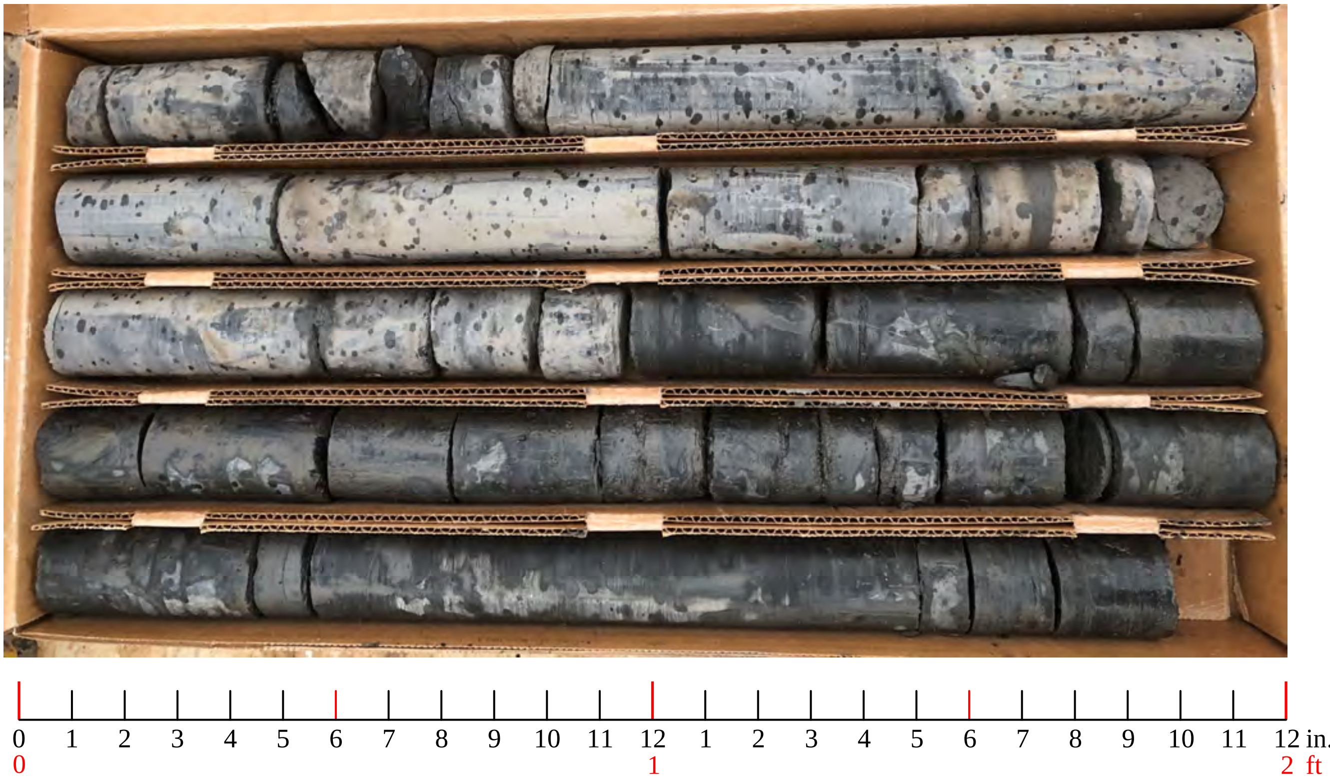


FB-73: Run 3 (55-60 ft), Run 4 (60-65 ft)

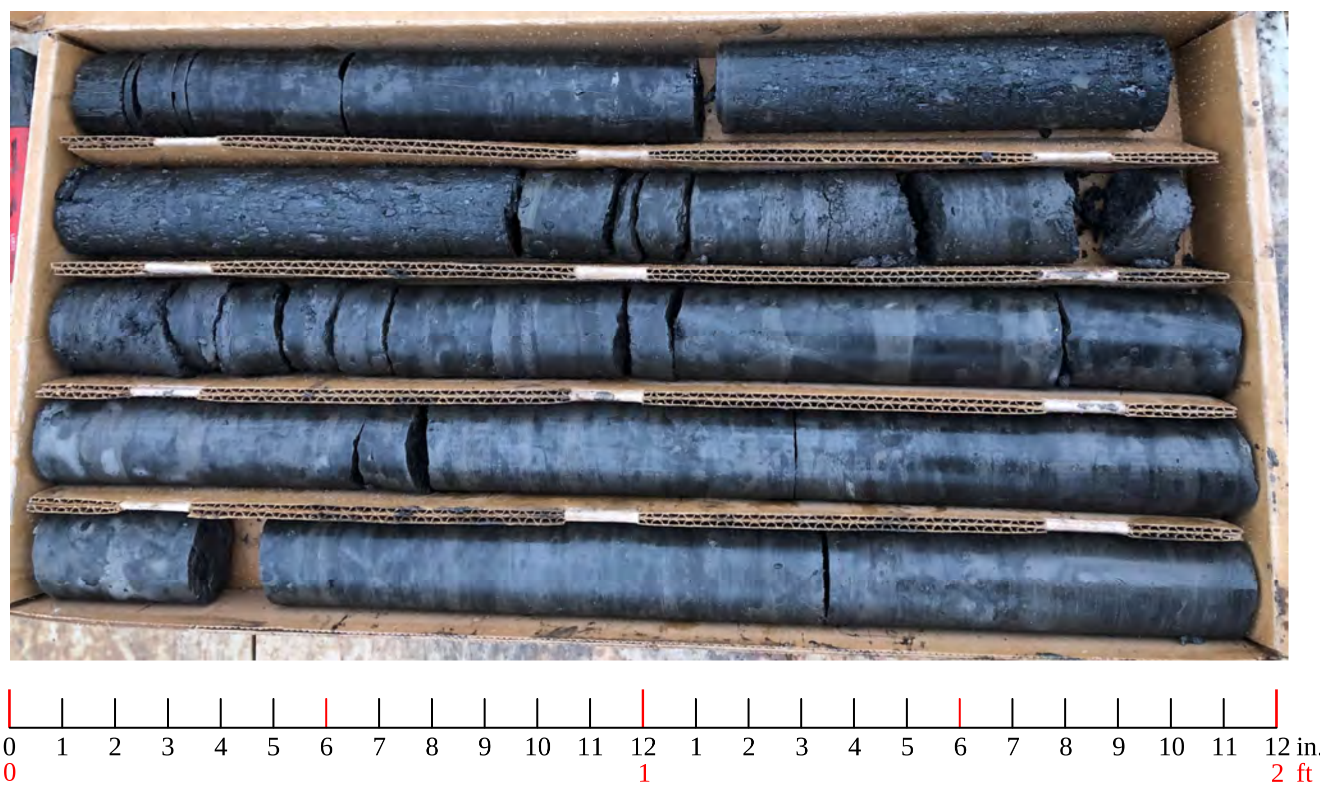


Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>**ROCK CORE PHOTOS**</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-73: Run 5 (65-70 ft), Run 6 (70-75 ft)

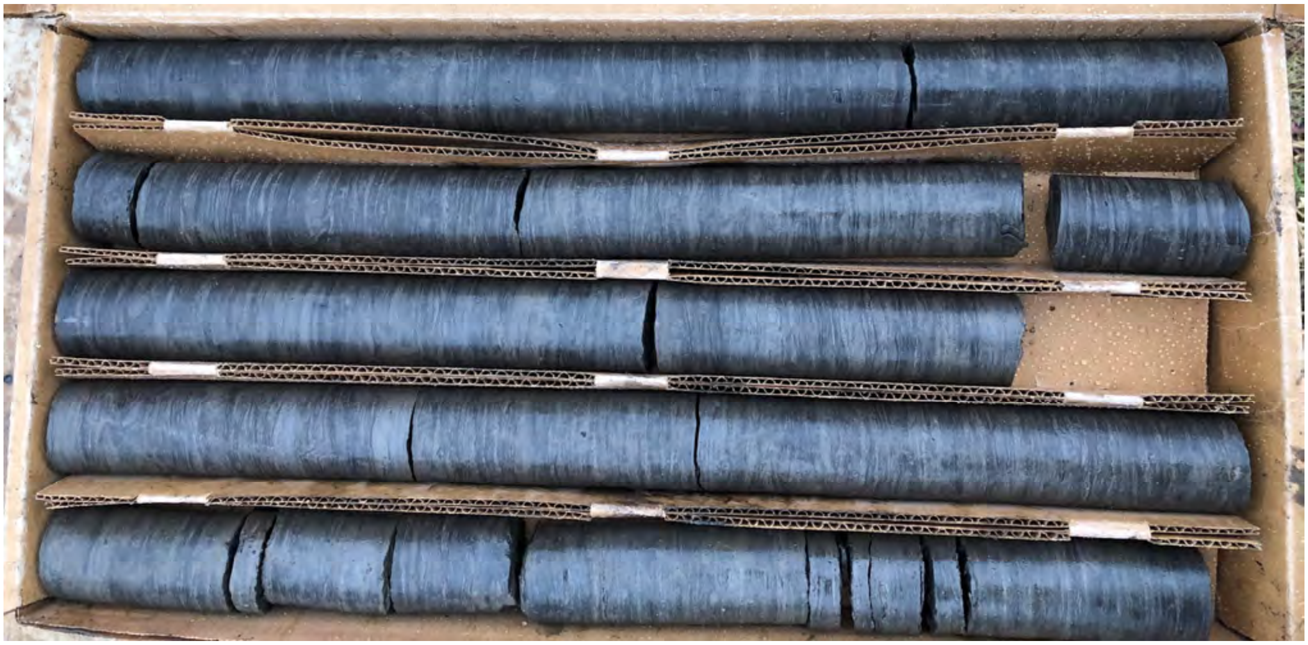


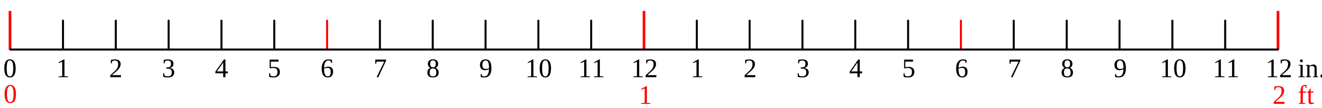
FB-73: Run 7 (75-80 ft), Run 8 (80-85 ft)



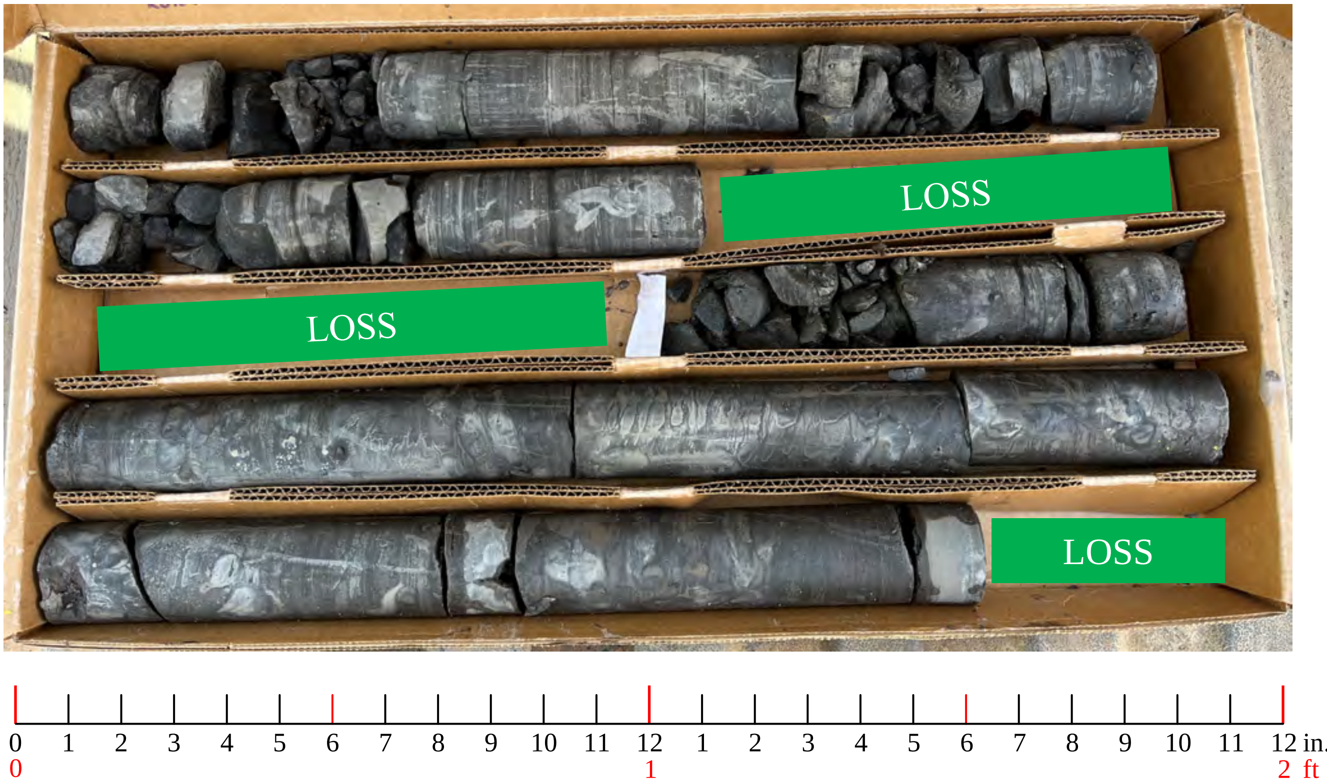
Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-73: Run 9 (85-90 ft), Run 10 (90-95 ft)

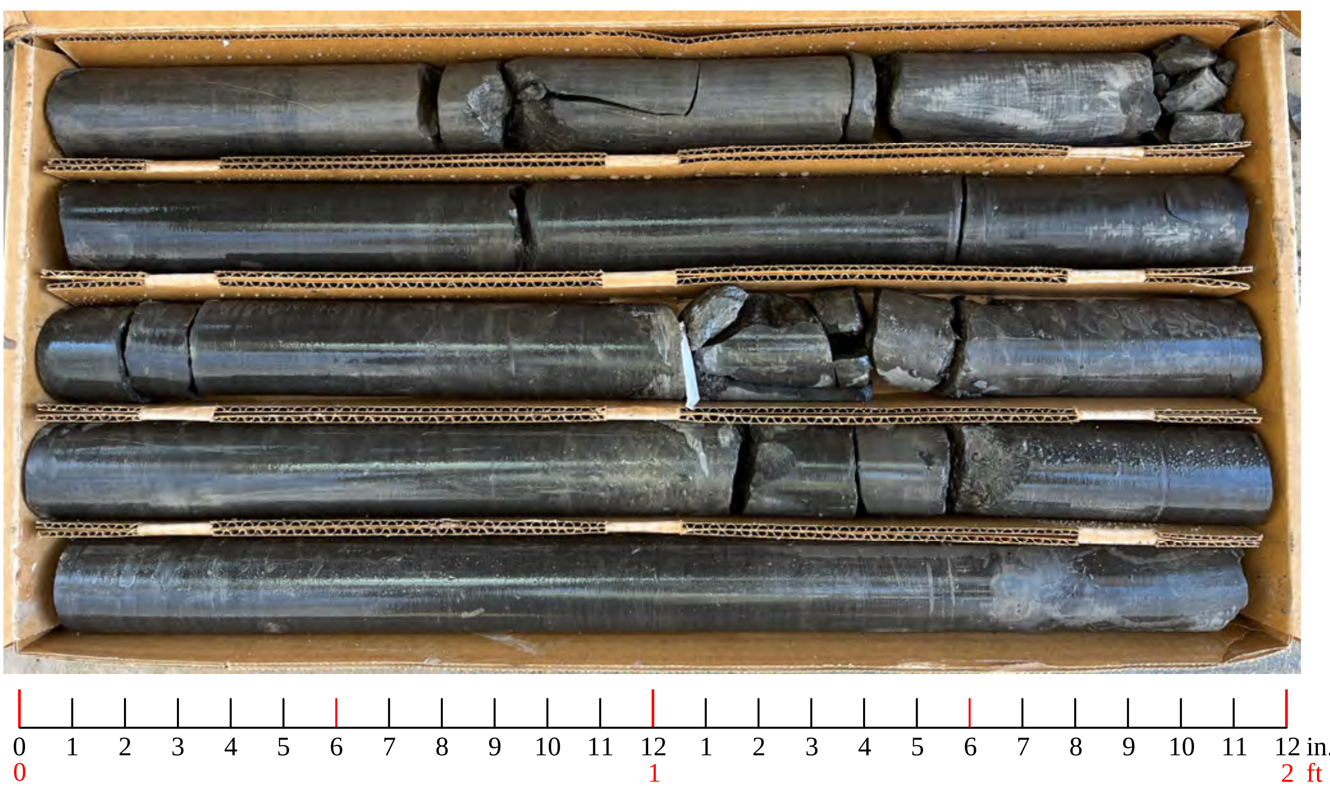




FB-74: Run 1 (45-50 ft), Run 2 (50-55 ft)



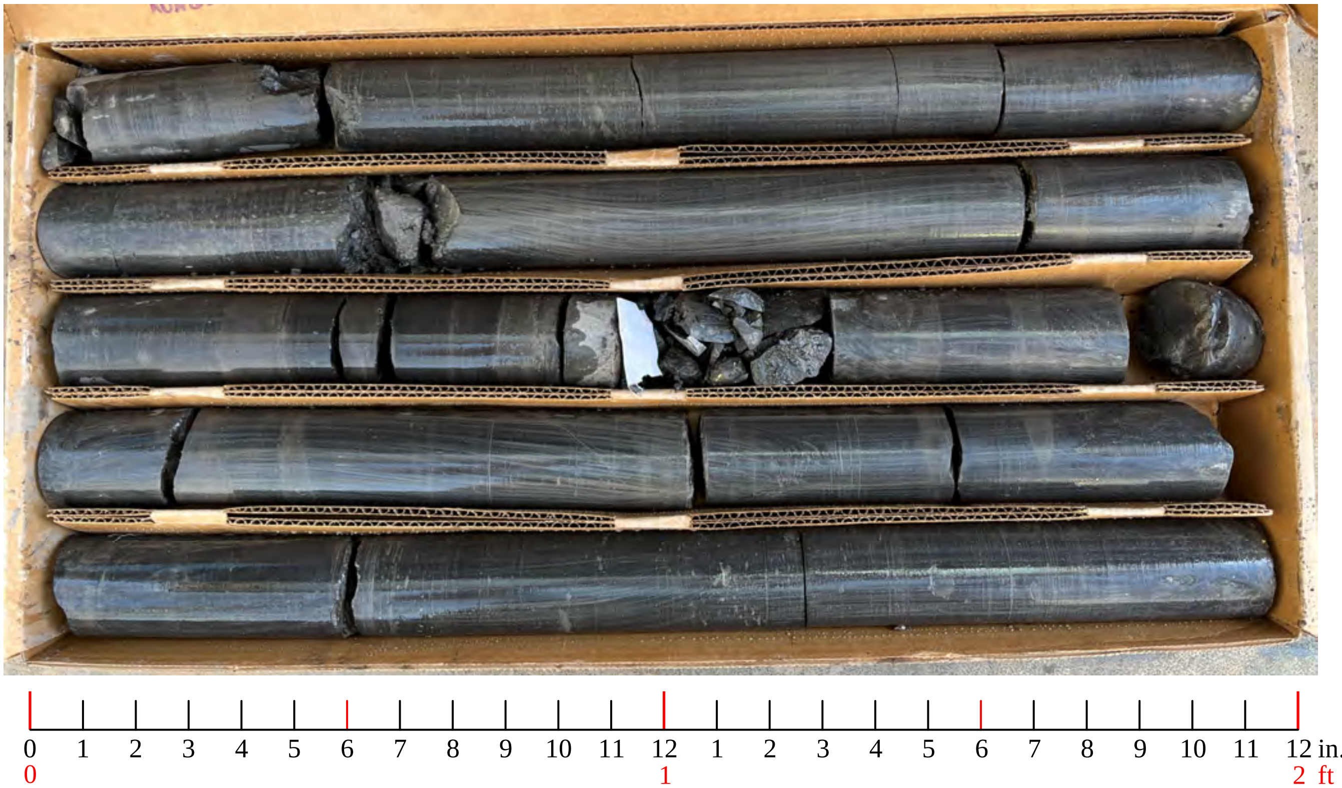
FB-74: Run 3 (55-60 ft), Run 4 (60-65 ft)



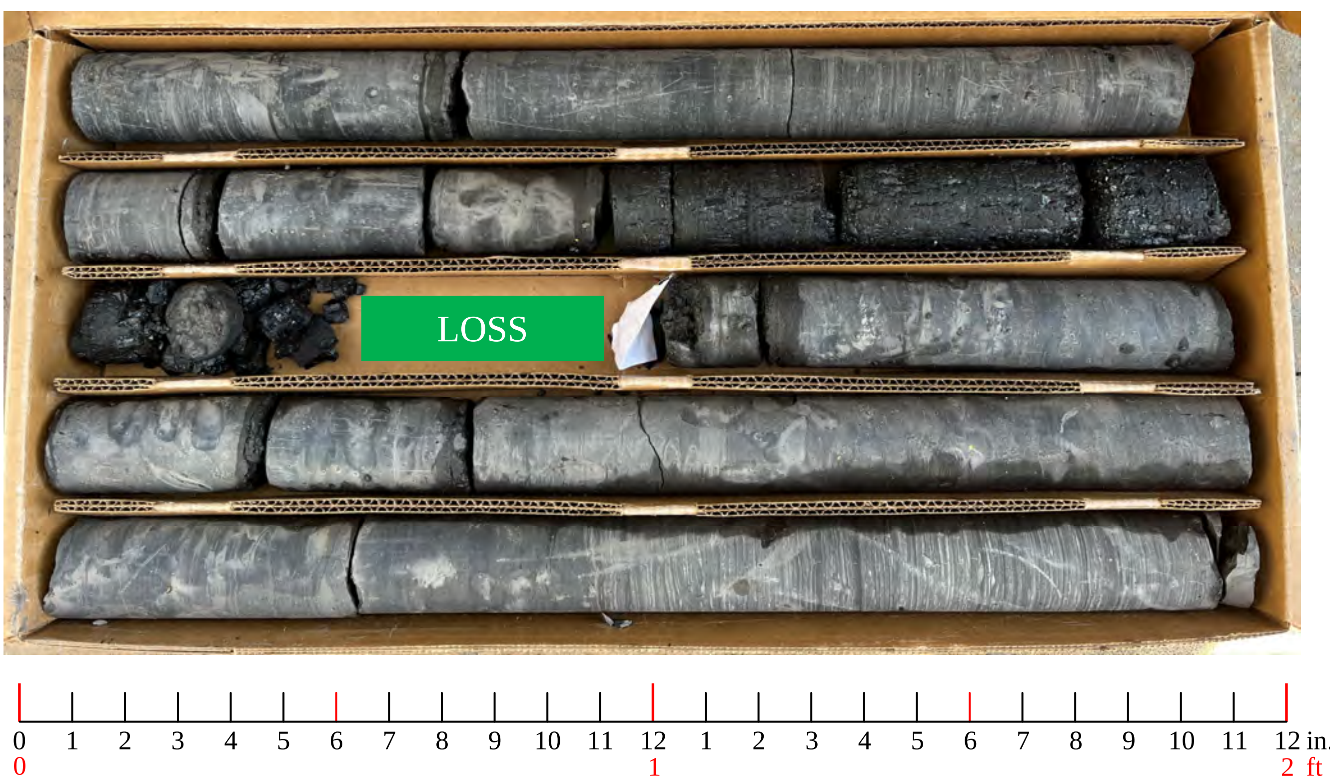
Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	Job No. 21-071
	Plate

FB-74: Run 5 (65-70 ft), Run 6 (70-75 ft)



FB-74: Run 7 (75-80 ft), Run 8 (80-85 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-74: Run 9 (85-90 ft), Run 10 (90-95 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ROCK CORE PHOTOS
040748 Hwy 22 to I-40
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FB-75: Run 1 (46-51 ft), Run 2 (51-56 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

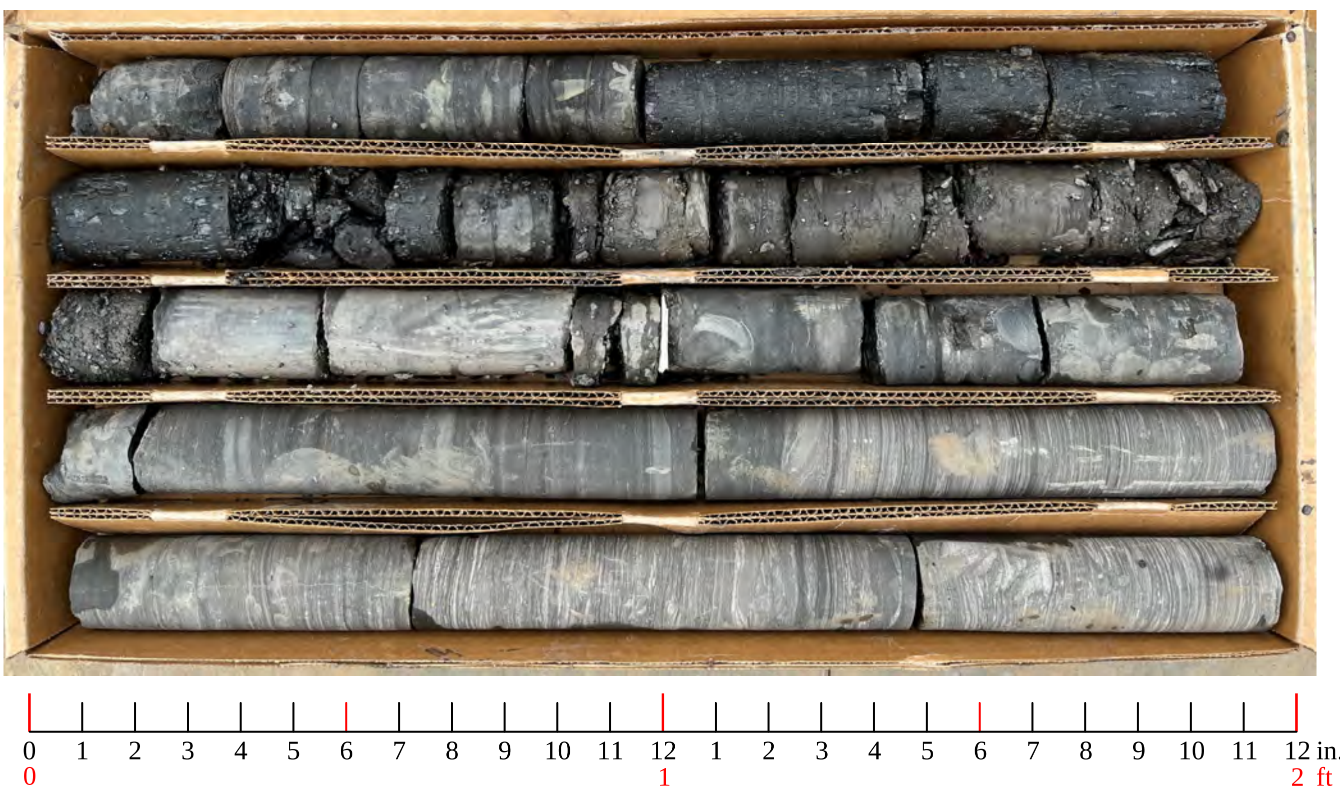
FB-75: Run 3 (56-61 ft), Run 4 (61-66 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

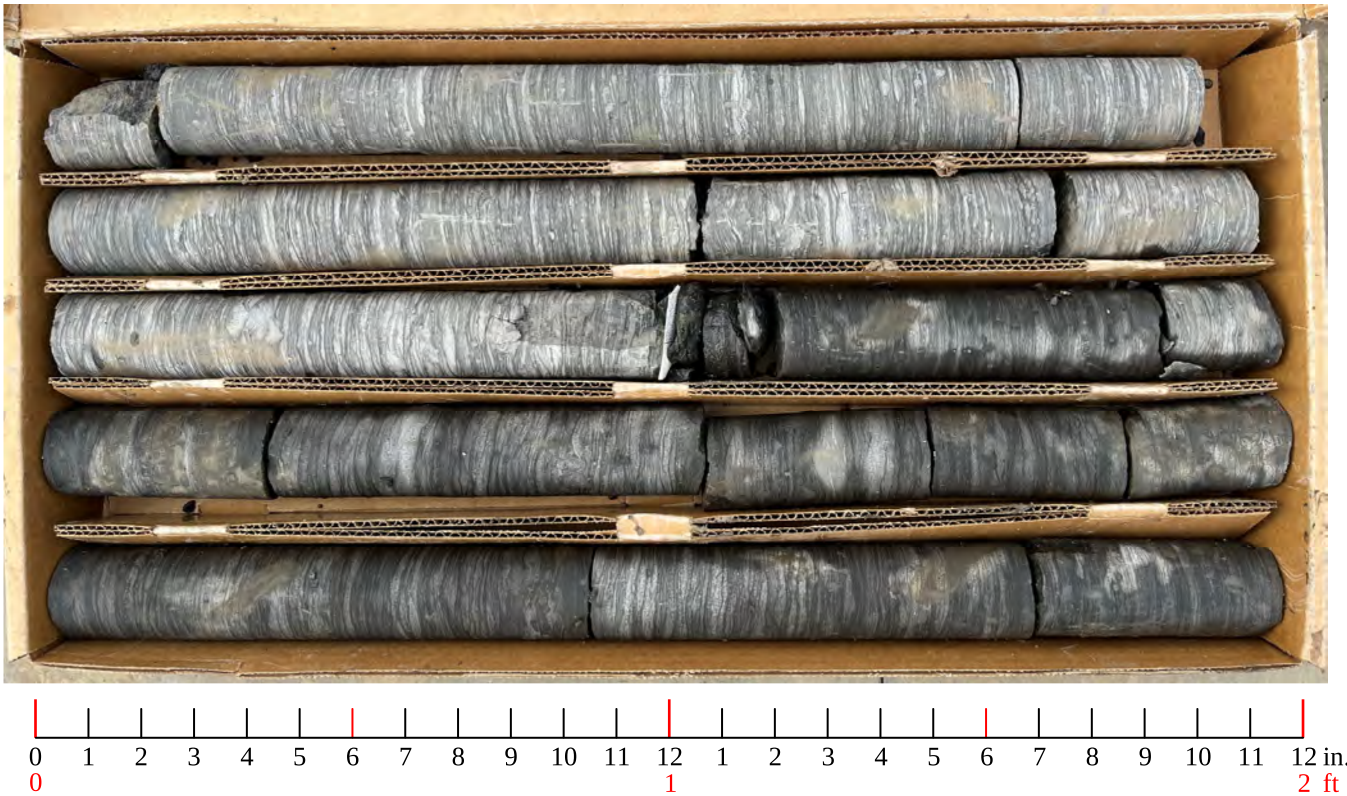
FB-75: Run 5 (66-71 ft), Run 6 (71-76 ft)

FB-75: Run 7 (76-81 ft), Run 8 (81-86 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-75: Run 9 (86-91 ft), Run 10 (91-96 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-77: Run 1 (50-55 ft), Run 2 (55-60 ft)

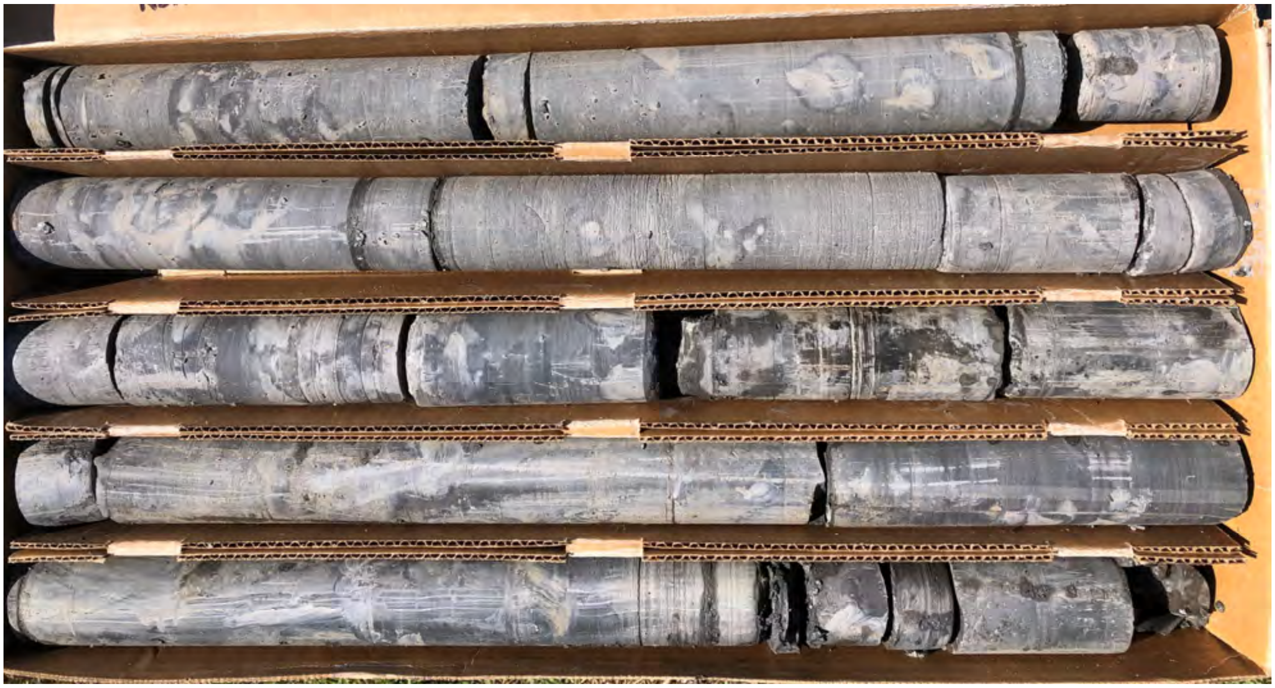
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-77: Run 3 (60-65 ft), Run 4 (65-70 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-77: Run 5 (70-75 ft), Run 6 (75-80 ft)



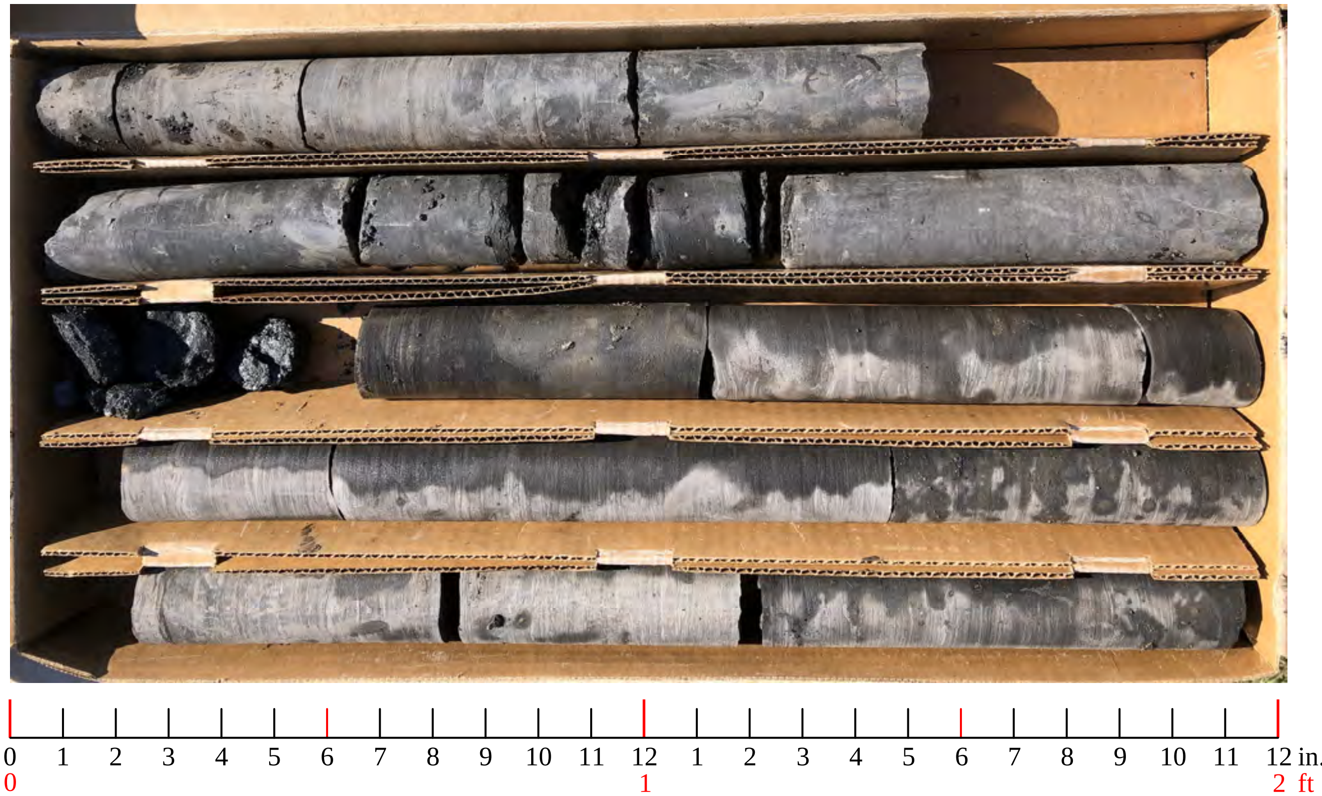
0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-77: Run 7 (80-85 ft), Run 8 (85-90 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

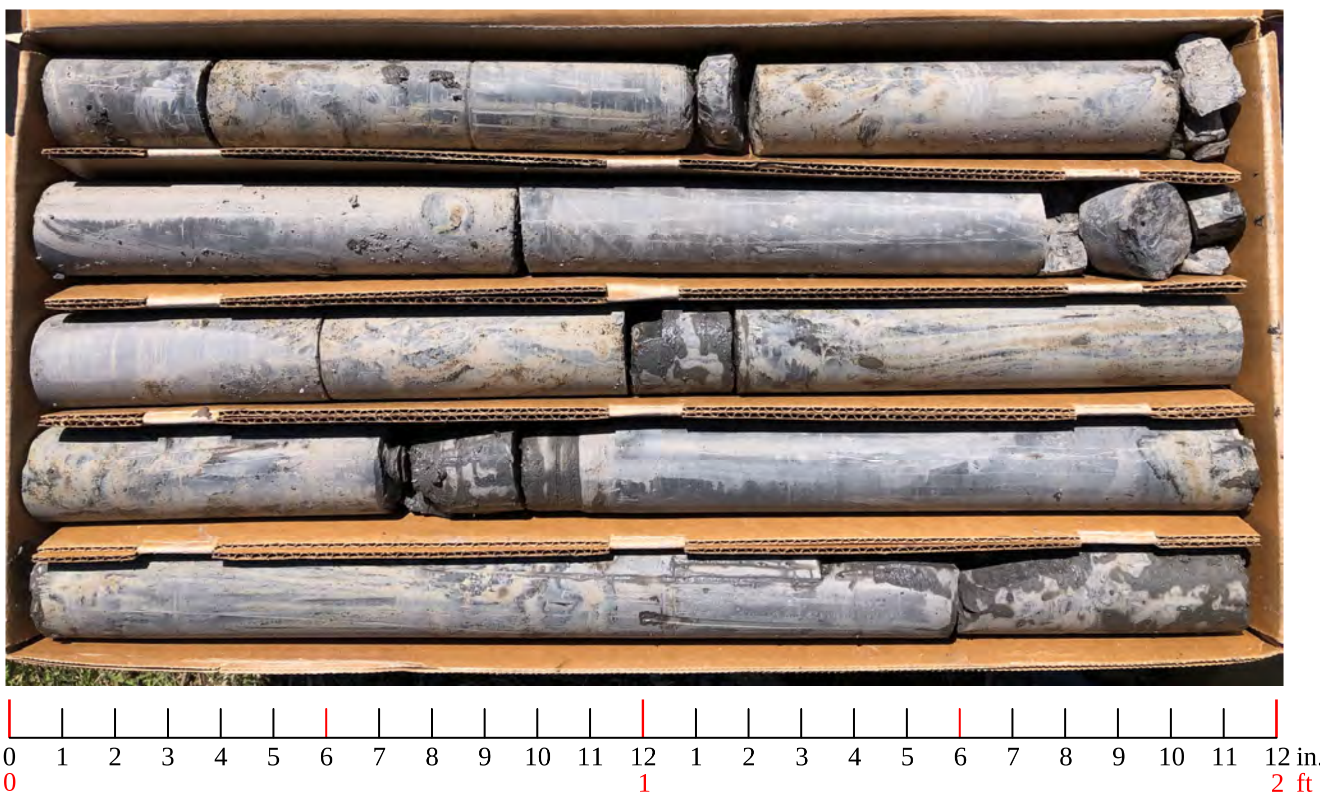
FB-77: Run 9 (90-95 ft), Run 10 (95-100 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-78: Run 1 (55-60 ft), Run 2 (60-65 ft)

FB-78: Run 3 (65-70 ft), Run 4 (70-75 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-78: Run 5 (75-80 ft), Run 6 (80-85 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-78: Run 7 (85-90 ft), Run 8 (90-95 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	ROCK CORE PHOTOS 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	Job No. 21-071 Plate

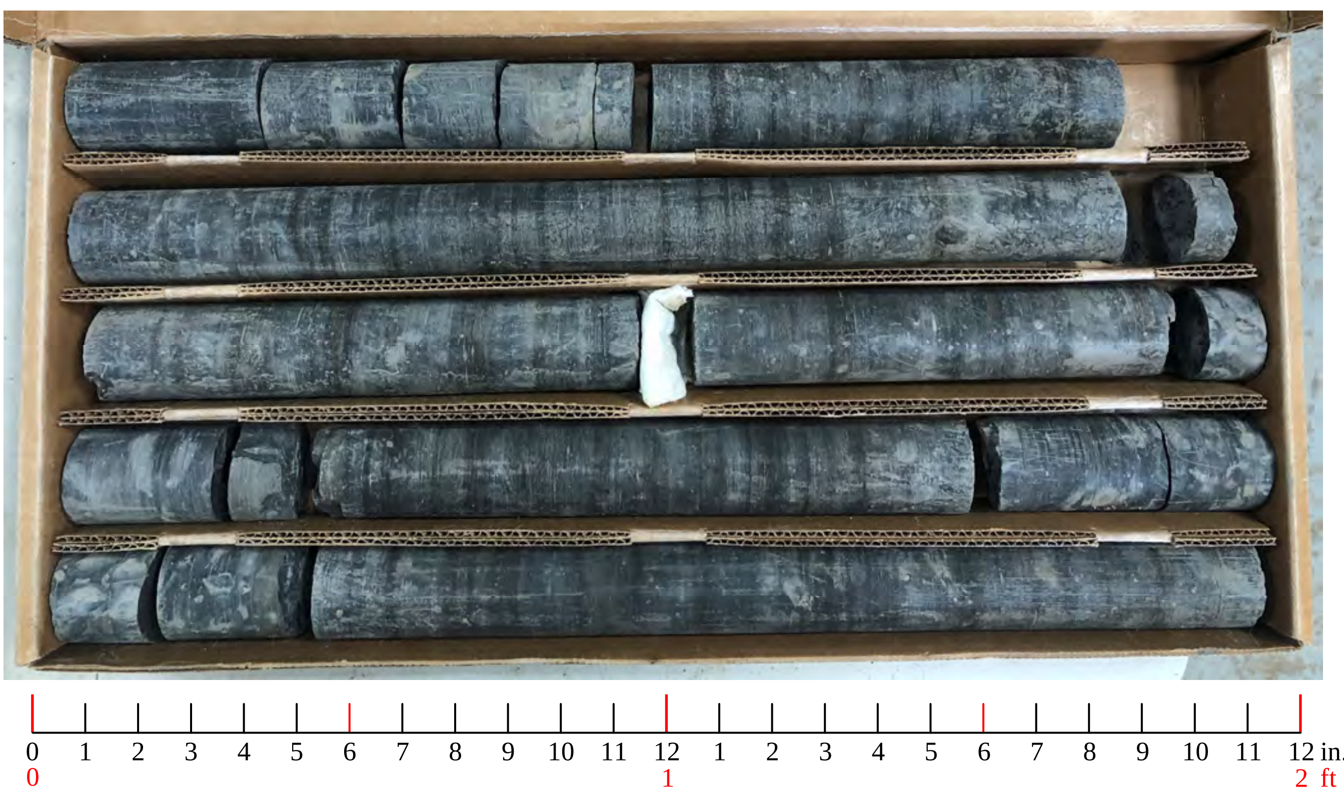
FB-78: Run 9 (95-100 ft), Run 10 (100-105 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>ROCK CORE PHOTOS</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-79: Run 1 (49-50 ft), Run 2 (50-55 ft)

FB-79: Run 3 (55-60 ft), Run 4 (60-65 ft)



Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-79: Run 5 (65-70 ft), Run 6 (70-75 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-79: Run 7 (75-80 ft), Run 8 (80-85 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** 040748 Hwy 22 to I-40 Crawford & Sebastian Counties, Arkansas	**Job No. 21-071**
		Plate

FB-79: Run 9 (85-90 ft), Run 10 (90-95 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

FB-79: Run 11 (95-100 ft)

0 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 in.
0 1 2 ft

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-80: Run 1 (50-55 ft), Run 2 (55-60 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	**ROCK CORE PHOTOS** **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071** **Plate**

FB-81: Run 1 (50-55 ft), Run 2 (55-60 ft)

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	<u>ROCK CORE PHOTOS</u> **040748 Hwy 22 to I-40** **Crawford & Sebastian Counties, Arkansas**	**Job No. 21-071**
		Plate

APPENDIX C

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Crawford & Sebastian Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
FB-4	0.5-1.5	24	39	20	19	---	---	---	---	---	---	---	---	CL	A-6
FB-4	29-30	22	---	---	---	100	100	100	99	98	97	90	1	SP	A-3
FB-5	2.5-3.5	24	---	---	---	100	100	100	100	100	100	99	96	ML	A-4
FB-5	19-20	20	---	---	---	100	100	100	99	99	99	91	2	SP	A-3
FB-5	34-35	---	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FB-7	0.5-1.5	30	---	---	---	100	100	100	100	100	100	100	95	ML	A-4
FB-7	2.5-3.5	30	28	23	5	---	---	---	---	---	---	---	---	CL-ML	A-4
FB-7	4.5-5.5	39	---	---	---	100	100	100	100	100	100	100	99	CL-ML	A-4
FB-7	6.5-7.5	37	53	21	32	---	---	---	---	---	---	---	---	CH	A-7-6
FB-7	14-15	49	---	---	---	100	100	100	100	100	100	100	98	CH	A-7-6
FB-8	0.5-1.5	28	31	22	9	100	100	100	100	100	---	---	98	CL	A-4
FB-8	2.5-3.5	29	---	---	---	100	100	100	100	100	100	99	97	ML	A-4
FB-8	9-9.5	41	---	---	---	---	---	---	---	---	---	---	---	CL	A-7-6
FB-8	14-15	44	42	23	19	100	100	100	100	100	100	100	100	CL	A-7-6
FB-8	24-25	30	---	---	---	100	100	100	100	100	100	100	29	SM	A-2-4
FB-10	2.5-3.5	26	---	---	---	100	100	100	100	100	100	100	99	ML	A-4
FB-10	19-20	23	---	---	---	100	100	100	100	100	100	99	75	ML	A-4
FB-10	44-45	15	---	---	---	100	100	100	100	100	100	89	12	SHALE	
FB-11	0.5-1.5	17	---	---	---	100	100	100	100	100	100	100	74	ML	A-4
FB-11	14-15	30	33	25	8	100	100	100	100	100	100	100	99	ML	A-4
FB-11	29-30	11	---	---	---	100	100	100	93	80	58	20	3	SW	A-1-b
FB-11	39-40	19	---	---	---	100	100	100	100	100	100	83	26	SM	A-2-4
FB-12	2.5-3.5	23	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FB-12	24-25	19	---Non Plastic---			---	---	---	---	---	---	---	---	SM	A-3
FB-13	0.5-1.5	18	---Non Plastic---			100	100	100	100	100	100	100	72	ML	A-4
FB-13	4.5-5.5	30	---	---	---	100	100	100	100	100	100	99	94	ML	A-4
FB-13	6.5-7.5	15	---	---	---	100	100	100	100	100	100	98	97	ML	A-4

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Crawford & Sebastian Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
FB-14	2.5-3.5	20	---	---	---	100	100	100	100	100	100	100	78	ML	A-4
FB-14	9-10	19	---	---	---	100	100	100	100	100	100	99	98	ML	A-4
FB-14	19-20	33	---	---	---	100	100	100	100	100	100	100	45	SM	A-4
FB-14	24-25	19	---	---	---	100	100	100	100	100	100	89	3	SP	A-3
FB-15	2.5-3.5	13	---	---	---	100	100	100	100	100	100	100	62	ML	A-4
FB-15	14-15	27	---	---	---	100	100	100	100	100	100	100	100	ML	A-4
FB-15	24-25	19	---	---	---	100	100	100	100	100	100	72	7	SM-SP	A-3
FB-16	0.5-1.5		---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FB-16	4.5-5.5	9	28	21	7	100	100	100	100	100	100	100	51	CL-ML	A-4
FB-16	9-10	13	---	---	---	100	100	100	100	100	100	100	99	ML	A-4
FB-16	24-25	20	---	---	---	100	100	100	100	100	97	79	4	SP	A-3
FB-17	2.5-3.5	13	---	---	---	100	100	100	100	100	100	100	48	SM	A-4
FB-17	14-15	27	---	---	---	100	100	100	100	100	100	100	100	ML	A-4
FB-18	2.5-3.5	14	---	---	---	100	100	100	100	100	100	99	31	SM	A-2-4
FB-18	14-15	23	---	---	---	100	100	100	96	91	82	31	2	SW	A-1-b
FB-19	4.5-5.5	8	---	---	---	100	100	100	100	100	100	100	22	SM	A-2-4
FB-19	14-15	3	---	---	---	100	100	100	92	89	80	30	2	SW	A-1-b
FB-19	34-35	---	---	---	---	100	100	100	100	95	92	66	5	SP	A-3
FB-20	2.5-3.5	19	---	---	---	100	100	100	100	100	100	95	56	ML	A-4
FB-21	2-2.5	8	---	---	---	100	100	100	86	72	53	32	20	SHALE	
FB-22	1.5-2.0	9	---	---	---	100	100	100	78	62	48	24	8	SM-SP	A-1-a
FB-22	2.5-3	9	---	---	---	100	100	100	100	100	100	42	25	SHALE	
FB-23	0.5-1	19	---	---	---	100	100	100	100	99	98	18	3	SW	A-1-b
FB-23	1-1.5	9	---	---	---	100	100	100	100	100	100	37	24	SHALE	
FB-25	0.5-1.5	19	---	---	---	100	90	90	84	81	79	68	1	SP	A-3
FB-25	0-4.5	14	---	---	---	100	91	91	80	60	24	1	1	SW	A-1-a

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Crawford & Sebastian Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
FB-25	4.5-5	14	---	---	---	100	100	100	100	100	100	25	17	SHALE	
FB-26	0-4.5	12	---	---	---	100	100	95	64	47	23	3	2	GW	A-1-a
FB-26	4.5-5	10	---	---	---	100	100	100	100	100	100	42	32	SHALE	
FB-27	0.5-1.5	16	---	---	---	100	100	100	100	100	---	---	28	SM	A-3
FB-27	9-10	2	---	---	---	100	100	100	100	100	---	---	4	SP	A-3
FB-27	24-25	---	---	---	---	100	100	100	100	99	---	---	5	SP	A-3
FB-28	0.5-1.5	22	---	---	---	100	100	100	100	100	100	95	57	ML	A-4
FB-28	9-10	4	---	---	---	100	100	100	100	100	100	100	4	SP	A-3
FB-29	0.5-1.5	20	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FB-29	4.5-5.5	20	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FB-29	9-10	18	---	---	---	---	---	---	---	100	---	---	64	ML	A-4
FB-29	19-20	---	---	---	---	---	---	---	---	96	---	---	2	SP	A-3
FB-29	29-30	---	---	---	---	---	---	---	---	65	---	---	3	SW	A-1-b
FB-30	0.5-1.5	25	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FB-30	4.5-5.5	3	---	---	---	100	100	100	100	100	100	95	4	SP	A-3
FB-31	4.5-5.5	2	---	---	---	100	100	100	100	100	100	58	2	SP	A-3
FB-34	2.5-3.5	3	---	---	---	100	100	100	100	100	100	82	1	SP	A-3
FB-34	6.5-7.5	25	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FB-34	9-10	3	---	---	---	100	100	100	100	100	100	95	5	SP	A-3
FB-34	19-20	29	---	---	---	100	100	100	100	100	100	99	15	SM	A-3
FB-35	2.5-3.5	8	---	---	---	100	100	100	94	79	65	37	19	SM	A-1-b
FB-35	14-15	8	---	---	---	100	100	100	100	100	100	100	19	SP	A-2-4
FB-36	2.5-3.5	3	---	---	---	100	100	100	97	90	79	26	2	SW	A-1-b
FB-36	14-15	2	---	---	---	100	100	100	100	100	100	99	3	SP	A-3
FB-37	2.5-3.5	8	---	---	---	100	100	100	97	93	86	41	2	SP	A-1-b
FB-37	14-15	3	---	---	---	100	100	100	100	100	100	99	1	SP	A-3

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40

LOCATION: Crawford & Sebastian Counties, Arkansas

GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
FB-37	39-40	17	---	---	---	100	100	96	86	80	72	32	3	SP	A-1-b
FB-38	2.5-3.5	3	---	---	---	100	100	100	97	94	85	38	2	SP	A-1-b
FB-38	9-10	31	32	14	18	---	---	---	---	---	---	---	---	CL	A-6
FB-38	19-20	4	---	---	---	100	100	100	100	100	100	98	3	SP	A-3
FB-38	29-30	20	---	---	---	100	100	100	100	99	98	50	2	SP	A-1-b
FB-39	6.5-7.5	9	---	---	---	100	100	100	100	95	86	50	17	SM	A-1-b
FB-39	14-15	3	---	---	---	100	100	100	100	100	100	95	3	SP	A-3
FB-40	0.5-1.5	3	---	---	---	100	100	100	97	94	87	44	1	SP	A-1-b
FB-40	9-10	3	---	---	---	100	100	100	100	100	100	96	2	SP	A-3
FB-40	29-30	25	---	---	---	100	100	100	100	97	96	38	2	SP	A-1-b
FB-41	2.5-3.5	3	---	---	---	100	100	100	91	91	89	59	3	SP	A-3
FB-41	14-15	4	---	---	---	100	100	91	83	80	79	59	4	SP	A-3
FB-41	24-25	20	---	---	---	100	100	100	100	100	99	85	3	SP	A-3
FB-42	2.5-3.5	4	---	---	---	100	100	100	96	93	86	37	1	SP	A-1-b
FB-42	9-10	3	---	---	---	100	100	100	100	100	100	93	4	SP	A-3
FB-42	29-30	23	---	---	---	100	100	100	100	100	99	41	2	SP	A-1-b
FB-43	2.5-3.5	22	---Non Plastic---			---	---	---	---	---	---	---	---	SM	A-3
FB-43	6.5-7.5	2	---	---	---	100	100	100	100	100	---	---	1	SP	A-3
FB-43	29-30	---	---	---	---	100	100	100	100	99	93	58	3	SP	A-3
FB-45	0.5-1.5	6	---	---	---	100	100	100	100	100	100	95	11	SM-SP	A-3
FB-45	6.5-7.5	10	---	---	---	100	100	100	100	100	100	100	33	SM	A-3
FB-45	24-25	---	---	---	---	100	100	100	100	97	92	47	2	SP	A-1-b
FB-46	2.5-3.5	8	---	---	---	100	100	100	100	100	100	100	47	SM	A-4
FB-46	24-25	---	---	---	---	100	100	100	98	97	96	60	4	SP	A-3
FB-48	0.5-1.5	22	---	---	---	100	100	100	100	100	---	---	84	ML	A-4
FB-50	0.5-1.5	30	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Crawford & Sebastian Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
FB-50	29-30		---	---	---	---	---	---	---	88	---	---	3	SW	A-1-a
FB-53	4.5-5.5	2	---	---	---	---	---	---	---	---	---	---	3	SP	A-3
FB-53	24-25	2	---	---	---	---	---	---	---	---	---	---	3	SP	A-3
FB-57	0.5-1.5	17	---	---	---	100	100	100	100	100	---	---	67	ML	A-4
FB-57	6.5-7.5	5	---	---	---	100	100	100	100	100	---	---	39	SM	A-3
FB-60	0.5-1.5	14	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FB-60	14-15	1	---	---	---	100	100	100	100	100	---	---	2	SP	A-3
FB-63	0.5-1.5	13	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FB-63	9-10	25	---	---	---	100	100	100	100	100	---	---	97	ML	A-4
FB-65	0.5-1.5	25	23	20	3	100	100	100	100	100	---	---	---	ML	A-4
FB-65	4.5-5.5	13	---	---	---	100	100	100	100	100	---	---	39	SM	A-3
FB-65	24-25	---	---	---	---	100	100	100	100	100	---	---	6	SM-SP	A-3
FB-66	0.5-1.5	32	47	19	28	---	---	---	---	---	---	---	---	CL	A-7-6
FB-66	4.5-5	28	47	21	26	100	100	100	100	100	100	100	99	CL	A-7-6
FB-66	6.5-7.5	22	---	---	---	100	100	100	100	100	100	100	64	ML	A-4
FB-66	14-15	23	---	---	---	100	100	100	100	100	100	100	71	ML	A-4
FB-66	29-30	23	---	---	---	100	100	100	93	91	88	31	4	SW	A-1-b
FB-69	6-6.5	17	---	---	---	100	100	100	100	100	100	100	46	SM	A-4
FB-69	6.5-7	17	---Non Plastic---			100	100	100	100	100	---	---	45	SM	A-4
FB-71	2.5-3.5	9	---	---	---	100	100	100	100	100	100	97	21	SM	A-2-4
FB-71	4.5-5.5	24	24	20	4	---	---	---	---	---	---	---	---	CL-ML	A-4
FB-71	6.5-7.5	26	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FB-71	9-10		---Non Plastic---			---	---	---	---	---	---	---	---	SP	A-3
FB-71	24-25	21	---	---	---	100	100	100	94	94	94	57	4	SP	A-3
FB-72	2-3.5	9	30	22	8	---	---	---	---	---	---	---	---	CL	A-4
FB-72	14-15	36	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FB-72	24-25	---	---	---	---	100	100	93	83	78	68	23	4	SW	A-1-b

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40

LOCATION: Crawford & Sebastian Counties, Arkansas

GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
FB-73	2.5-3.5	---	54	22	32	---	---	---	---	---	---	---	---	CH	A-7-6
FB-73	14-15	25	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FB-73	19-20	33	---	---	---	100	100	100	100	100	100	100	98	ML	A-4
FB-74	2-2.5	32	51	29	22	---	---	---	---	---	---	---	89	MH	A-7-6
FB-74	2.5-3	28	42	27	15	---	---	---	---	---	---	---	90	ML	A-7-6
FB-74	3-3.5	29	40	22	18	---	---	---	---	---	---	---	91	CL	A-7-6
FB-74	6.5-7	---	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FB-74	29-30	9	---	---	---	100	100	92	72	56	49	29	6	SM-SP	A-3
FB-75	4-4.5	27	44	22	22	---	---	---	---	---	---	---	99	CL	A-7-6
FB-75	9-10		70	26	44	---	---	---	---	---	---	---	---	CH	A-7-6
FB-75	24-25	26	---	---	---	100	100	100	100	100	100	95	6	SM-SP	A-3
FB-75	34-35	18	---	---	---	100	100	100	100	100	100	49	2	SP	A-1-b
FB-77	0.5-1.5	24	26	20	6	---	---	---	---	---	---	---	---	CL	A-7-6
FB-77	5-5.5	23	26	19	7	100	100	100	100	100	---	---	98	CL-ML	A-4
FB-77	24-25	25	---	---	---	100	100	100	100	100	100	98	18	SM	A-3
FB-77	34-35	22	---	---	---	100	100	100	97	92	91	69	7	SM-SP	A-3
FB-78	2.5-3	23	24	19	5	100	100	100	100	100	---	---	94	CL-ML	A-4
FB-78	3-3.5	23	26	20	6	100	100	100	100	100	---	---	94	CL-ML	A-4
FB-78	14-15	10	---	---	---	100	100	100	100	100	100	100	43	SM	A-4
FB-79	0.5-1	18	23	20	3	---	---	---	---	---	---	---	---	ML	A-4
FB-79	4.5-5.5	22	25	18	7	100	100	100	100	100	---	---	90	CL-ML	A-4
FB-79	9-10	20	24	19	5	---	---	---	---	---	---	---	---	CL-ML	A-4
FB-79	13.5-14	24	---Non Plastic---			100	100	100	100	100	---	---	54	ML	A-4
FB-79	19-20	24	---	---	---	100	100	100	100	100	100	100	12	SM	A-2-4
FB-79	24-25	22	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FB-80	0.5-1.5	20	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FB-80	6-6.5	23	44	20	24	100	100	100	100	100	---	---	97	CL	A-7-6
FB-80	9-10	20	27	17	10	---	---	---	---	---	---	---	---	CL	A-4
FB-80	14-15	11	---	---	---	100	100	100	100	100	---	---	44	SM	A-4

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Crawford & Sebastian Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
FB-80	29-30	20	---	---	---	100	100	100	100	100	---	---	10	SM-SP	A-3
FB-81	2.5-3	18	41	17	24	---	---	---	---	---	---	---	---	CL	A-7-6
FB-81	4.5-5.5	23	46	20	26	---	---	---	---	---	---	---	---	CL	A-7-6
FB-81	19-20	19	---	---	---	100	100	100	100	100	---	---	7	SM-SP	A-3
FB-81	29-30	24	---	---	---	100	100	100	100	100	---	---	10	SM-SP	A-3
FE-8	2.5-3.5	29	72	23	49	---	---	---	---	---	---	---	---	CH	A-7-6
FE-8	14-15	21	64	23	41	---	---	---	---	---	---	---	---	CH	A-7-6
FE-9	6.5-7.5	22	43	17	26	---	---	---	---	---	---	---	---	CL	A-76
FE-10	2-2.5	23	---Non Plastic---			100	100	100	100	100	---	---	80	ML	A-4
FE-10	2.5-3	21	---Non Plastic---			100	100	100	100	100	---	---	78	ML	A-4
FE-10	3-3.5	19	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FE-10	4.5-5.5	18	40	20	20	---	---	---	---	---	---	---	---	CL	A-6
FE-10	9-10	22	44	18	26	---	---	---	---	---	---	---	---	CL	A-7-6
FE-10	14-15	8	---	---	---	100	100	100	100	100	100	100	24	SM	A-2-4
FE-11	2.5-3.5	22	30	18	12	---	---	---	---	---	---	---	---	CL	A-6
FE-11	6-6.5	22	33	17	16	100	100	100	100	100	---	---	93	CL	A-6
FE-11	14-15	34	48	19	29	---	---	---	---	---	---	---	---	CL	A-7-6
FE-11	21.5-22	17	43	20	23	100	100	100	100	100	---	---	92	CL	A-7-6
FE-11	34-35	20	---Non Plastic---			---	---	---	---	---	---	---	---	SM	A-3
FE-12	0.5-1	22	30	19	11	100	100	100	100	100	---	---	95	CL	A-6
FE-12	1.5-2	24	36	20	16	---	---	---	---	---	---	---	---	CL	A-6
FE-12	9-10	21	40	18	22	---	---	---	---	---	---	---	---	CL	A-6
FE-13	2-2.5	21	---Non Plastic---			100	100	100	100	100	---	---	75	ML	A-4
FE-13	6.5-7.5	18	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4
FE-13	8-8.5	18	---Non Plastic---			100	100	100	100	100	---	---	71	ML	A-4
FE-13	19-20	26	---	---	---	100	100	100	100	100	100	100	16	SM	A-2-4
FE-13	24-25	26	---	---	---	100	100	100	100	100	100	100	5	SM-SP	A-3
FE-14	0.5-1.5	28.1	---Non Plastic---			---	---	---	---	---	---	---	---	ML	A-4

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Crawford & Sebastian Counties, Arkansas
GHBW JOB NUMBER: 21-071

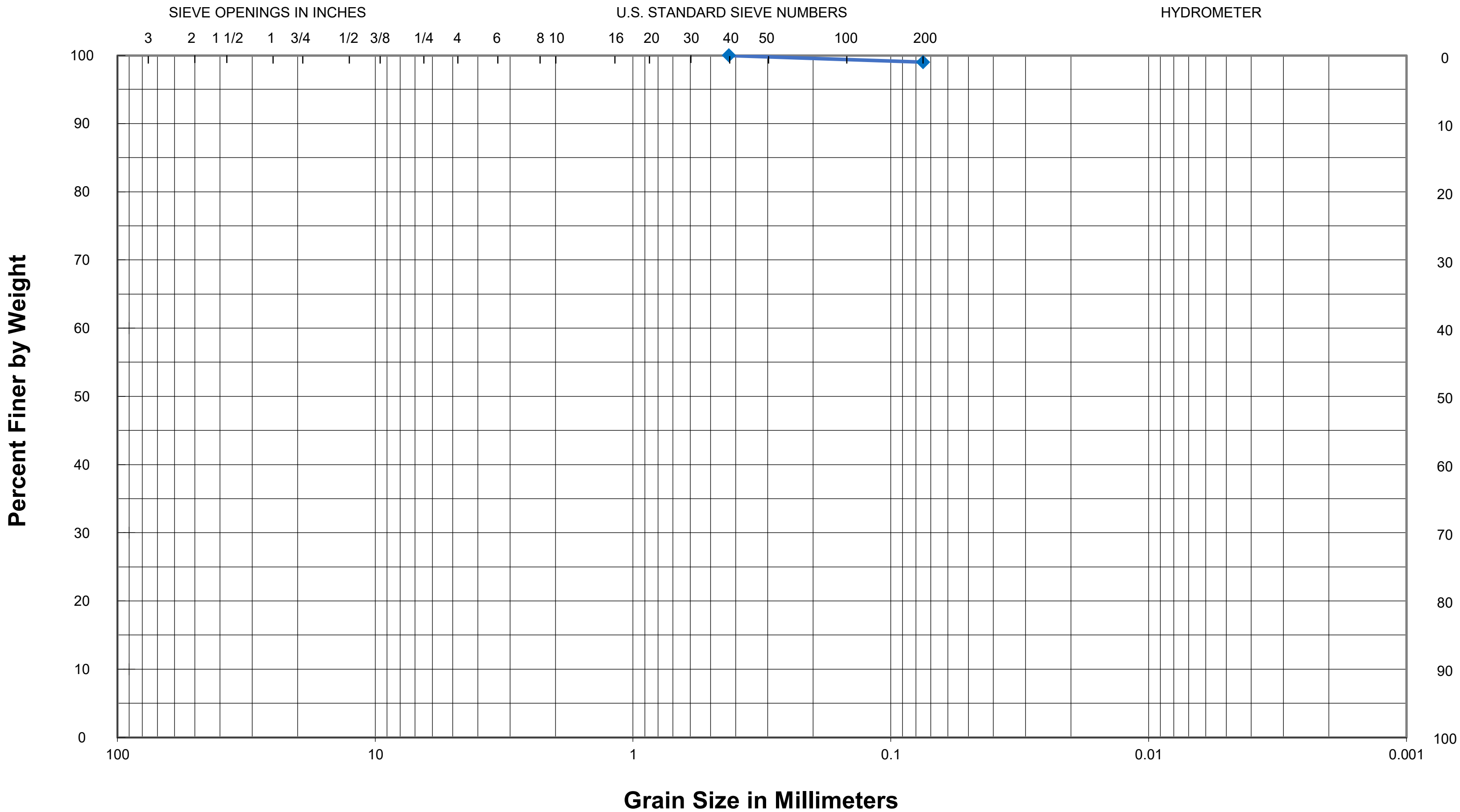
BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
FE-14	4.5-5	21	24	21	3	---	---	---	---	---	---	---	84	ML	A-4
FE-14	10.5-11	28	45	20	25	---	---	---	---	---	---	---	98	CL	A-7-6
FE-14	14-15	32	61	25	36	---	---	---	---	---	---	---	---	CH	A-7-6
FE-14	24-25	25	---	---	---	100	100	100	100	100	100	99	57	ML	A-4
FE-14	34-35	16	---	---	---	100	100	94	93	93	89	58	6	SM-SP	A-3
FE-14	39-40	16	---	---	---	100	100	100	98	94	80	22	7	SM-SW	A-1-b
FP-14	2-2.5	23	30	19	11	---	---	---	---	---	---	---	84	CL	A-6
FP-14	3.5-4	25	46	19	27	---	---	---	---	---	---	---	97	CL	A-7-6
FP-14	4.5-5	22	40	20	20	---	---	---	---	---	---	---	---	CL	A-6
FP-15	2.5-3.5	22	37	21	16	---	---	---	---	---	---	---	---	CL	A-6
FP-15	4.5-5.5	17	37	19	18	---	---	---	---	---	---	---	---	CL	A-6

APPENDIX D

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

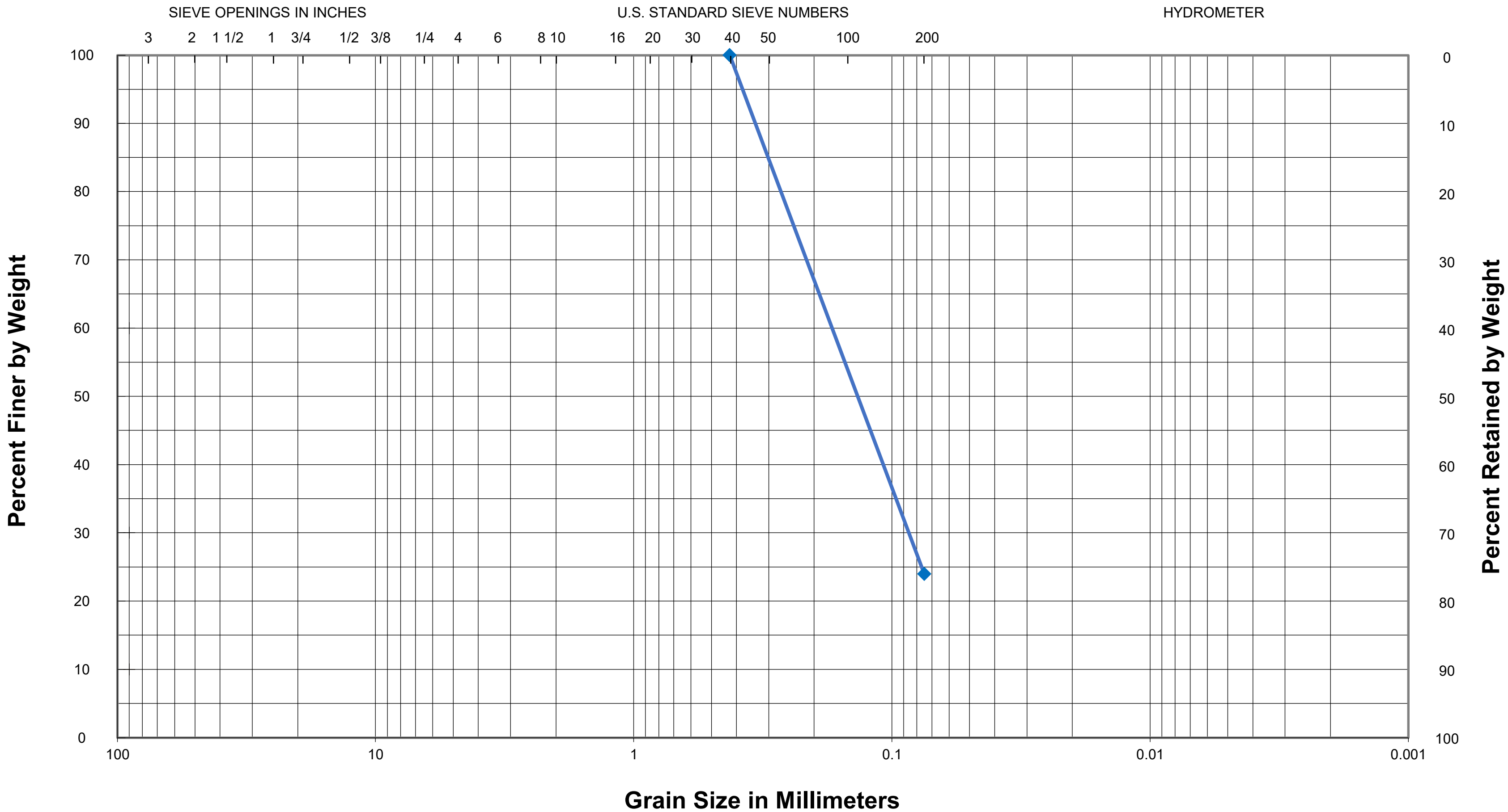
Sample: Boring FB-10, 2.5-3.5
Description: Brown silty fine SAND

USCS Classification = SM
AASHTO Classification = A-4

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

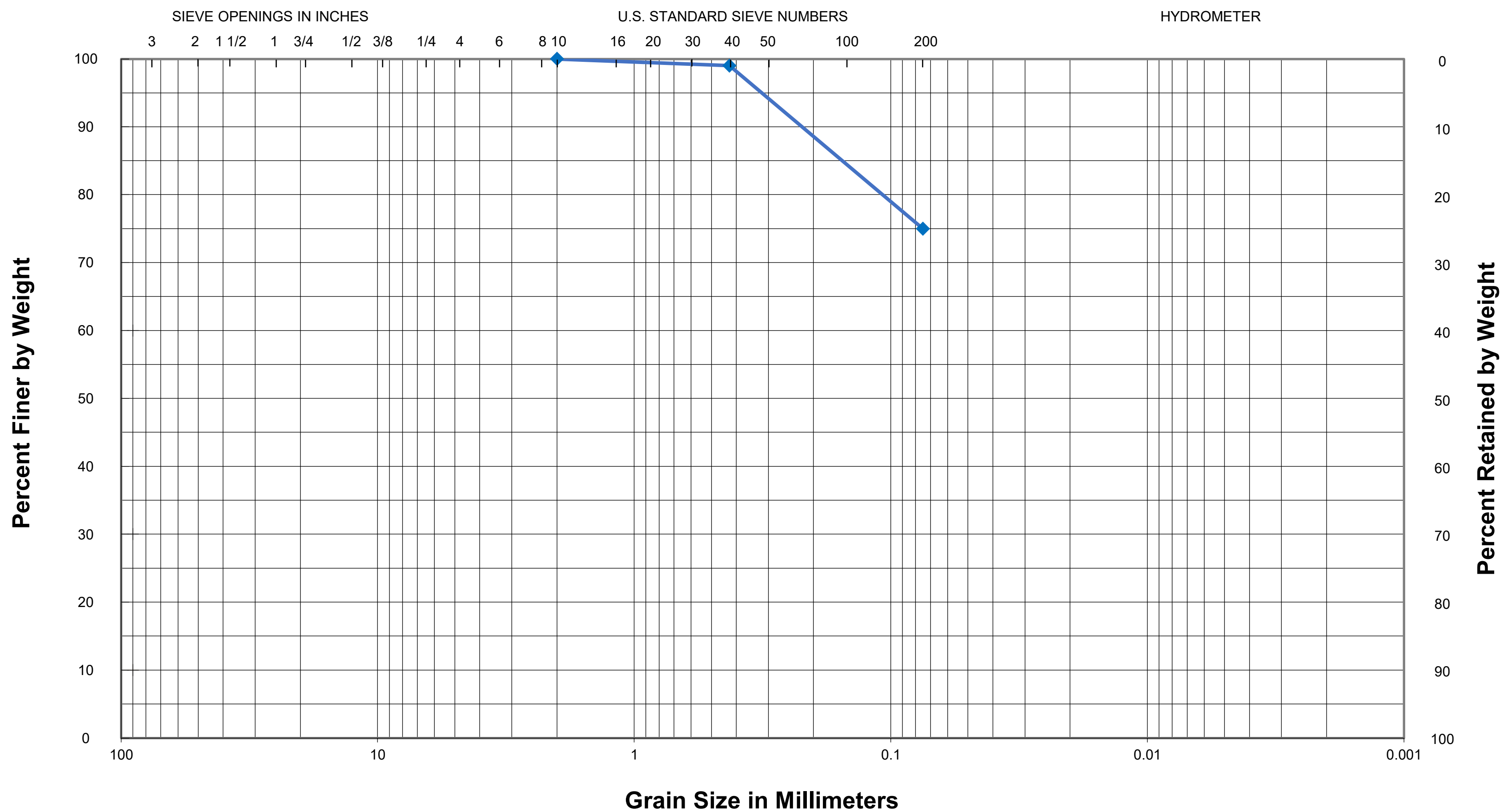
Sample: Boring FE-10, 14-15 ft
Description: Brown SILT

USCS Classification = ML
AASHTO Classification = A-4

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

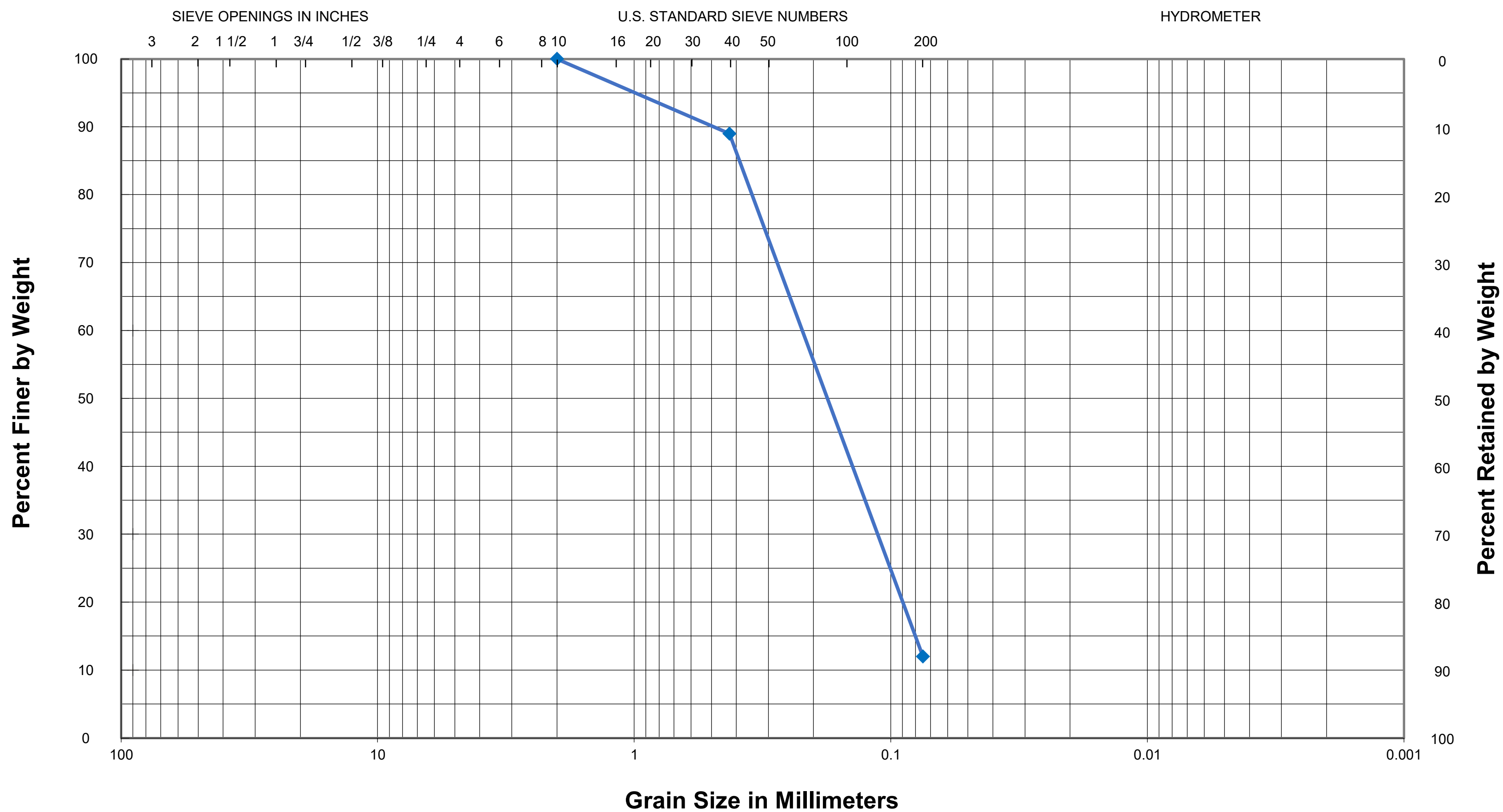
Sample: Boring FB-10, 19-20
Description: Brown clayey SILT

USCS Classification = CL-ML
AASHTO Classification = A-4

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

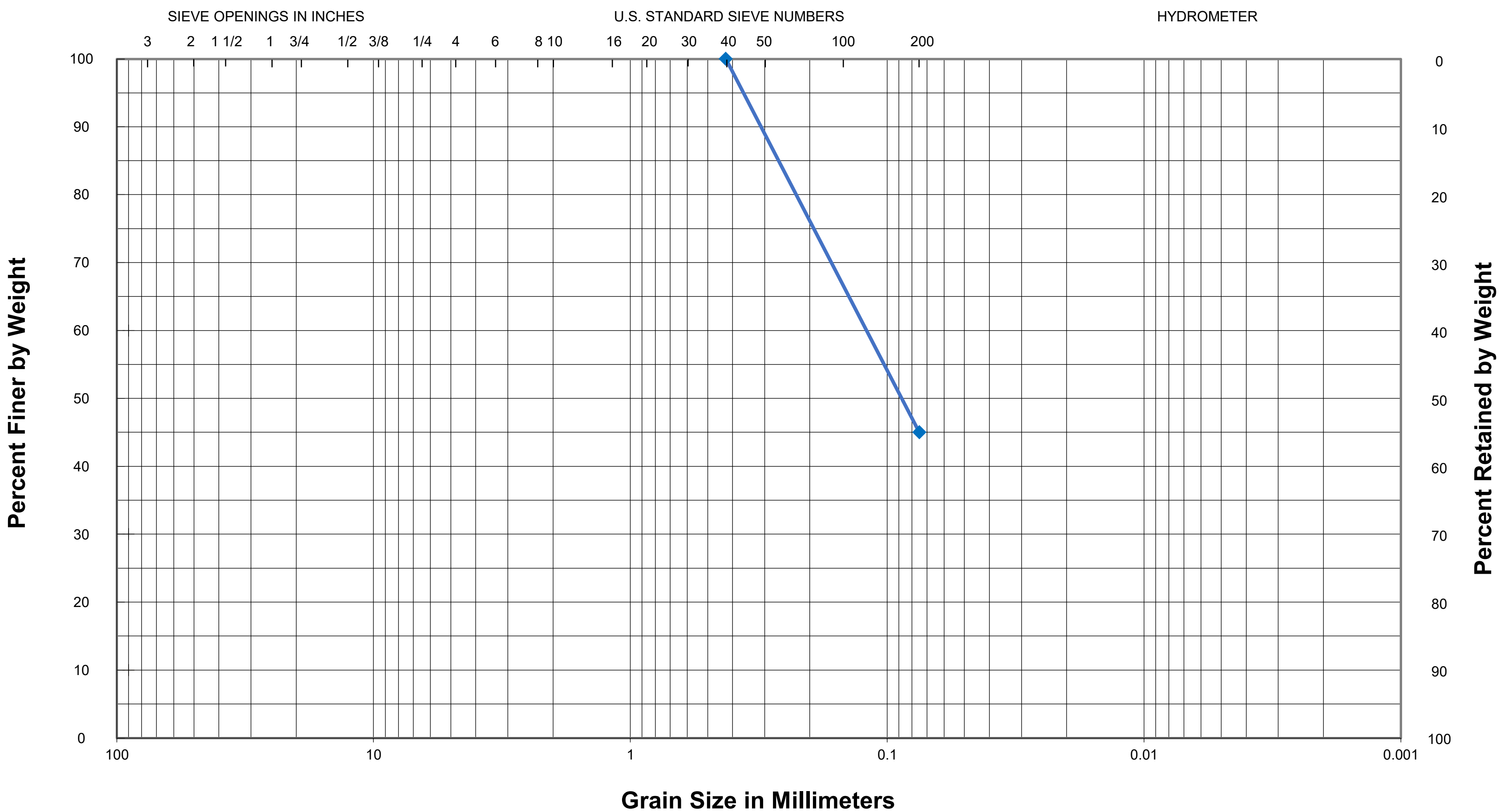
Sample: Boring FB-10, 44-45
Description: Dark gray SHALE

USCS Classification = SHALE
AASHTO Classification = SHALE

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

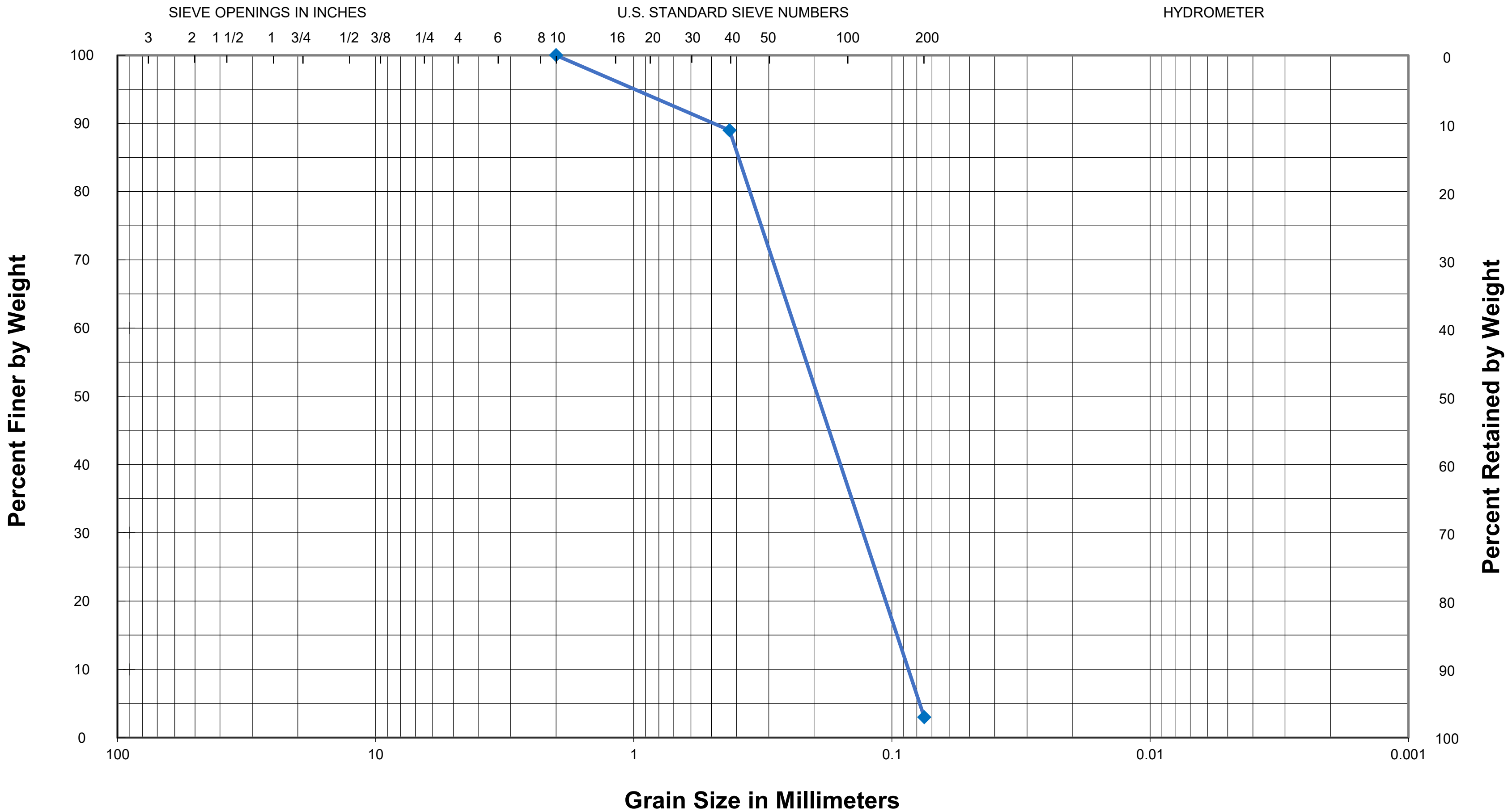
Sample: Boring FB-14, 19-20
Description: Brown silty fine SAND

USCS Classification = SM
AASHTO Classification = A-4

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

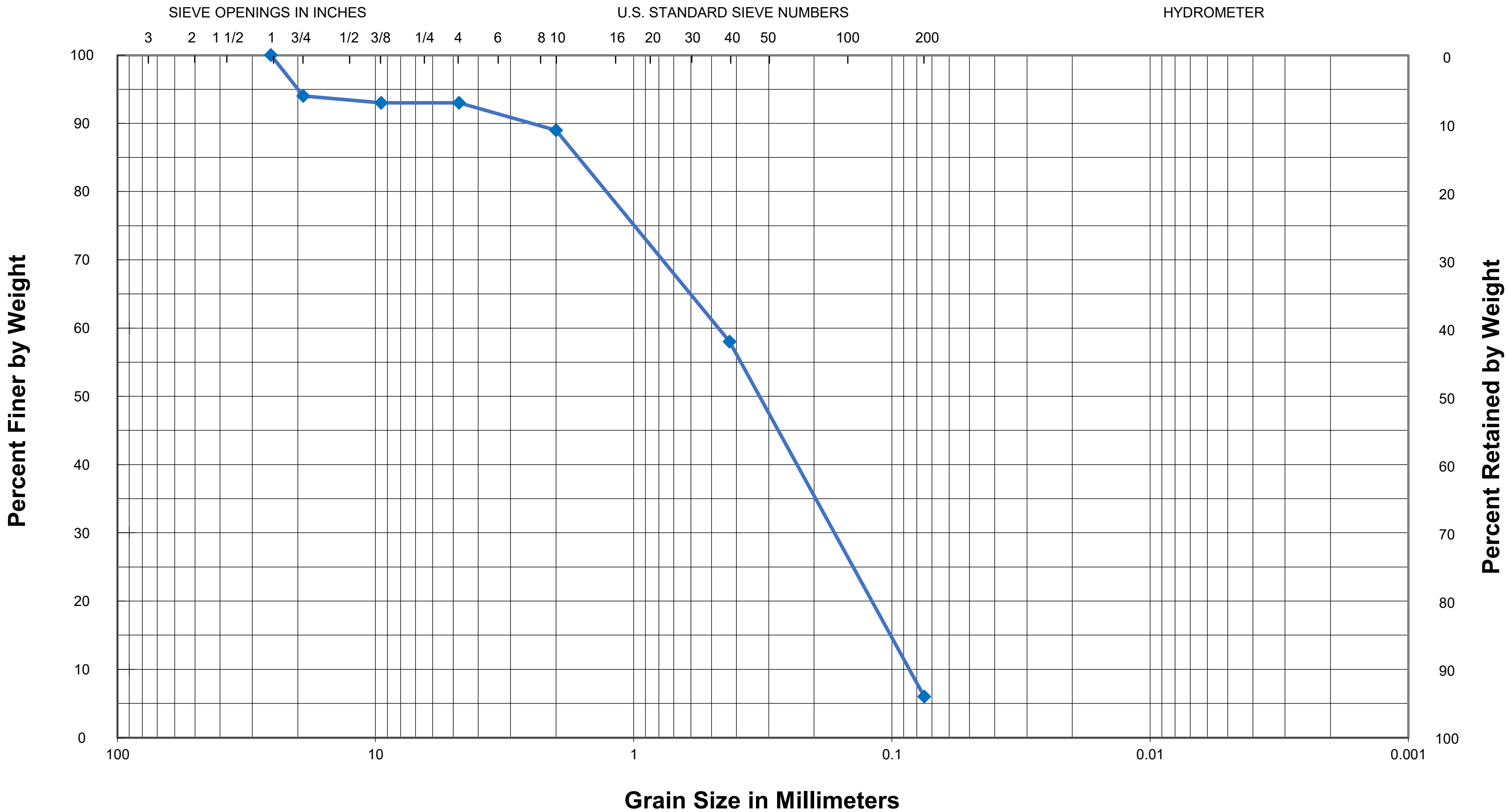
Sample: Boring FB-14, 24-25
Description: Tan and brown fine to medium SAND

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

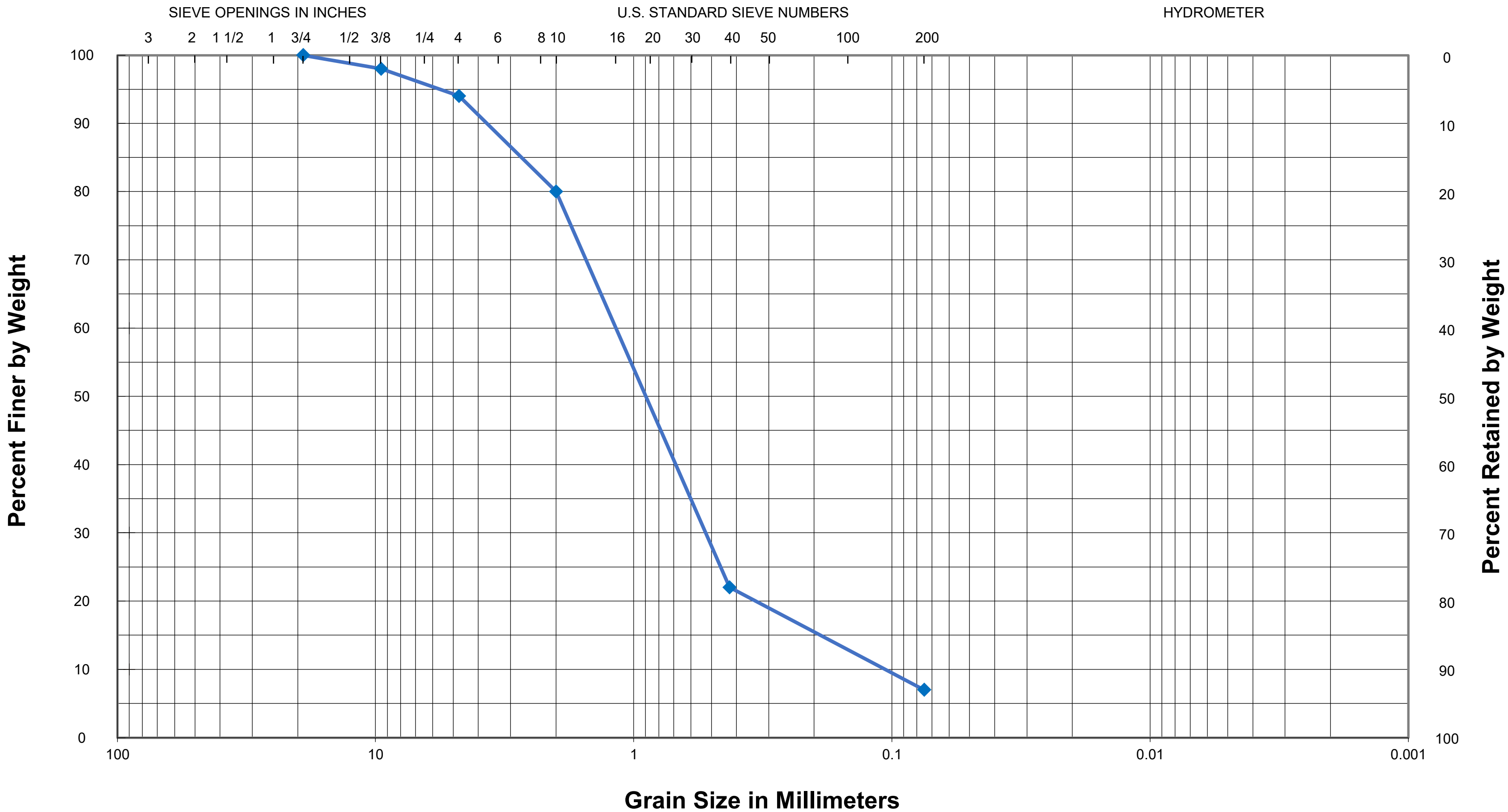
Sample: Boring FE-14, 34-35 ft
Description: Tan fine to coarse SAND with a some fine to coarse gravel

USCS Classification = SM-SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

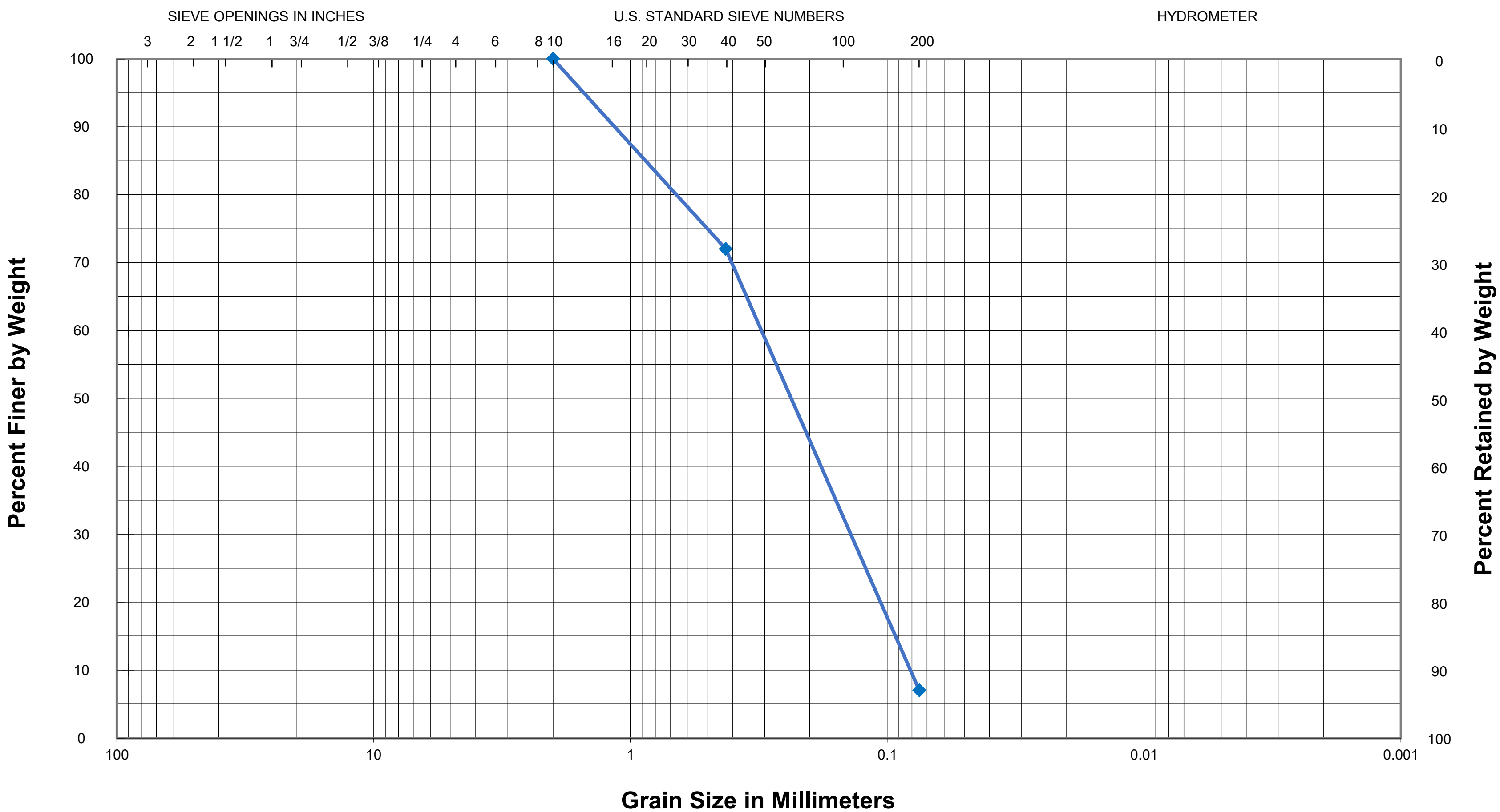
Sample: Boring FE-14, 39-40 ft
Description: Tan fine to coarse SAND with a fine to coarse gravel

USCS Classification = SM-SW
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



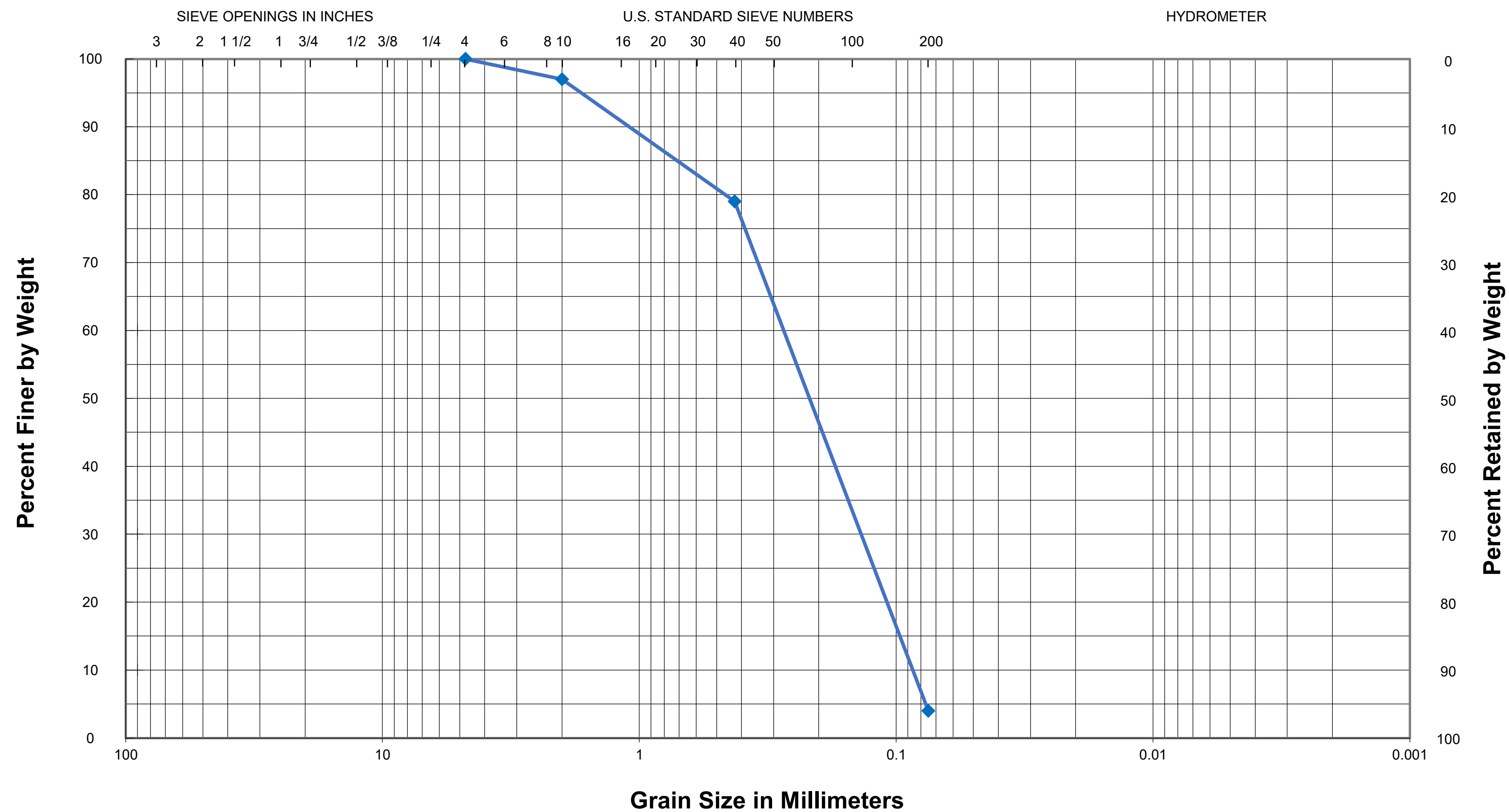
GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring FB-15, 24-25
Description: Dark gray and gray fine to medium SAND w/trace silt

USCS Classification = SM-SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

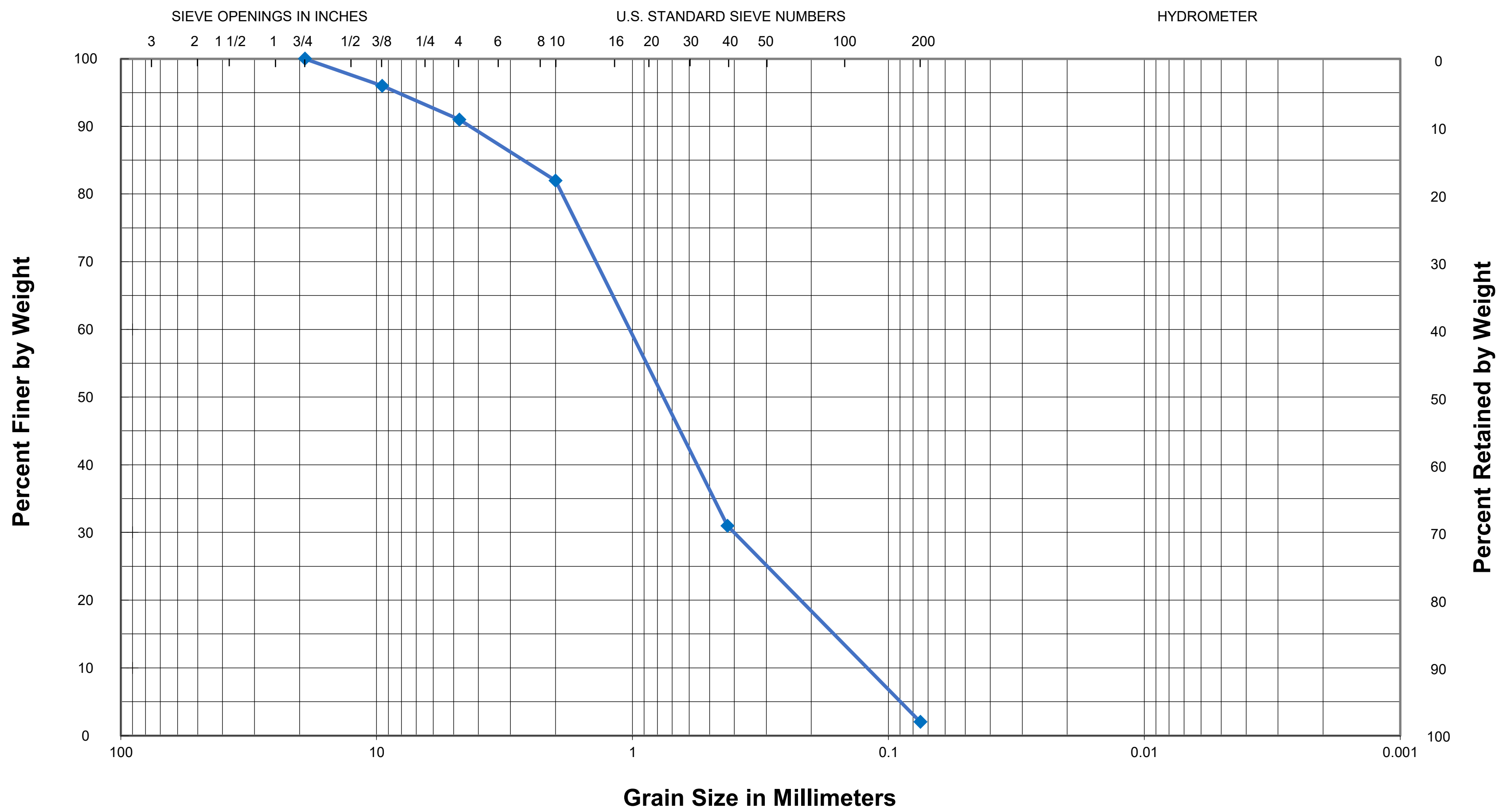
Sample: Boring FB-16, 24-25
Description: Gray fine to medium SAND w/trace silt

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

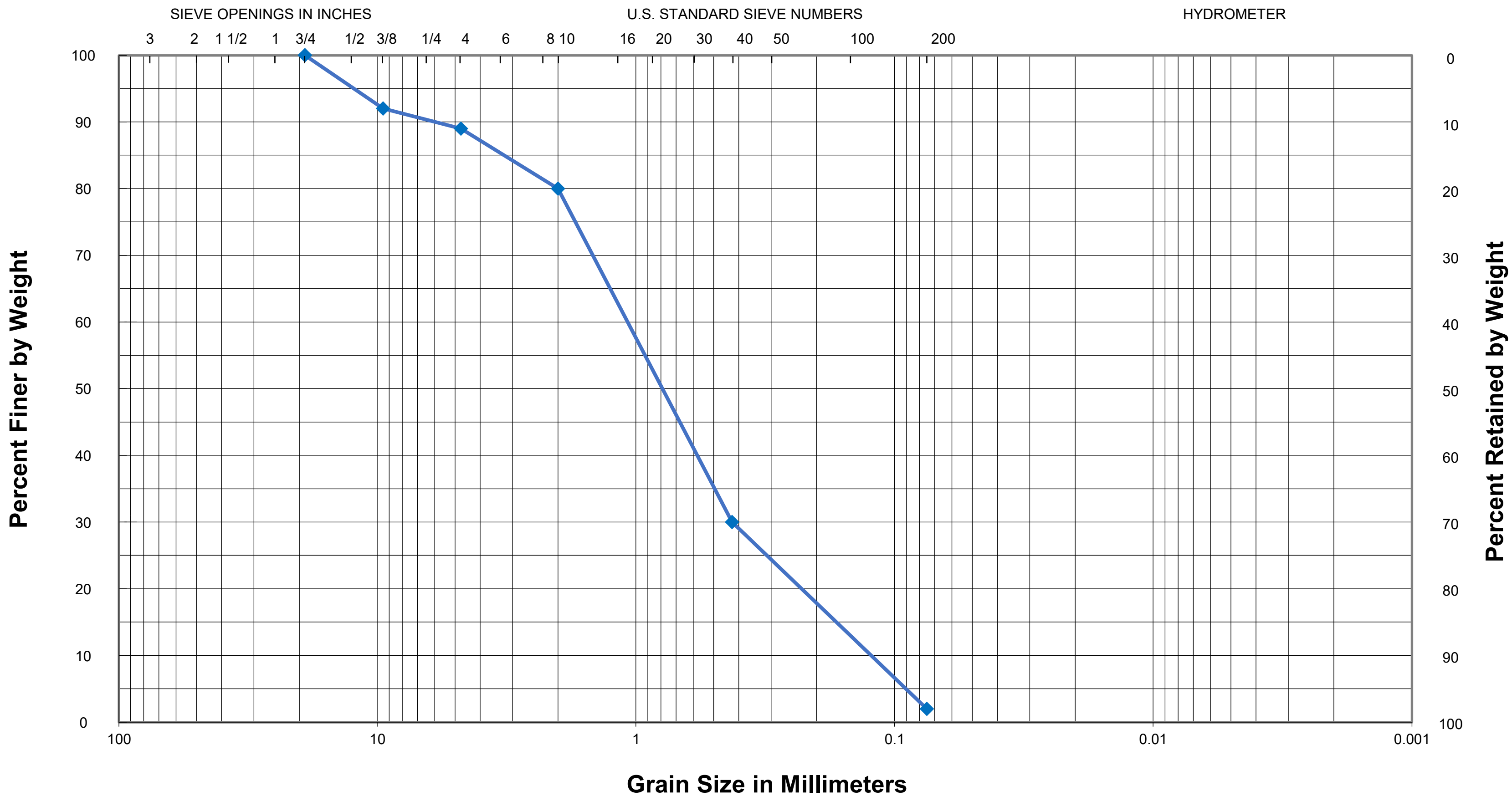
Sample: Boring FB-18, 14-15
Description: Tan fine to coarse SAND w/some fine to coarse gravel

USCS Classification = SW
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

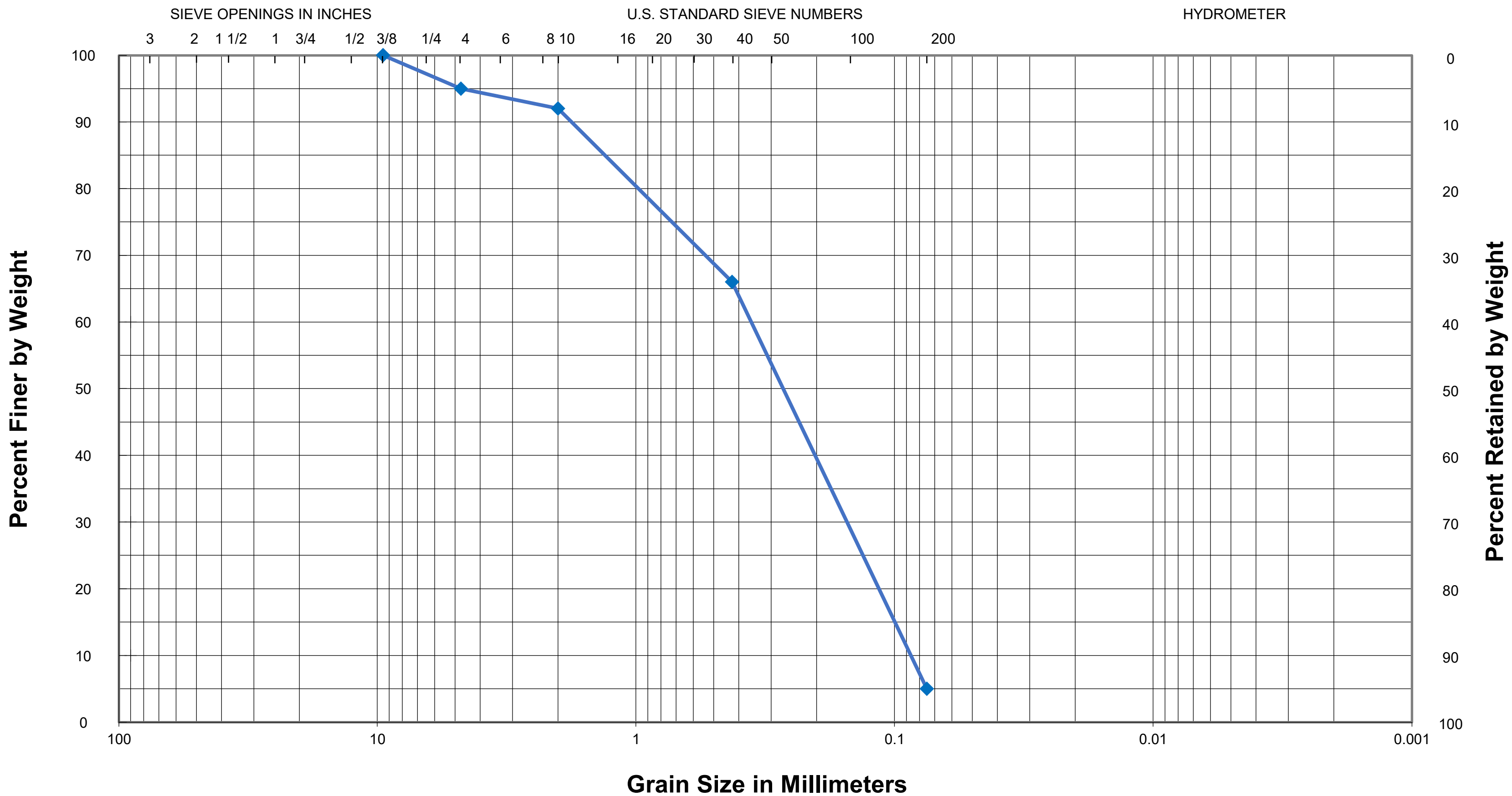
Sample: Boring FB-19, 14-15
Description: Tan fine to coarse SAND w/some fine to coarse gravel

USCS Classification = SW
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

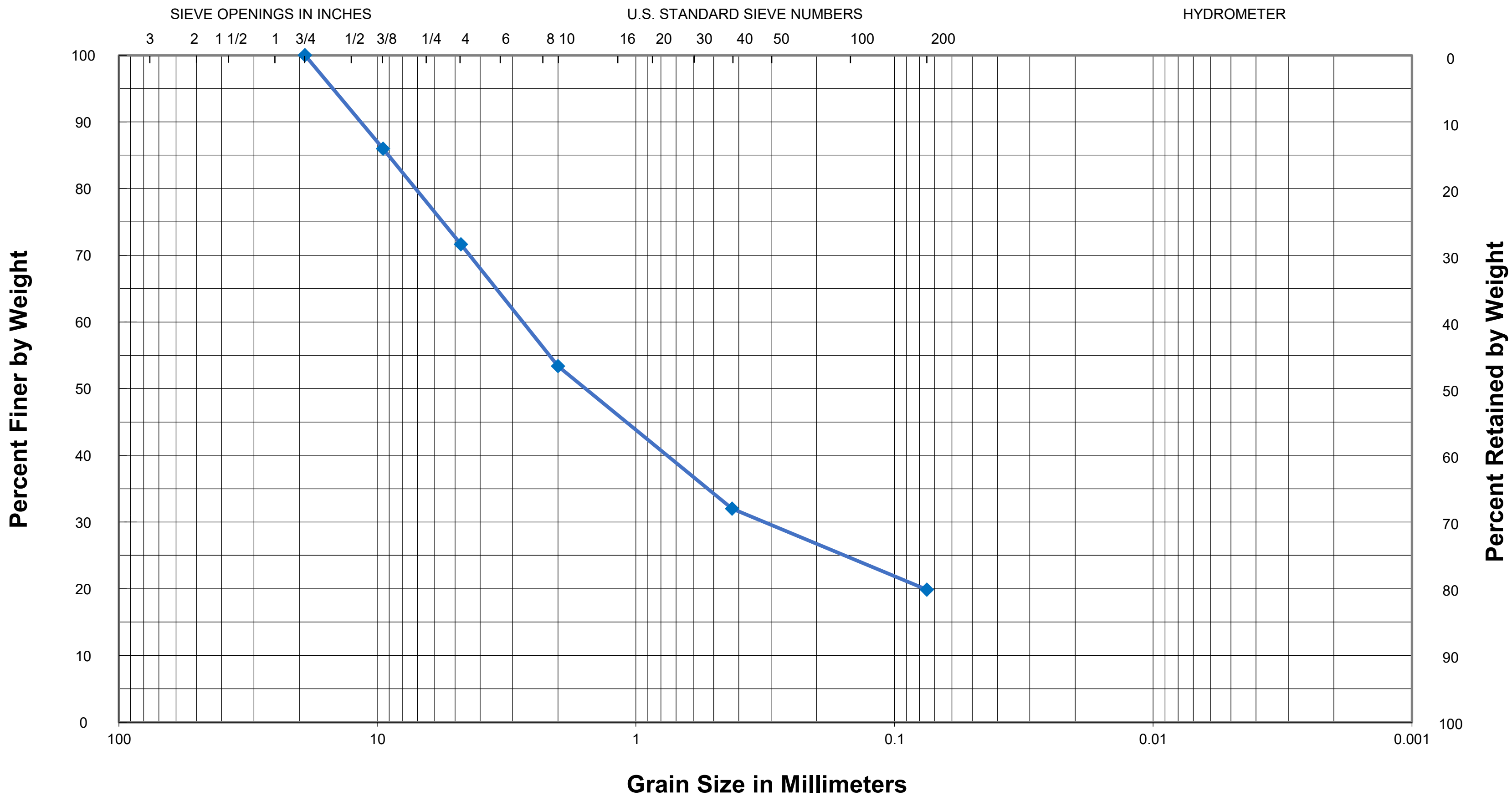
Sample: Boring FB-19, 34-35
Description: Tan fine to coarse SAND w/some fine gravel

USCS Classification = SP
AASHTO Classification = A-3

21-071

Grubbs, Hoskyn, Barton & Wyatt, LLC

GRAIN SIZE CURVE



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<tr><td>COARSE</td><td>FINE</td><td>COARSE</td><td>MEDIUM</td><td>FINE</td></tr>
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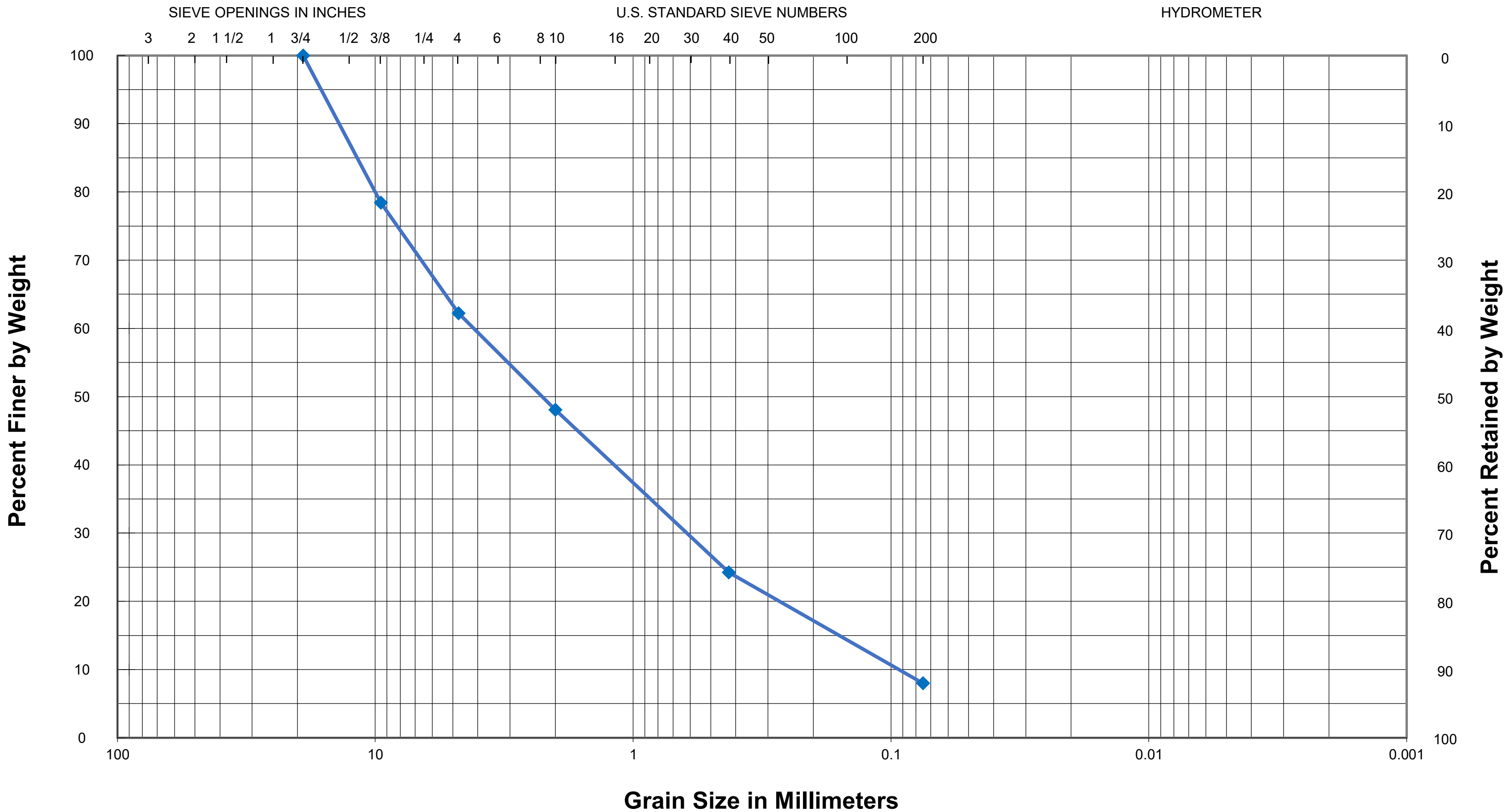
Sample: Boring FB-21, 2.5-3.5
Description: Dark gray SHALE

USCS Classification = SHALE
AASHTO Classification = SHALE

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

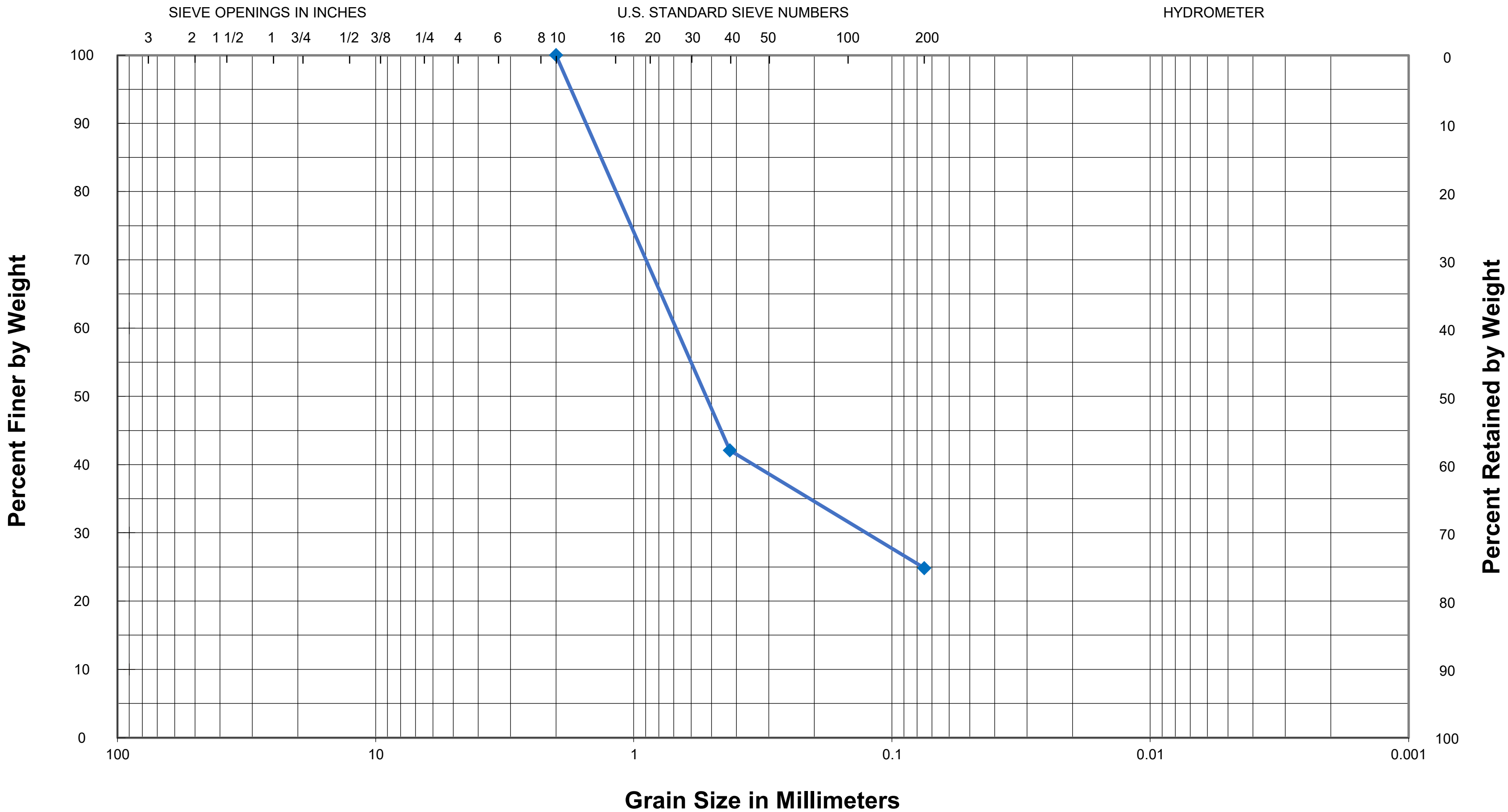
Sample: Boring FB-22, 1.5-2
Description: Gray and brown fine to coarse SAND w/fine to coarse gravel

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

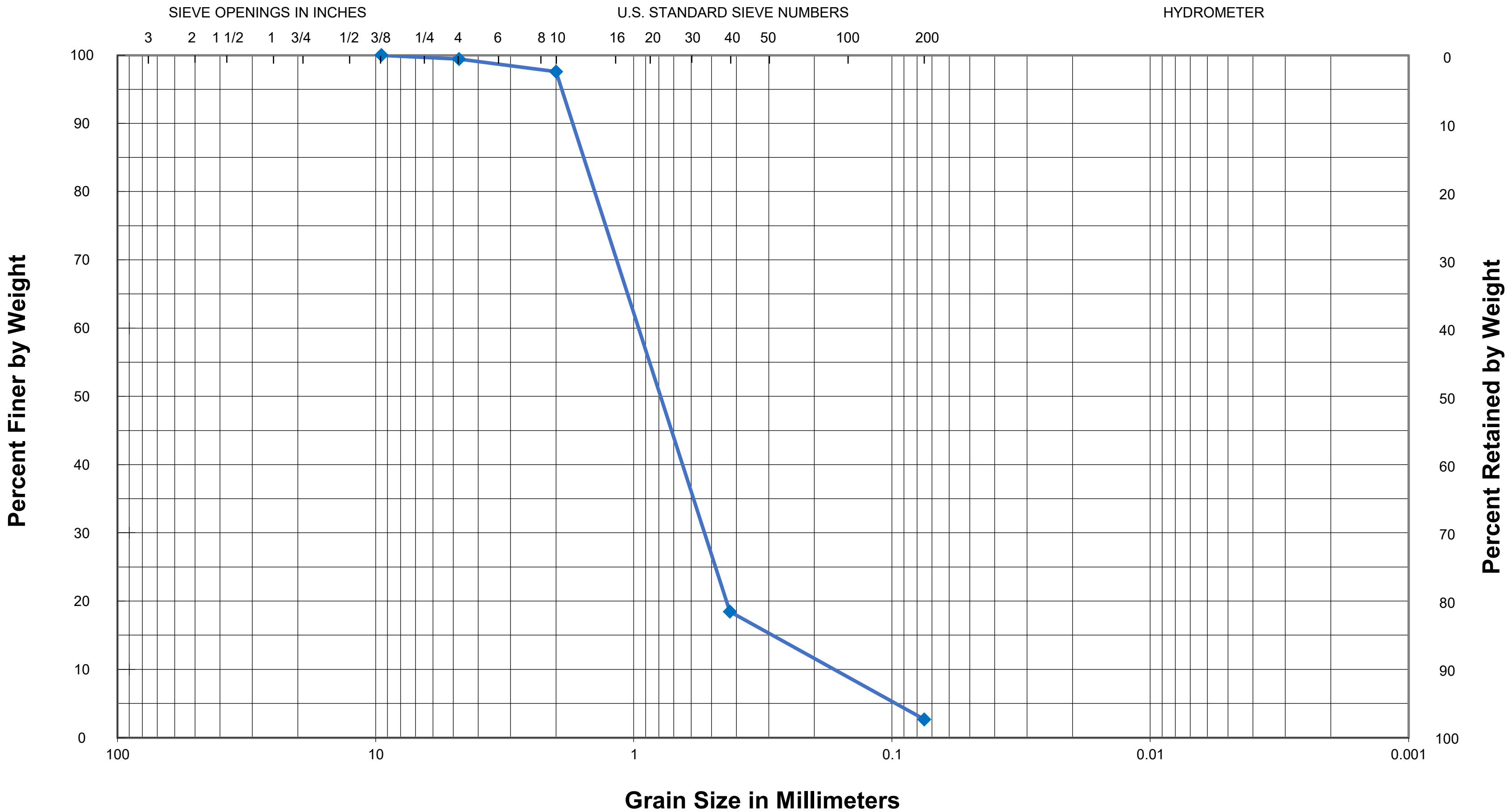
Sample: Boring FB-22, 2.5-3
Description: Dark gray SHALE

USCS Classification = SHALE
AASHTO Classification = SHALE

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

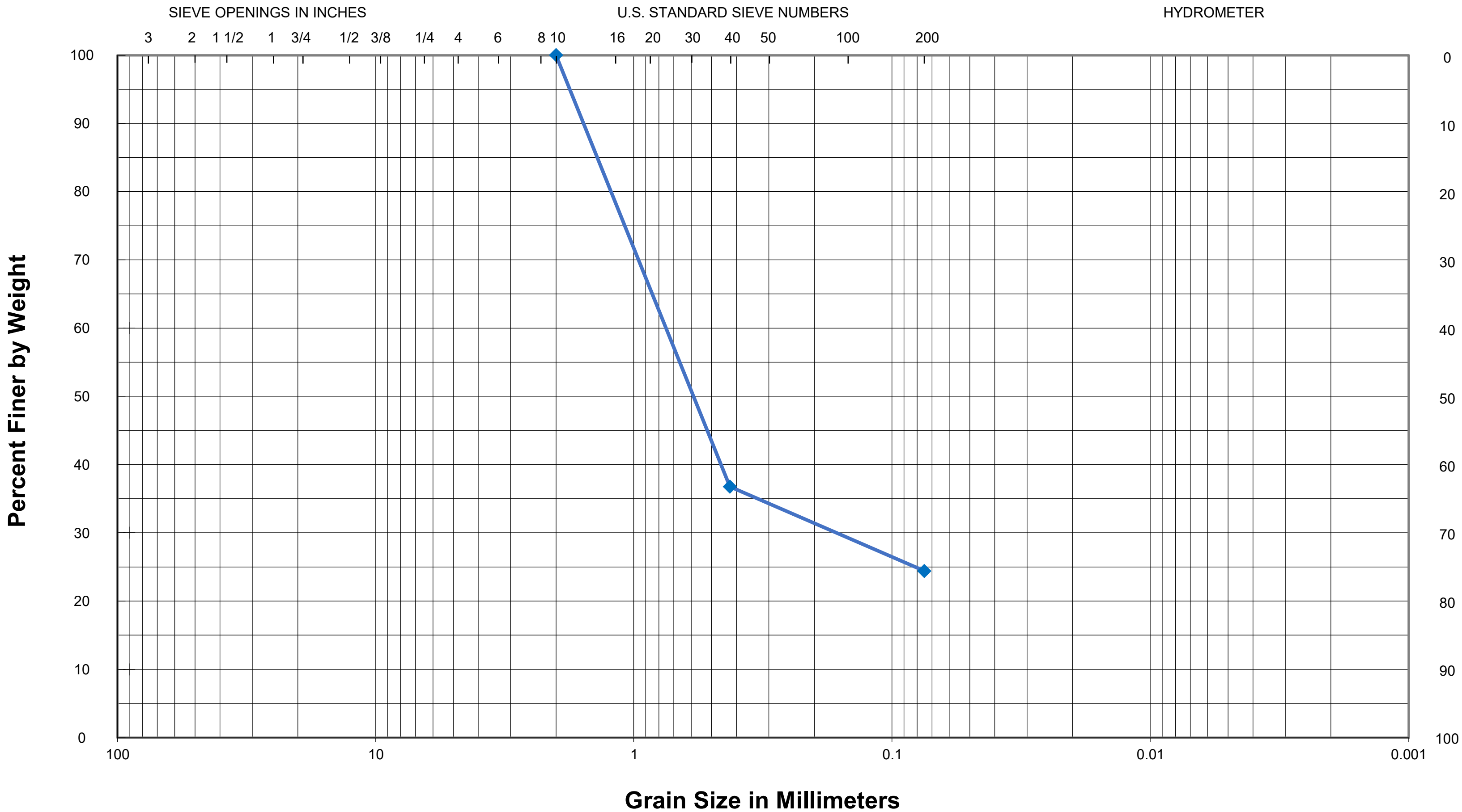
Sample: Boring FB-23, 0.5-1
Description: Tan and brown fine to coarse SAND w/little fine gravel

USCS Classification = SW
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

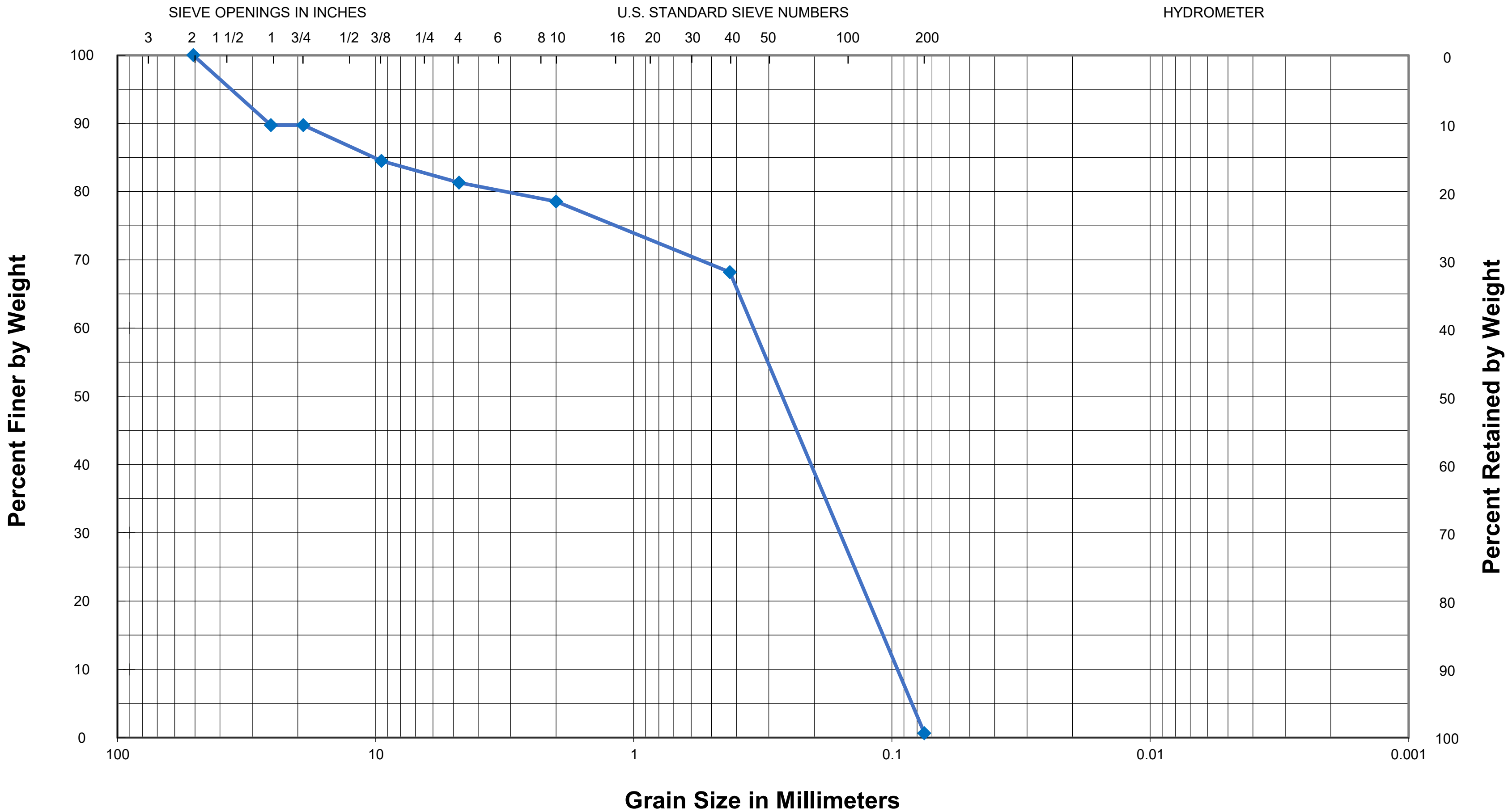
Sample: Boring FB-23, 1-1.5
Description: Dark gray SHALE

USCS Classification = SHALE
AASHTO Classification = SHALE

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

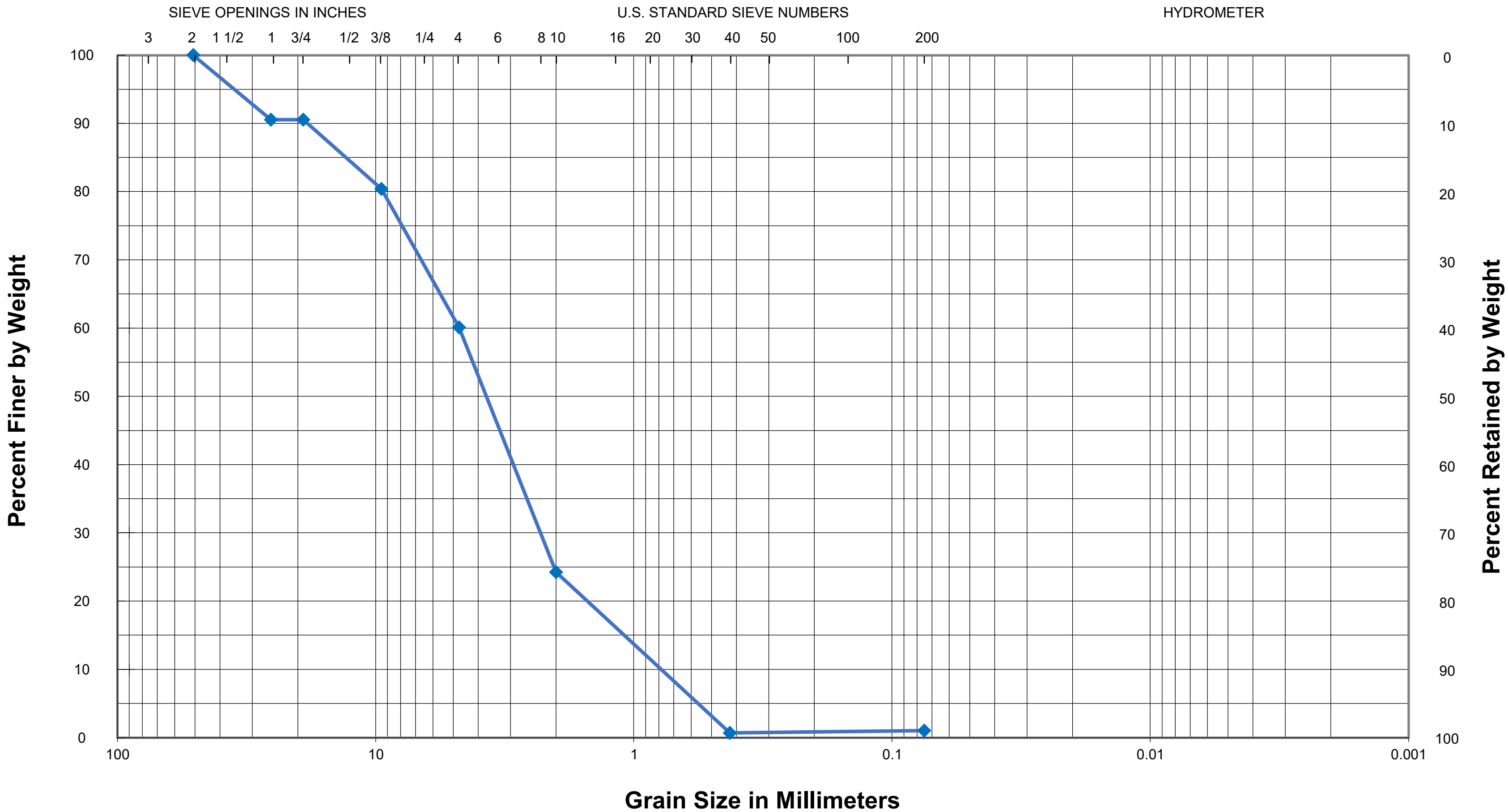
Sample: Boring FB-25, 0.5-1.5
Description: Brown fine to coarse SAND w/fine to coarse gravel

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

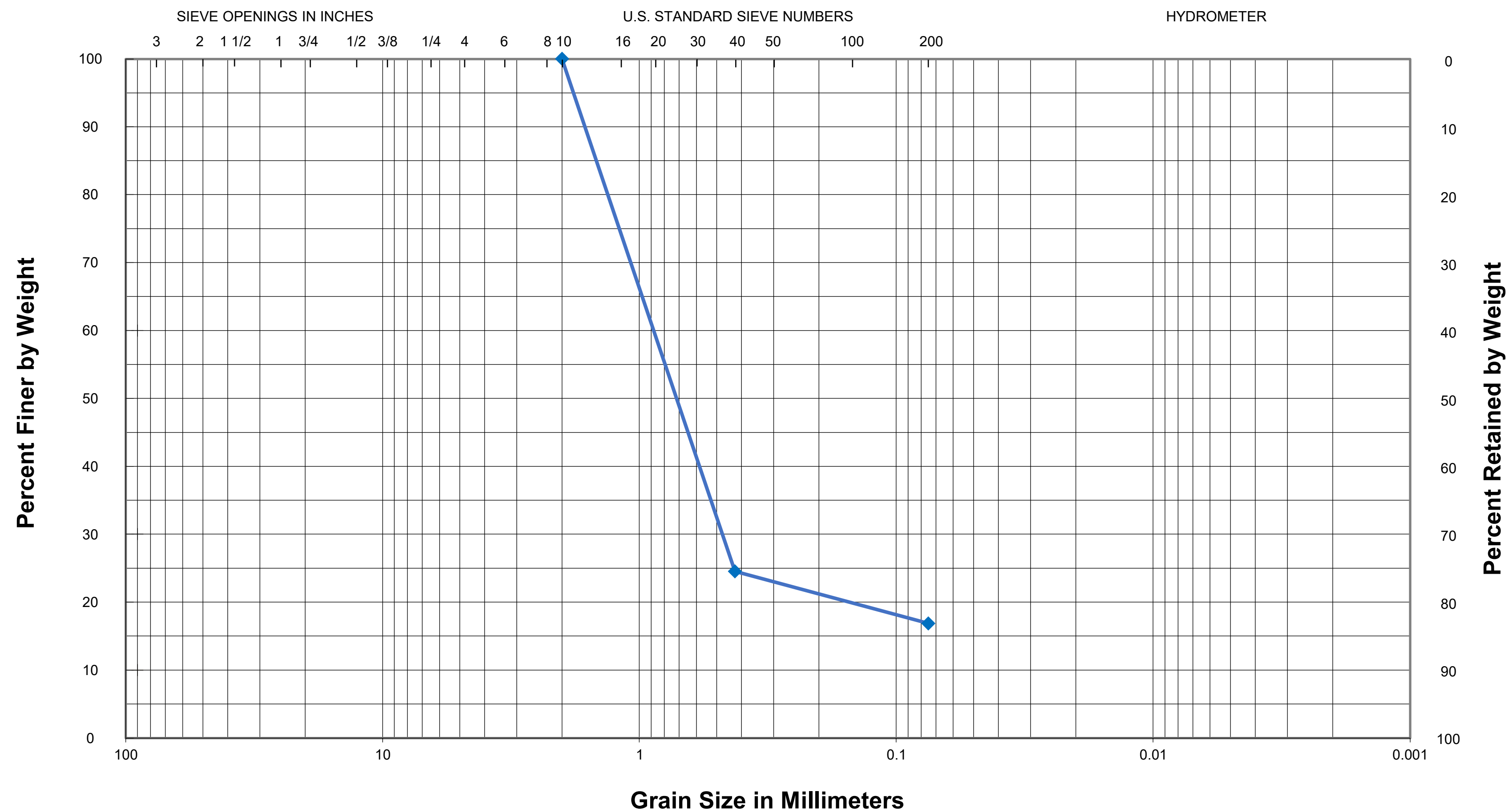
Sample: Boring FB-25, 0-4.5
Description: Brown fine to coarse SAND w/fine to coarse gravel

USCS Classification = SW
AASHTO Classification = A-1-a

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

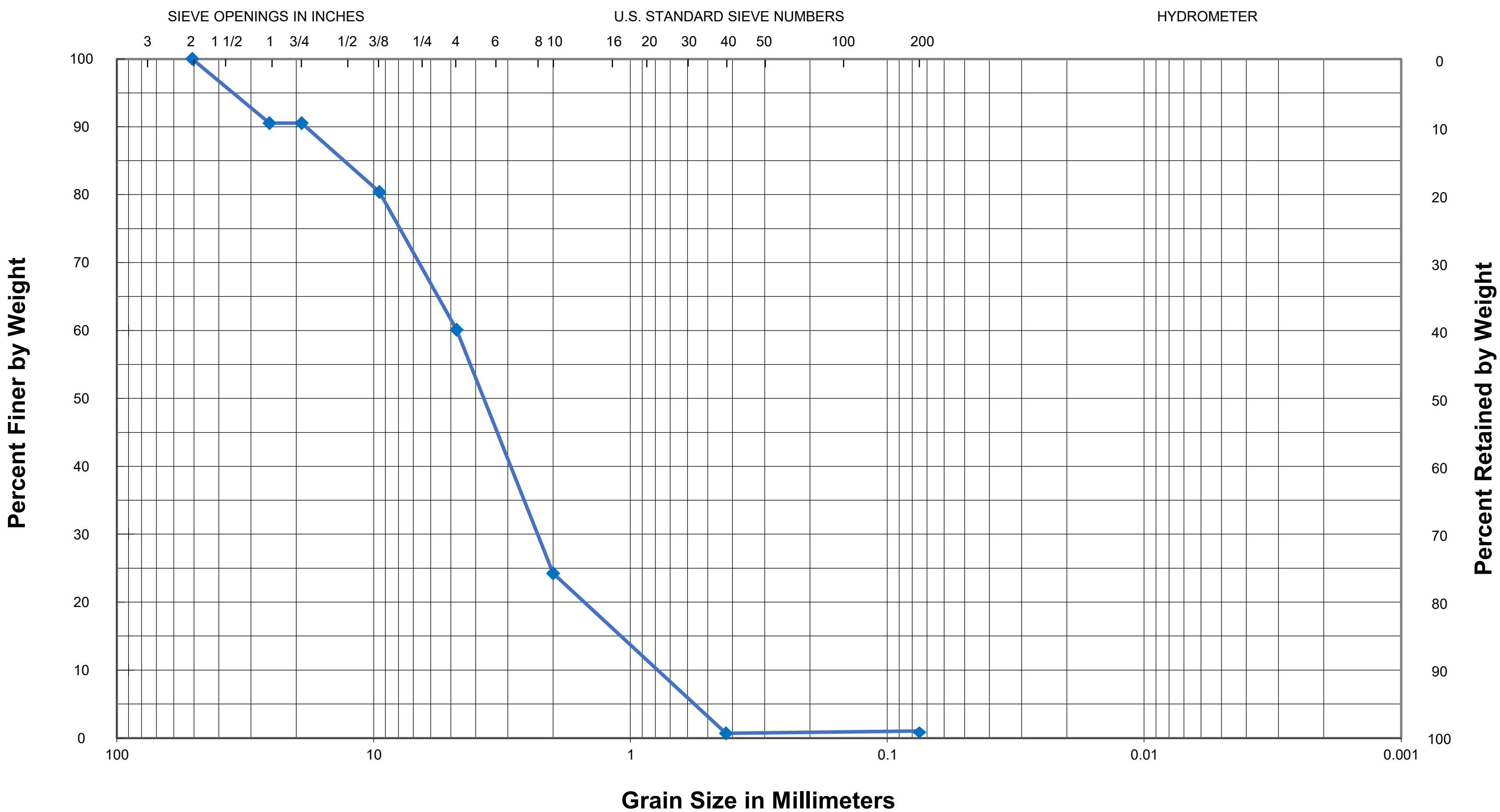
Sample: Boring FB-25, 4.5-5
Description: Dark gray SHALE

USCS Classification = SHALE
AASHTO Classification = SHALE

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

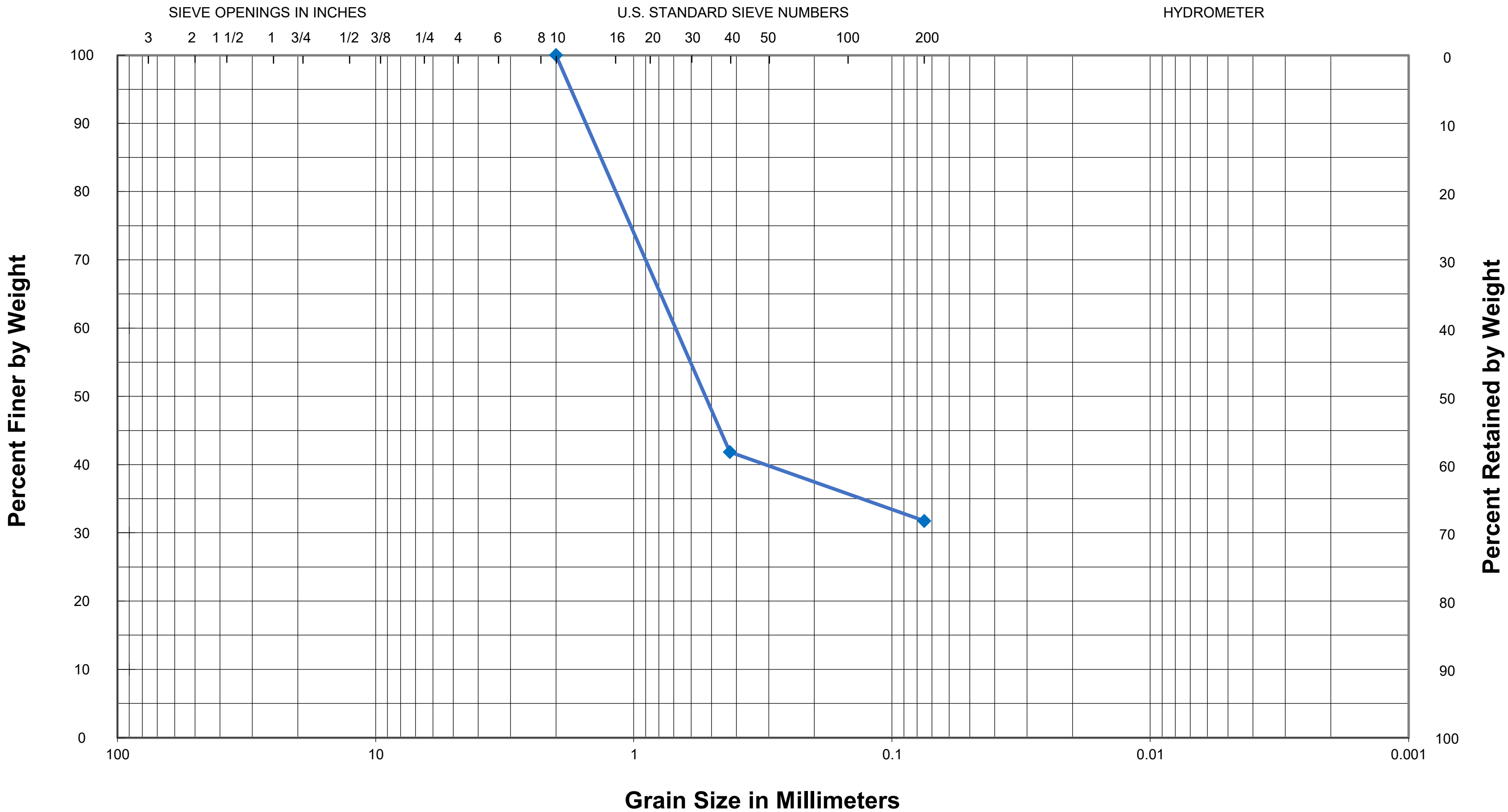
Sample: Boring FB-26, 0-4.5
Description: Tan and brown sandy fine to coarse GRAVEL

USCS Classification = GW
AASHTO Classification = A-1-a

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



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<tr><td>COARSE</td><td>FINE</td><td>COARSE</td><td>MEDIUM</td><td>FINE</td></tr>
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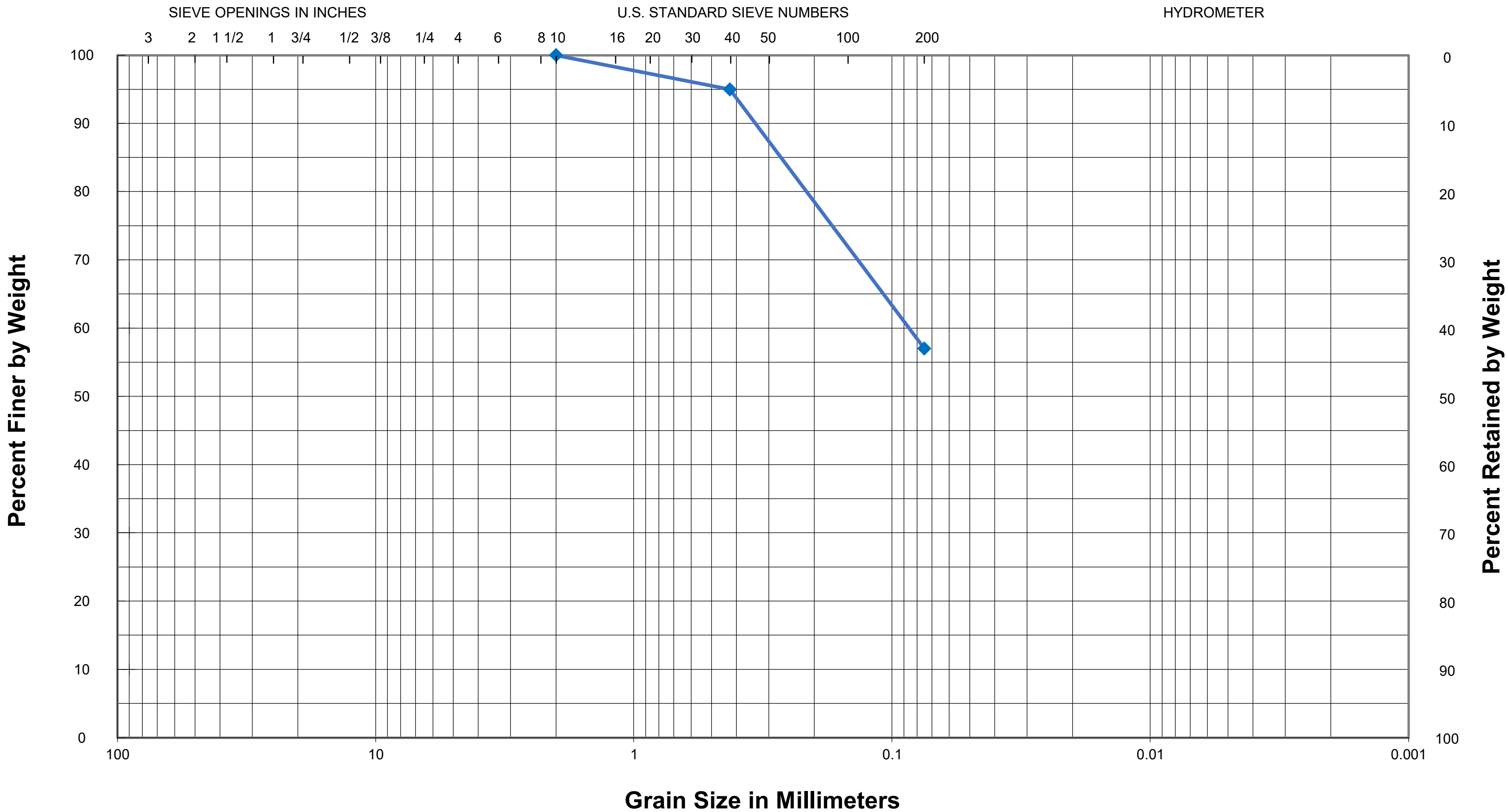
Sample: Boring FB-26, 4.5-5
Description: Dark gray SHALE

USCS Classification = SHALE
AASHTO Classification = SHALE

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

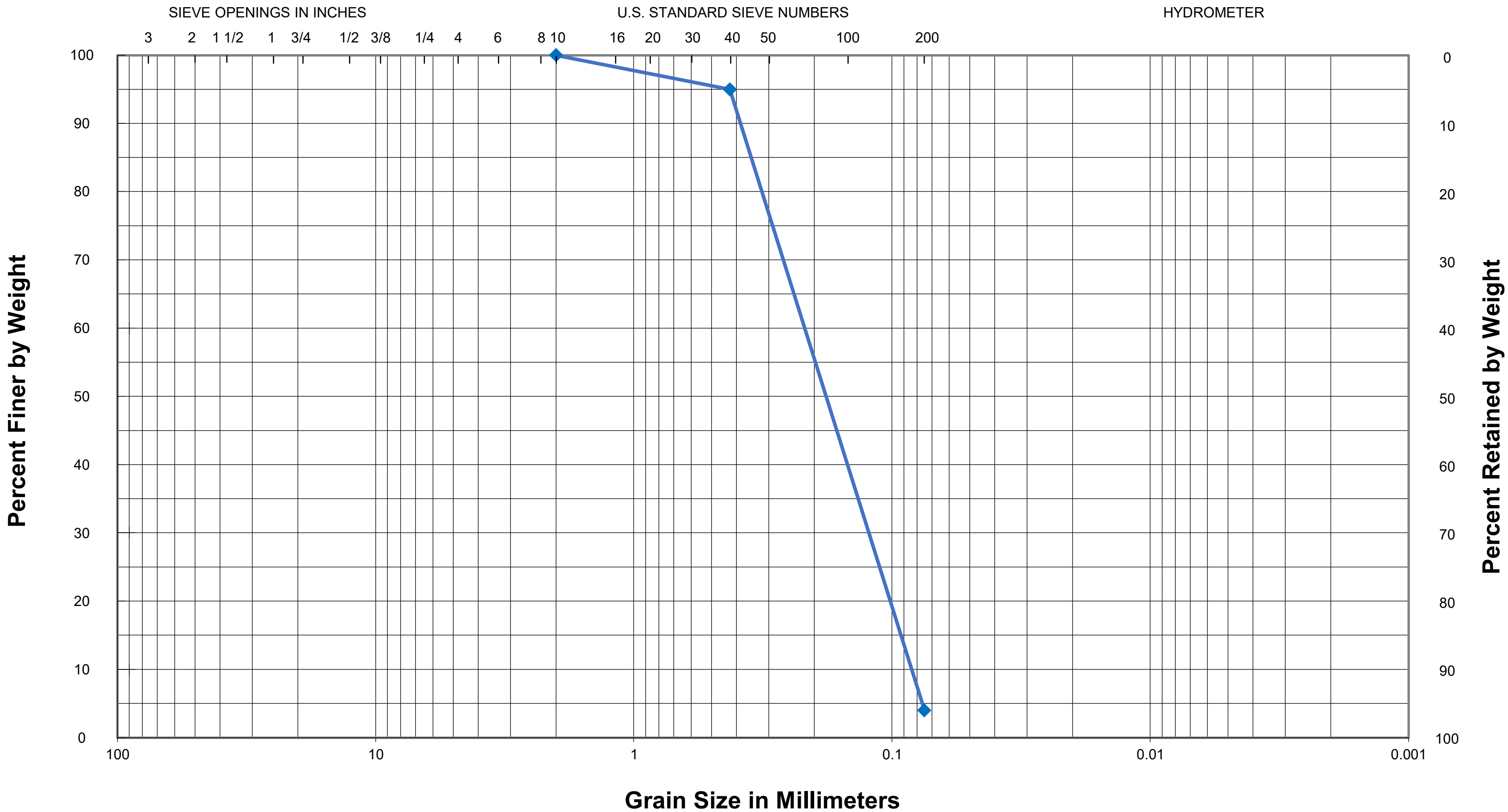
Sample: Boring FB-28, 0.5-1.5
Description: Tan and brown fine to medium sandy SILT

USCS Classification = ML
AASHTO Classification = A-4

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

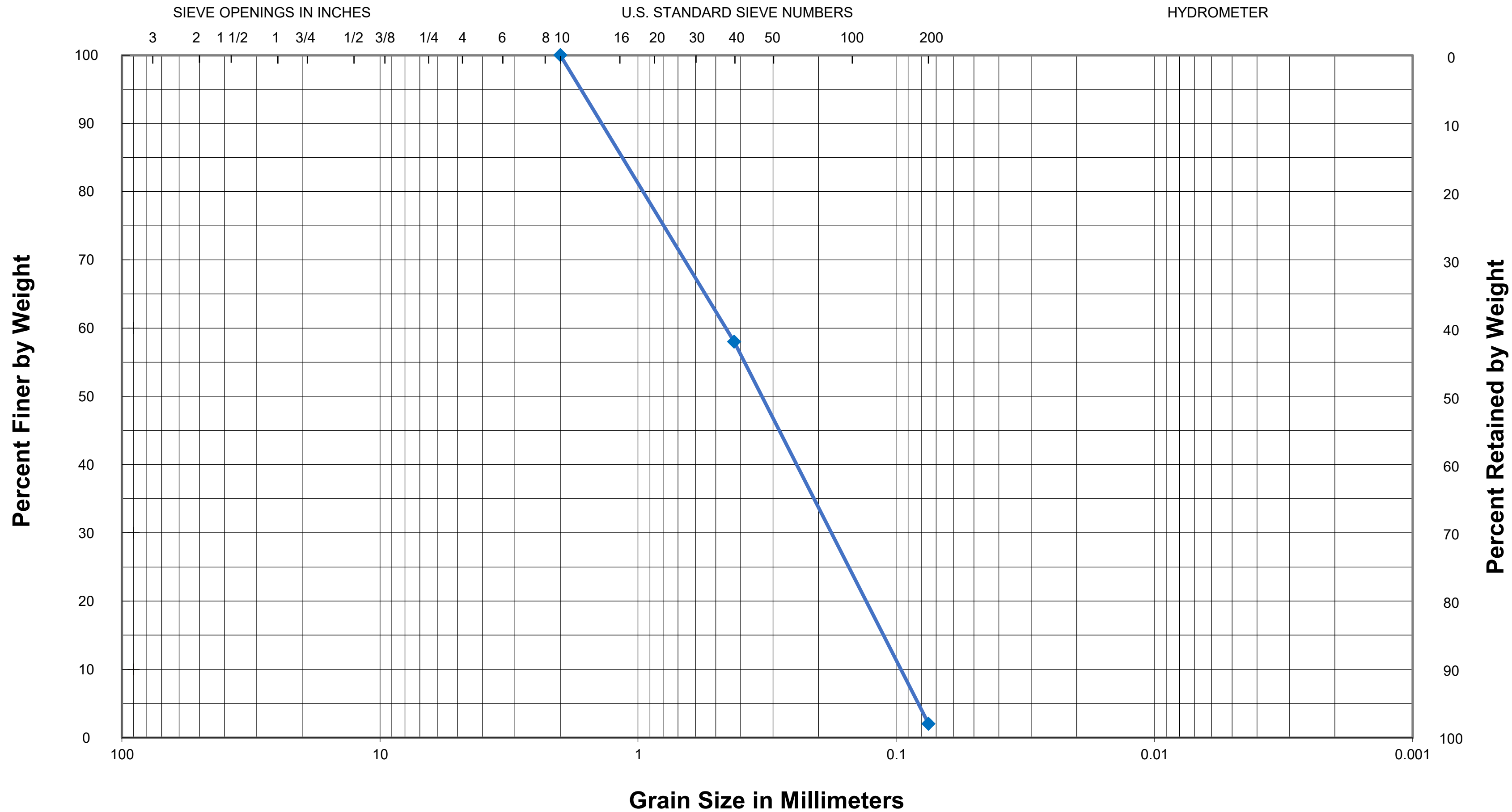
Sample: Boring FB-30, 4.5-5.5
Description: Reddish tan fine to medium SAND with trace silt

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

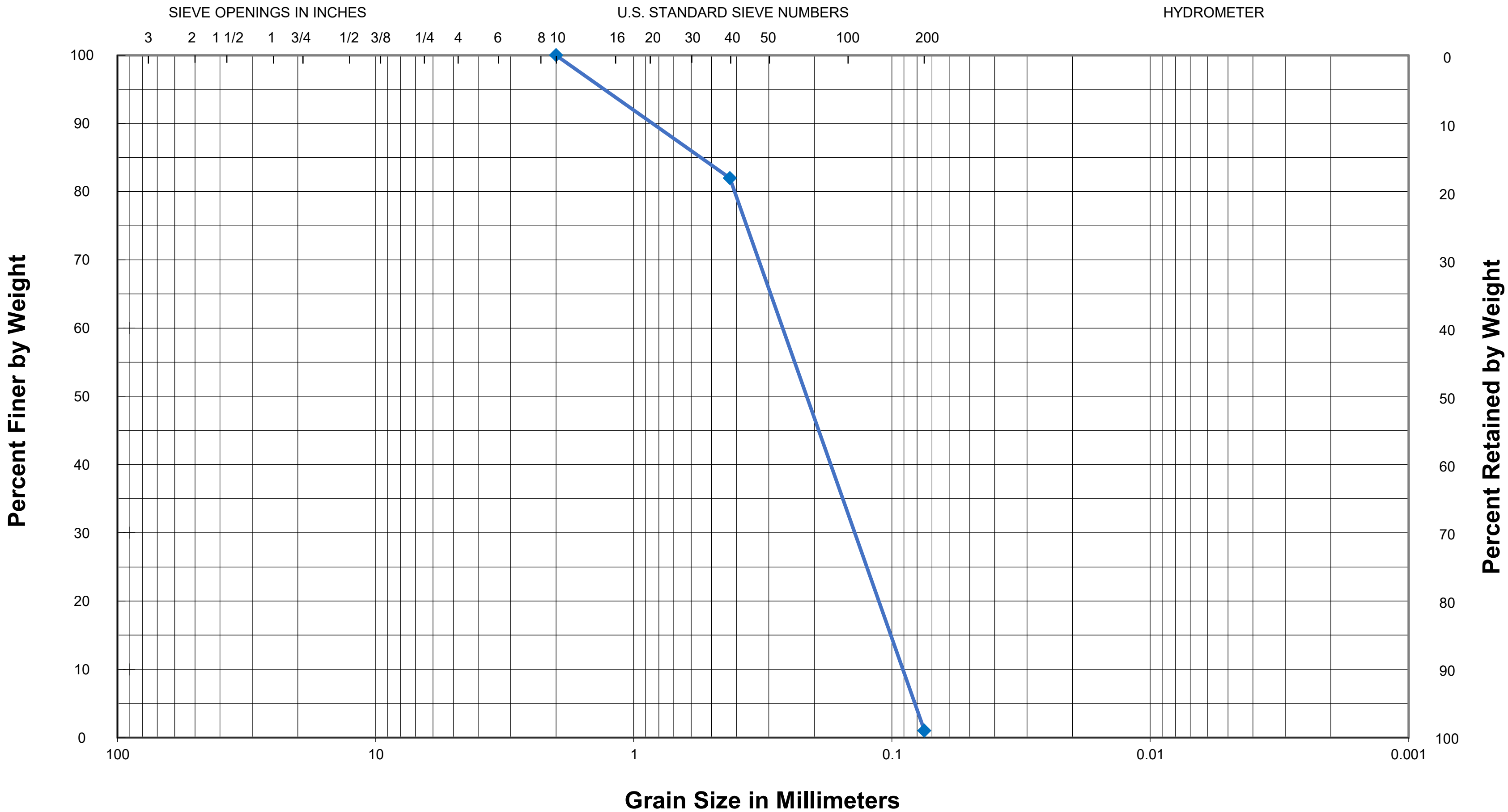
Sample: Boring FB-31, 4.5-5.5
Description: Reddish tan fine to medium SAND

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

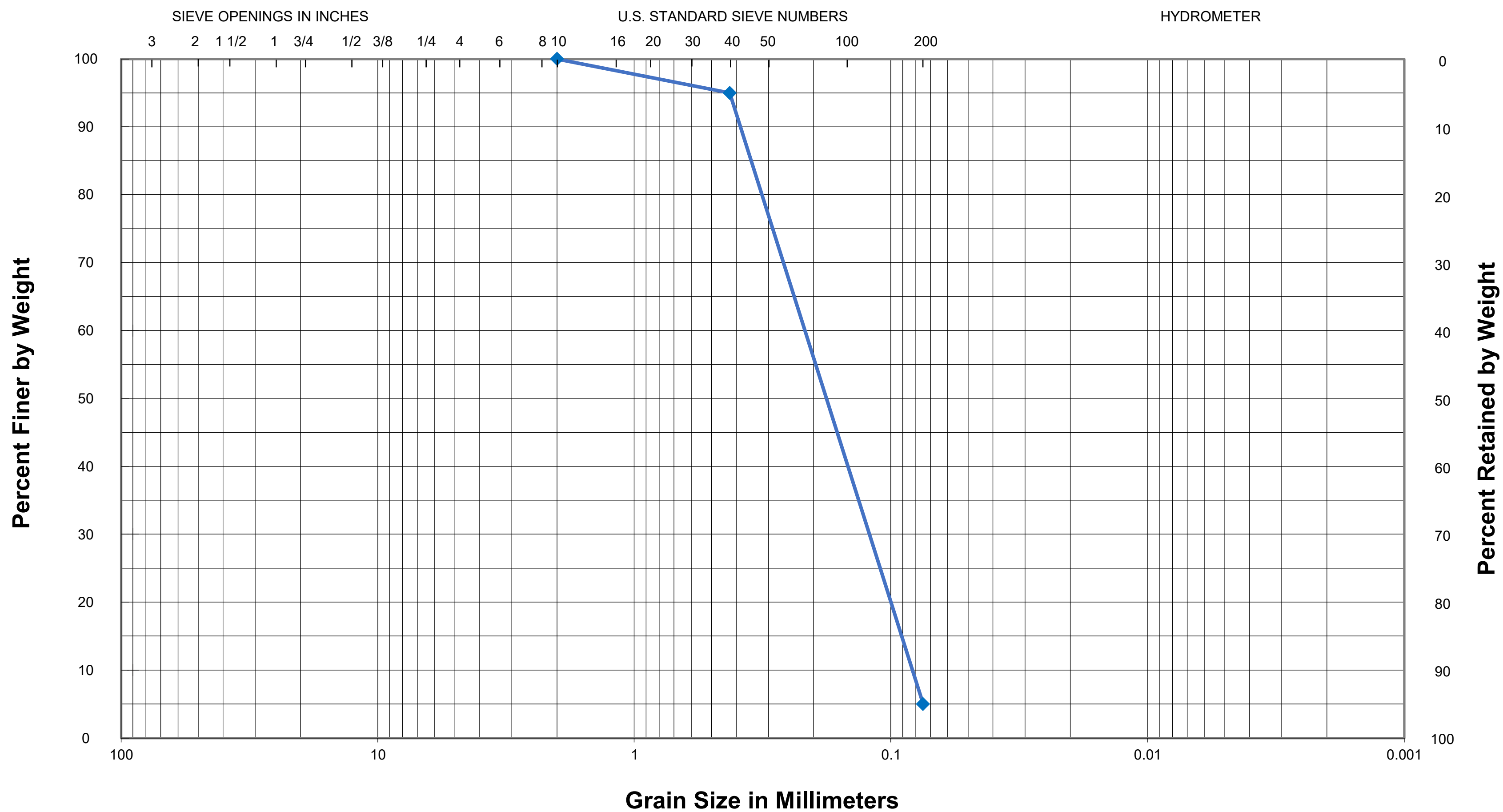
Sample: Boring FB-34, 2.5-3.5
Description: Brown fine to medium SAND

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

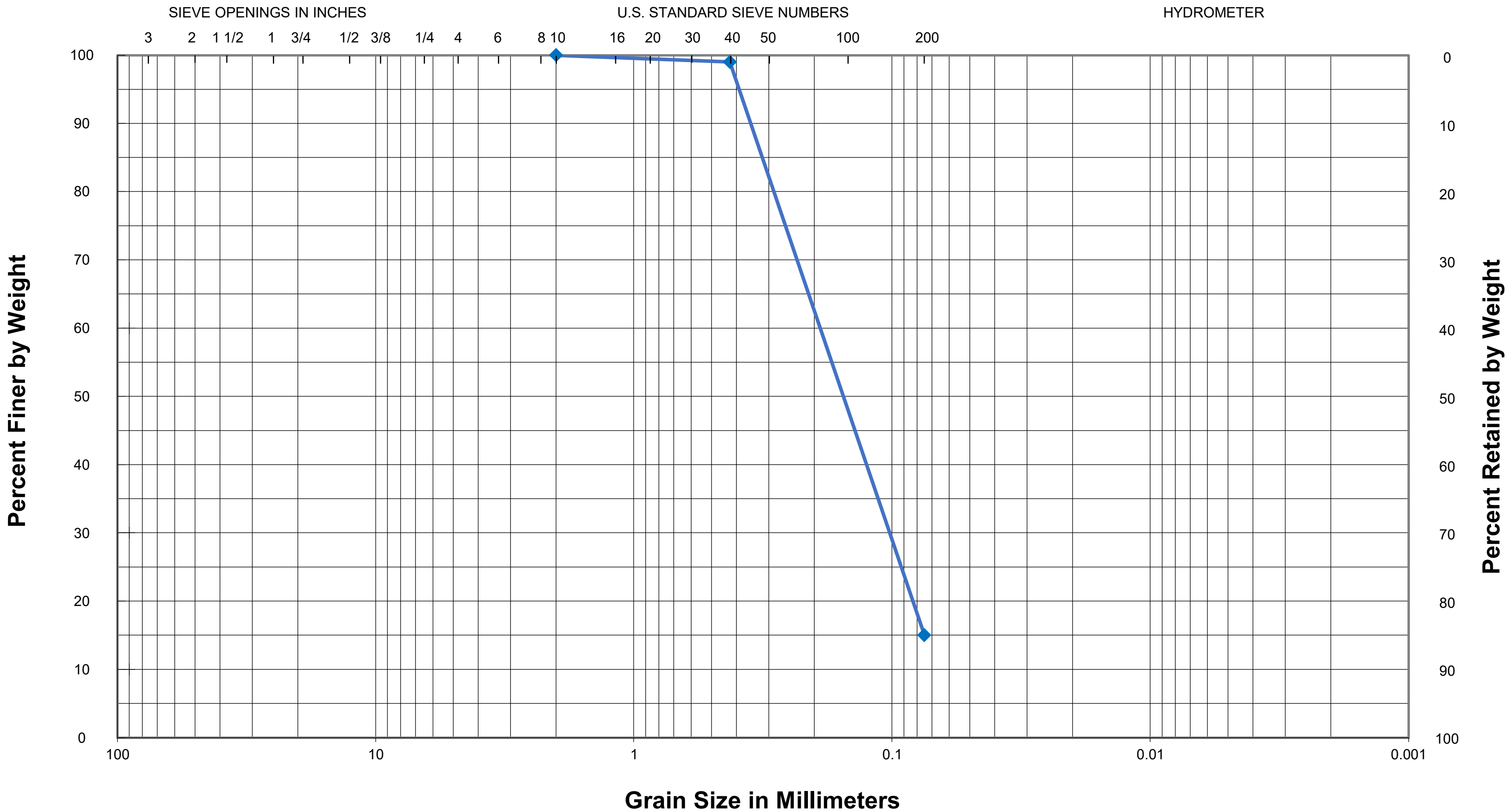
Sample: Boring FB-34, 9-10
Description: Tan fine SAND, slightly silty

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

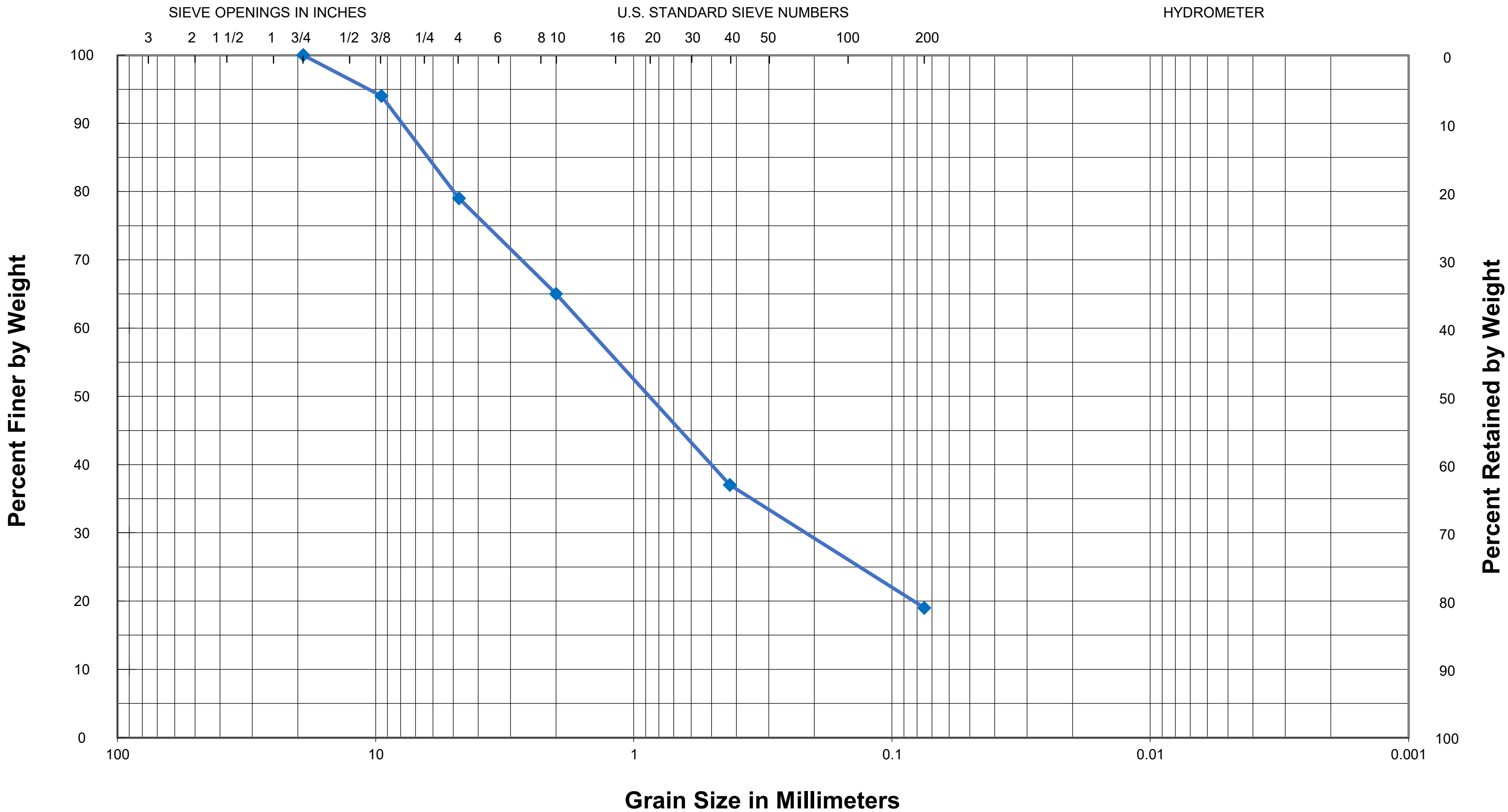
Sample: Boring FB-34, 19-20
Description: Tan silty fine SAND

USCS Classification = SM
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

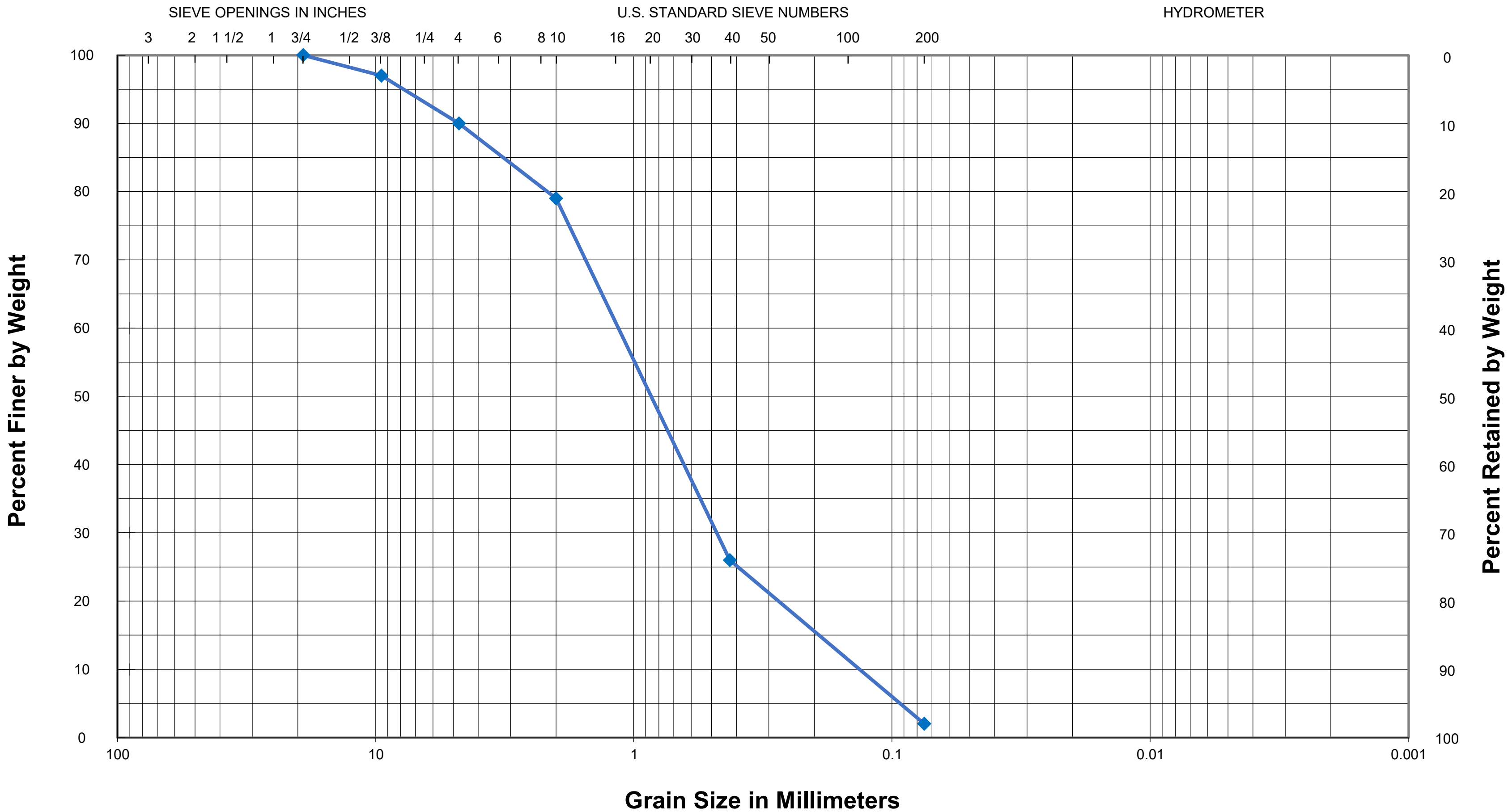
Sample: Boring FB-35, 2.5-3.5
Description: Reddish tan silty fine to medium SAND w/ a little fine gravel

USCS Classification = SM
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

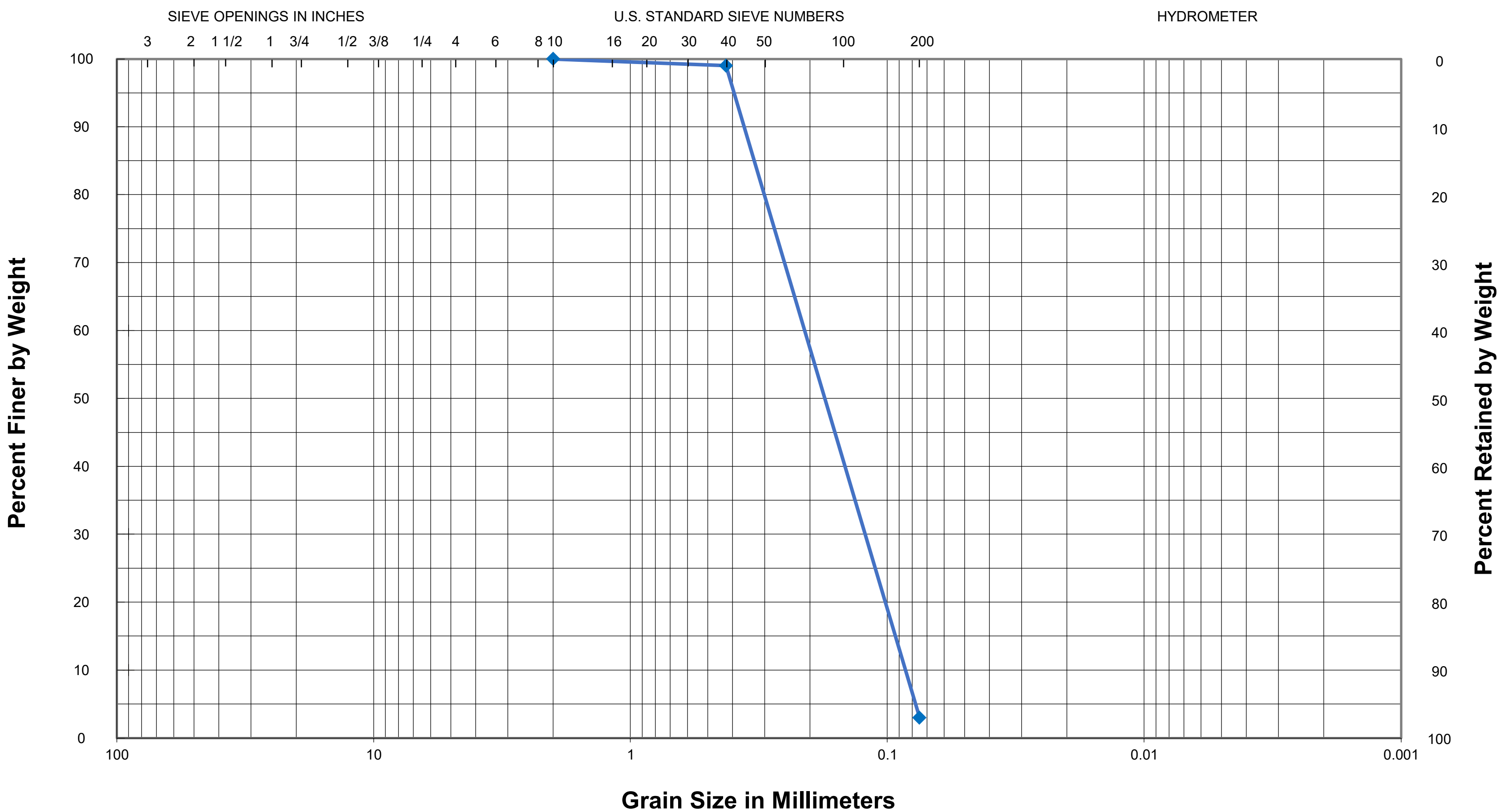
Sample: Boring FB-36, 2.5-3.5
Description: Tan fine to coarse SAND w/ a little fine to coarse gravel

USCS Classification = SW
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

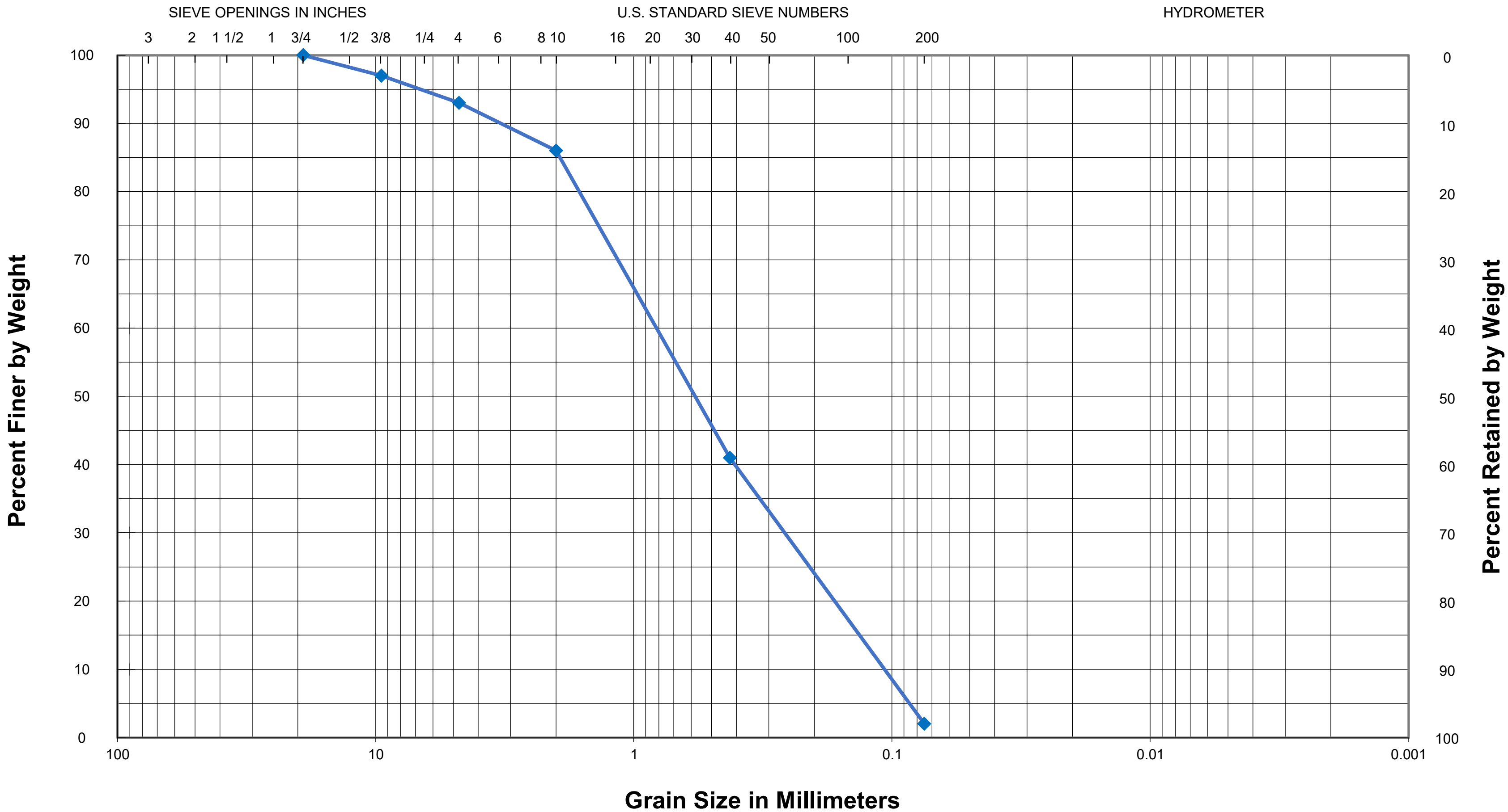
Sample: Boring FB-36, 14-15
Description: Tan fine SAND

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

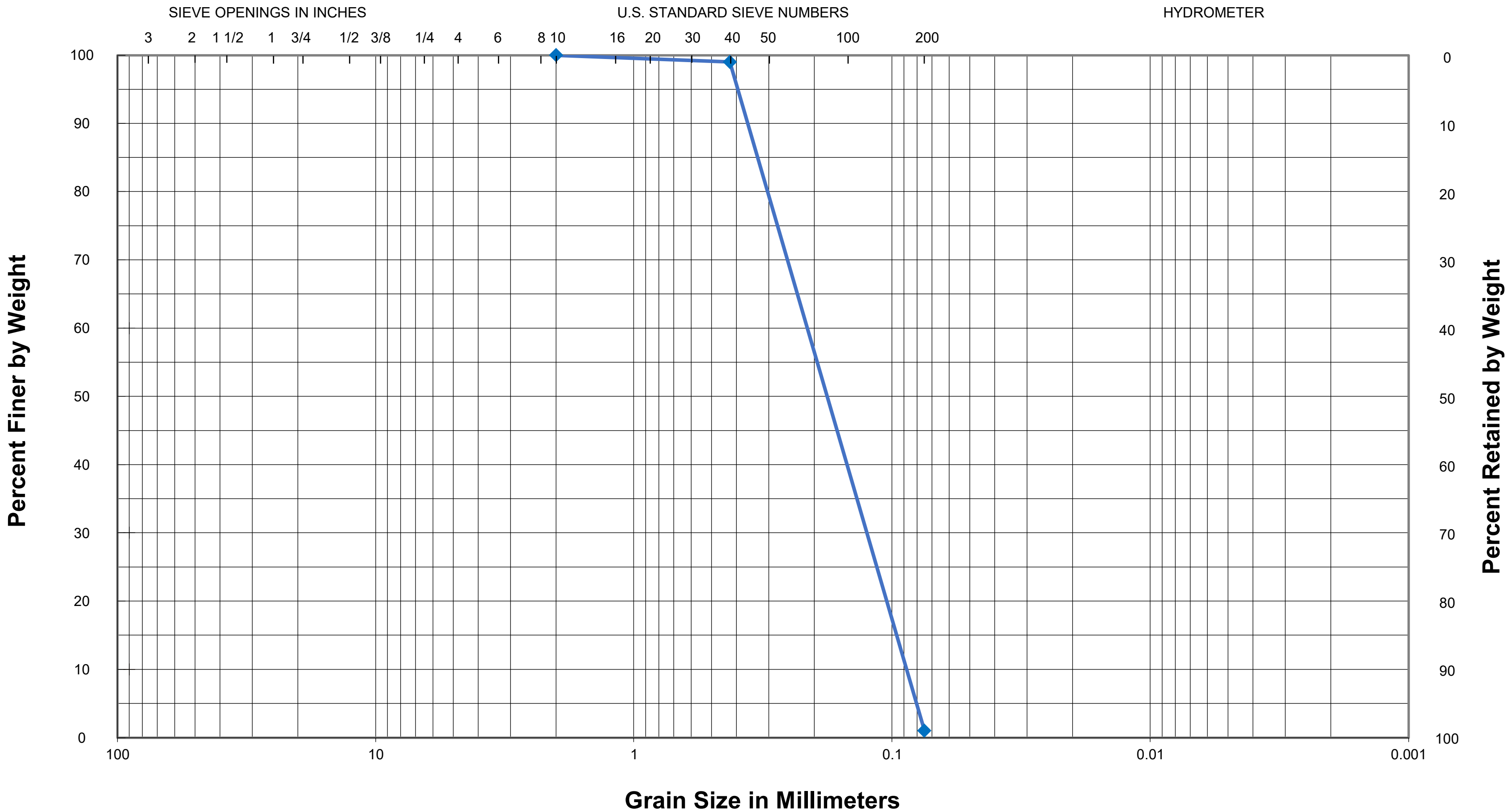
Sample: Boring FB-37, 2.5-3.5
Description: Tan fine to coarse SAND w/a little fine gravel

USCS Classification = SP
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

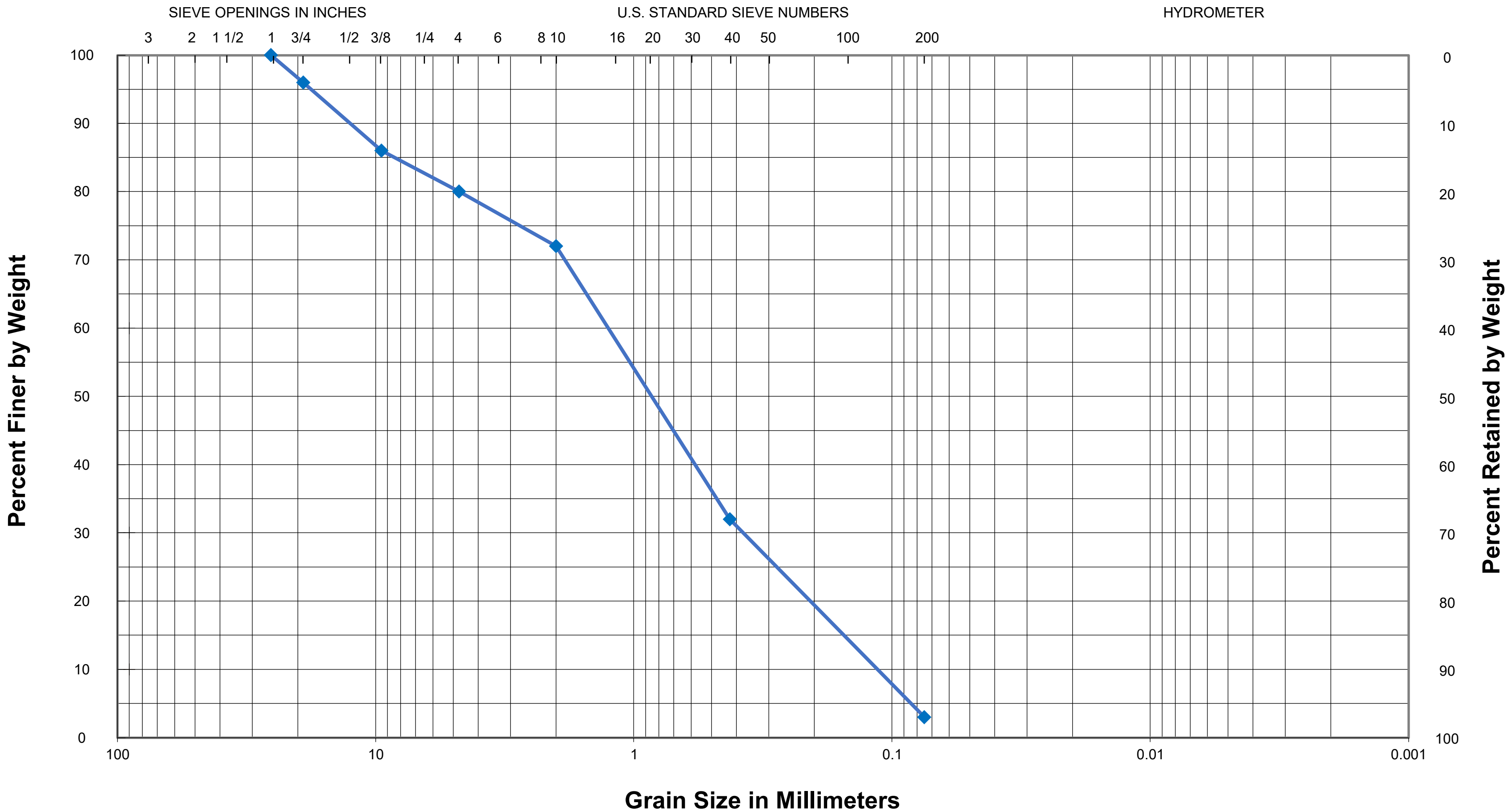
Sample: Boring FB-37, 14-15
Description: Tan fine SAND

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

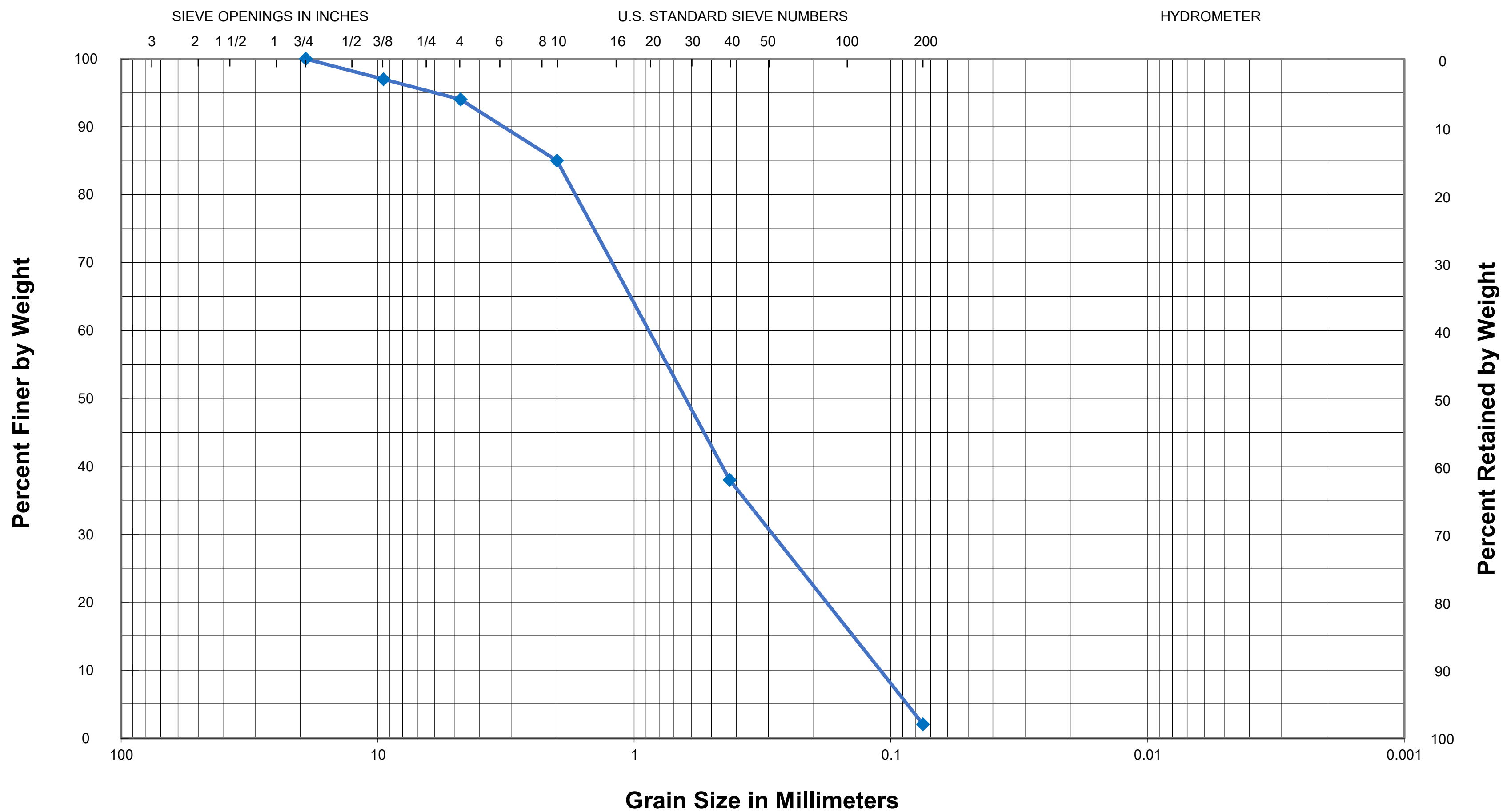
Sample: Boring FB-37, 39-40
Description: Tan fine to coarse SAND w/fine to coarse gravel

USCS Classification = SP
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

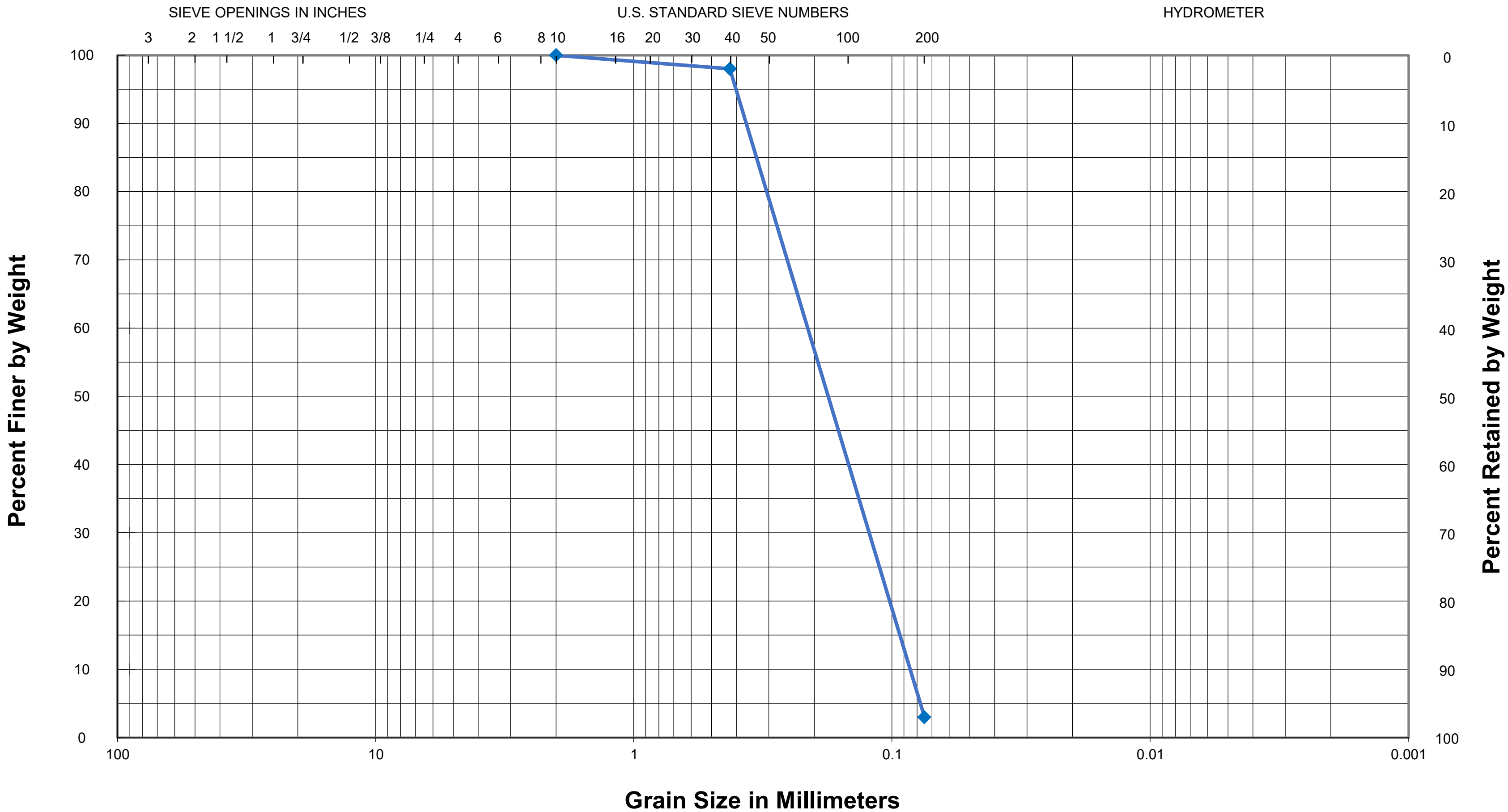
Sample: Boring FB-38, 2.5-3.5
Description: Tan fine to coarse SAND w/ some fine gravel

USCS Classification = SP
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

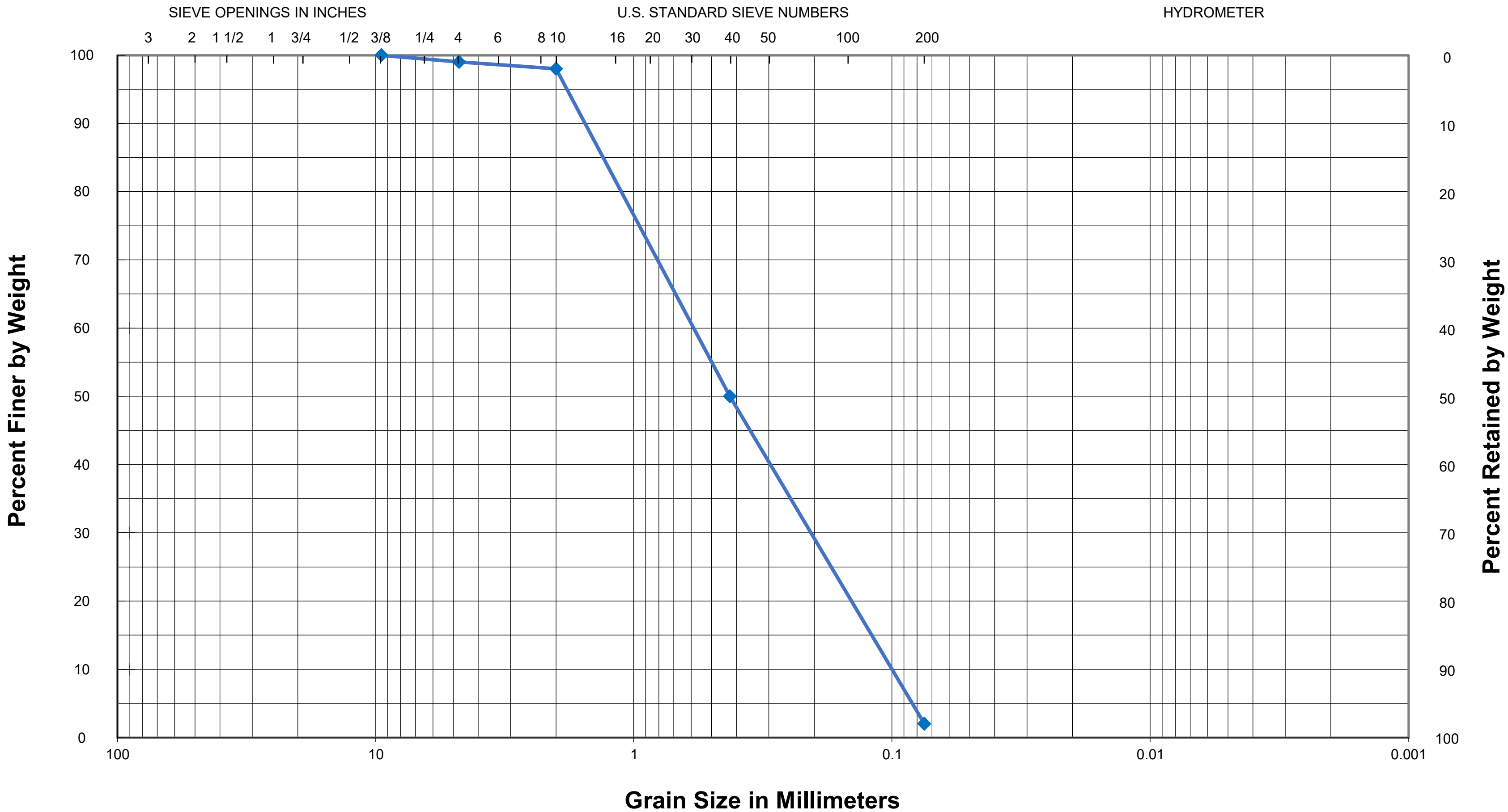
Sample: Boring FB-38, 19-20
Description: Tan fine SAND

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

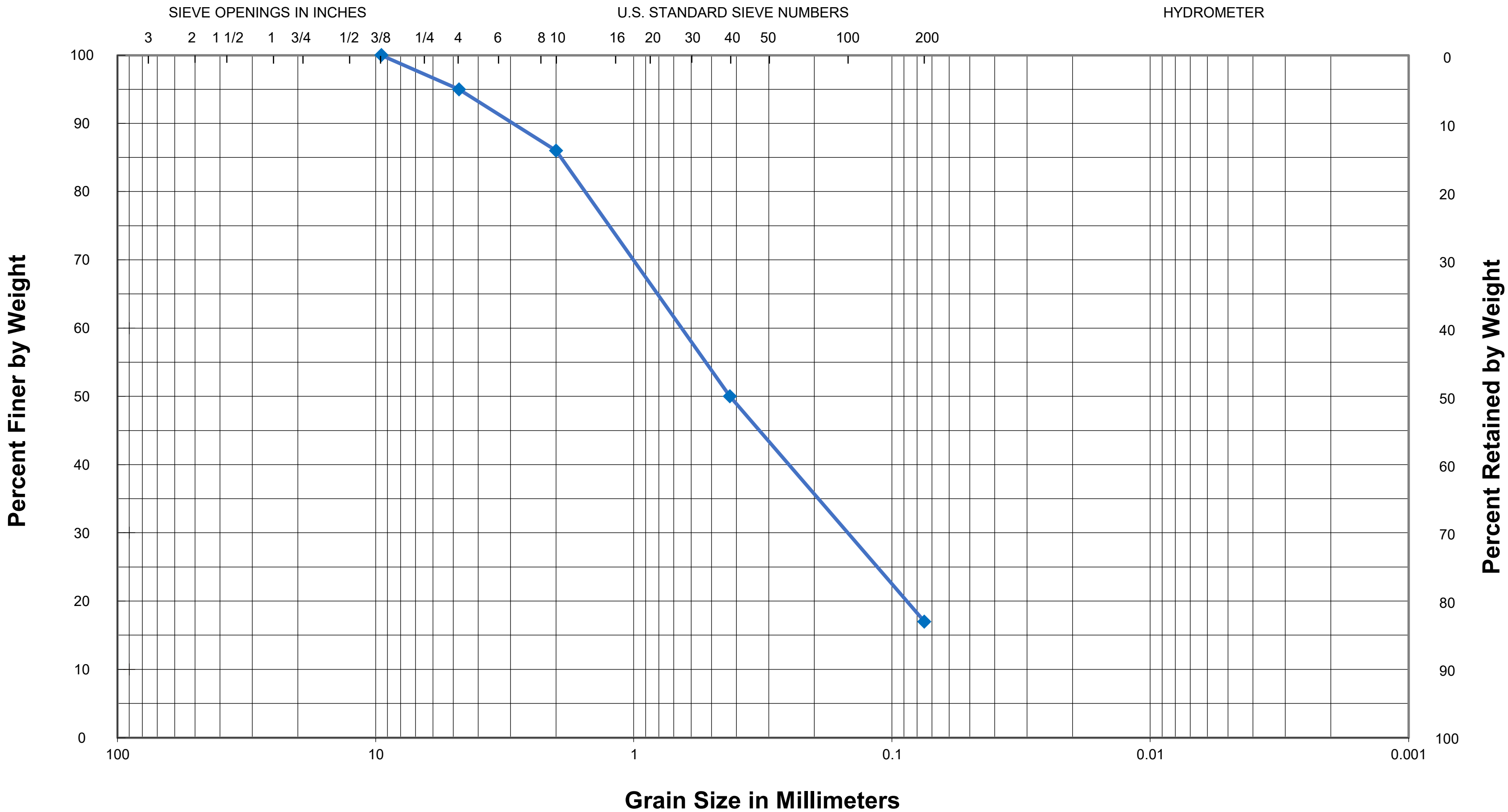
Sample: Boring FB-38, 29-30
Description: Tan fine to coarse SAND

USCS Classification = SP
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

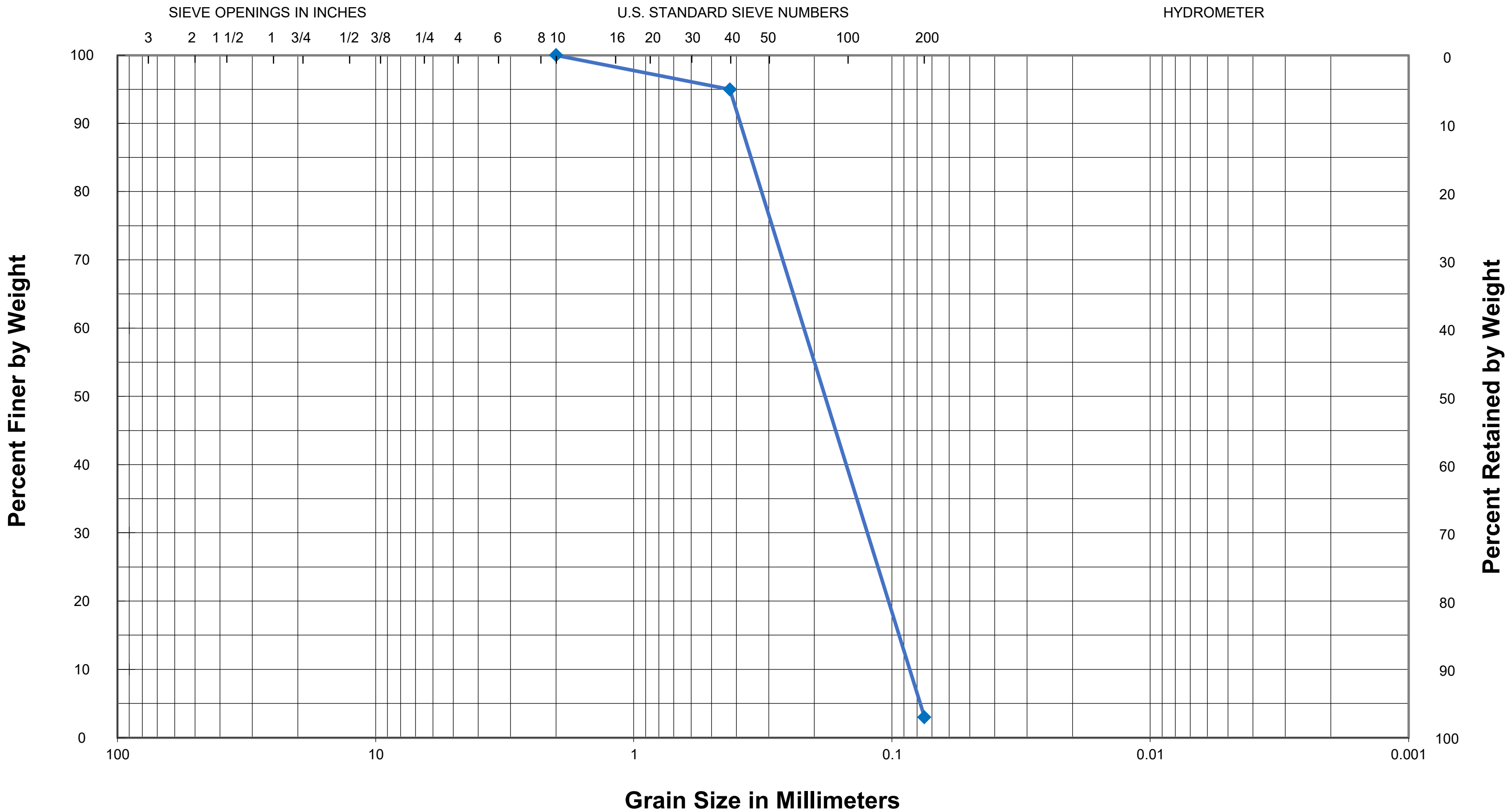
Sample: Boring FB-39, 6.5-7.5
Description: Tan silty fine to coarse SAND

USCS Classification = SM
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

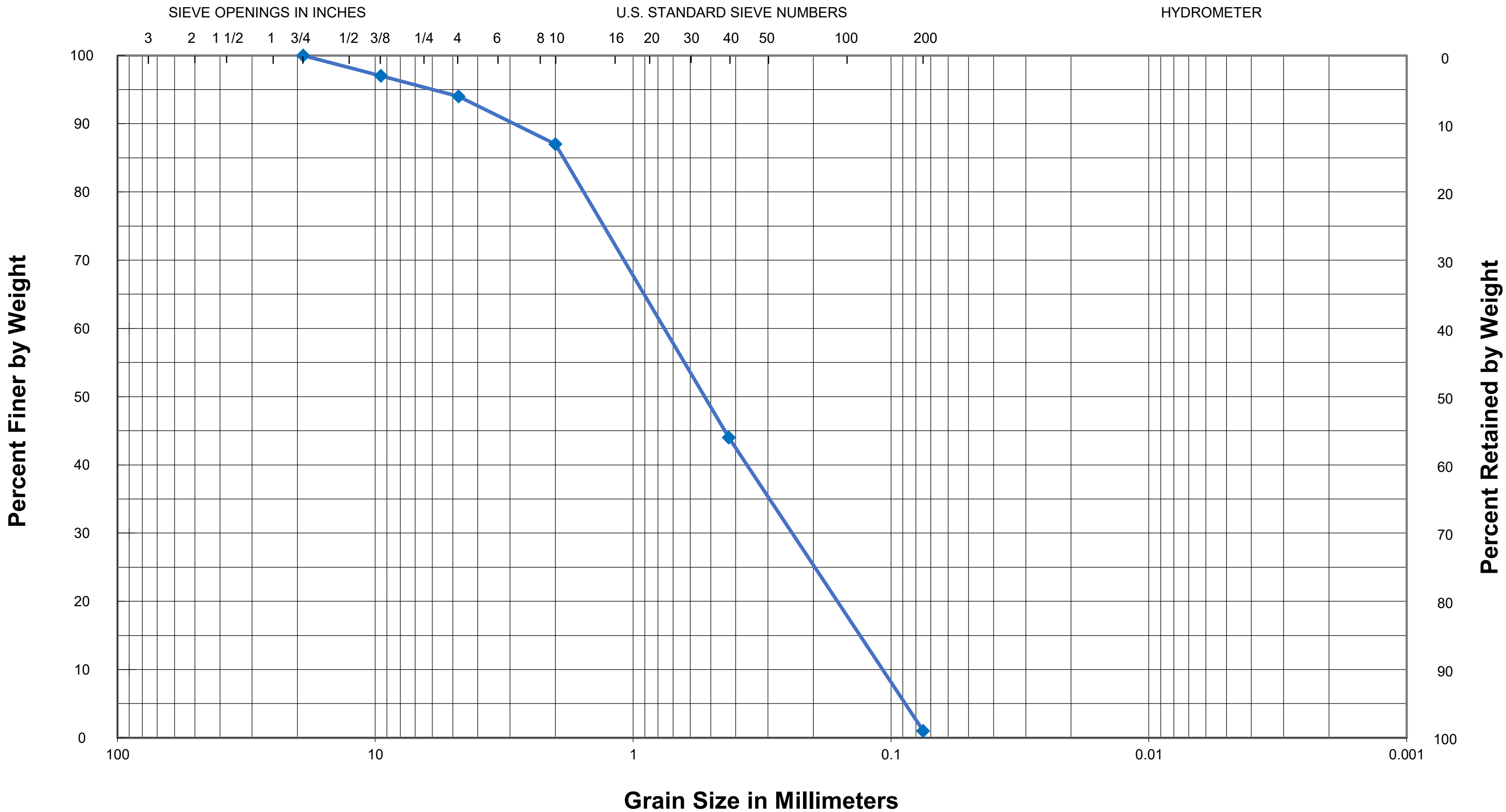
Sample: Boring FB-39, 14-15
Description: Tan fine SAND

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

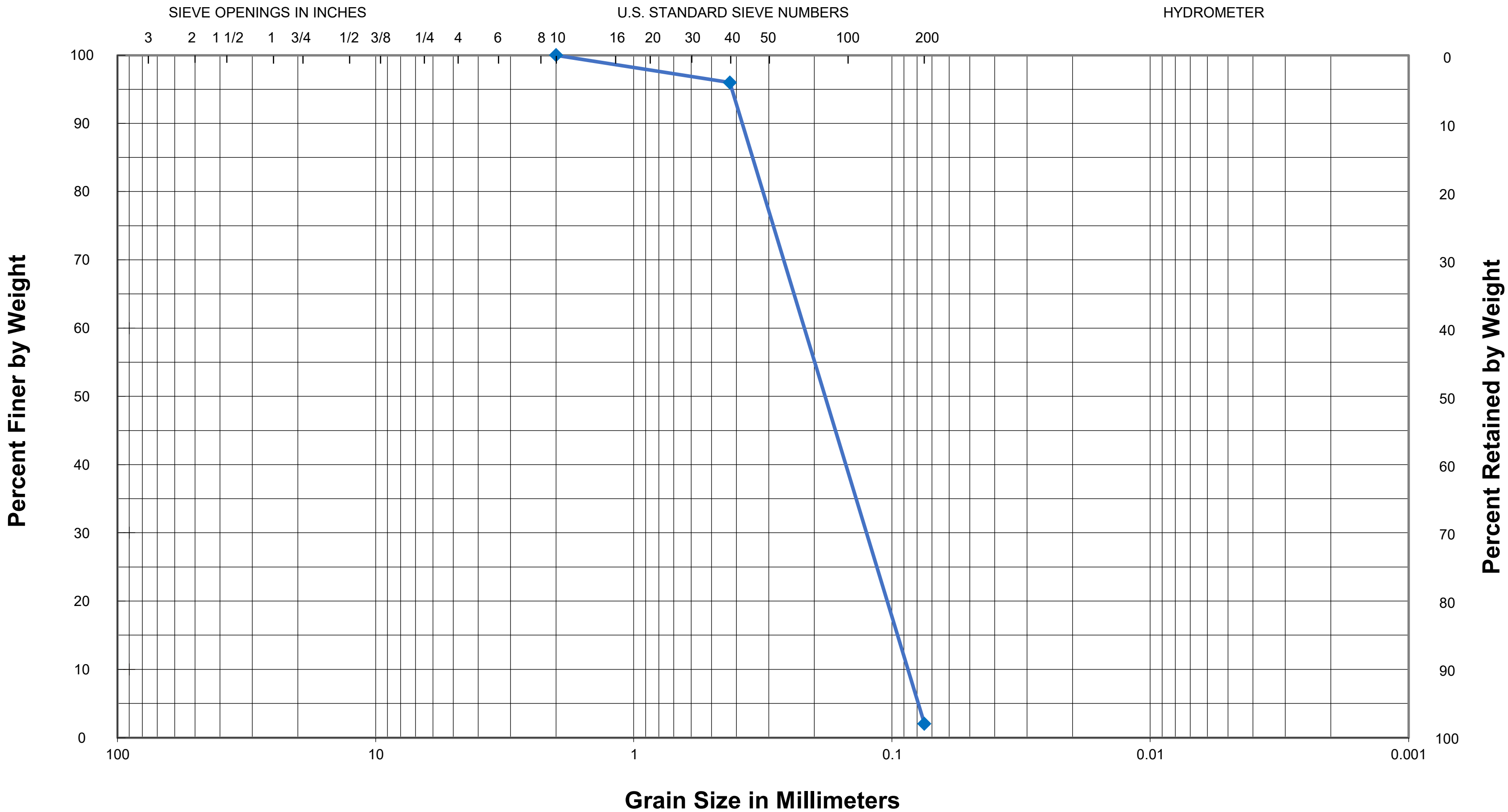
Sample: Boring FB-40, 0.5-1.5
Description: Tan fine to coarse SAND

USCS Classification = SP
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



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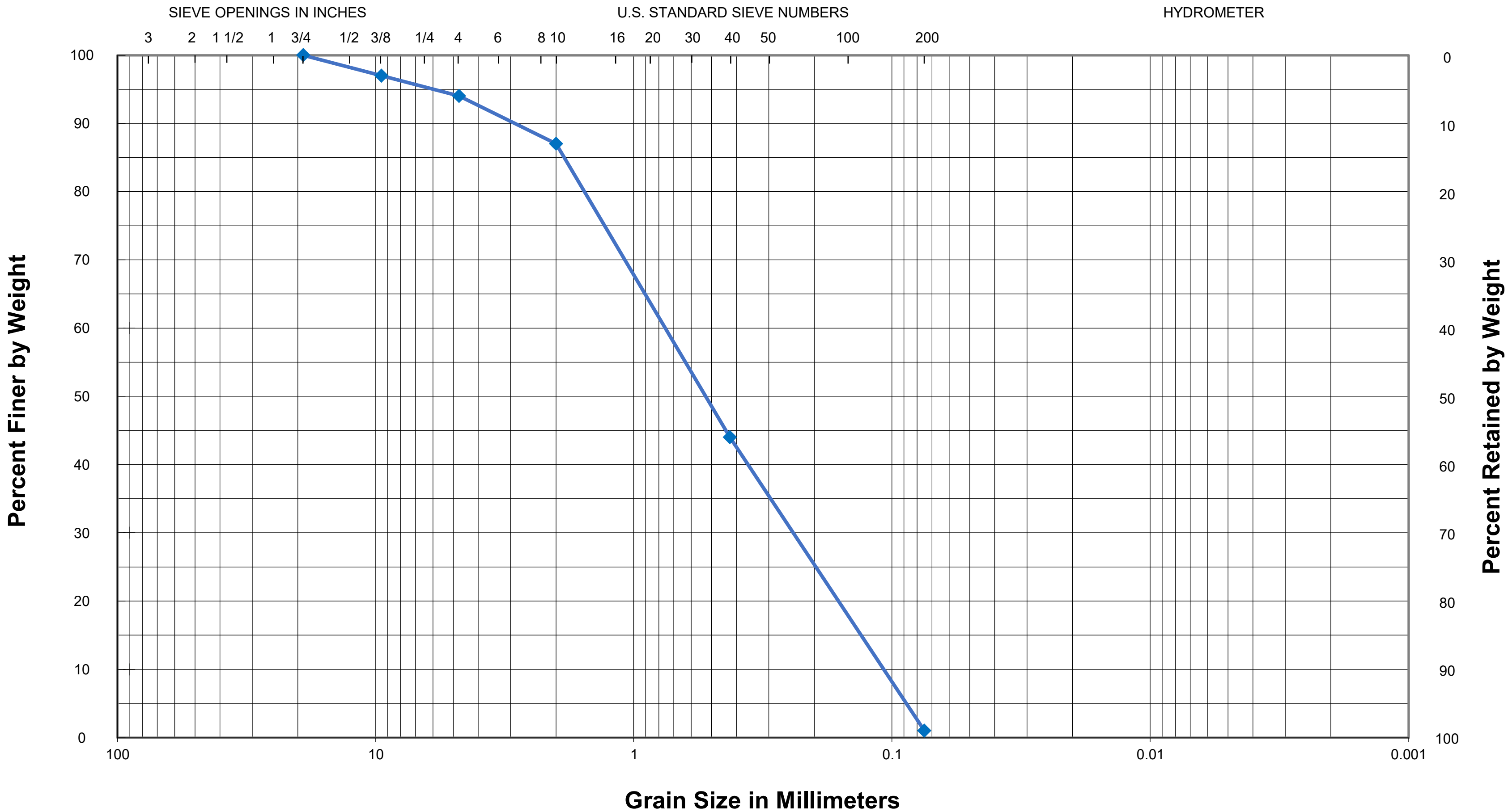
Sample: Boring FB-40, 9-10
Description: Tan fine SAND

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

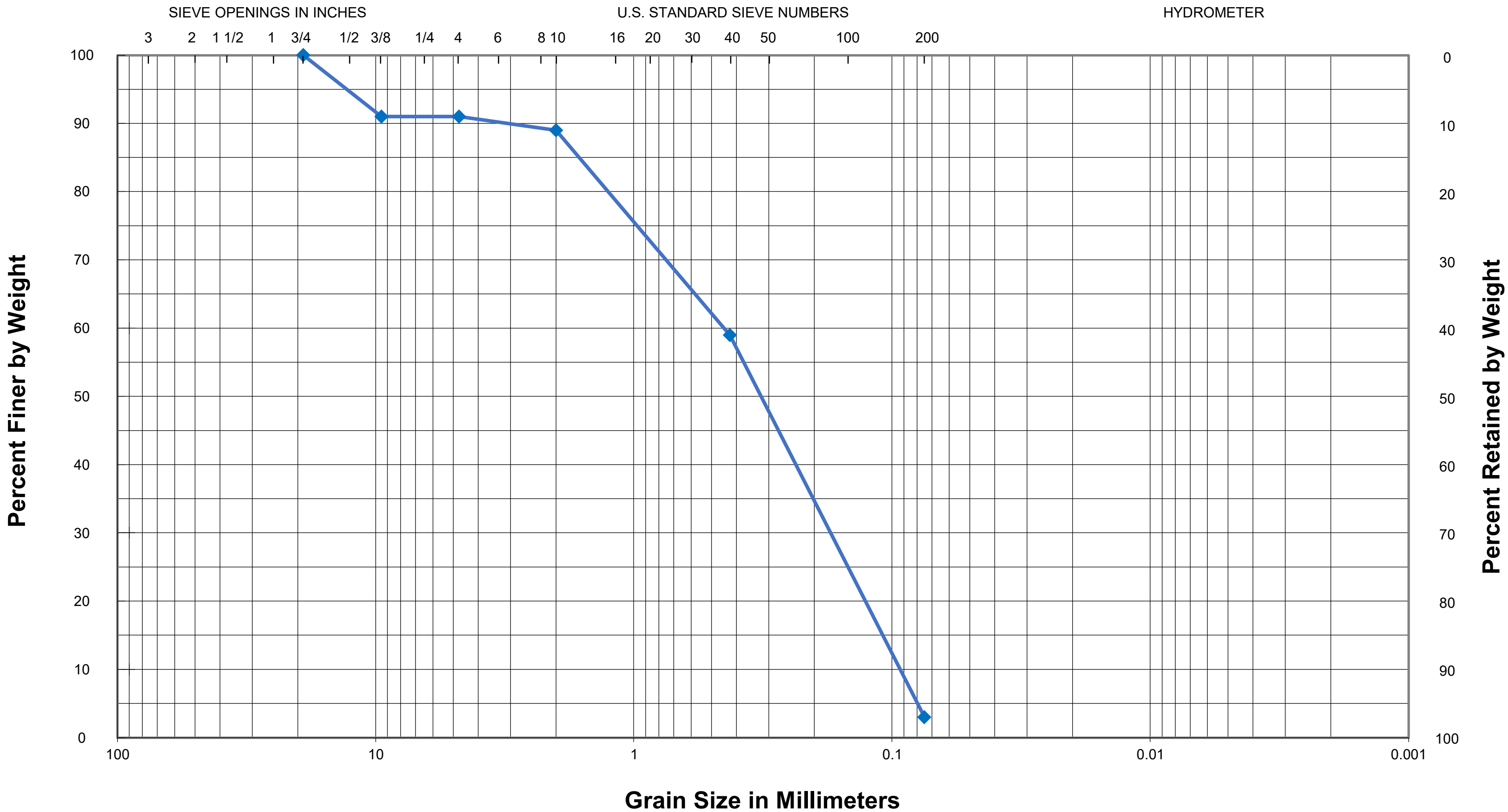
Sample: Boring FB-40, 0.5-1.5
Description: Tan fine to coarse SAND

USCS Classification = SP
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

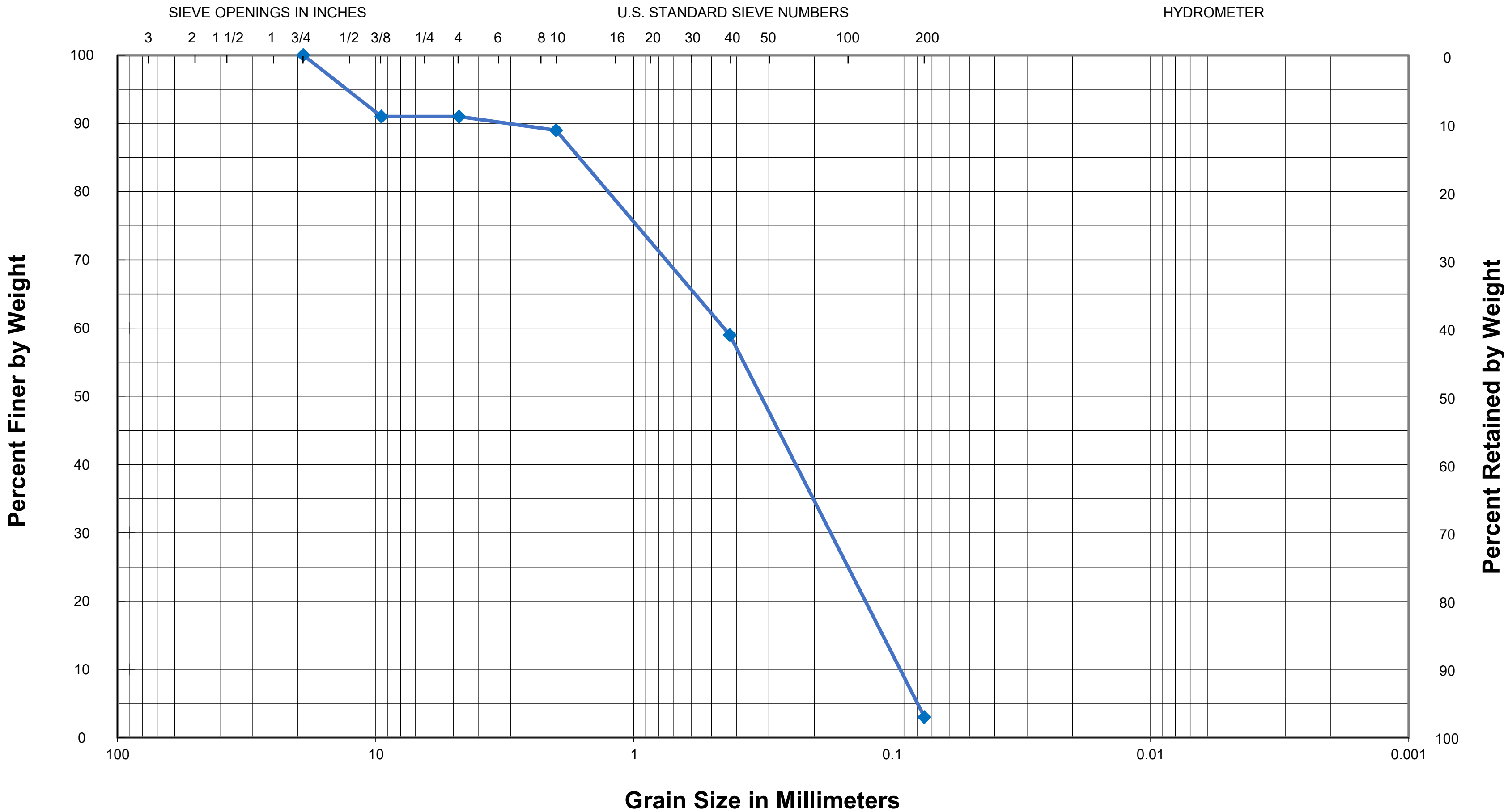
Sample: Boring FB-41, 2.5-3.5
Description: Tan fine to medium SAND w/some coarse sand and trace fine gravel

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

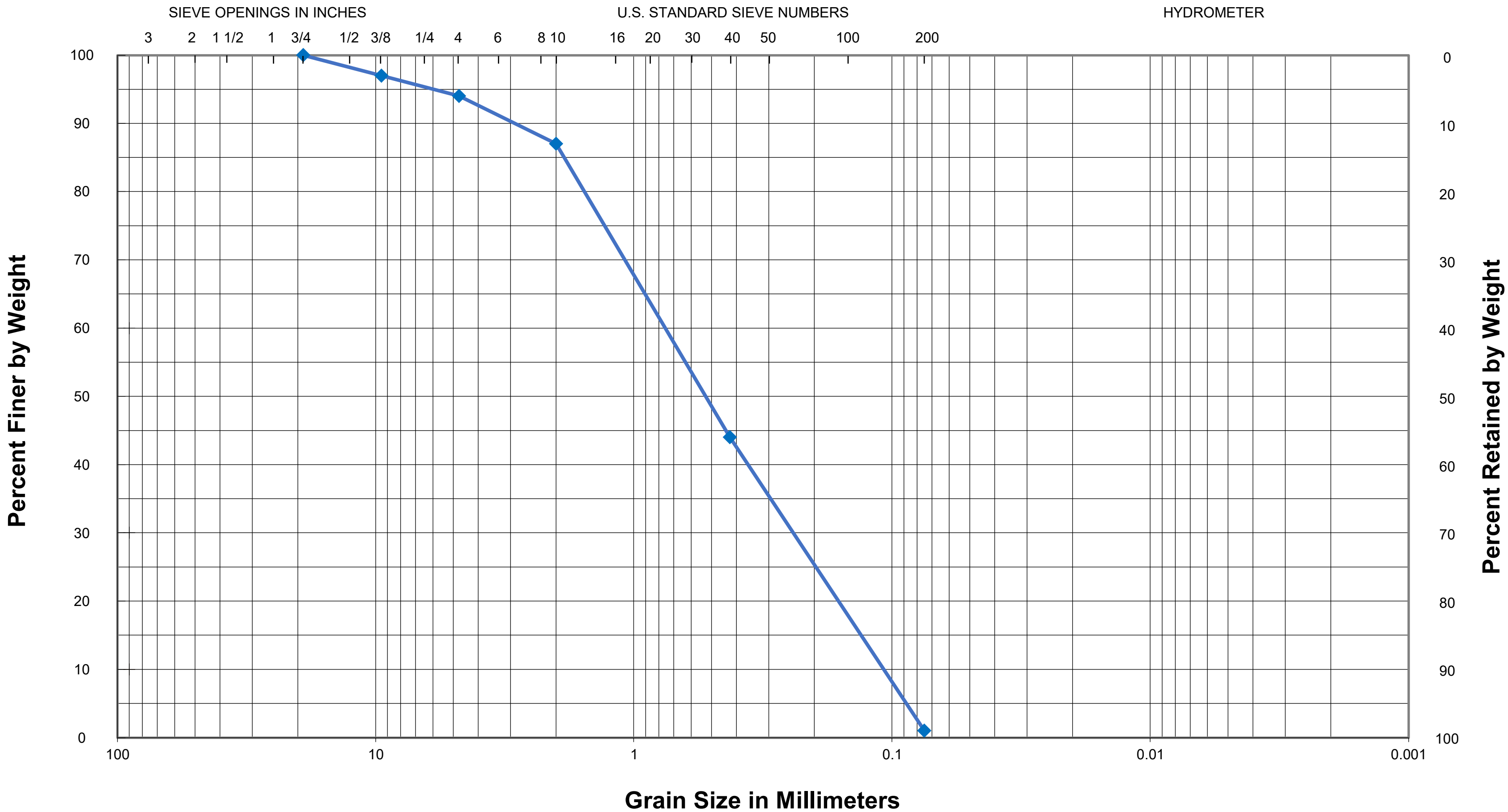
Sample: Boring FB-41, 14-15
Description: Tan fine to medium SAND w/some coarse sand and trace fine gravel

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

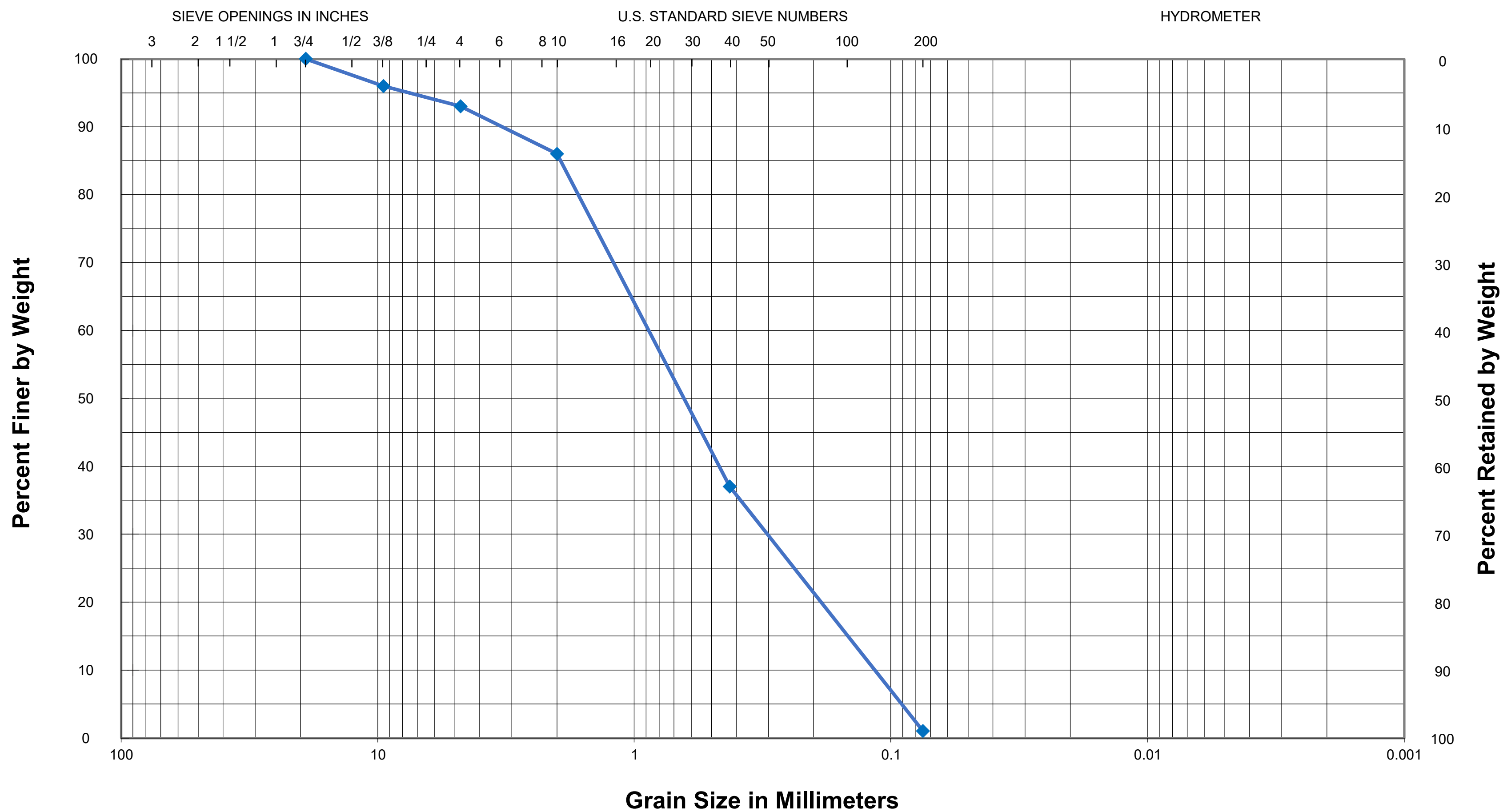
Sample: Boring FB-41, 24-25
Description: Tan fine to medium SAND

USCS Classification = SP
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

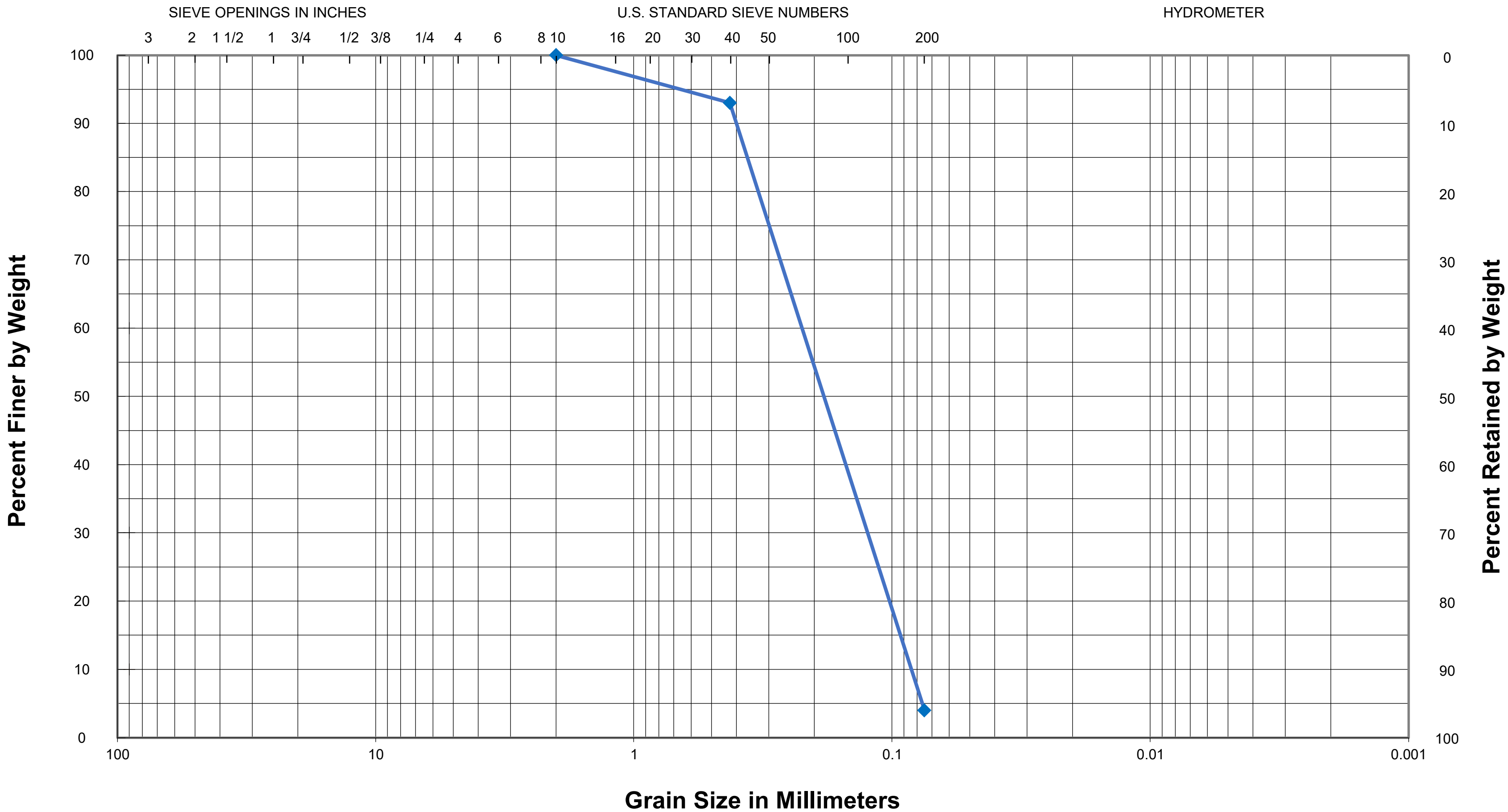
Sample: Boring FB-42, 2.5-3.5
Description: Tan fine to medium SAND w/some coarse sand and fine to coarse gravel

USCS Classification = SP
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

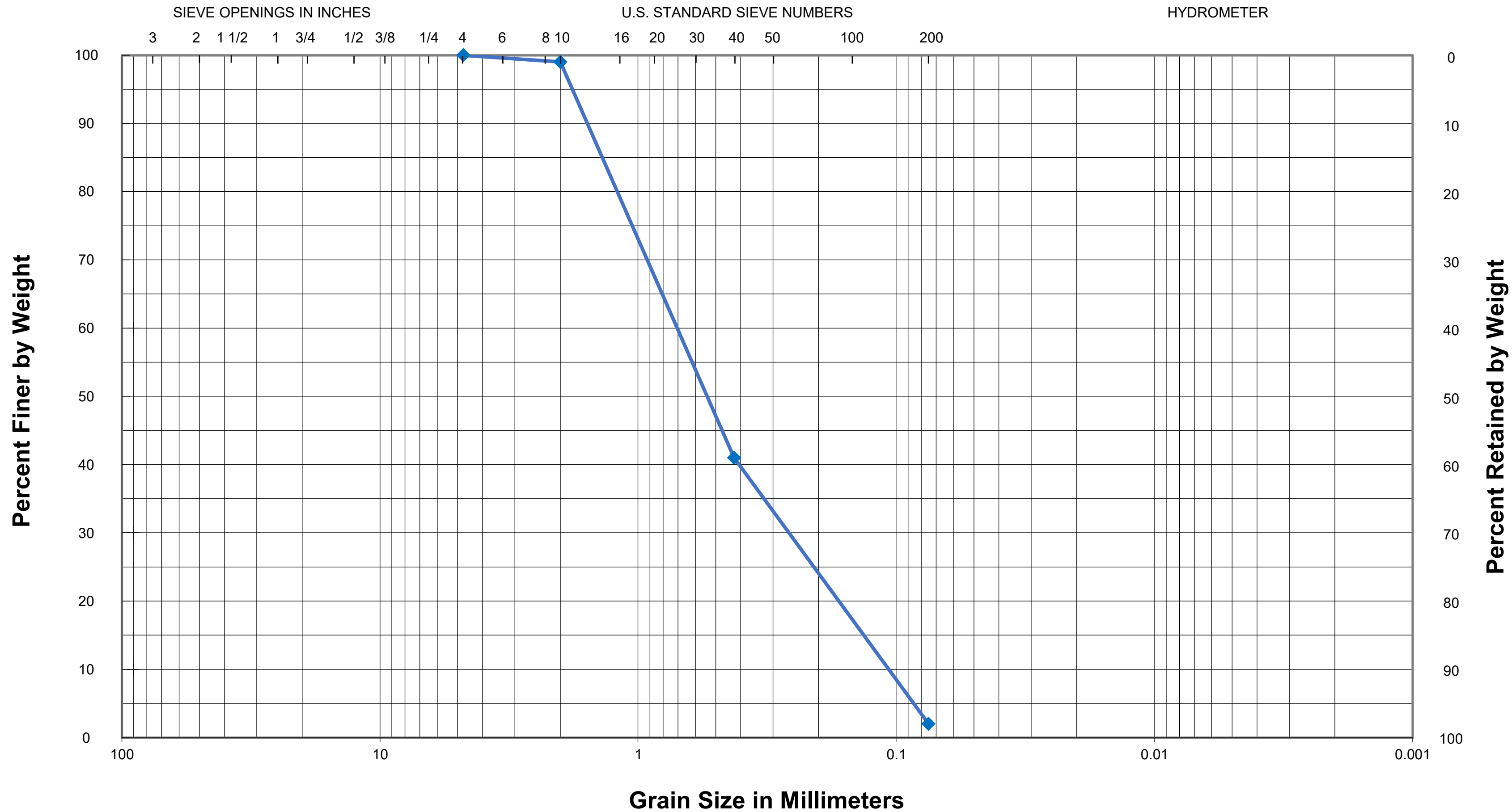
Sample: Boring FB-42, 9-10
Description: Tan fine SAND

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



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<tr><td>COARSE</td><td>FINE</td><td>COARSE</td><td>MEDIUM</td><td>FINE</td></tr>
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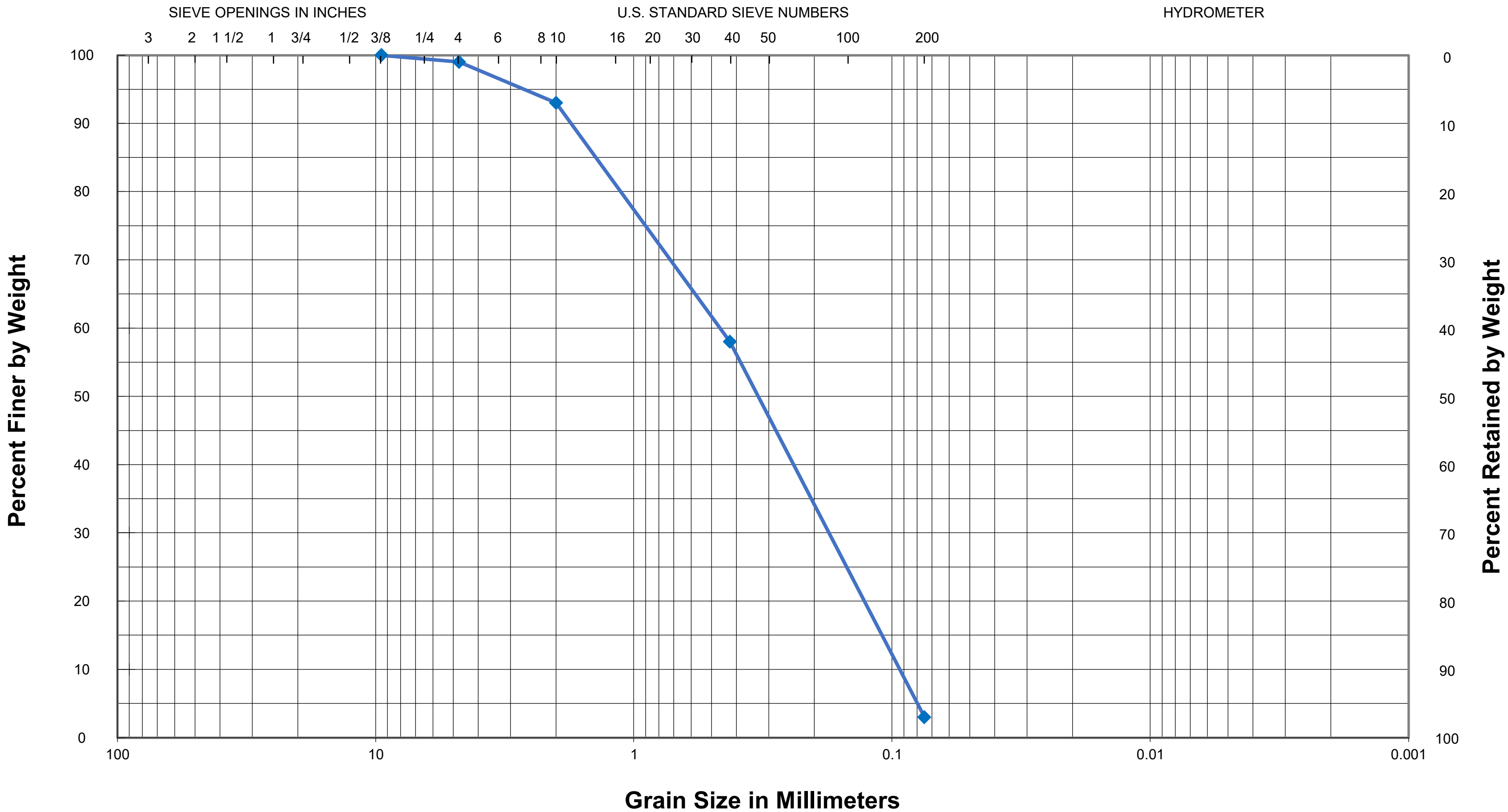
Sample: Boring FB-42, 29-30
Description: Tan fine SAND

USCS Classification = SP
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

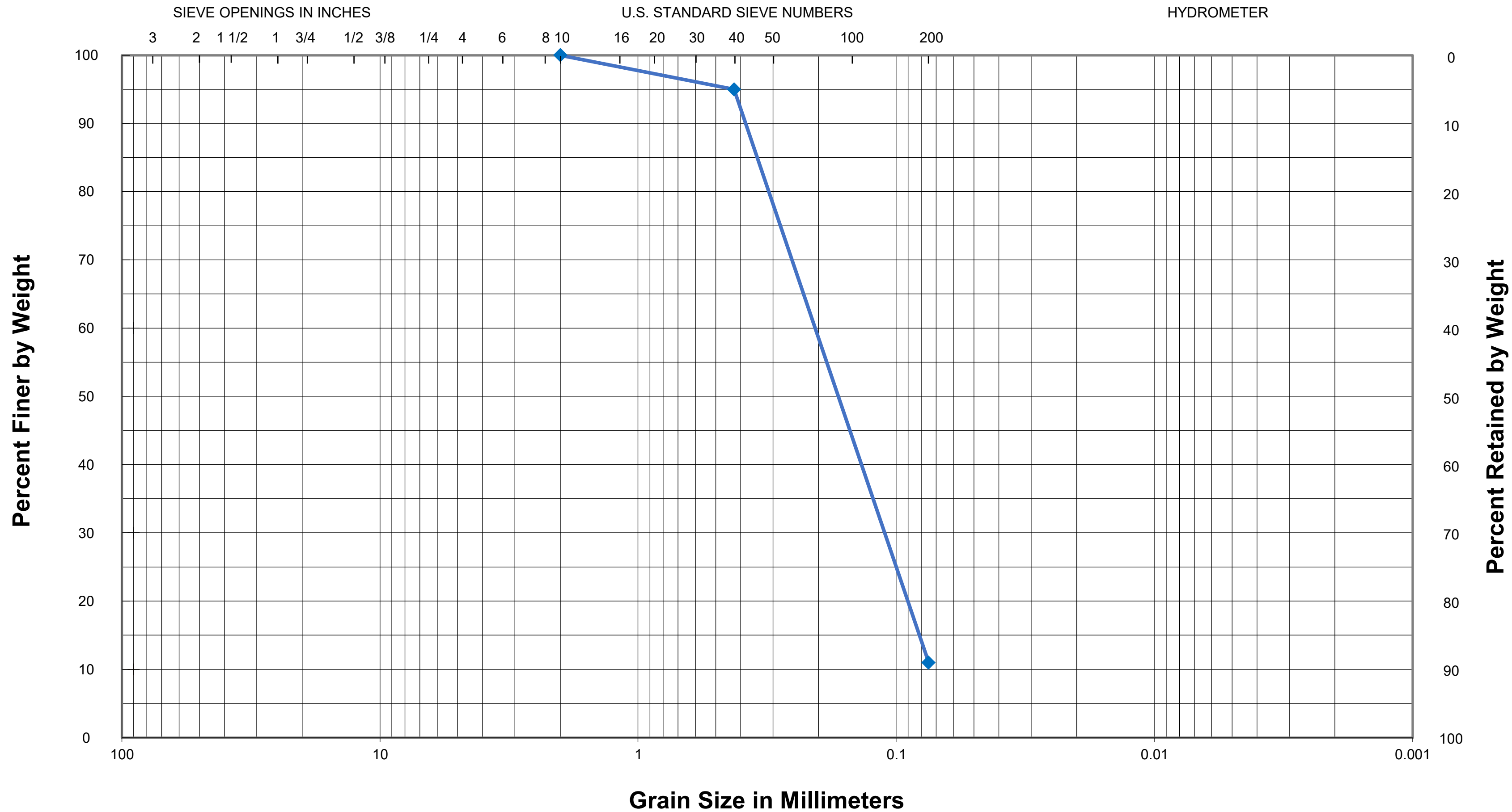
Sample: Boring FB-43, 29-30
Description: Tan fine to medium SAND

USCS Classification = SP
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

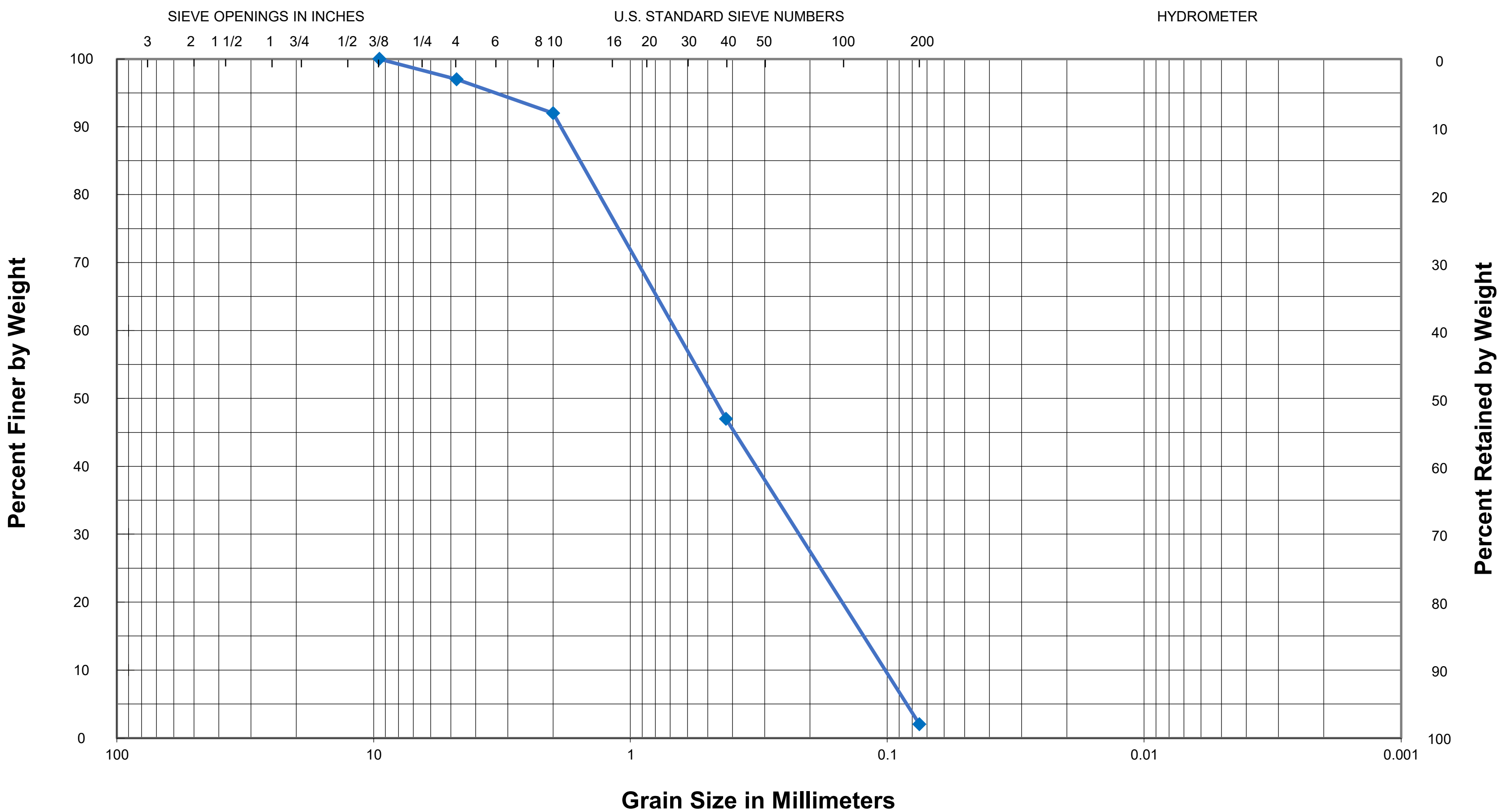
Sample: Boring FB-45, 0.5-1.5
Description: Tan fine SAND, slightly silty

USCS Classification = SM-SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

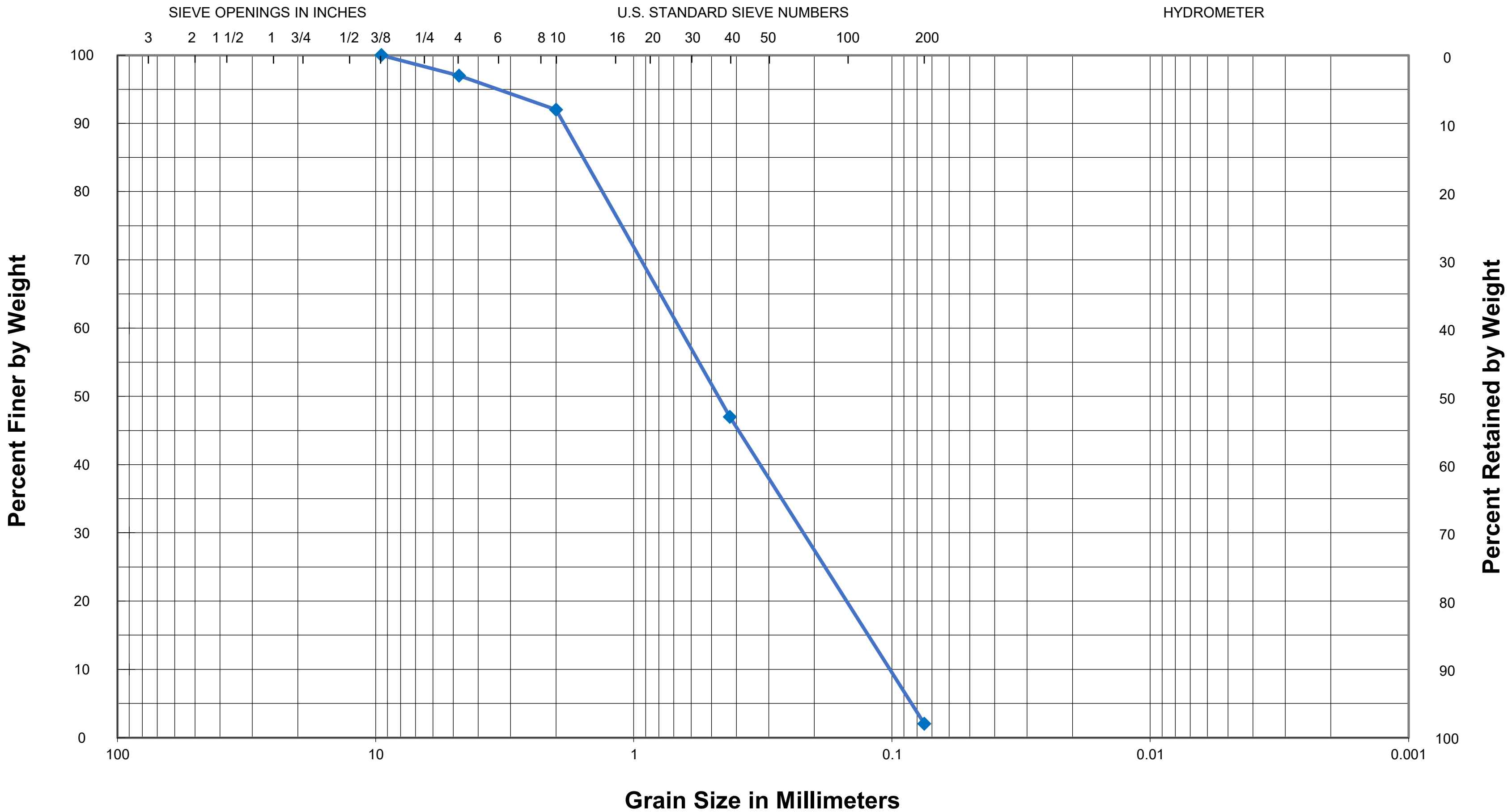
Sample: Boring FB-45, 24-25
Description: Tan fine to medium SAND w/some coarse sand and fine gravel

USCS Classification = SP
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

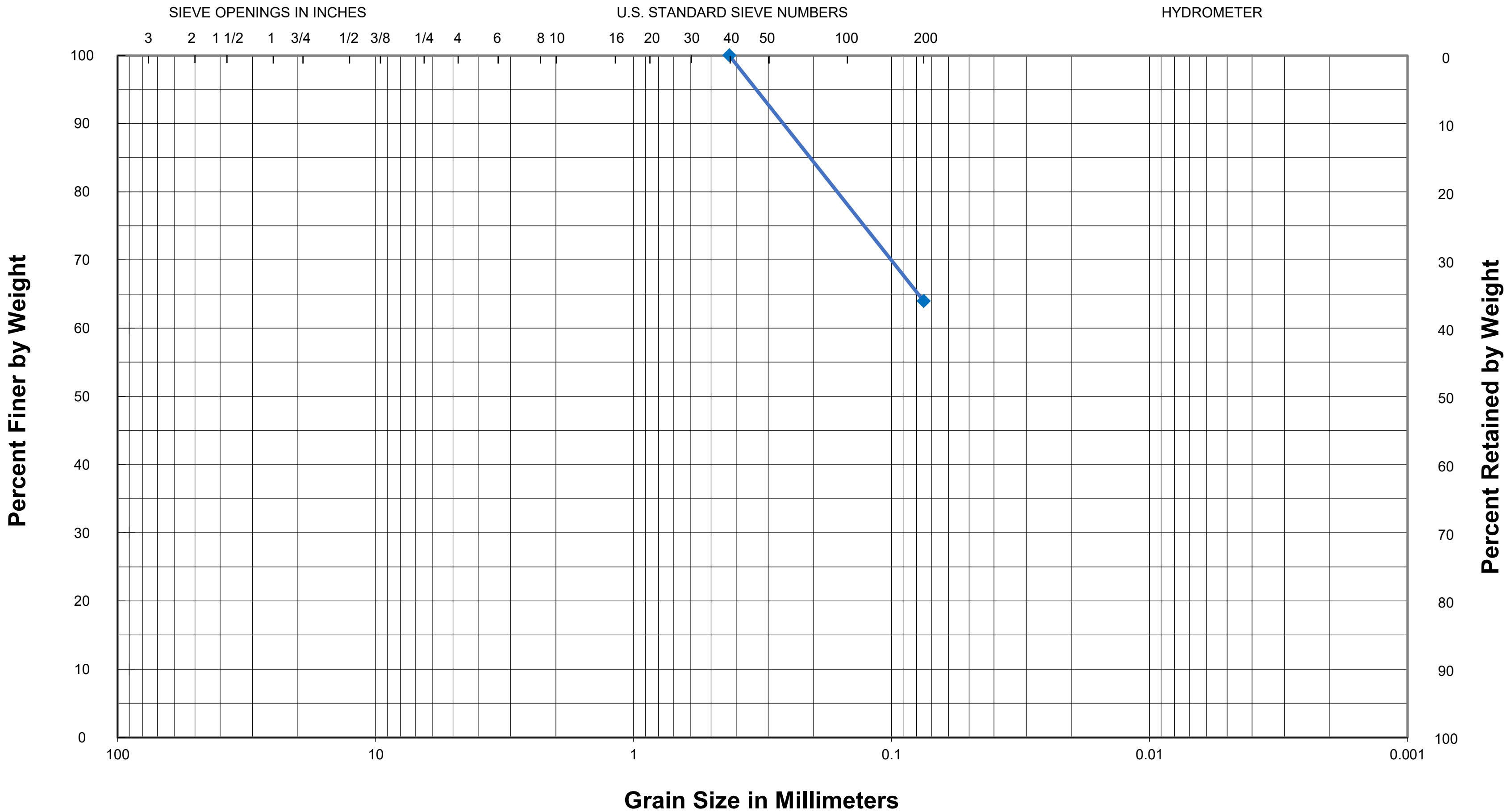
Sample: Boring FB-46, 24-25
Description: Tan fine to coarse SAND w/trace fine gravel

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

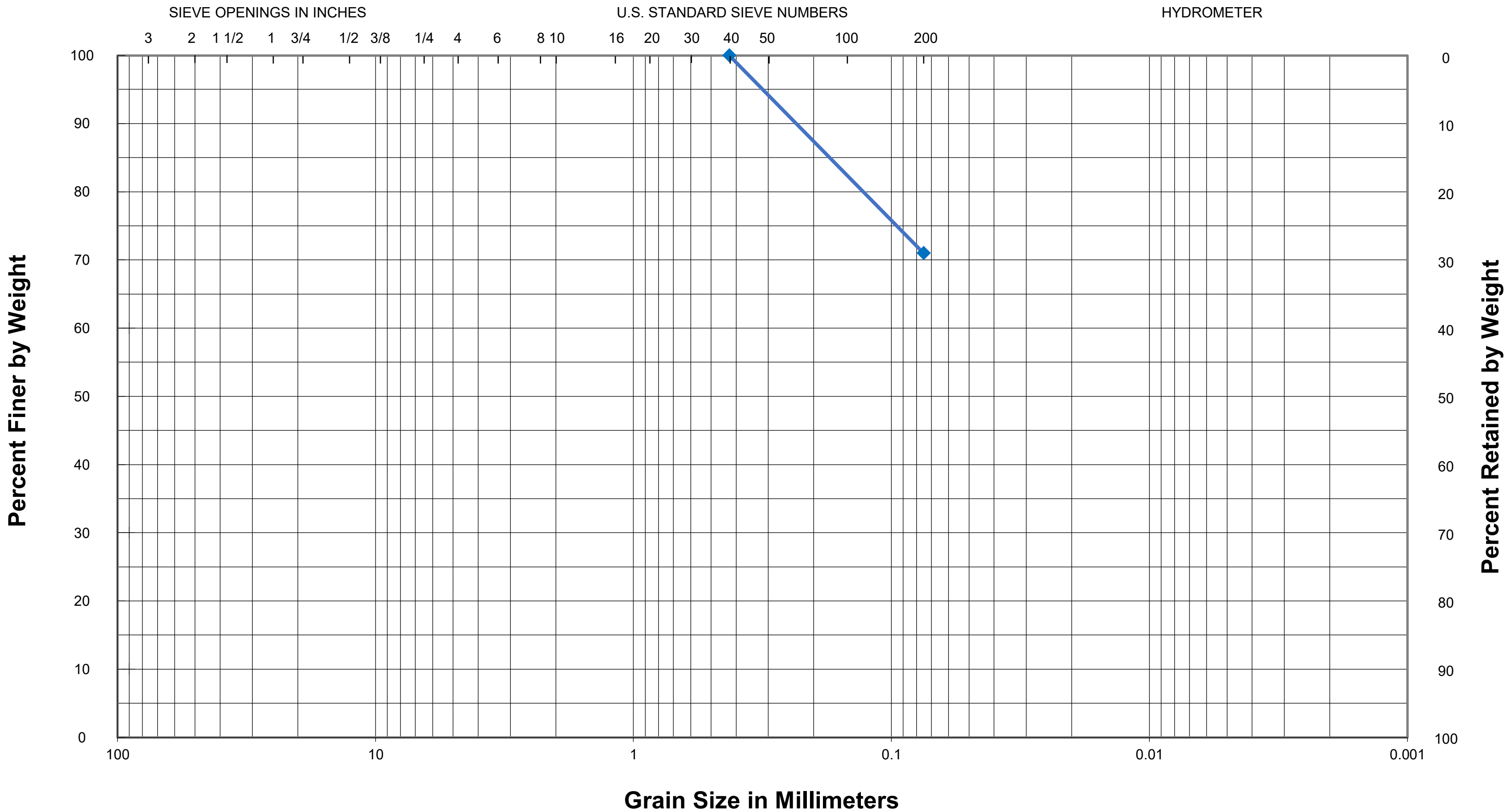
Sample: Boring FB-66, 6.5-7.5
Description: Reddish tan fine sandy SILT

USCS Classification = ML
AASHTO Classification = A-4

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

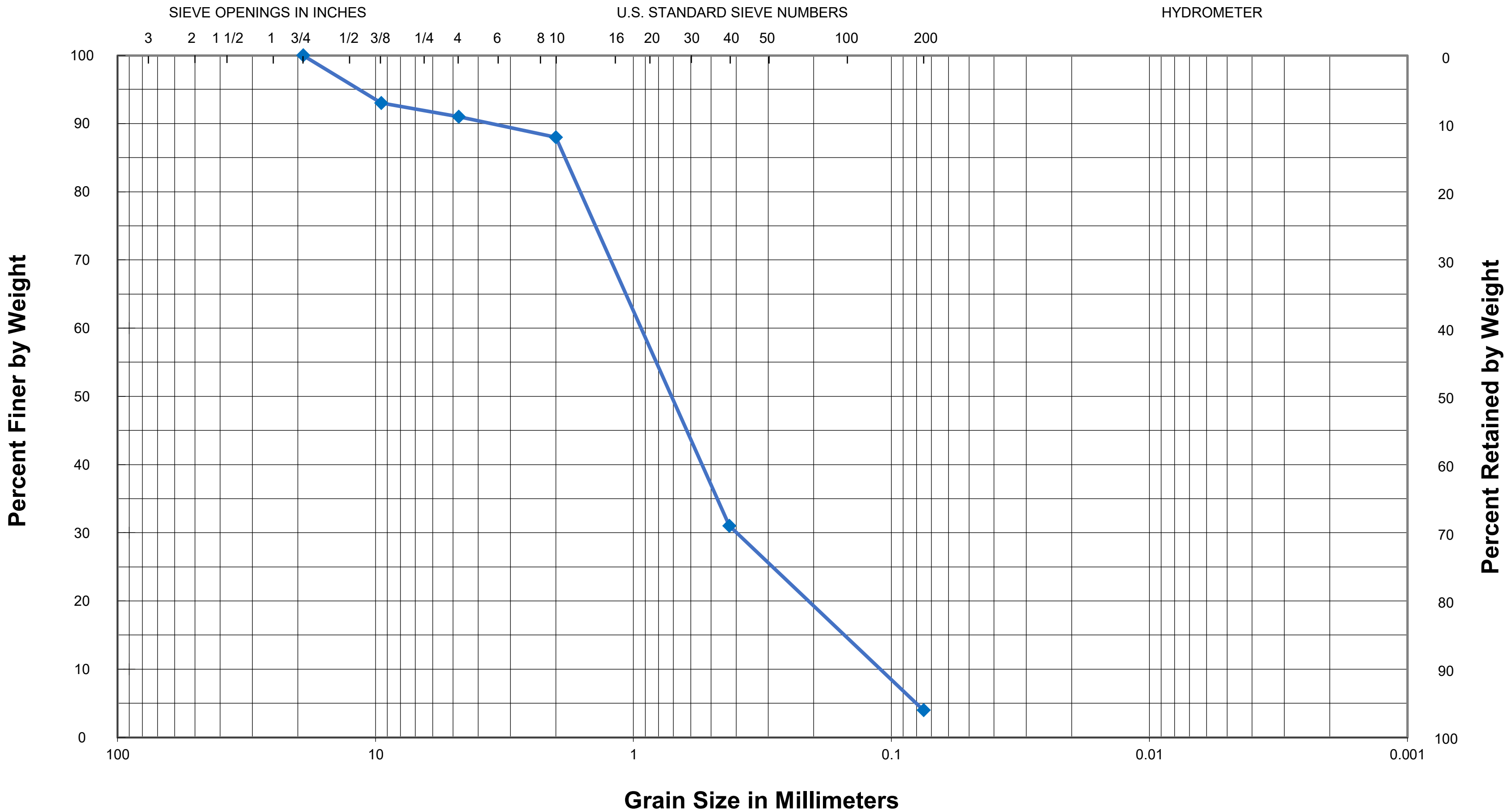
Sample: Boring FB-66, 14-15
Description: Reddish tan fine sandy SILT

USCS Classification = ML
AASHTO Classification = A-4

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



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<tr><td>COARSE</td><td>FINE</td><td>COARSE</td><td>MEDIUM</td><td>FINE</td></tr>
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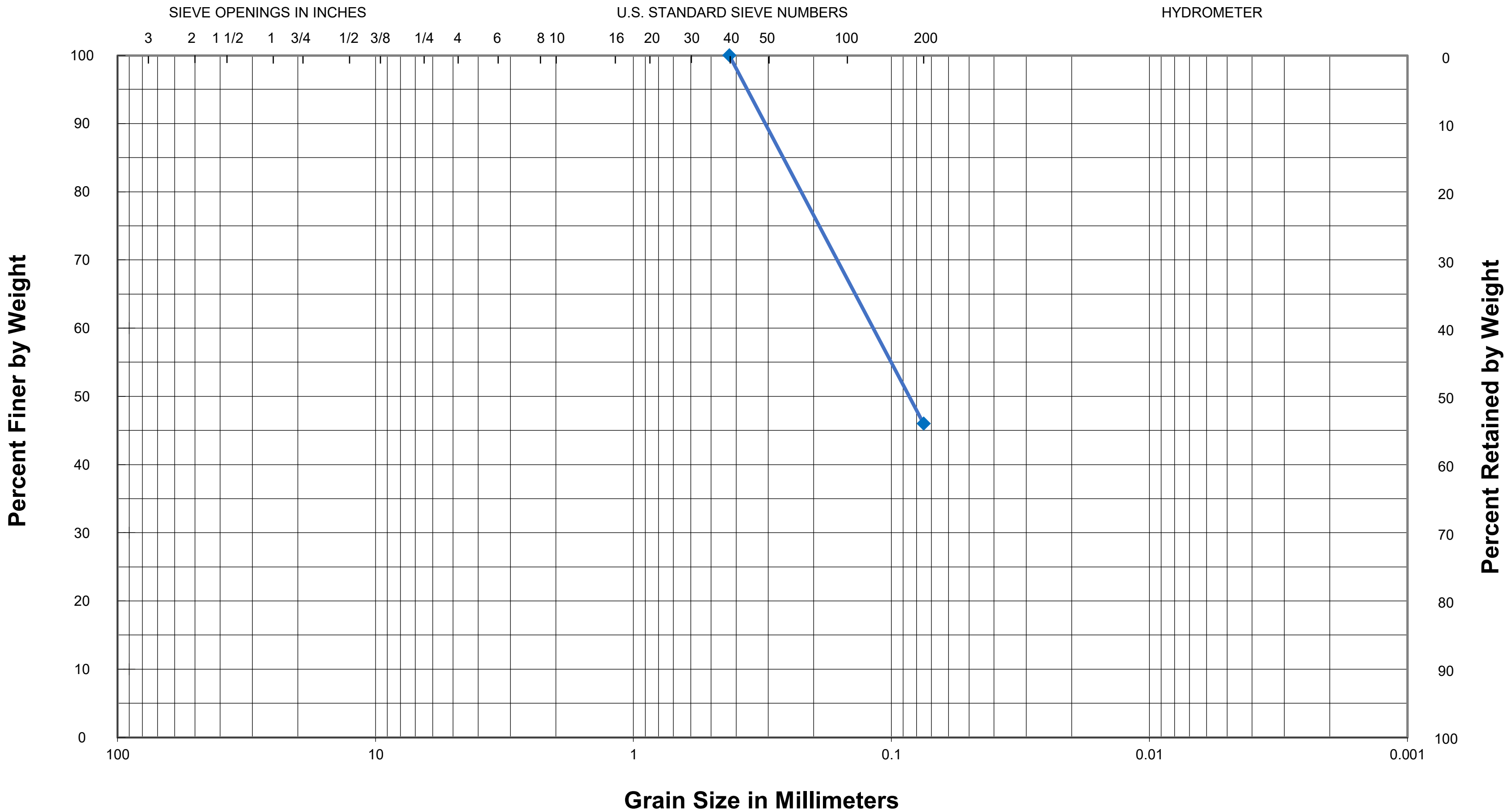
Sample: Boring FB-66, 29-30
Description: Tan fine to coarse SAND w/some fine to coarse gravel (SW)

USCS Classification = SW
AASHTO Classification = A-

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

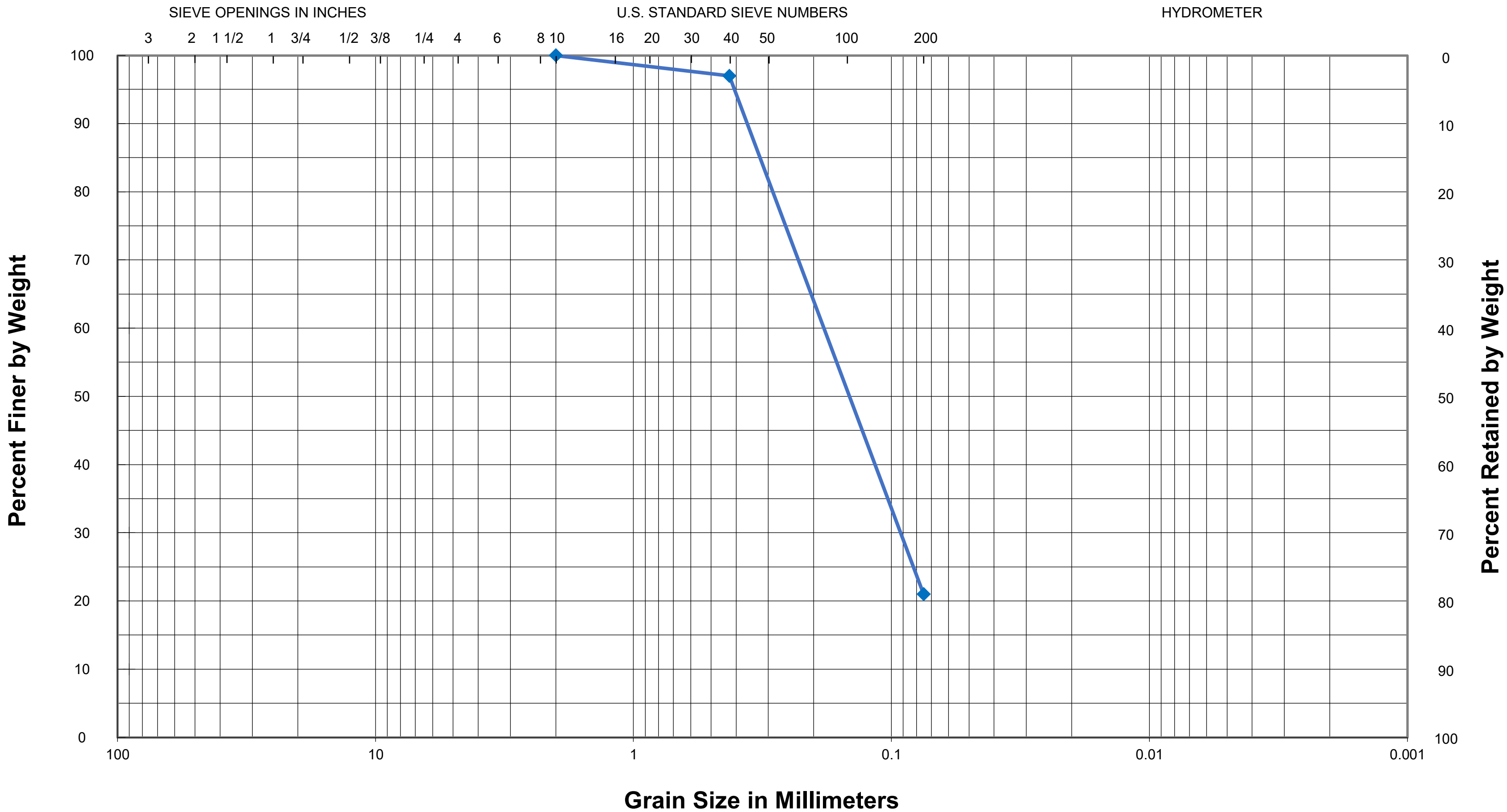
Sample: Boring FB-69, 6-6.5
Description: Tan silty fine SAND

USCS Classification = SM
AASHTO Classification = A-4

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

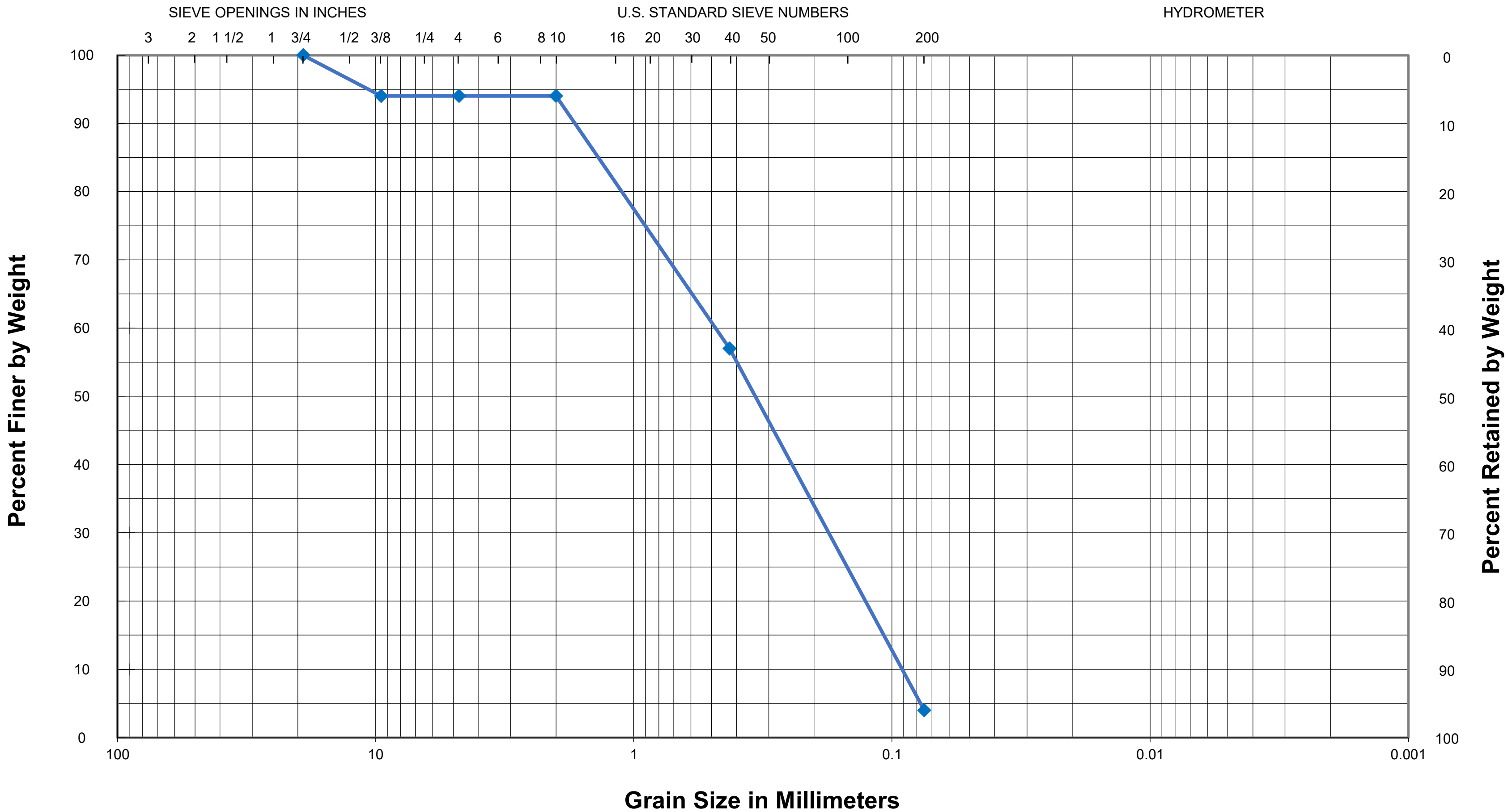
Sample: Boring FB-71, 2.5-3.5 ft
Description: Reddish tan silty fine SAND

USCS Classification = SM
AASHTO Classification = A-2-4

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

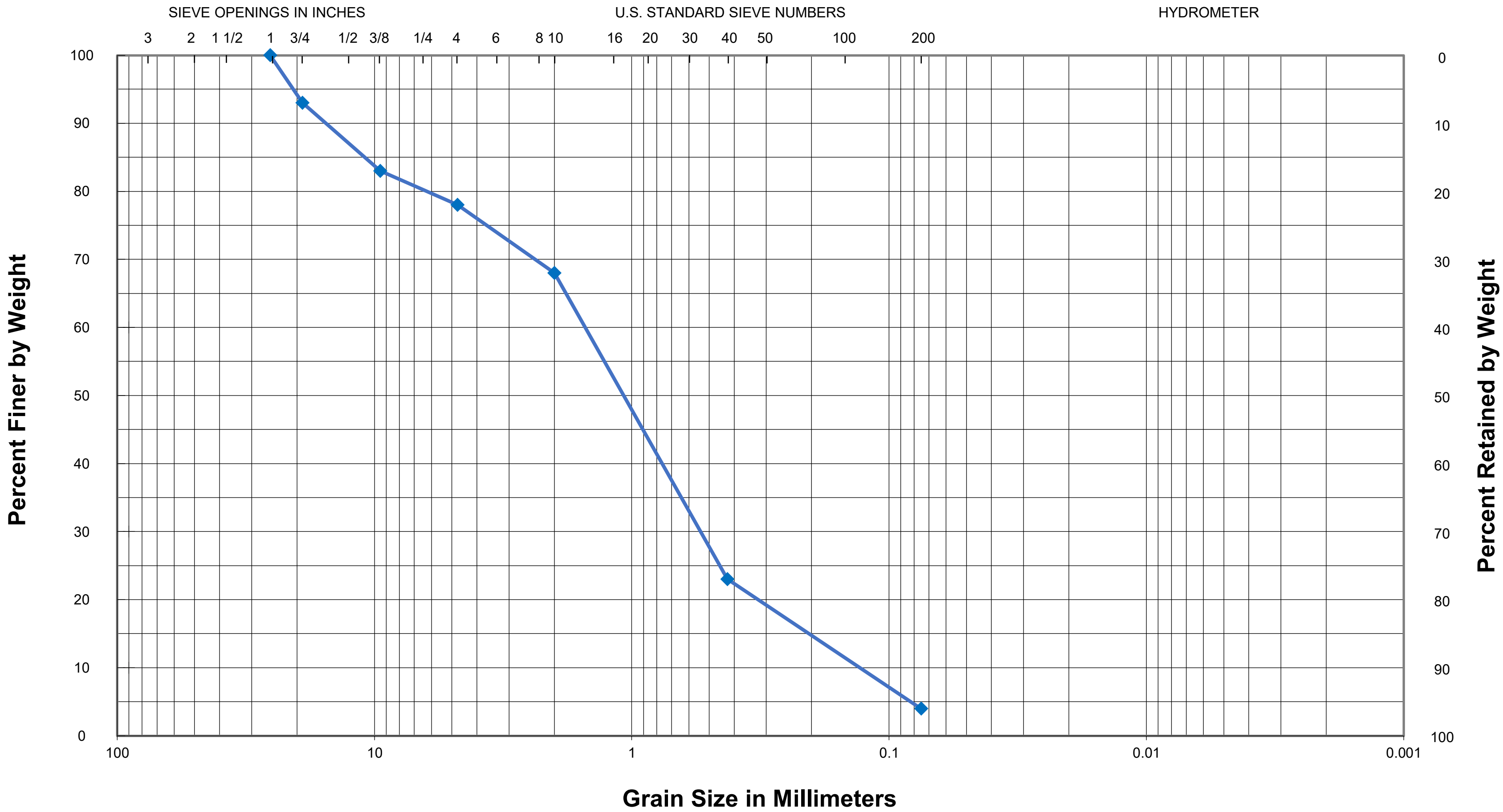
Sample: Boring FB-71, 24-25 ft
Description: Reddish tan fine to coarse SAND with some fine gravel

USCS Classification = SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

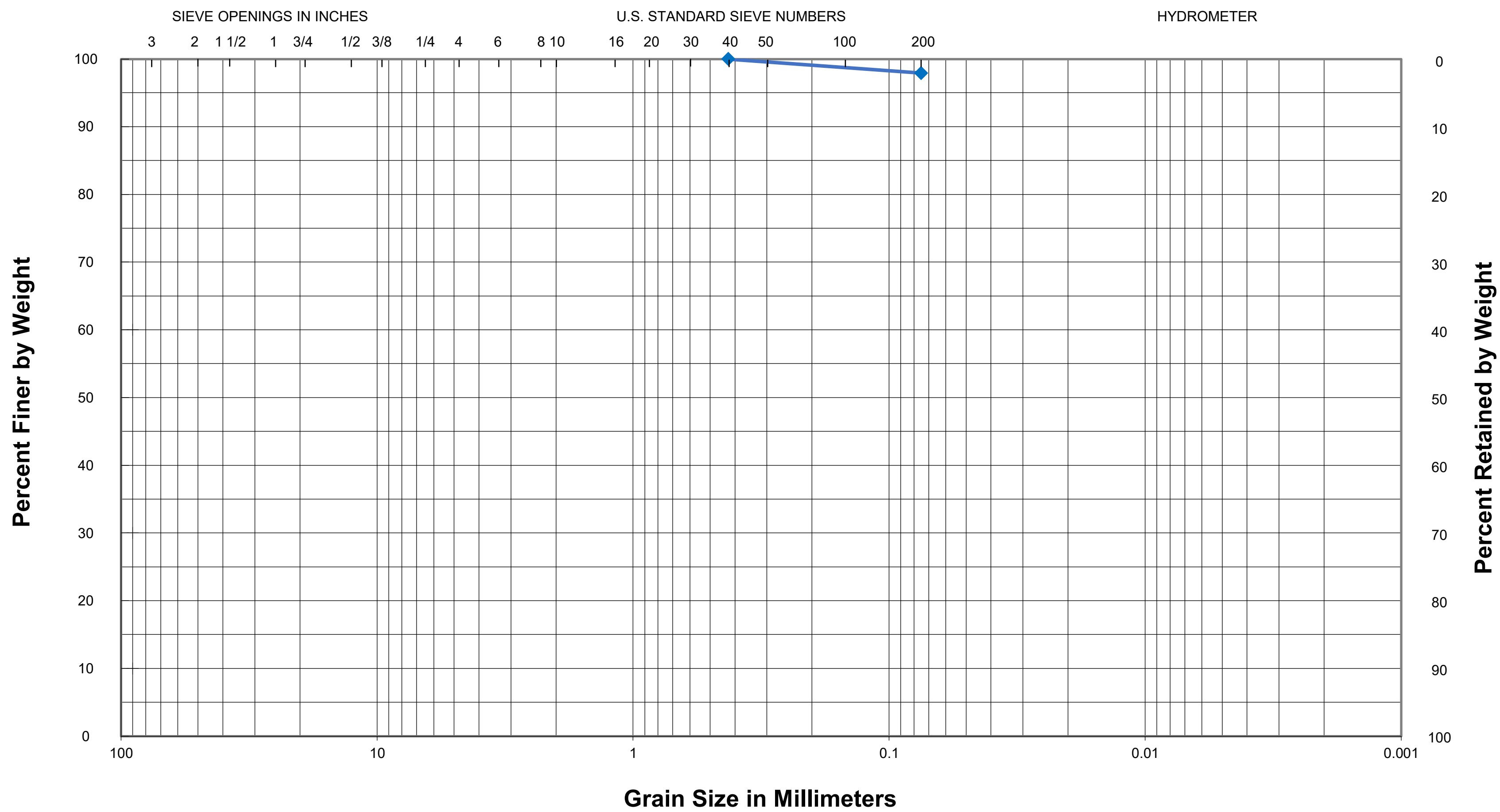
Sample: Boring FB-72, 24-25 ft
Description: Brown fine to coarse SAND with some fine to coarse gravel

USCS Classification = SW
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

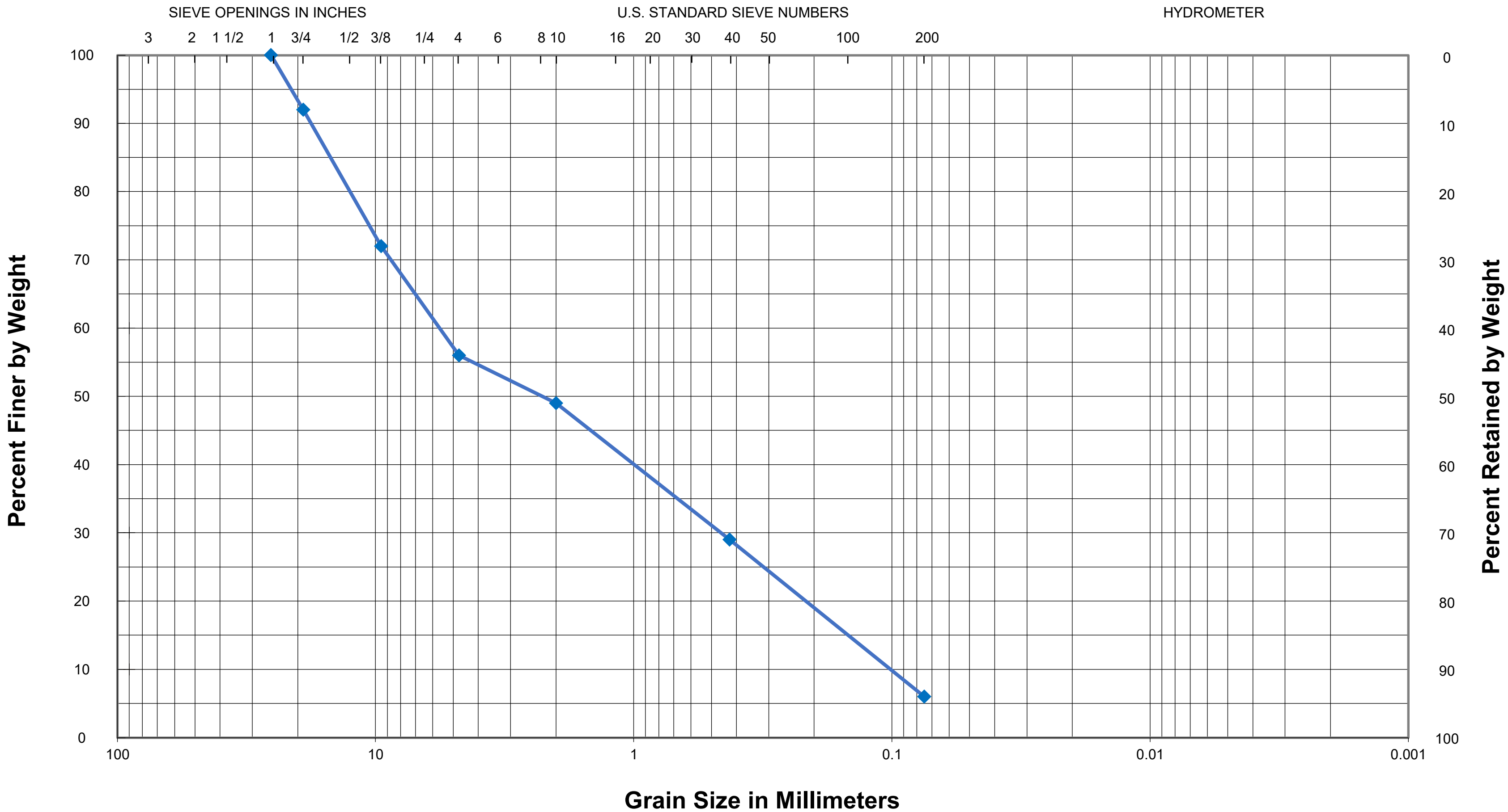
Sample: Boring FB-73, 19-20 ft
Description: Reddish brown SILT

USCS Classification = ML
AASHTO Classification = A-4

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

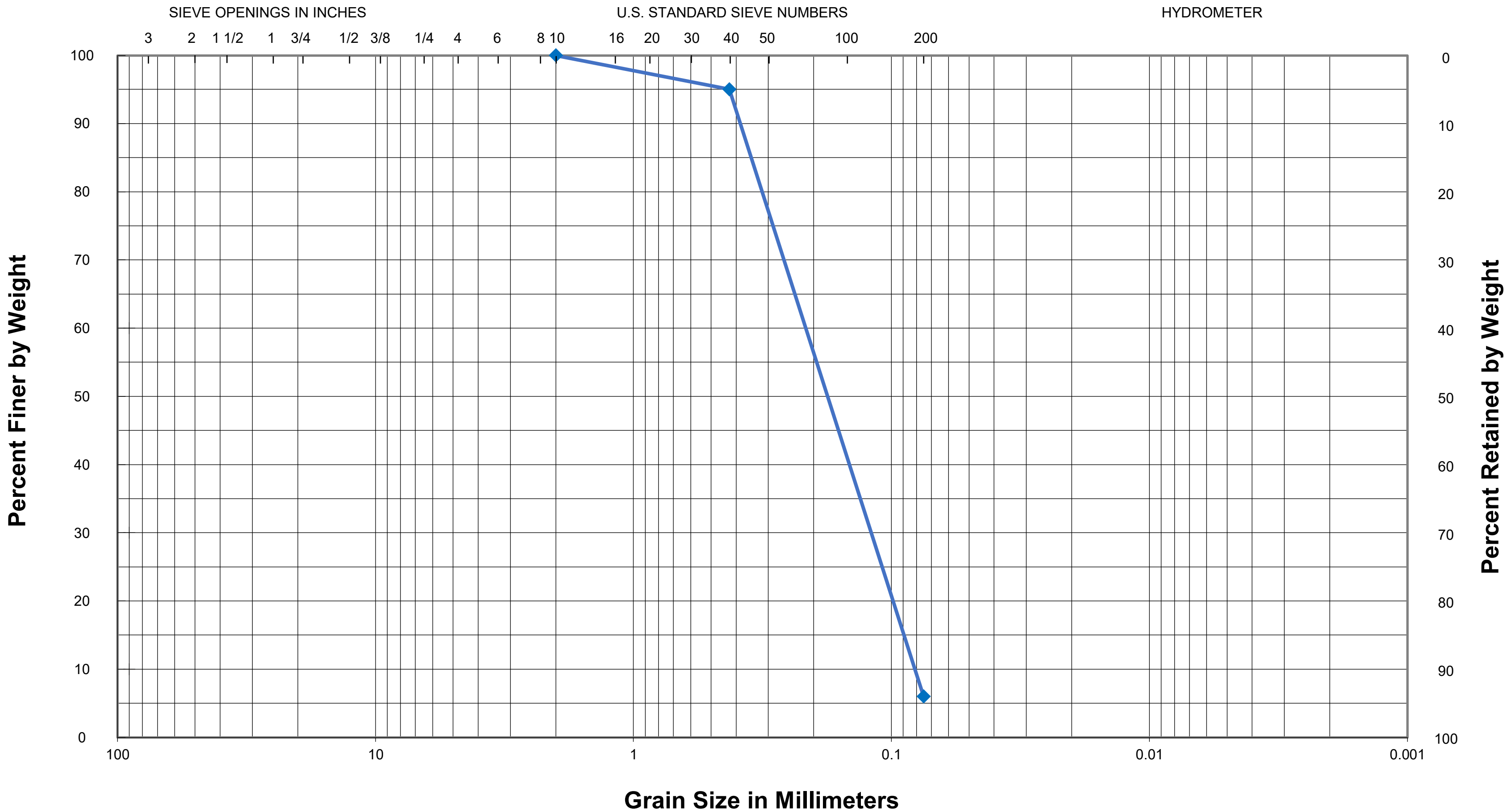
Sample: Boring FB-74, 29-30
Description: Tan fine SAND, slightly silty

USCS Classification = SM-SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

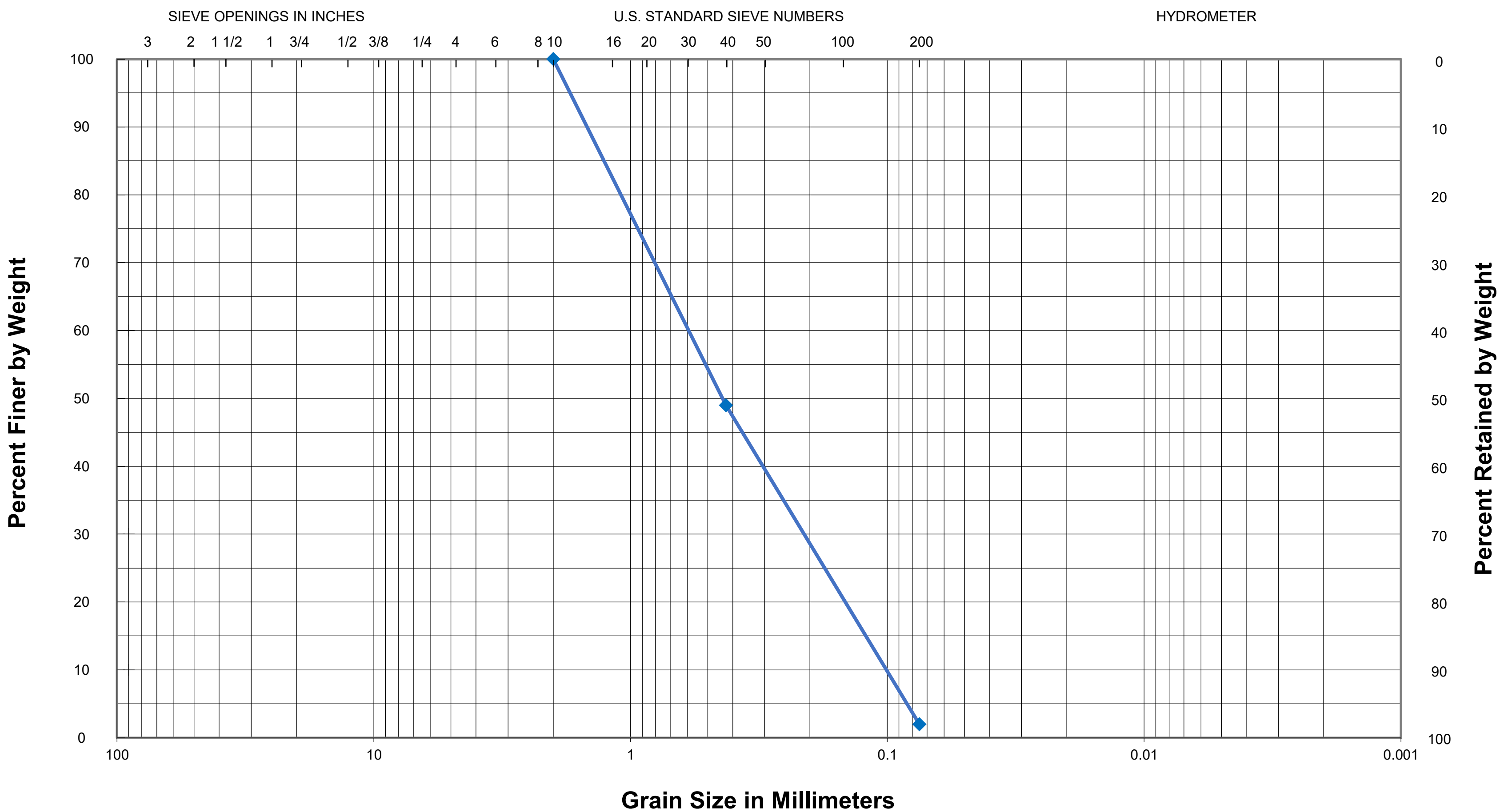
Sample: Boring FB-75, 24-25
Description: Tan fine SAND, slightly silty

USCS Classification = SM-SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

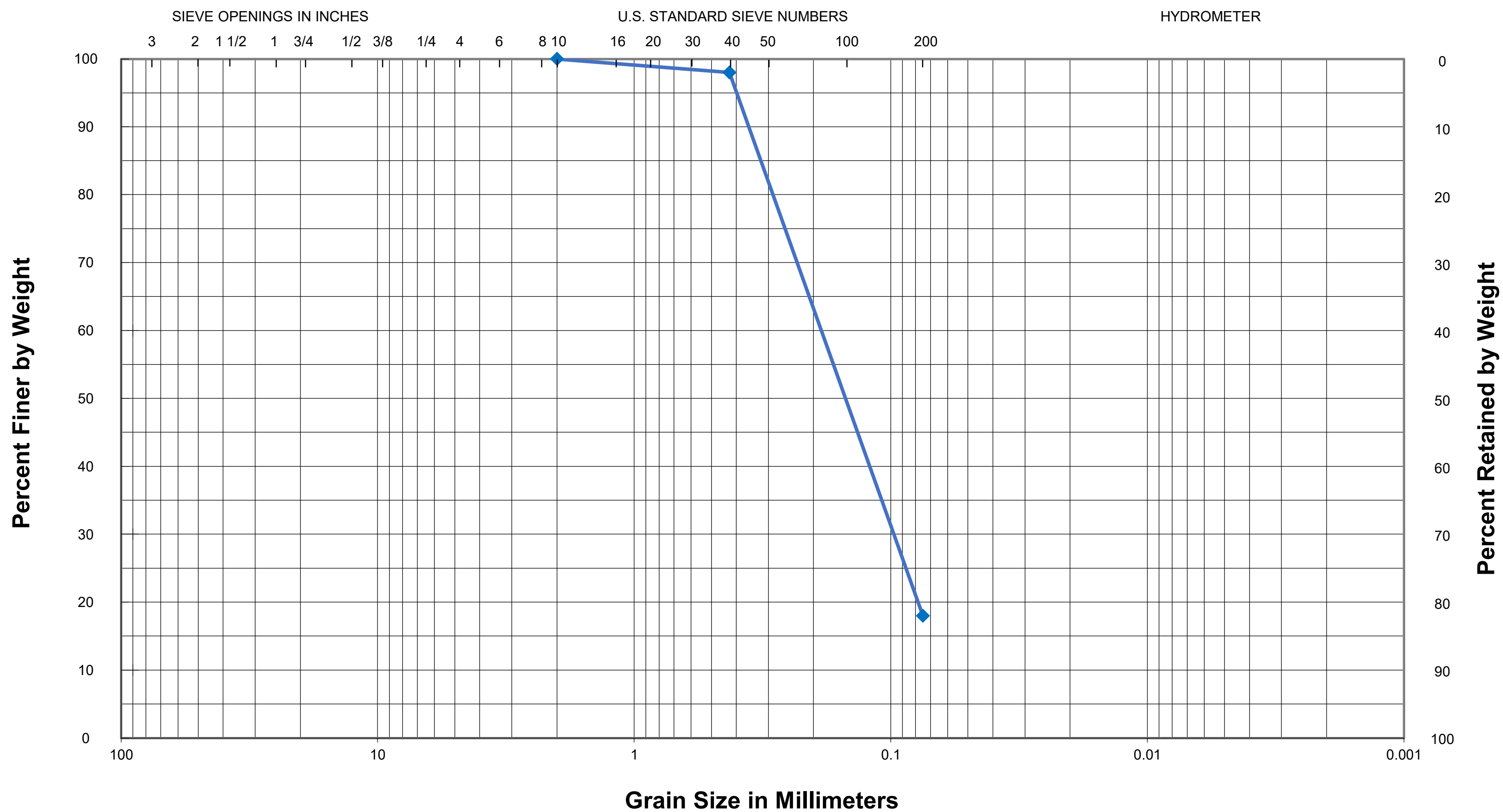
Sample: Boring FB-75, 34-35
Description: Tan fine to medium SAND

USCS Classification = SP
AASHTO Classification = A-1-b

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

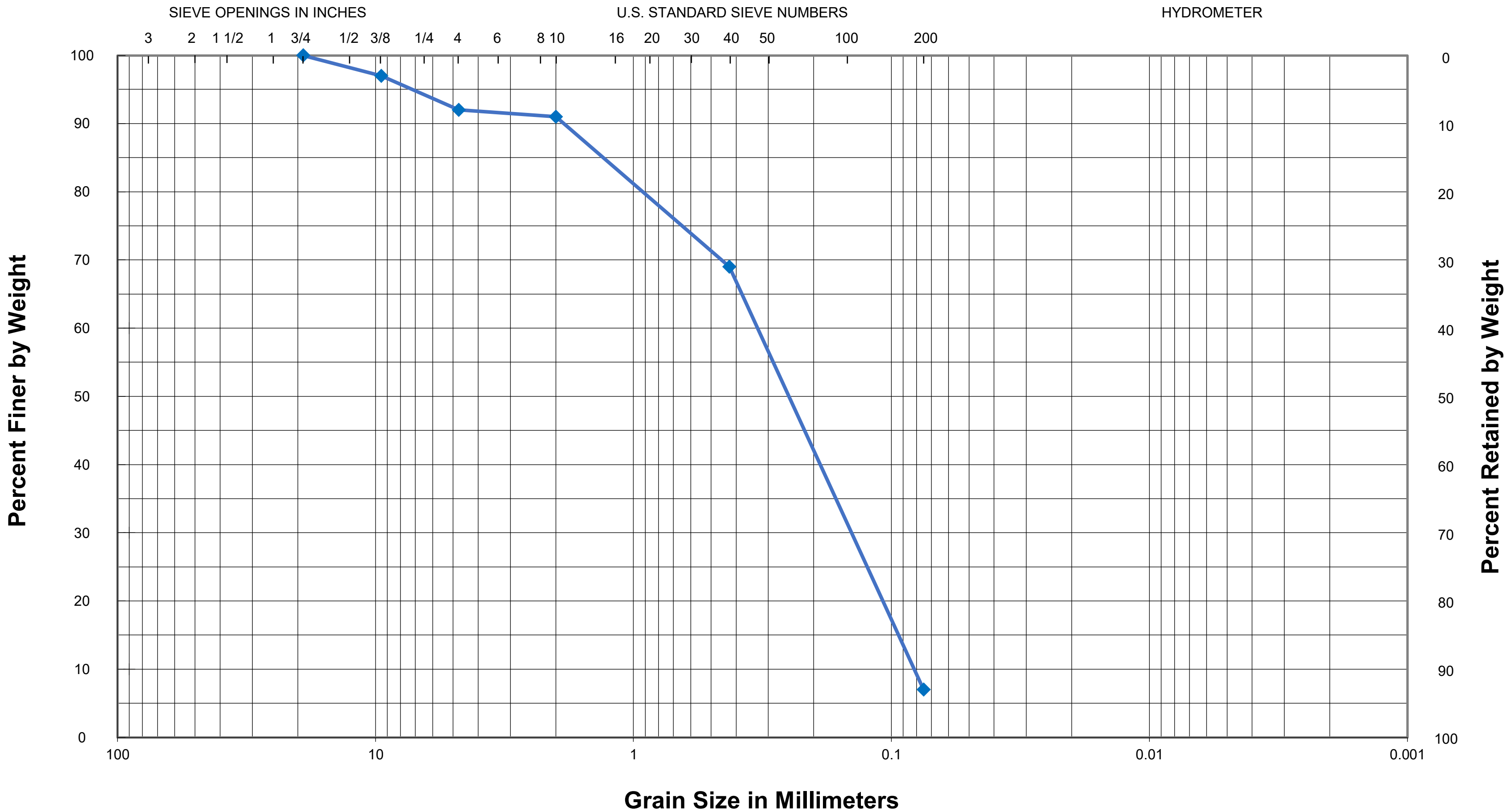
Sample: Boring FB-77, 24-25
Description: Tan silty fine SAND

USCS Classification = SM
AASHTO Classification = A-2-4

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

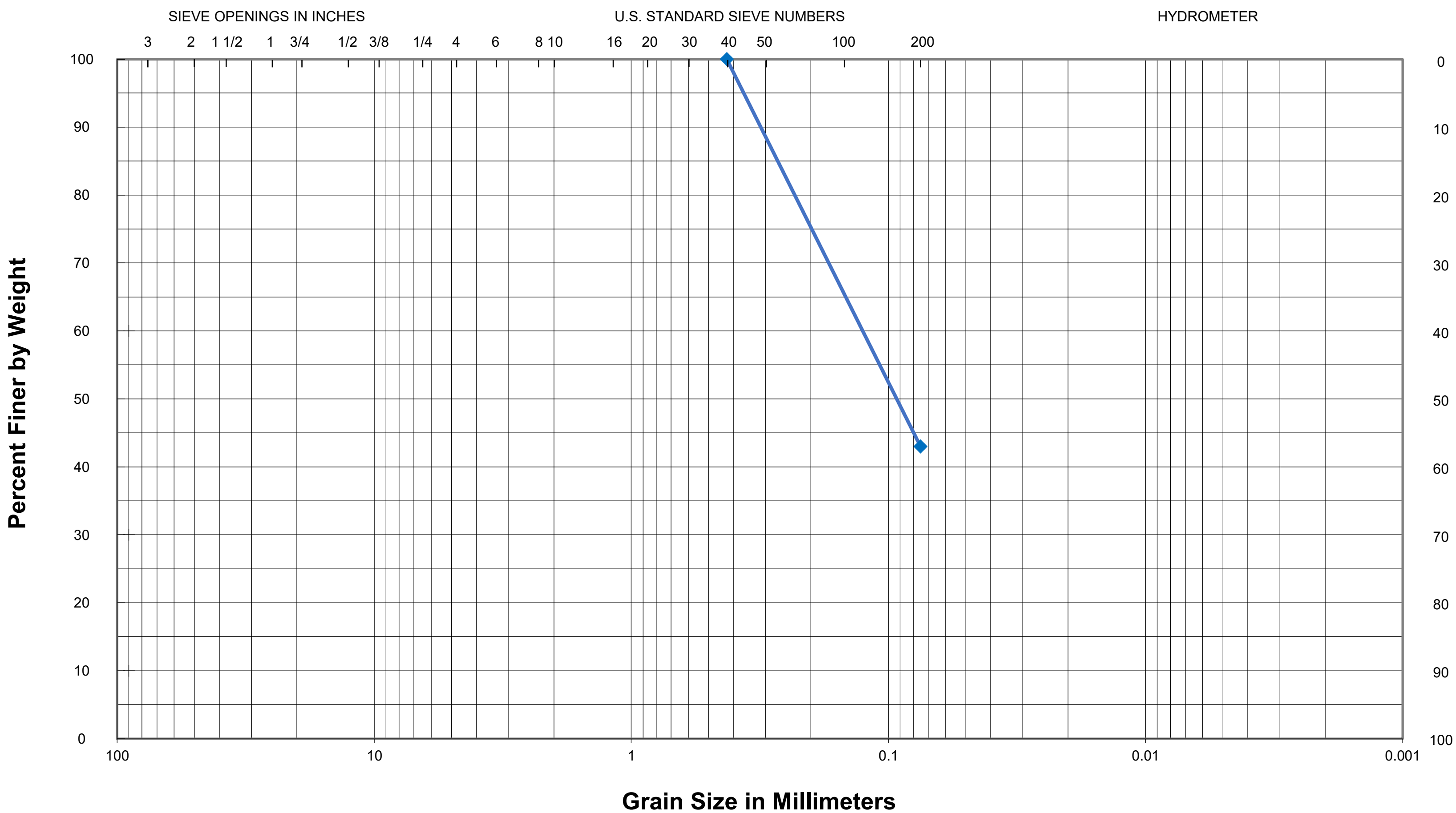
Sample: Boring FB-77, 34-35
Description: Tan fine to medium SAND, slightly silty, with trace fine to coarse gravel

USCS Classification =SM-SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

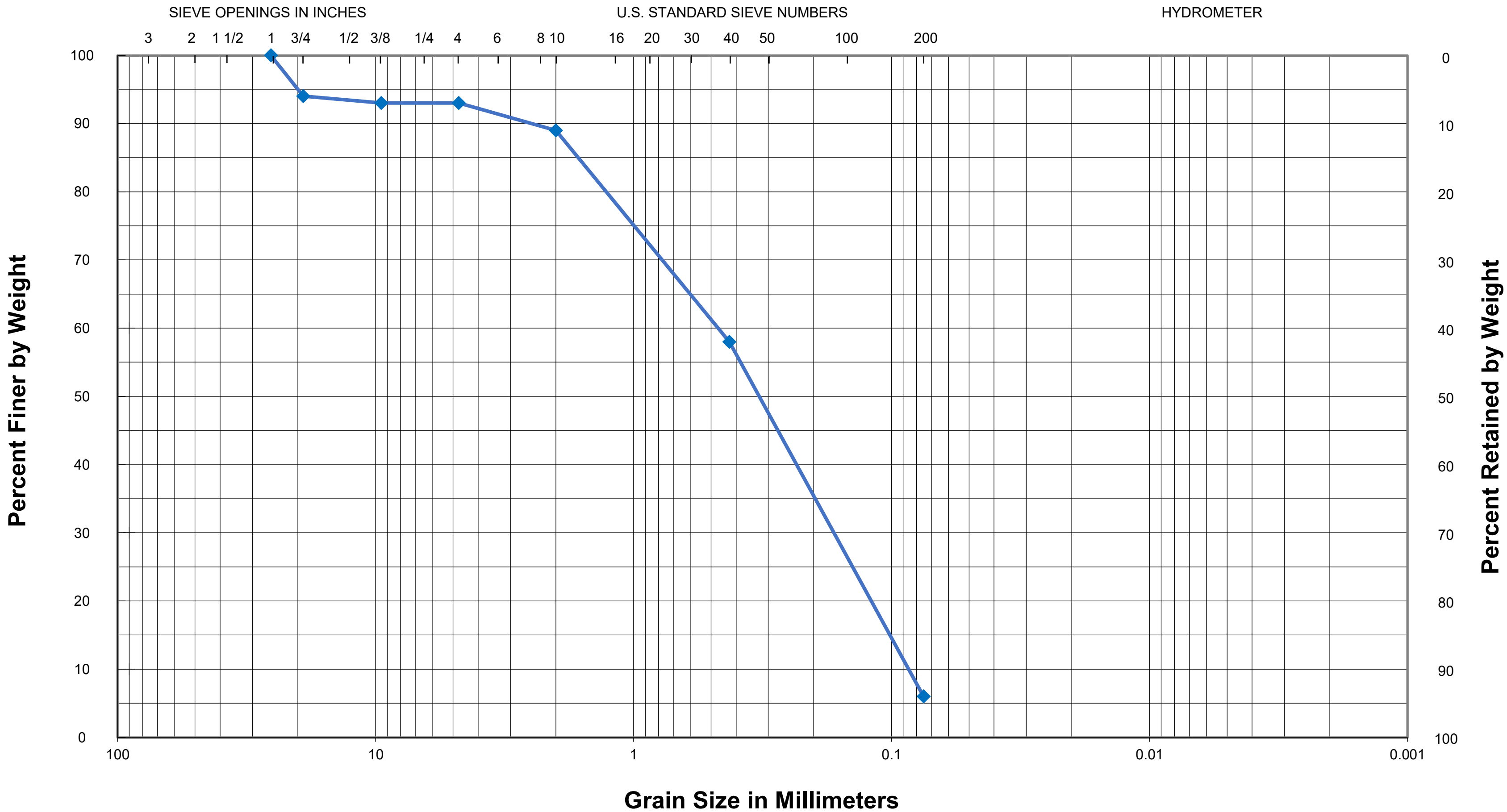
Sample: Boring FB-78, 14-15
Description: Reddish brown silty fine SAND

USCS Classification = SM
AASHTO Classification = A-4

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

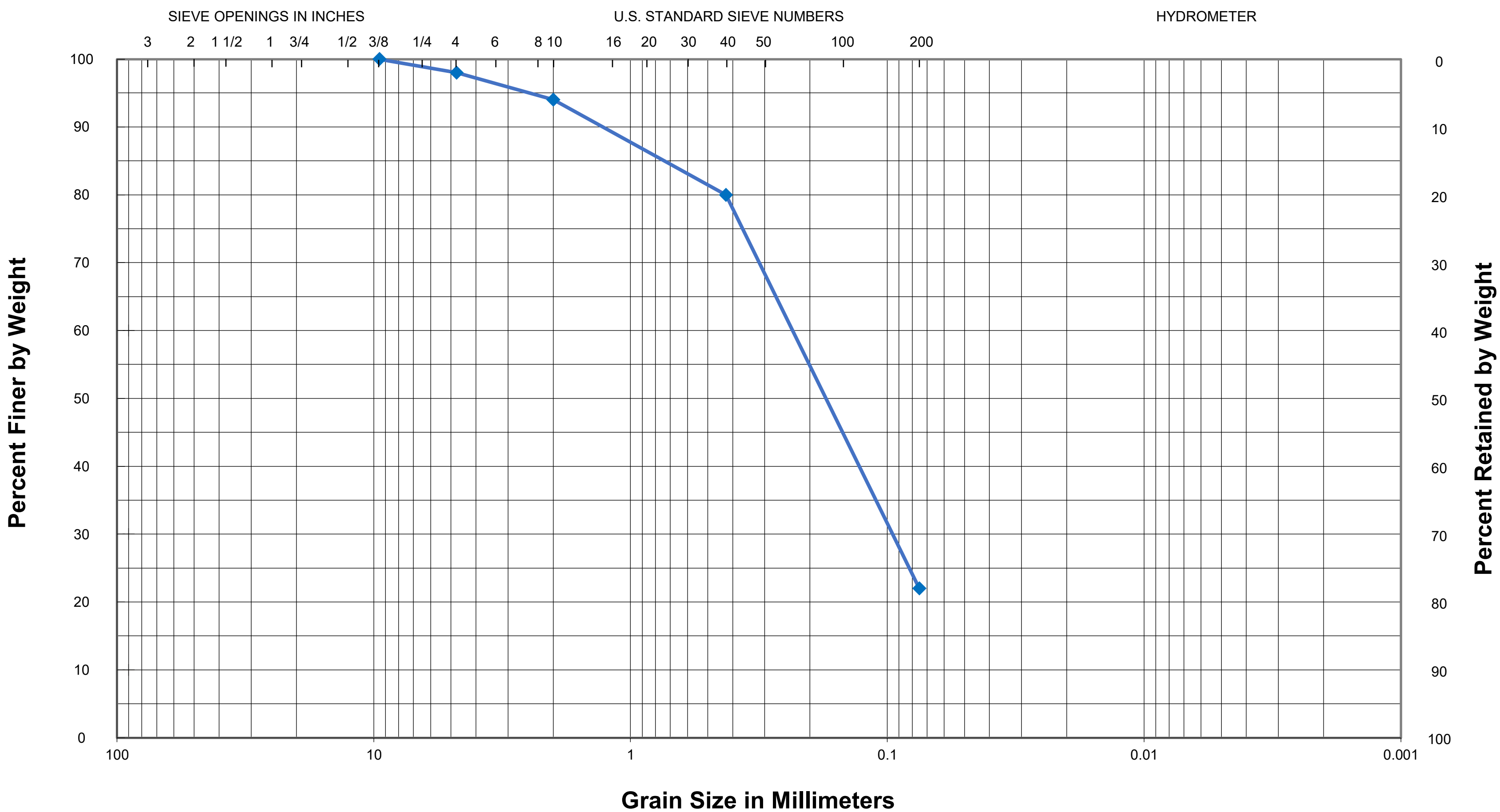
Sample: Boring FE-14, 34-35
Description: Tan fine to coarse SAND, slightly silty

USCS Classification =SM-SP
AASHTO Classification = A-3

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring FE-14, 39-40
Description: Tan fine to coarse SAND, slightly silty

USCS Classification =SM-SW
AASHTO Classification = A-1-b

APPENDIX E

21-071

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, LLC
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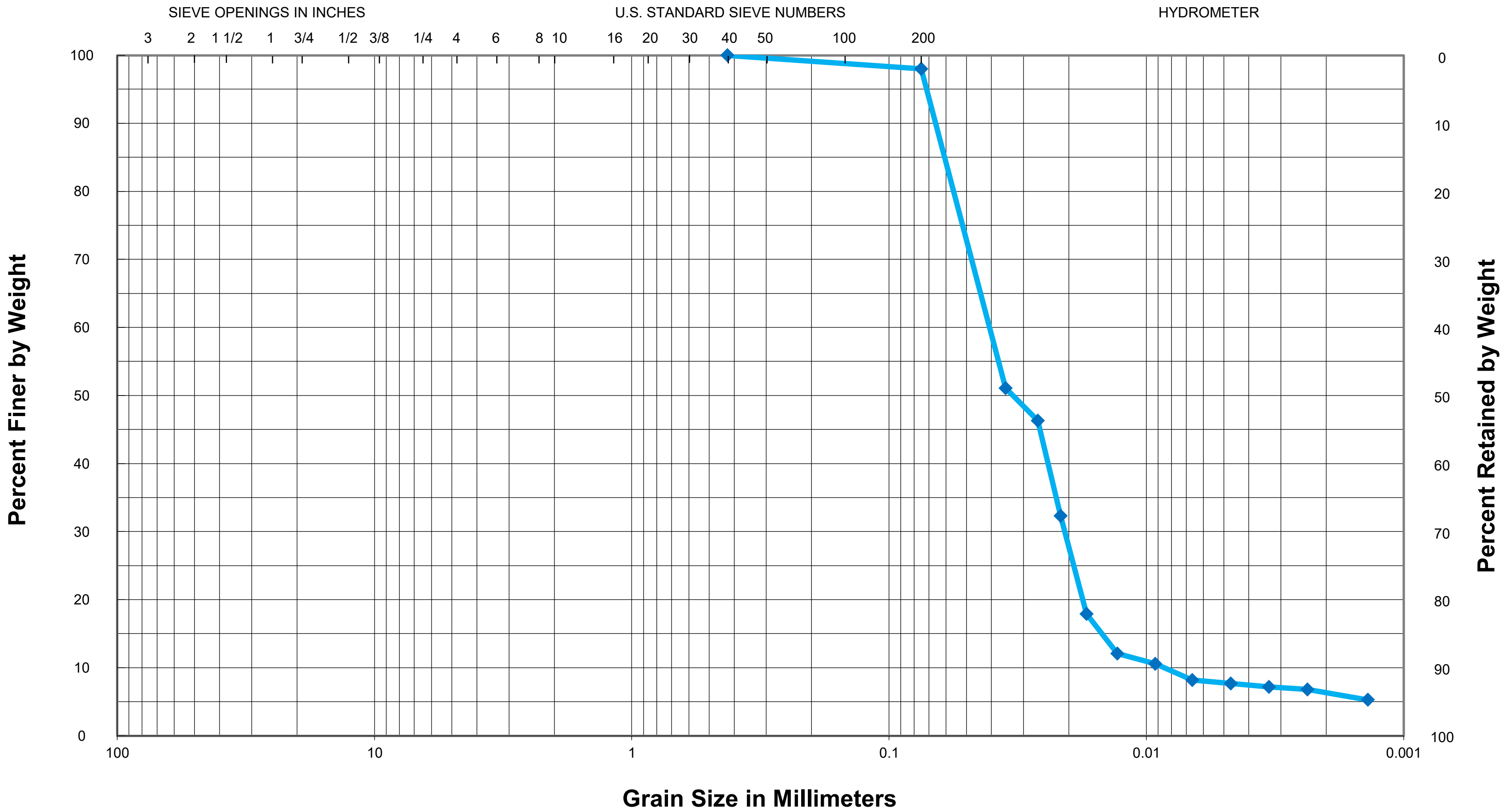


GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Sample: Boring FB-73, 19-20 ft
Description: Reddish brown SILT

USCS Classification = ML
AASHTO Classification = A-4

APPENDIX F

SUMMARY of SOIL COMPRESSION TEST RESULTS and UNIT WEIGHTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Crawford & Sebastian Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	DRY UNIT WEIGHT (lbs/ft^3)	CONFINING PRESSURE (lbs/in.^{2})	UNDRAINED SHEAR STRENGTH (cohesion, s_u) (lbs/ft^2)
FB-4	6.5-7.5	35	89	---	1110
FB-8	9-9.5	41	82	---	720
FB-13	6.5-7.5	12	84	---	---
FB-14	9-10	24	86	---	---
FB-15	2.5-3.5	16	91	---	---
FB-15	14-15	31	84	---	---
FB-16	4.5-5.5	12	89	---	---
FB-16	9-10	26	88	---	---
FB-17	14-15	28	91	---	---
FB-20	2.5-3.5	16	94	---	---
FB-23	1-1.5	9	113	---	---
FB-72	2.5-3.5	24	89	---	---
FB-73	2.5-3.5	35	79	---	---
FB-73	6.5-7	25	101	---	1200
FB-74	3-3.5	29	96	---	---

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	DRY UNIT WEIGHT (lbs/ft^3)	CONFINING PRESSURE (lbs/in.^{2})	UNDRAINED SHEAR STRENGTH (cohesion, s_u) (lbs/ft^2)
FB-75	4.5-5	28	96	---	1600
FB-75	9-10	28	81	---	---
FB-75	15-15.5	26	90	---	1460
FB-77	4-4.5	24	98	---	1000
FB-78	6.5-7	21	104	---	2240
FB-78	7-7.5	19	108	---	4160
FB-79	1-1.5	23	104	---	940
FB-79	13-13.5	24	100	---	660
FB-80	4-4.5	23	102	---	2020
FB-80	5.5-6	21	104	---	1540
FB-80	6.5-7	19	108	---	4500
FB-80	7.5-8	19	109	---	3460
FB-81	2-2.5	18	106	---	760
FB-81	14-14.5	19	107	---	960
FE-10	4.5-5.5	18	102	---	---
FE-10	9-10	22	99	---	---
FE-11	2.5-3.5	22	104	---	---
FE-11	6-6.5	22	102	---	560
FE-12	1.5-2	24	96	---	---

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	DRY UNIT WEIGHT (lbs/ft^3)	CONFINING PRESSURE (lbs/in.^{2})	UNDRAINED SHEAR STRENGTH (cohesion, s_u) (lbs/ft^2)
FE-14	4.5-5	20	103	---	---
FE-14	5-5.5	30	94	---	2880
FP-14	2.5-3	24	100	---	1220
FP-14	4.5-5.5	23	100	---	---
FP-15	4.5-5.5	17	100	---	---

Notes:

1. NS = sample not suitable for compression testing
2. If no confining pressure shown, test is an unconfined compression test performed per AASHTO T 296.
3. Where a confining pressure is indicated, the test is an Unconsolidated-Undrained Triaxial compression test performed per AASHTO T 208.

APPENDIX G

DIRECT SHEAR (ASTM D-3080) TEST RESULTS

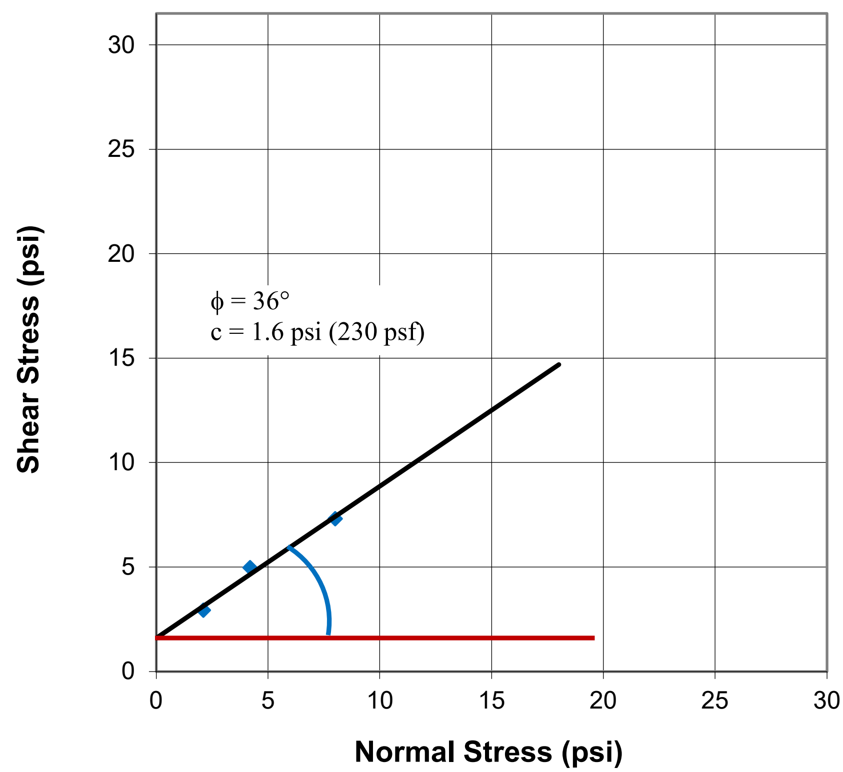
(Consolidated Drained)

Job Number: 21-071
Project: 040748 Hwy 22 to I-40
Crawford County, Arkansas
Sample Depth: 2-2.5
Source: FB-53
Sample Description: Dark brown and tan fine SAND

Tested By: LLC
Reported by: JDF
Test Date: 10/16/2023

Material Properties: Non Plastic; Percent Passing No. 200 Sieve = 3
ASTM Classification: SP, AASHTO Classification = A-3

Specimen	Normal Stress, σ'_v (psi)	Shear at failure, τ_f (psi)	Unit Dry Wt, γ_d (lb/ft^3)	Moisture Content, w (%)
1	2.1	2.9	105.8	13.3
2	4.2	5.0	105.8	13.1
3	8.0	7.3	105.8	13.6



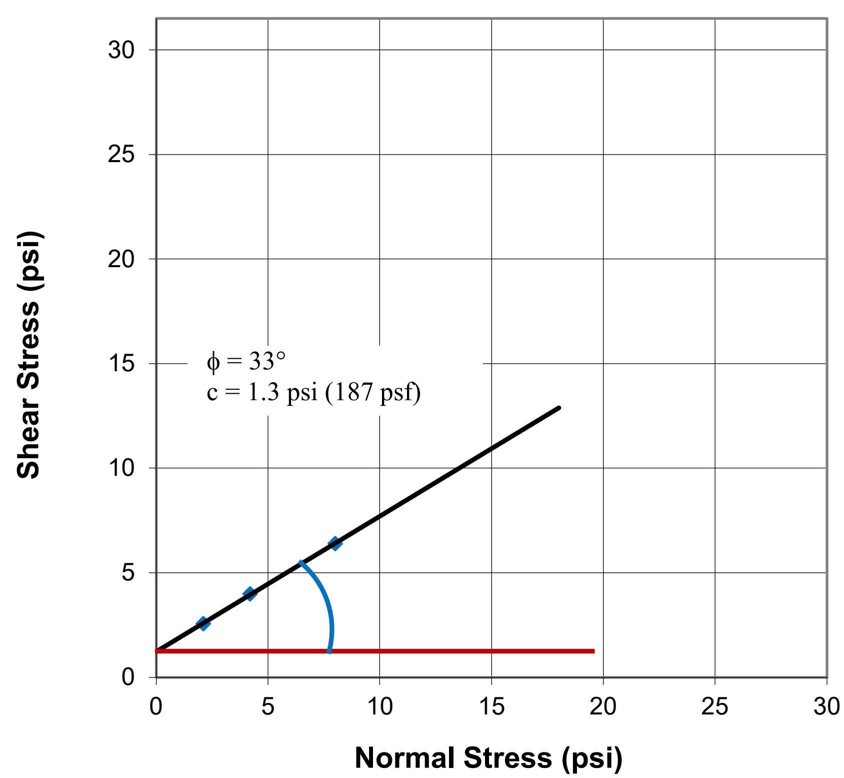
DIRECT SHEAR (ASTM D-3080) TEST RESULTS
(Consolidated Drained)

Job Number: 21-071
Project: 040748 Hwy 22 to I-40
Crawford County, Arkansas
Sample Depth: 2-2.5
Source: FB-57
Sample Description: Reddish brown fine sandy SILT

Tested By: LLC
Reported by: JDF
Test Date: 10/19/2023

Material Properties: Percent Passing No. 200 Sieve = 67%
ASTM Classification: ML, AASHTO Classification = A-4

Specimen	Normal Stress, σ'_v (psi)	Shear at failure, τ_f (psi)	Unit Dry Wt, γ_d (lb/ft^3)	Moisture Content, w (%)
1	2.1	2.6	95.4	18.0
2	4.2	4.0	95.4	18.3
3	8.0	6.4	95.4	17.6



Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS

Plate

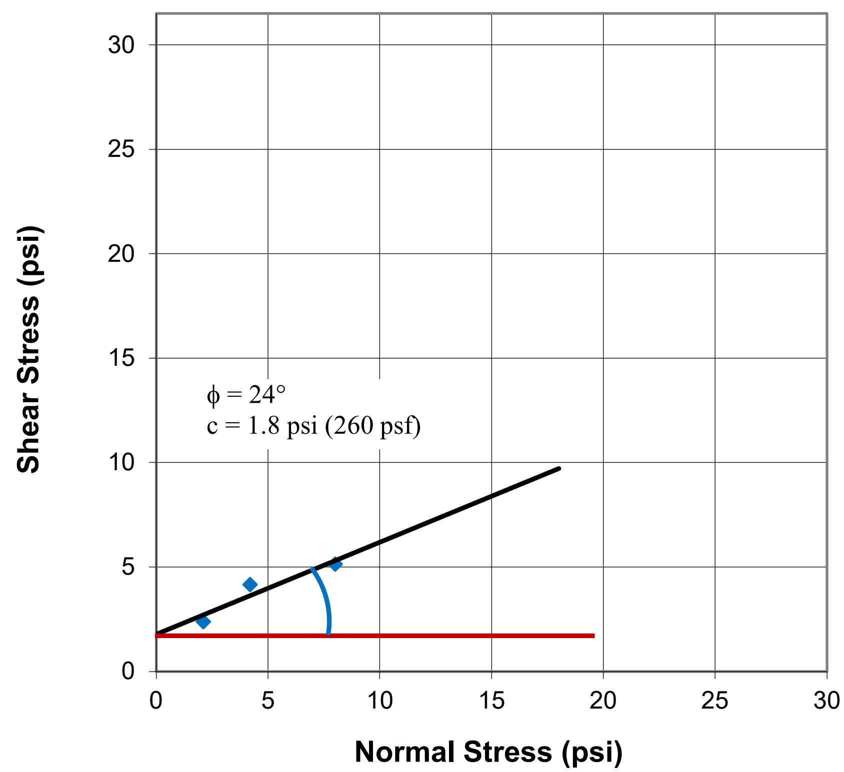
DIRECT SHEAR (ASTM D-3080) TEST RESULTS
(Consolidated Drained)

Job Number: 21-071
Project: 040748 Hwy 22 to I-40
Crawford County, Arkansas
Sample Depth: 2-2.5
Source: FB-60
Sample Description: Reddish brown fine sandy SILT

Tested By: LLC
Reported by: JDF
Test Date: 10/3/2023

Material Properties: Non Plastic; Percent Passing No. 200 Sieve = NA
ASTM Classification: ML, AASHTO Classification = A-4

Specimen	Normal Stress, σ'_v (psi)	Shear at failure, τ_f (psi)	Unit Dry Wt, γ_d (lb/ft^3)	Moisture Content, w (%)
1	2.1	2.4	110.4	12.4
2	4.2	4.2	110.4	12.6
3	8.0	5.1	110.4	11.0



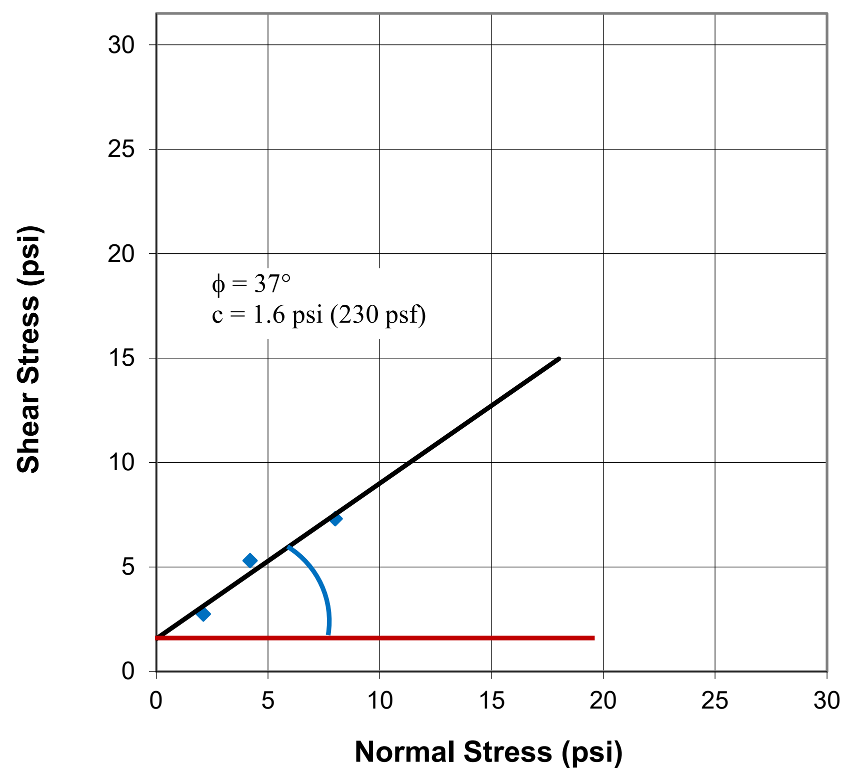
DIRECT SHEAR (ASTM D-3080) TEST RESULTS

(Consolidated Drained)

Job Number:	21-071	Tested By:	LLC
Project:	040748 Hwy 22 to I-40	Reported by:	JDF
	Crawford County, Arkansas	Test Date:	10/27/2023
Sample Depth:	4.5-5.5		
Source:	FB-63		
Sample Description:	Reddish brown fine sandy SILT		

Material Properties: Non Plastic; Percent Passing No. 200 Sieve = NA
ASTM Classification: ML, AASHTO Classification = A-4

Specimen	Normal Stress, σ'_v (psi)	Shear at failure, τ_f (psi)	Unit Dry Wt, γ_d (lb/ft^3)	Moisture Content, w (%)
1	2.1	2.8	102.2	11.8
2	4.2	5.3	102.2	11.6
3	8.0	7.3	102.2	11.0



DIRECT SHEAR (ASTM D-3080) TEST RESULTS

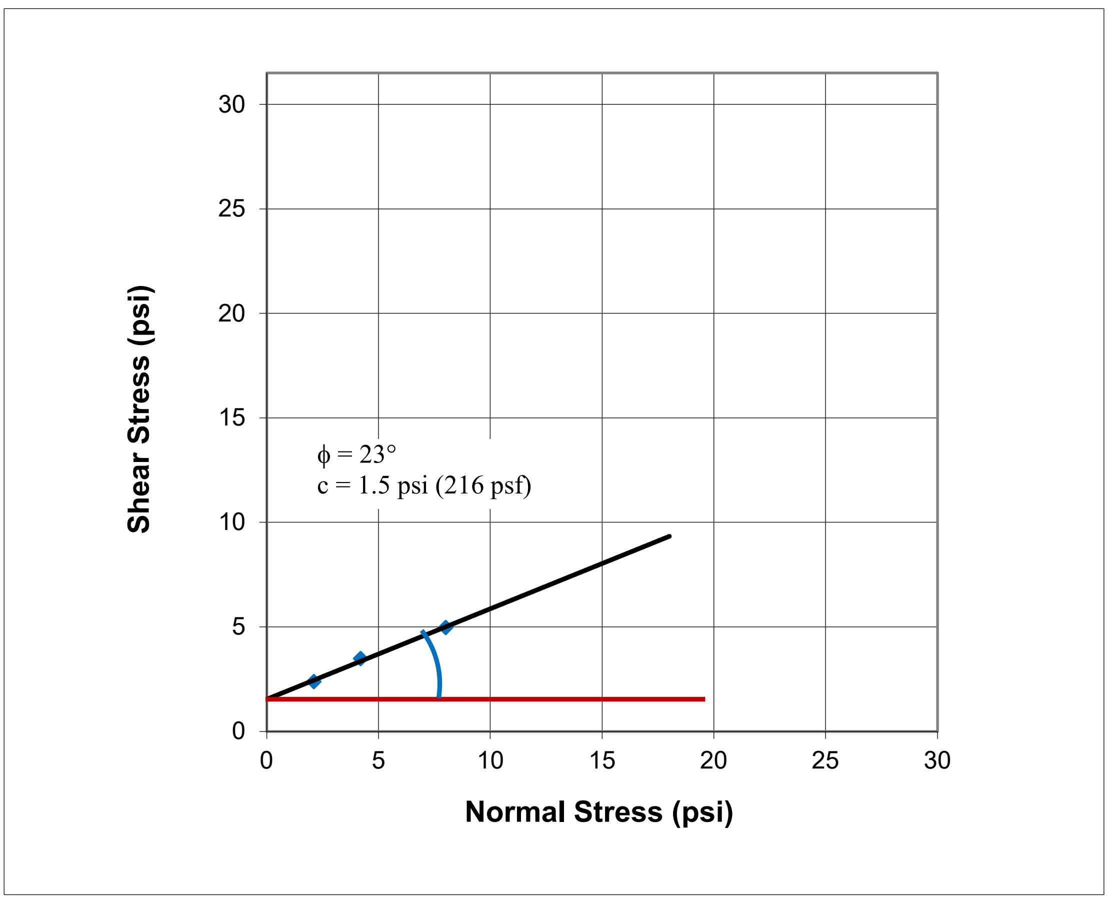
(Consolidated Drained)

Job Number: 21-071
Project: 040748 Hwy 22 to I-40
Crawford County, Arkansas
Sample Depth: 2.5-3
Source: FB-74
Sample Description: Reddish brown silty CLAY

Tested By: LLC
Reported by: JDF
Test Date: 10/3/2023

Material Properties: LL=42, PL=27, PI=15; Percent Passing No. 200 Sieve = 90%
ASTM Classification: ML, AASHTO Classification = A-7-6

Specimen	Normal Stress, σ'_v (psi)	Shear at failure, τ_f (psi)	Unit Dry Wt, γ_d (lb/ft^3)	Moisture Content, w (%)
1	2.1	2.4	95.1	28.3
2	4.2	3.5	95.1	28.1
3	8.0	5.0	95.1	28.4

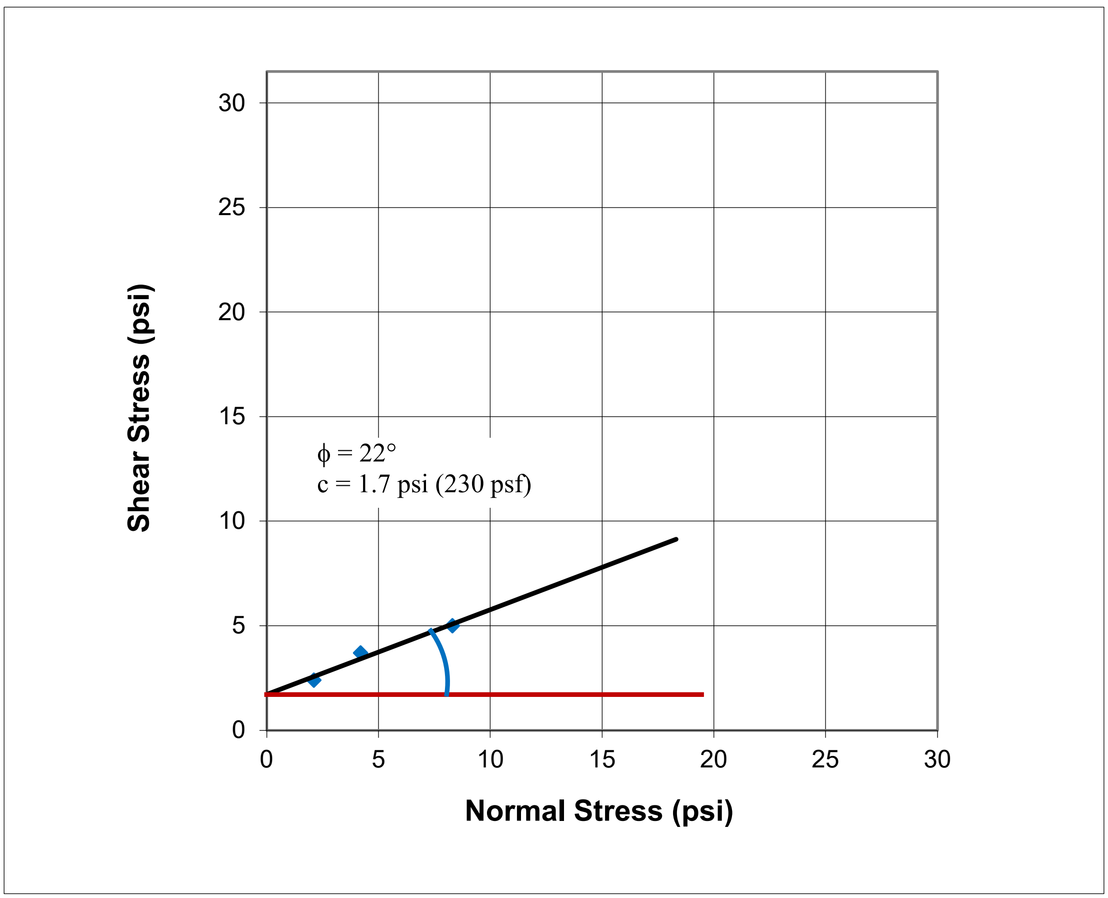


DIRECT SHEAR (ASTM D-3080) TEST RESULTS
(Consolidated Drained)

Job Number:	21-071	Tested By:	LLC
Project:	040748 Hwy 22 to I-40	Reported by:	JDF
	Crawford County, Arkansas	Test Date:	7/21/2023
Sample Depth:	4.5-5		
Source:	FB-77		
Sample Description:	Dark brown silty clay		

Material Properties: LL=26, PL=19, PI=7; Percent Passing No. 200 Sieve = 98%
ASTM Classification: CL-ML, AASHTO Classification = A-4

Specimen	Normal Stress, σ'_v (psi)	Shear at failure, τ_f (psi)	Unit Dry Wt, γ_d (lb/ft^3)	Moisture Content, w (%)
1	2.1	2.4	98.1	22.1
2	4.2	3.7	98.2	22.1
3	8.3	5.0	98.4	22.1



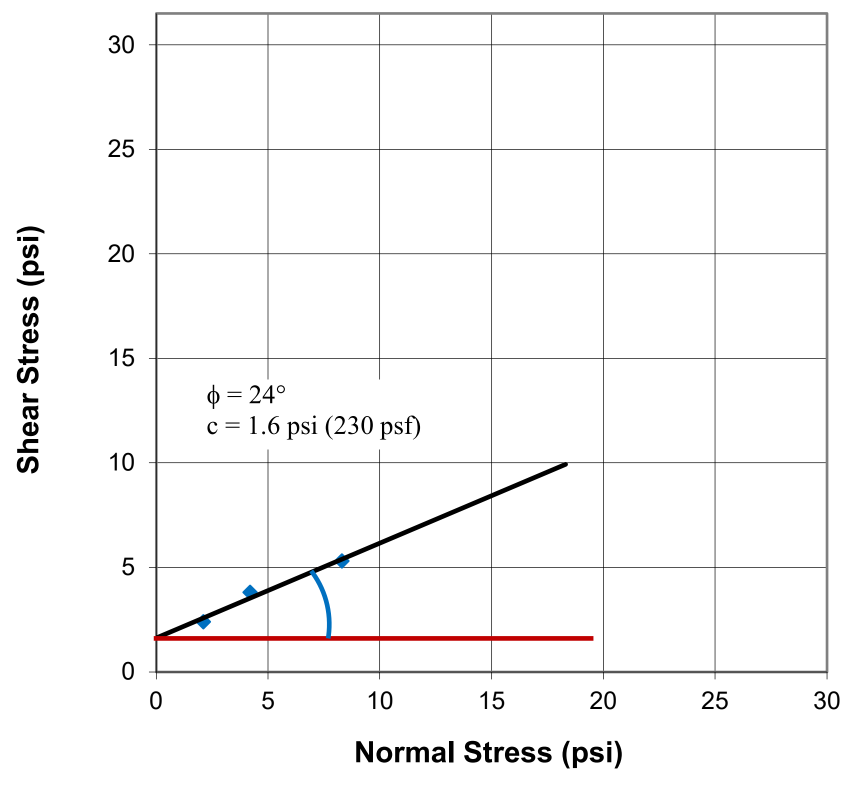
DIRECT SHEAR (ASTM D-3080) TEST RESULTS
(Consolidated Drained)

Job Number: 21-071
Project: 040748 Hwy 22 to I-40
Crawford County, Arkansas
Sample Depth: 5-5.5
Source: FB-77
Sample Description: Dark brown clayey SILT

Tested By: LLC
Reported by: JDF
Test Date: 7/24/2023

Material Properties: LL=26, PL=19, PI=7; Percent Passing No. 200 Sieve = 98%
ASTM Classification: CL-ML, AASHTO Classification = A-4

Specimen	Normal Stress, σ'_v (psi)	Shear at failure, τ_f (psi)	Unit Dry Wt, γ_d (lb/ft^3)	Moisture Content, w (%)
1	2.1	2.4	99.1	22.9
2	4.2	3.8	99.1	22.9
3	8.3	5.3	99.1	22.9

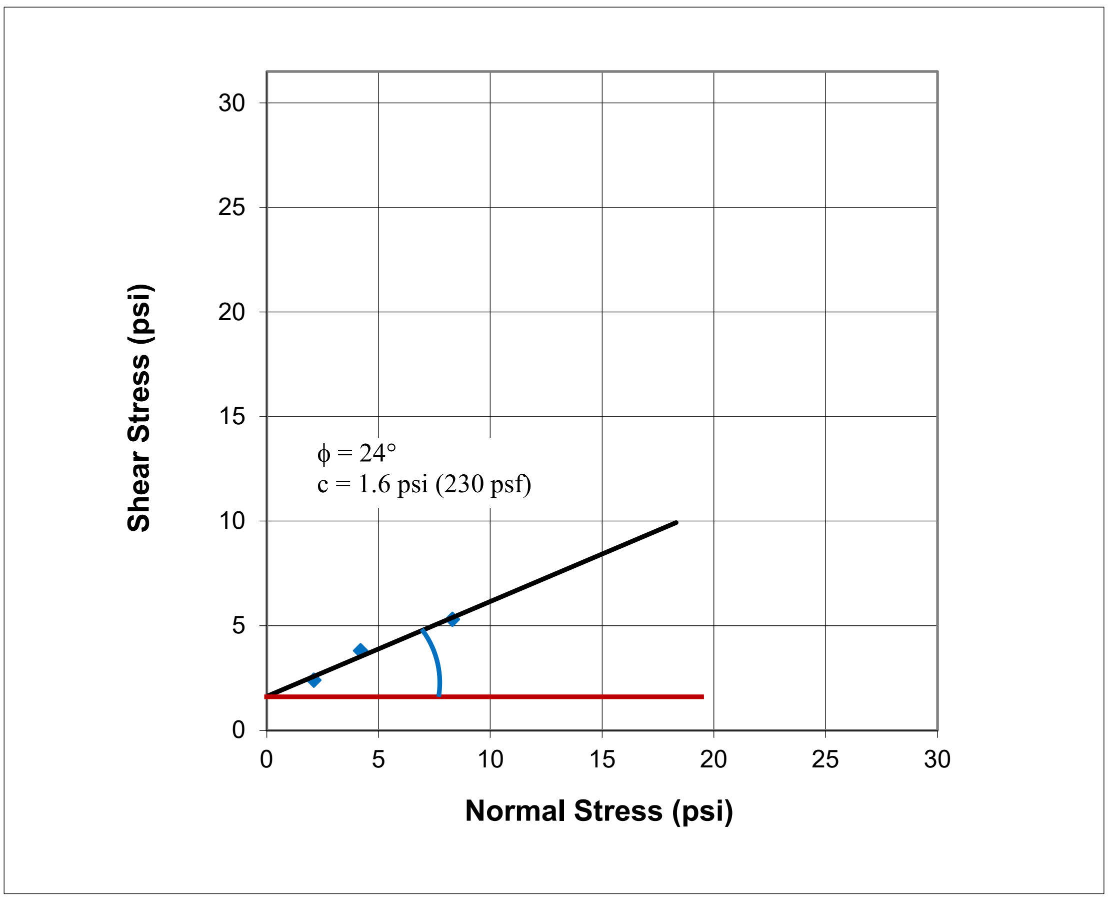


DIRECT SHEAR (ASTM D-3080) TEST RESULTS
(Consolidated Drained)

Job Number:	21-071	Tested By:	LLC
Project:	040748 Hwy 22 to I-40	Reported by:	JDF
	Crawford County, Arkansas	Test Date:	7/31/2023
Sample Depth:	2.5-3		
Source:	FB-78		
Sample Description:	Dark brown clayey SILT		

Material Properties: LL=24, PL=19, PI=5; Percent Passing No. 200 Sieve = 94%
ASTM Classification: CL-ML, AASHTO Classification = A-4

Specimen	Normal Stress, σ'_v (psi)	Shear at failure, τ_f (psi)	Unit Dry Wt, γ_d (lb/ft^3)	Moisture Content, w (%)
1	2.1	2.4	101.5	24.6
2	4.2	3.8	101.5	24.9
3	8.3	5.3	101.5	25.0

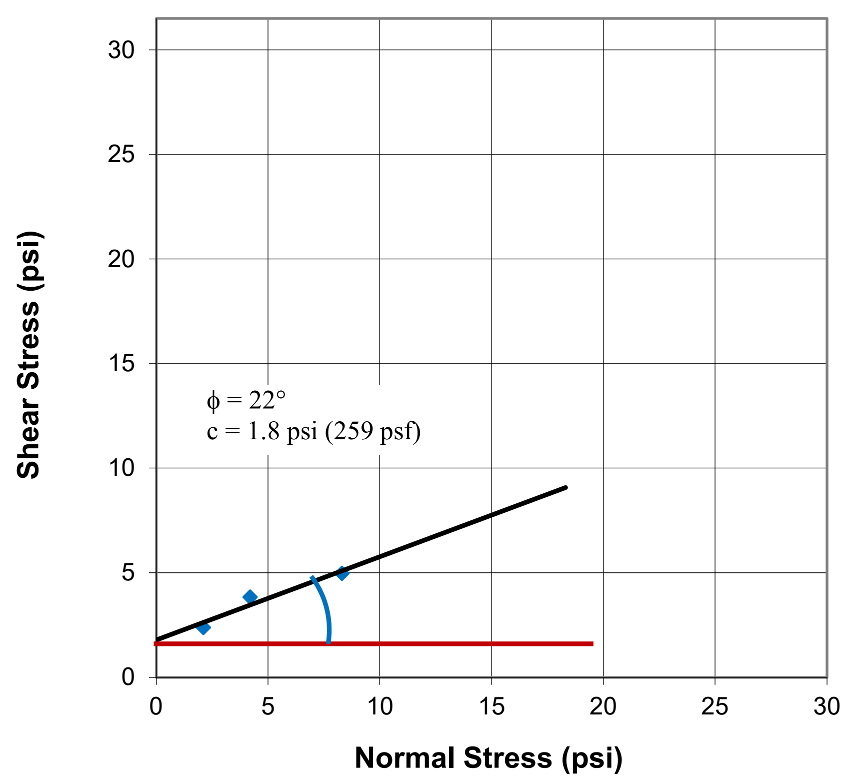


DIRECT SHEAR (ASTM D-3080) TEST RESULTS
(Consolidated Drained)

Job Number:	21-071	Tested By:	LLC
Project:	040748 Hwy 22 to I-40	Reported by:	JDF
	Crawford County, Arkansas	Test Date:	7/31/2023
Sample Depth:	3-3.5		
Source:	FB-78		
Sample Description:	Dark brown clayey SILT		

Material Properties: LL=24, PL=19, PI=5; Percent Passing No. 200 Sieve = 94%
ASTM Classification: CL-ML, AASHTO Classification = A-4

Specimen	Normal Stress, σ'_v (psi)	Shear at failure, τ_f (psi)	Unit Dry Wt, γ_d (lb/ft^3)	Moisture Content, w (%)
1	2.1	2.4	100.5	24.5
2	4.2	3.8	100.5	24.7
3	8.3	5.0	100.5	25.1

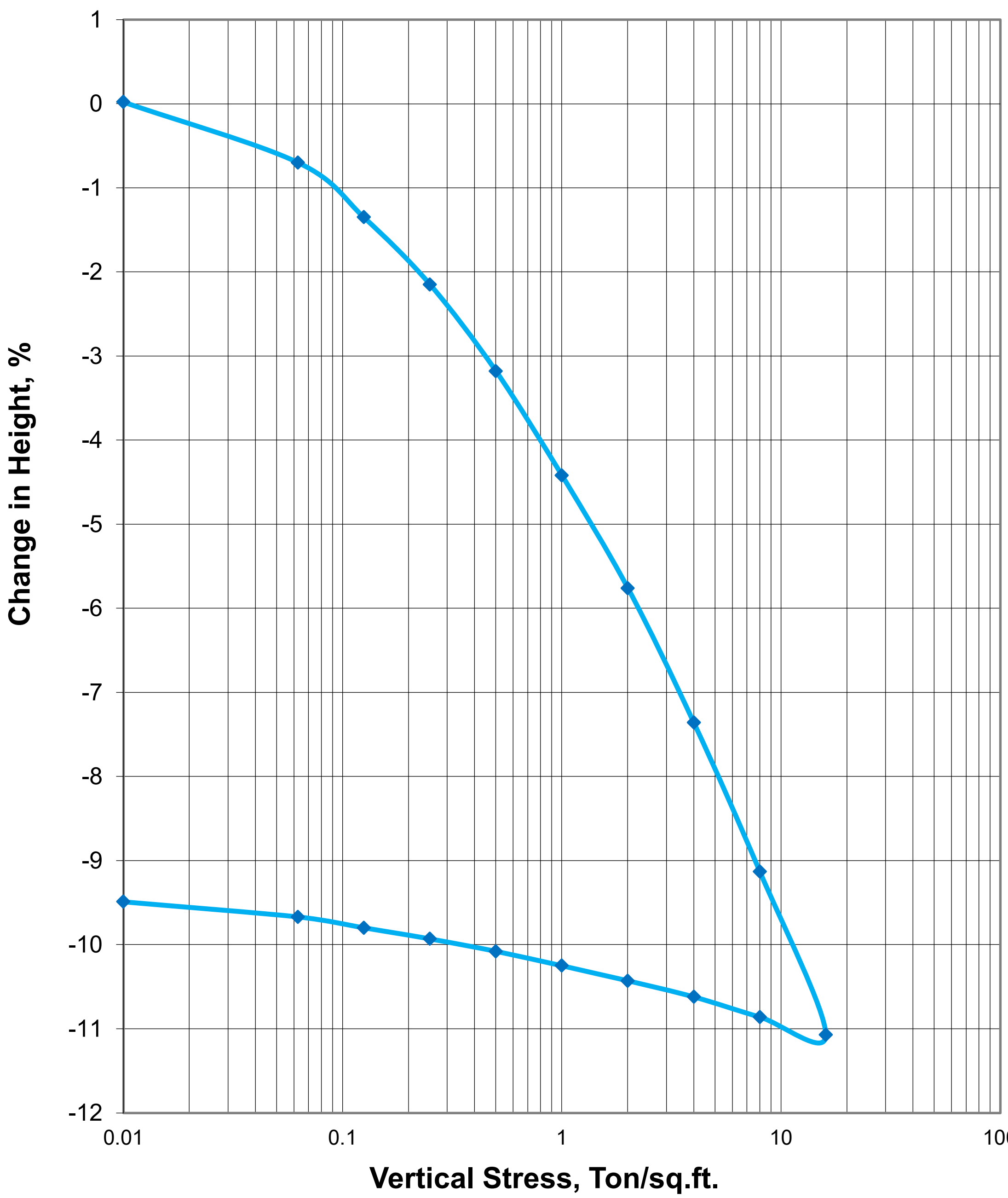


APPENDIX H

CONSOLIDATION TEST RESULTS
(AASHTO T 216)

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-10
Sample Depth: 2-2.5 ft
Description: Dark brown fine sandy SILT
USCS Classification: ML
AASHTO Classification: A-4
Specific Gravity: 2.7

Unit Dry Weight: 93.3 lbs/cu ft
Initial Water Content: 23.4%
Final Water Content: 19.7%
Initial Saturation: 129.3%
Final Saturation: -12.1%
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 80%



Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS

PLATE

CONSOLIDATION TEST RESULTS
(AASHTO T 216)

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-10
Sample Depth: 2-2.5 ft
Description: Dark brown fine sandy SILT
USCS Classification: ML
AASHTO Classification: A-4
Specific Gravity: 2.7

Unit Dry Weight: 93.3 lbs/cu ft
Initial Water Content: 23.4%
Final Water Content: 19.7%
Initial Saturation: 129.3%
Final Saturation: -12.1%
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 80%

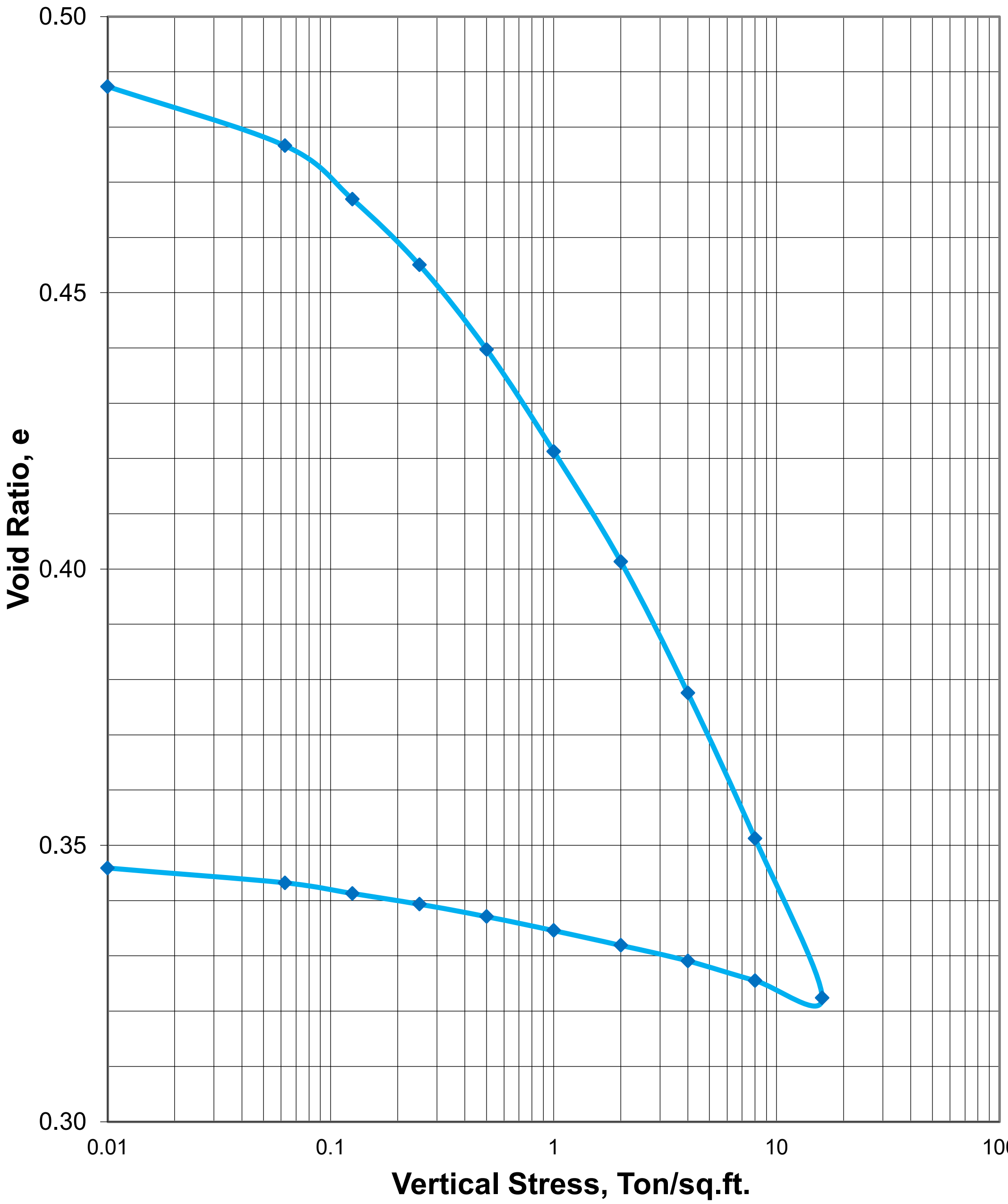


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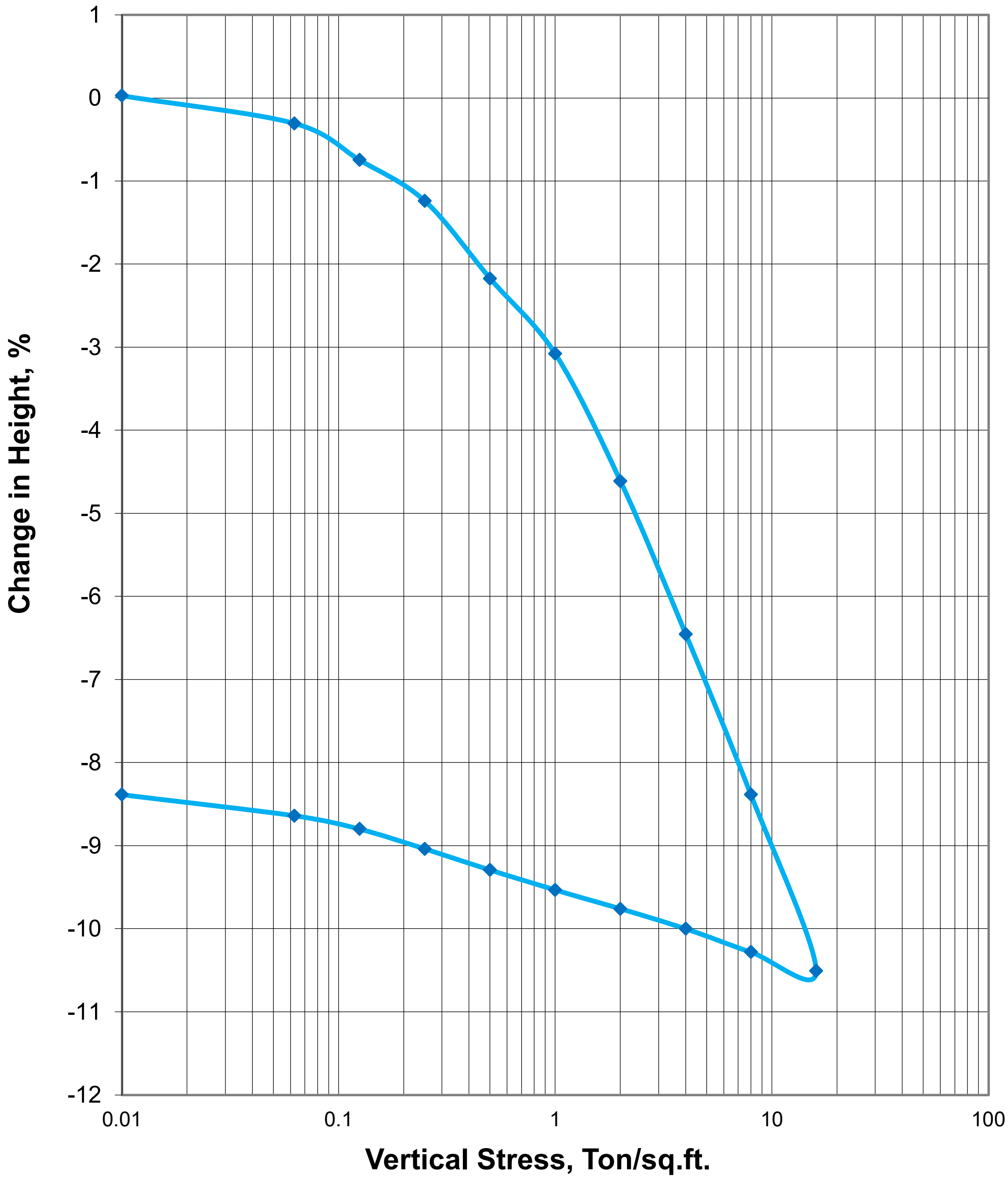
PLATE

CONSOLIDATION TEST RESULTS
(AASHTO T 216)

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-11
Sample Depth: 21.5-22 ft
Description: Reddish tan and brown silty CLAY
USCS Classification: CL
AASHTO Classification: A-7-6
Specific Gravity: 2.65

Unit Dry Weight: 103.8 lbs/cu ft
Initial Water Content: 17.4%
Final Water Content: 17.9%
Initial Saturation: 50.54%
Final Saturation: 103.99%
Liquid Limit: 43
Plastic Limit: 20
Percent Passing #200: 92%



Grubbs, Hoskyn,
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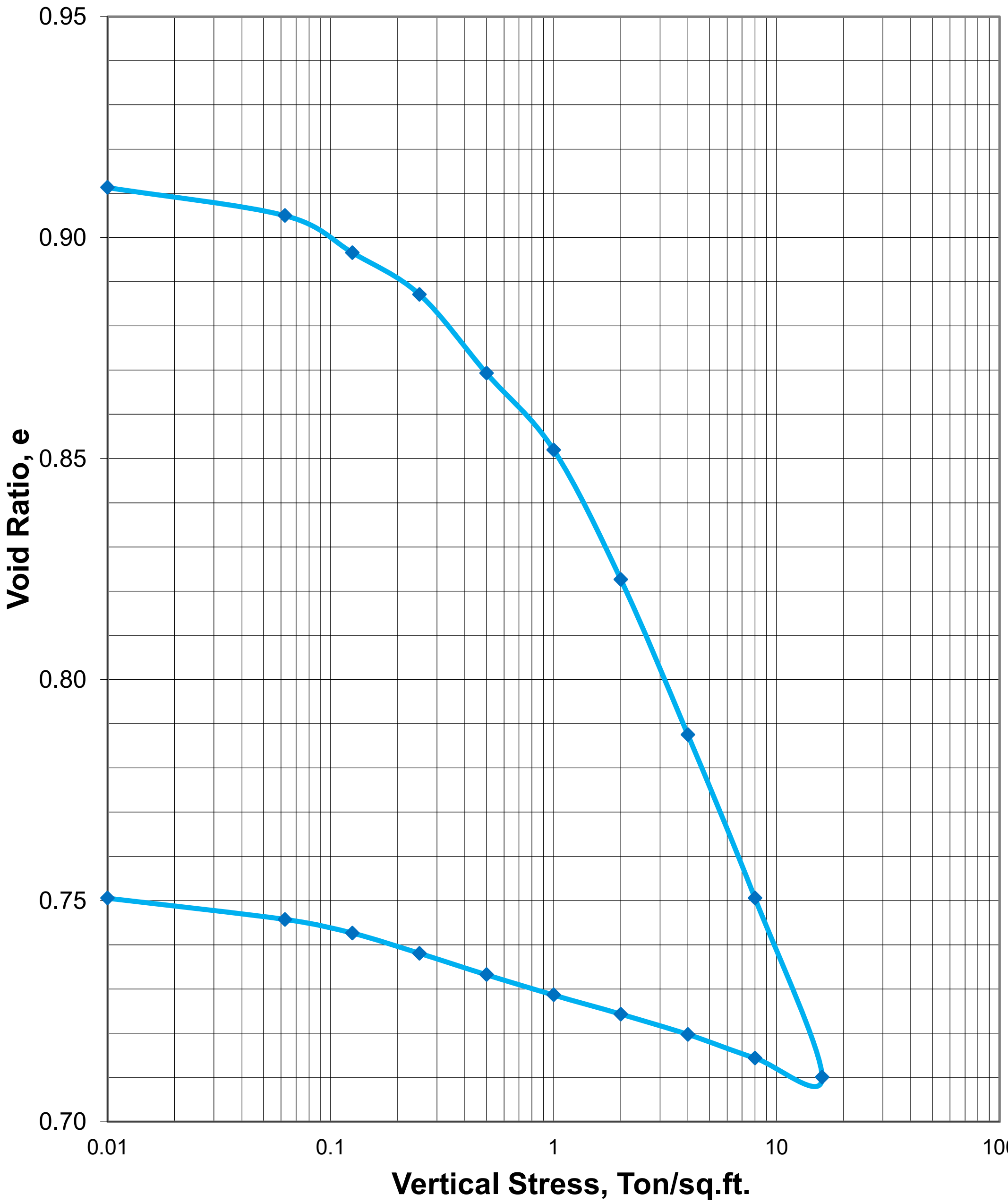
CONSULTING ENGINEERS

PLATE

CONSOLIDATION TEST RESULTS
(AASHTO T 216)

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-11
Sample Depth: 21.5-22 ft
Description: Reddish tan and brown silty CLAY
USCS Classification: CL
AASHTO Classification: A-7-6
Specific Gravity: 2.65

Unit Dry Weight: 103.8 lbs/cu ft
Initial Water Content: 17.4%
Final Water Content: 17.9%
Initial Saturation: 50.54%
Final Saturation: 103.99%
Liquid Limit: 43
Plastic Limit: 20
Percent Passing #200: 92%



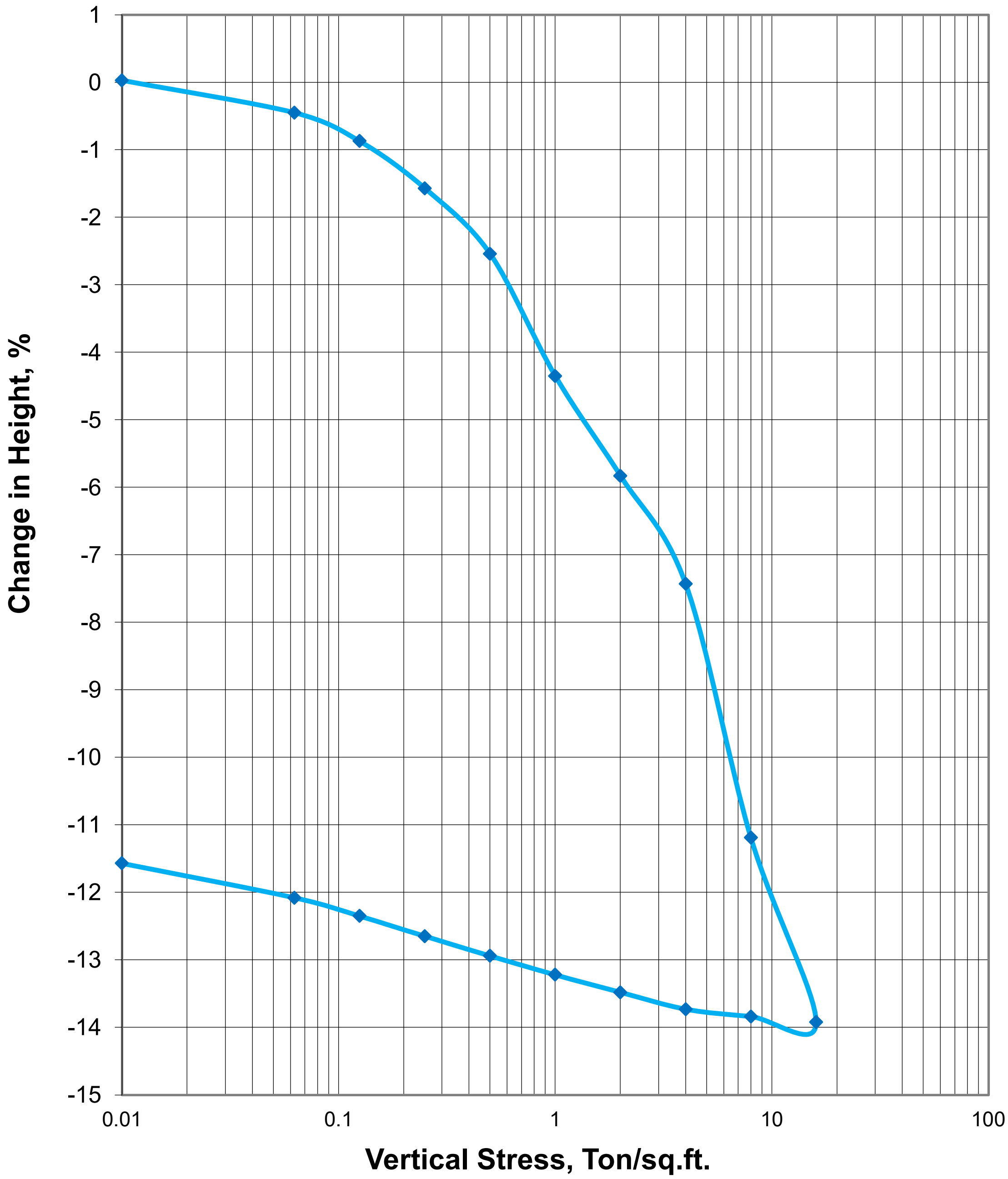
Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS

PLATE

CONSOLIDATION TEST RESULTS
(AASHTO T 216)

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-12
Sample Depth: 0.5-1 ft
Description: Dark brown and tan silty CLAY
USCS Classification: CL
AASHTO Classification: A-6
Specific Gravity: 2.65

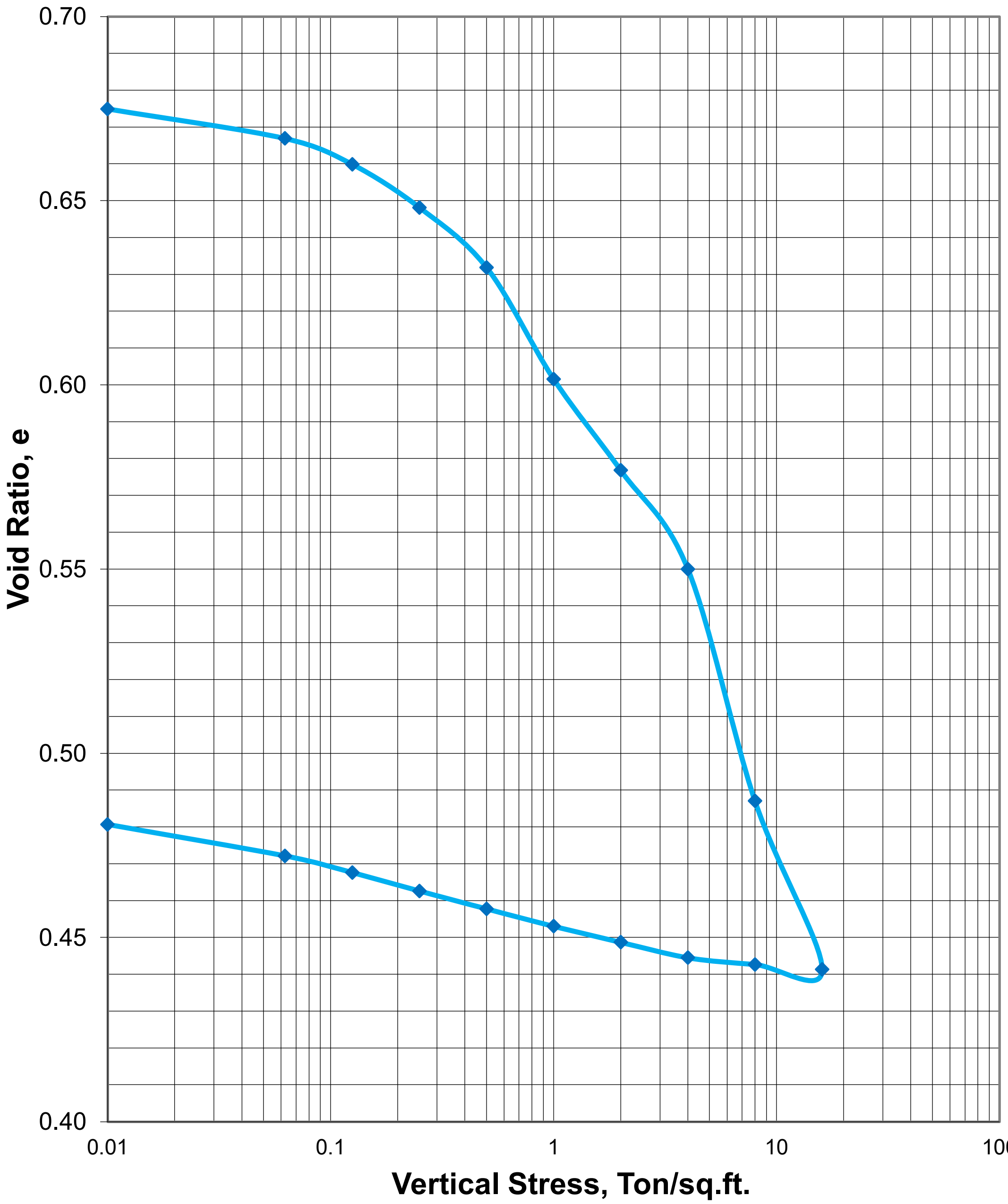
Unit Dry Weight: 100.8 lbs/cu ft
Initial Water Content: 22.3%
Final Water Content: 21.1%
Initial Saturation: 89.3%
Final Saturation: 118.4%
Liquid Limit: 30
Plastic Limit: 19
Percent Passing #200: 95%



CONSOLIDATION TEST RESULTS
(AASHTO T 216)

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-12
Sample Depth: 0.5-1 ft
Description: Dark brown and tan silty CLAY
USCS Classification: CL
AASHTO Classification: A-6
Specific Gravity: 2.65

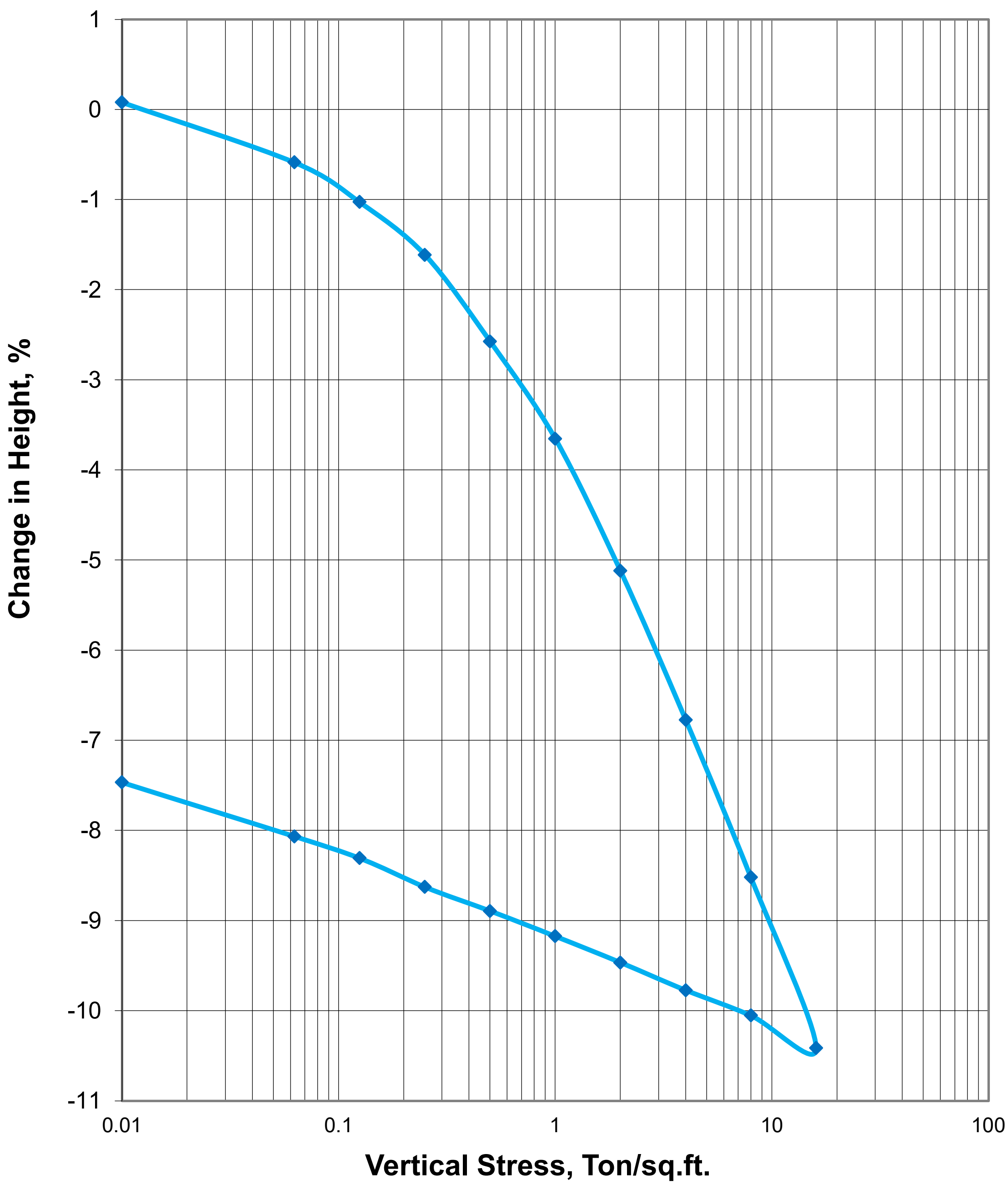
Unit Dry Weight: 100.8 lbs/cu ft
Initial Water Content: 22.3%
Final Water Content: 21.1%
Initial Saturation: 89.3%
Final Saturation: 118.4%
Liquid Limit: 30
Plastic Limit: 19
Percent Passing #200: 95%



CONSOLIDATION TEST RESULTS
(AASHTO T 216)

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-13
Sample Depth: 8-8.5 ft
Description: Reddish brown fine sandy SILT
USCS Classification: ML
AASHTO Classification: A-4
Specific Gravity: 2.70

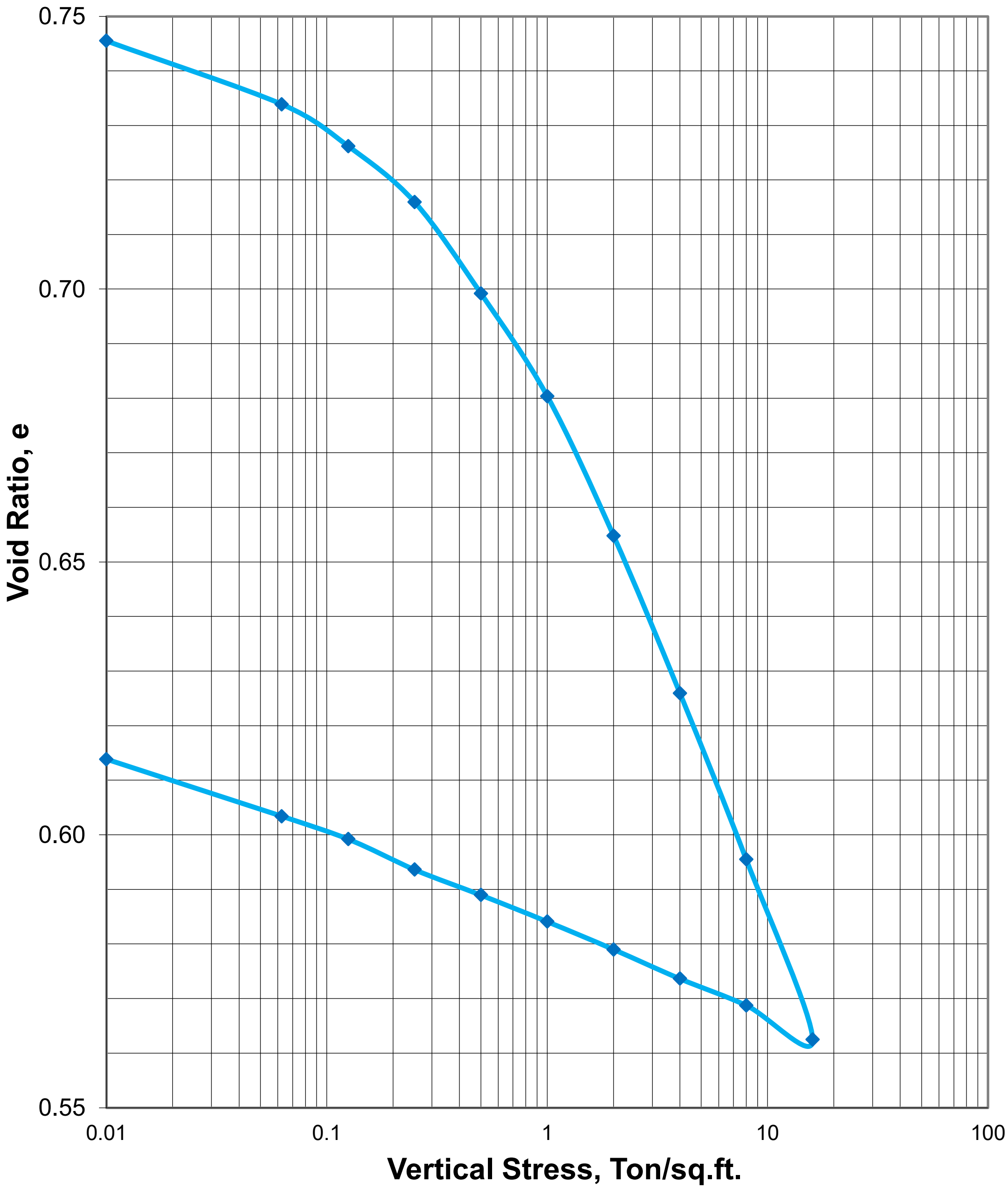
Unit Dry Weight: 96.6 lbs/cu ft
Initial Water Content: 17.6%
Final Water Content: 20.3%
Initial Saturation: 449.2%
Final Saturation: -390.7%
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 71%



CONSOLIDATION TEST RESULTS
(AASHTO T 216)

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-13
Sample Depth: 8-8.5 ft
Description: Reddish brown fine sandy SILT
USCS Classification: ML
AASHTO Classification: A-4
Specific Gravity: 2.70

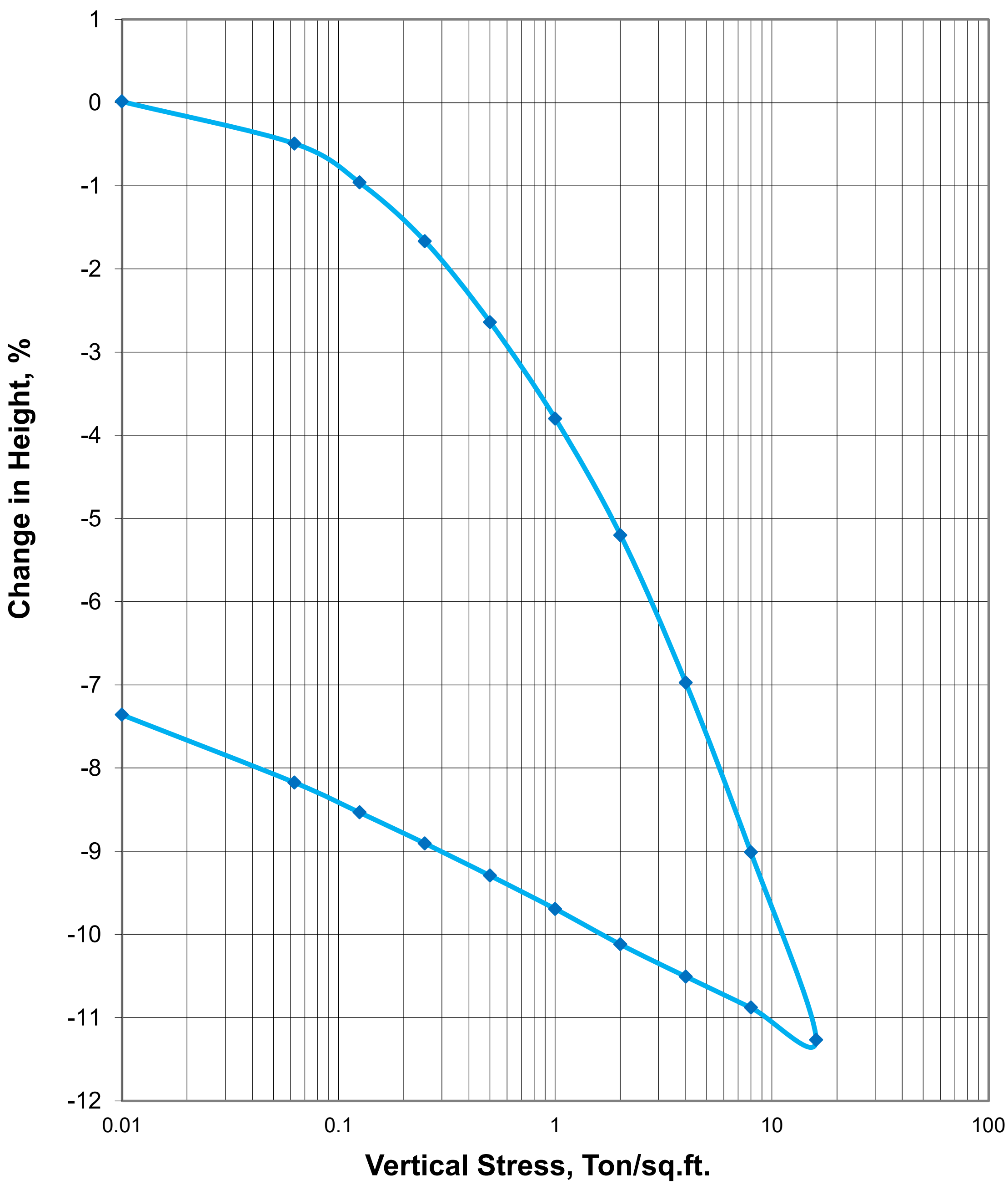
Unit Dry Weight: 96.6 lbs/cu ft
Initial Water Content: 17.6%
Final Water Content: 20.3%
Initial Saturation: 449.2%
Final Saturation: -390.7%
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 71%



CONSOLIDATION TEST RESULTS
(AASHTO T 216)

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-14
Sample Depth: 4.5-5 ft
Description: Brown clayey silt, slightly sandy
USCS Classification: ML
AASHTO Classification: A-4
Specific Gravity: 2.65

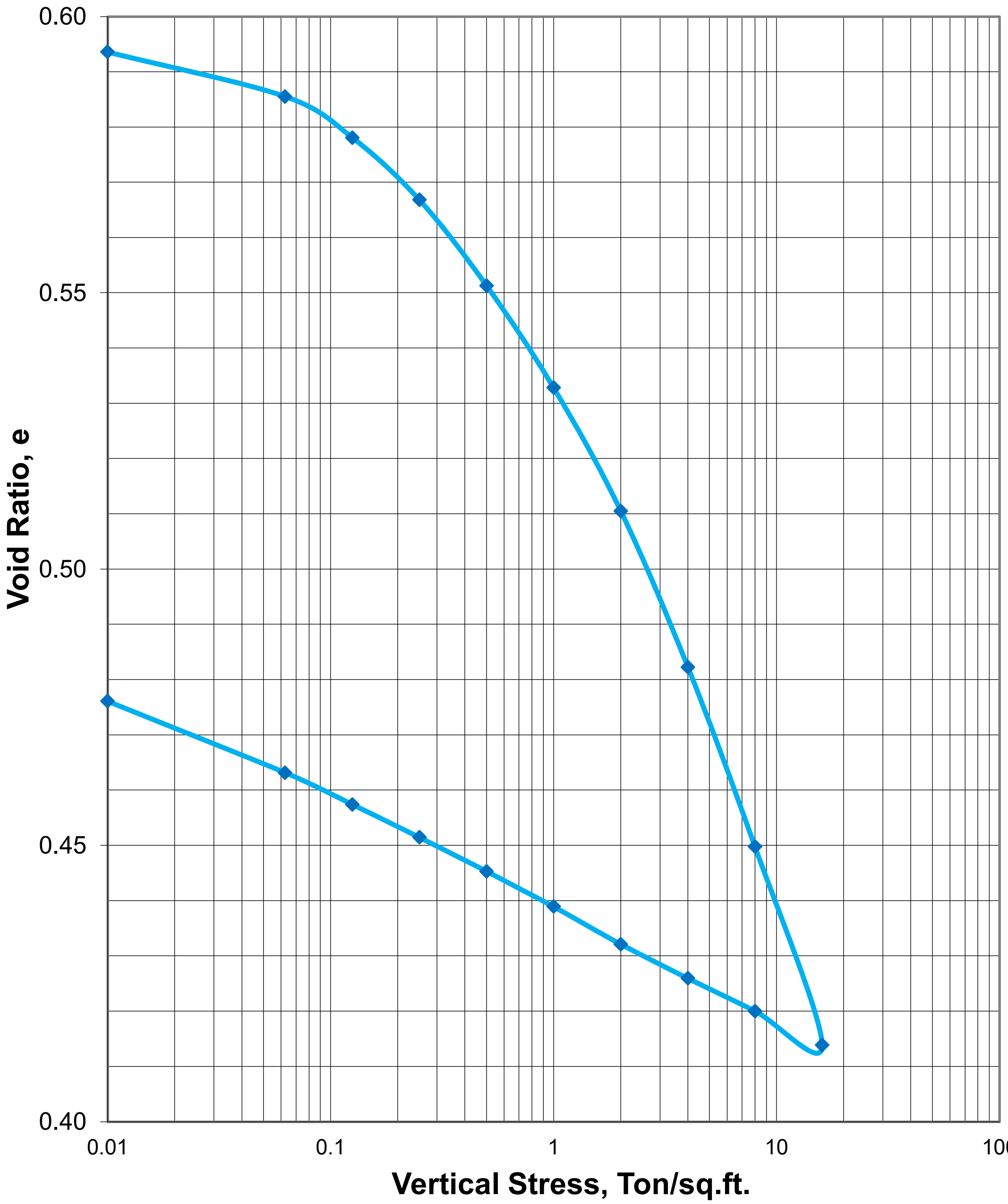
Unit Dry Weight: 103.8 lbs/cu ft
Initial Water Content: 21.0%
Final Water Content: 19.6%
Initial Saturation: 233.9%
Final Saturation: -67.15%
Liquid Limit: 24
Plastic Limit: 21
Percent Passing #200: 83%



CONSOLIDATION TEST RESULTS
(AASHTO T 216)

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-14
Sample Depth: 4.5-5 ft
Description: Brown clayey silt, slightly sandy
USCS Classification: ML
AASHTO Classification: A-4
Specific Gravity: 2.65

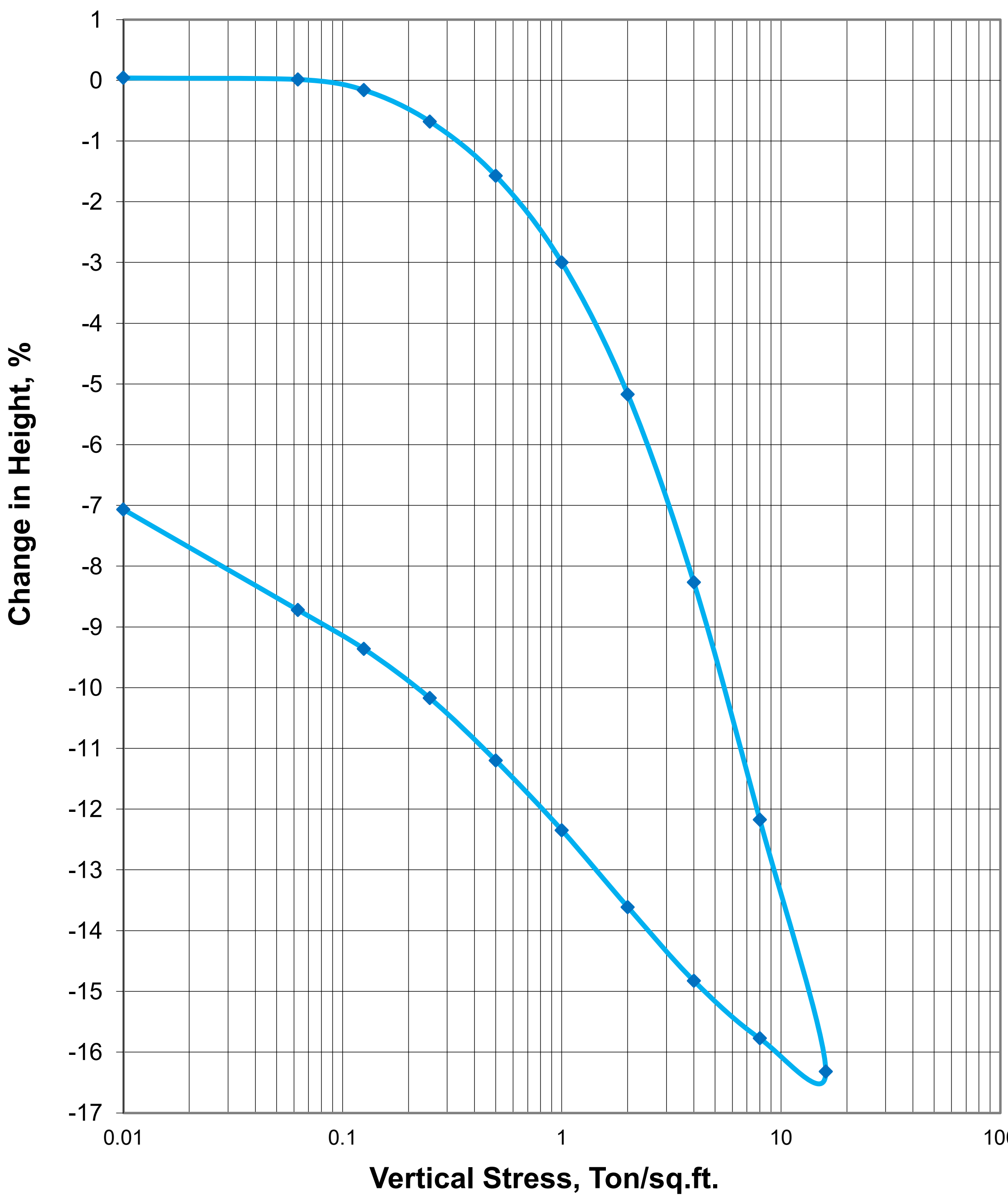
Unit Dry Weight: 103.8 lbs/cu ft
Initial Water Content: 21.0%
Final Water Content: 19.6%
Initial Saturation: 233.9%
Final Saturation: -67.15%
Liquid Limit: 24
Plastic Limit: 21
Percent Passing #200: 83%



CONSOLIDATION TEST RESULTS
(AASHTO T 216)

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-14
Sample Depth: 10.5-11 ft
Description: Reddish brown silty clay
USCS Classification: CL
AASHTO Classification: A-7-6
Specific Gravity: 2.67

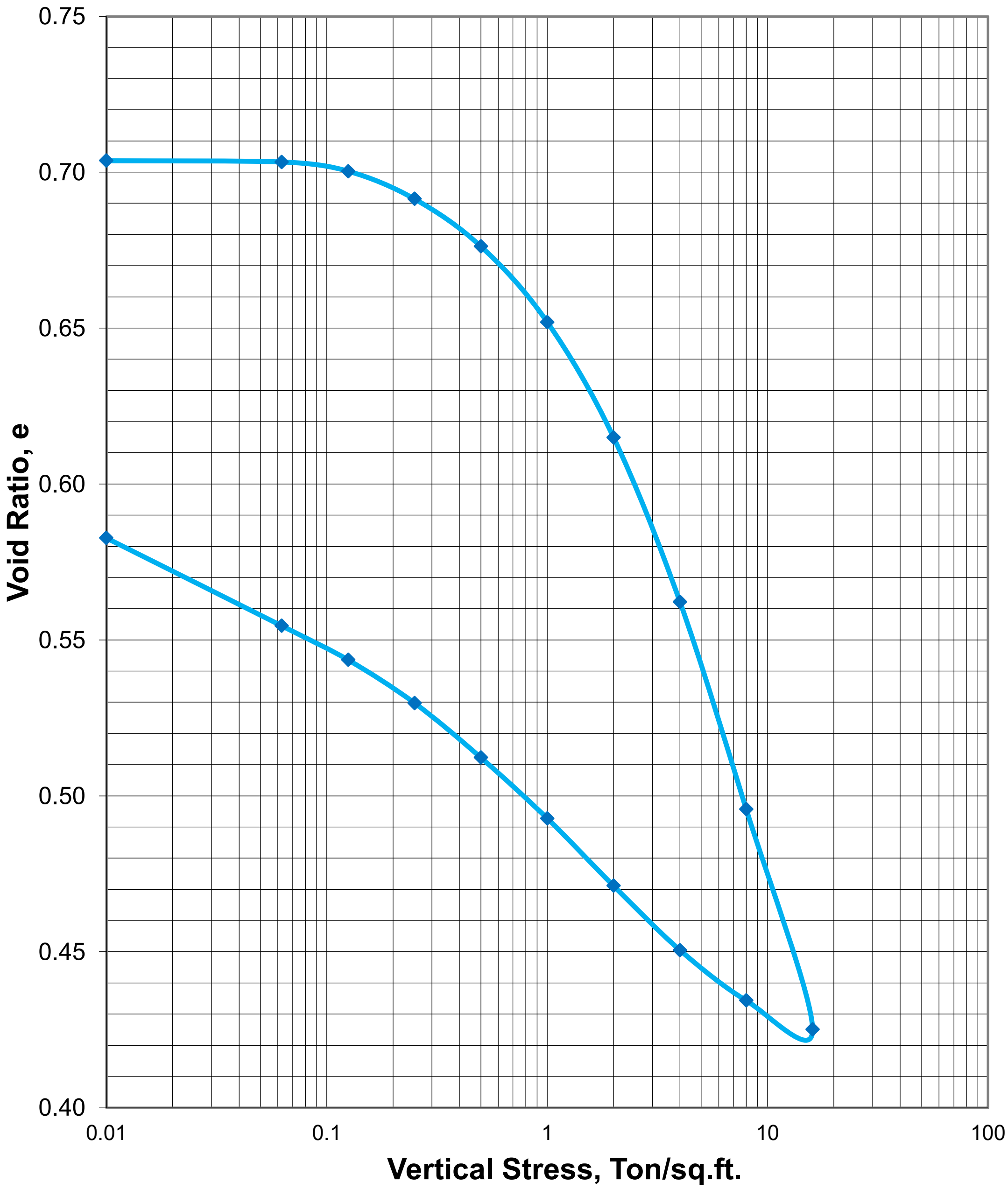
Unit Dry Weight: 92.0 lbs/cu ft
Initial Water Content: 28.1%
Final Water Content: 31.2%
Initial Saturation: 185.93%
Final Saturation: -12.1%
Liquid Limit: 45
Plastic Limit: 20
Percent Passing #200: 98%



CONSOLIDATION TEST RESULTS
(AASHTO T 216)

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-14
Sample Depth: 10.5-11 ft
Description: Reddish brown silty clay
USCS Classification: CL
AASHTO Classification: A-7-6
Specific Gravity: 2.67

Unit Dry Weight: 92.0 lbs/cu ft
Initial Water Content: 28.1%
Final Water Content: 31.2%
Initial Saturation: 185.93%
Final Saturation: -12.1%
Liquid Limit: 45
Plastic Limit: 20
Percent Passing #200: 98%



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CONSOLIDATION TEST RESULTS
(AASHTO T 216)

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FP-14
Sample Depth: 2-2.5 ft
Description: Brown silty clay
USCS Classification: CL
AASHTO Classification: A-6
Specific Gravity: 2.67

Unit Dry Weight: 108.4 lbs/cu ft
Initial Water Content: 22.7%
Final Water Content: 17.2%
Initial Saturation: 268.5%
Final Saturation: -49.7%
Liquid Limit: 30
Plastic Limit: 19
Percent Passing #200: 84%

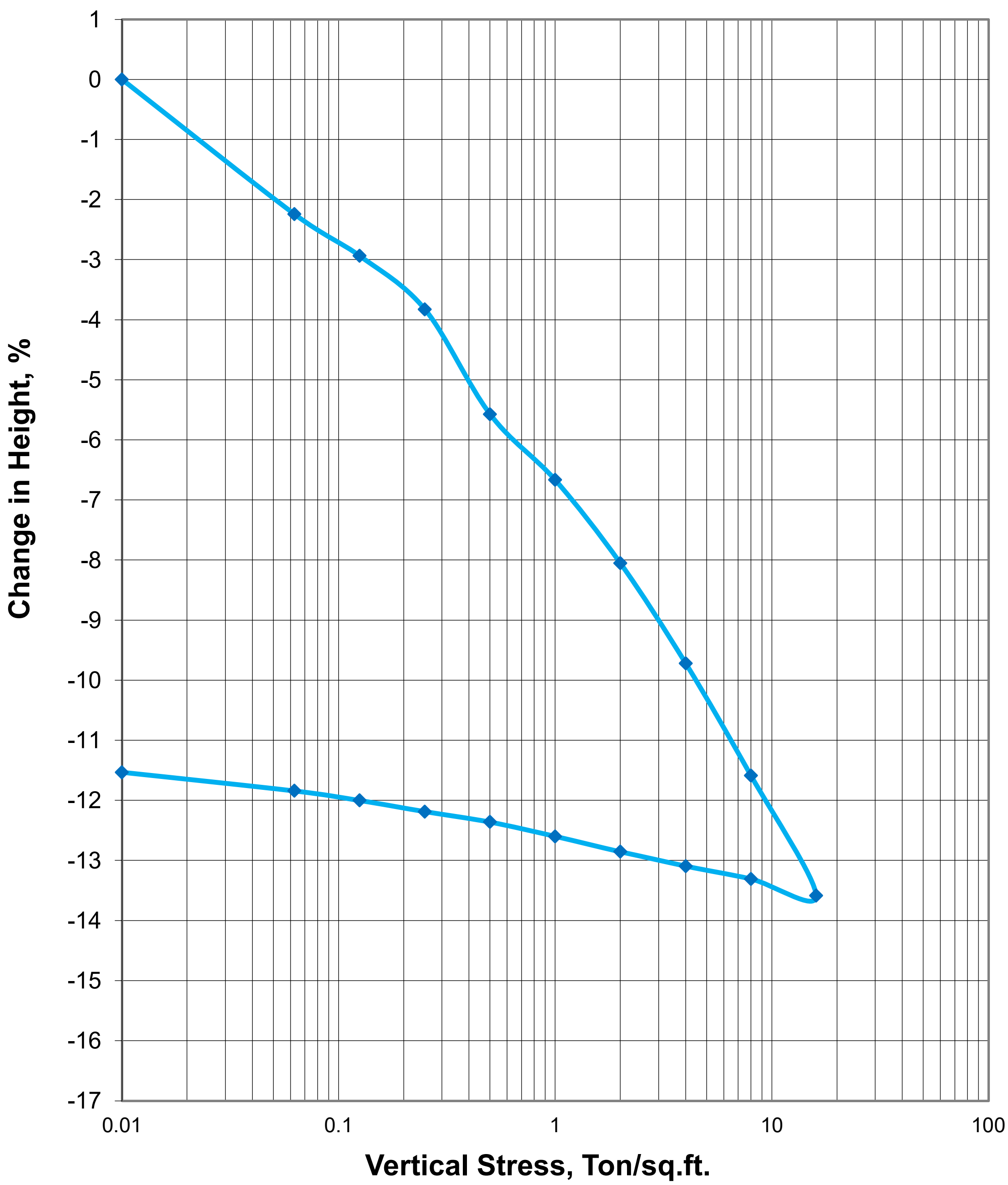

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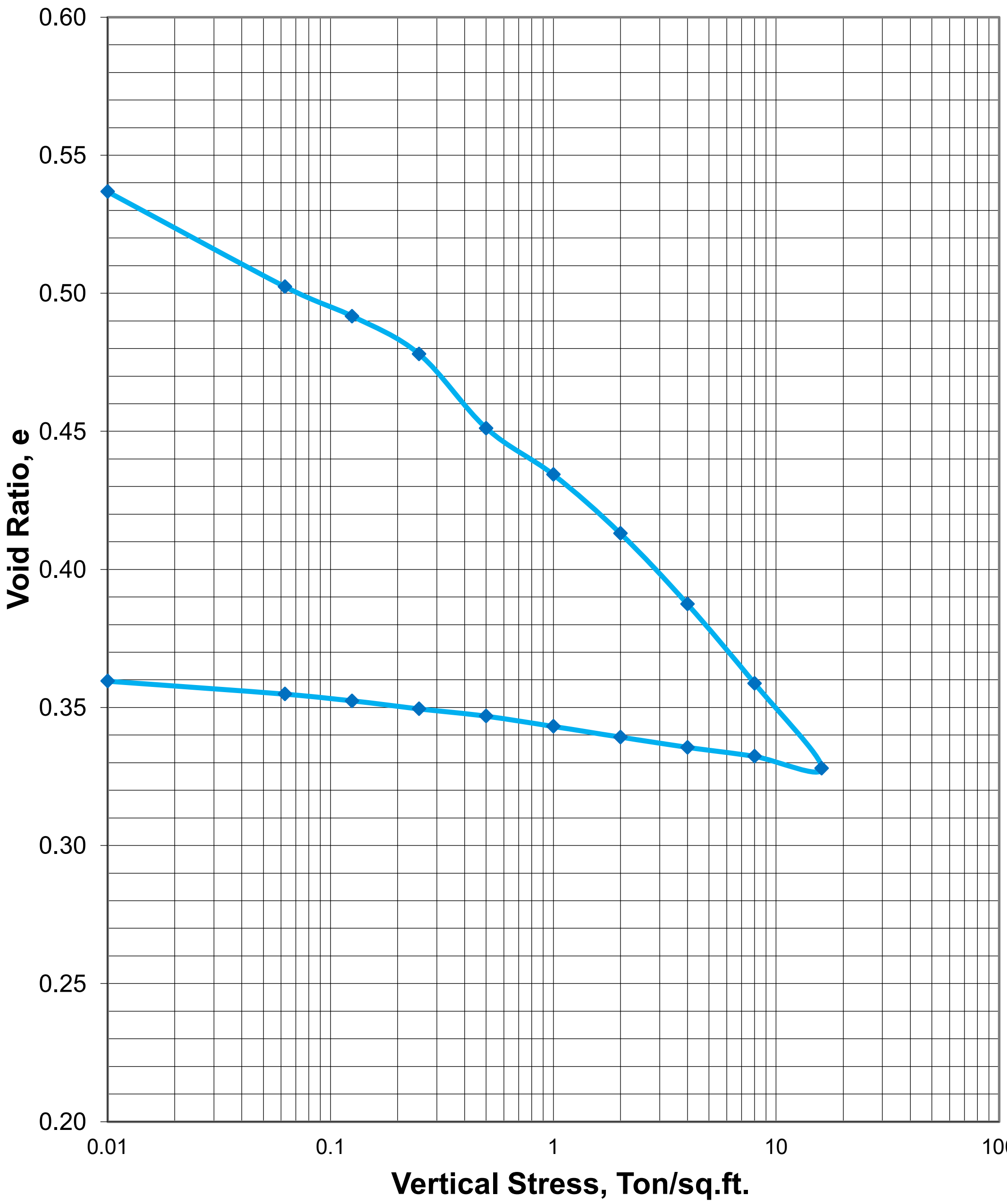
PLATE

CONSOLIDATION TEST RESULTS
(AASHTO T 216)

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FP-14
Sample Depth: 2-2.5 ft
Description: Brown silty clay
USCS Classification: CL
AASHTO Classification: A-6
Specific Gravity: 2.67

Unit Dry Weight: 108.4 lbs/cu ft
Initial Water Content: 22.7%
Final Water Content: 17.2%
Initial Saturation: 268.5%
Final Saturation: -49.7%
Liquid Limit: 30
Plastic Limit: 19
Percent Passing #200: 84%



APPENDIX I

SUMMARY of COEFFICIENTS OF CONSOLIDATION

PROJECT: 040748 - Hwy 22 to I-40
LOCATION: Crawford and Sebastian Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING NO.	DEPTH, FT	ATTERBERG LIMITS			PERCENT PASSING #200	Soil Description	UNIFIED CLASS.	AASHTO CLASS.	c_v, cm^2/sec
		LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX					
FE-10	2-2.5	Non-plastic			80	Dark brown fine sandy SILT	ML	A-4	$8x10^{-4}$
FE-11	21.5-22	43	20	23	92	Reddish tan and brown silty CLAY	CL	A-7-6	$2x10^{-3}$
FE-12	0.5-1	30	19	11	95	Dark brown and tan silty CLAY	CL	A-6	$7x10^{-4}$
FE-13	2-2.5	Non-plastic			75	Brown fine SILT	ML	A-4	$2x10^{-4}$
FE-13	8-8.5	Non-plastic			71	Reddish brown fine sandy SILT	ML	A-4	$4x10^{-4}$
FE-14	4.5-5	24	21	3	83	Brown clayey silt, slightly sandy	ML	A-4	$6x10^{-4}$
FE-14	10.5-11	45	20	25	98	Reddish brown silty CLAY	CL	A-7-6	$4x10^{-4}$

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FB-153
Sample Depth: 6.5-7 ft
Loading Increment, tsf: 1
Description: Reddish brown and tan silty CLAY
USCS Classification: CL
AASHTO Classification: A-6

Unit Dry Weight: 102.3 lbs/cu ft
Initial Water Content: 16.4%
Final Water Content: 21.5%
Liquid Limit: 37
Plastic Limit: 23
Percent Passing #200: 87%
Initial Height Sample, cm: 2.4646

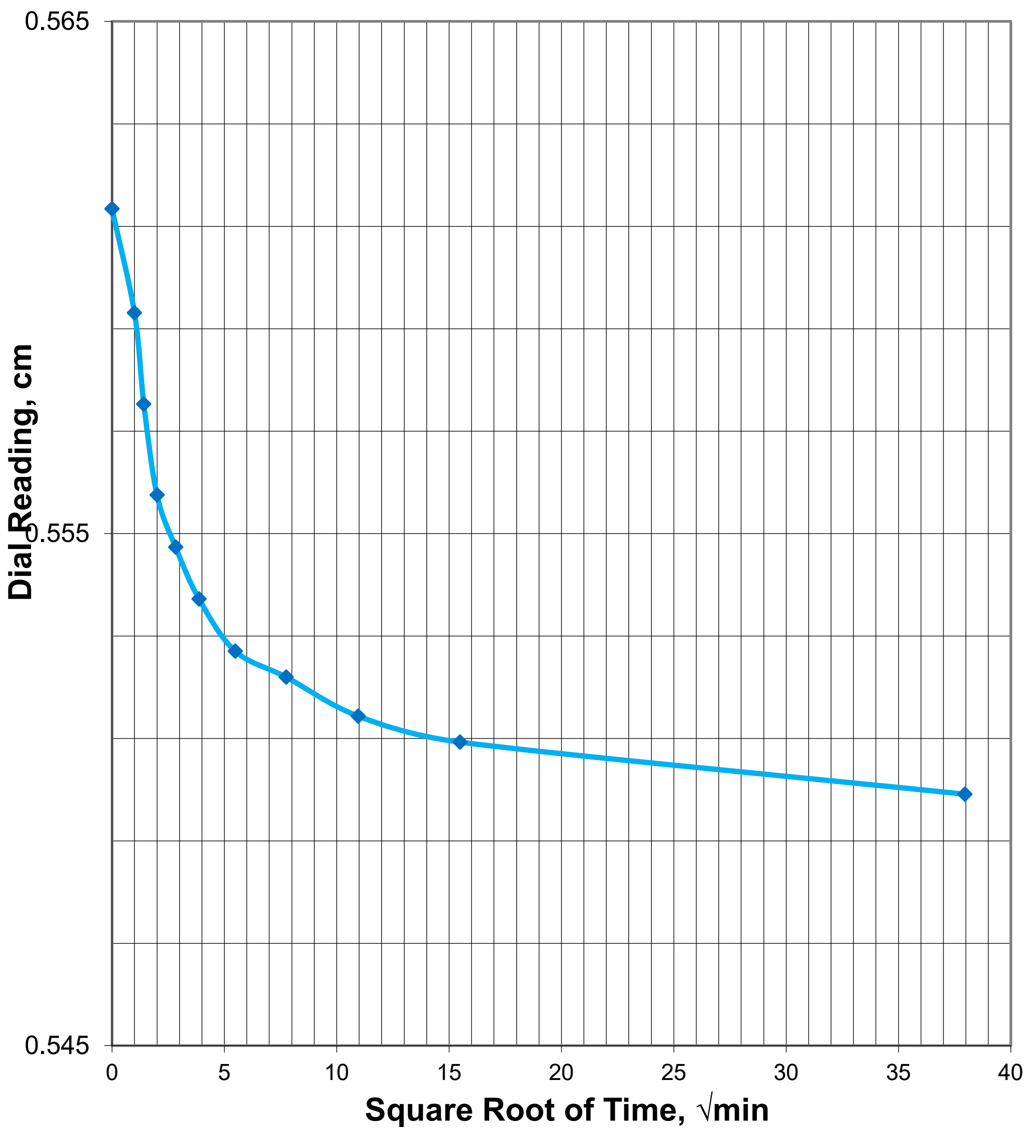


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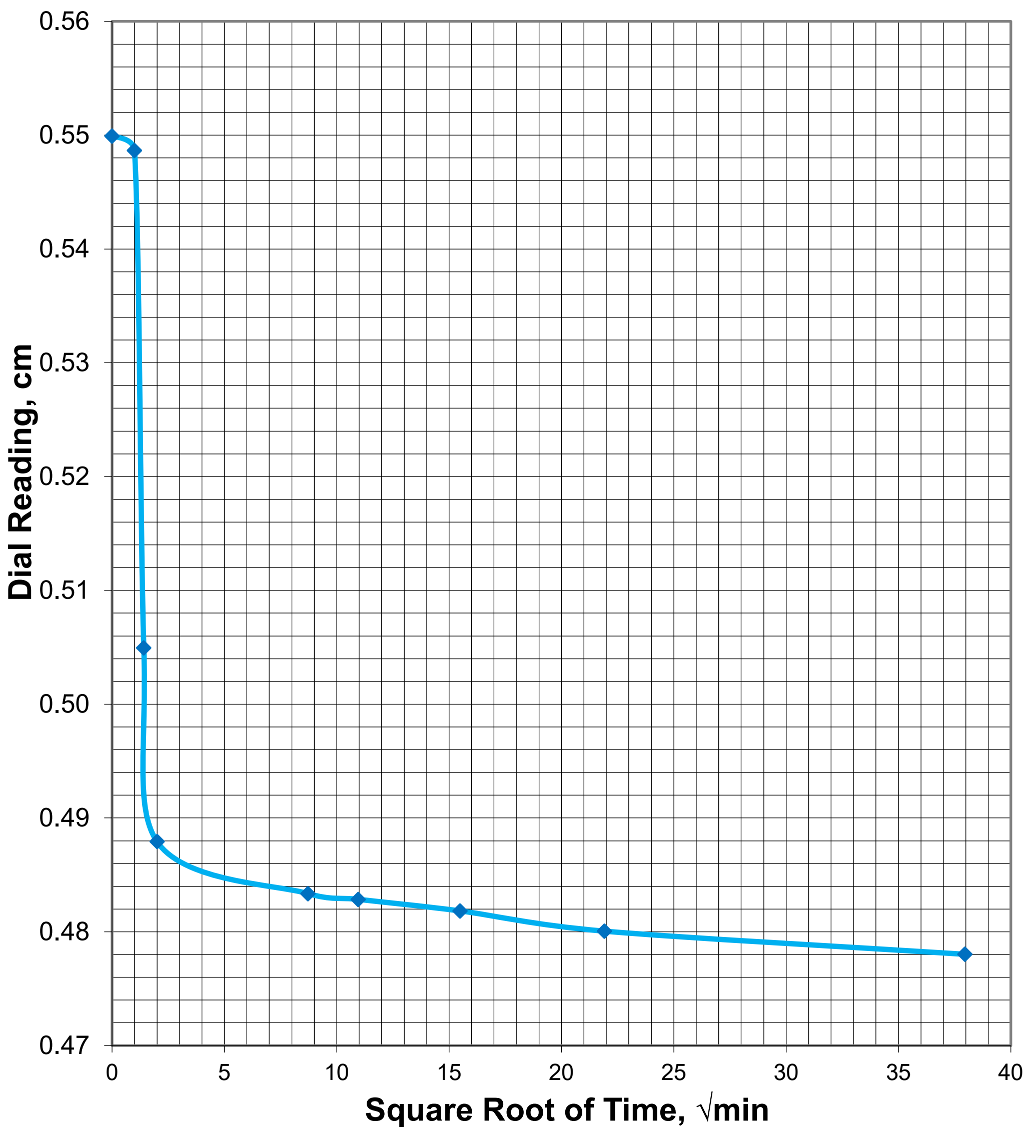
PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FB-153
Sample Depth: 6.5-7 ft
Loading Increment, tsf: 2
Description: Reddish brown and tan silty CLAY
USCS Classification: CL
AASHTO Classification: A-6

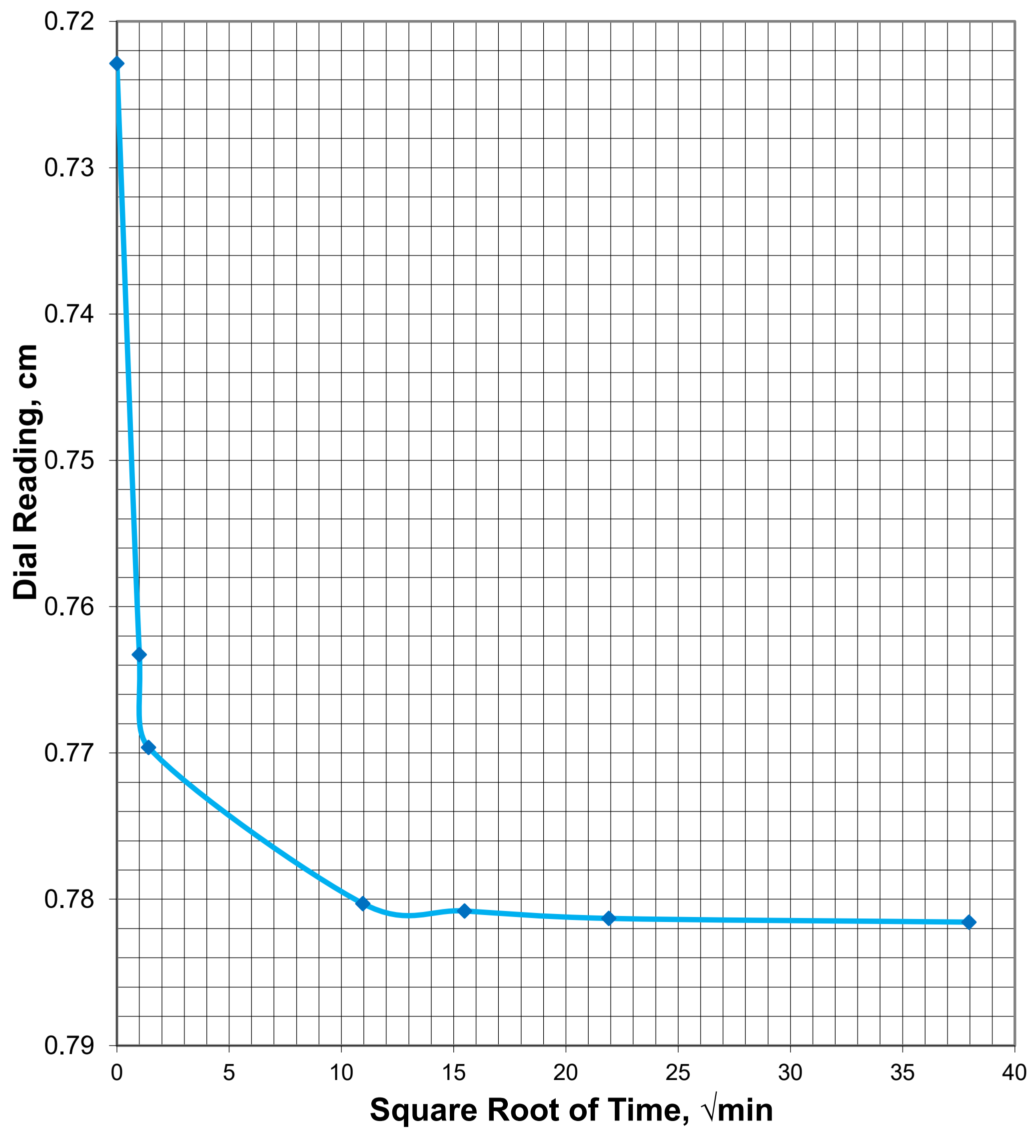
Unit Dry Weight: 102.3 lbs/cu ft
Initial Water Content: 16.4%
Final Water Content: 21.5%
Liquid Limit: 37
Plastic Limit: 23
Percent Passing #200: 87%
Initial Height Sample, cm: 2.4531



SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FB-156
Sample Depth: 7-7.5 ft
Loading Increment, tsf: 8
Description: Reddish brown and tan silty CLAY
USCS Classification: CL
AASHTO Classification: A-6

Unit Dry Weight: 99.1 lbs/cu ft
Initial Water Content: 17.1%
Final Water Content: 23.8%
Liquid Limit: 41
Plastic Limit: 25
Percent Passing #200: 86%
Initial Height Sample, cm: 1.7155



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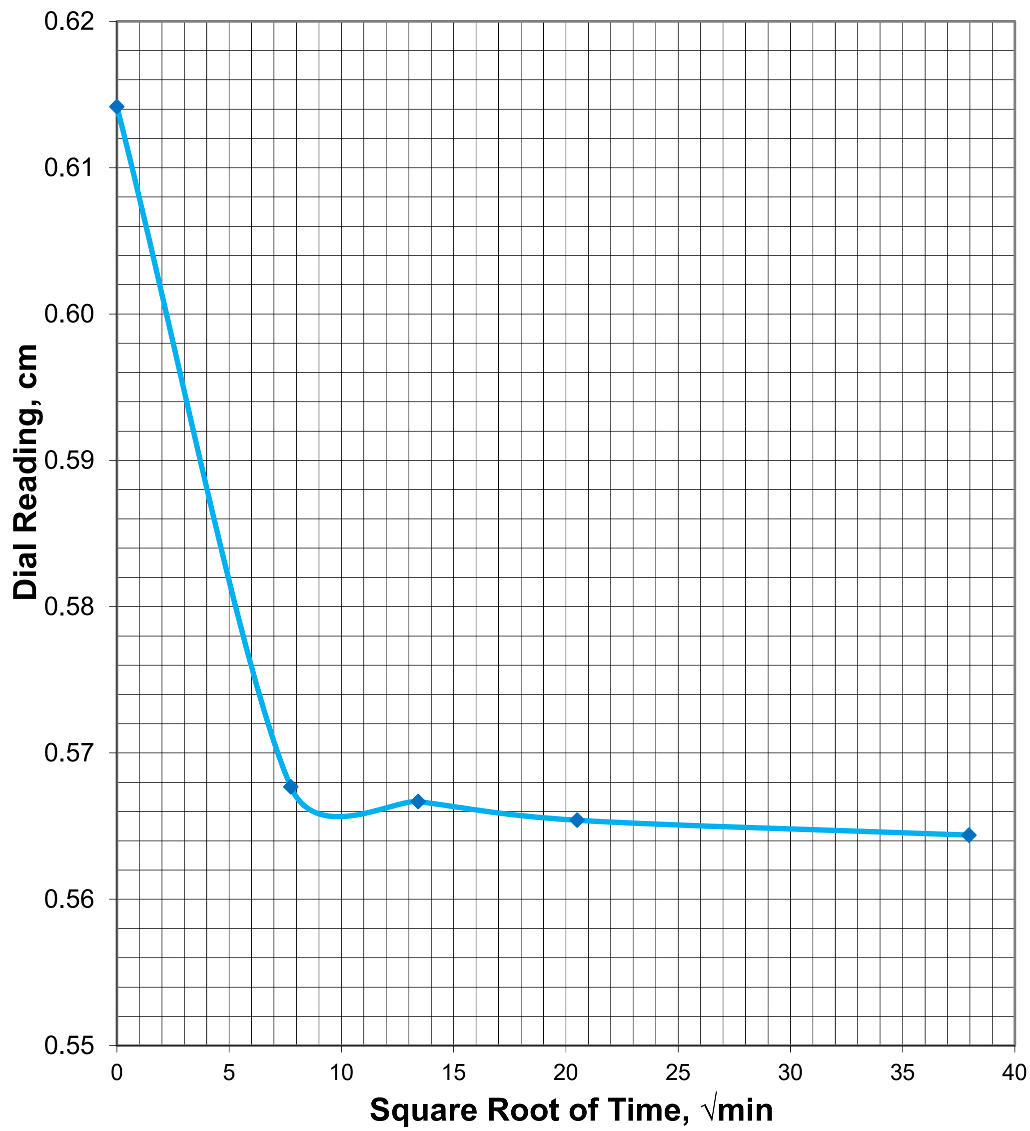
SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FB-157
Sample Depth: 8.5-9 ft
Loading Increment, tsf: 8
Description: Reddish brown and tan silty CLAY
USCS Classification: CL
AASHTO Classification: A-6

Unit Dry Weight: 104.2 lbs/cu ft
Initial Water Content: 21.3%
Final Water Content: 22.5%
Liquid Limit: 39
Plastic Limit: 24
Percent Passing #200: 79%
Initial Height Sample, cm: 2.4671



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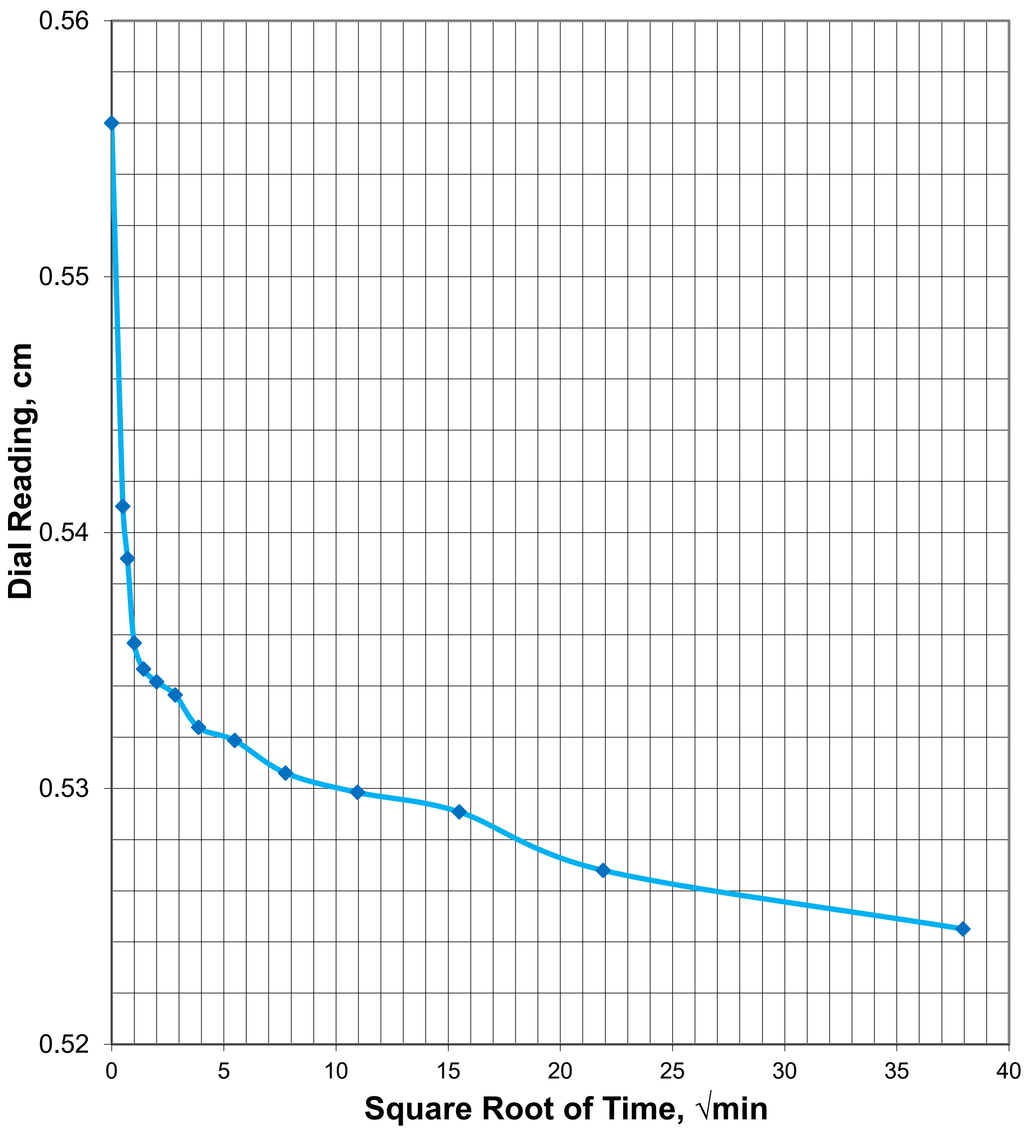
SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-10
Sample Depth: 2-2.5 ft
Loading Increment, tsf: 1
Description: Dark brown fine sandy SILT
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 93.3 lbs/cu ft
Initial Water Content: 23.4%
Final Water Content: 19.7
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 80%
Initial Height Sample, cm: 2.4592



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SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-10
Sample Depth: 2-2.5 ft
Loading Increment, tsf: 2
Description: Dark brown fine sandy SILT
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 93.3 lbs/cu ft
Initial Water Content: 23.4%
Final Water Content: 19.7
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 80%
Initial Height Sample, cm: 2.4277

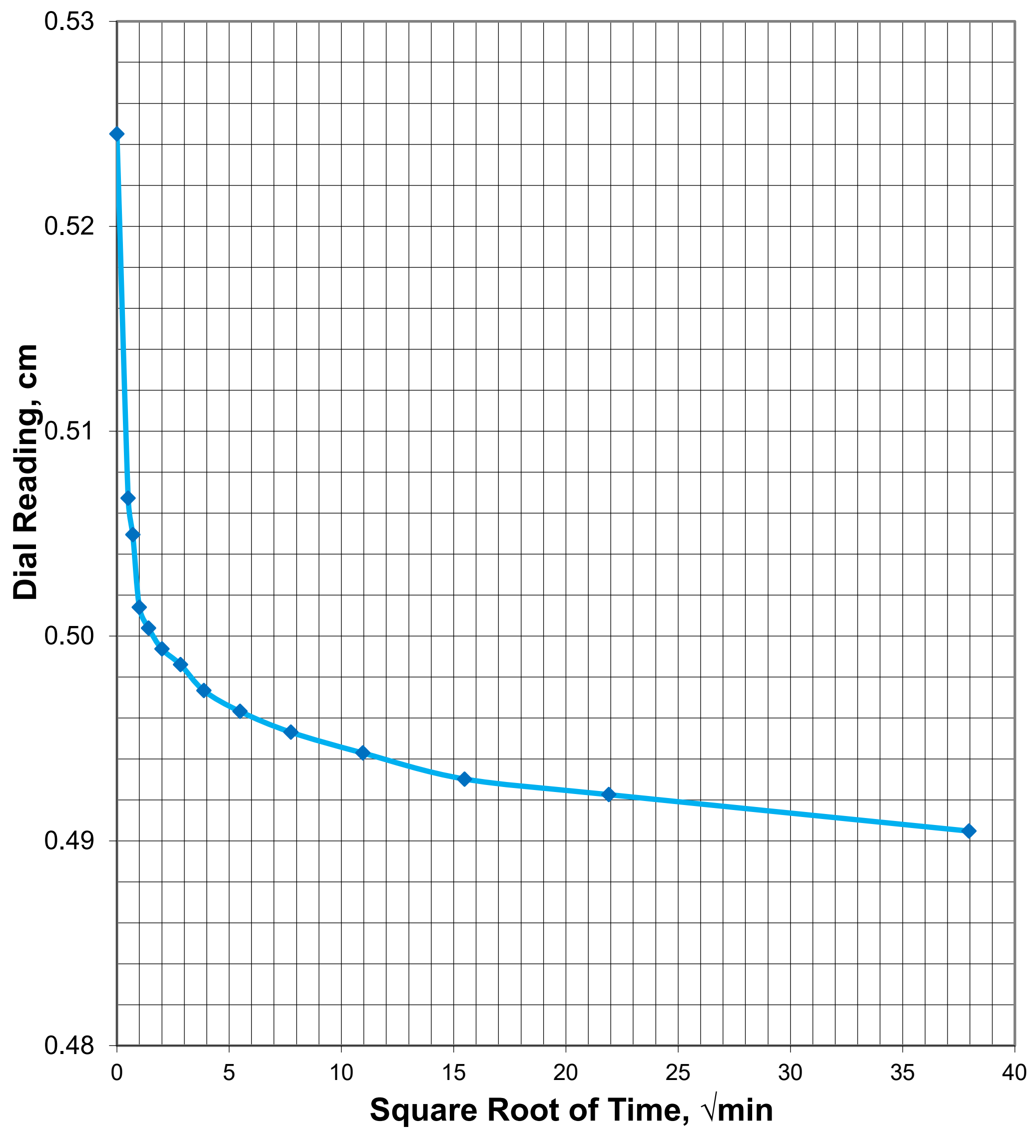

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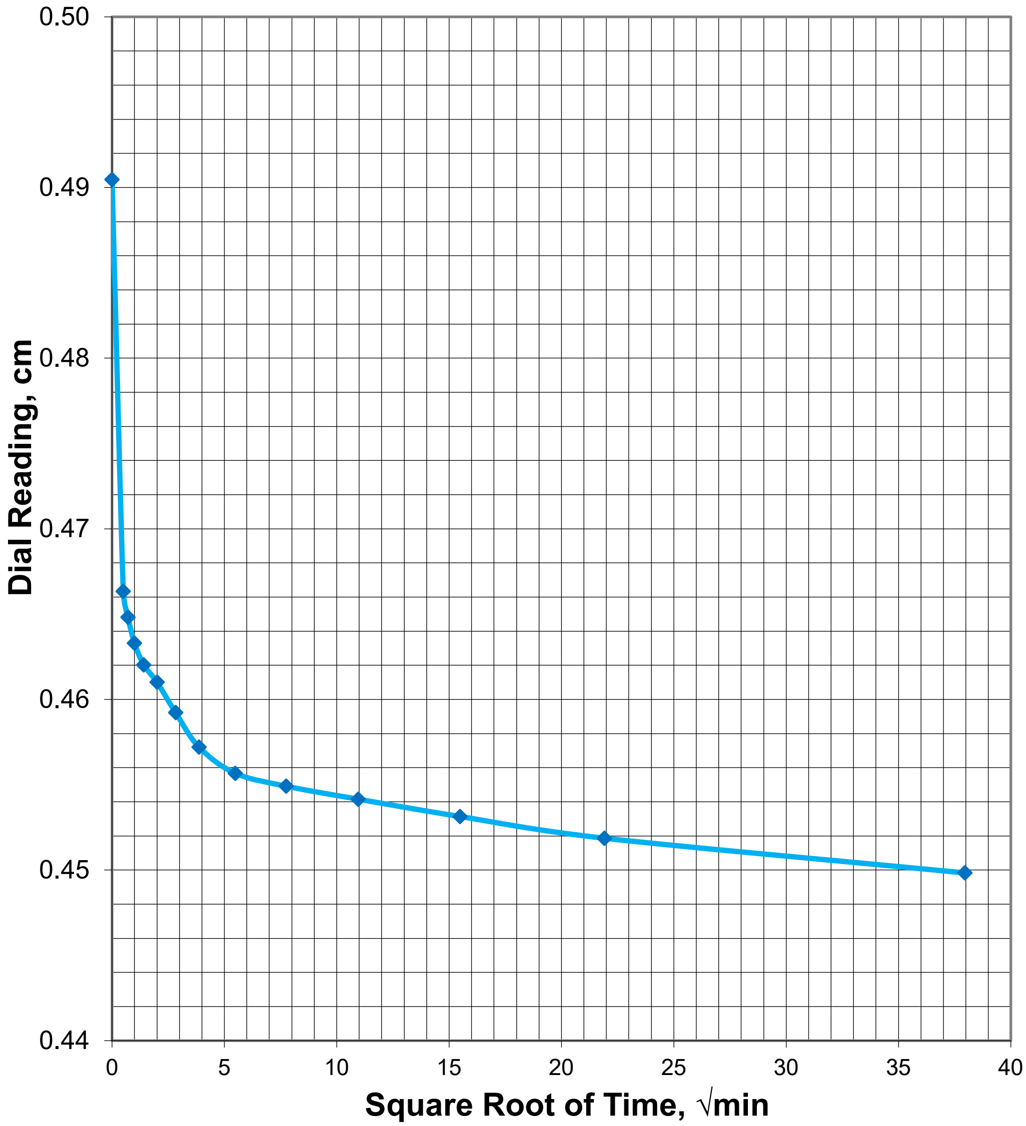
PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-10
Sample Depth: 2-2.5 ft
Loading Increment, tsf: 4
Description: Dark brown fine sandy SILT
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 93.3 lbs/cu ft
Initial Water Content: 23.4%
Final Water Content: 19.7
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 80%
Initial Height Sample, cm: 2.3937



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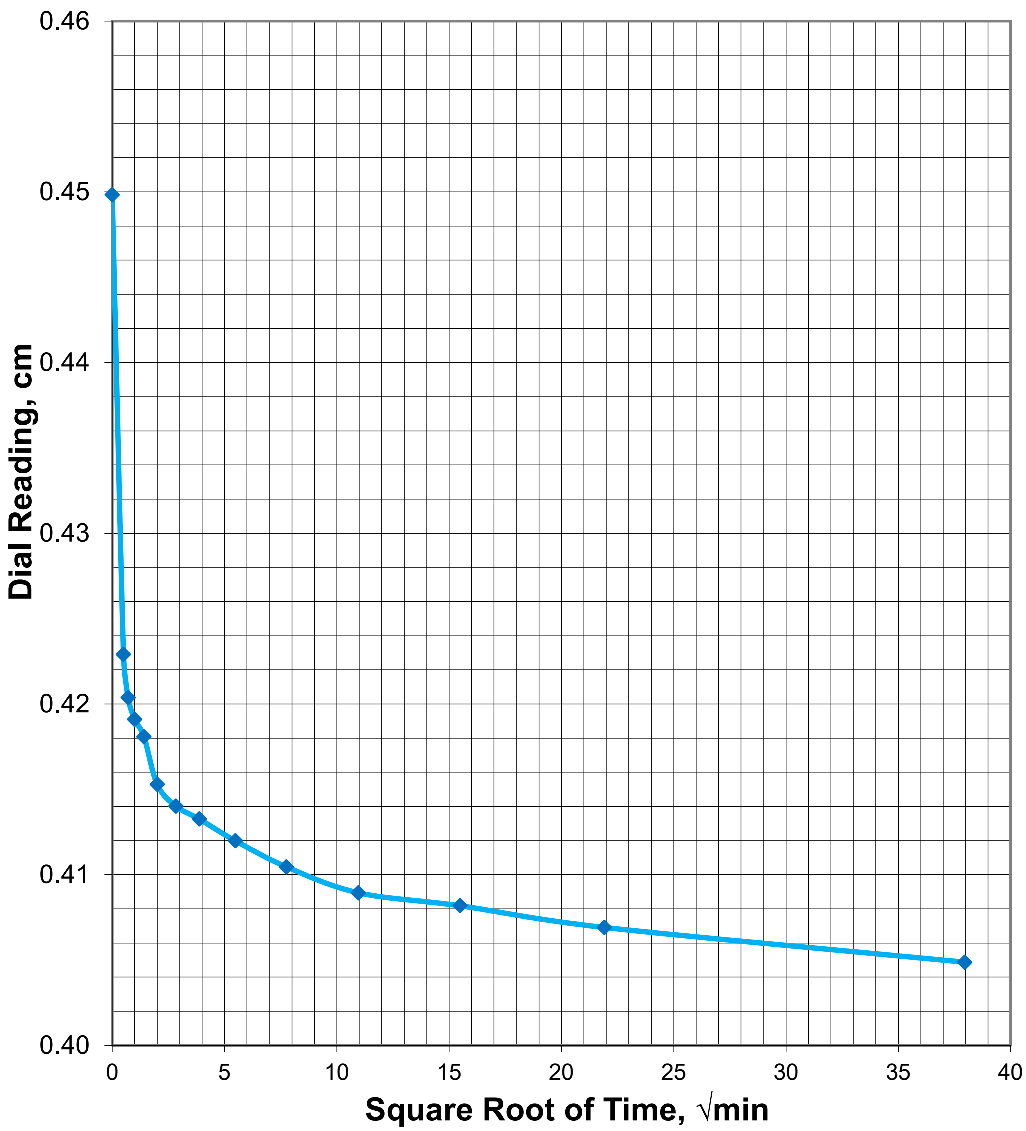
SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-10
Sample Depth: 2-2.5 ft
Loading Increment, tsf: 8
Description: Dark brown fine sandy SILT
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 93.3 lbs/cu ft
Initial Water Content: 23.4%
Final Water Content: 19.7
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 80%
Initial Height Sample, cm: 2.3531



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SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-10
Sample Depth: 2-2.5 ft
Loading Increment, tsf: 16
Description: Dark brown fine sandy SILT
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 93.3 lbs/cu ft
Initial Water Content: 23.4%
Final Water Content: 19.7
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 80%
Initial Height Sample, cm: 2.3081

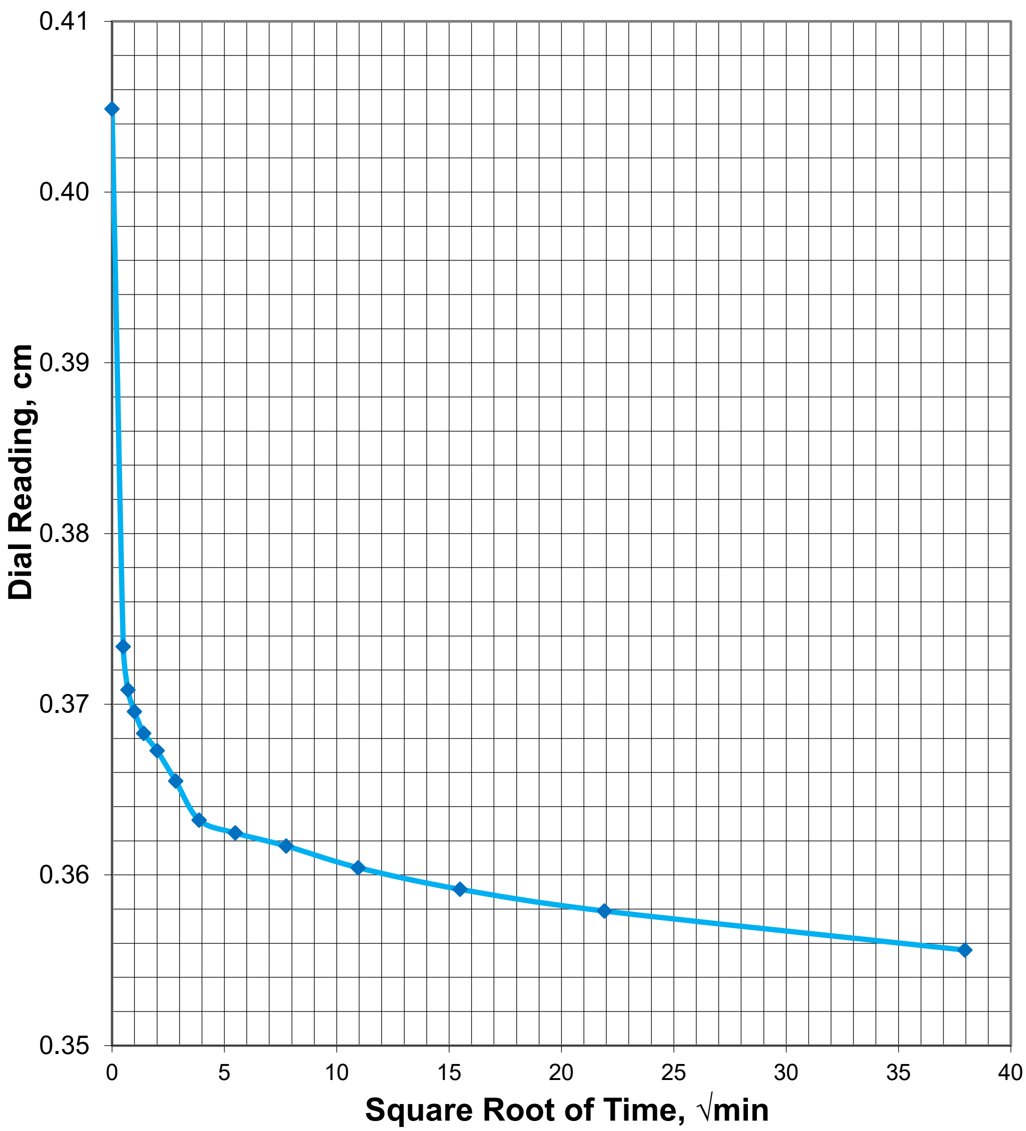

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-11
Sample Depth: 21.5-22 ft
Loading Increment, tsf: 1
Description: Reddish tan and brown silty CLAY
USCS Classification: CL
AASHTO Classification: A-7-6

Unit Dry Weight: 103.8 lbs/cu ft
Initial Water Content: 17.4%
Final Water Content: 17.9%
Liquid Limit: 43
Plastic Limit: 20
Percent Passing #200: 92%
Initial Height Sample, cm: 1.8626

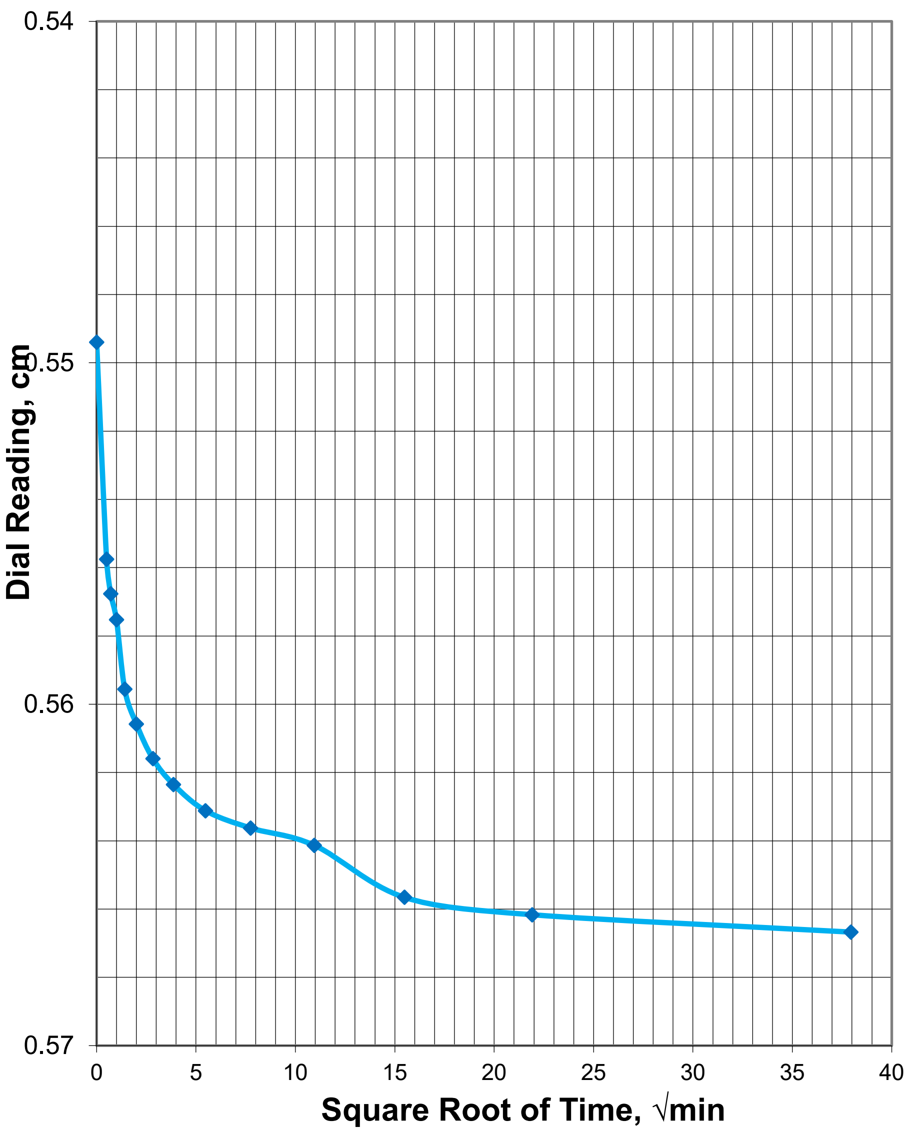

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-11
Sample Depth: 21.5-22 ft
Loading Increment, tsf: 2
Description: Reddish tan and brown silty CLAY
USCS Classification: CL
AASHTO Classification: A-7-6

Unit Dry Weight: 103.8 lbs/cu ft
Initial Water Content: 17.4%
Final Water Content: 17.9%
Liquid Limit: 43
Plastic Limit: 20
Percent Passing #200: 92%
Initial Height Sample, cm: 1.8463

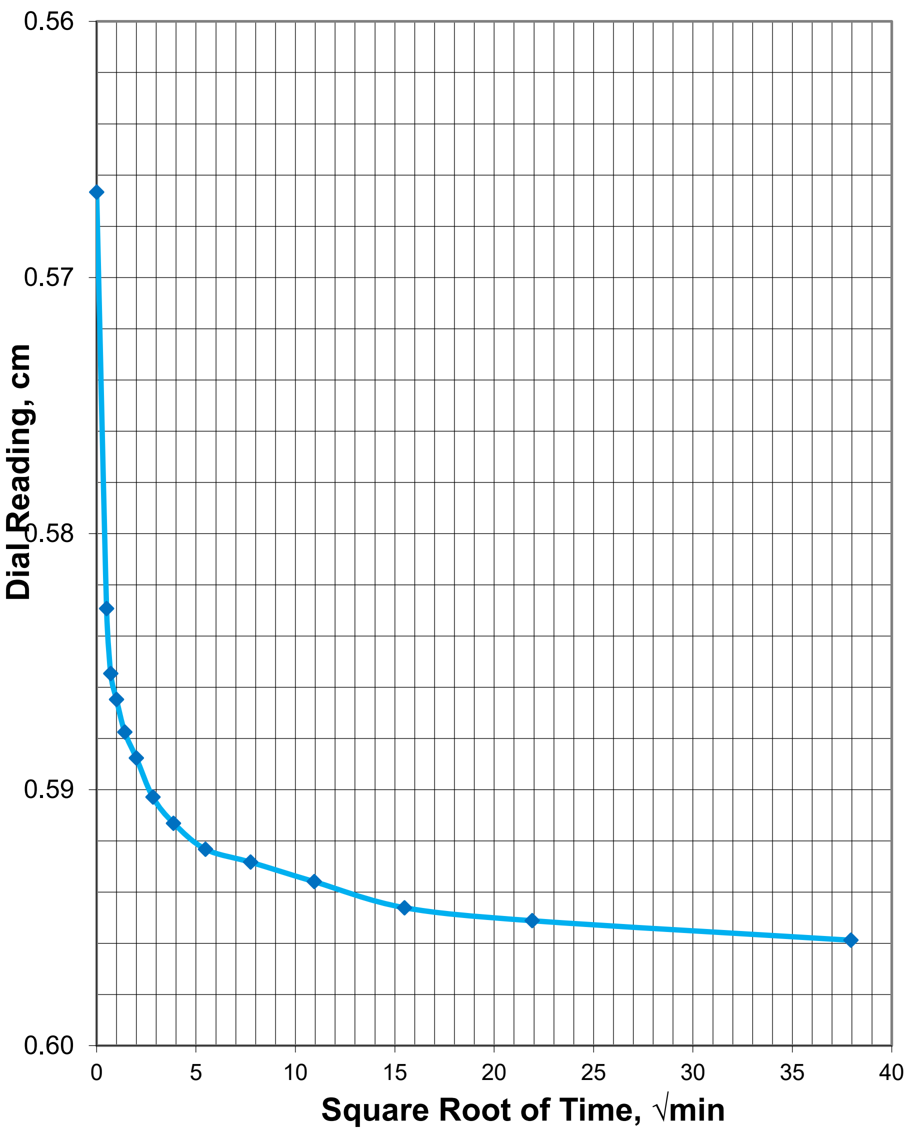

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-11
Sample Depth: 21.5-22 ft
Loading Increment, tsf: 4
Description: Reddish tan and brown silty CLAY
USCS Classification: CL
AASHTO Classification: A-7-6

Unit Dry Weight: 103.8 lbs/cu ft
Initial Water Content: 17.4%
Final Water Content: 17.9%
Liquid Limit: 43
Plastic Limit: 20
Percent Passing #200: 92%
Initial Height Sample, cm: 1.8171

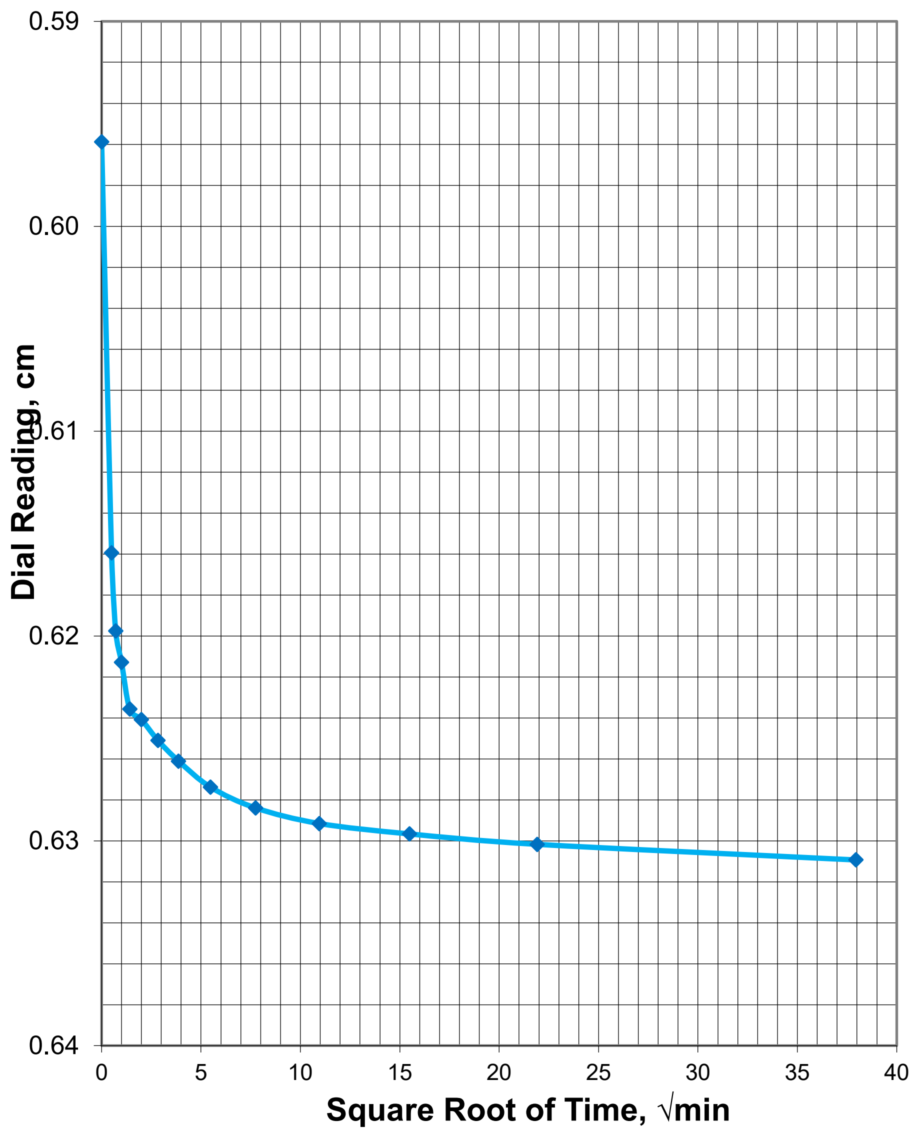

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-11
Sample Depth: 21.5-22 ft
Loading Increment, tsf: 8
Description: Reddish tan and brown silty CLAY
USCS Classification: CL
AASHTO Classification: A-7-6

Unit Dry Weight: 103.8 lbs/cu ft
Initial Water Content: 17.4%
Final Water Content: 17.9%
Liquid Limit: 43
Plastic Limit: 20
Percent Passing #200: 92%
Initial Height Sample, cm: 1.7821

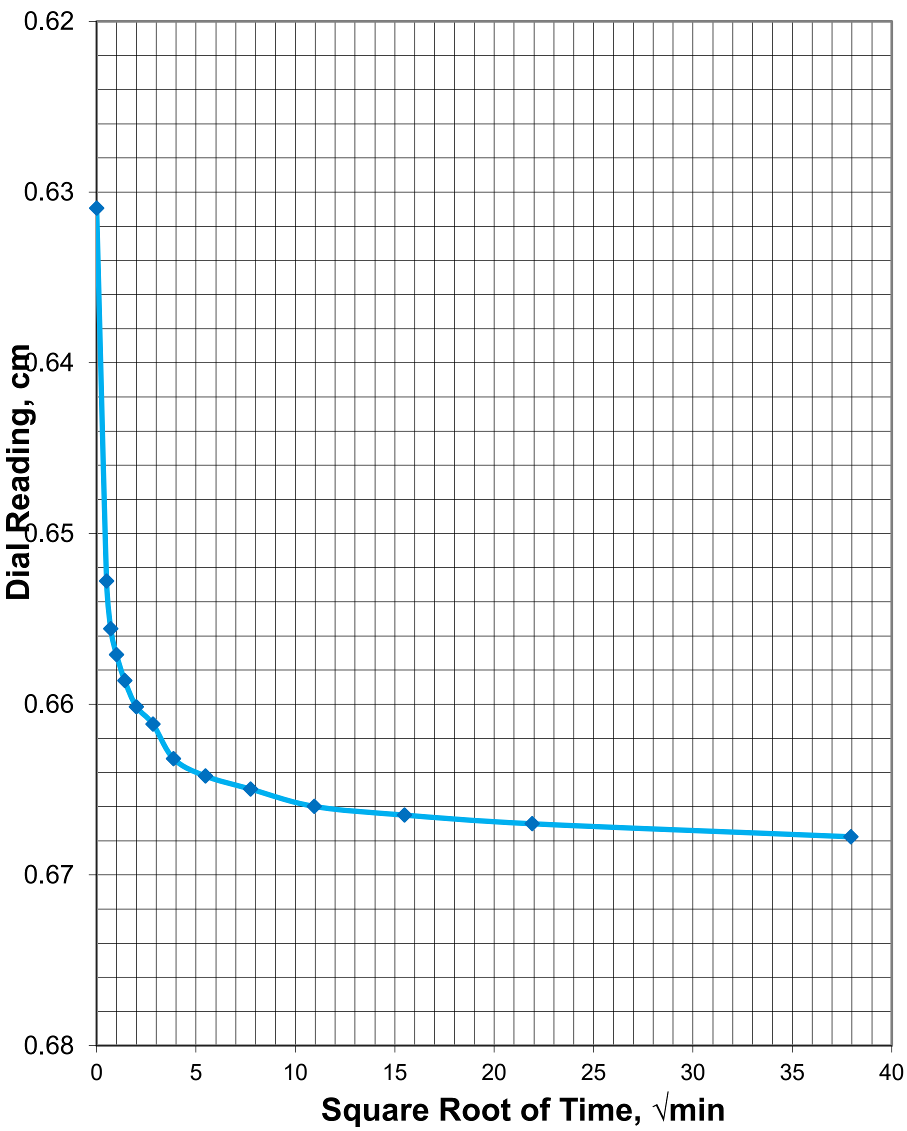

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-11
Sample Depth: 21.5-22 ft
Loading Increment, tsf: 16
Description: Reddish tan and brown silty CLAY
USCS Classification: CL
AASHTO Classification: A-7-6

Unit Dry Weight: 103.8 lbs/cu ft
Initial Water Content: 17.4%
Final Water Content: 17.9%
Liquid Limit: 43
Plastic Limit: 20
Percent Passing #200: 92%
Initial Height Sample, cm: 1.7452

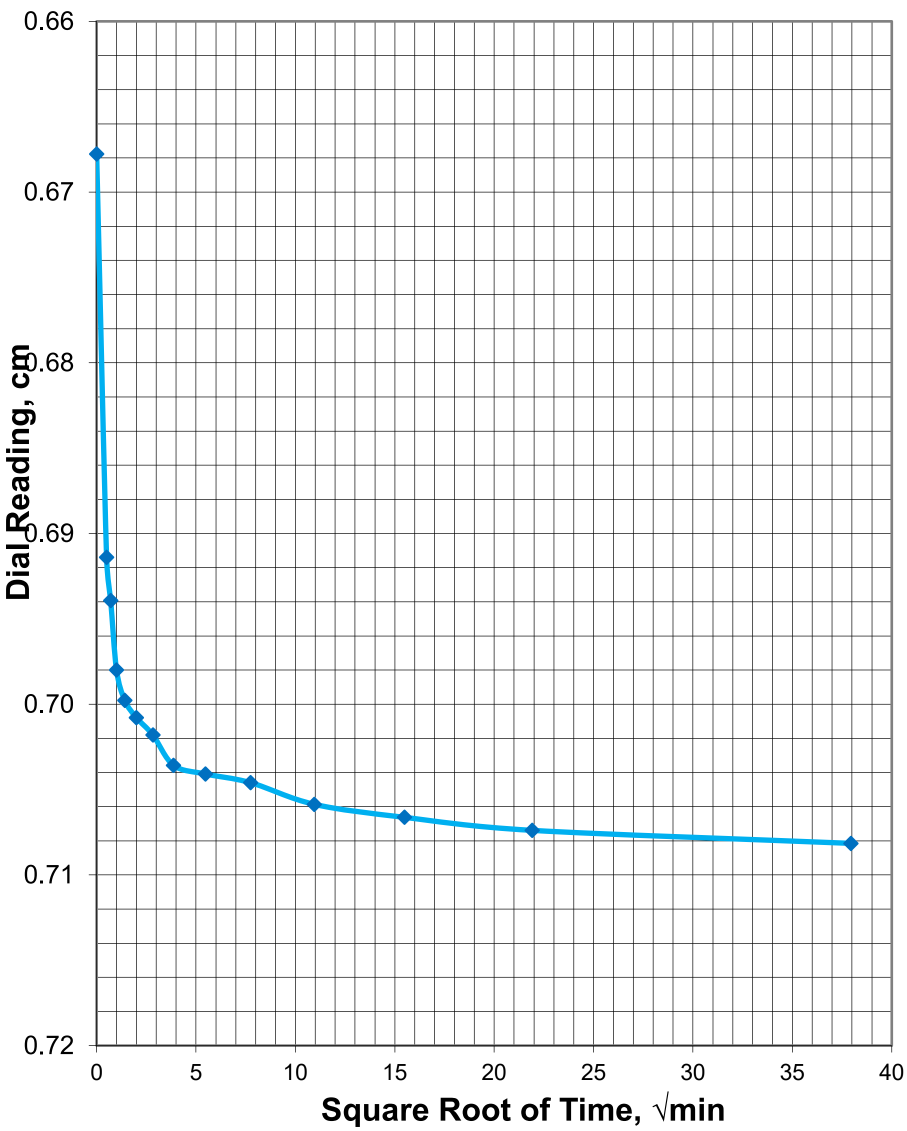

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-12
Sample Depth: 0.5-1 ft
Loading Increment, tsf: 4
Description: Dark brown and tan silty CLAY
USCS Classification: CL
AASHTO Classification: A-6

Unit Dry Weight: 100.8 lbs/cu ft
Initial Water Content: 22,3%
Final Water Content: 21.1%
Liquid Limit: 30
Plastic Limit: 19
Percent Passing #200: 95%
Initial Height Sample, cm: 2.3919

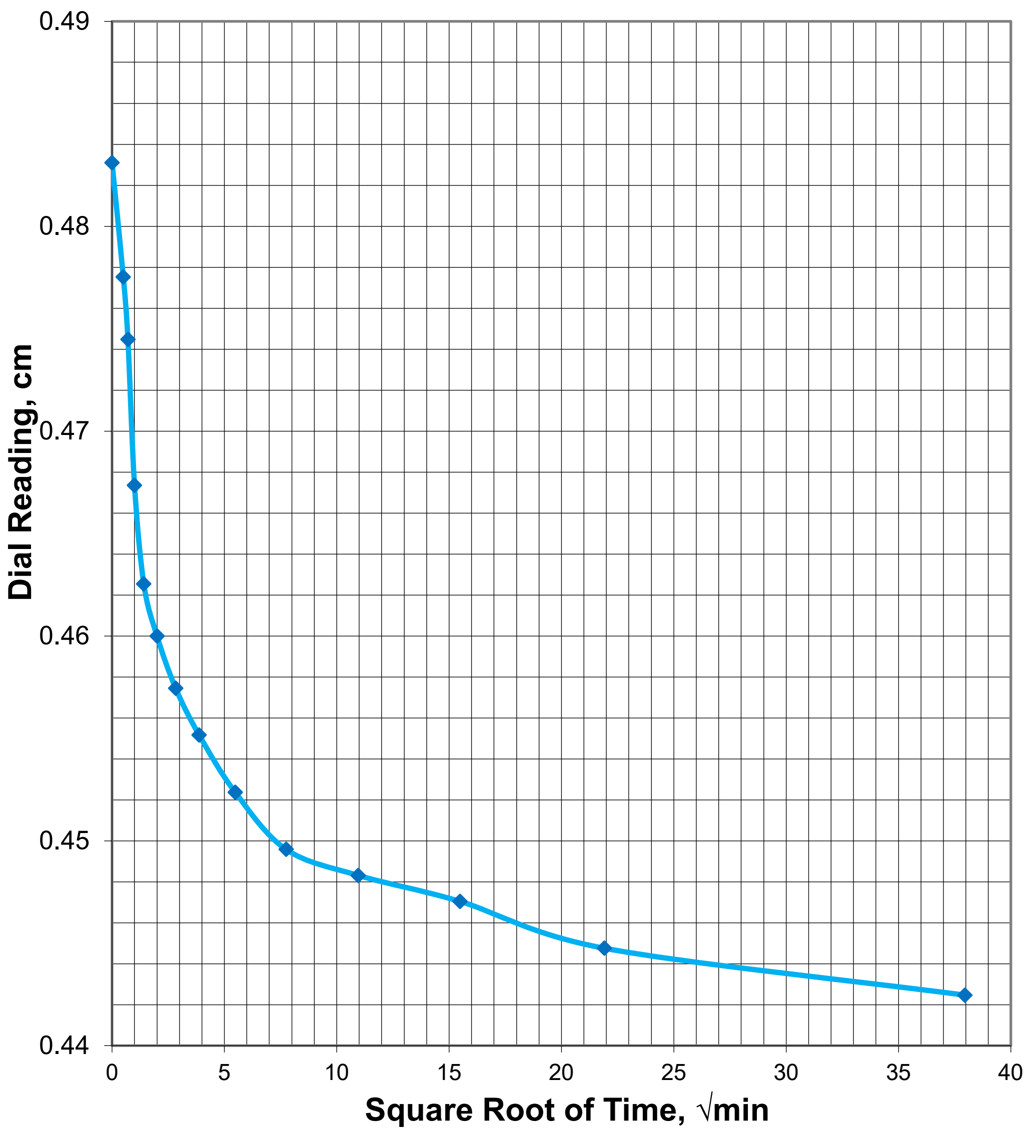

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-12
Sample Depth: 0.5-1 ft
Loading Increment, tsf: 8
Description: Dark brown and tan silty CLAY
USCS Classification: CL
AASHTO Classification: A-6

Unit Dry Weight: 100.8 lbs/cu ft
Initial Water Content: 22,3%
Final Water Content: 21.1%
Liquid Limit: 30
Plastic Limit: 19
Percent Passing #200: 95%
Initial Height Sample, cm: 2.3513

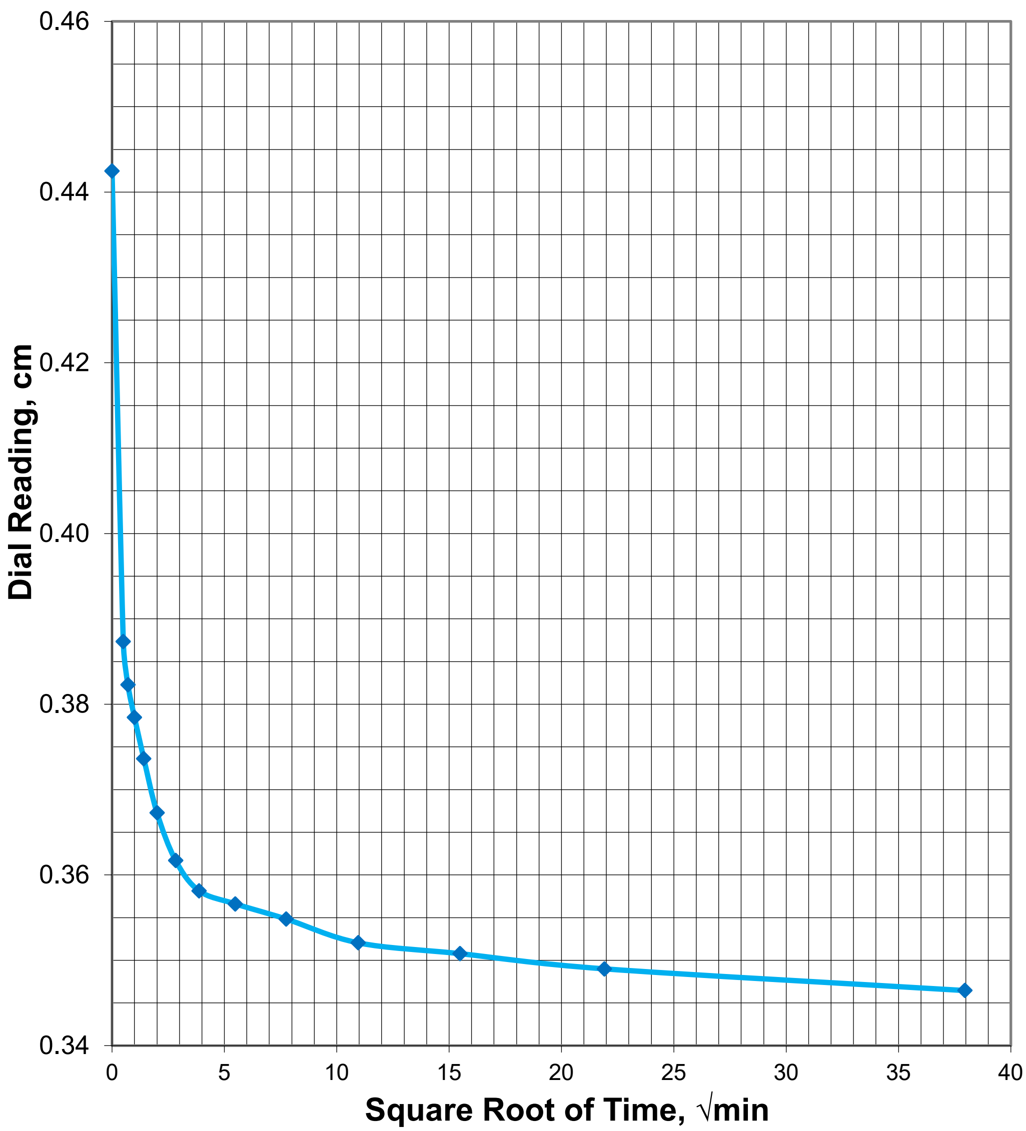

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-12
Sample Depth: 0.5-1 ft
Loading Increment, tsf: 16
Description: Dark brown and tan silty CLAY
USCS Classification: CL
AASHTO Classification: A-6

Unit Dry Weight: 100.8 lbs/cu ft
Initial Water Content: 22,3%
Final Water Content: 21.1%
Liquid Limit: 30
Plastic Limit: 19
Percent Passing #200: 95%
Initial Height Sample, cm: 2.2553

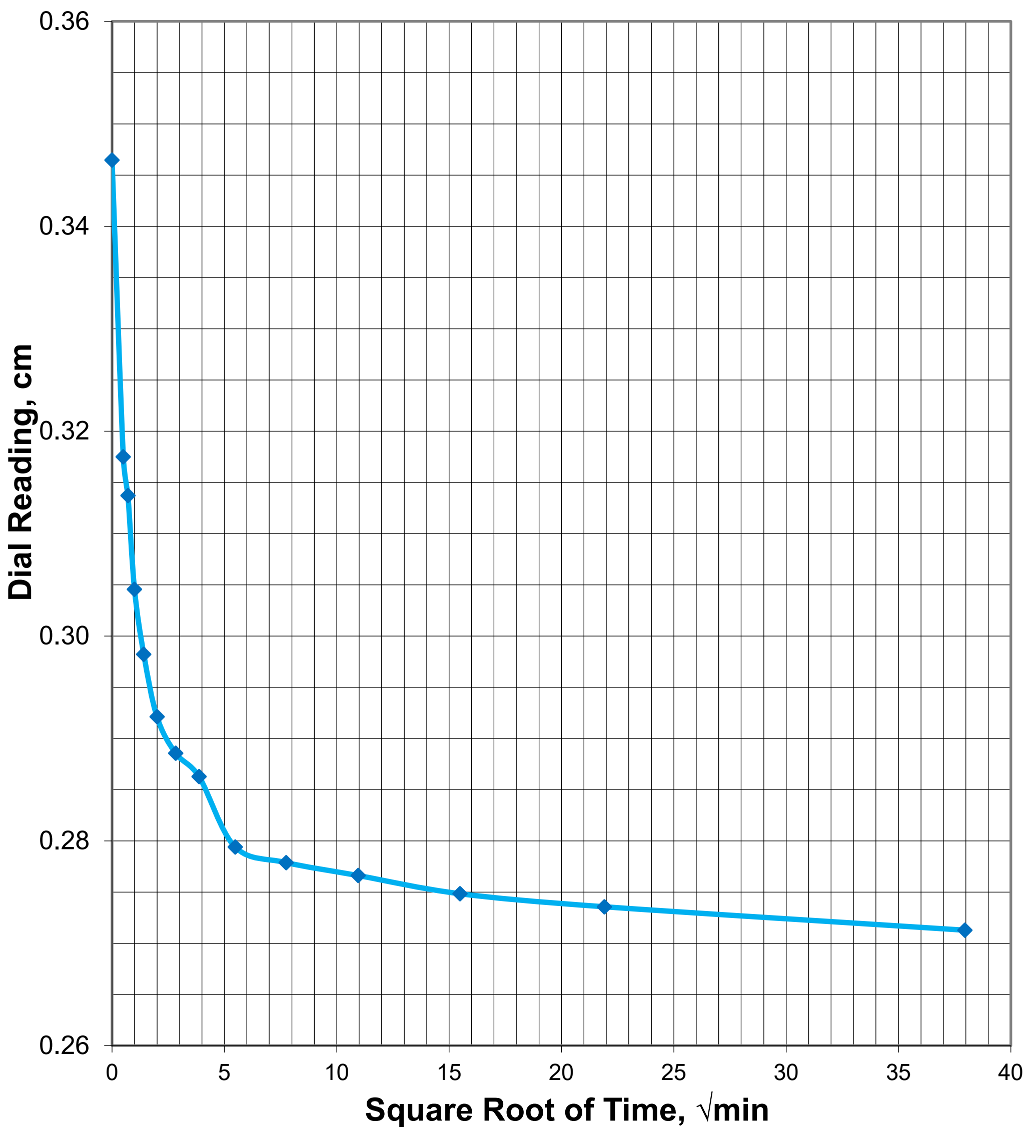

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-13
Sample Depth: 2-2.5 ft
Loading Increment, tsf: 2
Description: Brown fine SILT
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 102.5 lbs/cu ft
Initial Water Content: 20.6%
Final Water Content: 20.5%
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 75%
Initial Height Sample, cm: 1.8458

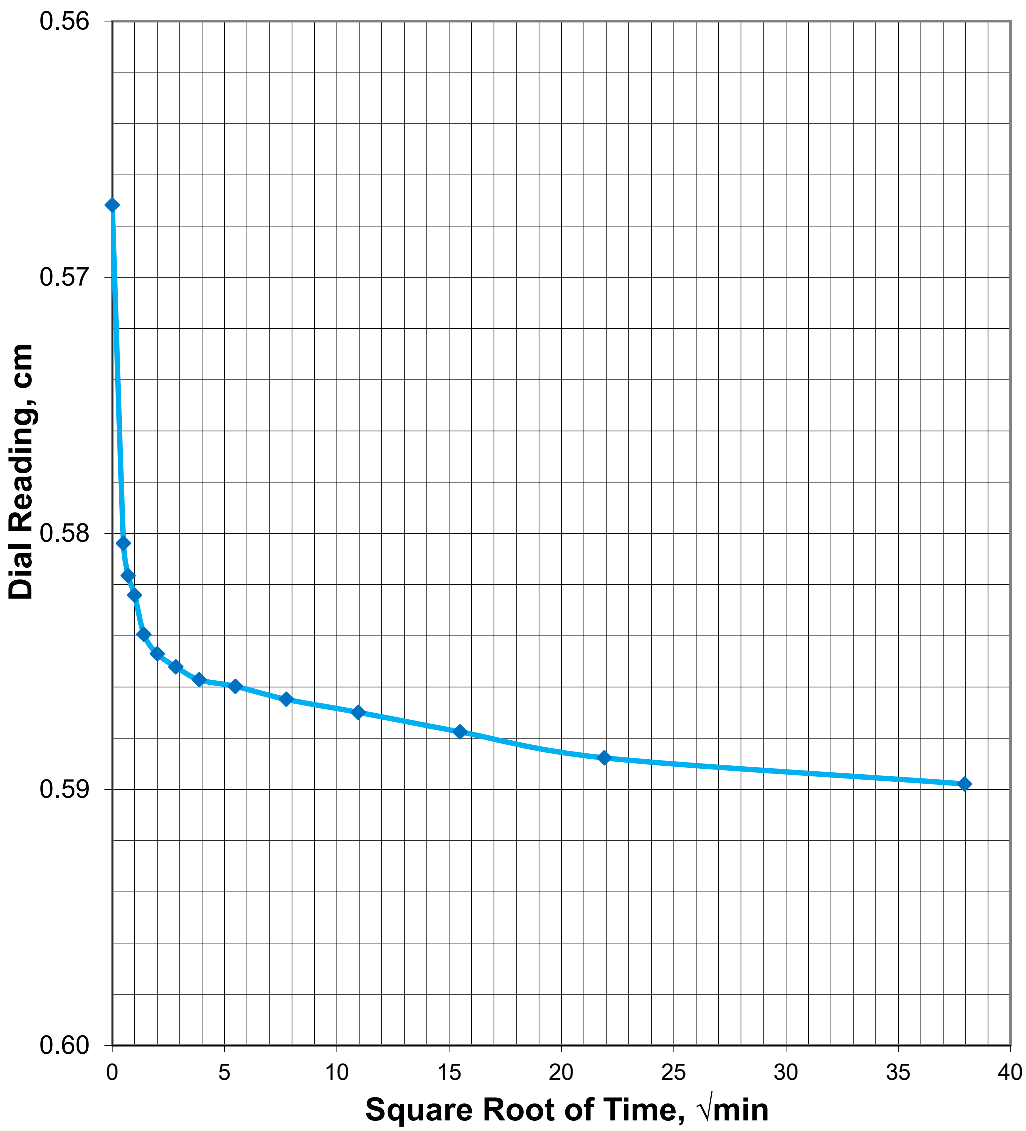

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-13
Sample Depth: 2-2.5 ft
Loading Increment, tsf: 4
Description: Brown fine SILT
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 102.5 lbs/cu ft
Initial Water Content: 20.6%
Final Water Content: 20.5%
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 75%
Initial Height Sample, cm: 1.8232

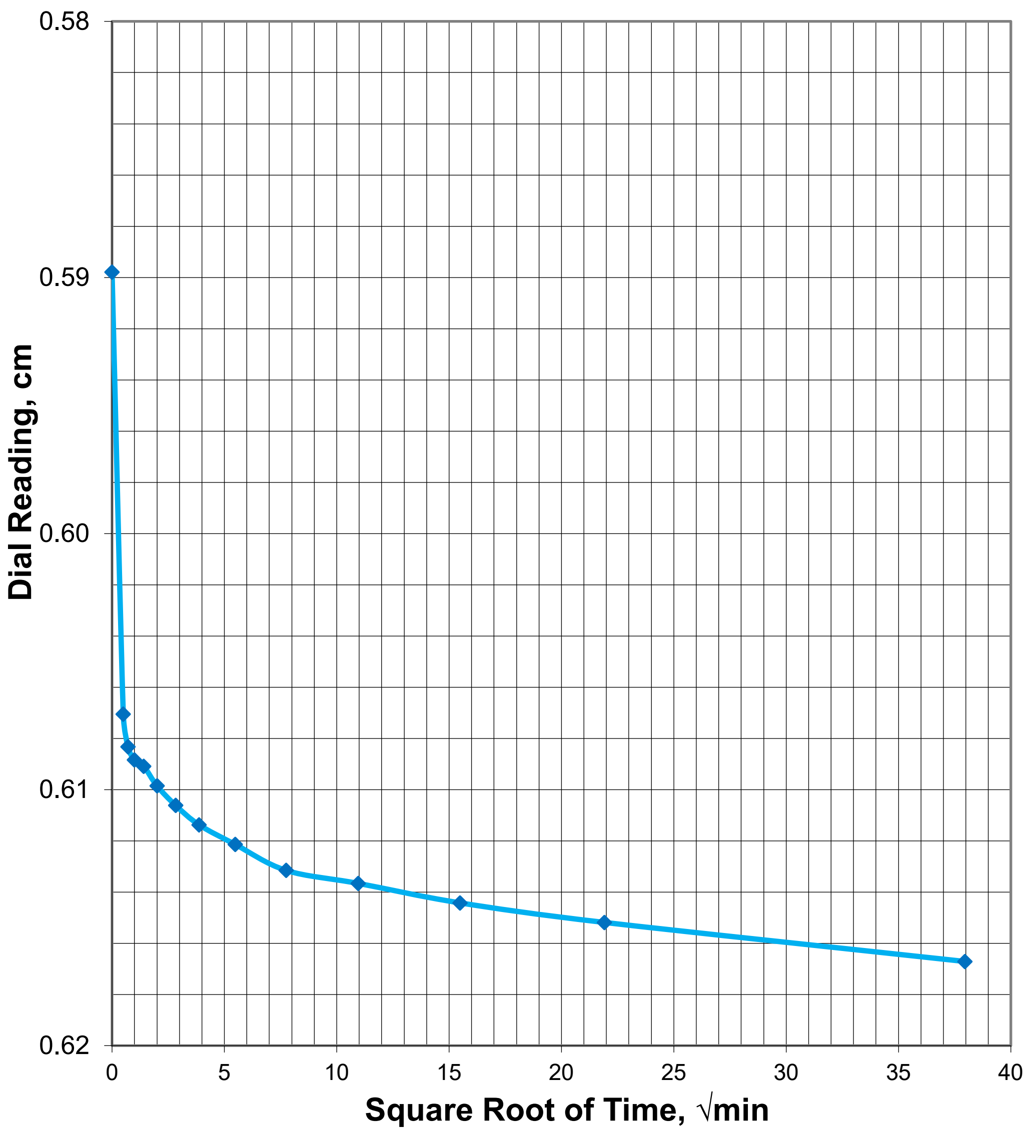

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-13
Sample Depth: 2-2.5 ft
Loading Increment, tsf: 8
Description: Brown fine SILT
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 102.5 lbs/cu ft
Initial Water Content: 20.6%
Final Water Content: 20.5%
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 75%
Initial Height Sample, cm: 1.7963

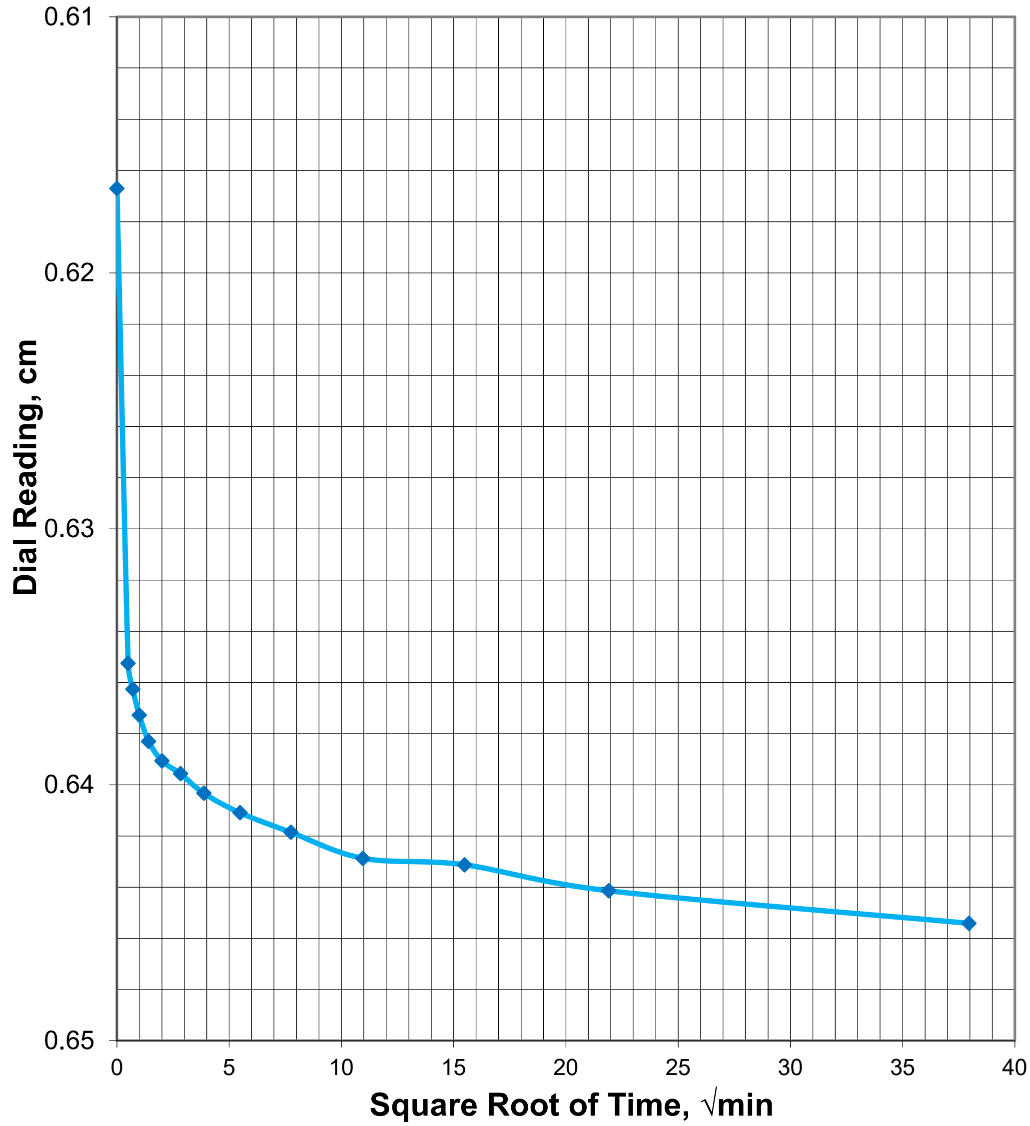

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-13
Sample Depth: 2-2.5 ft
Loading Increment, tsf: 16
Description: Brown fine SILT
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 102.5 lbs/cu ft
Initial Water Content: 20.6%
Final Water Content: 20.5%
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 75%
Initial Height Sample, cm: 1.7676

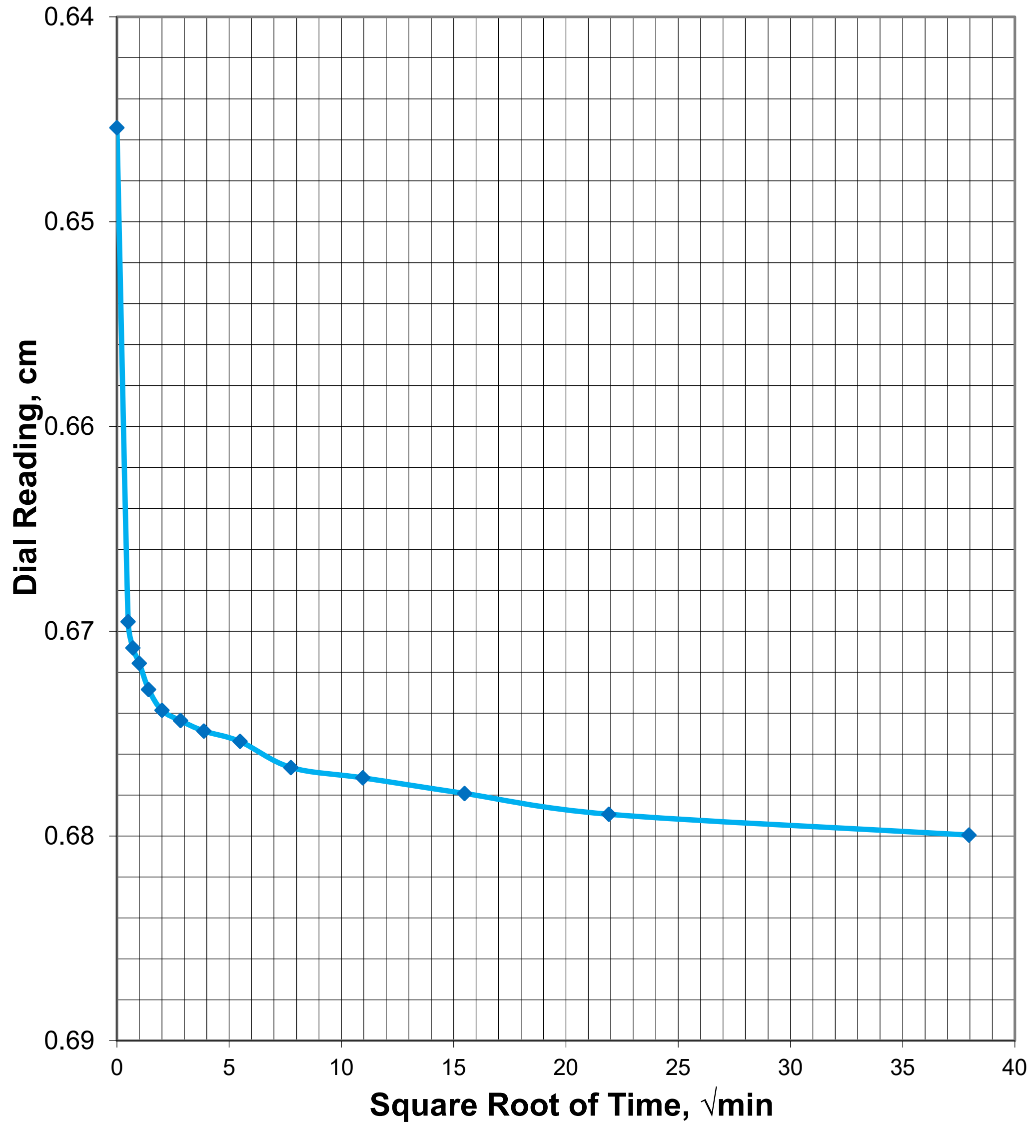

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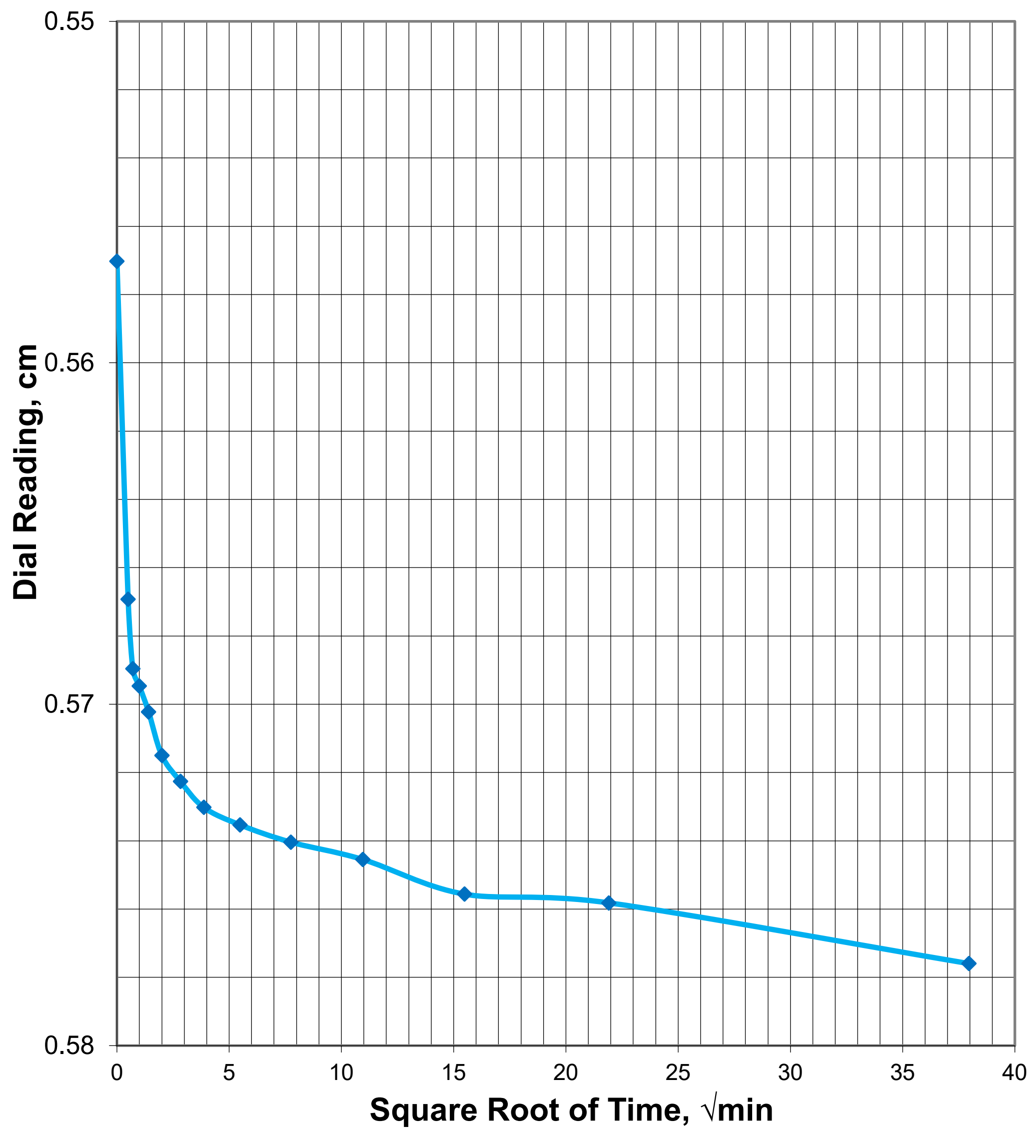
PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-13
Sample Depth: 8-8.5 ft
Loading Increment, tsf: 1
Description: Reddish brown fine sandy SILT
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 96.6 lbs/cu ft
Initial Water Content: 17.6%
Final Water Content: 20.3%
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 71%
Initial Height Sample, cm: 1.8560



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CONSULTING ENGINEERS

PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-13
Sample Depth: 8-8.5 ft
Loading Increment, tsf: 2
Description: Reddish brown fine sandy SILT
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 96.6 lbs/cu ft
Initial Water Content: 17.6%
Final Water Content: 20.3%
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 71%
Initial Height Sample, cm: 1.8354

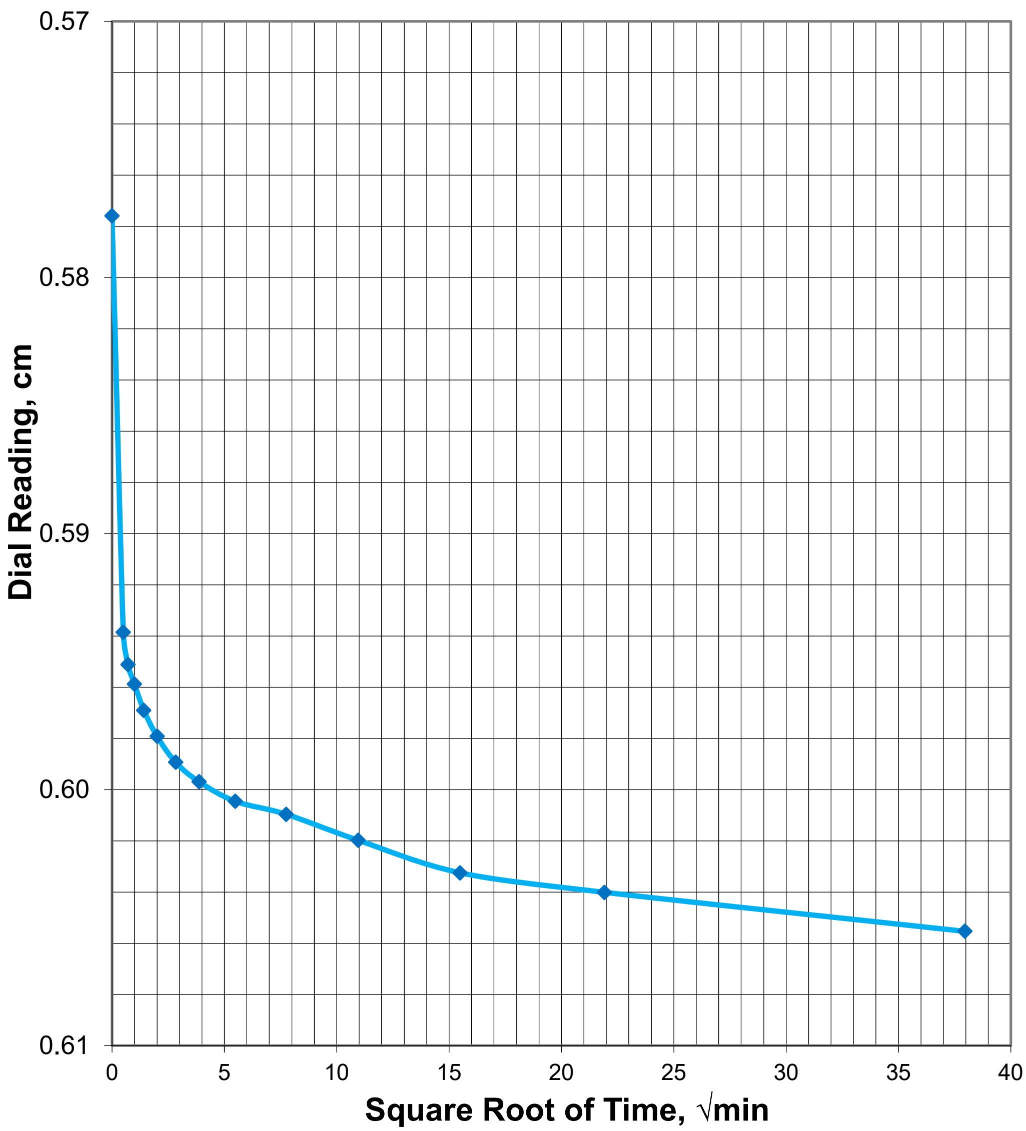

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-13
Sample Depth: 8-8.5 ft
Loading Increment, tsf: 4
Description: Reddish brown fine sandy SILT
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 96.6 lbs/cu ft
Initial Water Content: 17.6%
Final Water Content: 20.3%
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 71%
Initial Height Sample, cm: 1.8075

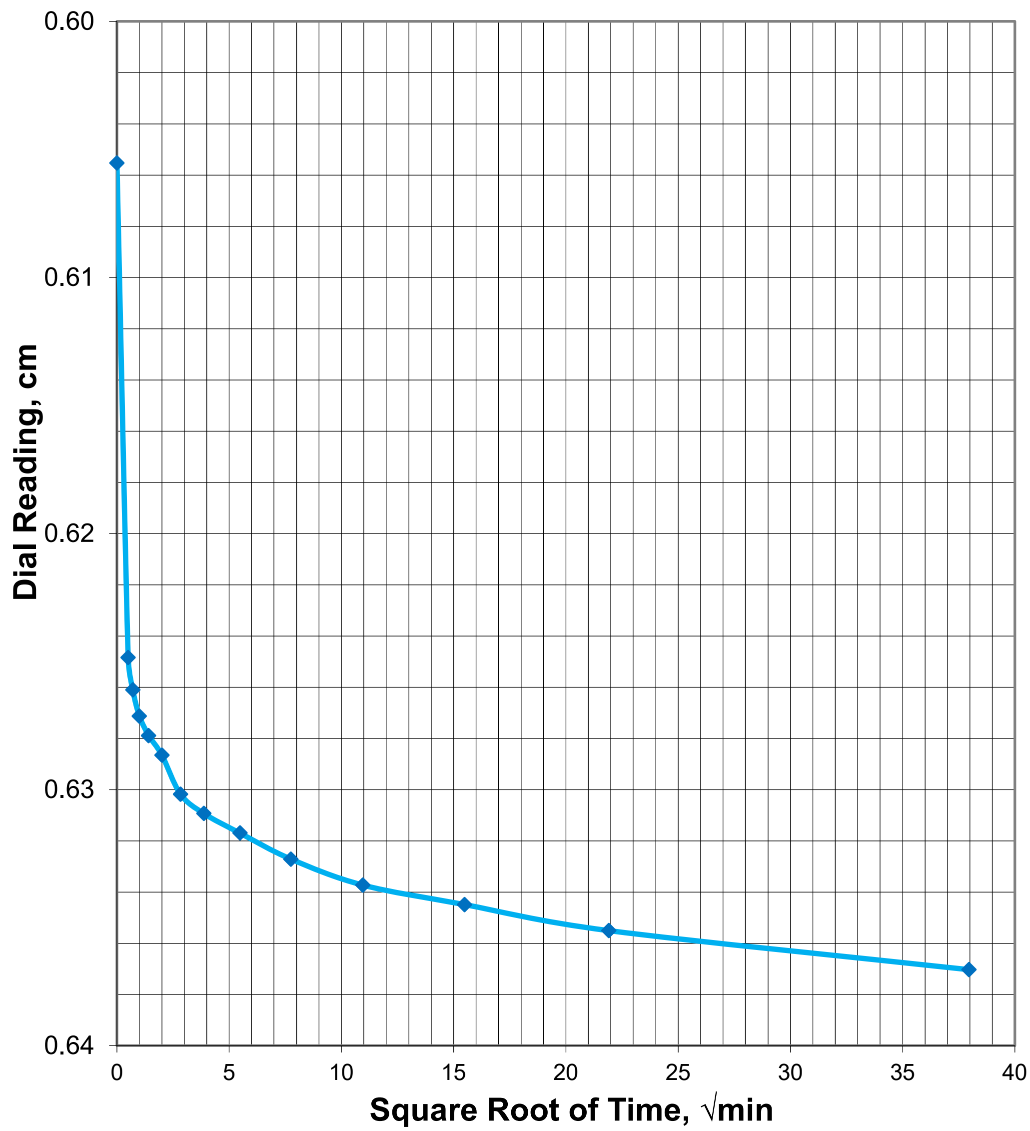

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-13
Sample Depth: 8-8.5 ft
Loading Increment, tsf: 8
Description: Reddish brown fine sandy SILT
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 96.6 lbs/cu ft
Initial Water Content: 17.6%
Final Water Content: 20.3%
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 71%
Initial Height Sample, cm: 1.7760

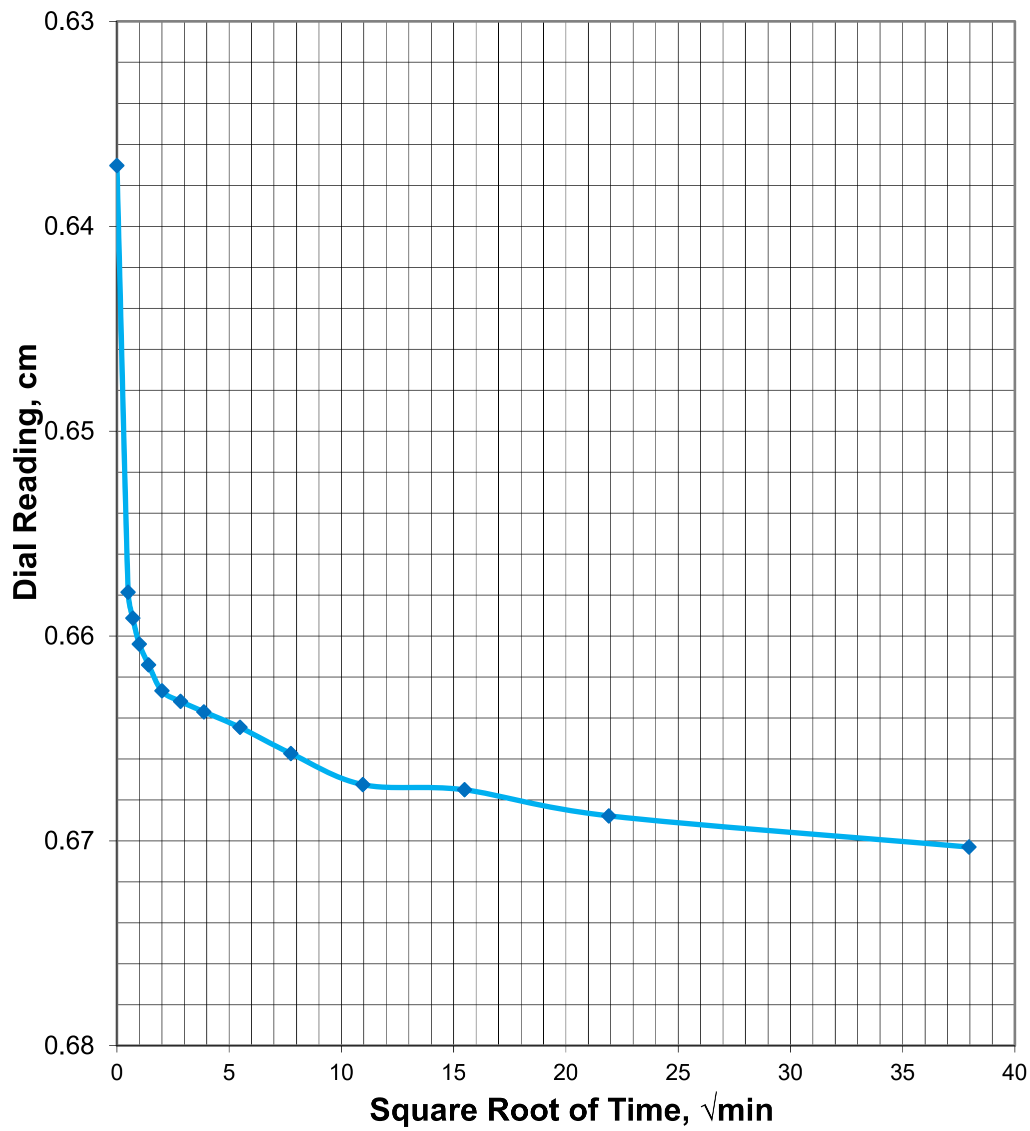

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-13
Sample Depth: 8-8.5 ft
Loading Increment, tsf: 16
Description: Reddish brown fine sandy SILT
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 96.6 lbs/cu ft
Initial Water Content: 17.6%
Final Water Content: 20.3%
Liquid Limit: NP
Plastic Limit: NP
Percent Passing #200: 71%
Initial Height Sample, cm: 1.7427

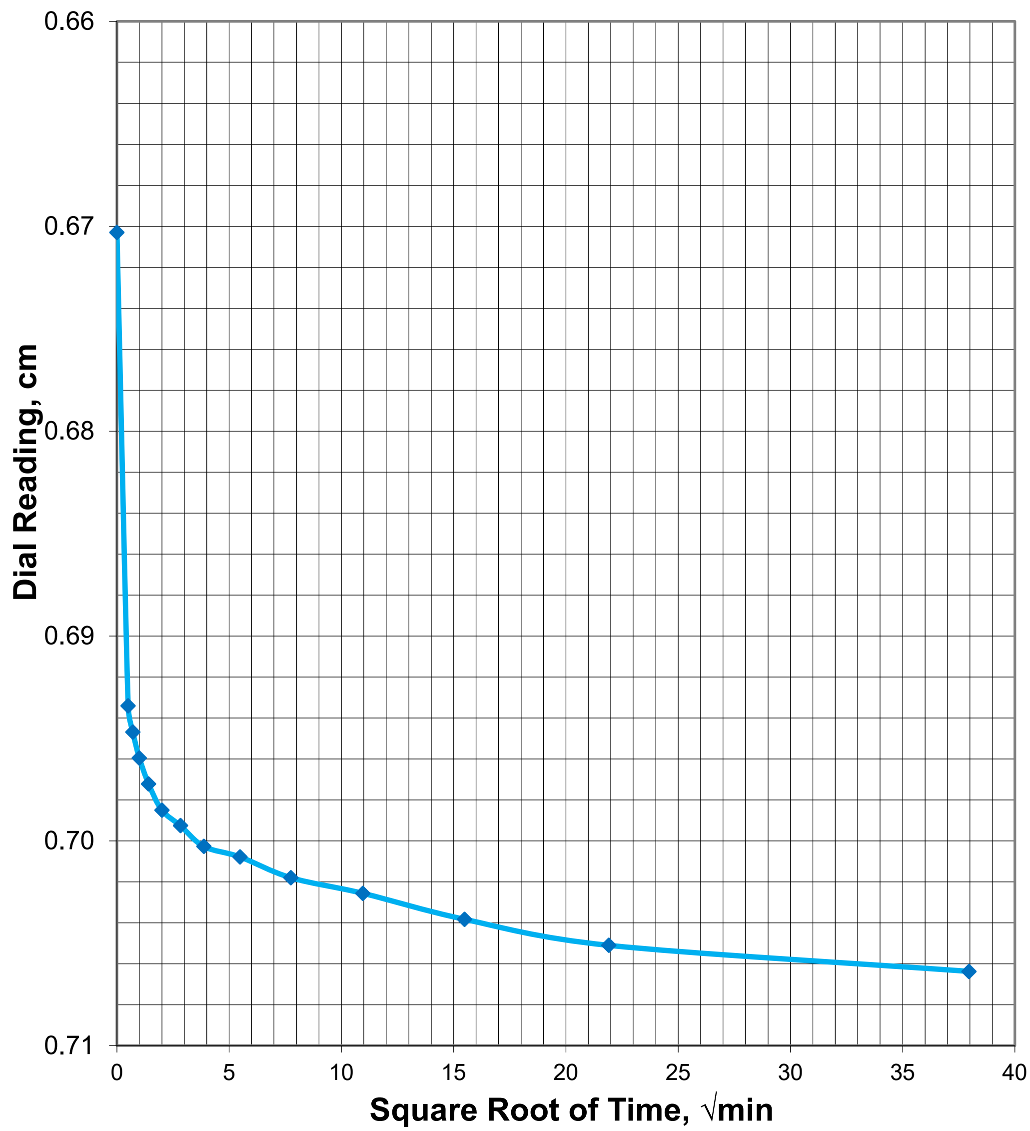

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PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-14
Sample Depth: 4.5-5 ft
Loading Increment, tsf: 1
Description: Brown clayey SILT, slightly sandy
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 103.8 lbs/cu ft
Initial Water Content: 21.0%
Final Water Content: 19.6%
Liquid Limit: 24
Plastic Limit: 21
Percent Passing #200: 83%
Initial Height Sample, cm: 1.8547

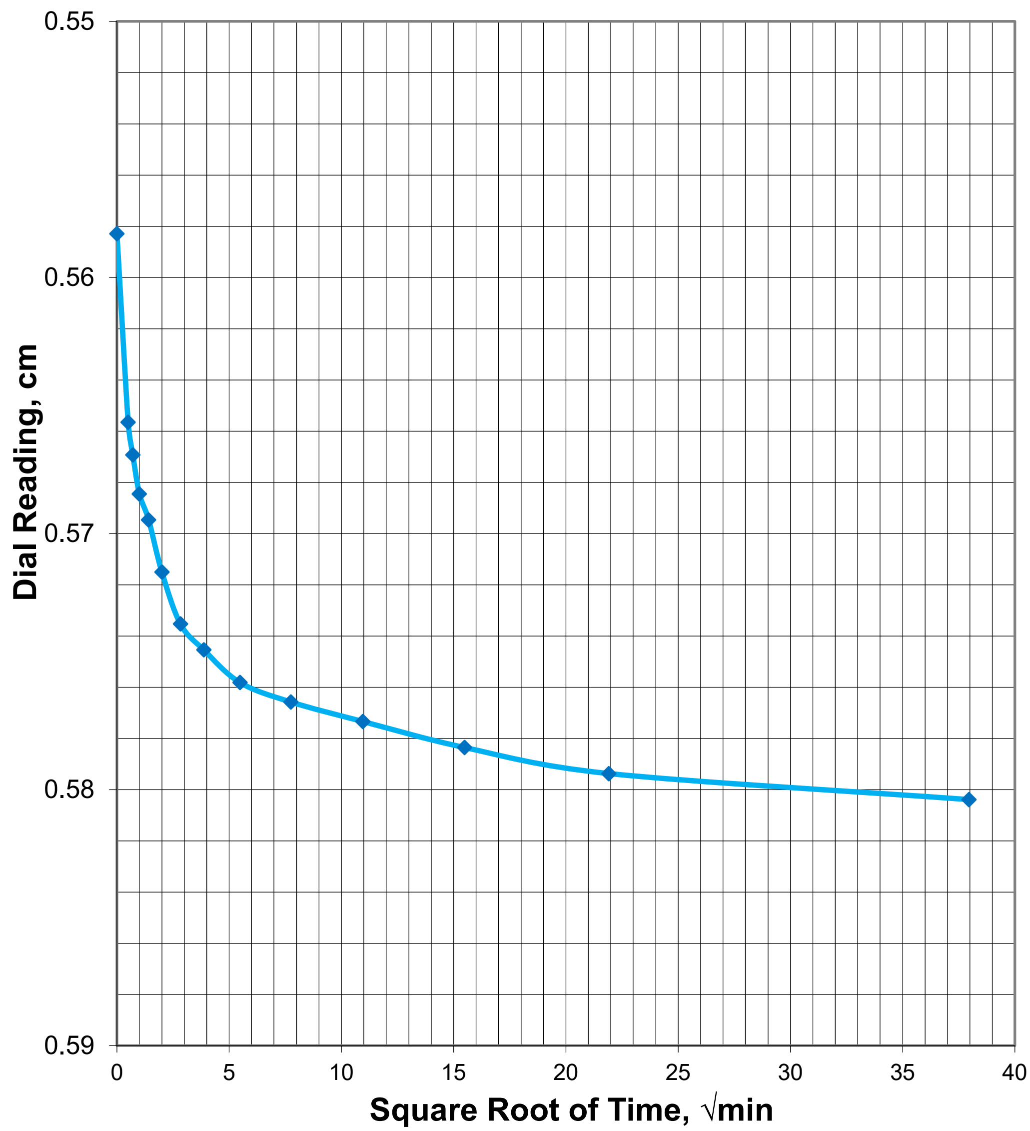

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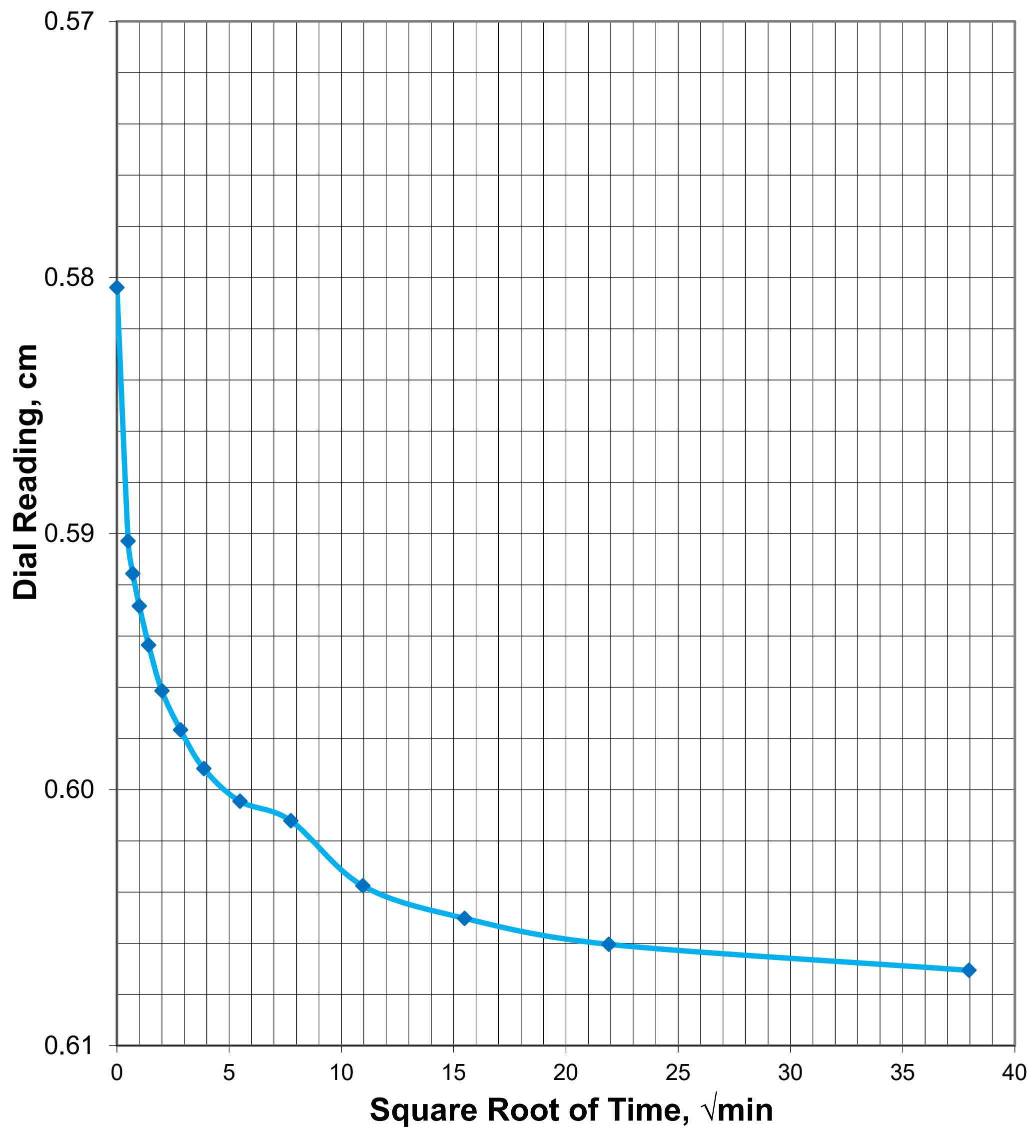
PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-14
Sample Depth: 4.5-5 ft
Loading Increment, tsf: 2
Description: Brown clayey SILT, slightly sandy
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 103.8 lbs/cu ft
Initial Water Content: 21.0%
Final Water Content: 19.6%
Liquid Limit: 24
Plastic Limit: 21
Percent Passing #200: 83%
Initial Height Sample, cm: 1.8326



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SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-14
Sample Depth: 4.5-5 ft
Loading Increment, tsf: 4
Description: Brown clayey SILT, slightly sandy
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 103.8 lbs/cu ft
Initial Water Content: 21.0%
Final Water Content: 19.6%
Liquid Limit: 24
Plastic Limit: 21
Percent Passing #200: 83%
Initial Height Sample, cm: 1.8059

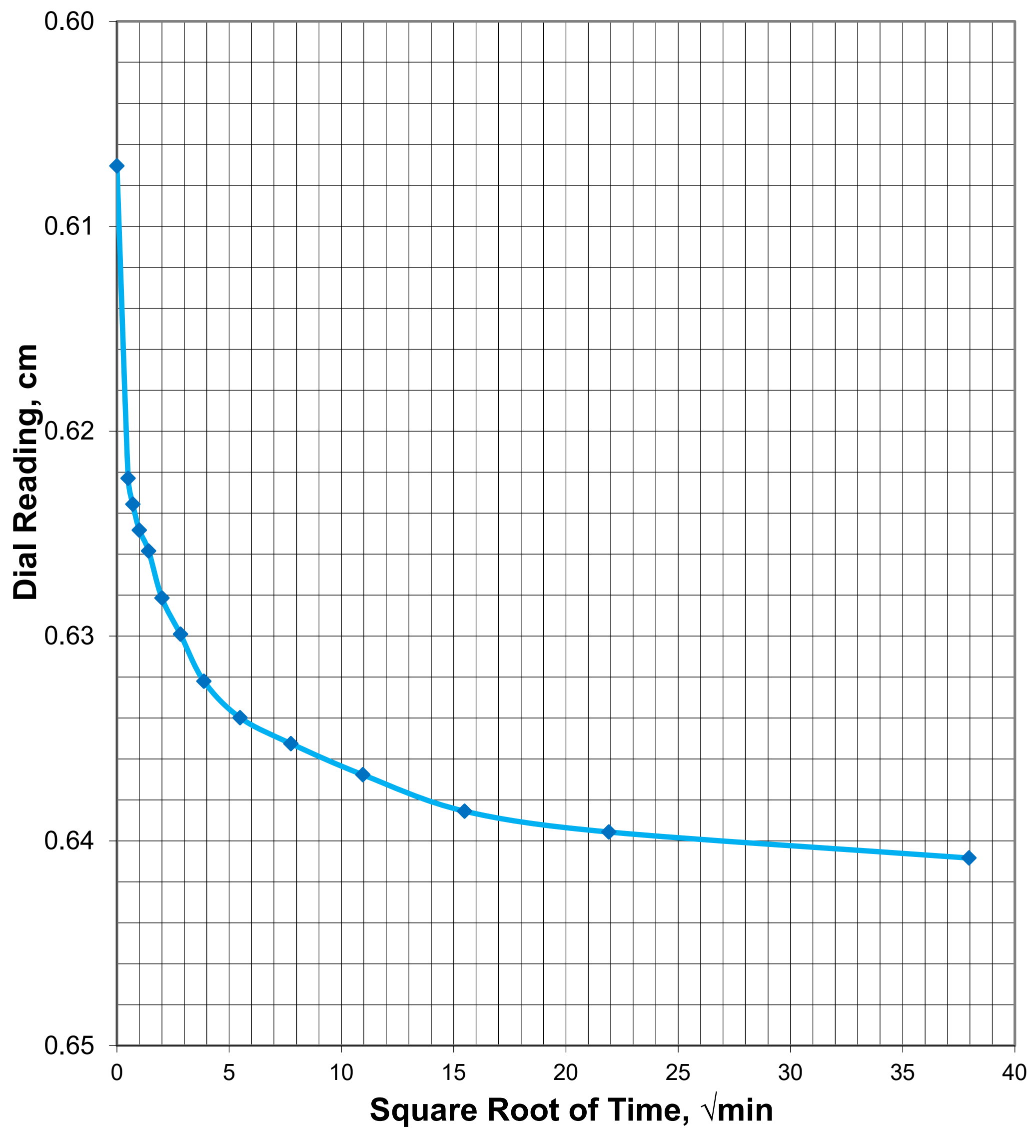

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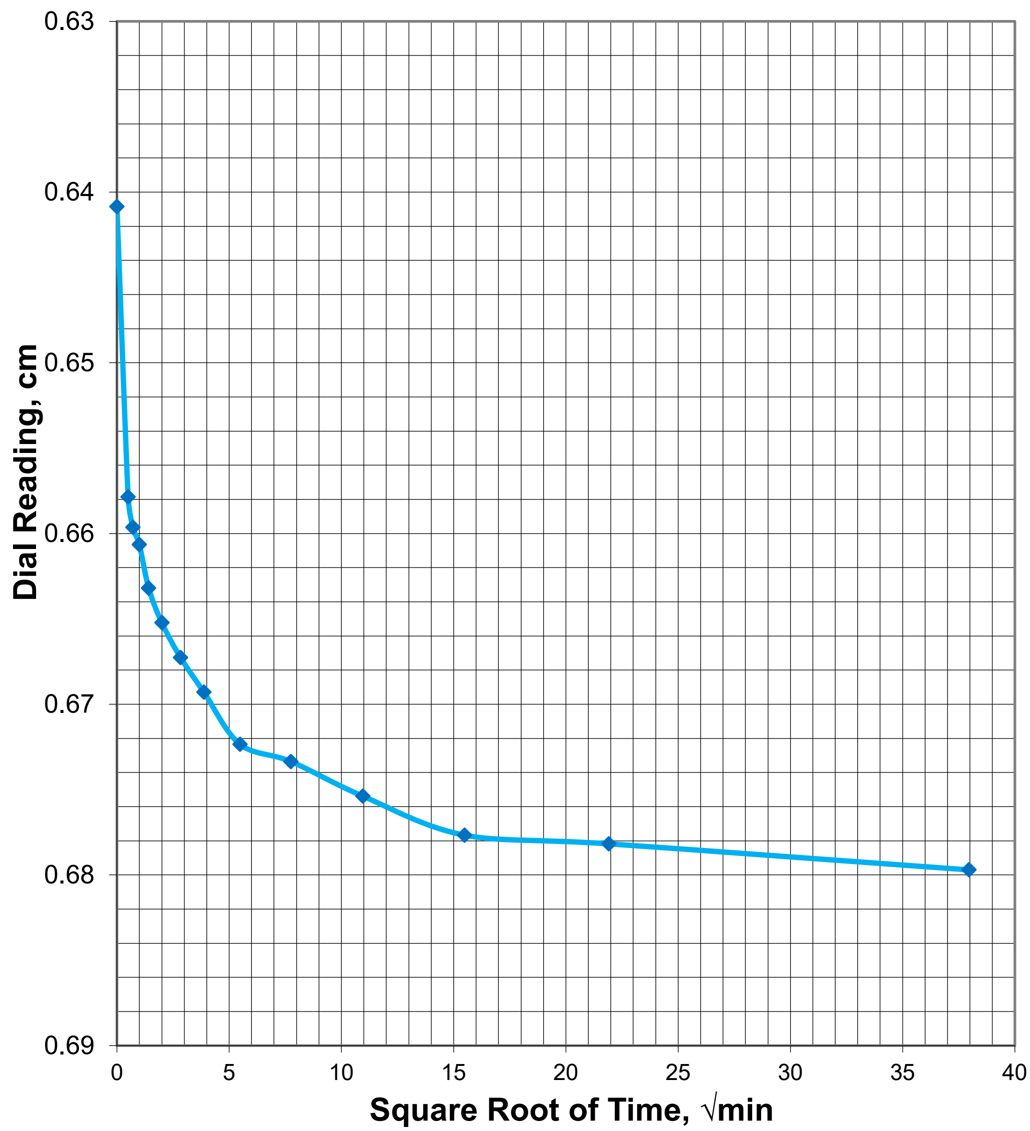
PLATE

SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-14
Sample Depth: 4.5-5 ft
Loading Increment, tsf: 8
Description: Brown clayey SILT, slightly sandy
USCS Classification: ML
AASHTO Classification: A-4

Unit Dry Weight: 103.8 lbs/cu ft
Initial Water Content: 21.0%
Final Water Content: 19.6%
Liquid Limit: 24
Plastic Limit: 21
Percent Passing #200: 83%
Initial Height Sample, cm: 1.7722



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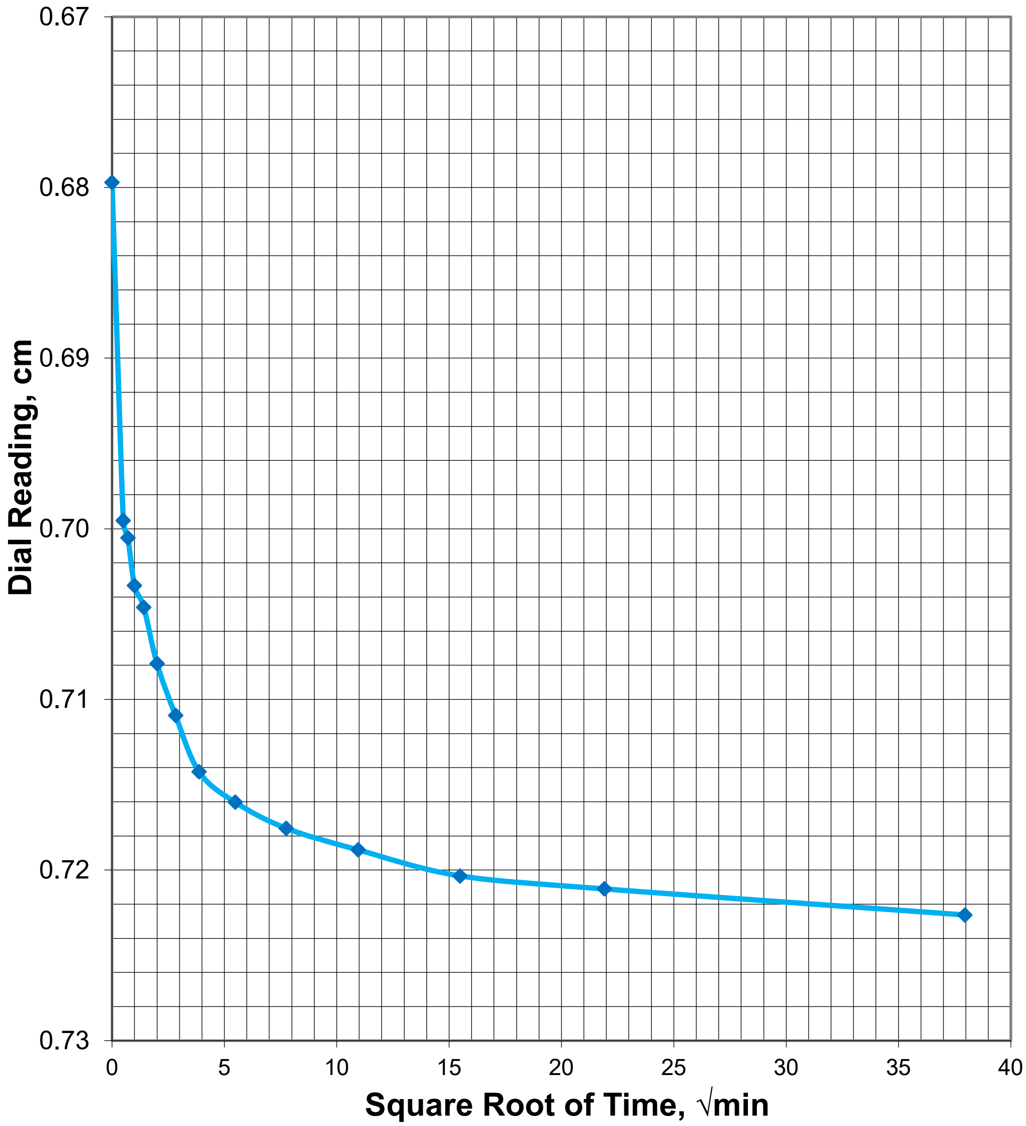
SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-14
Sample Depth: 4.5-5 ft
Loading Increment, tsf: 16
Description: Brown clayey SILT, slightly sandy
USCS Classification: ML
AASHTO Classification: A-4

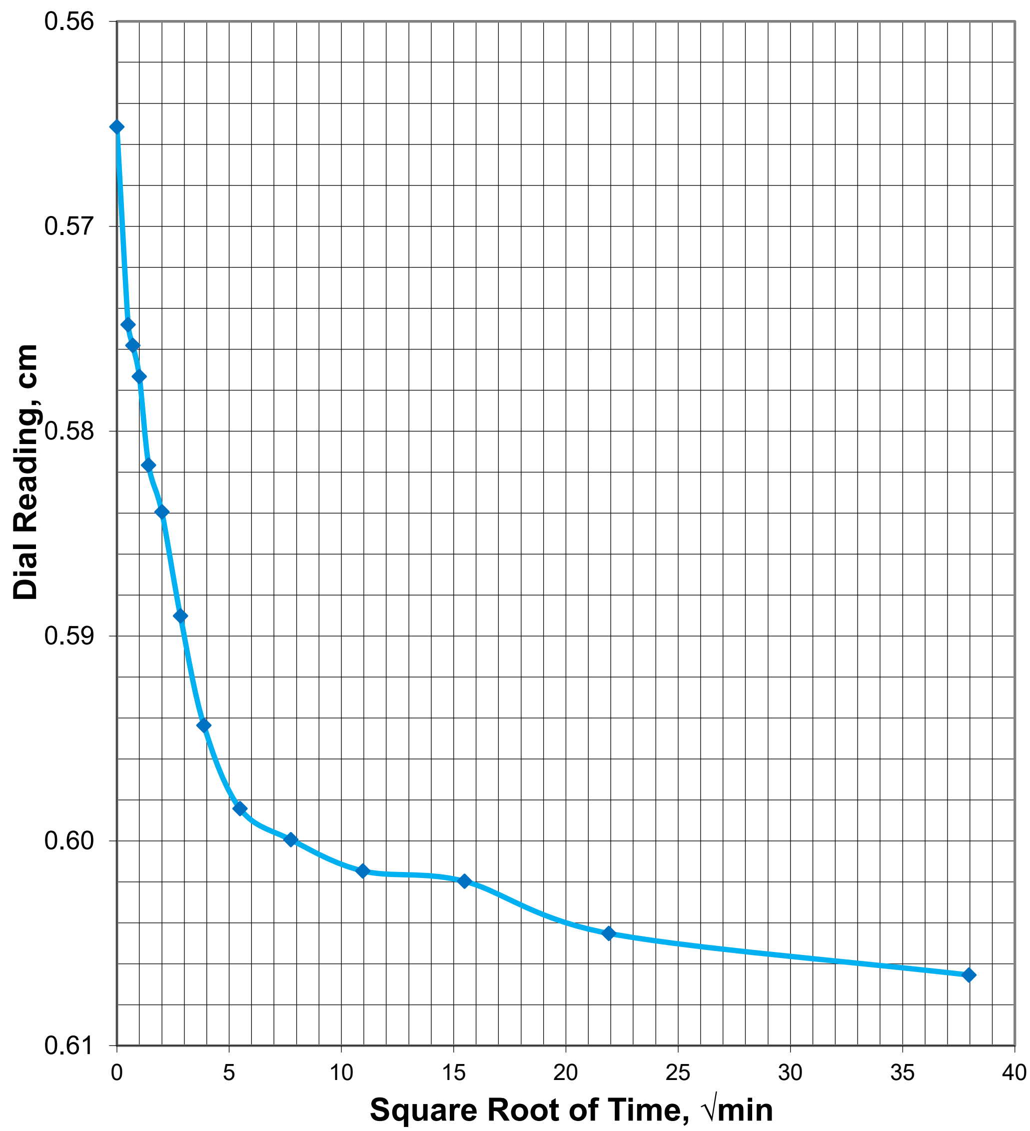
Unit Dry Weight: 103.8 lbs/cu ft
Initial Water Content: 21.0%
Final Water Content: 19.6%
Liquid Limit: 24
Plastic Limit: 21
Percent Passing #200: 83%
Initial Height Sample, cm: 1.7333



SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-14
Sample Depth: 10.5-11 ft
Loading Increment, tsf: 2
Description: Reddish brown silty CLAY
USCS Classification: CL
AASHTO Classification: A-7-6

Unit Dry Weight: 92.0 lbs/cu ft
Initial Water Content: 28.1%
Final Water Content: 31.2%
Liquid Limit: 45
Plastic Limit: 20
Percent Passing #200: 98%
Initial Height Sample, cm: 1.8479



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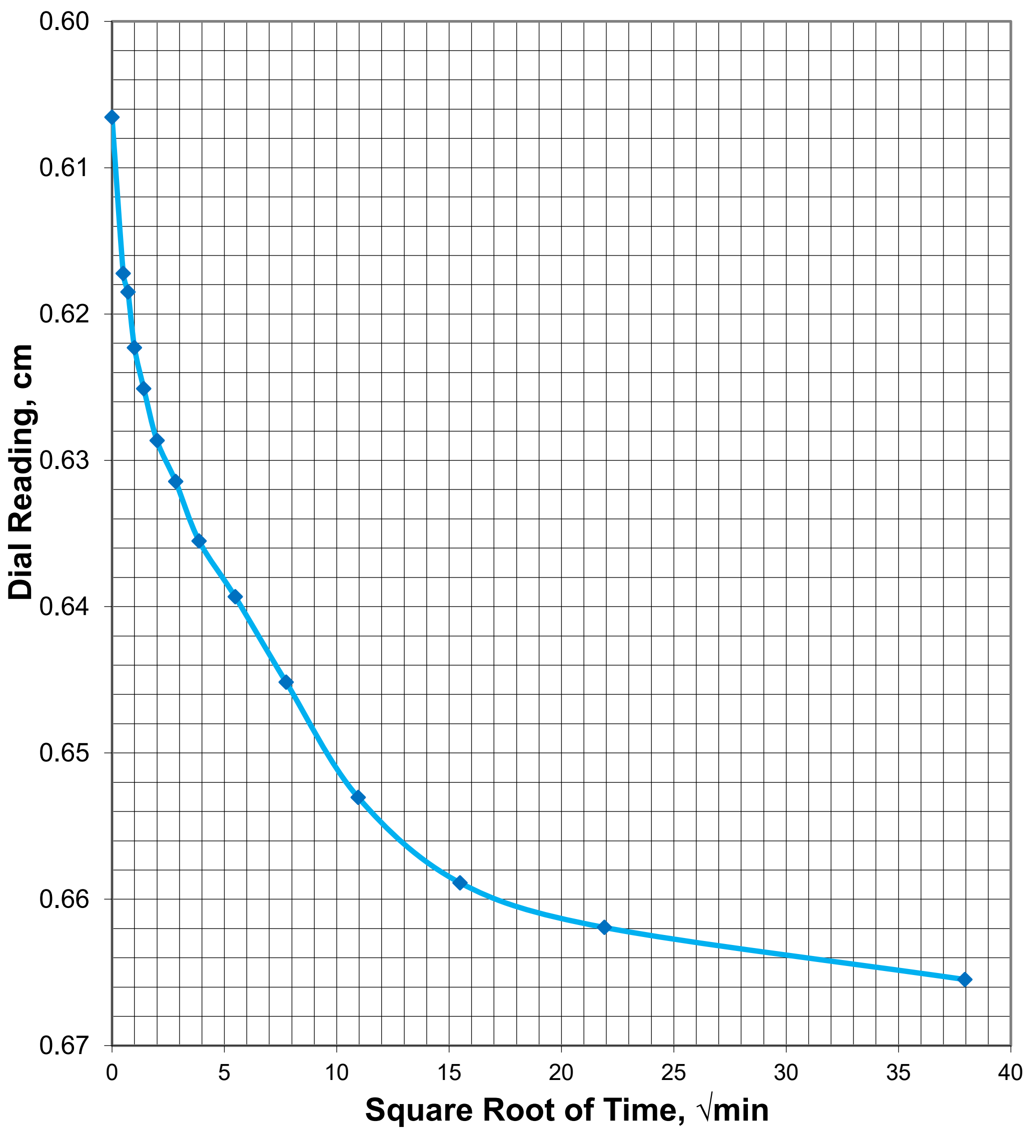
SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-14
Sample Depth: 10.5-11 ft
Loading Increment, tsf: 4
Description: Reddish brown silty CLAY
USCS Classification: CL
AASHTO Classification: A-7-6

Unit Dry Weight: 92.0 lbs/cu ft
Initial Water Content: 28.1%
Final Water Content: 31.2%
Liquid Limit: 45
Plastic Limit: 20
Percent Passing #200: 98%
Initial Height Sample, cm: 1.8064



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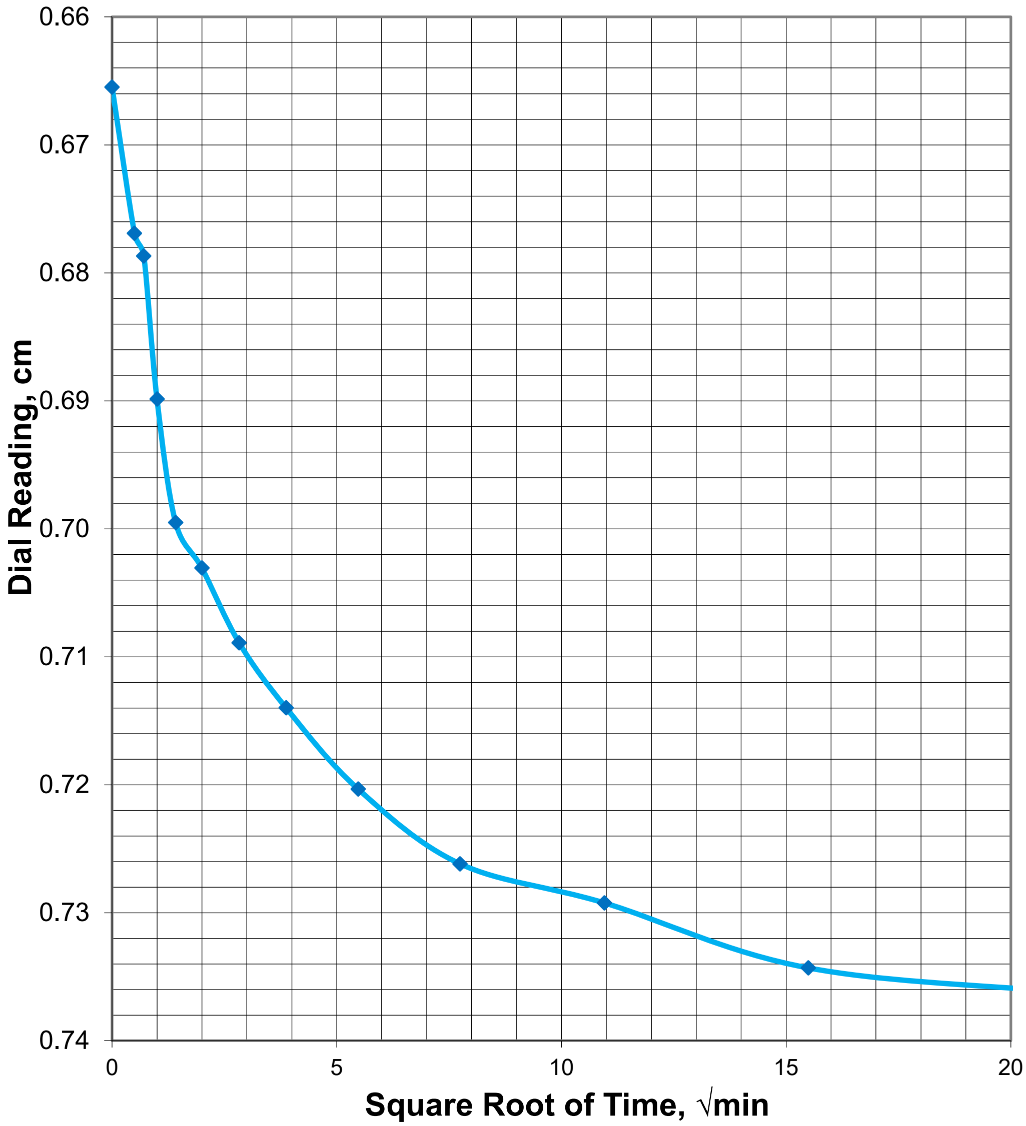
SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-14
Sample Depth: 10.5-11 ft
Loading Increment, tsf: 8
Description: Reddish brown silty CLAY
USCS Classification: CL
AASHTO Classification: A-7-6

Unit Dry Weight: 92.0 lbs/cu ft
Initial Water Content: 28.1%
Final Water Content: 31.2%
Liquid Limit: 45
Plastic Limit: 20
Percent Passing #200: 98%
Initial Height Sample, cm: 1.7475



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SQUARE ROOT OF TIME
CONSOLIDATION TEST RESULTS

Project: 040748 Hwy 22 to I-40
GHBW Job Number: 21-071
Boring: FE-14
Sample Depth: 10.5-11 ft
Loading Increment, tsf: 16
Description: Reddish brown silty CLAY
USCS Classification: CL
AASHTO Classification: A-7-6

Unit Dry Weight: 92.0 lbs/cu ft
Initial Water Content: 28.1%
Final Water Content: 31.2%
Liquid Limit: 45
Plastic Limit: 20
Percent Passing #200: 98%
Initial Height Sample, cm: 1.6731

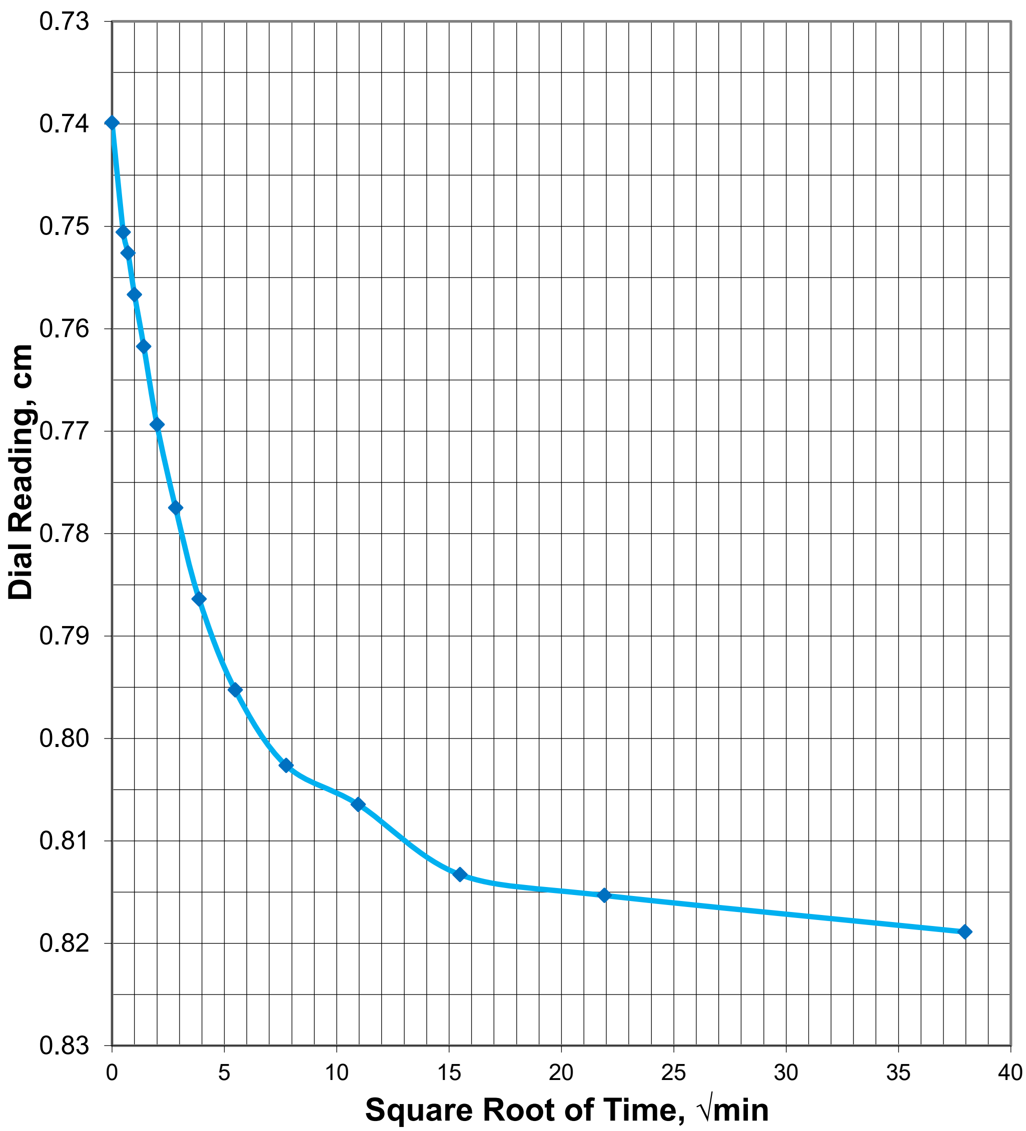

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PLATE

APPENDIX J

Permeability with Flexible Wall Permeameter
(ASTM D-5084)

Job No.:	21-071	Tested Date:	9/20/2023
Project:	040748 Hwy 22 to I-40	Tested by:	LLC
Location:	Crawford County, AR	Checked by:	JDF
Sample:	FB-27 S-2		

Sample Description: Tan fine SAND with some silt

Sample Data

	Height	Diameter			Initial Moisture	Final Moisture
1	2.263	2.859	in.	WW	50.94	547.28
2	2.267	2.860	in.	DW	49.63	499.47
3	2.266	2.863	in.	TW	36.91	111.07
Average	2.265	2.861	in.	Water Content	10.30%	12.31%

Sample Weight =	466.21	g
Sample Cross Area =	6.43	sq.in.
Sample Volume =	14.56	cu.in.
Wet Unit Weight =	121.98	lbs/cu.ft.
Dry Unit Weight =	110.59	lbs/cu.ft.

Test Conditions:

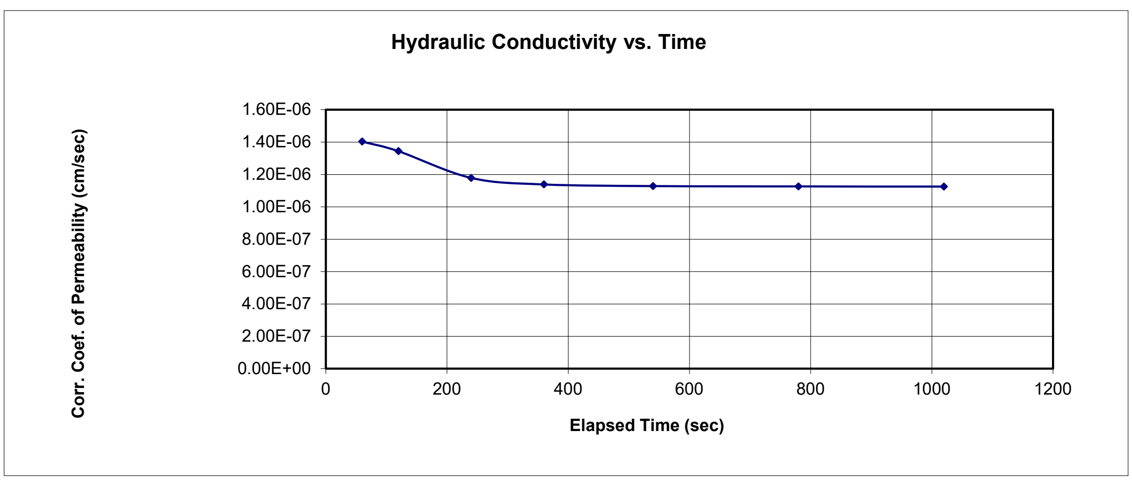
Cell Pressure, psi =	100
Back Pressure, psi =	95
Eff. Conf. Pressure, psi =	5.0

Initial Permometer Readings:

Annulus = 1.00 cm   Pipette = 20.2 cm   Test Cell # 1

Note: Minimum four data point is required

Time		Temp	Pipette Reading	Elapsed Time	Reading Difference	Coefficient of Permeability	Corrected Coefficient of Permeability
hour	minute	(^{o}C)	(cm)	(sec)	(cm)	(cm/sec)	(cm/sec)
6	50	21	20.2	initial			
6	51	21	16.0	60	4.20	1.44E-06	1.40E-06
6	52	21	13.0	120	7.20	1.38E-06	1.34E-06
6	54	21	9.5	240	10.70	1.21E-06	1.18E-06
6	56	21	7.0	360	13.20	1.17E-06	1.14E-06
6	59	21	4.6	540	15.60	1.16E-06	1.13E-06
7	3	21	3.0	780	17.20	1.15E-06	1.13E-06
7	7	21	2.3	1020	17.90	1.15E-06	1.13E-06
						Mean:	**1.1E-06**



Permeability with Flexible Wall Permeameter
(ASTM D-5084)

Job No.:	21-071	Tested Date:	6/15/2023
Project:	040748 Hwy 22 to I-40	Tested by:	LLC
Location:	Crawford County AR	Checked by:	
Sample:	FB-71, S-3, 4.5-5.5		

Sample Description: Brn silty clay

Sample Data

	Height	Diameter			Initial Moisture	Final Moisture
1	2.260	2.860	in.	WW	82.96	415.01
2	2.260	2.860	in.	DW	71.10	352.91
3	2.260	2.860	in.	TW	21.13	110.19
Average	2.260	2.860	in.	Water Content	23.73%	25.59%

Sample Weight =	438.43	g
Sample Cross Area =	6.42	sq.in.
Sample Volume =	14.52	cu.in.
Wet Unit Weight =	115.04	lbs/cu.ft.
Dry Unit Weight =	92.97	lbs/cu.ft.

Test Conditions:

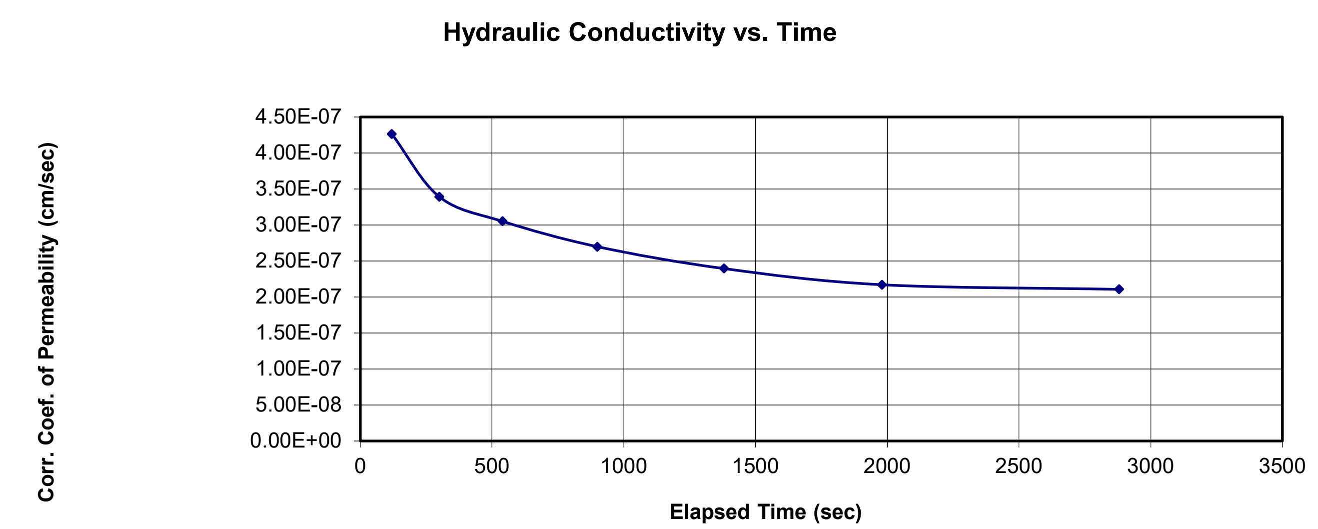
Cell Pressure, psi =	100
Back Pressure, psi =	95
Eff. Conf. Pressure, psi =	5.0

Initial Permometer Readings:

Annulus = 1.00 cm Pipette = 19.6 cm Test Cell # 1

Note: Minimum four data point is required

Time		Temp	Pipette Reading	Elapsed Time	Reading Difference	Coefficient of Permeability	Corrected Coefficient of Permeability
hour	minute	(^{o}C)	(cm)	(sec)	(cm)	(cm/sec)	(cm/sec)
6	42	21	19.6	initial			
6	44	21	17.0	120	2.60	4.37E-07	4.26E-07
6	47	21	14.8	300	4.80	3.48E-07	3.39E-07
6	51	21	12.5	540	7.10	3.13E-07	3.05E-07
6	57	21	10.2	900	9.40	2.76E-07	2.70E-07
7	5	21	8.2	1380	11.40	2.45E-07	2.39E-07
7	15	21	6.5	1980	13.10	2.22E-07	2.17E-07
7	30	21	4.5	2880	15.10	2.16E-07	2.11E-07
						Mean:	**2.3E-07**



Permeability with Flexible Wall Permeameter
(ASTM D-5084)

Job No.: 21-071 | Tested Date: 4/24/2023
Project: 040748 Hwy 22 to I-40 | Tested by: LLC
Location: FE-10 | Checked by:
Sample: 3 2.5-3.0
Sample Description: Brown fine sandy silt with some clayey silt pockets

Sample Data

	Height	Diameter	
1	2.271	2.886	in.
2	2.275	2.886	in.
3	2.277	2.886	in.
Average	2.274	2.886	in.

	Initial Moisture	Final Moisture
WW	270.36	600.16
DW	242.85	513.21
TW	110.30	111.01
Water Content	20.75%	21.62%

Sample Weight = 489.39 g
Sample Cross Area = 6.54 sq.in.
Sample Volume = 14.88 cu.in.
Wet Unit Weight = 125.31 lbs/cu.ft.
Dry Unit Weight = 103.77 lbs/cu.ft.

Test Conditions:

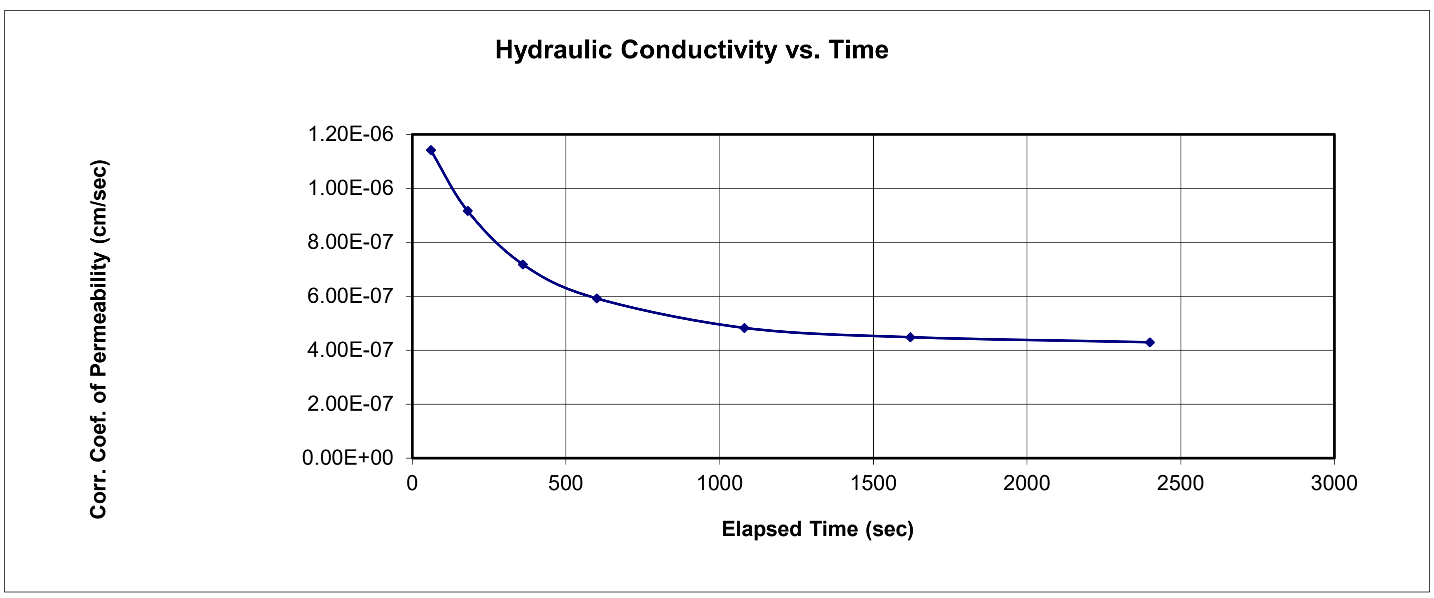
Cell Pressure, psi = 100
Back Pressure, psi = 95
Eff. Conf. Pressure, psi = 5.0

Initial Permometer Readings:

Annulus = 1.10 cm | Pipette = 19.0 cm | Test Cell # 1

Note: Minimum four data point is required

Time		Temp	Pipette Reading	Elapsed Time	Reading Difference	Coefficient of Permeability	Corrected Coefficient of Permeability
hour	minute	(^{o}C)	(cm)	(sec)	(cm)	(cm/sec)	(cm/sec)
8	50	21	19.0	initial			
8	51	21	15.7	60	3.30	1.17E-06	1.14E-06
8	53	21	12.1	180	6.90	9.39E-07	9.16E-07
8	56	21	9.5	360	9.50	7.36E-07	7.18E-07
9	0	21	7.5	600	11.50	6.07E-07	5.92E-07
9	8	21	5.2	1080	13.80	4.95E-07	4.83E-07
9	17	21	3.6	1620	15.40	4.59E-07	4.48E-07
9	30	21	2.5	2400	16.50	4.40E-07	4.30E-07
						Mean:	**4.9E-07**



Permeability with Flexible Wall Permeameter
(ASTM D-5084)

Job No.: 21-071 | Tested Date: 4/1/2023
Project: 040748 Hwy 22 to I-40 | Tested by: LLC
Location: Crawford County, AR | Checked by:
Sample: FE-11, 21.5'-22'
Sample Description: Brown silty clay with fine sand

Sample Data

	Height	Diameter	
1	2.543	2.869	in.
2	2.543	2.869	in.
3	2.543	2.869	in.
Average	2.543	2.869	in.

	Initial Moisture	Final Moisture
WW	210.37	601.36
DW	195.83	521.64
TW	112.20	109.86
Water Content	17.39%	19.36%

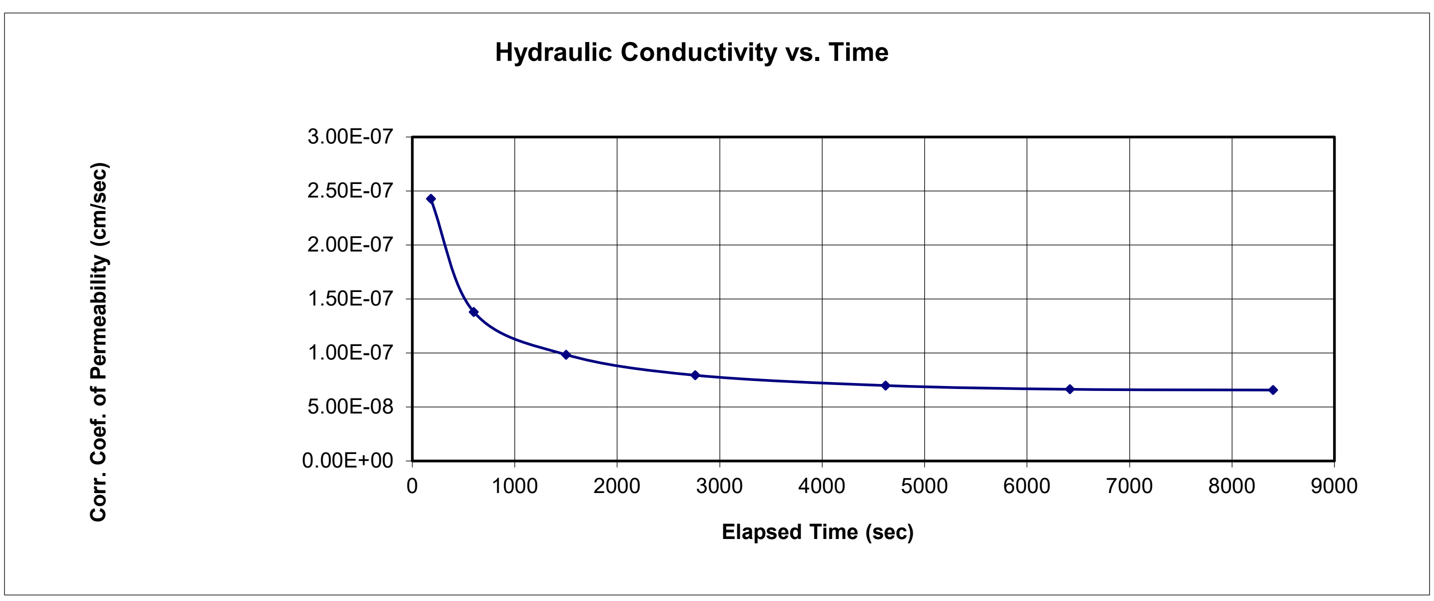
Sample Weight = 526.21 g
Sample Cross Area = 6.46 sq.in.
Sample Volume = 16.44 cu.in.
Wet Unit Weight = 121.94 lbs/cu.ft.
Dry Unit Weight = 103.88 lbs/cu.ft.

Test Conditions:
Cell Pressure, psi = 100
Back Pressure, psi = 95
Eff. Conf. Pressure, psi = 5.0

Initial Permometer Readings:
Annulus = 1.00 cm
Pipette = 19.4 cm
Test Cell # 2

Note: Minimum four data point is required

Time		Temp	Pipette Reading	Elapsed Time	Reading Difference	Coefficient of Permeability	Corrected Coefficient of Permeability
hour	minute	(^{o}C)	(cm)	(sec)	(cm)	(cm/sec)	(cm/sec)
6	10	22	19.4	initial			
6	13	21	17.4	180	2.00	2.49E-07	2.43E-07
6	20	21	15.8	600	3.60	1.41E-07	1.38E-07
6	35	21	13.5	1500	5.90	1.01E-07	9.85E-08
6	56	21	11.4	2760	8.00	8.14E-08	7.94E-08
7	27	21	9.0	4620	10.40	7.16E-08	6.99E-08
7	57	21	7.2	6420	12.20	6.80E-08	6.64E-08
8	30	21	5.6	8400	13.80	6.73E-08	6.57E-08
						Mean:	**7.0E-08**



Permeability with Flexible Wall Permeameter

(ASTM D-5084)

Job No.: 21-071
Project: 040748 Hwy 22 to I-40
Location: Crawford Co., AR
Sample: FE-13, 2 2'-2.5'
Sample Description: Brown fine sandy SILT

Tested Date: 4/3/2023
Tested by: LLC
Checked by:

Sample Data

	Height	Diameter	
1	2.798	2.823	in.
2	2.794	2.832	in.
3	2.799	2.824	in.
Average	2.797	2.826	in.

	Initial Moisture	Final Moisture
WW	262.85	676.48
DW	236.78	574.51
TW	110.06	111.07
Water Content	20.57%	22.00%

Sample Weight =	569.42	g
Sample Cross Area =	6.27	sq.in.
Sample Volume =	17.55	cu.in.
Wet Unit Weight =	123.62	lbs/cu.ft.
Dry Unit Weight =	102.53	lbs/cu.ft.

Test Conditions:

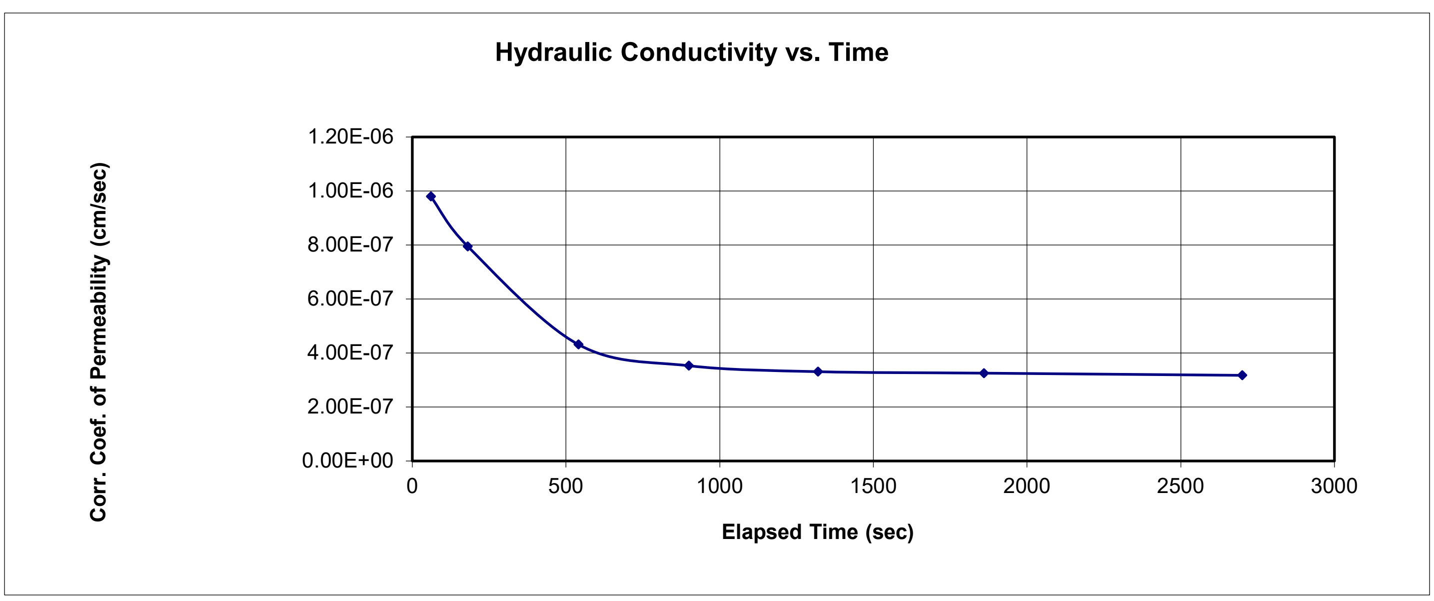
Cell Pressure, psi =	100
Back Pressure, psi =	95
Eff. Conf. Pressure, psi =	5.0

Initial Permometer Readings:

Annulus = 1.00 cm Pipette = 19.8 cm Test Cell # 2

Note: Minimum four data point is required

Time		Temp	Pipette Reading	Elapsed Time	Reading Difference	Coefficient of Permeability	Corrected Coefficient of Permeability
hour	minute	(^{o}C)	(cm)	(sec)	(cm)	(cm/sec)	(cm/sec)
8	50	21	19.8	initial			
8	51	21	17.4	60	2.40	1.00E-06	9.80E-07
8	53	21	14.5	180	5.30	8.15E-07	7.95E-07
8	59	21	12.0	540	7.80	4.42E-07	4.32E-07
9	5	21	10.1	900	9.70	3.61E-07	3.53E-07
9	12	21	8.0	1320	11.80	3.39E-07	3.31E-07
9	21	21	5.9	1860	13.90	3.33E-07	3.25E-07
9	35	21	4.0	2700	15.80	3.25E-07	3.17E-07
						Mean:	**3.3E-07**



Permeability with Flexible Wall Permeameter
(ASTM D-5084)

Job No.: 21-071 | Tested Date: 4/1/2023
Project: 040748 Hwy 22 to I-40 | Tested by: LLC
Location: Crawford Co., AR | Checked by:
Sample: FE-13, 7 8'-8.5'
Sample Description: Brown silty fine sand

Sample Data

	Height	Diameter			Initial Moisture	Final Moisture
1	2.651	2.871	in.	WW	283.64	602.21
2	2.651	2.873	in.	DW	257.72	524.18
3	2.651	2.871	in.	TW	110.41	110.61
Average	2.651	2.872	in.	Water Content	17.60%	18.87%

Sample Weight = 511.86 g
Sample Cross Area = 6.48 sq.in.
Sample Volume = 17.17 cu.in.
Wet Unit Weight = 113.57 lbs/cu.ft.
Dry Unit Weight = 96.58 lbs/cu.ft.

Test Conditions:

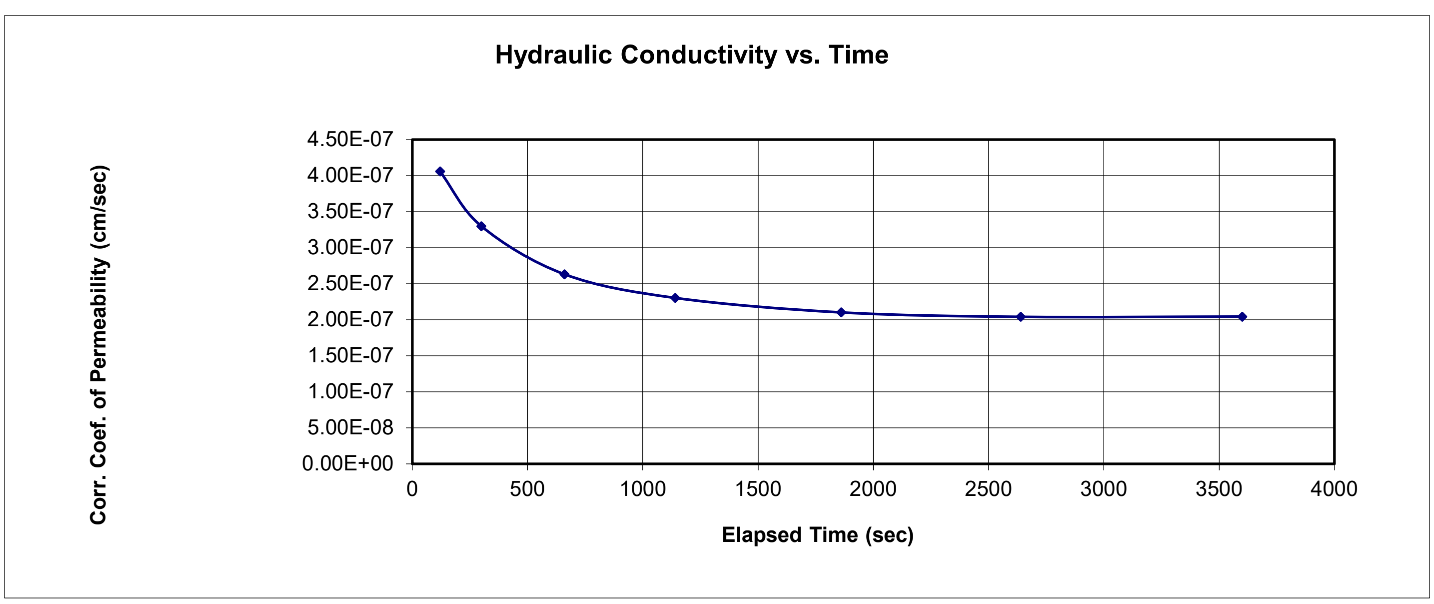
Cell Pressure, psi = 100
Back Pressure, psi = 95
Eff. Conf. Pressure, psi = 5.0

Initial Permometer Readings:

Annulus = 1.10 cm   Pipette = 19.2 cm   Test Cell # 1

Note: Minimum four data point is required

Time		Temp	Pipette Reading	Elapsed Time	Reading Difference	Coefficient of Permeability	Corrected Coefficient of Permeability
hour	minute	(^{o}C)	(cm)	(sec)	(cm)	(cm/sec)	(cm/sec)
7	40	21	19.2	initial			
7	42	21	17.1	120	2.10	4.16E-07	4.06E-07
7	45	21	15.2	300	4.00	3.38E-07	3.30E-07
7	51	21	12.8	660	6.40	2.70E-07	2.63E-07
7	59	21	10.5	1140	8.70	2.36E-07	2.30E-07
8	11	21	8.0	1860	11.20	2.15E-07	2.10E-07
8	24	21	6.0	2640	13.20	2.09E-07	2.04E-07
8	40	21	4.3	3600	14.90	2.09E-07	2.04E-07
						Mean:	**2.1E-07**



Permeability with Flexible Wall Permeameter
(ASTM D-5084)

Job No.: 21-071 Tested Date: 4/23/2023
Project: 040748 Hwy 22 to I-40 Tested by: LLC
Location: FE-14 Checked by:
Sample: 4 4.5'-5'
Sample Description: Reddish brown silty clay with some silt pockets

Sample Data

	Height	Diameter	
1	2.291	2.830	in.
2	2.294	2.830	in.
3	2.290	2.830	in.
Average	2.292	2.830	in.

	Initial Moisture	Final Moisture
WW	266.39	585.64
DW	239.23	497.21
TW	110.13	110.62
Water Content	21.04%	22.87%

Sample Weight = 475.15 g
Sample Cross Area = 6.29 sq.in.
Sample Volume = 14.41 cu.in.
Wet Unit Weight = 125.57 lbs/cu.ft.
Dry Unit Weight = 103.75 lbs/cu.ft.

Test Conditions:

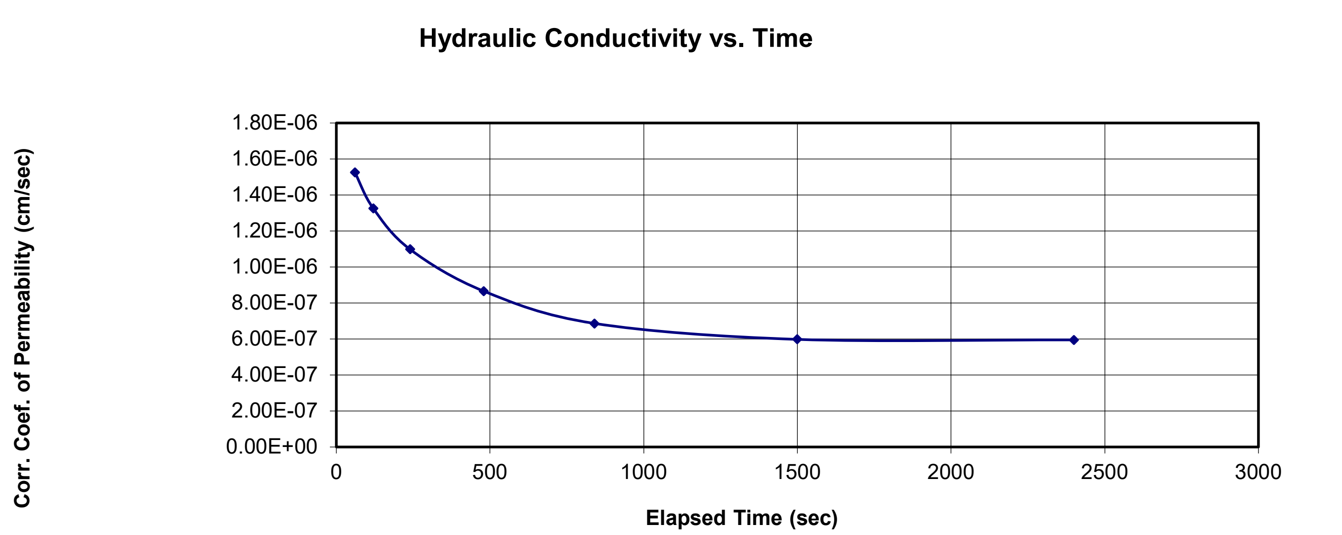
Cell Pressure, psi = 100
Back Pressure, psi = 95
Eff. Conf. Pressure, psi = 5.0

Initial Permometer Readings:

Annulus = 1.00 cm Pipette = 19.8 cm Test Cell # 3

Note: Minimum four data point is required

Time		Temp	Pipette Reading	Elapsed Time	Reading Difference	Coefficient of Permeability	Corrected Coefficient of Permeability
hour	minute	(^{o}C)	(cm)	(sec)	(cm)	(cm/sec)	(cm/sec)
8	10	21	19.8	initial			
8	11	21	15.5	60	4.30	1.56E-06	1.53E-06
8	12	21	13.0	120	6.80	1.36E-06	1.33E-06
8	14	21	10.0	240	9.80	1.12E-06	1.10E-06
8	18	21	7.0	480	12.80	8.87E-07	8.66E-07
8	24	21	5.0	840	14.80	7.03E-07	6.86E-07
8	35	21	3.0	1500	16.80	6.13E-07	5.98E-07
8	50	21	2.0	2400	17.80	6.10E-07	5.95E-07
						Mean:	**6.9E-07**



Permeability with Flexible Wall Permeameter
(ASTM D-5084)

Job No.: 21-071
Project: 040748 Hwy 22 to I-40
Location: FP-14
Sample: 4 3-3.5
Sample Description: Brown silty clay

Tested Date: 4/25/2023
Tested by: LLC
Checked by:

Sample Data

	Height	Diameter	
1	2.254	2.832	in.
2	2.251	2.832	in.
3	2.255	2.832	in.
Average	2.253	2.832	in.

	Initial Moisture	Final Moisture
WW	340.12	563.26
DW	293.80	468.34
TW	110.05	110.05
Water Content	25.21%	26.49%

Sample Weight = 450.29 g
Sample Cross Area = 6.30 sq.in.
Sample Volume = 14.19 cu.in.
Wet Unit Weight = 120.86 lbs/cu.ft.
Dry Unit Weight = 96.52 lbs/cu.ft.

Test Conditions:

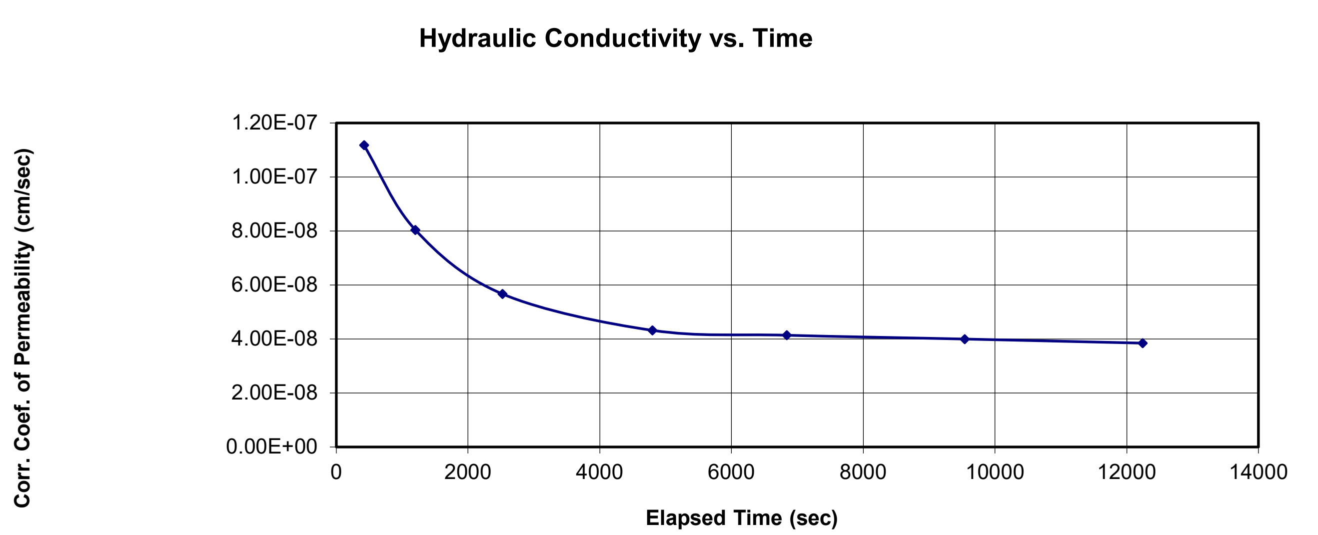
Cell Pressure, psi = 100
Back Pressure, psi = 95
Eff. Conf. Pressure, psi = 5.0

Initial Permometer Readings:

Annulus = 1.00 cm Pipette = 19.1 cm Test Cell # 2

Note: Minimum four data point is required

Time		Temp	Pipette Reading	Elapsed Time	Reading Difference	Coefficient of Permeability	Corrected Coefficient of Permeability
hour	minute	(^oC)	(cm)	(sec)	(cm)	(cm/sec)	(cm/sec)
7	10	21	19.1	initial			
7	17	21	16.8	420	2.30	1.14E-07	1.12E-07
7	30	21	14.7	1200	4.40	8.24E-08	8.04E-08
7	52	21	13.0	2520	6.10	5.81E-08	5.67E-08
8	30	21	11.0	4800	8.10	4.43E-08	4.32E-08
9	4	21	9.1	6840	10.00	4.24E-08	4.14E-08
9	49	21	7.2	9540	11.90	4.10E-08	4.00E-08
10	34	21	5.9	12240	13.20	3.94E-08	3.85E-08
						Mean:	**4.1E-08**



APPENDIX K

SUMMARY of ANALYTICAL TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Crawford & Sebastian Counties, Arkansas
GHBW JOB NUMBER: 21-071

Boring No.	**Sample Depth, ft**	**Sulfate Content, ppm** (AASHTO T290)	**Chloride Content, ppm** (AASHTO T291)	**Soil pH** (ASTM G51)	**Soil Resistivity, ohm-cm** (AASHTO T288)	**Soil Description and Classification** (ASTM D2488)
FB-45	9-10	22	< 10	8.80	18,450	Tan fine sand, slightly silty (SM-SP)
FB-46	4.5-5.5	24	< 10	8.80	18,450	Reddish tan silty fine sand (SM)
FB-66	2.5-3.5	48	< 10	8.10	2,475	Reddish brown silt (ML)
FE-9	2.5-3.5	101	< 10	6.30	2,453	Grayish brown clay w/silt pockets and ferrous nodules (CH)

APPENDIX L

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-4	38-38.6	---	160	3000	Multiple vertical shears	Dark gray SHALE w/ occassional gray fine-grained SANDSTONE partings
FB-4	46-46.5	---	152	2160	Multiple vertical shears	Dark gray SHALE w/ occassional gray fine-grained SANDSTONE partings
FB-4	50.1-50.6	---	160	2220	Multiple vertical shears	Dark gray SHALE w/ occassional gray fine-grained SANDSTONE partings
FB-4	56-56.6	---	160	1570	Multiple vertical shears	Dark gray SHALE w/ interbedded, very close, very thin fine-grained SANDSTONE partings
FB-4	81.2-81.8	---	162	5170	Multiple vertical shears	Light gray fine-grained SANDSTONE w/ very close SHALE laminations
FB-5	39-39.5	---	165	2440	Multiple vertical shears	Dark gray SHALE w/ some gray fine-grained SANDSTONE partings
FB-5	39.5-40	---	165	1300	Multiple vertical shears	Dark gray SHALE w/ some gray fine-grained SANDSTONE partings
FB-5	44-44.5	---	166	2180	Multiple vertical shears	Dark gray SHALE w/ some gray fine-grained SANDSTONE partings
FB-5	51-51.5	---	162	1430	Multiple vertical shears w/ some horizontal shears	Dark gray SHALE w/ some gray fine-grained SANDSTONE partings
FB-5	55.5-56	---	165	2080	Multiple vertical shears w/ some horizontal shears	Dark gray SHALE w/ some gray fine-grained SANDSTONE partings
FB-7	40.5-41	---	162	1550	Multiple vertical shears	Dark gray SHALE w/ occassional gray fine-grained SANDSTONE partings
FB-7	46.5-47	---	163	970	Multiple vertical shears	Dark gray SHALE w/ occassional gray fine-grained SANDSTONE partings
FB-7	57-57.5	---	161	1570	Multiple vertical shears	Dark gray SHALE w/ occassional gray fine-grained SANDSTONE partings
FB-8	32-32.5	---	166	3870	Multiple vertical shears w/ some horizontal shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-8	36-36.5	---	163	4750	Multiple vertical shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-8	44-44.5	---	157	1900	Multiple vertical shears w/ some horizontal shears	Dark gray SHALE w/some gray fine-grained SANDSTONE partings
FB-8	49-49.5	---	159	2090	Multiple vertical shears w/ some horizontal shears	Dark gray SHALE w/some gray fine-grained SANDSTONE partings

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-8	65.5-66	---	164	8340	Multiple vertical shears w/ some horizontal shears	Dark gray SHALE w/some gray fine-grained SANDSTONE partings
FB-10	49.5-50	---	162	1790	Vertical Shear	Dark gray weathered SHALE w/ fine-grained SANDSTONE partings
FB-10	66-66.5	---	158	1730	Vertical shear	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-10	89.5-90	---	164	2970	Vertical shear	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-10	93.5-94	---	160	2370	Multiple vertical shears	Gray fine-grained SANDSTONE w/ very close, very thin dark gray SHALE partings
FB-12	37-37.5	---	163	1030	Multiple vertical shears	Dark gray SHALE w/ occassional gray fine-grained SANDSTONE partings
FB-12	42-42.5	---	162	2100	Multiple vertical shears	Dark gray SHALE w/ occassional gray fine-grained SANDSTONE partings
FB-12	45-45.5	---	162	1240	Multiple vertical shears	Dark gray SHALE w/ occassional gray fine-grained SANDSTONE partings
FB-12	58-58.5	---	162	2720	Multiple vertical shears	Dark gray SHALE
FB-12	71-71.5	---	164	1590	Multiple vertical shears	Dark gray SHALE w/ interbedded, very close, very thin fine-grained SANDSTONE partings
FB-13	35-35.5	---	167	2420	Multiple vertical shears	Dark gray SHALE w/ occassional gray fine-grained SANDSTONE partings
FB-13	37.5-38	---	166	1520	Multiple vertical shears	Dark gray SHALE w/ occassional gray fine-grained SANDSTONE partings
FB-13	41.3-41.8	---	164	1450	Multiple vertical shears	Dark gray SHALE w/ occassional gray fine-grained SANDSTONE partings
FB-13	50-50.5	---	169	1740	Multiple vertical shears	Dark gray SHALE w/ occassional gray fine-grained SANDSTONE partings
FB-13	57.5-58	---	162	2310	Multiple vertical shears	Dark gray SHALE w/ occassional gray fine-grained SANDSTONE partings
FB-13	61-61.7	---	166	4470	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded very close, very thin dark gray SHALE partings
FB-13	70-70.5	---	161	3300	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded very close, very thin dark gray SHALE partings

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-13	75-75.5	---	161	3190	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded very close, very thin dark gray SHALE partings
FB-14	37.5-38	---	163	3210	Multiple vertical shears w/ some horizontal shears	Dark gray SHALE w/close to very close, very thin fine-grained SANDSTONE partings
FB-14	46.3-46.9	---	160	2200	Multiple vertical shears	Dark gray SHALE w/close to very close, very thin fine-grained SANDSTONE partings
FB-14	51-51.5	---	163	3060	Multiple vertical shears	Dark gray SHALE w/close to very close, very thin fine-grained SANDSTONE partings
FB-14	61.5-62	---	165	1770	Multiple vertical shears w/ some horizontal shears	Dark gray SHALE w/close to very close, very thin fine-grained SANDSTONE partings
FB-14	71.5-72	---	164	3590	Multiple vertical shears w/ some horizontal shears	Dark gray SHALE w/close to very close, very thin fine-grained SANDSTONE partings
FB-14	84.3-84.8	---	164	4300	Multiple vertical shears	Light gray fine-grained SANDSTONE w/ very close, very thin dark gray SHALE laminations
FB-15	41-41.5	---	162	3620	Multiple vertical shears	Dark gray SHALE w/ very close, very thin fine-grained SANDSTONE partings
FB-15	46-46.8	---	162	1830	Multiple vertical shears	Dark gray SHALE w/ very close, very thin fine-grained SANDSTONE partings
FB-15	53-53.5	---	162	2120	Multiple vertical shears	Dark gray SHALE w/ very close, very thin fine-grained SANDSTONE partings
FB-15	57-57.8	---	161	4090	Multiple vertical shears	Dark gray SHALE w/ very close, very thin fine-grained SANDSTONE partings
FB-15	65-65.5	---	165	8870	Multiple vertical shears	Light gray fine-grained SANDSTONE w/ very close, very thin dark gray SHALE laminations
FB-15	85-85.5	---	160	7910	Multiple vertical shears	Light gray fine-grained SANDSTONE w/ very close, very thin dark gray SHALE laminations
FB-16	48.5-49	---	159	1600	Multiple vertical shears	Dark gray SHALE
FB-16	52.5-53	---	157	1300	Multiple vertical shears	Dark gray SHALE
FB-16	55.6-56.2	---	161	3900	Multiple vertical shears	Light gray fine-grained SANDSTONE w/ very close, very thin dark gray SHALE laminations
FB-16	63-63.5	---	164	4610	Multiple vertical shears	Light gray fine-grained SANDSTONE w/ very close, very thin dark gray SHALE laminations

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-16	80.5-81.1	---	162	3580	Multiple vertical shears	Dark gray SHALE w/ very close, very thin fine-grained SANDSTONE partings
FB-16	82-82.5	---	161	4500	Multiple vertical shears	Light gray fine-grained SANDSTONE w/ very close, very thin dark gray SHALE laminations
FB-17	51-51.5	---	157	1290	Multiple vertical shears	Dark gray SHALE w/ very close, very thin fine-grained SANDSTONE partings
FB-17	62-62.8	---	162	2990	Multiple vertical shears w/ Some Horizontal Shears	Light gray fine-grained SANDSTONE w/ very close SHALE laminations
FB-17	79.5-80	---	165	1840	Vertical and partial horizontal shear	Dark gray SHALE w/some gray fine-grained SANDSTONE partings
FB-17	84-84.6	---	161	5250	Multiple vertical shears	Light gray fine-grained SANDSTONE w/ very close SHALE laminations
FB-18	52.6-53.4	---	161	3820	Multiple Vertical w/ few Horizontal shears	Dark gray SHALE w/ very close, very thin fine-grained SANDSTONE partings
FB-18	59-59.5	---	161	4050	Multiple Vertical and Horizontal shears	Dark gray SHALE w/ very close, very thin fine-grained SANDSTONE partings
FB-18	62-62.5	---	160	3810	Multiple Vertical and Horizontal shears	Dark gray SHALE w/ very close, very thin fine-grained SANDSTONE partings
FB-18	79.5-80	---	161	5500	Multiple Vertical Shears	Light gray fine-grained SANDSTONE w/ very close SHALE laminations
FB-18	84.7-85.2	---	161	4500	Multiple Vertical Shears	Light gray fine-grained SANDSTONE w/ very close SHALE laminations
FB-19	47-47.5	---	157	830	Multiple Vertical Shears	Dark gray SHALE
FB-19	91.5-92	---	160	4730	Multiple Vertical and Horizontal shears	Gray fine-grained SANDSTONE w/ very close SHALE laminations
FB-20	45-45.5	---	160	3740	Multiple Vertical Shears	Dark gray SHALE w/interbedded very close, very thin fine-grained SANDSTONE partings
FB-20	54-54.5	---	162	4640	Multiple Vertical Shears	Dark gray SHALE w/interbedded very close, very thin fine-grained SANDSTONE partings
FB-20	58-58.5	---	163	3770	Multiple Vertical Shears	Dark gray SHALE w/interbedded very close, very thin fine-grained SANDSTONE partings

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-20	64-64.5	---	167	4380	Multiple Vertical Shears	Dark gray SHALE w/interbedded very close, very thin fine-grained SANDSTONE partings
FB-20	66-66.5	---	169	5040	Multiple Vertical Shears	Dark gray SHALE w/interbedded very close, very thin fine-grained SANDSTONE partings
FB-20	69-69.5	---	161	1680	Multiple Vertical Shears	Dark gray SHALE w/close, fine-grained SANDSTONE partings
FB-20	76-76.5	---	160	4590	Multiple Vertical Shears	Dark gray SHALE w/interbedded very close, very thin fine-grained SANDSTONE partings
FB-20	85-85.4	---	163	5640	Multiple Vertical Shears	Dark gray SHALE w/interbedded very close, very thin fine-grained SANDSTONE partings
FB-21	34-34.6	---	167	2130	Vertical and horizontal shears	Dark gray SHALE w/interbedded very close, very thin fine-grained SANDSTONE partings
FB-23	28-28.5	---	163	3900	Vertical shears and horizontal shears	Dark gray SHALE w/very close, very thin fine-grained SANDSTONE partings
FB-23	61.5-62.3	---	158	3000	Multiple vertical shears	Dark gray SHALE w/very close, very thin fine-grained SANDSTONE partings
FB-24	12.8-13.2	---	161	3040	Vertical and partial horizontal shear	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin dark gray SHALE partings
FB-24	29.1-29.6	---	161	2990	Vertical and partial horizontal shear	Dark gray SHALE w/very close, very thin fine-grained SANDSTONE partings
FB-24	34-34.5	---	162	4980	Vertical shear and partial horizontal shear	Dark gray SHALE w/very close fine-grained SANDSTONE partings
FB-24	54.5-55	---	154	10170	Vertical shear and partial horizontal shear	Gray fine-grained SANDSTONE w/interbedded, very close, very thin dark gray SHALE partings
FB-25	20.2-20.7	---	159	2660	Vertical shear	Dark gray SHALE w/very close, very thin fine-grained SANDSTONE partings
FB-25	24.3-24.8	---	160	4090	Vertical shear	Dark gray SHALE w/very close, very thin fine-grained SANDSTONE partings
FB-25	52.1-52.7	---	155	8590	Multiple vertical shears	Gray and dark gray fine-grained SANDSTONE w/some dark gray SHALE partings and inclusions
FB-25	54-54.5	---	157	11780	Vertical shear	Gray and dark gray fine-grained SANDSTONE w/some dark gray SHALE partings and inclusions

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-26	32-32.5	---	159	2870	Vertical shear	Light gray fine-grained SANDSTONE w/ very close SHALE laminations
FB-26	51.7-52.2	---	148	8640	Vertical and horizontal shears	Light gray fine-grained SANDSTONE w/ very close SHALE laminations
FB-26	65.2-65.6	---	159	2730	Vertical shear	Dark gray SHALE w/ very close fine-grained SANDSTONE partings
FB-26	79.5-80	---	161	2870	Vertical shear	Dark gray SHALE w/ very close fine-grained SANDSTONE partings
FB-27	37.4-37.9	---	160	6670	Multiple vertical shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-27	40-40.5	---	162	5510	Multiple vertical shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-27	44-44.5	---	164	2930	Multiple vertical shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-27	46-46.5	---	164	6550	Multiple vertical shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-27	59.3-59.8	---	164	2800	Vertical shear	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-27	72-72.5	---	162	4110	Vertical and horizontal shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-27	85-85.5	---	163	3070	Vertical and horizontal shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-28	40.4-41	---	164	5840	Vertical shear	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-28	51.3-52	---	164	2810	Diagonal shear	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-28	65-65.6	---	161	3690	Multiple diagonal shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-28	81-81.7	---	161	5390	Multiple vertical shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-28	91-91.5	---	162	5520	Vertical shear	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-29	41.3-41.8	---	165	5250	Multiple vertical shears	Gray fine-grained SANDSTONE w/ very close, very thin SHALE partings
FB-29	45-45.5	---	161	7410	Vertical and horizontal shears	Gray fine-grained SANDSTONE w/ very close, very thin SHALE partings
FB-29	50-50.5	---	160	4200	Multiple vertical shears	Gray fine-grained SANDSTONE w/ very close, very thin SHALE partings
FB-29	60-60.5	---	162	5250	Multiple vertical shears	Gray fine-grained SANDSTONE w/ very close, very thin SHALE partings
FB-29	75-75.5	---	160	3330	Vertical and horizontal shears	Gray fine-grained SANDSTONE w/ very close, very thin SHALE partings and seams
FB-29	95-95.5	---	166	2640	Vertical and horizontal shears	Gray fine-grained SANDSTONE w/ very close, very thin SHALE partings and seams
FB-30	41.5-42	---	162	2700	Vertical shear	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-30	48-48.5	---	164	3360	Multiple vertical shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-30	53-53.5	---	164	4150	Vertical shear	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-30	62.6-63.3	---	164	2680	Diagonal shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-30	70.5-71	---	162	3170	Vertical shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-30	80.5-81	---	164	2900	Diagonal shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-31	40.7-41.3	---	163	3960	Multiple vertical shears	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-31	48-48.5	---	161	4980	Vertical and horizontal shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-31	56-56.7	---	163	3430	Diagonal shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-31	67-67.8	---	158	8170	Vertical shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-31	75.5-76	---	159	3220	Diagonal shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-32	38.3-39	---	162	3620	Diagonal shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-32	42-42.7	---	162	3740	Diagonal shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-32	50-50.6	---	167	2780	Multiple diagonal shears	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-32	59.5-60	---	163	3600	Diagonal shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-32	68-68.7	---	161	5170	Vertical shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-32	71-71.7	---	160	2150	Diagonal shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-33	38.5-39	---	161	5920	Multiple vertical shears	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-33	41.5-42	---	163	7910	Diagonal shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-33	51-51.7	---	164	5310	Vertical shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-33	60-60.7	---	162	8330	Vertical and diagonal shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-33	70-70.7	---	157	2870	Diagonal and horizontal shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-34	41.2-41.6	---	161	6300	Multiple vertical shears	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-34	46-46.5	---	160	4650	Diagonal shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-34	57-57.7	---	162	4220	Multiple vertical shears	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-34	65-65.5	---	165	5490	Multiple vertical shears	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-34	74-74.5	---	164	3000	Diagonal shear	Gray fine-grained SANDSTONE w/interbedded SHALE partings
FB-35	50.2-50.8	---	166	5420	Multiple diagonal shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-35	53-53.5	---	162	3050	Multiple vertical shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-35	63-63.5	---	161	2420	Vertical shear	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-35	72-72.7	---	163	3490	Multiple vertical shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-35	82-82.5	---	169	2760	Multiple vertical shears	Dark gray fine-grained SANDSTONE w/ very close, very thin SHALE partings
FB-36	48.5-49	---	164	9310	Vertical shear	Gray fine-grained SANDSTONE w/interbedded very close, very thin SHALE partings
FB-36	54-54.9	---	164	3360	Vertical shear	Gray fine-grained SANDSTONE w/interbedded very close, very thin SHALE partings
FB-36	56.3-56.7	---	163	4350	Vertical shear	Gray fine-grained SANDSTONE w/interbedded very close, very thin SHALE partings
FB-36	72-72.6	---	165	3460	Multiple vertical shears	Gray fine-grained SANDSTONE w/interbedded very close, very thin SHALE partings
FB-36	86-86.5	---	165	4810	Partial vertical and diagonal shears	Gray fine-grained SANDSTONE w/interbedded very close, very thin SHALE partings
FB-37	49-49.3	---	167	2130	Vertical shear	Dark gray SHALE w/fine-grained SANDSTONE partings
FB-37	52-52.4	---	163	5110	Multiple vertical shears	Gray fine-grained SANDSTONE w/interbedded very close, very thin SHALE partings
FB-37	61-61.5	---	161	2270	Diagonal shear	Gray fine-grained SANDSTONE w/interbedded very close, very thin SHALE partings
FB-37	68.4-69.1	---	160	3060	Diagonal and vertical shear	Gray fine-grained SANDSTONE w/interbedded very close, very thin SHALE partings
FB-37	77.5-78	---	171	3940	Diagonal shear	Gray fine-grained SANDSTONE w/interbedded very close, very thin SHALE partings
FB-37	92-92.5	---	160	550	Partial diagonal shear	Gray fine-grained SANDSTONE w/interbedded very close, very thin SHALE partings
FB-38	51-51.5	---	168	4200	Multiple diagonal shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-38	56-56.5	---	160	5310	Multiple vertical shears	Gray fine-grained SANDSTONE w/interbedded very close, very thin SHALE partings

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-38	66-66.5	---	164	2640	Vertical shear	Gray fine-grained SANDSTONE w/interbedded very close, very thin SHALE partings
FB-38	76.5-77	---	165	5180	Vertical and diagonal shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-38	85-85.6	---	163	3190	Partial diagonal shears	Dark gray SHALE w/ interbedded fine-grained SANDSTONE partings
FB-39	49-49.8	---	162	1710	Vertical shear	Dark gray fine-grained SANDSTONE w/ interbedded SHALE partings
FB-39	54.5-55	---	169	3380	Diagonal shear	Dark gray fine-grained SANDSTONE w/ interbedded SHALE partings
FB-39	64-64.7	---	162	4630	Diagonal and horizontal shears	Dark gray fine-grained SANDSTONE w/ interbedded SHALE partings
FB-39	69-69.8	---	163	2830	Horizontal shear	Dark gray fine-grained SANDSTONE w/ interbedded SHALE partings
FB-39	91-91.6	---	162	1890	Partial diagonal shears	Dark gray fine-grained SANDSTONE w/ interbedded SHALE partings
FB-40	50.5-51	---	165	5560	Diagonal and horizontal shears	Gray fine-grained SANDSTONE w/ interbedded very close, very thin SHALE partings
FB-40	57-57.5	---	163	6350	Multiple diagonal shears	Gray fine-grained SANDSTONE w/ interbedded very close, very thin SHALE partings
FB-40	62.3-63	---	164	1560	Multiple diagonal shears	Gray fine-grained SANDSTONE w/ interbedded very close, very thin SHALE partings
FB-40	72-72.6	---	153	1750	Partial diagonal shears	Gray fine-grained SANDSTONE w/ interbedded very close, very thin SHALE partings
FB-40	76.4-77	---	164	4750	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded very close, very thin SHALE partings
FB-40	86-86.7	---	161	4110	Vertical and diagonal shears	Gray fine-grained SANDSTONE w/ interbedded very close, very thin SHALE partings
FB-41	51-51.7	---	163	3130	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded SHALE partings
FB-41	57.2-58	---	162	850	Partial diagonal shear	Gray fine-grained SANDSTONE w/ interbedded SHALE partings
FB-41	66.5-67	---	163	6030	Diagonal and vertical shear	Gray fine-grained SANDSTONE w/ interbedded SHALE partings

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-41	71.4-72	---	155	1980	Multiple diagonal shears	Gray fine-grained SANDSTONE w/ interbedded SHALE partings
FB-41	77.2-78	---	161	3710	Multi-directional shears	Gray fine-grained SANDSTONE w/ interbedded SHALE partings
FB-41	87.5-88	---	163	5130	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded SHALE partings
FB-42	48.3-48.9	---	163	3030	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded SHALE laminations
FB-42	57.2-57.6	---	165	2160	Diagonal shear	Gray fine-grained SANDSTONE w/ interbedded SHALE laminations
FB-42	66.6-67	---	163	3540	Vertical and diagonal shear	Gray fine-grained SANDSTONE w/ interbedded SHALE laminations
FB-42	78-78.5	---	168	2970	Vertical shear	Gray fine-grained SANDSTONE w/ interbedded SHALE laminations
FB-43	45-45.5	---	164	2840	Vertical and diagonal shear	Gray fine-grained SANDSTONE w/ interbedded SHALE laminations
FB-43	48.5-49	---	165	6600	Vertical and diagonal shear	Gray fine-grained SANDSTONE w/ interbedded SHALE laminations
FB-43	58-58.5	---	160	3830	Vertical and horizontal shears	Dark gray SHALE w/ interbedded, very close, very thin gray fine-grained SANDSTONE
FB-43	67.4-68	---	164	2780	Vertical and horizontal shears	Dark gray SHALE w/ interbedded, very close, very thin gray fine-grained SANDSTONE
FB-43	78.5-79	---	164	5520	Vertical and diagonal shear	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings
FB-44	41.5-42	---	161	5740	Vertical and horizontal shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings
FB-44	43-43.5	---	159	5230	Vertical and horizontal shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings
FB-44	47-47.5	---	164	3840	Vertical and diagonal shear	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings
FB-44	64-64.5	---	165	4590	Vertical and diagonal shear	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings
FB-44	74.1-74.8	---	162	4250	Vertical and diagonal shear	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
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BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-44	79.1-79.6	---	163	4420	Vertical and diagonal shear	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings
FB-45	47-47.5	---	163	1820	Vertical and diagonal shear	Dark gray SHALE w/occassional gray fine-grained SANDSTONE partings
FB-45	55.2-55.7	---	159	2540	Vertical and horizontal shears	Dark gray SHALE w/occassional gray fine-grained SANDSTONE partings
FB-45	61-61.5	---	164	6250	Vertical and horizontal shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings
FB-45	70-70.5	---	159	5150	Vertical and horizontal shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings
FB-45	80-80.5	---	158	7490	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings
FB-46	44.1-44.6	---	162	7340	Vertical and horizontal shears	Dark gray SHALE w/interbedded very close, very thin gray fine-grained SANDSTONE partings
FB-46	53-53.5	---	151	860	Multiple vertical shears	Dark gray SHALE w/occassional gray fine-grained SANDSTONE partings and coal parting
FB-46	56.4-57	---	162	3040	Vertical and horizontal shears	Dark gray SHALE w/occassional gray fine-grained SANDSTONE partings and coal parting
FB-46	65-65.5	---	167	4080	Vertical and horizontal shears	Dark gray SHALE w/ interbedded very close, very thin fine-grained SANDSTONE partings
FB-46	75-75.5	---	164	6210	Multiple vertical shears	Dark gray SHALE w/ interbedded very close, very thin fine-grained SANDSTONE partings
FB-46	87-87.5	---	153	2810	Multiple vertical shears	Dark gray SHALE w/ interbedded very close, very thin fine-grained SANDSTONE partings
FB-65	46.5-47	---	163	1460	Multiple vertical shears	Dark gray SHALE
FB-65	51-51.5	---	163	1000	Vertical and diagonal shear	Dark gray SHALE
FB-65	59-59.5	---	154	1500	Vertical and horizontal shears	Dark gray SHALE
FB-65	66-66.5	---	161	4310	Vertical and horizontal shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-65	75-75.5	---	166	5130	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings
FB-65	82-82.5	---	162	3740	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings
FB-66	40.5-41	---	159	1760	Vertical and diagonal shear	Dark gray SHALE
FB-66	48.3-48.9	---	160	2330	Vertical and diagonal shear	Dark gray SHALE
FB-66	50.3-50.8	---	164	1290	Vertical and horizontal shears	Dark gray SHALE
FB-66	59.5-60	---	160	1300	Vertical and diagonal shear	Dark gray SHALE
FB-66	66-66.5	---	172	1590	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings
FB-66	70-70.5	---	165	6080	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings
FB-67	53-53.5	---	161	1220	Vertical and horizontal shears	Dark gray SHALE
FB-67	56-56.5	---	160	1150	Vertical and horizontal shears	Dark gray SHALE
FB-67	66-66.5	---	164	1800	Multiple vertical shears	Dark gray SHALE
FB-67	77.3-77.8	---	164	4290	Vertical and horizontal shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings
FB-67	85.4-85.9	---	166	5030	Vertical and horizontal shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin SHALE partings

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PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
				0		
FB-69	43-43.3	---	158	2320	Horizontal shear	Dark gray SHALE
FB-69	47-47.5	---	174	4370	Vertical shear	Dark gray SHALE
FB-69	63.5-64	---	161	1350	Vertical and horizontal shears	Dark gray SHALE
FB-69	73.8-74.3	---	164	2770	Vertical and horizontal shears	Dark gray SHALE
FB-69	74.3-75	---	164	1130	Vertical and horizontal shears	Dark gray SHALE
FB-69	76-76.5	---	166	4220	Vertical and diagonal shear	Dark gray SHALE
FB-69	80-80.5	---	163	2110	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin dark gray SHALE partings
FB-69	80.5-81	---	167	6880	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin dark gray SHALE partings
FB-70	40.2-40.7	---	161	2470	Vertical and horizontal shears	Dark gray SHALE
FB-70	43.5-44	---	161	1060	Vertical and horizontal shears	Dark gray SHALE
FB-70	53-53.5	---	164	1180	Vertical and horizontal shears	Dark gray SHALE
FB-70	58.5-59	---	161	3330	Vertical and horizontal shears	Dark gray SHALE
FB-70	74-74.5	---	164	1070	Multiple vertical shears	Dark gray SHALE
FB-70	80-80.5	---	165	2460	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin dark gray SHALE partings
FB-71	41-41.5	---	162	2200	Multiple vertical shears	Dark gray SHALE w/occasional fine-grained SANDSTONE partings
FB-71	43.7-44.2	---	161	2420	Multiple vertical shears	Dark gray SHALE w/occasional fine-grained SANDSTONE partings
FB-71	46.3-46.8	---	163	440	Vertical and diagonal shear (possible bad break)	Dark gray SHALE w/occasional fine-grained SANDSTONE partings

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-71	51.5-52	---	168	1840	Multiple vertical shears	Dark gray SHALE w/occasional fine-grained SANDSTONE partings
FB-71	59.5-60	---	164	2260	Vertical and diagonal shear	Dark gray SHALE w/occasional fine-grained SANDSTONE partings
FB-71	75-75.5	---	161	1730	Multiple vertical shears	Dark gray SHALE w/several fine-grained SANDSTONE partings
FB-71	78-78.7	---	169	3730	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin dark gray SHALE partings
FB-72	47-47.5	---	161	540	Vertical and horizontal shears	Dark gray SHALE
FB-72	57-57.5	---	160	1080	Vertical and horizontal shears	Dark gray SHALE
FB-72	64.3-65	---	160	2210	Vertical shear	Dark gray SHALE
FB-72	76-76.5	---	165	1050	Vertical shear	Dark gray SHALE
FB-72	85-85.5	---	167	4690	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin dark gray SHALE partings
FB-72	90-90.5	---	159	4310	Vertical and horizontal shears	Gray fine-grained SANDSTONE w/ interbedded, very close, very thin dark gray SHALE partings
FB-73	46-46.5	---	159	1140	Vertical and horizontal shears	Dark gray SHALE w/occassional gray fine-grained SANDSTONE partings
FB-73	54-54.5	---	160	3590	Vertical and horizontal shears	Dark gray SHALE w/occassional gray fine-grained SANDSTONE partings
FB-73	59.5-60	---	164	1960	Vertical and horizontal shears	Dark gray SHALE w/occassional gray fine-grained SANDSTONE partings
FB-73	62-62.7	---	159	620	Vertical and diagonal shear	Dark gray SHALE w/occassional gray fine-grained SANDSTONE partings
FB-73	74-74.5	---	163	1550	Vertical and horizontal shears	Dark gray SHALE w/occassional gray fine-grained SANDSTONE partings
FB-74	54.3-54.8	---	158	1800	Vertical and horizontal shears	Dark gray SHALE
FB-74	62.5-63	---	161	1270	Vertical and horizontal shears	Dark gray SHALE

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PROJECT: 040748 Hwy 22 to I-40
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BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-74	68-68.5	---	158	960	Vertical shear	Dark gray SHALE w/occassional gray fine-grained SANDSTONE partings
FB-74	82.4-83	---	167	2750	Vertical shear	Dark gray SHALE w/occassional gray fine-grained SANDSTONE partings
FB-75	46.5-47	---	162	1890	Multiple vertical shears	Dark gray SHALE w/ occasional very thin gray fine-grained SANDSTONE partings
FB-75	51-51.6	---	159	1420	Multiple vertical shears	Dark gray SHALE w/occassional gray fine-grained SANDSTONE partings
FB-75	64-64.5	---	158	1040	Multiple vertical shears	Dark gray SHALE w/occassional gray fine-grained SANDSTONE partings
FB-75	83-83.5	---	166	2170	Multiple vertical shears	Gray fine-grained SANDSTONE w/ interbedded very close, very thin dark gray SHALE partings
FB-75	84-84.5	---	163	2650	Vertical and horizontal shears	Gray fine-grained SANDSTONE w/ interbedded very close, very thin dark gray SHALE partings
FB-77	52-52.5	---	160	1190	Vertical and horizontal shears	Dark gray SHALE
FB-77	59-59.5	---	156	1410	Vertical and horizontal shears	Dark gray SHALE
FB-77	69.3-70	---	158	1610	Vertical and horizontal shears	Dark gray SHALE
FB-77	72.8-73.6	---	158	1340	Vertical and horizontal shears	Dark gray SHALE w/occassional gray fine-grained SANDSTONE partings
FB-77	81-81.5	---	163	640	Vertical and horizontal shears	Dark gray SHALE w/occassional gray fine-grained SANDSTONE partings
FB-77	95-95.5	---	161	4750	Multiple vertical shears	Gray fine-grained SANDSTONE w/some DG SHALE laminations
FB-78	56.5-57	---	162	1400	Multiple vertical shears	Dark gray SHALE
FB-78	68-68.5	---	167	940	Multiple vertical shears	Dark gray SHALE
FB-78	73-73.5	---	162	2490	Multiple vertical shears	Dark gray SHALE
FB-78	81-81.7	---	160	1820	Multiple vertical shears	Dark gray SHALE

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PROJECT: 040748 Hwy 22 to I-40
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GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FB-78	92-92.5	---	165	2760	Vertical and horizontal shears	Dark gray SHALE w/interbedded very close, very thin fine-grained SANDSTONE partings
FB-79	50-50.5	---	163	1260	Multiple vertical shears	Dark gray SHALE
FB-79	57-57.5	---	161	1440	Vertical and diagonal shear	Dark gray SHALE
FB-79	64.5-65	---	164	1950	Vertical and horizontal shears	Dark gray SHALE
FB-79	67.5-68	---	164	3150	Vertical and diagonal shear	Dark gray SHALE
FB-79	73.7-74.2	---	164	2750	Vertical and diagonal shear	Dark gray SHALE
FB-79	77.3-77.8	---	162	2210	Multiple vertical shears	Dark gray SHALE
FB-79	81-81.5	---	160	2550	Vertical and horizontal shears	Dark gray SHALE
FB-79	86.5-87	---	164	2760	Vertical and horizontal shears	Dark gray SHALE w/some very close fine-grained SANDSTONE partings
FB-79	91-91.5	---	165	3790	Vertical and horizontal shears	Dark gray SHALE w/some very close fine-grained SANDSTONE partings
FB-79	98-98.5	---	163	5260	Vertical and horizontal shears	Dark gray SHALE w/interbedded very close, very thin fine-grained SANDSTONE partings
FB-80	53-53.5	---	158	2000	Vertical and horizontal shears	Dark gray SHALE
FB-80	56.7-57.2	---	164	1410	Vertical and horizontal shears	Dark gray SHALE
FB-81	53.2-53.8	---	166	1780	Multiple vertical shears	Dark gray SHALE
FB-81	56-56.7	---	161	2130	Vertical shear	Dark gray SHALE
FE-1	15.5-16	---	169	2740	Multiple vertical shears	Dark gray SHALE w/occassional gray fine-grained sandstone partings

SUMMARY of COMPRESSION TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Sebastian and Crawford Counties, Arkansas
GHBW JOB NUMBER: 21-071

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	TOTAL UNIT WEIGHT (pcf)	COMPRESSIVE STRENGTH (psi)	FAILURE DESCRIPTION	DESCRIPTION
FE-1	20-20.5	---	164	2300	Vertical and horizontal shears	Dark gray SHALE w/occassional gray fine-grained sandstone partings
FE-3	11-11.5	---	160	5590	Vertical and horizontal shears	Dark gray SHALE w/interbedded very close, very thin fine-grained SANDSTONE partings and inclusions
FE-3	17-17.5	---	160	11360	Vertical and horizontal shears	Dark gray SHALE w/interbedded very close, very thin fine-grained SANDSTONE partings and inclusions
FE-4	7-7.5	---	154	10400	Multiple vertical shears	Tan and brown fine-grained sandstone
FE-4	13.5-14	---	155	2990	Multiple vertical shears	Dark gray SHALE w/some very thin gray fine-grained sandstone partings
FE-6	17-17.6	---	168	2100	Multiple vertical shears	Dark gray SHALE w/interbedded very close, very thin fine-grained SANDSTONE partings and
FE-6	20-20.5	---	166	3360	Multiple vertical shears	Dark gray SHALE w/interbedded very close, very thin fine-grained SANDSTONE partings and

Notes:
1. All tests performed on NQwl or NQ2 rock cores.
2. Tested as per ASTM D7012

APPENDIX M

MODIFIED SLAKE DURABILITY TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Crawford & Sebastian Counties, Arkansas
GHBW JOB NUMBER: 21-071
SAMPLE: Boring FB-21, Run 2 (5-10 ft)
Dark Gray SHALE with Interbedded Sandstone partings

Cumulative Time, min	Incremental Time, min	Sample Weight, g	Normalized Sample Weight, g	Incremental loss, g	Loss between increments, g	Normalized Incremental loss, g	Normalized Incremental loss, cm^3	Equivalent Hourly Scour Depth, ft	Equivalent Hourly Stream Power, ft-lbs/s/ft^2
0	0	543.20	500.00	0.00	0.00	----	----	----	----
30	30	519.50	478.18	23.70	23.70	20.86	8.1	0.00029	8.75965
60	30	489.90	450.94	53.30	29.60	27.25	10.6	0.00037	8.32030
90	30	464.40	427.47	78.80	25.50	24.89	9.7	0.00034	7.86612
120	30	444.80	409.43	98.40	19.60	20.18	7.8	0.00028	7.49437
180	60	410.50	377.85	132.70	34.30	36.87	14.3	0.00050	7.05008
240	60	376.80	346.83	166.40	33.70	39.26	15.2	0.00054	6.48957
300	60	351.20	323.27	192.00	25.60	32.49	12.6	0.00044	6.00077
360	60	326.70	300.72	216.50	24.50	33.36	12.9	0.00046	5.58781
420	60	303.70	279.55	239.50	23.00	33.66	13.1	0.00046	5.19627
480	60	286.80	263.99	256.40	16.90	26.61	10.3	0.00036	4.86739
540	60	261.90	241.07	281.30	24.90	41.52	16.1	0.00057	4.52284

Notes: 1. Test performed as per ASTM D4644-08 as modified by Keaton & Mishra 2010
2. Unit Wt = 2.58 g per cm^3 = 161.0 lb per ft^3
2. Equivalent hourly scour depth is normalized incremental loss in ft^3 normalized to a unit area of 1 ft^2

GEOTECHNICAL SCOUR NUMBER: 0.000060

Slake Description: III - Retained material is exclusively small fragments

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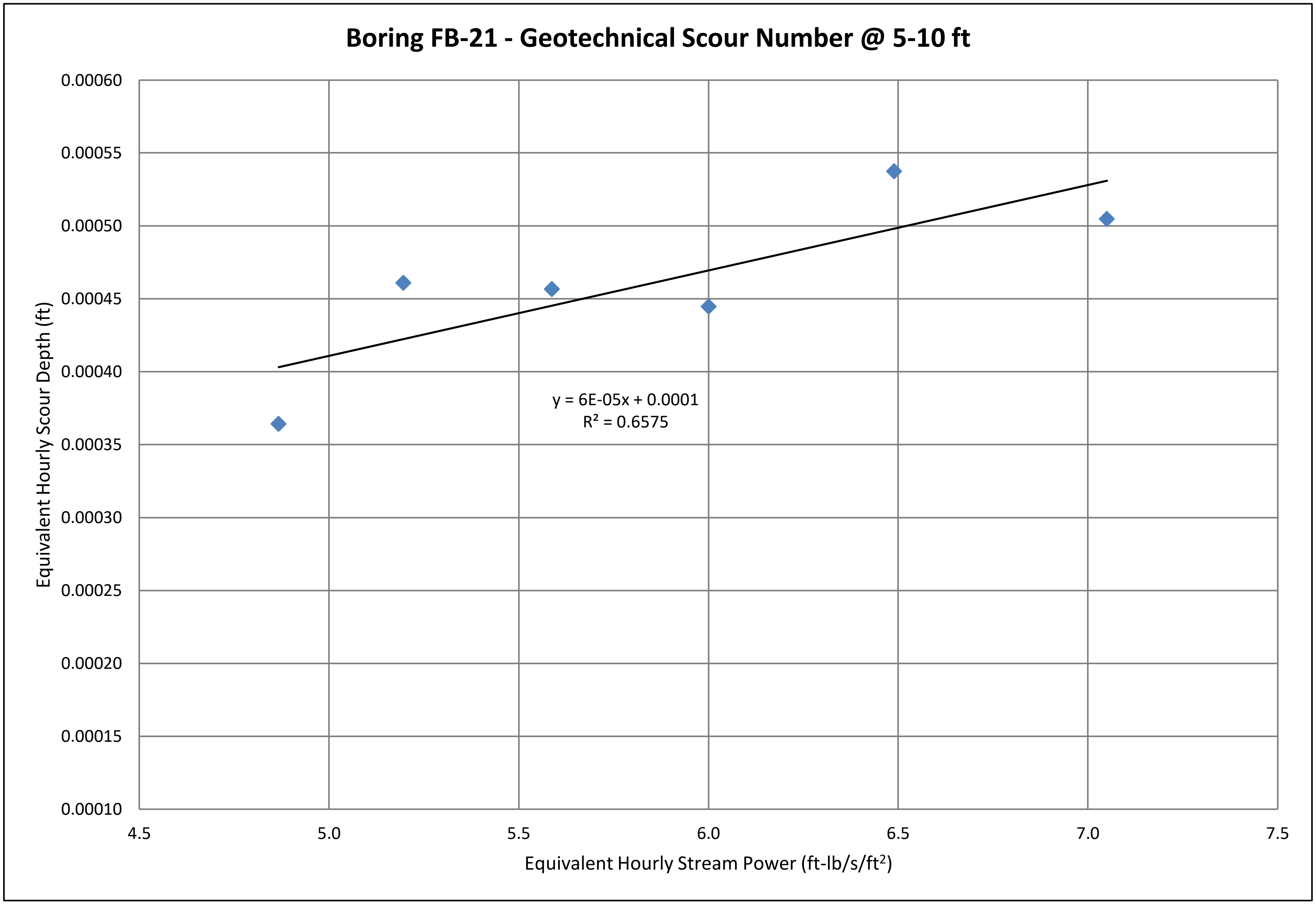
PLATE


Boring FB-21 - Geotechnical Scour Number @ 5-10 ft
0.00060
0.00055
0.00050
0.00045
0.00040
0.00035
0.00030
0.00025
0.00020
0.00015
0.00010
Equivalent Hourly Scour Depth (ft)
y = 6E-05x + 0.0001
R² = 0.6575
4.5
5.0
5.5
6.0
6.5
7.0
7.5
Equivalent Hourly Stream Power (ft-lb/s/ft²)


Job No. 21-071
Job Title 040748
Hwy 22 to I-40
Sample No. FB-21
Run 2 5'-10'
~~Date Received~~
~~Tests Assigned~~ Before
Date Completed
GRUBBS, HOSKYN, BARTON, & WYATT, INC.


Job No. 21-071
Job Title 040748
Hwy 22 to I-40
Sample No. FB-21
Run 2 5'-10'
~~Date Received~~
~~Tests Assigned~~ AFTER
Date Completed
GRUBBS, HOSKYN, BARTON, & WYATT, INC.

MODIFIED SLAKE DURABILITY TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Crawford & Sebastian Counties, Arkansas
GHBW JOB NUMBER: 21-071
SAMPLE: Boring FB-21, Run 4 (15-20 ft)
Dark Gray SHALE with Interbedded Sandstone partings

Cumulative Time, min	Incremental Time, min	Sample Weight, g	Normalized Sample Weight, g	Incremental loss, g	Loss between increments, g	Normalized Incremental loss, g	Normalized Incremental loss, cm^3	Equivalent Hourly Scour Depth, ft	Equivalent Hourly Stream Power, ft-lbs/s/ft^2
0	0	518.80	500.00	0.00	0.00	----	----	----	----
30	30	495.70	477.74	23.10	23.10	21.27	8.2	0.00029	8.75564
60	30	467.90	450.94	50.90	27.80	26.79	10.4	0.00037	8.31634
90	30	452.80	436.39	66.00	15.10	15.42	6.0	0.00021	7.94610
120	30	435.60	419.81	83.20	17.20	18.15	7.0	0.00025	7.66733
180	60	408.00	393.22	110.80	27.60	30.27	11.7	0.00041	7.28068
240	60	385.30	371.34	133.50	22.70	26.58	10.3	0.00036	6.84657
300	60	363.70	350.52	155.10	21.60	26.78	10.4	0.00037	6.46424
360	60	343.50	331.05	175.30	20.20	26.53	10.3	0.00036	6.10348
420	60	326.90	315.05	191.90	16.60	23.09	9.0	0.00032	5.78588
480	60	312.30	300.98	206.50	14.60	21.34	8.3	0.00029	5.51661
540	60	293.20	282.58	225.60	19.10	29.22	11.3	0.00040	5.22576

Notes: 1. Test performed as per ASTM D4644-08 as modified by Keaton & Mishra 2010
2. Unit Wt = 2.58 g per cm^3 = 161.0 lb per ft^3
2. Equivalent hourly scour depth is normalized incremental loss in ft^3 normalized to a unit area of 1 ft^2

GEOTECHNICAL SCOUR NUMBER: 0.000060

Slake Description: II - Retained material consists of large and small pieces

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PLATE

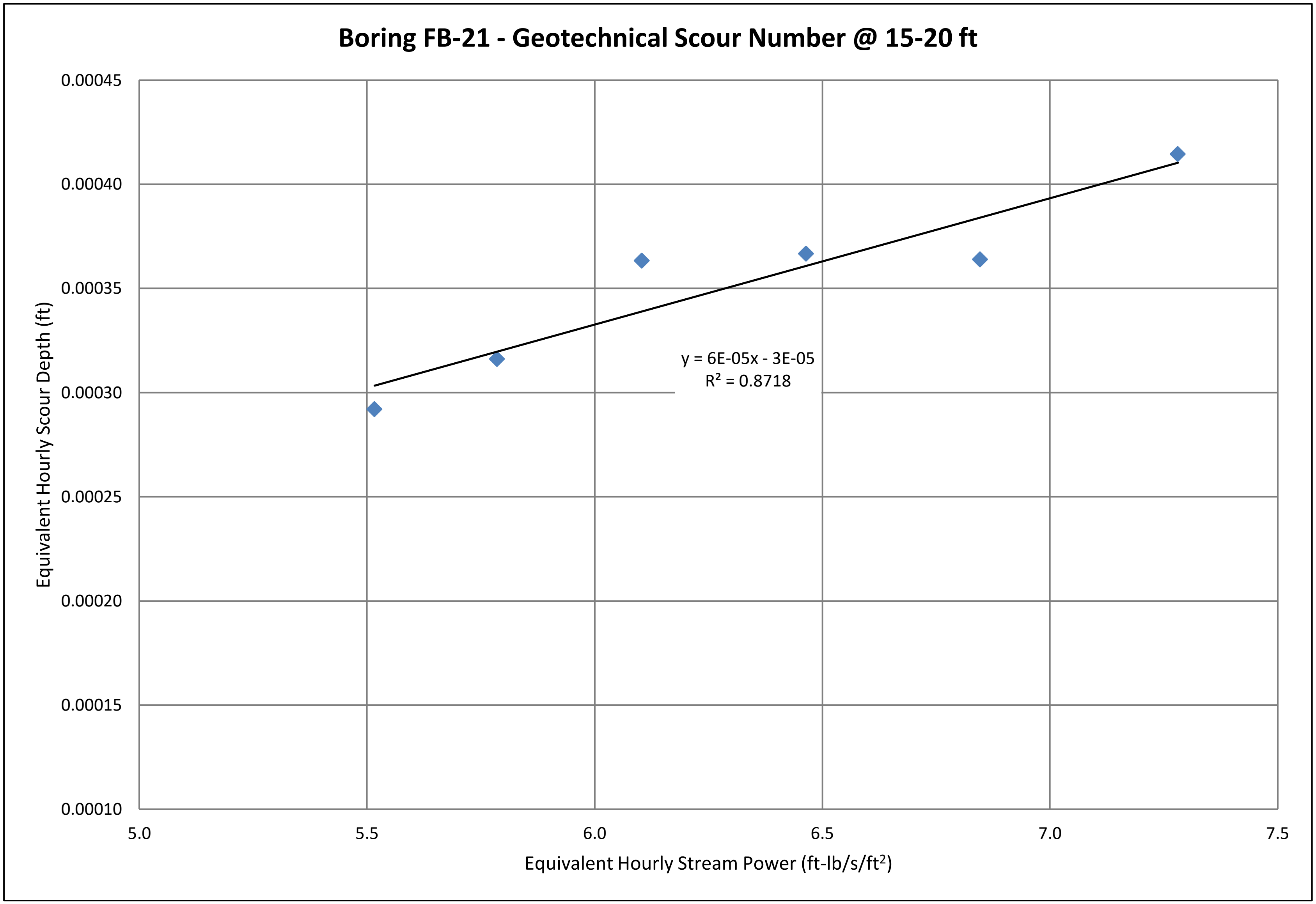

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PLATE

Boring FB-21, 15-20 ft (before test)

Boring FB-21, 15-20 ft (after test)

MODIFIED SLAKE DURABILITY TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Crawford & Sebastian Counties, Arkansas
GHBW JOB NUMBER: 21-071
SAMPLE: Boring FB-23, Run 6 (24-29 ft)
Dark Gray SHALE with Interbedded Sandstone partings

Cumulative Time, min	Incremental Time, min	Sample Weight, g	Normalized Sample Weight, g	Incremental loss, g	Loss between increments, g	Normalized Incremental loss, g	Normalized Incremental loss, cm^3	Equivalent Hourly Scour Depth, ft	Equivalent Hourly Stream Power, ft-lbs/s/ft^2
0	0	541.80	500.00	0.00	0.00	----	----	----	----
30	30	535.40	494.09	6.40	6.40	5.84	2.2	0.00008	8.90211
60	30	522.30	482.00	19.50	13.10	12.09	4.6	0.00016	8.74096
90	30	510.60	471.21	31.20	11.70	11.07	4.2	0.00015	8.53601
120	30	498.80	460.32	43.00	11.80	11.42	4.4	0.00015	8.34180
180	60	483.30	446.01	58.50	15.50	15.35	5.9	0.00021	8.11619
240	60	467.20	431.16	74.60	16.10	16.46	6.3	0.00022	7.85505
300	60	452.90	417.96	88.90	14.30	15.12	5.8	0.00020	7.60382
360	60	441.00	406.98	100.80	11.90	12.98	5.0	0.00018	7.38730
420	60	427.70	394.70	114.10	13.30	14.90	5.7	0.00020	7.17904
480	60	419.20	386.86	122.60	8.50	9.82	3.8	0.00013	6.99888
540	60	408.50	376.98	133.30	10.70	12.61	4.8	0.00017	6.84021

Notes: 1. Test performed as per ASTM D4644-08 as modified by Keaton & Mishra 2010
2. Unit Wt = 2.61 g per cm^3 = 163.0 lb per ft^3
2. Equivalent hourly scour depth is normalized incremental loss in ft^3 normalized to a unit area of 1 ft^2

GEOTECHNICAL SCOUR NUMBER: 0.000050

Slake Description: II - Retained material consists of large and small pieces

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PLATE

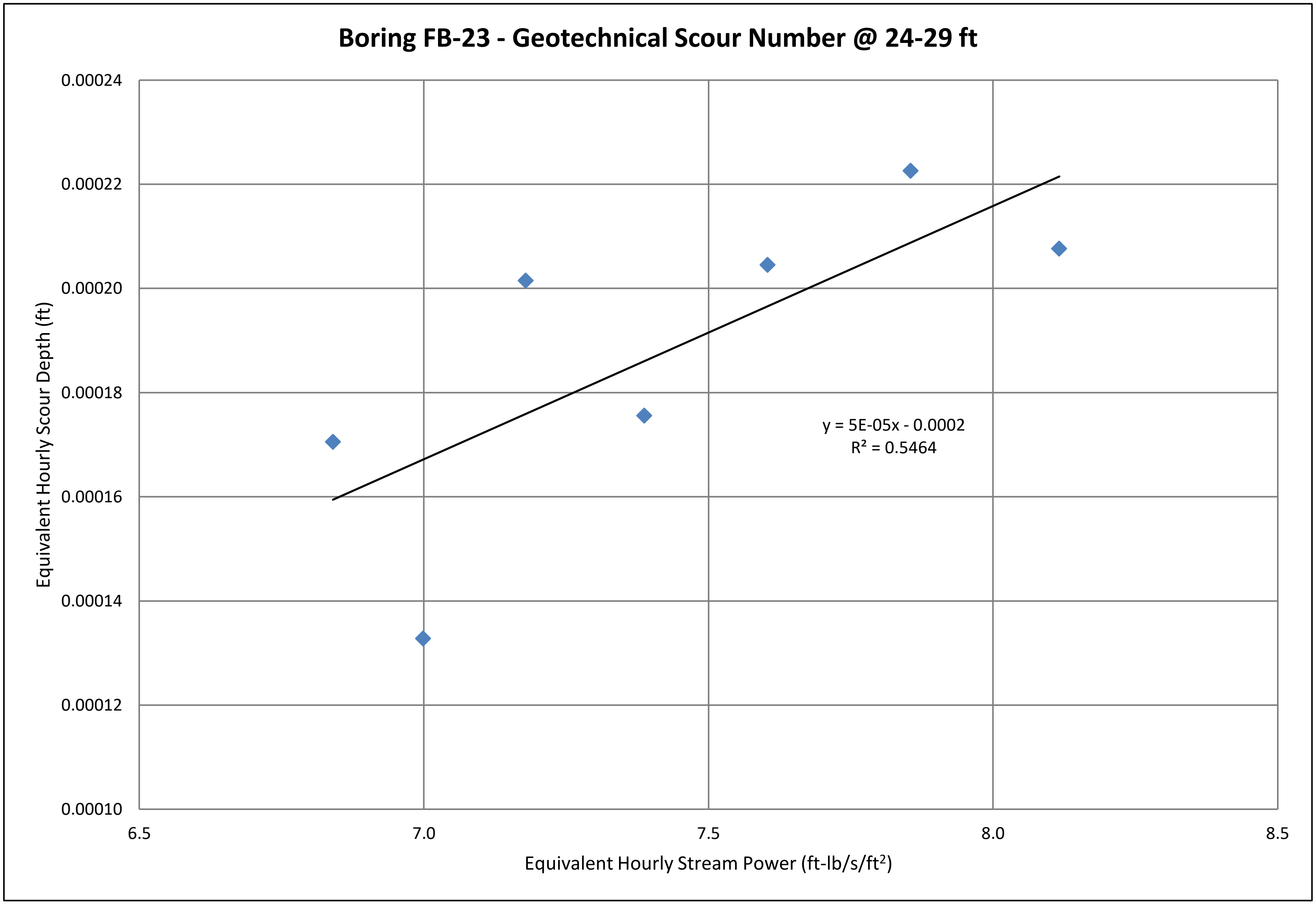

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PLATE

Boring FB-23, 24-29 ft (before test)

Boring FB-23, 24-29 ft (after test)

MODIFIED SLAKE DURABILITY TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Crawford & Sebastian Counties, Arkansas
GHBW JOB NUMBER: 21-071
SAMPLE: Boring FB-25, Run 6 (24-29 ft)
Dark Gray SHALE with Interbedded Sandstone partings

Cumulative Time, min	Incremental Time, min	Sample Weight, g	Normalized Sample Weight, g	Incremental loss, g	Loss between increments, g	Normalized Incremental loss, g	Normalized Incremental loss, cm^3	Equivalent Hourly Scour Depth, ft	Equivalent Hourly Stream Power, ft-lbs/s/ft^2
0	0	564.60	500.00	0.00	0.00	----	----	----	----
30	30	560.40	496.28	4.20	4.20	3.69	1.4	0.00005	8.92169
60	30	558.70	494.78	5.90	1.70	1.51	0.6	0.00002	8.87490
90	30	552.80	489.55	11.80	5.90	5.24	2.0	0.00007	8.81463
120	30	548.80	486.01	15.80	4.00	3.59	1.4	0.00005	8.73612
180	60	526.90	466.61	37.70	21.90	19.80	7.7	0.00027	8.53072
240	60	509.30	451.03	55.30	17.60	16.58	6.5	0.00023	8.21747
300	60	495.90	439.16	68.70	13.40	13.06	5.1	0.00018	7.97163
360	60	482.50	427.29	82.10	13.40	13.41	5.2	0.00018	7.75910
420	60	469.00	415.34	95.60	13.50	13.89	5.4	0.00019	7.54577
480	60	457.80	405.42	106.80	11.20	11.85	4.6	0.00016	7.34989
540	60	442.30	391.69	122.30	15.50	16.80	6.6	0.00023	7.13815

Notes: 1. Test performed as per ASTM D4644-08 as modified by Keaton & Mishra 2010
2. Unit Wt = 2.56 g per cm^3 = 160.0 lb per ft^3
2. Equivalent hourly scour depth is normalized incremental loss in ft^3 normalized to a unit area of 1 ft^2

GEOTECHNICAL SCOUR NUMBER: 0.000080

Slake Description: I - Retained pieces remain virtually unchanged

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PLATE

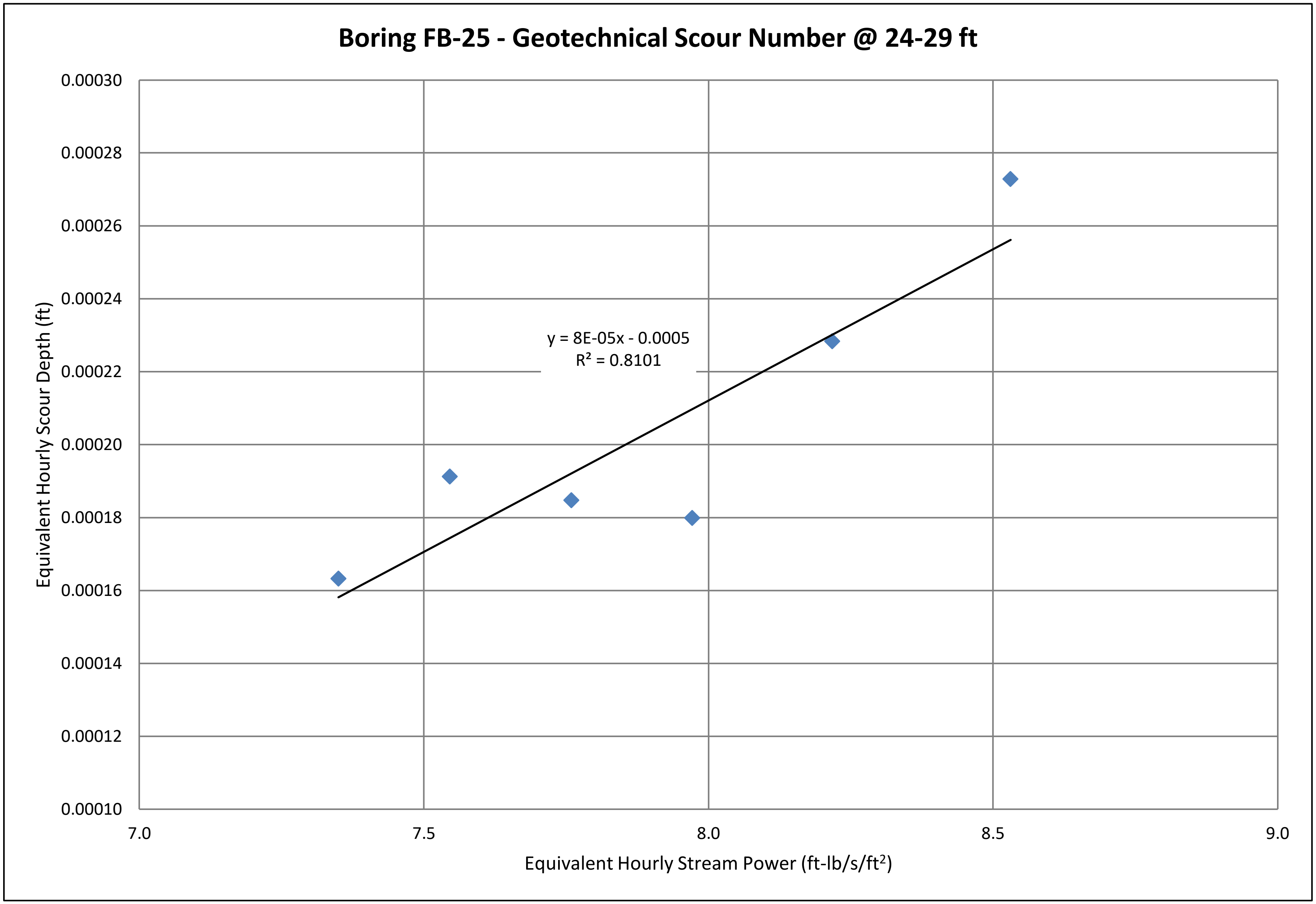

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PLATE

Boring FB-25, 24-29 ft (before test)

Boring FB-25, 24-29 ft (after test)

MODIFIED SLAKE DURABILITY TEST RESULTS

PROJECT: 040748 Hwy 22 to I-40
LOCATION: Crawford & Sebastian Counties, Arkansas
GHBW JOB NUMBER: 21-071
SAMPLE: Boring FB-26, Run 6 (9-14 ft)
Dark Gray SHALE with Interbedded Sandstone partings

Cumulative Time, min	Incremental Time, min	Sample Weight, g	Normalized Sample Weight, g	Incremental loss, g	Loss between increments, g	Normalized Incremental loss, g	Normalized Incremental loss, cm^3	Equivalent Hourly Scour Depth, ft	Equivalent Hourly Stream Power, ft-lbs/s/ft^2
0	0	541.40	500.00	0.00	0.00	----	----	----	----
30	30	533.50	492.70	7.90	7.90	7.19	2.8	0.00010	8.88967
60	30	523.30	483.28	18.10	10.20	9.42	3.7	0.00013	8.73997
90	30	512.60	473.40	28.80	10.70	10.07	3.9	0.00014	8.56713
120	30	503.80	465.28	37.60	8.80	8.46	3.3	0.00012	8.40586
180	60	487.40	450.13	54.00	16.40	16.04	6.3	0.00022	8.19745
240	60	472.40	436.28	69.00	15.00	15.16	5.9	0.00021	7.93776
300	60	458.60	423.53	82.80	13.80	14.39	5.6	0.00020	7.69958
360	60	446.10	411.99	95.30	12.50	13.43	5.2	0.00019	7.48207
420	60	432.40	399.34	109.00	13.70	15.13	5.9	0.00021	7.26539
480	60	423.20	390.84	118.20	9.20	10.48	4.1	0.00014	7.07600
540	60	408.70	377.45	132.70	14.50	16.88	6.6	0.00023	6.88000

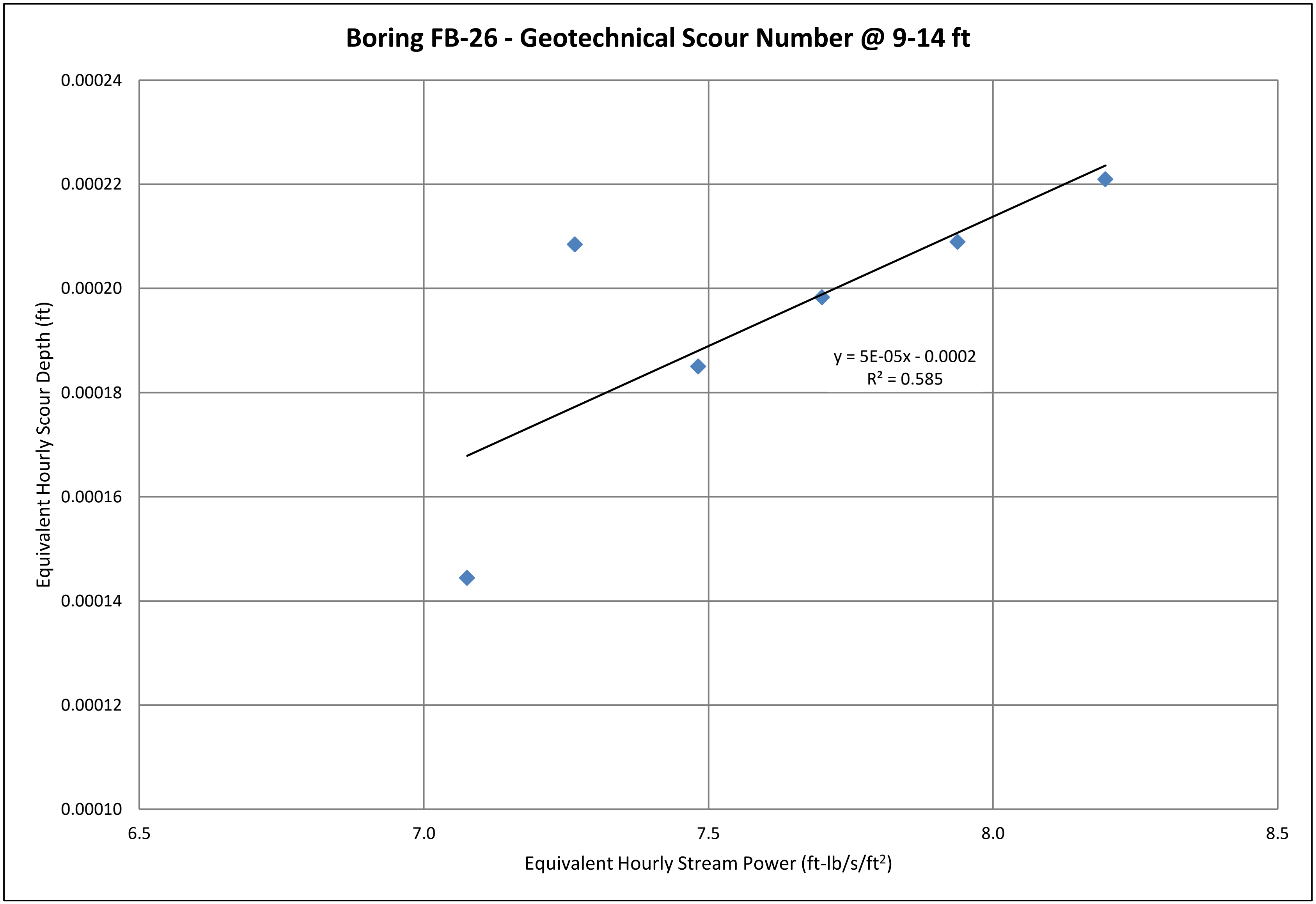
Notes: 1. Test performed as per ASTM D4644-08 as modified by Keaton & Mishra 2010
2. Unit Wt = 2.56 g per cm^3 = 160.0 lb per ft^3
2. Equivalent hourly scour depth is normalized incremental loss in ft^3 normalized to a unit area of 1 ft^2

GEOTECHNICAL SCOUR NUMBER: 0.000050

Slake Description: I - Retained pieces remain virtually unchanged

Grubbs, Hoskyn,
Barton & Wyatt, LLC
CONSULTING ENGINEERS

PLATE



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Barton & Wyatt, LLC
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PLATE

Boring FB-26, 9-14 ft (before test)

Boring FB-26, 9-14 ft (after test)

APPENDIX N

Jar Slake Test
ARDOT Test Method 398-07

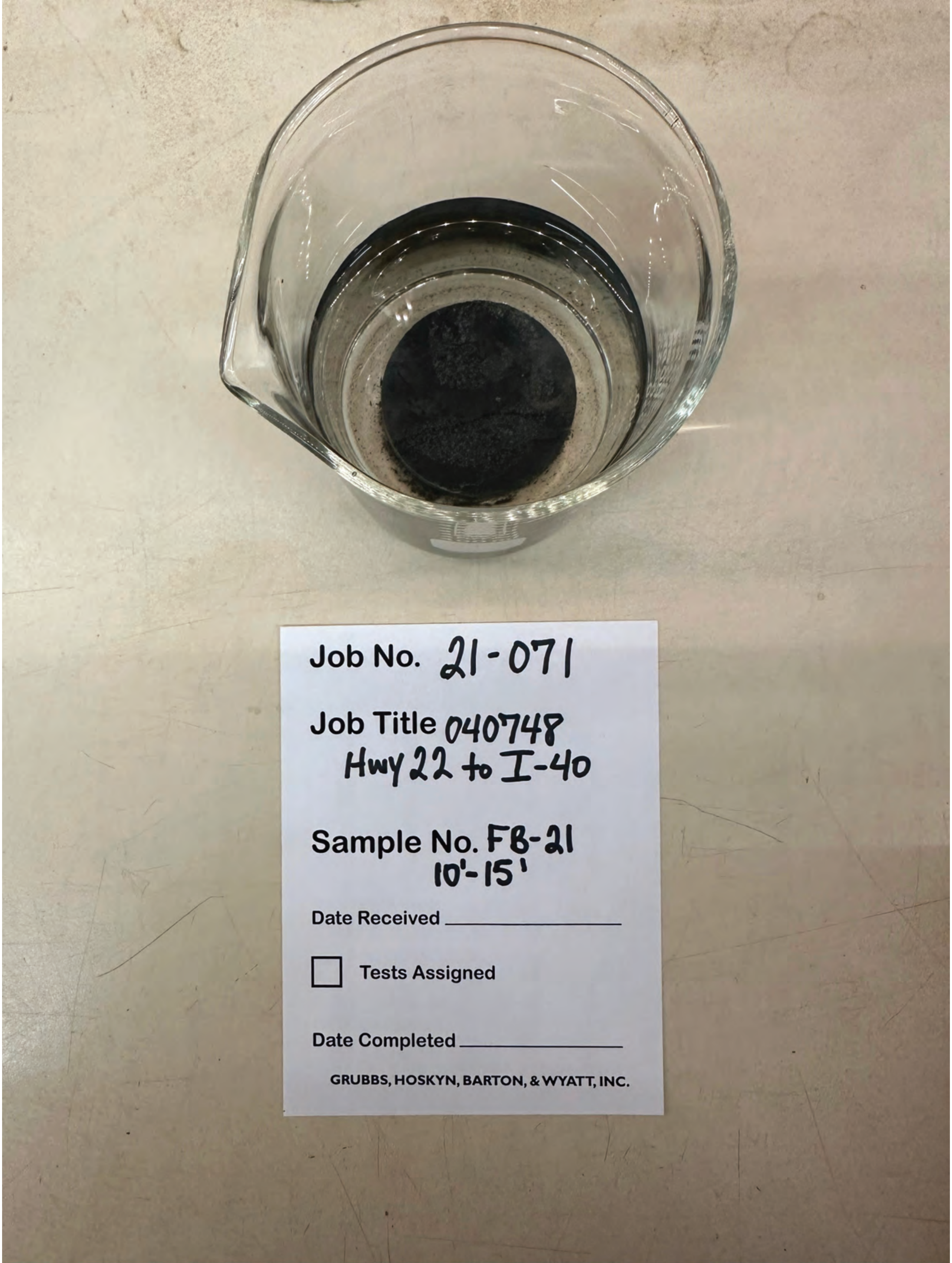
Job Number: 21-071
Boring: FB-21
Depth: 10'-15'
Start Date: 1/23/23

Oven Dried Mass = 53.53 g
Start Time = 0700

Duration	Behavior
5 minutes (0705)	6
10 minutes (0710)	6
15 minutes (0715)	6
30 minutes (0730)	6
45 minutes (0745)	6
60 minutes (0800)	6
2 hours (0900)	6
4 hours (1100)	6
6 hours (1300)	6
8 hours (1500)	6
24 hours (1/24/23 @ 0700)	6

Category Behavior
1. Degrades to pile of flakes or mud (complete Breakdown).
2. Breaks rapidly and/or forms many chips.
3. Breaks slowly and/or forms many chips.
4. Breaks rapidly and/or develops several fractures.
5. Breaks slowly and/or develops few fractures.
6. No change.

If sample breaks down completely, report SDI = 0.


Job No. 21-071
Job Title 040748
Hwy 22 to I-40
Sample No. FB-21
10'-15'
Date Received
Tests Assigned
Date Completed
GRUBBS, HOSKYN, BARTON, & WYATT, INC.

Jar Slake Test
ARDOT Test Method 398-07

Job Number: 21-071
Boring: FB-22
Depth: 5’-10’
Start Date: 1/18/23

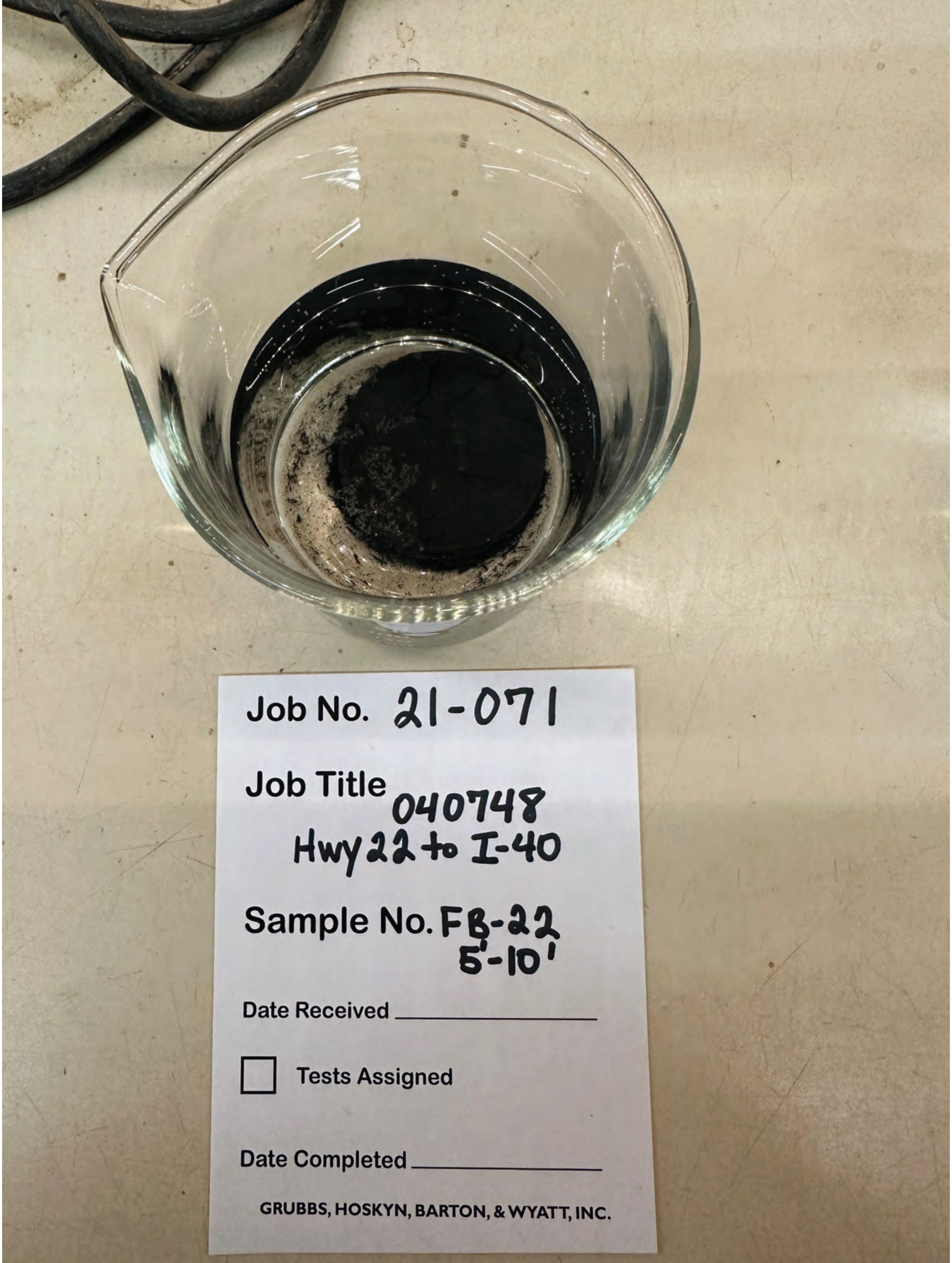
Oven Dried Mass = 49.22 g
Start Time = 0725

Duration	Behavior
5 minutes (0730)	6
10 minutes (0735)	6
15 minutes (0740)	6
30 minutes (0755)	6
45 minutes (0810)	6
60 minutes (0825)	5
2 hours (0925)	5
4 hours (1125)	5
6 hours (1325)	5
8 hours (1525)	5
24 hours (1/19/23 @ 0725)	3*

Category Behavior
1. Degrades to pile of flakes or mud (complete Breakdown).
2. Breaks rapidly and/or forms many chips.
3. Breaks slowly and/or forms many chips.
4. Breaks rapidly and/or develops several fractures.
5. Breaks slowly and/or develops few fractures.
6. No change.

If sample breaks down completely, report SDI = 0.

*NOTE: Upon assigning final grade and documenting with pictures, sample was discovered to have broken down more than was visually apparent.



Job No. 21-071
Job Title 040748
Hwy 22 to I-40
Sample No. FB-22
5'-10'
Date Received
Tests Assigned
Date Completed
GRUBBS, HOSKYN, BARTON, & WYATT, INC.

Jar Slake Test
ARDOT Test Method 398-07

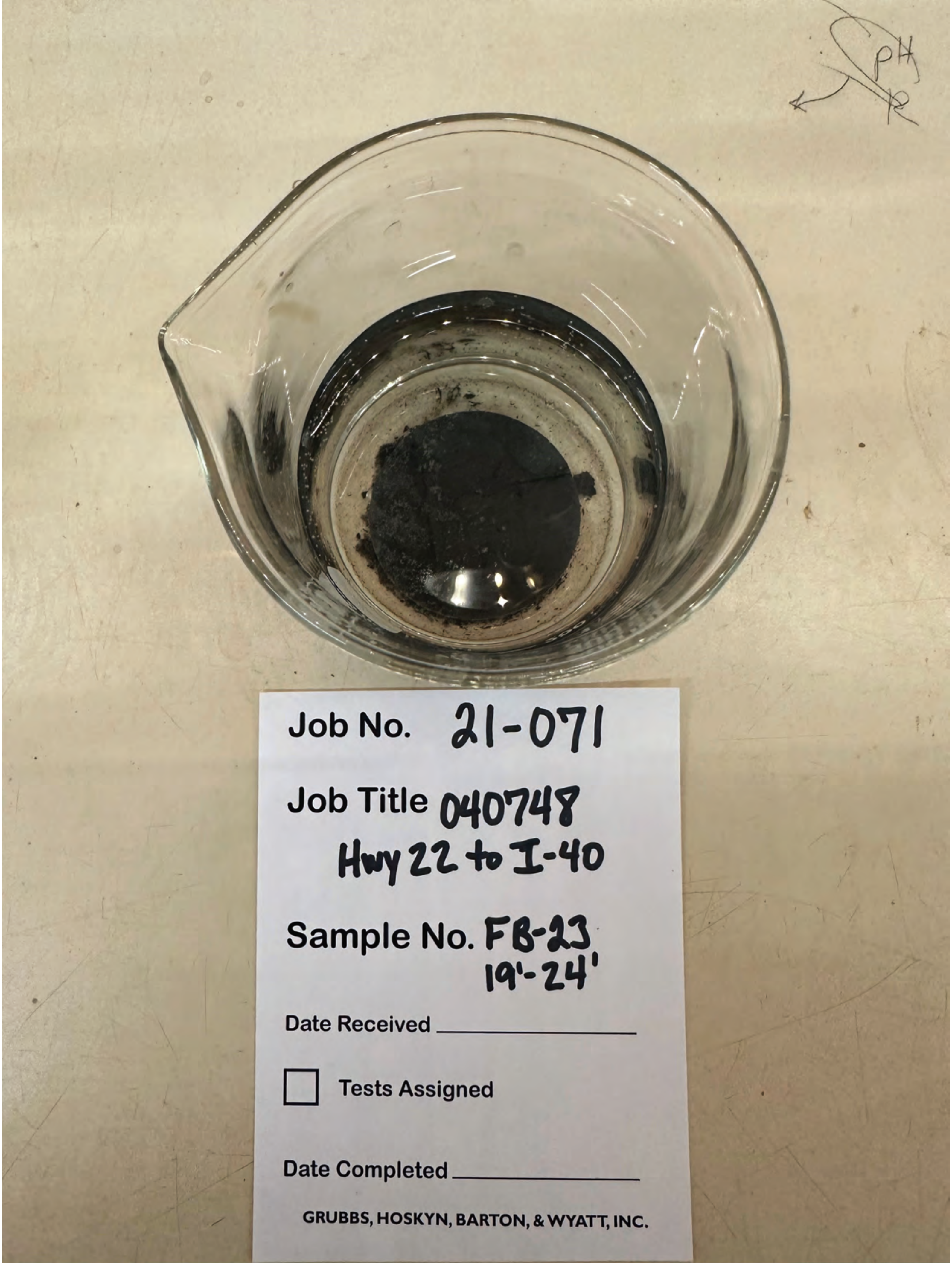
Job Number: 21-071
Boring: FB-23
Depth: 19'-24'
Start Date: 1/18/23

Oven Dried Mass = 52.61 g
Start Time = 0726

Duration	Behavior
5 minutes (0731)	6
10 minutes (0736)	6
15 minutes (0741)	6
30 minutes (0756)	6
45 minutes (0811)	6
60 minutes (0826)	6
2 hours (0926)	6
4 hours (1126)	6
6 hours (1326)	6
8 hours (1526)	6
24 hours (1/19/23 @ 0726)	6

Category Behavior
1. Degrades to pile of flakes or mud (complete Breakdown).
2. Breaks rapidly and/or forms many chips.
3. Breaks slowly and/or forms many chips.
4. Breaks rapidly and/or develops several fractures.
5. Breaks slowly and/or develops few fractures.
6. No change.

If sample breaks down completely, report SDI = 0.


pH
Job No. 21-071
Job Title 040748
Hwy 22 to I-40
Sample No. FB-23
19'-24'
Date Received
Tests Assigned
Date Completed
GRUBBS, HOSKYN, BARTON, & WYATT, INC.

Jar Slake Test

ARDOT Test Method 398-07

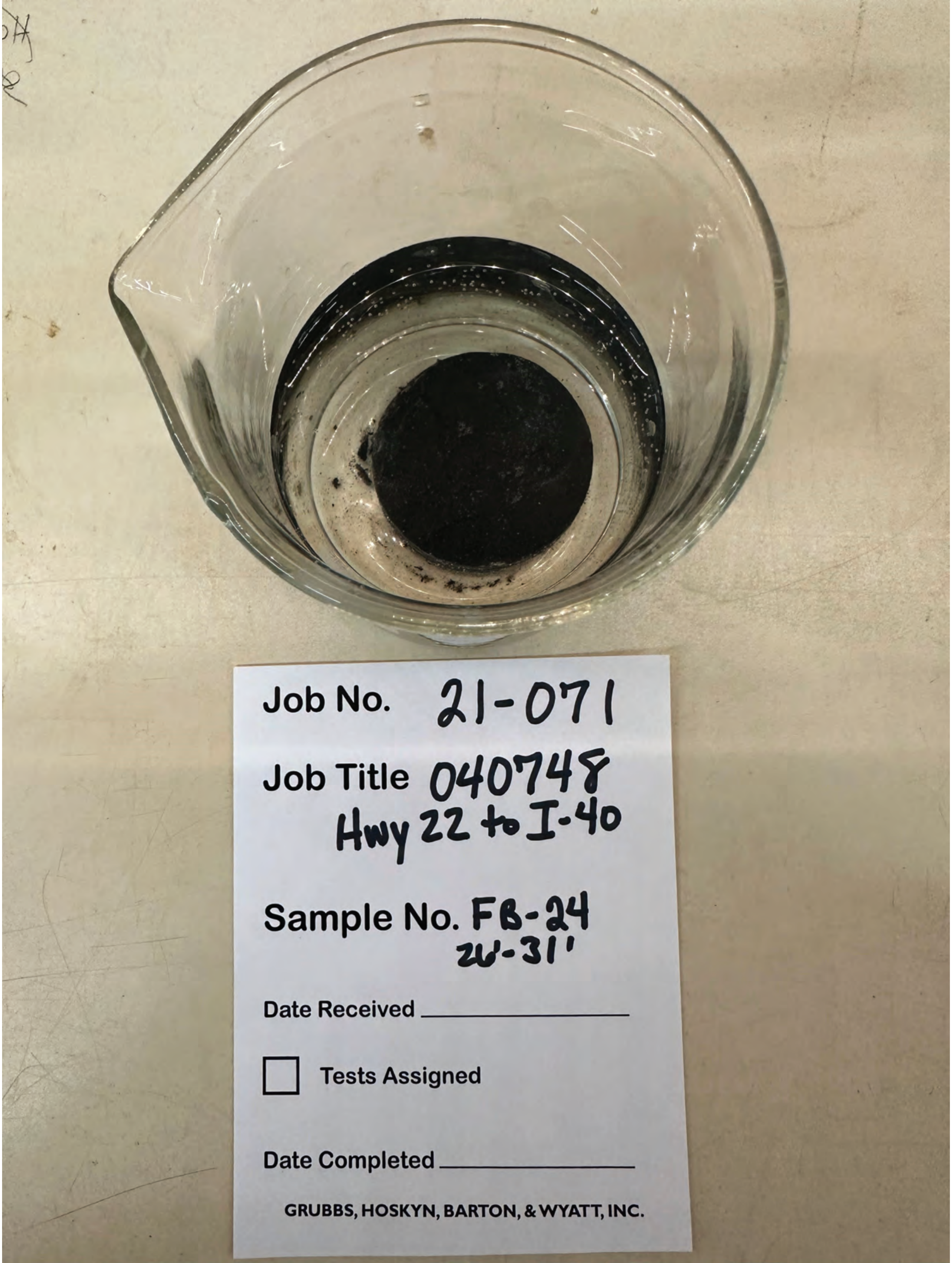
Job Number: 21-071
Boring: FB-24
Depth: 26'-31'
Start Date: 1/18/23

Oven Dried Mass = 50.66 g
Start Time = 0727

Duration	Behavior
5 minutes (0732)	6
10 minutes (0737)	6
15 minutes (0742)	6
30 minutes (0757)	6
45 minutes (0812)	6
60 minutes (0827)	6
2 hours (0927)	6
4 hours (1127)	6
6 hours (1327)	6
8 hours (1527)	6
24 hours (1/19/23 @ 0727)	6

Category Behavior
1. Degrades to pile of flakes or mud (complete Breakdown).
2. Breaks rapidly and/or forms many chips.
3. Breaks slowly and/or forms many chips.
4. Breaks rapidly and/or develops several fractures.
5. Breaks slowly and/or develops few fractures.
6. No change.

If sample breaks down completely, report SDI = 0.


Job No. 21-071
Job Title 040748
Hwy 22 to I-40
Sample No. FB-24
26-31'
Date Received
Tests Assigned
Date Completed
GRUBBS, HOSKYN, BARTON, & WYATT, INC.

Jar Slake Test
ARDOT Test Method 398-07

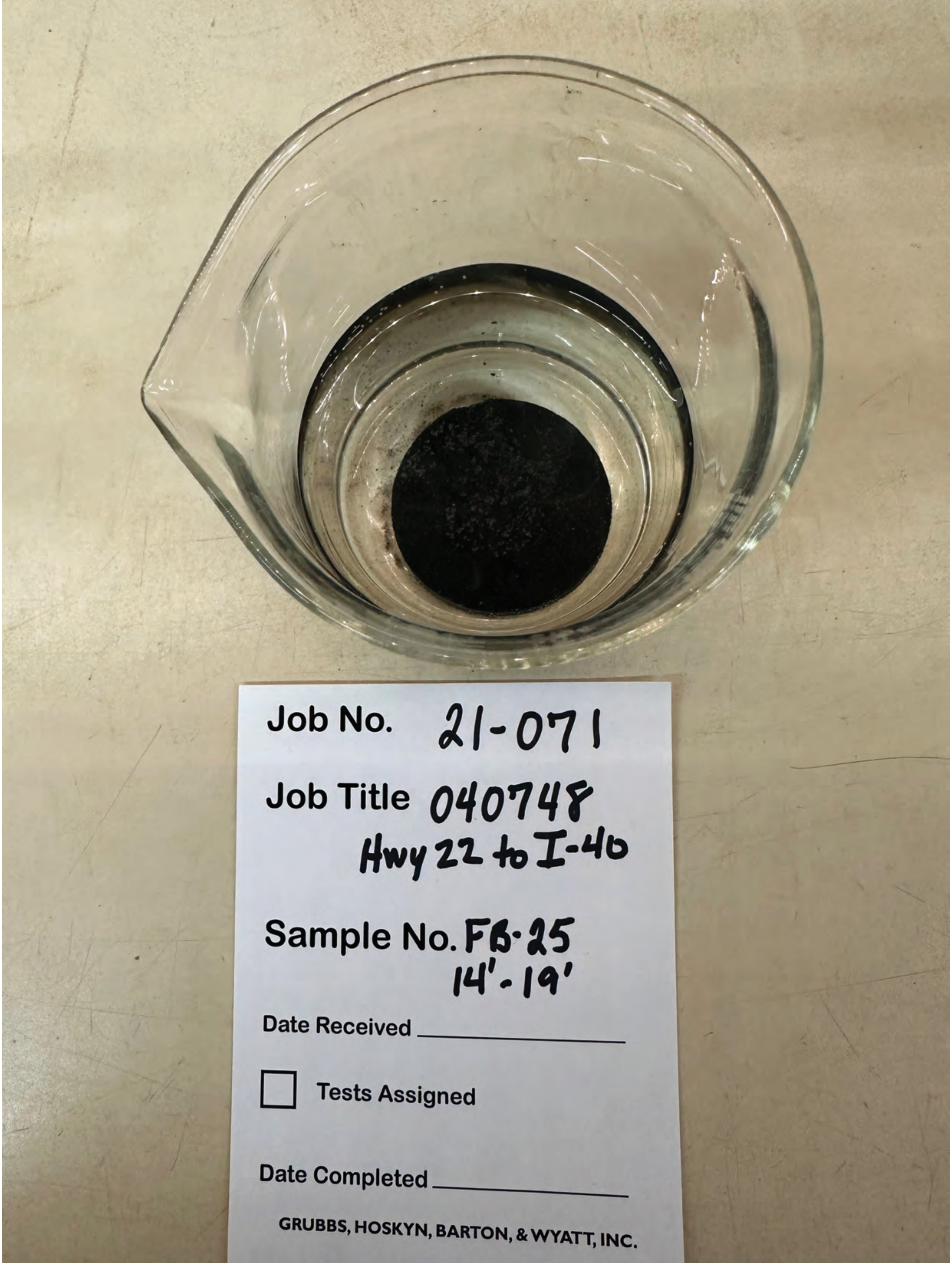
Job Number: 21-071
Boring: FB-25
Depth: 14’-19’
Start Date: 1/18/23

Oven Dried Mass = 55.28 g
Start Time = 0728

Duration	Behavior
5 minutes (0733)	6
10 minutes (0738)	6
15 minutes (0743)	6
30 minutes (0758)	6
45 minutes (0813)	6
60 minutes (0828)	6
2 hours (0928)	6
4 hours (1128)	6
6 hours (1328)	6
8 hours (1528)	6
24 hours (1/19/23 @ 0728)	6

Category Behavior
1. Degrades to pile of flakes or mud (complete Breakdown).
2. Breaks rapidly and/or forms many chips.
3. Breaks slowly and/or forms many chips.
4. Breaks rapidly and/or develops several fractures.
5. Breaks slowly and/or develops few fractures.
6. No change.

If sample breaks down completely, report SDI = 0.


Job No. 21-071
Job Title 040748
Hwy 22 to I-40
Sample No. FB-25
14'-19'
Date Received
Tests Assigned
Date Completed
GRUBBS, HOSKYN, BARTON, & WYATT, INC.

Jar Slake Test
ARDOT Test Method 398-07

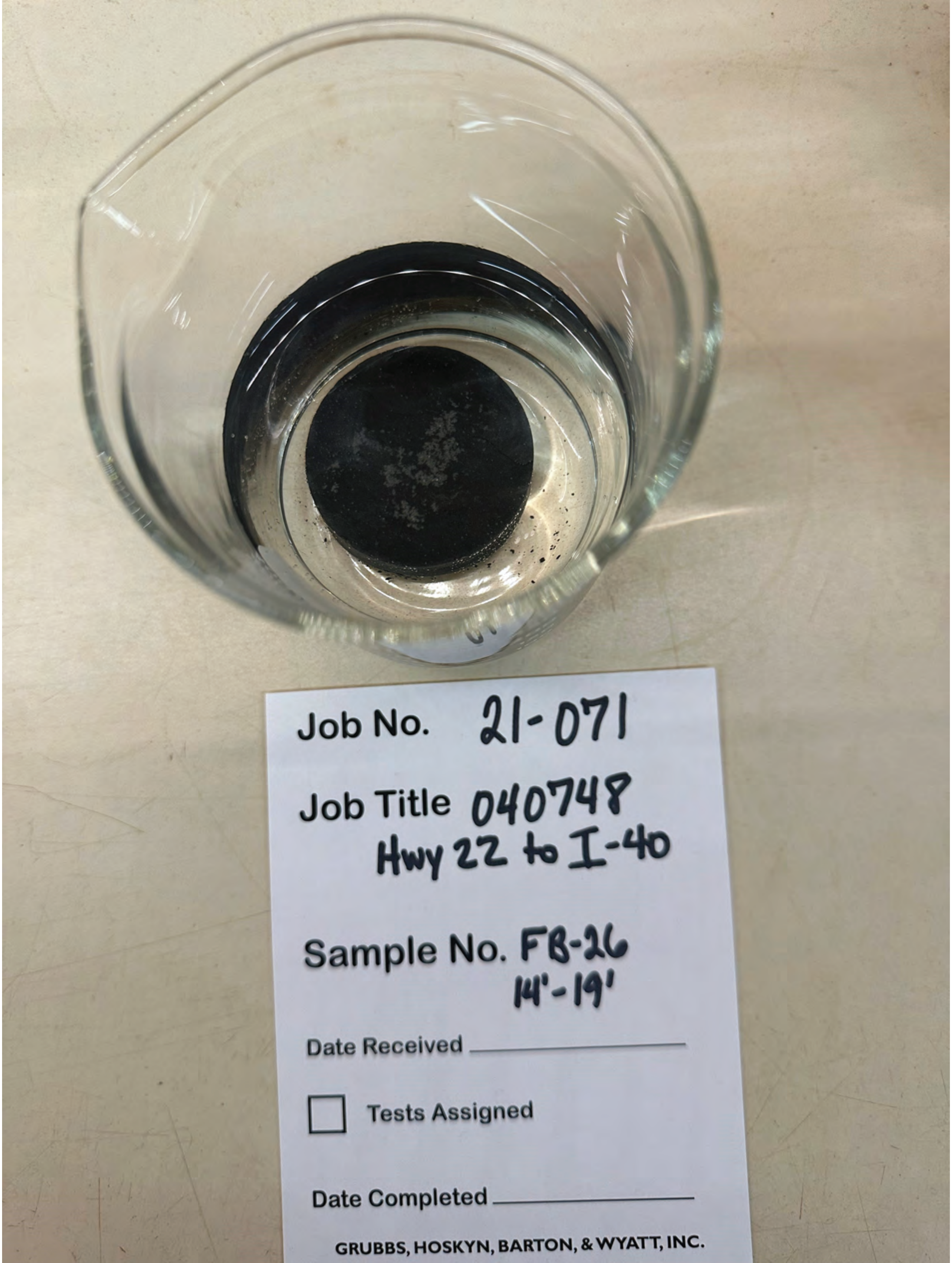
Job Number: 21-071
Boring: FB-26
Depth: 14’-19’
Start Date: 1/18/23

Oven Dried Mass = 54.46 g
Start Time = 0729

Duration	Behavior
5 minutes (0734)	6
10 minutes (0739)	6
15 minutes (0744)	6
30 minutes (0759)	6
45 minutes (0814)	6
60 minutes (0829)	6
2 hours (0929)	6
4 hours (1129)	6
6 hours (1329)	6
8 hours (1529)	6
24 hours (1/19/23 @ 0729)	6

Category Behavior
1. Degrades to pile of flakes or mud (complete Breakdown).
2. Breaks rapidly and/or forms many chips.
3. Breaks slowly and/or forms many chips.
4. Breaks rapidly and/or develops several fractures.
5. Breaks slowly and/or develops few fractures.
6. No change.

If sample breaks down completely, report SDI = 0.


Job No. 21-071
Job Title 040748
Hwy 22 to I-40
Sample No. FB-26
14'-19'
Date Received
Tests Assigned
Date Completed
GRUBBS, HOSKYN, BARTON, & WYATT, INC.

APPENDIX O

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

P.O. Box 30970
Little Rock, Arkansas 72260-0970
#1 Trigon Place 72209
(501) 455-2536
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REPORT OF STANDARD PROCTOR TEST
(AASHTO T-99)

Project: ARDOT Job No.040748 Hwy 22 to I-40 Sebastion Co. Job No: 21-071
Material Description: Brown fine sandy SILT
Location Sampled/Source: FP-2
Sample Depth, ft: 0.5-1.5
Date Sampled: 11/9/2023
Date Tested: 11/30/2023
Tested By: JW
Report Date: 12/6/2023

LAB COMPACTION PROCEDURE: AASHTO T-99 Method: A	
Maximum Unit Dry Wt. (pcf):	104.3
Optimum Water Content (%):	17.3

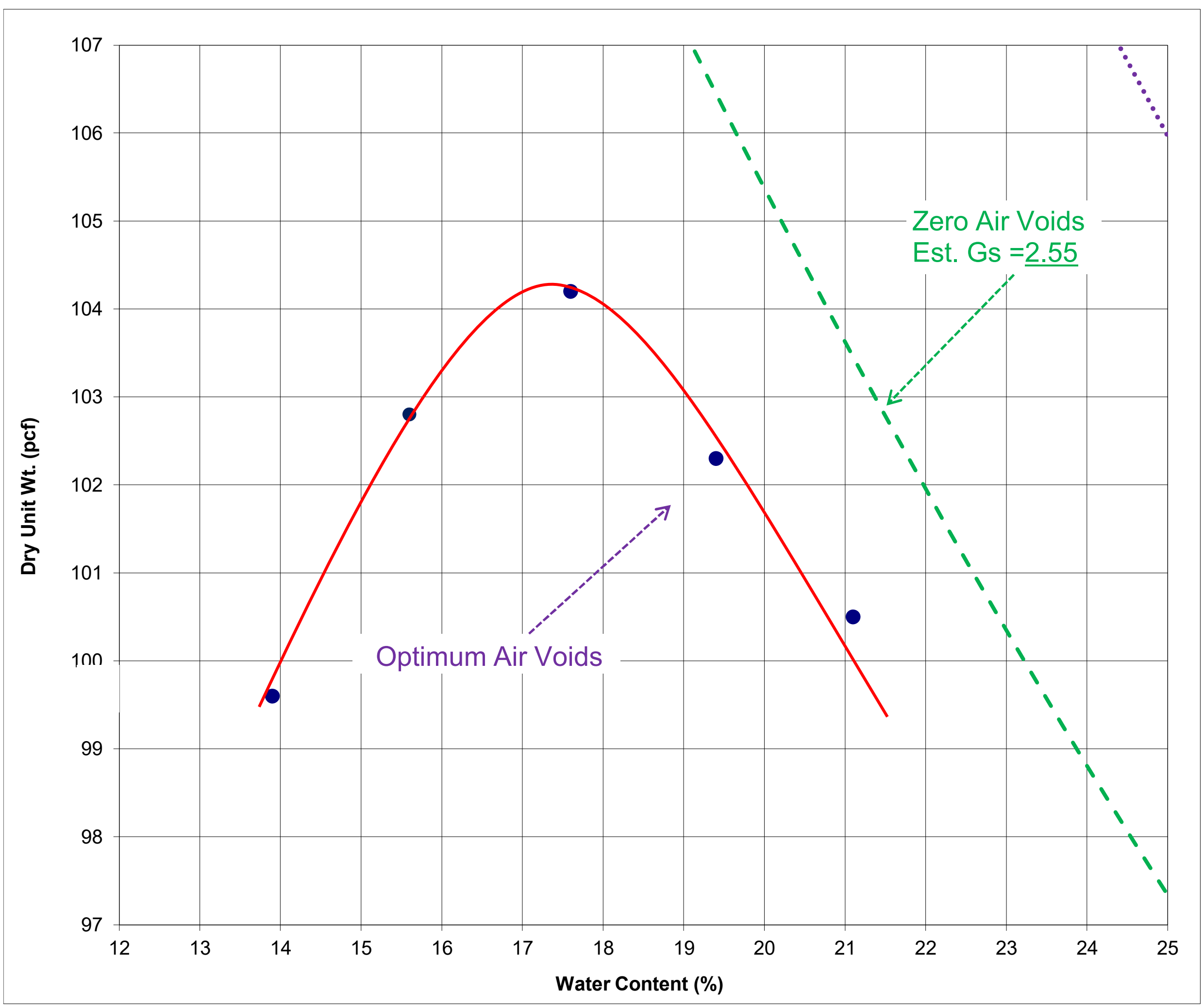
ATTERBERG LIMITS AASHTO T-89 & T-90
Liquid Limit: NP
Plastic Limit: NP
Plasticity Index: NP

USCS Classification:
ML

AASHTO Classification:
A-4

GRADATION AASHTO T-88	
Sieve Number	Percent Passing
3 in.	100
2 in.	100
3/4 in.	100
3/8 in.	100
#4	100
#10	98
#40	95
#200	82

As Recieved Water Content: 25.3 %



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REPORT OF STANDARD PROCTOR TEST
(AASHTO T-99)

Project: ARDOT Job No.040748 Hwy 22 to I-40 Sebastion Co. Job No: 21-071
Material Description: Brown SILT, sightly sandy
Location Sampled/Source: FP-5
Sample Depth, ft: 0.5-1.5
Date Sampled: 11/9/2023
Date Tested: 11/29/2023
Tested By: JW
Report Date: 12/6/2023

LAB COMPACTION PROCEDURE: AASHTO T-99 Method: A	
Maximum Unit Dry Wt. (pcf):	100.6
Optimum Water Content (%):	20.2

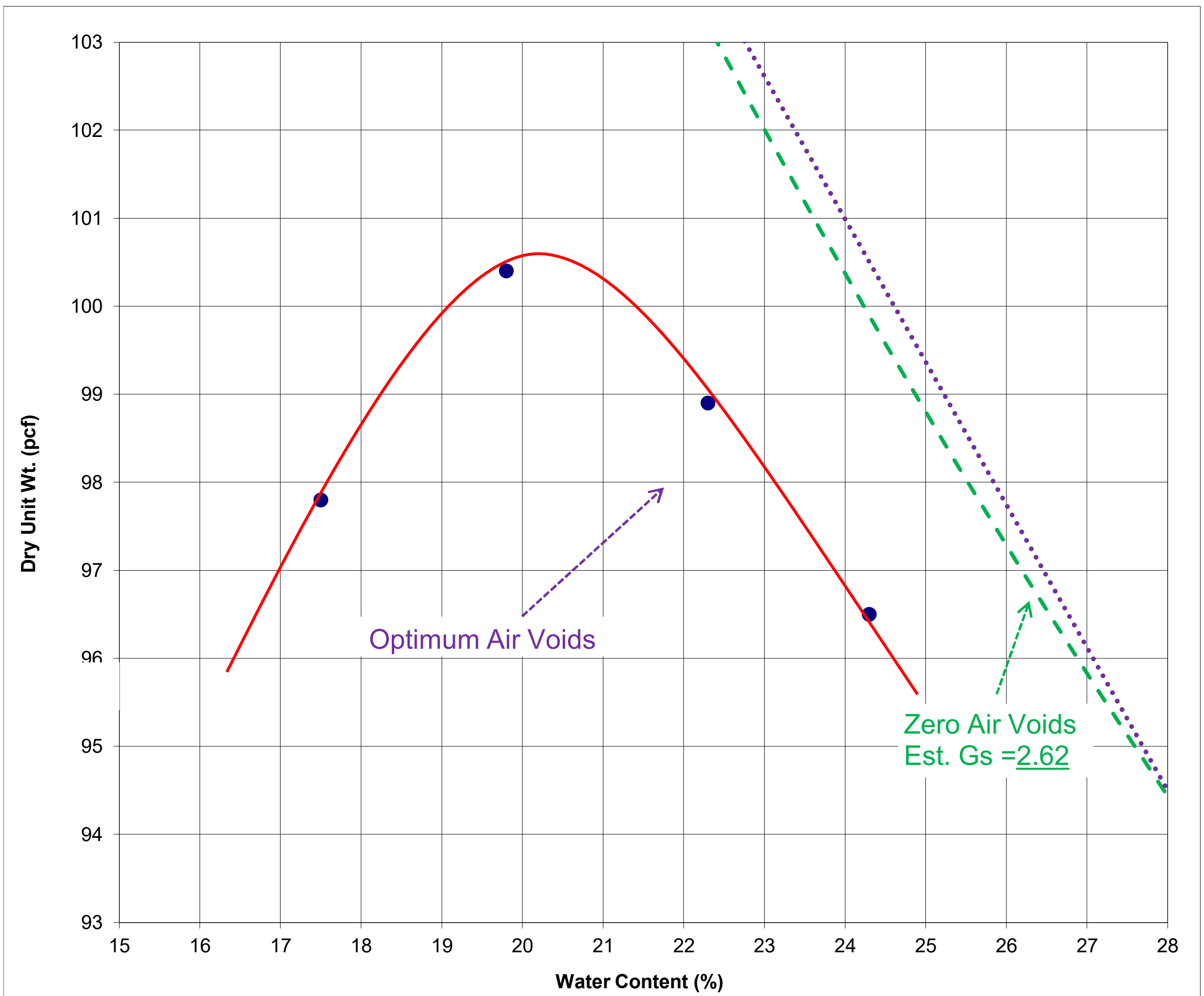
ATTERBERG LIMITS AASHTO T-89 & T-90
Liquid Limit: 34
Plastic Limit: 25
Plasticity Index: 9

USCS Classification:
ML

AASHTO Classification:
A-4

GRADATION AASHTO T-88	
Sieve Number	Percent Passing
3 in.	100
2 in.	100
3/4 in.	100
3/8 in.	100
#4	100
#10	100
#40	96
#200	90

As Recieved Water Content: 27.0 %



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REPORT OF STANDARD PROCTOR TEST
(AASHTO T-99)

Project: ARDOT Job No.040748 Hwy 22 to I-40 Sebastion Co. Job No: 21-071
Material Description: Brown fine sandy SILT
Location Sampled/Source: FP-10
Sample Depth, ft: 0.5-1.5
Date Sampled: 11/9/2023
Date Tested: 11/29/2023
Tested By: JW
Report Date: 12/6/2023

LAB COMPACTION PROCEDURE: AASHTO T-99 Method: A	
Maximum Unit Dry Wt. (pcf):	101.6
Optimum Water Content (%):	17.8

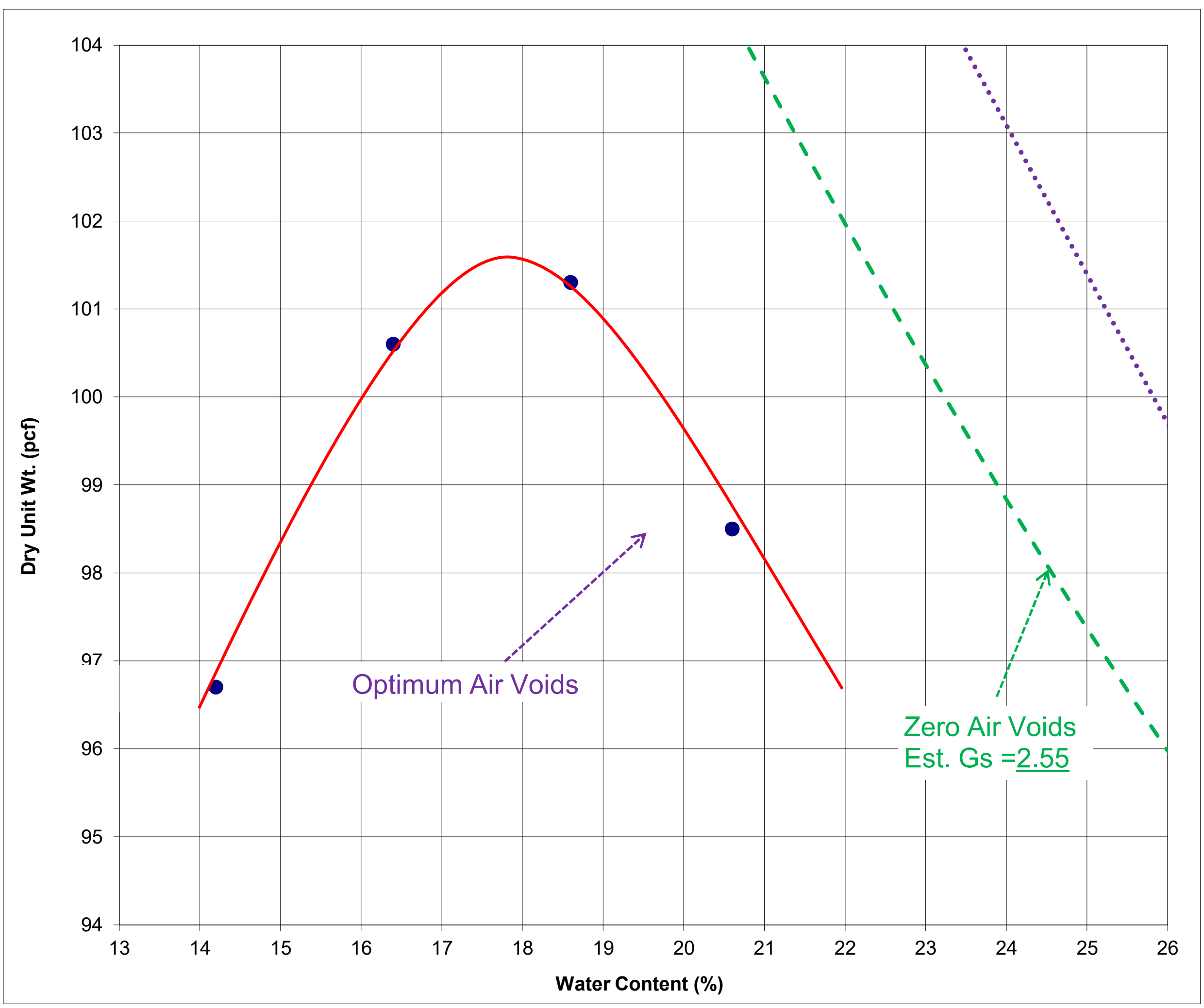
As Recieved Water Content: 27.1 %

ATTERBERG LIMITS AASHTO T-89 & T-90
Liquid Limit: NP
Plastic Limit: NP
Plasticity Index: NP

USCS Classification:
ML

AASHTO Classification:
A-4

GRADATION AASHTO T-88	
Sieve Number	Percent Passing
3 in.	100
2 in.	100
3/4 in.	100
3/8 in.	100
#4	100
#10	100
#40	98
#200	87



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REPORT OF STANDARD PROCTOR TEST
(AASHTO T 99)

Project: 040748 Hwy 22 to I-40 - Crawford & Sebastian County, AR   Job No: 21-071
Material Description: Dark brown silty CLAY
Location Sampled/Source: FB-1
Sample Depth, ft: 0.5-1
Date Sampled: 10/6/2023
Date Tested: 10/11/2023
Tested By: JW
Report Date: 10/30/2023

LAB COMPACTION PROCEDURE: AASHTO T 99 Method: A	
Maximum Unit Dry Wt. (pcf):	91.7
Optimum Water Content (%):	26.1

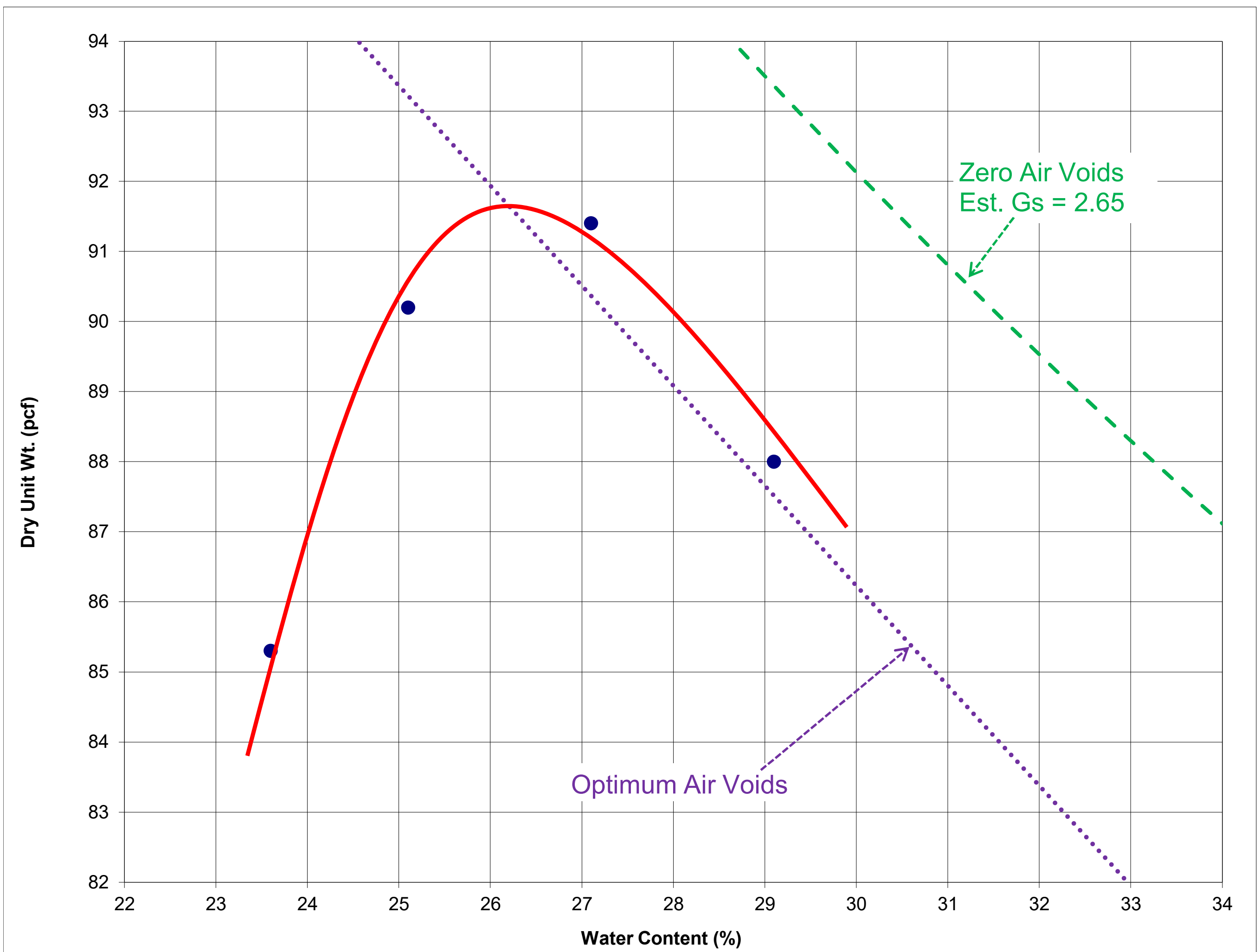
As Received Water Content: 24.1 %

ATTERBERG LIMITS AASHTO T 89 & T 90
Liquid Limit: 52
Plastic Limit: 34
Plasticity Index: 18

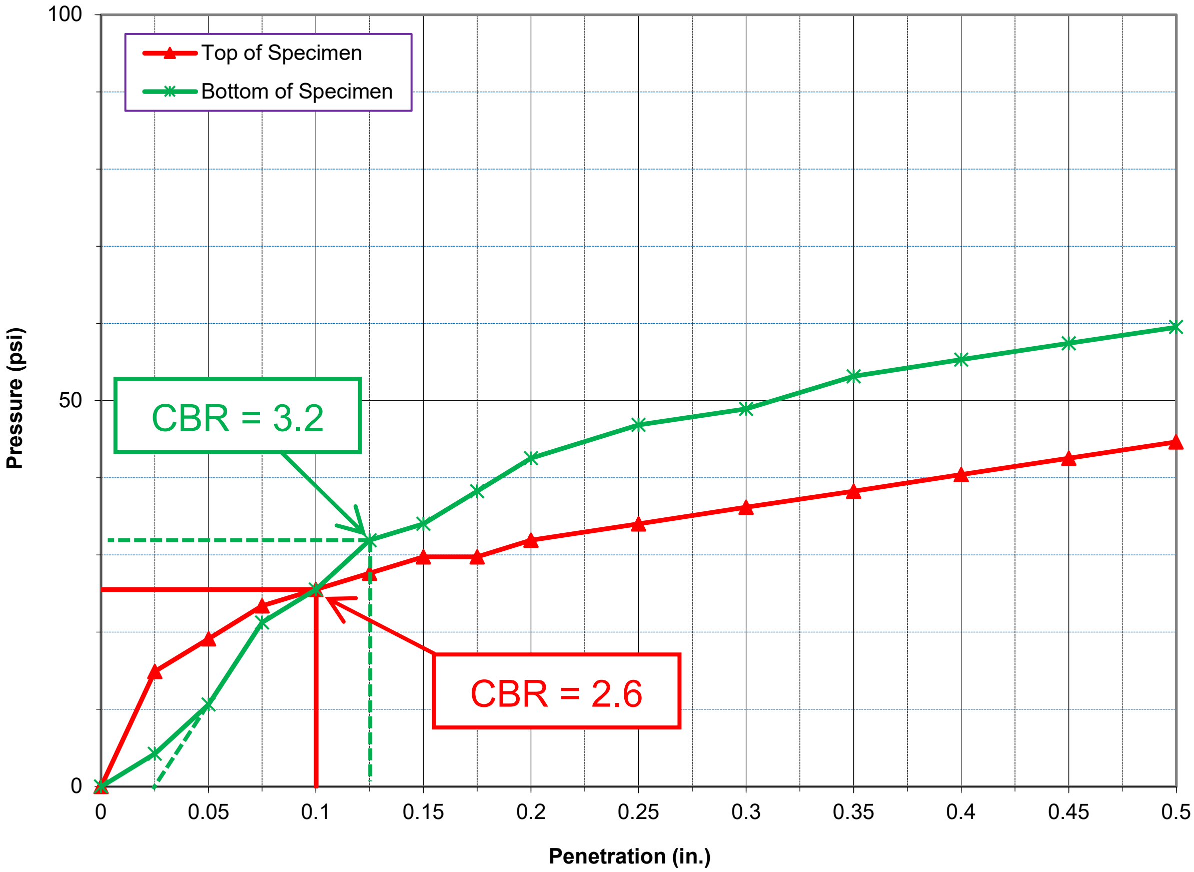
USCS Classification:
MH

AASHTO Classification:
A-7-5

GRADATION AASHTO T 88	
Sieve Number	Percent Passing
3 in.	100
2 in.	100
3/4 in.	100
3/8 in.	100
#4	100
#10	100
#40	99
#200	98



Laboratory CBR Test Report
(AASHTO T 193)



Test Pit No./ Depth, ft	Classification		Natural Moisture Content, %	Assumed Specific Gravity	Liquid Limit, %	Plastic Limit, %	% Retained No.4	% Passing No.200
	USCS	AASHTO						
FB-1 / 0.5-1'	MH	A-7-5	24.1	2.65	52	34	0	98

PROCTOR TEST RESULTS (AASHTO T 99)	**MATERIAL DESCRIPTION**
Optimum Moisture Content = 26.1% Maximum Dry Density = 91.7 pcf	Dark brown silty CLAY

Remarks:

As Molded: γ_d = 87.1 pcf @ 27.5%; Percent swell: 0.6%

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	Project: 040748 Hwy 22 to I-40
	GHBW Project Number: 21-071
	Location:Crawford & Sebastian County, Arkansas
	Sample Date: 10/06/23
	Test Date: 10/23/23

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REPORT OF STANDARD PROCTOR TEST
(AASHTO T-99)

Project: ARDOT Job No.040748 Hwy 22 to I-40 Sebastion Co. Job No: 21-071
Material Description: Brown fine sandy SILT
Location Sampled/Source: FB-2
Sample Depth, ft: 0.5-1.5
Date Sampled:
Date Tested: 3/1/2023
Tested By: RB
Report Date: 3/15/2023

LAB COMPACTION PROCEDURE: AASHTO T-99 Method: A	
Maximum Unit Dry Wt. (pcf):	113.9
Optimum Water Content (%):	12.9

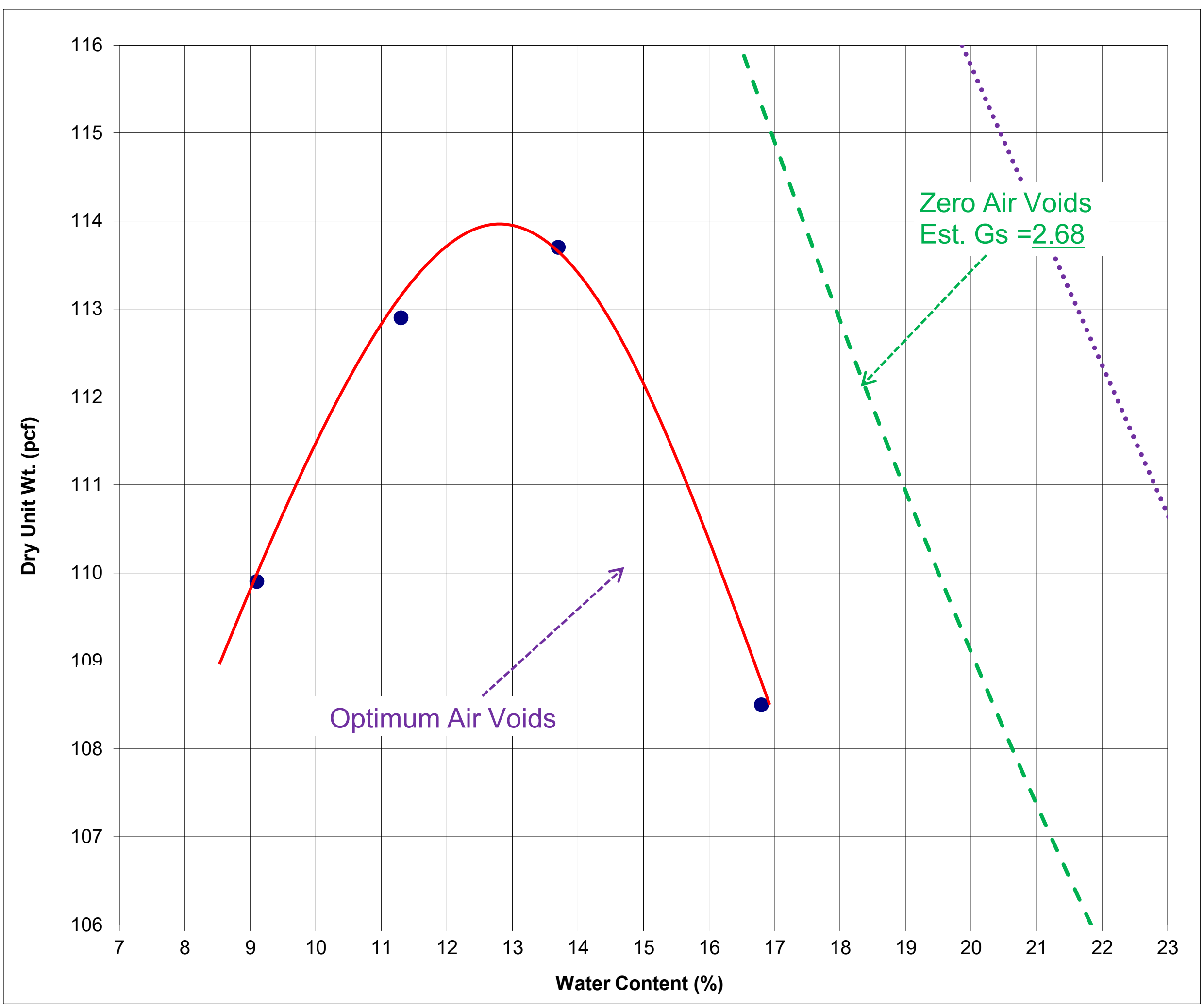
As Recieved Water Content: 16.6 %

ATTERBERG LIMITS AASHTO T-89 & T-90
Liquid Limit: 20
Plastic Limit: 19
Plasticity Index: 1

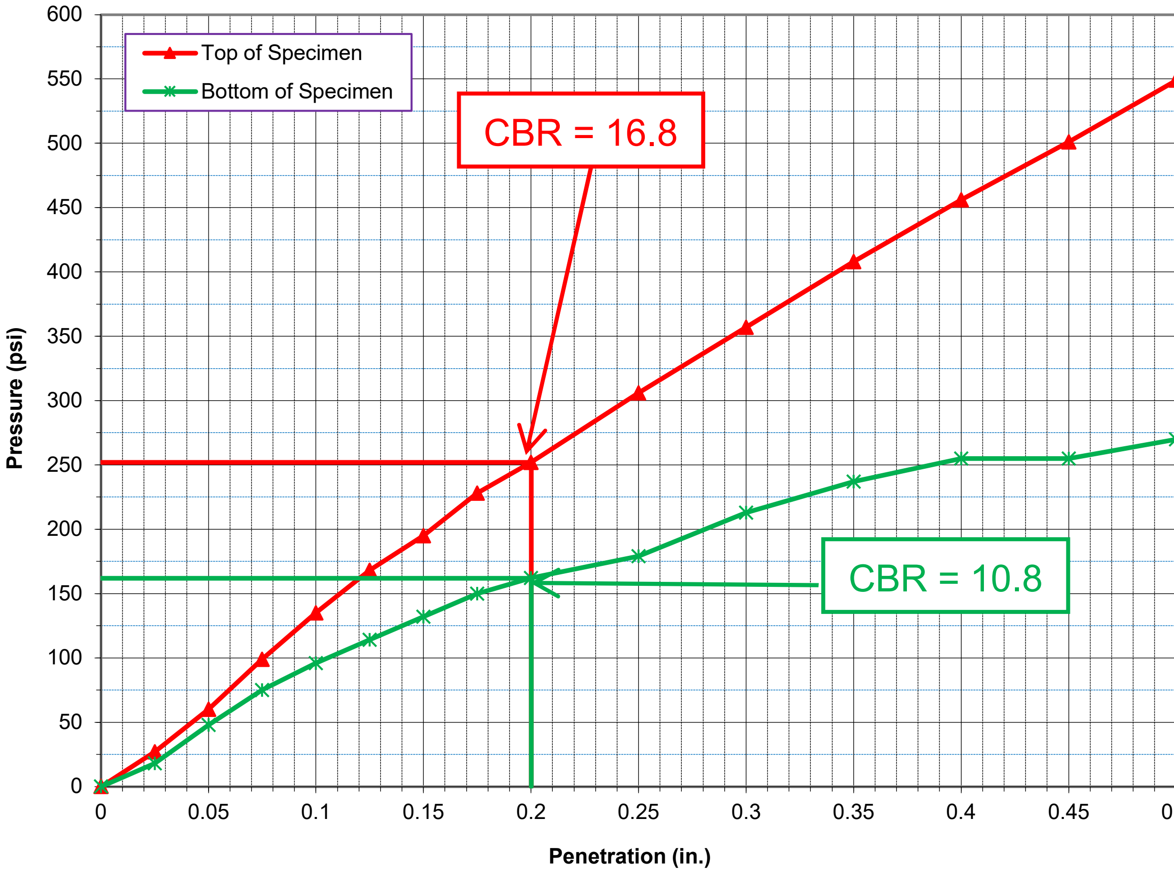
USCS Classification:
ML

AASHTO Classification:
A-4

GRADATION AASHTO T-88	
Sieve Number	Percent Passing
3 in.	100
2 in.	100
3/4 in.	100
3/8 in.	100
#4	100
#10	100
#40	100
#200	70



Laboratory CBR Test Report
(AASHTO T-193)



Boring No./Depth, ft	Classification		Natural Moisture Content, %	Assumed Specific Gravity	Liquid Limit	Plastic Limit	% Retained No.4	% Passing No.200
	USCS	AASHTO						
FB-2 @ 0.5-1.5'	ML	A-4	16.6	2.68	20	19	0	70

PROCTOR TEST RESULTS (AASHTO T-99)	**MATERIAL DESCRIPTION**
Optimum Moisture Content = 12.9% Maximum Dry Density = 113.9 pcf	Brown fine sandy SILT

Remarks:
As Molded: 109.6 pcf @ 12.8%; Percent swell: 0.0%

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	Project: 040708 Hwy. 22 to I-40 - Sebastian Co.
	GHBW Project No.: 21-071
	Location: Sebastian Co., Arkansas
	Sample Date: 3/01/23
	Test Date: 3/01/23

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REPORT OF STANDARD PROCTOR TEST
(AASHTO T 99)

Project: 040748 Hwy 22 to I-40 - Crawford & Sebastian County, AR   Job No: 21-071
Material Description: Dark brown clayey SILT
Location Sampled/Source: FB-3
Sample Depth, ft: 0.5-1
Date Sampled: 10/6/2023
Date Tested: 10/11/2023
Tested By: JW
Report Date: 10/30/2023

LAB COMPACTION PROCEDURE: AASHTO T 99 Method: A	
Maximum Unit Dry Wt. (pcf):	99.7
Optimum Water Content (%):	19.6

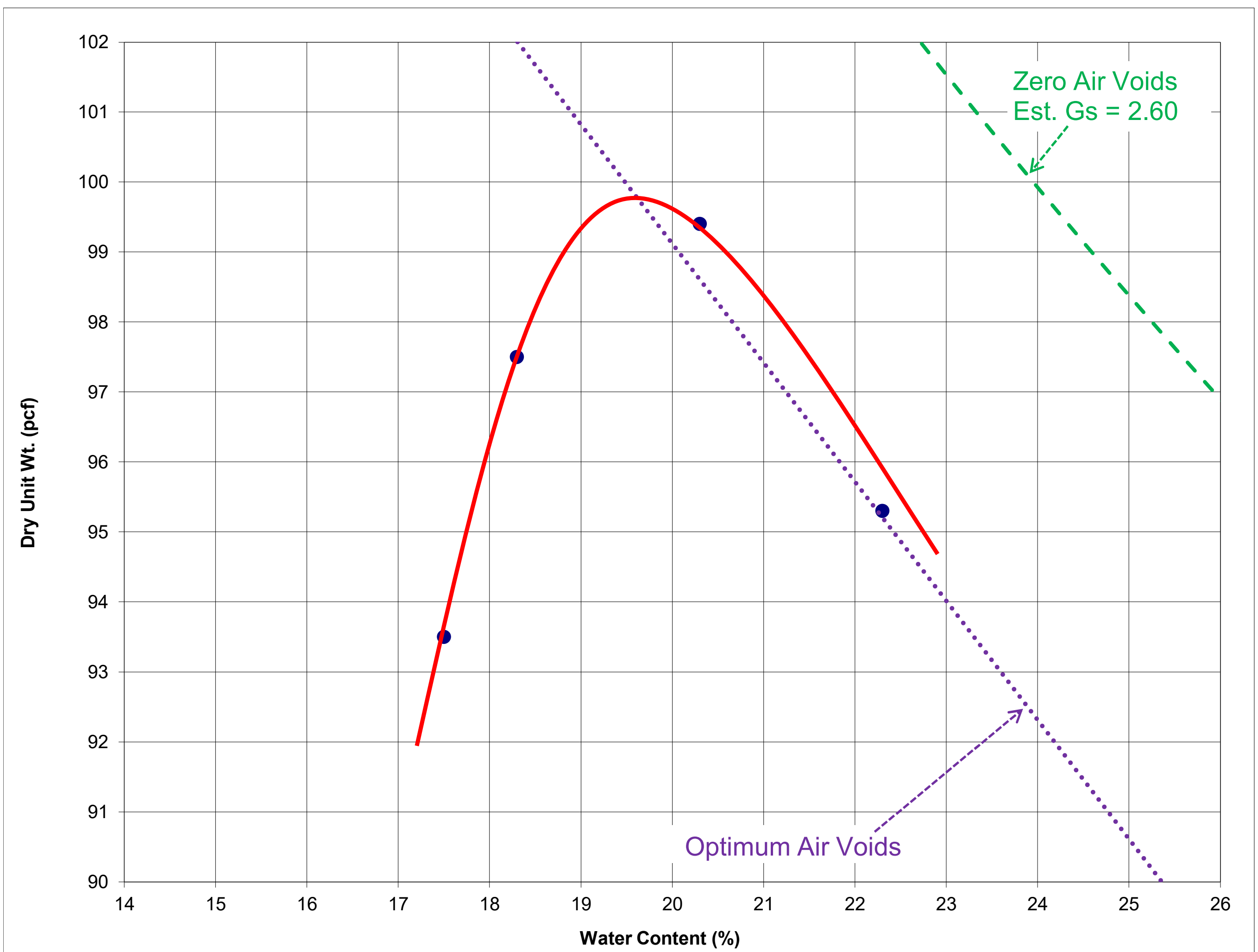
As Received Water Content: 24.1 %

ATTERBERG LIMITS AASHTO T 89 & T 90
Liquid Limit: 42
Plastic Limit: 28
Plasticity Index: 14

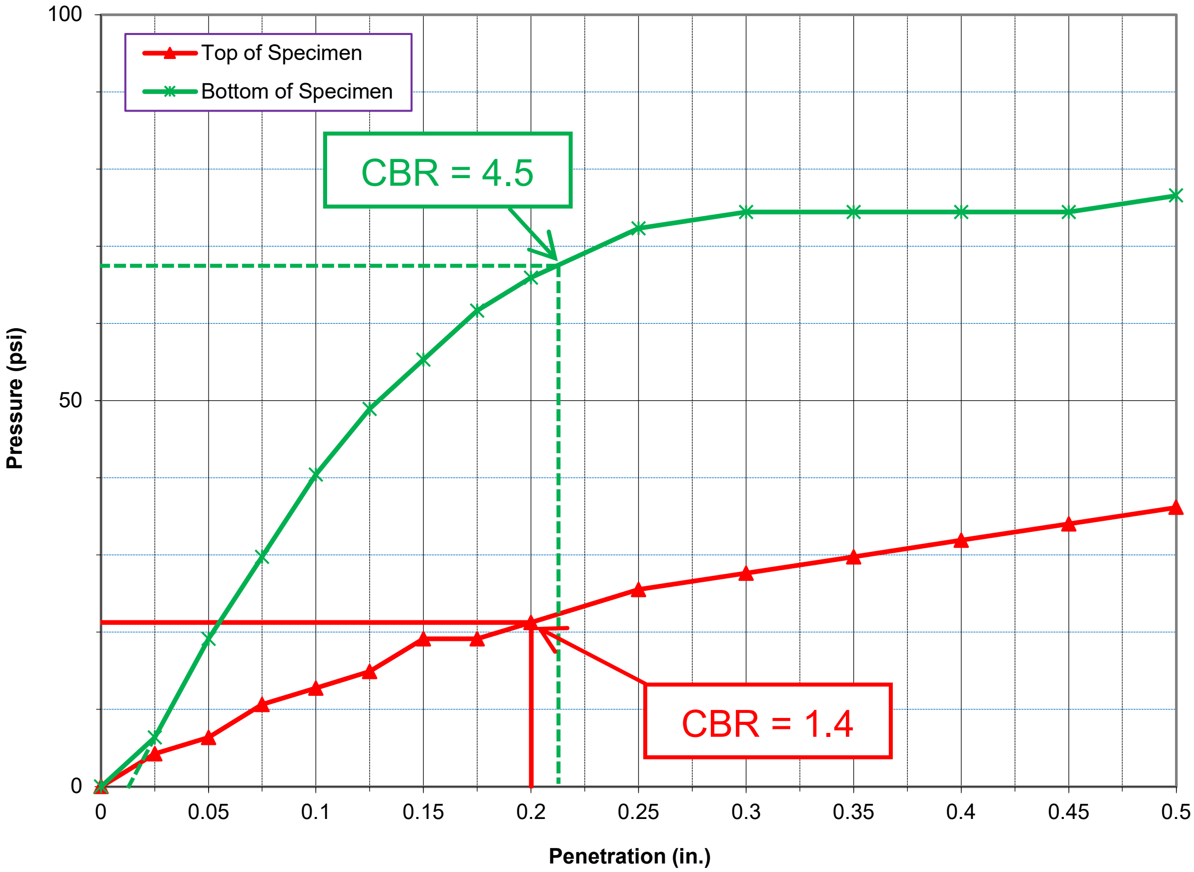
USCS Classification:
ML

AASHTO Classification:
A-7-6

GRADATION AASHTO T 88	
Sieve Number	Percent Passing
3 in.	100
2 in.	100
3/4 in.	100
3/8 in.	100
#4	100
#10	100
#40	100
#200	98



Laboratory CBR Test Report
(AASHTO T 193)



Test Pit No./ Depth, ft	Classification		Natural Moisture Content, %	Assumed Specific Gravity	Liquid Limit, %	Plastic Limit, %	% Retained No.4	% Passing No.200
	USCS	AASHTO						
FB-3 / 0.5-1'	ML	A-7-6	24.1	2.60	42	28	0	98

PROCTOR TEST RESULTS (AASHTO T 99)	**MATERIAL DESCRIPTION**
Optimum Moisture Content = 19.6% Maximum Dry Density = 99.7 pcf	Dark brown clayey SILT

Remarks:

As Molded: γ_d = 94.8 pcf @ 21.0%; Percent swell: -1.3%

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	Project: 040748 Hwy 22 to I-40
	GHBW Project Number: 21-071
	Location:Crawford & Sebastian County, Arkansas
	Sample Date: 10/06/23
	Test Date: 10/23/23

Grubbs, Hoskyn, Barton & Wyatt, LLC
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REPORT OF STANDARD PROCTOR TEST
(AASHTO T-99)

Project: ARDOT Job No.040748 Hwy 22 to I-40 Sebastion Co. Job No: 21-071
Material Description: Brown fine sandy SILT
Location Sampled/Source: FB-8
Sample Depth, ft: 0.5-1.5
Date Sampled: 11/9/2023
Date Tested: 11/20/2023
Tested By: JW
Report Date: 12/6/2023

LAB COMPACTION PROCEDURE: AASHTO T-99 Method: A	
Maximum Unit Dry Wt. (pcf):	100.9
Optimum Water Content (%):	18.4

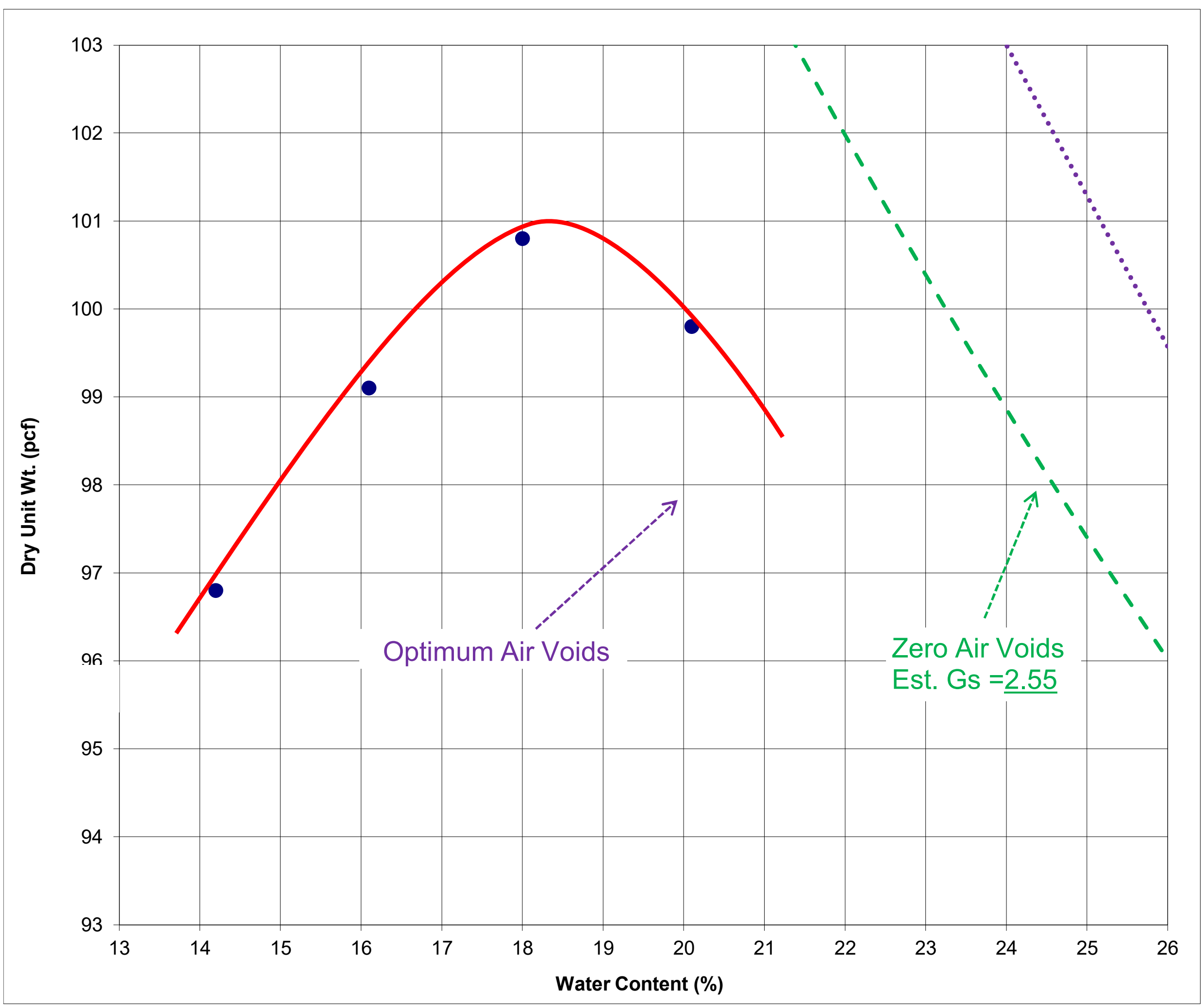
As Recieved Water Content: 20.2 %

ATTERBERG LIMITS AASHTO T-89 & T-90
Liquid Limit: NP
Plastic Limit: NP
Plasticity Index: NP

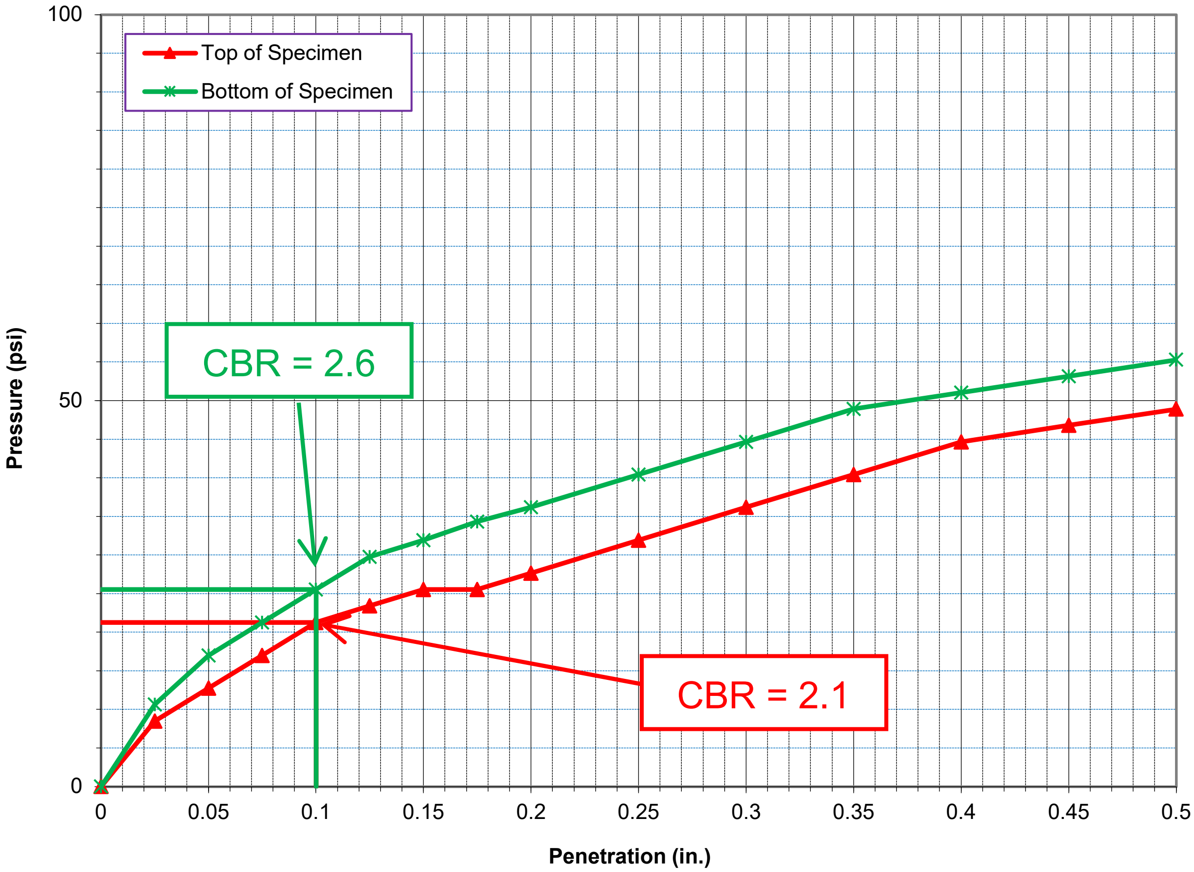
USCS Classification:
ML

AASHTO Classification:
A-4

GRADATION AASHTO T-88	
Sieve Number	Percent Passing
3 in.	100
2 in.	100
3/4 in.	100
3/8 in.	100
#4	100
#10	100
#40	97
#200	82



Laboratory CBR Test Report
(AASHTO T-193)



Boring No./Depth, ft	Classification		Natural Moisture Content, %	Assumed Specific Gravity	Liquid Limit	Plastic Limit	% Retained No.4	% Passing No.200
	USCS	AASHTO						
FB-8 @ 0.5-1.5'	ML	A-4	20.2	2.55	NP	NP	0	82

PROCTOR TEST RESULTS (AASHTO T-99)	MATERIAL DESCRIPTION
Optimum Moisture Content = 18.4% Maximum Dry Density = 100.9 pcf	Brown fine sandy SILT

Remarks:
As Molded: 95.9 pcf @ 19.6%; Percent swell: 0.72%

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

Project: 040708 Hwy. 22 to I-40	
GHBW Project No.: 21-071	
Location: Sebastian Co., Arkansas	
Sample Date: 11/09/23	
Test Date: 11/21/23	

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REPORT OF STANDARD PROCTOR TEST
(AASHTO T-99)

Project: ARDOT Job No.040748 Hwy 22 to I-40 Sebastion Co. Job No: 21-071
Material Description: Brown fine sandy SILT
Location Sampled/Source: FB-10
Sample Depth, ft: 0.5-1.5
Date Sampled:
Date Tested: 11/30/2023
Tested By: JW
Report Date: 12/6/2023

LAB COMPACTION PROCEDURE: AASHTO T-99 Method: A	
Maximum Unit Dry Wt. (pcf):	105.8
Optimum Water Content (%):	15.2

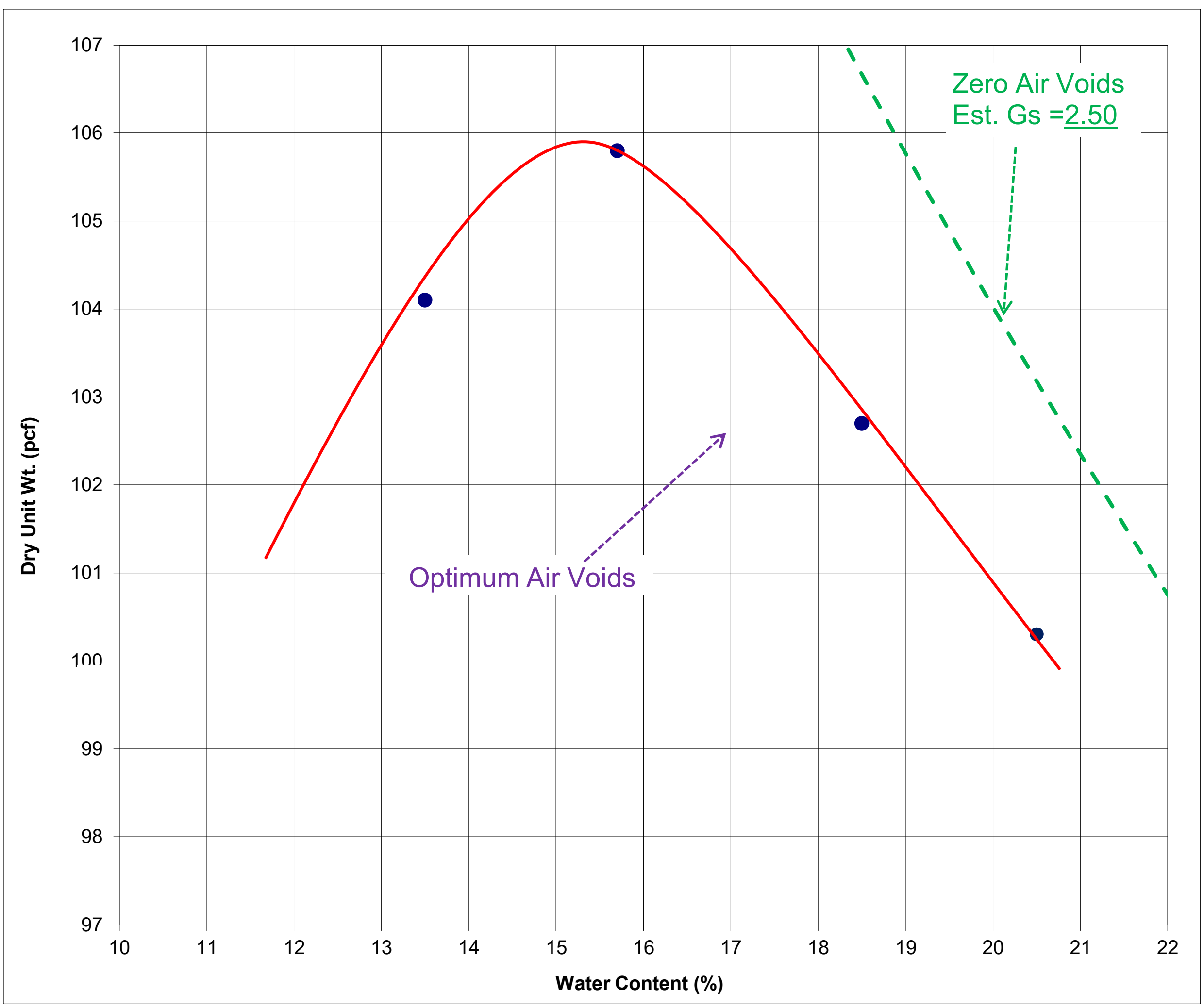
ATTERBERG LIMITS AASHTO T-89 & T-90
Liquid Limit: NP
Plastic Limit: NP
Plasticity Index: NP

USCS Classification:
ML

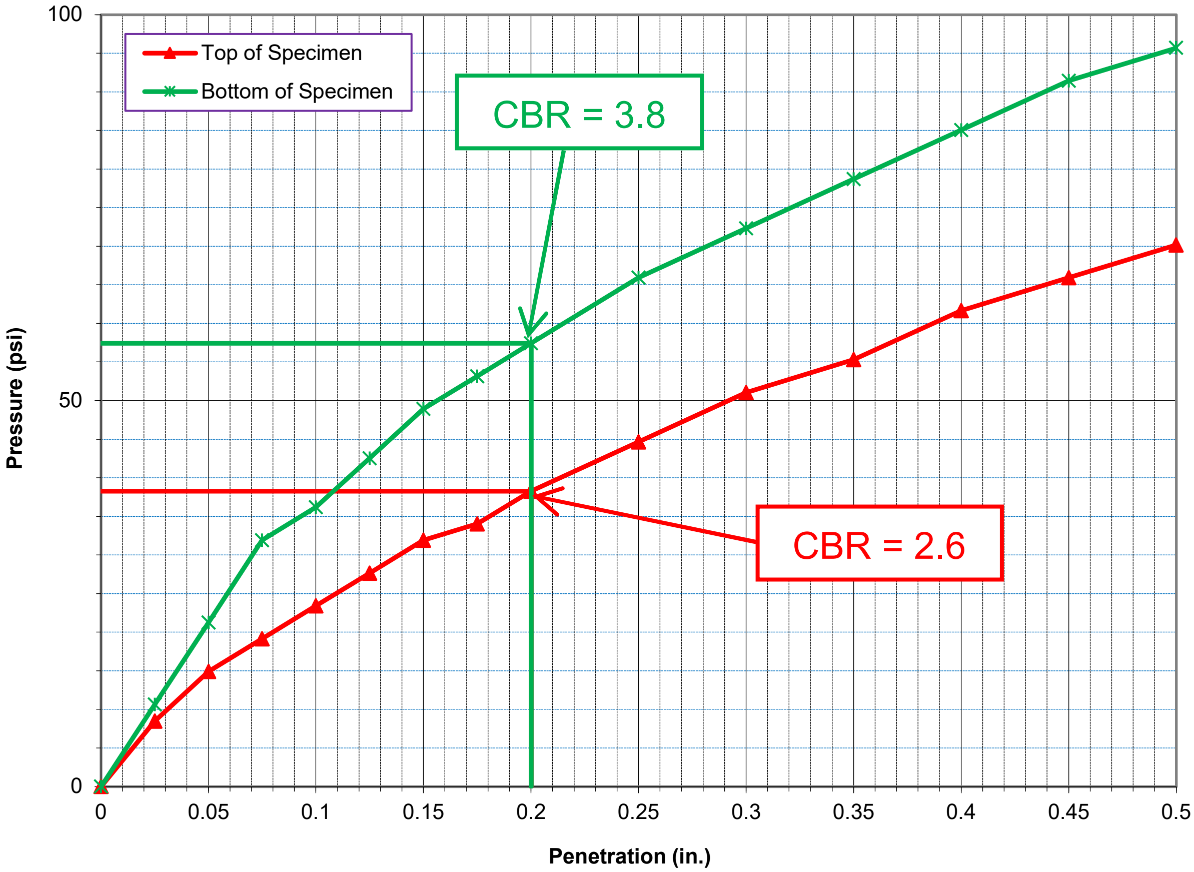
AASHTO Classification:
A-4

GRADATION AASHTO T-88	
Sieve Number	Percent Passing
3 in.	100
2 in.	100
3/4 in.	100
3/8 in.	100
#4	100
#10	98
#40	92
#200	73

As Recieved Water Content: 17.0 %



Laboratory CBR Test Report
(AASHTO T-193)



Boring No./Depth, ft	Classification		Natural Moisture Content, %	Assumed Specific Gravity	Liquid Limit	Plastic Limit	% Retained No.4	% Passing No.200
	USCS	AASHTO						
FB-10 @ 0.5-1.5'	ML	A-4	17	2.5	NP	NP	0	73

PROCTOR TEST RESULTS (AASHTO T-99)	MATERIAL DESCRIPTION
Optimum Moisture Content = 15.2% Maximum Dry Density = 105.8 pcf	Brown fine sandy SILT

Remarks:
As Molded: 95.9 pcf @ 19.6%; Percent swell: 0.72%

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	Project: 040708 Hwy. 22 to I-40 GHBW Project No.: 21-071 Location: Sebastian Co., Arkansas Sample Date: 11/01/23 Test Date: 11/30/23

Grubbs, Hoskyn, Barton & Wyatt, LLC
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REPORT OF STANDARD PROCTOR TEST
(AASHTO T-99)

Project: ARDOT Job No.040748 Hwy 22 to I-40 Sebastion Co. Job No: 21-071
Material Description: Dark brown silty CLAY with organic stains
Location Sampled/Source: FB-80
Sample Depth, ft: 0.5-2
Date Sampled:
Date Tested: 3/1/2023
Tested By: RB
Report Date: 3/15/2023

LAB COMPACTION PROCEDURE: AASHTO T-99 Method: A	
Maximum Unit Dry Wt. (pcf):	100.4
Optimum Water Content (%):	18.9

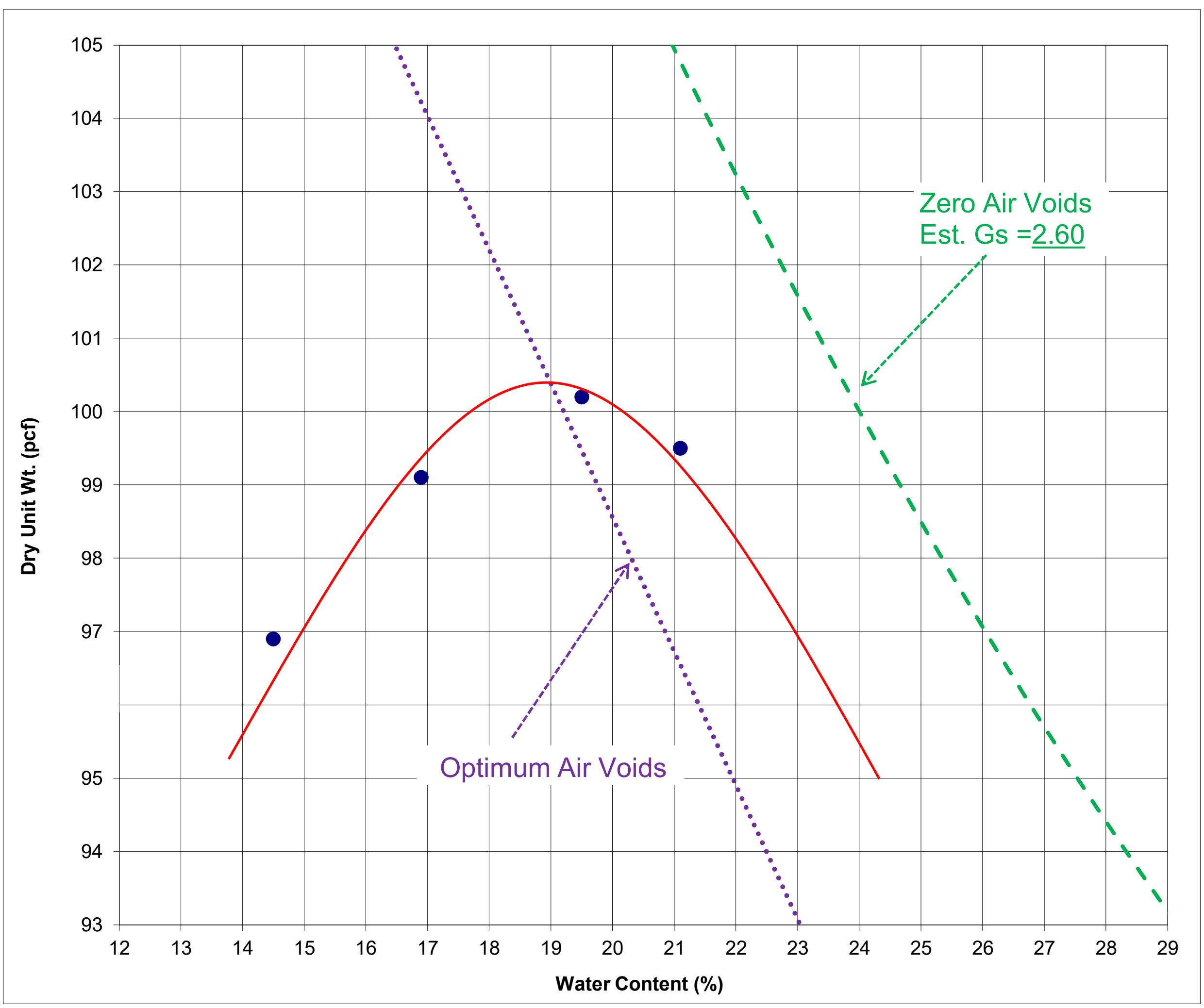
As Recieved Water Content: 27.0 %

ATTERBERG LIMITS AASHTO T-89 & T-90
Liquid Limit: 49
Plastic Limit: 20
Plasticity Index: 29

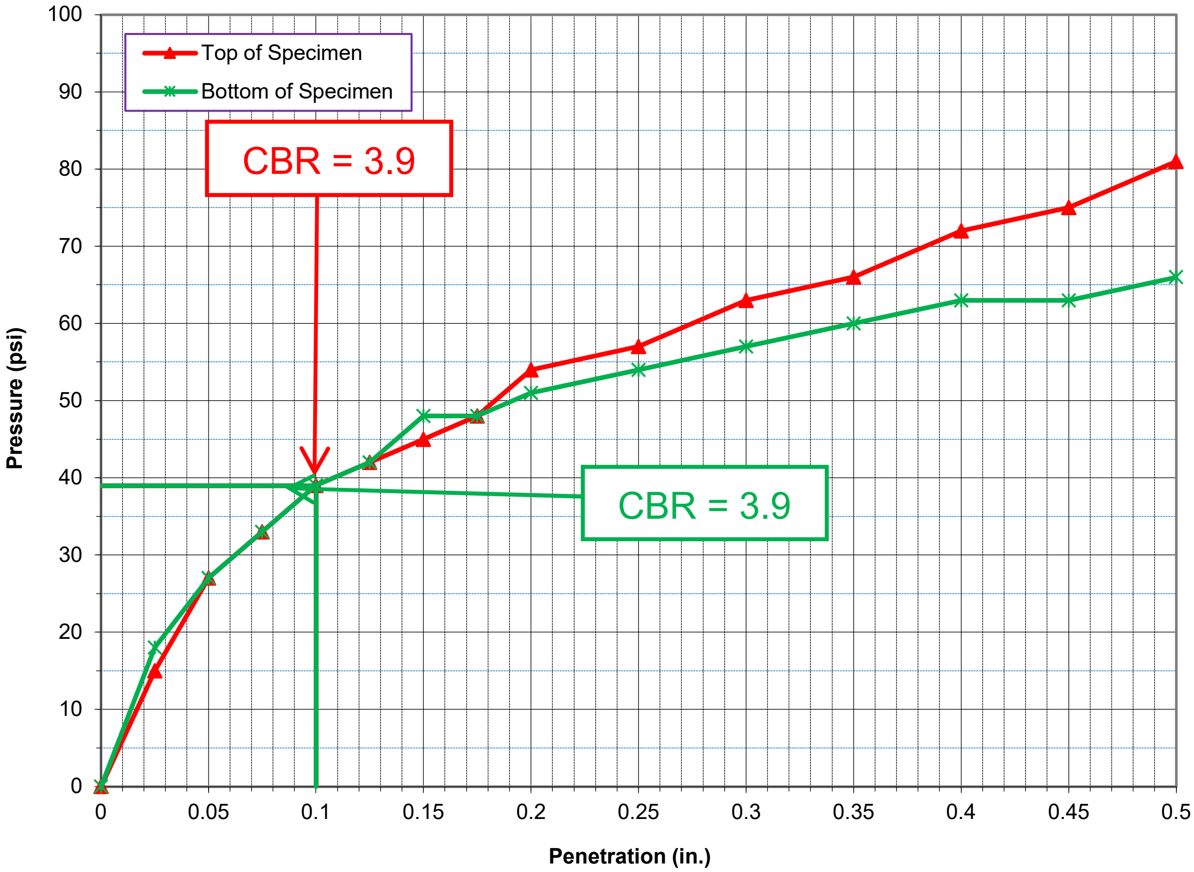
USCS Classification:
ML

AASHTO Classification:
A-7-6

GRADATION AASHTO T-88	
Sieve Number	Percent Passing
3 in.	100
2 in.	100
3/4 in.	100
3/8 in.	100
#4	100
#10	100
#40	98
#200	96



Laboratory CBR Test Report
(AASHTO T-193)



Boring No./Depth, ft	Classification		Natural Moisture Content, %	Assumed Specific Gravity	Liquid Limit	Plastic Limit	% Retained No.4	% Passing No.200
	USCS	AASHTO						
FB-80 @ 0.5-2'	ML	A-7-6	27.7	2.6	49	20	0	96

PROCTOR TEST RESULTS (AASHTO T-99)	**MATERIAL DESCRIPTION**
Optimum Moisture Content = 18.9% Maximum Dry Density = 100.4 pcf	Dark brown silty CLAY with organic stains

Remarks:
As Molded: 94.9 pcf @ 19.3%; Percent swell: 1.1%

Grubbs, Hoskyn, Barton & Wyatt, LLC CONSULTING ENGINEERS A UES Company	Project: 040708 Hwy. 22 to I-40 - Sebastian Co.
	GHBW Project No.: 21-071
	Location: Sebastian Co., Arkansas
	Sample Date: 3/01/23
	Test Date: 3/02/23

Appendix 2: Scour Summary

SCOUR SUMMARY TABLE (100yr+): 570kcfs

	FOUNDATION ELEMENT	BENT NO.	θ	LONG-TERM AGGRADATION/ DEGRADATION	CONTRACTION	LOCAL	TOTAL	ABRASION	EX. GROUND/BED ELEVATION	TOTAL SCOUR ELEVATION
BRIDGE 16	PIER (257+78)	15	0	4.0	0.1	0.0	4.1	---	398.79	**394.69**
	PIER (256+48)	14	0	4.0	0.1	0.0	4.1	---	400.91	**396.81**
	PIER (255+33)	13	0	4.0	0.1	0.0	4.1	---	400.41	**396.31**
	PIER (254+03)	12	4	4.0	0.1	5.0	9.1	---	397.47	**388.37**
	PIER (252+73)	11	17	4.0	0.1	8.5	12.6	---	389.65	**377.01**
	PIER (251+43)	10	3	4.0	0.1	7.4	11.5	---	390.43	**378.93**
	PIER (250+13)	9	4	4.0	0.1	7.4	11.5	---	392.57	**381.04**
	PIER (249+13)	8	5	4.0	0.1	7.6	11.7	---	393.15	**381.47**
	PIER (248+13)	7	5	4.0	0.1	8.6	12.7	---	387.49	**374.79**
	PIER (246+83)	6	8	4.0	0.1	8.5	12.6	---	386.92	**374.29**
	PIER (245+93)	5	15	4.0	0.1	8.7	12.8	---	386.42	**373.66**
	PIER (244+63)	4	22	4.0	0.1	11.4	15.5	---	385.79	**370.28**
	PIER (243+33)	3	21	4.0	0.1	11.8	15.9	---	390.54	**374.62**
	PIER (242+03)	2	41	4.0	0.1	13.8	17.9	---	388.31	**370.38**
BRIDGE 1	PIER (214+73)	32	36	4.0	0.0	13.6	17.6	---	393.89	**376.34**
	PIER (213+43)	31	5	4.0	0.0	7.7	11.7	---	392.07	**380.40**
	PIER (212+13)	30	22	4.0	0.0	9.9	13.9	---	394.49	**380.58**
	PIER (210+83)	29	20	4.0	0.0	8.9	12.9	---	398.57	**385.67**
	PIER (209+53)	28	21	4.0	0.0	8.7	12.7	---	400.44	**387.74**
	PIER (208+23)	27	11	4.0	0.0	7.3	11.3	---	400.67	**389.37**
	PIER (206+93)	26	8	4.0	0.0	7.9	11.9	---	400.31	**388.45**
	PIER (205+63)	25	4	4.0	0.0	7.2	11.2	---	399.51	**388.28**
	PIER (204+33)	24	6	4.0	0.0	7.3	11.3	---	399.92	**388.63**
	PIER (203+03)	23	6	4.0	0.0	7.6	11.6	---	398.84	**387.27**
	PIER (201+73)	22	15	4.0	0.0	8.7	12.7	---	398.50	**385.78**
	PIER (200+43)	21	4	4.0	0.0	8.4	12.4	---	387.84	**375.45**
	PIER (199+13)	20	6	4.0	0.0	8.7	12.7	---	388.23	**375.57**
	PIER (197+83)	19	34	4.0	0.0	13.5	17.5	---	389.00	**371.53**
	PIER (196+53)	18	35	4.0	0.0	16.9	20.9	---	386.60	**365.69**
	PIER (195+23)	17	47	4.0	0.0	21.1	25.1	---	385.63	**360.54**
	PIER (193+93)	16	10	4.0	0.0	17.9	21.9	---	386.71	**364.86**
	PIER (190+38)	15	2	4.0	0.0	20.0	24.0	3.2	360.45	**349.83***
	PIER (185+98)	14	3	4.0	0.0	24.0	28.0	5.7	354.13	**343.35***
	PIER (181+58)	13	40	4.0	0.0	25.2	29.2	---	387.29	**358.05**
	PIER (178+03)	12	74	4.0	0.0	23.4	27.4	---	394.65	**367.23**
	PIER (176+73)	11	68	4.0	0.0	16.9	20.9	---	387.63	**366.76**
	PIER (175+43)	10	70	4.0	0.0	16.7	20.7	---	391.74	**371.06**
	PIER (174+13)	9	72	4.0	0.0	17.2	21.2	---	389.93	**368.76**
	PIER (172+83)	8	74	4.0	0.0	16.0	20.0	---	389.29	**369.30**
	PIER (171+53)	7	73	4.0	0.0	15.3	19.3	---	388.19	**368.94**
	PIER (170+23)	6	71	4.0	0.0	14.4	18.4	---	386.65	**368.27**
	PIER (168+93)	5	64	4.0	0.0	13.7	17.7	---	385.45	**367.78**
	PIER (167+63)	4	60	4.0	0.0	11.6	15.6	---	385.55	**369.91**
	PIER (166+33)	3	46	4.0	0.0	9.5	13.5	---	384.74	**371.29**
	PIER (165+03)	2	15	4.0	0.0	6.0	10.0	---	393.61	**383.63**

*Final elevation based on top of rock shale elevation minus abrasion scour. Consider elevation 340ft per report explanation.

SCOUR SUMMARY TABLE (500yr+): 713kcfs

	FOUNDATION ELEMENT	BENT NO.	θ	LONG-TERM AGGRADATION/ DEGRADATION	CONTRACTION	LOCAL	TOTAL	ABRASION	EX. GROUND/BED ELEVATION	TOTAL SCOUR ELEVATION
BRIDGE 16	PIER (257+78)	15	20	4.0	0.1	7.7	11.8	---	398.79	**386.96**
	PIER (256+48)	14	13	4.0	0.1	5.4	9.5	---	400.91	**391.39**
	PIER (255+33)	13	54	4.0	0.1	8.6	12.7	---	400.41	**387.72**
	PIER (254+03)	12	75	4.0	0.1	10.9	15.0	---	397.47	**382.43**
	PIER (252+73)	11	7	4.0	0.1	6.0	10.1	---	389.65	**379.57**
	PIER (251+43)	10	5	4.0	0.1	8.3	12.4	---	390.43	**378.04**
	PIER (250+13)	9	0	4.0	0.1	6.7	10.8	---	392.57	**381.73**
	PIER (249+13)	8	8	4.0	0.1	9.1	13.2	---	393.15	**379.93**
	PIER (248+13)	7	7	4.0	0.1	9.7	13.8	---	387.49	**373.68**
	PIER (246+83)	6	9	4.0	0.1	9.0	13.1	---	386.92	**373.81**
	PIER (245+93)	5	15	4.0	0.1	9.1	13.2	---	386.42	**373.27**
	PIER (244+63)	4	21	4.0	0.1	11.9	16.0	---	385.79	**369.79**
	PIER (243+33)	3	22	4.0	0.1	12.6	16.7	---	390.54	**373.81**
	PIER (242+03)	2	40	4.0	0.1	15.0	19.1	---	388.31	**369.17**
BRIDGE 1	PIER (214+73)	32	37	4.0	0.0	14.4	18.4	---	393.89	**375.52**
	PIER (213+43)	31	4	4.0	0.0	8.0	12.0	---	392.07	**380.12**
	PIER (212+13)	30	23	4.0	0.0	11.0	15.0	---	394.49	**379.45**
	PIER (210+83)	29	20	4.0	0.0	10.0	14.0	---	398.57	**384.61**
	PIER (209+53)	28	22	4.0	0.0	10.1	14.1	---	400.44	**386.34**
	PIER (208+23)	27	11	4.0	0.0	8.5	12.5	---	400.67	**388.19**
	PIER (206+93)	26	8	4.0	0.0	8.9	12.9	---	400.31	**387.40**
	PIER (205+63)	25	3	4.0	0.0	7.9	11.9	---	399.51	**387.61**
	PIER (204+33)	24	6	4.0	0.0	8.5	12.5	---	399.92	**387.47**
	PIER (203+03)	23	9	4.0	0.0	9.2	13.2	---	398.84	**385.60**
	PIER (201+73)	22	16	4.0	0.0	10.4	14.4	---	398.50	**384.09**
	PIER (200+43)	21	7	4.0	0.0	9.8	13.8	---	387.84	**374.08**
	PIER (199+13)	20	2	4.0	0.0	8.5	12.5	---	388.23	**375.73**
	PIER (197+83)	19	32	4.0	0.0	14.0	18.0	---	389.00	**371.01**
	PIER (196+53)	18	34	4.0	0.0	17.8	21.8	---	386.60	**364.83**
	PIER (195+23)	17	44	4.0	0.0	21.5	25.5	---	385.63	**360.11**
	PIER (193+93)	16	11	4.0	0.0	18.6	22.6	---	386.71	**364.09**
	PIER (190+38)	15	2	4.0	0.0	20.3	24.3	3.2	360.45	**349.83***
	PIER (185+98)	14	5	4.0	0.0	24.4	28.4	5.7	354.13	**343.35***
	PIER (181+58)	13	44	4.0	0.0	27.7	31.7	---	387.29	**355.61**
	PIER (178+03)	12	71	4.0	0.0	25.0	29.0	---	394.65	**365.63**
	PIER (176+73)	11	66	4.0	0.0	18.2	22.2	---	387.63	**365.41**
	PIER (175+43)	10	68	4.0	0.0	17.7	21.7	---	391.74	**370.02**
	PIER (174+13)	9	69	4.0	0.0	18.1	22.1	---	389.93	**367.87**
	PIER (172+83)	8	71	4.0	0.0	16.9	20.9	---	389.29	**368.43**
	PIER (171+53)	7	71	4.0	0.0	16.0	20.0	---	388.19	**368.23**
	PIER (170+23)	6	67	4.0	0.0	15.0	19.0	---	386.65	**367.63**
	PIER (168+93)	5	64	4.0	0.0	14.3	18.3	---	385.45	**367.20**
	PIER (167+63)	4	56	4.0	0.0	12.0	16.0	---	385.55	**369.54**
	PIER (166+33)	3	39	4.0	0.0	9.6	13.6	---	384.74	**371.17**
	PIER (165+03)	2	9	4.0	0.0	5.8	9.8	---	393.61	**383.78**

*Final elevation based on top of rock shale elevation minus abrasion scour. Consider elevation 340ft per report explanation.

						100yr+ condition @ 570kcfs	
	BENT NO.	Boring **	Top of Rock ***	Ground-water Elev.	Bottom of Low Girder	Scour to Rock ***	Scour Below Ground-water
BRIDGE 16	15				422.29		No
	14				423.32		No
	13				423.69		No
	12	R-14	345.62	375.52	423.61	No	No
	11		343.77	372.23	422.92	No	No
	10		341.91	368.95	421.60	No	No
	9		340.06	365.66	419.67	No	No
	8		338.64	363.14	417.79	No	No
	7	R-13	337.21	360.61	415.55	No	No
	6		337.76	361.13	412.34	No	No
	5		338.14	361.49	410.32	No	No
	4		338.69	362.01	408.08	No	No
	3		339.24	362.53	406.69	No	No
	2		339.79	363.05	406.69	No	No
BRIDGE 1	32		351.32	373.94	410.06	No	No
	31		351.87	374.46	412.10	No	No
	30		352.42	374.98	414.14	No	No
	29		352.97	375.50	416.18	No	No
	28	R-8	353.52	376.02	418.22	No	No
	27		353.44	375.26	420.26	No	No
	26		353.36	374.49	422.31	No	No
	25		353.27	373.73	424.35	No	No
	24		353.19	372.97	426.39	No	No
	23		353.11	372.20	428.43	No	No
	22		353.03	371.44	430.47	No	No
	21		352.95	370.67	432.51	No	No
	20		352.87	369.91	434.55	No	No
	19		352.78	369.15	436.59	No	No
	18		352.70	368.38	438.63	No	Yes
	17	R-6	352.62	367.62	440.67	No	Yes
	16	R-6	352.62	367.62	440.00	No	Yes
	15	FB-26	353.00	359.00	440.00	Yes	Yes
	14	FB-23_R, FB-22_GW	349.00	355.00	440.00	Yes	Yes
	13	FB-18_R, FB-19_GW	353.40	372.70	440.00	No	Yes
	12	FB-15_R, FB-17_GW	357.30	375.60	440.00	No	Yes
	11	FB-14	357.00	370.50	436.49	No	Yes
	10	FB-13	0.00	373.40	432.59	No	Yes
	9	FB-12	0.00	0.00	428.69	No	No
	8	FB-11	340.30	364.50	424.79	No	No
	7	FB-1_R, R-3_GW	344.30	377.30	420.89	No	Yes
	6		350.90	377.15	416.99	No	Yes
	5	FB-8	357.50	377.00	413.24	No	Yes
	4	FB-7	357.00	371.10	410.11	No	Yes
	3	R-2	354.50	352.50	407.63	No	No
	2	FB-5	357.10	374.70	405.82	No	No

** The suffix "_R" and "_GW" indicate the conservative rock elevation (low) and groundwater elevation (high), respectively,

*** "Rock" refers to the topmost layer of shale except at boring R-8, which is top of sandst

	BENT NO.	Boring **	Top of Rock ***	Ground-water Elev.	Bottom of Low Girder	500yr+ condition @ 713kcfs: Scour to Rock ***	Scour Below Ground-water
BRIDGE 16	15				422.29		No
	14				423.32		No
	13				423.69		No
	12	R-14	345.62	375.52	423.61	No	No
	11		343.77	372.23	422.92	No	No
	10		341.91	368.95	421.60	No	No
	9		340.06	365.66	419.67	No	No
	8		338.64	363.14	417.79	No	No
	7	R-13	337.21	360.61	415.55	No	No
	6		337.76	361.13	412.34	No	No
	5		338.14	361.49	410.32	No	No
	4		338.69	362.01	408.08	No	No
	3		339.24	362.53	406.69	No	No
	2		339.79	363.05	406.69	No	No
BRIDGE 1	32		351.32	373.94	410.06	No	No
	31		351.87	374.46	412.10	No	No
	30		352.42	374.98	414.14	No	No
	29		352.97	375.50	416.18	No	No
	28	R-8	353.52	376.02	418.22	No	No
	27		353.44	375.26	420.26	No	No
	26		353.36	374.49	422.31	No	No
	25		353.27	373.73	424.35	No	No
	24		353.19	372.97	426.39	No	No
	23		353.11	372.20	428.43	No	No
	22		353.03	371.44	430.47	No	No
	21		352.95	370.67	432.51	No	No
	20		352.87	369.91	434.55	No	No
	19		352.78	369.15	436.59	No	No
	18		352.70	368.38	438.63	No	Yes
	17	R-6	352.62	367.62	440.67	No	Yes
	16	R-6	352.62	367.62	440.00	No	Yes
	15	FB-26	353.00	359.00	440.00	Yes	Yes
	14	FB-23_R, FB-22_GW	349.00	355.00	440.00	Yes	Yes
	13	FB-18_R, FB-19_GW	353.40	372.70	440.00	No	Yes
	12	FB-15_R, FB-17_GW	357.30	375.60	440.00	No	Yes
	11	FB-14	357.00	370.50	436.49	No	Yes
	10	FB-13	0.00	373.40	432.59	No	Yes
	9	FB-12	0.00	0.00	428.69	No	No
	8	FB-11	340.30	364.50	424.79	No	No
	7	FB-1_R, R-3_GW	344.30	377.30	420.89	No	Yes
	6		350.90	377.15	416.99	No	Yes
	5	FB-8	357.50	377.00	413.24	No	Yes
	4	FB-7	357.00	371.10	410.11	No	Yes
	3	R-2	354.50	352.50	407.63	No	No
	2	FB-5	357.10	374.70	405.82	No	No

** The suffix "_R" and "_GW" indicate the conservative rock elevation (low) and groundwater elevation (high), respectively,

one. *** "Rock" refers to the topmost layer of shale except at boring R-8, which is top of sandstor

Appendix 3: Lateral Design Parameters (FBMP Tables)

I-49, Crawford County, AR - Bridge 1 - Bent 2

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
2	2	FB-5	5.0	4.5	393.5	392.5	**357.0**	**339.0**	393.6

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Shale	
	Top	Bott
2	357.0	

Soil Layer	Layer Description	Global Data: Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)	Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)			
2[D]	Clayey Silt	Cohesive	1.5	to	18.0	120	varies	7	0.4	0.40
3	Sand	Cohesionless	18.0	to	36.0	120	varies	16	0.9	0.30
4	Shale	Rock	36.0	to	See Elev Table	160	varies	-	-	0.09

Soil Layer	Lateral Model Data: P-Y Model	Internal Friction Angle[5], φ (deg)	Subgrade Modulus[6], k (pci)	Rock Mass Modulus[7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength[8] (psf)	Major Principal Strain @ 50%[8] E50	Average Undrained Shear Strength[8] (psf)	Unconfined Compressive Strength of Rock[9] (psf)	RQD (%)
1										
2[D]	Soft Clay	-	-	-	-	720.0	0.02	720.0	-	-
3	Sand (O'Neill)	32	50	-	-	-	-	-	-	-
4	Weak Rock			301.3	0.0005	-	-	-	179,705	50

Soil Layer	Axial Model Data: T-Z Model	Nominal Unit Skin Friction (psf)	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	Torsional Model Data: T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Tip Model: Q-Z Model
1									
2[D]	DS Clay	20	-	-	-	Hyperbolic	0.1	100[A]	N/A
3	DS Gvly Sand	-	0.1[A]	2	0.47	Hyperbolic	0.3	100[A]	N/A
4	Custom T-Z	-	-	-	-	Hyperbolic	138.2	9,759	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer to adjust for top of rock elevation.

For 4.5-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.27	108	2	2.70	1,336,369
3	2.70	108	3	6.50	1,336,369

Superscript Notes:

1. Unit weight of Layer 2 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.
12. Socket length assume below tip of casing. Casing seating is 2 feet below interpreted top of rock.

HNTB	For I-49, Crawford County, Arkansas				Job No 63136
	Made by See QF-06	Check by See QF-06	Backchk by See QF-06	Updated by See QF-06	Verified by See QF-06
	Date See QF-06	Date See QF-06	Date See QF-06	Date See QF-06	Date See QF-06

I-49, Crawford County, AR - Bridge 1 - Bents 3 and 4

Assumptions:
1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
3	3	R-2	5.0	4.5	384.6	383.6	**353.0**	**335.0**	386.5
4	4	FB-7	5.0	4.5	385.4	384.4	**356.0**	**338.0**	386.0

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Shale Top	Shale Bott
3	353.0	
4	356.0	

	Global Data				Stratum				Lateral Model Data										Axial Model Data					Torsional Model Data			Tip Model
Soil Layer	Layer Description	Soil Type	Elevations (NAVD 88) Top to Bot	Unit Weight[1], γ (pcf)	Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus [6], k (pci)	Rock Mass Modulus [7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength [8] (psf)	Major Principal Strain @ 50% [8] E50	Average Undrained Shear Strength [8] (psf)	Unconfined Compressive Strength of Rock [9] (psf)	RQD (%)	T-Z Model	Nominal Unit Skin Friction (psf)	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0 to 1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)																						
2[D]	Clayey Silt	Cohesive	1.5 to 18.0	120	varies	7	0.4	0.40	Soft Clay	-	-	-	-	720.0	0.02	720.0	-	-	DS Clay	20	-	-	-	Hyperbolic	0.1	100 [A]	N/A
3	Sand	Cohesionless	18.0 to 35.0	120	varies	16	0.9	0.30	Sand (O'Neill)	32	50	-	-	-	-	-	-	-	DS Gvly Sand	-	0.1[A]	2	0.47	Hyperbolic	0.3	100[A]	N/A
4	Shale	Rock	35.0 to See Elev Table	160	varies	-	-	0.09	Weak Rock			301.3	0.0005	-	-	-	179,705	50	Custom T-Z	-	-	-	-	Hyperbolic	138.2	9,759	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer to adjust for top of rock elevation.

For 4.5-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.27	108	2	2.70	1,327,869
3	2.70	108	3	6.50	1,327,869

Superscript Notes:
1. Unit weight of Layer 2 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.
12. Socket length assume below tip of casing. Casing seating is 2 feet below interpreted top of rock.

I-49, Crawford County, AR - Bridge 1 - Bent 5

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
5	5	FB-8	6.0	5.5	385.4	384.4	**356.0**	**342.0**	385.5

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Shale	
	Top	Bott
5	356.0	

		Global Data									Lateral Model Data										Axial Model Data					Torsional Model Data			Tip Model
Soil Layer	Layer Description	Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)	Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	P-Y Model	Internal Friction Angle[5], φ (deg)	Subgrade Modulus [6], k (pci)	Rock Mass Modulus [7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength [8] (psf)	Major Principal Strain @ 50% [8] E50	Average Undrained Shear Strength [8] (psf)	Unconfined Compressive Strength of Rock [9] (psf)	RQD (%)	T-Z Model	Nominal Unit Skin Friction (psf)	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)																						
2	Silty Clay	Cohesive	1.5	to	18.0	120	varies	4	0.2	0.40	Soft Clay	-	-	-	-	720.0	0.02	720.0	-	-	DS Clay	19	-	-	-	Hyperbolic	0.1	100 [A]	N/A
3[D]	Sand	Cohesionless	18.0	to	29.0	120	varies	8	0.4	0.30	Sand (O'Neill)	32	50	-	-	-	-	-	-	-	DS Gvly Sand	-	0.1[A]	2	0.47	Hyperbolic	0.2	100[A]	N/A
4	Shale	Rock	29.0	to	See Elev Table	160	varies	-	-	0.09	Weak Rock			354.9	0.0005	-	-	-	176,564	50	Custom T-Z	-	-	-	-	Hyperbolic	162.8	9,674	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer to adjust for top of rock elevation.

For 5.5-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	107	2	3.30	1,945,467
3	3.30	107	3	6.50	1,945,467

Superscript Notes:

1. Unit weight of Layer 2 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 1 - Bents 6 through 8

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
6	6	N/A	6.0	5.5	386.5	385.5	**344.0**	**329.0**	
7	7	FB-10	6.0	5.5	387.5	386.5	**344.0**	**329.0**	388.3
8	8	FB-11	6.0	5.5	388.3	387.3	**339.0**	**324.0**	388.3

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Shale	
	Top	Bott
6	344.0	
7	344.0	
8	339.0	

Soil Layer	Layer Description	Global Data						Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	Lateral Model Data										Axial Model Data				Torsional Model Data			Tip Model
		Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)						P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus [6], k (pci)	Rock Mass Modulus [7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength [8] (psf)	Major Principal Strain @ 50% [8] E50	Average Undrained Shear Strength [8] (psf)	Unconfined Compressive Strength of Rock [9] (psf)	RQD (%)	T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)																						
2	Silty Sand	Cohesionless	1.5	to	20.0	120	varies	11	0.6	0.30	Sand (O'Neill)	30	50	-	-				-	-	DS Gvly Sand	0.1 [A]	2	0.50	Hyperbolic	0.2	100 [A]	N/A
3[D]	Sand	Cohesionless	20.0	to	44.0	120	varies	36	2.0	0.30	Sand (O'Neill)	32	50	-	-				-	-	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.8	100[A]	N/A
4	Shale	Rock	44.0	to	See Elev Table	160	varies	-	-	0.09	Weak Rock			182.8	0.0005	-	-	-	186,486	50	Custom T-Z	-	-	-	Hyperbolic	83.9	9,942	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer to adjust for top of rock elevation.

For 5.5-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	110	2	3.30	1,626,144
3	3.30	110	3	6.50	1,626,144

Superscript Notes:

1. Unit weight of Layer 2 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 1 - Bents 9 through 11

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
9	9	FB-12	7.0	6.5	389.8	388.8	**356.0**	**341.0**	390.6
10	10	FB-13	7.0	6.5	391.2	390.2	**356.0**	**341.0**	391.7
11	11	FB-14	7.0	6.5	387.3	386.3	**356.0**	**341.0**	392.0

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Shale	
	Top	Bott
9	356.0	
10	356.0	334
11	356.0	308.0

Soil Layer	Layer Description	Global Data					Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	Lateral Model Data										Axial Model Data				Torsional Model Data			Tip Model
		Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)					P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus [6], k (pci)	Rock Mass Modulus [7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength [8] (psf)	Major Principal Strain @ 50% [8] E50	Average Undrained Shear Strength [8] (psf)	Unconfined Compressive Strength of Rock [9] (psf)	RQD (%)	T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)																					
2	Silty Sand	Cohesionless	1.5	to	17.0	120	varies	9	0.5	0.30	Sand (O'Neill)	30	50	-	-				-	-	DS Gvly Sand	0.1 [A]	2	0.50	Hyperbolic	0.2	100 [A]	N/A
3[D]	Sand	Cohesionless	17.0	to	35.0	120	varies	11	0.6	0.30	Sand (O'Neill)	32	50	-	-				-	-	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.2	100[A]	N/A
4	Shale	Rock	35.0	to	See Elev Table	160	varies	-	-	0.09	Weak Rock			297.9	0.0005	-	-	-	175,722	50	Custom T-Z	-	-	-	Hyperbolic	136.7	9,651	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer to adjust for top of rock elevation.

For 6.5-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.39	107	2	3.90	2,785,704
3	3.90	107	3	6.50	2,785,704

Superscript Notes:

1. Unit weight of Layer 2 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

HNTB						
For	I-49, Crawford County, Arkansas				Job No	63136
Made by	See QF-06	Check by See QF-06	Backchk by See QF-06	Updated by See QF-06	Verified by See QF-06	
Date	See QF-06	Date See QF-06	Date See QF-06	Date See QF-06	Date See QF-06	Sheet No 1 of 1

I-49, Crawford County, AR - Bridge 1 - Bents 12

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 4 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
12	12	FB-15,16,17	9.5	9.0	394.3	393.3	**356.0**	**334.0**	394.3,394.9,394.6

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Shale	
	Top	Bott
12	356	313

		Global Data							Lateral Model Data										Axial Model Data				Torsional Model Data			Tip Model
Soil Layer	Layer Description	Soil Type	Elevations (NAVD 88) Top to Bot	Unit Weight[1], γ (pcf)	Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus [6], k (pci)	Rock Mass Modulus [7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength [8] (psf)	Major Principal Strain @ 50% [8] E50	Average Undrained Shear Strength [8] (psf)	Unconfined Compressive Strength of Rock [9] (psf)	RQD (%)	T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0 to 1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)																					
2[D]	Sandy Silt	Cohesionless	1.5 to 22	120	varies	12	0.7	0.25	Sand (O'Neill)	30	50	-	-	-	-	-	-	-	DS Gvly Sand	0.1[A]	2	0.50	Hyperbolic	0.3	100[A]	N/A
3	Sand	Cohesionless	22.0 to 38.0	120	varies	12	0.7	0.30	Sand (O'Neill)	32	50	-	-				-	-	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.3	100[A]	N/A
4	Shale	Rock	38.0 to See Elev Table	160	varies	-	-	0.09	Weak Rock			391.1	0.0005	-	-	-	302,795	50	Custom T-Z	-	-	-	Hyperbolic	179.4	12,668	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer to adjust for top of rock elevation.

For 9.0-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.54	141	2	5.40	7,917,624
3	5.40	141	3	6.50	7,917,624

Superscript Notes:

1. Unit weight of Layer 2 and 3 are from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 1 - Bents 13

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 4 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
13	13	FB-18,19,20	9.5	9.0	386.8	387.0	**352.0**	**330.0**	391.0,390.7,390.4

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Shale	
	Top	Bott
13	352	

Soil Layer	Layer Description	Global Data				Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	Lateral Model Data										Axial Model Data				Torsional Model Data			Tip Model
		Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)					P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus [6], k (pci)	Rock Mass Modulus [7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength [8] (psf)	Major Principal Strain @ 50% [8] E50	Average Undrained Shear Strength [8] (psf)	Unconfined Compressive Strength of Rock [9] (psf)	RQD (%)	T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)																					
2	Sandy Silt	Cohesionless	1.5	to	7	120	varies	8	0.4	0.25	Sand (O'Neill)	30	50	-	-				-	-	DS Gvly Sand	0.1 [A]	2	0.50	Hyperbolic	0.2	100 [A]	N/A
3 [D]	Sand	Cohesionless	7.0	to	39.0	120	varies	13	0.7	0.30	Sand (O'Neill)	30	50	-	-				-	-	DS Gvly Sand	0.1 [A]	2	0.50	Hyperbolic	0.3	100 [A]	N/A
4	Shale	Rock	39.0	to	See Elev Table	160	varies	-	-	0.09	Weak Rock			319.8	0.0005	-	-	-	320,827	50	Custom T-Z	-	-	-	Hyperbolic	146.7	13,040	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer to adjust for top of rock elevation.

For 9.0-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.54	145	2	5.40	7,282,330
3	5.40	145	3	6.50	7,282,330

Superscript Notes:

1. Unit weight of Layer 2 and 3 are from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 1 - Bents 14 and 15

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 4 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
14	14	FB-21,22,23	9.5	9.0	354.3	387.0	**349.0**	**323.0**	354.0,354.9,351.2
15	15	FB-24,25,26	9.5	9.0	360.4	387.0	**353.0**	**327.0**	359.0,359.7,358.8

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Shale	
	Top	Bott
14	349.0	
15	353.0	

Soil Layer	Layer Description	Global Data: Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)	Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)			
2[D]	Sand	Cohesionless	1.5	to	6.0	120	varies	7	0.4	0.30
3	Shale	Rock	6.0	to	See Elev Table	160	varies	-	-	0.09

Soil Layer	Lateral Model Data: P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus [6], k (pci)	Rock Mass Modulus [7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength [8] (psf)	Major Principal Strain @ 50% [8] E50	Average Undrained Shear Strength [8] (psf)	Unconfined Compressive Strength of Rock [9] (psf)	RQD (%)
1										
2[D]	Sand (O'Neill)	30	50	-	-				-	-
3	Weak Rock			245.8	0.0005	-	-	-	337,126	50

Soil Layer	Axial Model Data: T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	Torsional Model Data: T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Tip Model: Q-Z Model
1								
2[D]	DS Gvly Sand	0.1[A]	2	0.50	Hyperbolic	0.2	100[A]	N/A
3	Custom T-Z	-	-	-	Hyperbolic	112.8	13,367	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer to adjust for top of rock elevation.

For 9.0-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.54	149	2	5.40	3,531,110
3	5.40	149	3	6.50	3,531,110

Superscript Notes:

1. Unit weight of Layer 2 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 1 - Bent 16

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 4 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
16	16	FB-27,28,29	9.5	9.0	386.5	385.5	**353.0**	**331.0**	387.9,387.3,387.3

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Shale	
	Top	Bott
16	353	

Soil Layer	Layer Description	Global Data									Lateral Model Data										Axial Model Data				Torsional Model Data			Tip Model
		Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)	Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus [6], k (pci)	Rock Mass Modulus [7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength [8] (psf)	Major Principal Strain @ 50% [8] E50	Average Undrained Shear Strength [8] (psf)	Unconfined Compressive Strength of Rock [9] (psf)	RQD (%)	T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)																					
2	Sandy Silt	Cohesionless	1.5	to	6	120	varies	9	0.5	0.25	Sand (O'Neill)	30	50	-	-				-	-	DS Gvly Sand	0.1[A]	2	0.50	Hyperbolic	0.2	100[A]	N/A
3[D]	Sand	Cohesionless	6.0	to	34.0	120	varies	16	0.9	0.30	Sand (O'Neill)	32	50	-	-				-	-	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.3	100[A]	N/A
4	Shale	Rock	34.0	to	See Elev Table	160	varies	-	-	0.09	Weak Rock			504.7	0.0005	-	-	-	357,033	50	Custom T-Z	-	-	-	Hyperbolic	231.5	13,756	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer to adjust for top of rock elevation.

For 9.0-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.54	153	2	5.40	9,336,926
3	5.40	153	3	6.50	9,336,926

Superscript Notes:

1. Unit weight of Layer 2 and 3 are from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 1 - Bents 17 and 18

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
17	17	FB-30	7.0	6.5	385.4	384.4	**353.0**	**338.0**	387.7
18	18	FB-31	7.0	6.5	386.5	385.5	**352.0**	**337.0**	386.7

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Shale		Sandstone	
	Top	Bott	Top	Bott
17	353	325	325	301
18	352	346	346	

Soil Layer	Layer Description	Global Data: Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)	Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	Lateral Model Data: P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus[6], k (pci)	Rock Mass Modulus[7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength[8] (psf)	Major Principal Strain @ 50%[8] E50	Average Undrained Shear Strength[8] (psf)	Unconfined Compressive Strength of Rock[9] (psf)	RQD (%)	Axial Model Data: T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	Torsional Model Data: T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Tip Model: Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)																					
2[D]	Silty Sand	Cohesionless	1.5	to	22.0	120	varies	19	1.1	0.30	Sand (O'Neill)	30	50	-	-				-	-	DS Gvly Sand	0.1[A]	2	0.50	Hyperbolic	0.4	100[A]	N/A
3	Sand	Cohesionless	22.0	to	34.0	120	varies	10	0.6	0.30	Sand (O'Neill)	32	50	-	-				-	-	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.2	100[A]	N/A
4	Shale	Rock	34.0	to	47	160	varies	-	-	0.09	Weak Rock			504.6	0.0005	-	-	-	356,860	50	Custom T-Z	-	-	-	Hyperbolic	231.5	13,753	Custom Q-Z
5	Sandstone	Rock	47	to	See Elev Table	160	Varies	-	-	0.20	Weak Rock	-	-	508.3	0.0005	-	-	-	362,133	50	Custom T-Z	-	-	-	Hyperbolic	211.8	13,854	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer thickeness to adjust for top of rock elevation.

For 6.5-ft-diam sockets in Shale:

Custom T-Z Curve: Point No.	Z (in)	T (psi)	Custom Q-Z Curve: Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.39	153	2	3.90	4,840,714
3	3.90	153	3	6.50	4,840,714

For 6.5-ft-diam sockets in Sandstone:

Custom T-Z Curve: Point No.	Z (in)	T (psi)	Custom Q-Z Curve: Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.39	154	2	3.90	12,016,686
3	3.90	154	3	6.50	12,016,686

Superscript Notes:

1. Unit weight of Layer 2 and 3 are from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 1 - Bents 19 through 21

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
19	19	FB-32	6.0	5.5	388.6	387.6	**355.0**	**342.0**	389.0
20	20	FB-33	6.0	5.5	388.1	387.1	**354.0**	**341.0**	388.8
21	21	FB-34	6.0	5.5	387.8	386.8	**355.0**	**342.0**	389.5

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Sandstone	
	Top	Bott
19	355.0	
20	354.0	
21	355.0	

Soil Layer	Layer Description	Global Data: Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)	Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)			
2[D]	Sandy Silt	Cohesionless	1.5	to	22.0	120	20.5	17	1.0	0.30
3	Sand	Cohesionless	22.0	to	34.0	120	12.0	16	0.9	0.30
4	Sandstone	Rock	34	to	See Elev Table	160	Varies	-	-	0.20

Soil Layer	Lateral Model Data: P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus[6], k (pci)	Rock Mass Modulus[7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength[8] (psf)	Major Principal Strain @ 50%[8] E50	Average Undrained Shear Strength[8] (psf)	Unconfined Compressive Strength of Rock[9] (psf)	RQD (%)
1										
2[D]	Sand (O'Neill)	30	50	-	-				-	-
3	Sand (O'Neill)	32	50	-	-				-	-
4	Weak Rock	-	-	583.6	0.0005	-	-	-	379,183	50

Soil Layer	Axial Model Data: T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	Torsional Model Data: T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Tip Model: Q-Z Model
1								
2[D]	DS Gvly Sand	0.1[A]	2	0.50	Hyperbolic	0.4	100[A]	N/A
3	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.3	100[A]	N/A
4	Custom T-Z	-	-	-	Hyperbolic	243.2	14,176	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer thickeness to adjust for top of rock elevation.

Superscript Notes:

1. Unit weight of Layer 2 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

For 5.5-ft-diam sockets in Sandstone:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	158	2	3.30	7,380,257
3	3.30	158	3	6.50	7,380,257

I-49, Crawford County, AR - Bridge 1 - Bents 22 through 26

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
22	22	FB-35	6.0	5.5	398.2	397.2	**353.0**	**340.0**	399.1
23	23	FB-36	6.0	5.5	398.6	397.6	**354.0**	**341.0**	398.8
24	24	FB-37	6.0	5.5	399.8	398.8	**353.0**	**340.0**	400.2
25	25	FB-38	6.0	5.5	399.4	398.4	**352.0**	**339.0**	399.3
26	26	FB-39	6.0	5.5	400.3	399.3	**353.0**	**340.0**	399.9

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Shale		Sandstone	
	Top	Bott	Top	Bott
22	353		318	
23			354	
24	353.0		349.0	
25	352.0		344.0	
26			353.0	

Soil Layer	Layer Description	Global Data					Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v
		Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)				
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)			
2[D]	Silty Sand	Cohesionless	1.5	to	25.0	120	varies	26	1.5	0.30
3	Sand	Cohesionless	25.0	to	46.0	120	varies	14	0.8	0.30
4	Shale	Rock	46.0	to	48	160	varies	-	-	0.09
5	Sandstone	Rock	48	to	See Elev Table	160	Varies	-	-	0.20

Soil Layer	Lateral Model Data									
	P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus[6], k (pci)	Rock Mass Modulus[7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength[8] (psf)	Major Principal Strain @ 50%[8] E50	Average Undrained Shear Strength[8] (psf)	Unconfined Compressive Strength of Rock[9] (psf)	RQD (%)
1										
2[D]	Sand (O'Neill)	30	50	-	-				-	-
3	Sand (O'Neill)	32	50	-	-				-	-
4	Weak Rock			568.6	0.0005	-	-	-	453,069	50
5	Weak Rock	-	-	450.8	0.0005	-	-	-	284,821	50

Soil Layer	Axial Model Data				Torsional Model Data			Tip Model
	T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Q-Z Model
1								
2[D]	DS Gvly Sand	0.1[A]	2	0.50	Hyperbolic	0.6	100[A]	N/A
3	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.3	100[A]	N/A
4	Custom T-Z	-	-	-	Hyperbolic	260.8	15,496	Custom Q-Z
5	Custom T-Z	-	-	-	Hyperbolic	187.8	12,286	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer thickeness to adjust for top of rock elevation.

For 5.5-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	172	2	3.30	4,576,293
3	3.30	172	3	6.50	4,576,293

For 5.5-ft-diam sockets in Sandstone:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	137	2	3.30	6,766,866
3	3.30	137	3	6.50	6,766,866

Superscript Notes:

1. Unit weight of Layer 2 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

HNTB	For	I-49, Crawford County, Arkansas						Job No	63136
	Made by	See QF-06	Check by See QF-06	Backchk by See QF-06	Updated by See QF-06	Verified by See QF-06			
	Date	See QF-06	Date See QF-06	Date See QF-06	Date See QF-06	Date See QF-06		Sheet No	1 of 1

I-49, Crawford County, AR - Bridge 1 - Bents 27 through 29

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
27	27	FB-40	5.0	4.5	400.4	399.4	**351.0**	**339.0**	400.5
28	28	FB-41	5.0	4.5	400.3	399.3	**351.0**	**339.0**	400.3
29	29	FB-42	5.0	4.5	399.2	398.2	**354.0**	**342.0**	400.0

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Sandstone	
	Top	Bott
27	351.0	
28	351.0	
29	354.0	

Soil Layer	Layer Description	Global Data					Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	Lateral Model Data										Axial Model Data				Torsional Model Data			Tip Model
		Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)					P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus[6], k (pci)	Rock Mass Modulus[7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength[8] (psf)	Major Principal Strain @ 50%[8] E50	Average Undrained Shear Strength[8] (psf)	Unconfined Compressive Strength of Rock[9] (psf)	RQD (%)	T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)																					
2[D]	Sand	Cohesionless	1.5	to	49.0	120	varies	18	1.0	0.30	Sand (O'Neill)	32	50	-	-	-	-	-	-	-	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.4	100[A]	N/A
3	Sandstone	Rock	49	to	See Elev Table	160	Varies	-	-	0.20	Weak Rock	-	-	424.2	0.0005	-	-	-	252,183	50	Custom T-Z	-	-	-	Hyperbolic	176.7	11,561	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer thickeness to adjust for top of rock elevation.

Superscript Notes:

1. Unit weight of Layer 2 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

For 4.5-ft-diam sockets in Sandstone:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.27	128	2	2.70	3,961,621
3	2.70	128	3	6.50	3,961,621

I-49, Crawford County, AR - Bridge 1 - Bent 30

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
30	30	FB-43	5.0	4.5	395.7	394.7	**354.0**	**343.0**	396.1

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Sandstone		Shale	
	Top	Bott	Top	Bott
30	354	339		
30			339	324
30	324.0	304.0		

Soil Layer	Layer Description	Global Data: Soil Type	Elevations (NAVD 88) Top to Bot	Unit Weight[1], γ (pcf)	Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], ν	Lateral Model Data: P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus[6], k (pci)	Rock Mass Modulus[7], E_m (ksi)	Stiffness Constant, k_{rm}
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0 to 1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)								
2	Silty Sand	Cohesionless	1.5 to 18.0	120	varies	14	0.8	0.30	Sand (O'Neill)	32	50	-	-
3[D]	Sand	Cohesionless	18.0 to 42.0	120	varies	13	0.7	0.30	Sand (O'Neill)	32	50	-	-
5	Sandstone	Rock	42.0 to 57.0	160	Varies	-	-	0.20	Weak Rock	-	-	515.6	0.0005
4	Shale	Rock	57.0 to 72	160	varies	-	-	0.09	Weak Rock			498.0	0.0005
5	Sandstone	Rock	72 to See Elev Table	160	Varies	-	-	0.20	Weak Rock	-	-	515.6	0.0005

Soil Layer	Undrained Shear Strength[8] (psf)	Major Principal Strain @ 50%[8] E50	Average Undrained Shear Strength[8] (psf)	Unconfined Compressive Strength of Rock[9] (psf)	RQD (%)	Axial Model Data: T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	Torsional Model Data: T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Tip Model: Q-Z Model
1													
2				-	-	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.3	100[A]	N/A
3[D]				-	-	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.3	100[A]	N/A
5	-	-	-	372,500	50	Custom T-Z	-	-	-	Hyperbolic	214.8	14,051	Custom Q-Z
4	-	-	-	347,623	50	Custom T-Z	-	-	-	Hyperbolic	228.5	13,574	Custom Q-Z
5	-	-	-	372,500	50	Custom T-Z	-	-	-	Hyperbolic	214.8	14,051	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer thickeness to adjust for top of rock elevation.

For 4.5-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.27	151	2	2.70	2,836,627
3	2.70	151	3	6.50	2,836,627

For 4.5-ft-diam sockets in Sandstone:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	156	2	2.70	5,924,358
3	3.30	156	3	6.50	5,924,358

Superscript Notes:

1. Unit weight of Layer 2 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 1 - Bent 31

Assumptions:
1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
31	31	FB-44	5.0	4.5	392.1	391.1	**353.0**	**342.0**	392.1

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Sandstone	
	Top	Bott
31	353.0	

Soil Layer	Layer Description	Global Data: Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)	Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	Lateral Model Data: P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus [6], k (pci)	Rock Mass Modulus [7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength [8] (psf)	Major Principal Strain @ 50% [8] E50	Average Undrained Shear Strength [8] (psf)	Unconfined Compressive Strength of Rock [9] (psf)	RQD (%)
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)													
2[D]	Sand	Cohesionless	1.5	to	39.0	120	varies	19	1.1	0.30	Sand (O'Neill)	32	50	-	-	-	-	-	-	-
3	Sandstone	Rock	39	to	See Elev Table	160	Varies	-	-	0.20	Weak Rock	-	-	558.1	0.0005	-	-	-	436,497	50

Soil Layer	Layer Description	Axial Model Data: T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	Torsional Model Data: T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Tip Model: Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)								
2[D]	Sand	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.4	100[A]	N/A
3	Sandstone	Custom T-Z	-	-	-	Hyperbolic	232.5	15,210	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer thickeness to adjust for top of rock elevation.

For 4.5-ft-diam sockets in Sandstone:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.27	169	2	2.70	5,355,735
3	2.70	169	3	6.50	5,355,735

Superscript Notes:
1. Unit weight of Layer 2 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 1 - Bent 32

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Boring Elevation (log)
32	32	FB-45	5.0	4.5	393.5	392.5	**353.0**	**338.0**	393.5

Elevations for FBMP Design Rock Profiles - Bridge 1

Bent	Shale		Sandstone	
	Top	Bott	Top	Bott
32	353		333	

Soil Layer	Layer Description	Global Data					Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	Lateral Model Data										Axial Model Data				Torsional Model Data			Tip Model
		Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)					P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus [6], k (pci)	Rock Mass Modulus [7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength [8] (psf)	Major Principal Strain @ 50% [8] E50	Average Undrained Shear Strength [8] (psf)	Unconfined Compressive Strength of Rock [9] (psf)	RQD (%)	T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 2 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)																					
2[D]	Sand	Cohesionless	1.5.	to	45.0	120	varies	17	1.0	0.30	Sand (O'Neill)	32	50	-	-	-	-	-	-	-	DS Gvly Sand	[A]0.1	2	0.47	Hyperbolic	0.4	100[A]	N/A
3	Sandstone	Rock	45.0	to	60	160	varies	-	-	0.09	Weak Rock	-	-	388.4	0.0005	-	-	-	298,692	50	Custom T-Z	-	-	-	Hyperbolic	178.2	12,582	Custom Q-Z
4	Shale	Rock	60	to	See Elev Table	160	Varies	-	-	0.20	Weak Rock	-	-	530.1	0.0005	-	-	-	556,240	50	Custom T-Z	-	-	-	Hyperbolic	220.9	17,170	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer thickeness to adjust for top of rock elevation.

For 4.5-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.27	140	2	2.70	1,915,131
3	2.70	140	3	6.50	1,915,131

For 4.5-ft-diam sockets in Sandstone:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.27	191	2	2.70	8,846,611
3	2.70	191	3	6.50	8,846,611

Superscript Notes:

1. Unit weight of Layer 2 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 16 - Bents 2 and 3

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Boring elevation (log)	Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Note
388.9	2	2	FB-66	6.0	5.5	388.2	387.2	**350.0**	**322.0**	See socket design conclusion for tip elevation (26 feet shaft below tip of casing)
390.8	3	3	FB-67	6.0	5.5	390.4	389.4	**347.0**	**321.0**	See socket design conclusion for tip elevation (24 feet shaft below tip of casing)

Elevations for FBMP Design Rock Profiles - Bridge 16

Bent	Shale		Coal		Sandstone	
	Top	Bott	Top	Bott	Top	Bottom
2	350	328	328	323	323	
3	347	325	325	322	322	

Soil Layer	Layer Description	Global Data					Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	Lateral Model Data										Axial Model Data				Torsional Model Data			Tip Model
		Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)					P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus [6], k (pci)	Rock Mass Modulus [7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength [8] (psf)	Major Principal Strain @ 50% [8] E50	Average Undrained Shear Strength [8] (psf)	Unconfined Compressive Strength of Rock [9] (psf)	RQD (%)	T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 1.5 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)																					
2	Sandy Silt	Cohesionless	1.5	to	19.0	120	varies	15	0.8	0.30	Sand (O'Neill)	30	50	-	-				-	-	DS Gvly Sand	0.1[A]	2	0.50	Hyperbolic	0.3	100[A]	N/A
3[D]	Sand	Cohesionless	19.0	to	44.0	120	varies	13	0.7	0.30	Sand (O'Neill)	32	50	-	-				-	-	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.3	100[A]	N/A
4	Shale	Rock	44.0	to	70	160	varies	-	-	0.09	Weak Rock			220.2	0.0005	-	-	-	152,193	50	Custom T-Z	-	-	-	Hyperbolic	101.0	8,981	Custom Q-Z
5	Sandstone	Rock	70	to	See Elev Table	160	Varies	-	-	0.20	Weak Rock	-	-	534.1	0.0005	-	-	-	399,844	50	Custom T-Z	-	-	-	Hyperbolic	222.6	14,557	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer thickeness to adjust for top of rock elevation.

For 5.5-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	100	2	3.30	1,660,931
3	3.30	100	3	6.50	1,660,931

For 5.5-ft-diam sockets in Sandstone:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	162	2	3.30	9,499,604
3	3.30	162	3	6.50	9,499,604

Superscript Notes:

1. Unit weight of Layer 2,3 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 16 - Bent 4

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Boring elevation (log)	Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.	Note
390.8	4	4	FB-67	6.0	5.5	385.6	384.6	**347.0**	**321.0**	See socket design conclusiion for tip elevation (24 feet shaft below tip of casing)

Elevations for FBMP Design Rock Profiles - Bridge 16

Bent	Shale		Coal		Sandstone	
	Top	Bott	Top	Bott	Top	Bottom
4	347	325	325	322	322	

Soil Layer	Layer Description	Global Data: Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)	Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	Lateral Model Data: P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus[6], k (pci)	Rock Mass Modulus[7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength[8] (psf)	Major Principal Strain @ 50%[8] E50	Average Undrained Shear Strength[8] (psf)	Unconfined Compressive Strength of Rock[9] (psf)	RQD (%)
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 1.5 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)													
2	Sandy Silt	Cohesionless	1.5	to	19.0	120	varies	15	0.8	0.30	Sand (O'Neill)	30	50	-	-				-	-
3[D]	Sand	Cohesionless	19.0	to	44.0	120	varies	13	0.7	0.30	Sand (O'Neill)	32	50	-	-				-	-
4	Shale	Rock	44.0	to	70	160	varies	-	-	0.09	Weak Rock			220.2	0.0005	-	-	-	152,193	50
5	Sandstone	Rock	70	to	See Elev Table	160	Varies	-	-	0.20	Weak Rock	-	-	534.1	0.0005	-	-	-	399,844	50

Soil Layer	Axial Model Data: T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	Torsional Model Data: T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Tip Model: Q-Z Model
1								
2	DS Gvly Sand	0.1[A]	2	0.50	Hyperbolic	0.3	100[A]	N/A
3[D]	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.3	100[A]	N/A
4	Custom T-Z	-	-	-	Hyperbolic	101.0	8,981	Custom Q-Z
5	Custom T-Z	-	-	-	Hyperbolic	222.6	14,557	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer thickeness to adjust for top of rock elevation.

For 5.5-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	100	2	3.30	1,660,931
3	3.30	100	3	6.50	1,660,931

For 5.5-ft-diam sockets in Sandstone:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	162	2	3.30	9,499,604
3	3.30	162	3	6.50	9,499,604

Superscript Notes:

1. Unit weight of Layer 2,3 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 16 - Bent 5

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Boring elevation (log)	Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.
389.7	5	5	FB-69	6.0	5.5	386.4	385.4	350.0	**334.0**

Elevations for FBMP Design Rock Profiles - Bridge 16

Bent	Shale		Sandstone	
	Top	Bott	Top	Bottom
5	350	310	310	

Soil Layer	Layer Description	Global Data: Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)	Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	Lateral Model Data: P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus [6], k (pci)
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 1.5 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)						
2	Sandy Silt	Cohesionless	1.5	to	17.0	120	varies	19	1.1	0.30	Sand (O'Neill)	30	50
3[D]	Sand	Cohesionless	17.0	to	40.0	120	varies	8	0.4	0.30	Sand (O'Neill)	32	50
4	Shale	Rock	40.0	to	80	160	varies	-	-	0.09	Weak Rock		
5	Sandstone	Rock	80	to	See Elev Table	160	Varies	-	-	0.20	Weak Rock	-	-

Soil Layer	Rock Mass Modulus [7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength [8] (psf)	Major Principal Strain @ 50% [8] E50	Average Undrained Shear Strength [8] (psf)	Unconfined Compressive Strength of Rock [9] (psf)	RQD (%)	Axial Model Data: T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	Torsional Model Data: T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Tip Model: Q-Z Model
1															
2	-	-				-	-	DS Gvly Sand	0.1 [A]	2	0.50	Hyperbolic	0.4	100 [A]	N/A
3[D]	-	-				-	-	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.2	100[A]	N/A
4	210.3	0.0005	-	-	-	138,776	50	Custom T-Z	-	-	-	Hyperbolic	96.5	8,576	Custom Q-Z
5	427.5	0.0005	-	-	-	256,160	50	Custom T-Z	-	-	-	Hyperbolic	178.1	11,652	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer thickeness to adjust for top of rock elevation.

For 5.5-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	95	2	3.30	1,468,718
3	3.30	95	3	6.50	1,468,718

For 5.5-ft-diam sockets in Sandstone:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	129	2	3.30	6,085,919
3	3.30	129	3	6.50	6,085,919

Superscript Notes:

1. Unit weight of Layer 2,3 and 4 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 16 - Bents 6 and 7

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Boring elevation (log)	Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.
386.9	6	6	FB-70	6.0	5.5	386.8	385.8	348.0	**331.0**
387.2	7	7	FB-71	6.0	5.5	387.3	386.3	348.0	**331.0**

Elevations for FBMP Design Rock Profiles - Bridge 16

Bent	Shale		Sandstone	
	Top	Bott	Top	Bottom
6	348	312	312	
7	348	310	310	

Soil Layer	Layer Description	Global Data				Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], ν	Lateral Model Data										Axial Model Data				Torsional Model Data			Tip Model
		Soil Type	Elevations (NAVD 88) Top	to	Bot					P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus [6], k (pci)	Rock Mass Modulus [7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength [8] (psf)	Major Principal Strain @ 50% [8] E50	Average Undrained Shear Strength [8] (psf)	Unconfined Compressive Strength of Rock [9] (psf)	RQD (%)	T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 1.5 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)																				
2	Sandy Silt	Cohesionless	1.5	to	7.0	120	varies	18	1.0	0.30	Sand (O'Neill)	30	50	-	-				-	-	DS Gvly Sand	0.1 [A]	2	0.50	Hyperbolic	0.4	100 [A]	N/A
3[D]	Sand	Cohesionless	7.0	to	39.0	120	varies	11	0.6	0.30	Sand (O'Neill)	32	50	-	-				-	-	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.2	100[A]	N/A
4	Shale	Rock	39.0	to	75	160	varies	-	-	0.09	Weak Rock			181.1	0.0005	-	-	-	102,899	50	Custom T-Z	-	-	-	Hyperbolic	83.1	7,385	Custom Q-Z
5	Sandstone	Rock	75	to	See Elev Table	160	Varies	-	-	0.20	Weak Rock	-	-	467.7	0.0005	-	-	-	306,559	50	Custom T-Z	-	-	-	Hyperbolic	194.9	12,747	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer thickeness to adjust for top of rock elevation.

For 5.5-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	82	2	3.30	1,196,348
3	3.30	82	3	6.50	1,196,348

For 5.5-ft-diam sockets in Sandstone:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	142	2	3.30	7,283,316
3	3.30	142	3	6.50	7,283,316

Superscript Notes:

1. Unit weight of Layer 2 and 3 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 16 - Bent 8

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Boring elevation (log)	Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.
393.9	8	8	FB-72	6.0	5.5	393.0	392.0	350.0	**331.0**

Elevations for FBMP Design Rock Profiles - Bridge 16

Bent	Shale		Sandstone	
	Top	Bott	Top	Bottom
8	350	309	309	

Soil Layer	Layer Description	Global Data: Soil Type	Elevations (NAVD 88) Top to Bot	Unit Weight[1], γ (pcf)	Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	Lateral Model Data: P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus[6], k (pci)	Rock Mass Modulus[7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength[8] (psf)	Major Principal Strain @ 50%[8] E50	Average Undrained Shear Strength[8] (psf)	Unconfined Compressive Strength of Rock[9] (psf)	RQD (%)	Axial Model Data: T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	Torsional Model Data: T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Tip Model: Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0 to 1.5	120	In FBMP Model set ground surface 1.5 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)																					
2	Silty Clay	Cohesive	1.5 to 7.0	120	varies	15.0	0.8	0.4	Soft Clay	-	-	-	-	800.0	0.010	800.0	-	-	DS Clay	13.6	-	-	Hyperbolic	0.3	100 [A]	N/A
3	Sandy Silt	Cohesionless	7.0 to 22.0	120	varies	10	0.6	0.30	Sand (O'Neill)	30	50	-	-				-	-	DS Gvly Sand	0.1 [A]	2	0.50	Hyperbolic	0.2	100 [A]	N/A
4[D]	Sand	Cohesionless	22.0 to 44.0	120	varies	11	0.6	0.30	Sand (O'Neill)	32	50	-	-				-	-	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.2	100[A]	N/A
5	Shale	Rock	44.0 to 85	160	varies	-	-	0.09	Weak Rock			248.8	0.0005	-	-	-	86,785	50	Custom T-Z	-	-	-	Hyperbolic	114.1	6,782	Custom Q-Z
6	Sandstone	Rock	85 to See Elev Table	160	Varies	-	-	0.20	Weak Rock	-	-	635.3	0.0005	-	-	-	565,593	50	Custom T-Z	-	-	-	Hyperbolic	264.7	17,314	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip. This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer thickeness to adjust for top of rock elevation.

For 5.5-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	75	2	3.30	1,411,993
3	3.30	75	3	6.50	1,411,993

For 5.5-ft-diam sockets in Sandstone:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	192	2	3.30	13,437,516
3	3.30	192	3	6.50	13,437,516

Superscript Notes:

1. Unit weight of Layer 2,3 and 4 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 16 - Bent 9

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Boring elevation (log)	Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.
392.7	9	9	FB-73	6.0	5.5	392.5	391.5	349.0	**332.0**

Elevations for FBMP Design Rock Profiles - Bridge 16

Bent	Shale		Coal		Shale	
	Top	Bott	Top	Bott	Top	Bottom
9	349	317	317	315	315	

Soil Layer	Layer Description	Global Data									Lateral Model Data											Axial Model Data				Torsional Model Data			Tip Model
		Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)	Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus [6], k (pci)	Rock Mass Modulus [7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength [8] (psf)	Major Principal Strain @ 50% [8] E50	Average Undrained Shear Strength [8] (psf)	Unconfined Compressive Strength of Rock [9] (psf)	RQD (%)	T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 1.5 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)																					
2	Silty Clay	Cohesive	1.5	to	10.0	120	varies	11.0	0.6	0.4	Soft Clay	-	-	-	-	750.0	0.010	750.0	-	-	DS Clay	13.9	-	-	Hyperbolic	0.2	100 [A]	N/A
3	Sandy Silt	Cohesionless	10.0	to	23.0	120	varies	11	0.6	0.30	Sand (O'Neill)	30	50	-	-				-	-	DS Gvly Sand	0.1 [A]	2	0.50	Hyperbolic	0.2	100 [A]	N/A
4[D]	Sand	Cohesionless	23.0	to	44.0	120	varies	14	0.8	0.30	Sand (O'Neill)	32	50	-	-				-	-	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.3	100[A]	N/A
5	Shale	Rock	44.0	to	See Elev Table	160	varies	-	-	0.09	Weak Rock			214.2	0.0005	-	-	-	90,820	50	Custom T-Z	-	-	-	Hyperbolic	98.3	6,938	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer thickeness to adjust for top of rock elevation.

For 5.5-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	77	2	3.30	1,346,065
3	3.30	77	3	6.50	1,346,065

Superscript Notes:

1. Unit weight of Layer 2,3 and 4 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 16 - Bents 10 through 12

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Boring elevation (log)	Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.
392.9	10	10	FB-74	6.0	5.5	390.2	389.2	349.0	**332.0**
392.1	11	11	FB-75	6.0	5.5	389.6	388.6	347.0	**330.0**
397.6	12	12	R-14	6.0	5.5	396.5	395.5	344.0	**327.0**

Elevations for FBMP Design Rock Profiles - Bridge 16

Bent	Shale		Sandstone	
	Top	Bott	Top	Bottom
10	349	309	309	
11	347			
12	344			

Soil Layer	Layer Description	Global Data: Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)	Stratum Thickness (ft)	$N_{1,60}$[2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 1.5 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)			
2	Silty Clay	Cohesive	1.5	to	5.0	120	varies	13.0	0.7	0.4
3	Sandy Silt	Cohesionless	5.0	to	20.0	120	varies	12	0.7	0.30
4[D]	Sand	Cohesionless	20.0	to	49.0	120	varies	17	1.0	0.30
5	Shale	Rock	49.0	to	84	160	varies	-	-	0.09

Soil Layer	Lateral Model Data: P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus[6], k (pci)	Rock Mass Modulus[7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength[8] (psf)	Major Principal Strain @ 50%[8] E50	Average Undrained Shear Strength[8] (psf)	Unconfined Compressive Strength of Rock[9] (psf)	RQD (%)
2	Soft Clay	-	-	-	-	600.0	0.010	600.0	-	-
3	Sand (O'Neill)	30	50	-	-				-	-
4[D]	Sand (O'Neill)	32	50	-	-				-	-
5	Weak Rock			194.3	0.0005	-	-	-	118,446	50

Soil Layer	Axial Model Data: T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	Torsional Model Data: T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Tip Model: Q-Z Model
2	DS Clay	15.8	-	-	Hyperbolic	0.3	100[A]	N/A
3	DS Gvly Sand	0.1[A]	2	0.50	Hyperbolic	0.3	100[A]	N/A
4[D]	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.4	100[A]	N/A
5	Custom T-Z	-	-	-	Hyperbolic	89.1	7,923	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip. This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer thickeness to adjust for top of rock elevation.

For 5.5-ft-diam sockets in Shale:

Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.33	88	2	3.30	1,419,378
3	3.30	88	3	6.50	1,419,378

Superscript Notes:

1. Unit weight of Layer 2,3 and 4 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

I-49, Crawford County, AR - Bridge 16 - Bents 13 through 15

Assumptions:

1) Shafts will be permanently cased to rock.
2) Permanent casing is discounted in structural analysis.
3) Casing will be seated about 2 foot into rock, creating disturbance to rock.

Elevations for FBMP Drilled Shaft Design Soil Profiles

Boring elevation (log)	Bent	Shaft	Design Boring	Shaft Diam (ft)	Socket Diam (ft)	Prop Ground "X"	Top of Shaft	Est. Top of Rock, Y	Antcipated Socket Tip Elev.
400.2	13	13	FB-77	5.0	4.5	400.2	399.2	350.0	**339.0**
400.7	14	14	FB-78	5.0	4.5	400.4	399.4	347.0	**336.0**
398.9	15	15	FB-79	5.0	4.5	399.0	398.0	350.0	**339.0**

Elevations for FBMP Design Rock Profiles - Bridge 16

Bent	Shale		Coal		Sandstone	
	Top	Bott	Top	Bott	Top	Bottom
13	350.0					
14	347.0					
15	350.0	308.0	308.0	306.0		

Soil Layer	Layer Description	Global Data						Stratum Thickness (ft)	$N_{1,60}$ [2] (bpf)	Elastic Modulus[3], E_s (ksi)	Poisson's Ratio[4], v	Lateral Model Data									Axial Model Data				Torsional Model Data			Tip Model
		Soil Type	Elevations (NAVD 88) Top	to	Bot	Unit Weight[1], γ (pcf)						P-Y Model	Internal Friction Angle[5], ϕ (deg)	Subgrade Modulus [6], k (pci)	Rock Mass Modulus [7], E_m (ksi)	Stiffness Constant, k_{rm}	Undrained Shear Strength [8] (psf)	Major Principal Strain @ 50% [8] E50	Average Undrained Shear Strength [8] (psf)	Unconfined Compressive Strength of Rock [9] (psf)	RQD (%)	T-Z Model	Skin Friction Factor, β	Range[10]	Coefficient of Lateral Earth Pressure k_o	T-Theta Model	Shear Modulus[10] (ksi)	Torsional Shear Stress[11] (psf)	Q-Z Model
1	Discount Zone (for Moisture Change/Freeze Thaw)	Cohesionless	0.0	to	1.5	120	In FBMP Model set ground surface 1.5 feet below proposed ground surface. (Discounted due to shrink/swell in this surficial layer.)																					
2	Silty Clay	Cohesive	1.5	to	15.0	120	varies	16.0	0.9	0.4	Soft Clay	-	-	-	-	1000.0	0.009	1000.0	-	-	DS Clay	18.1	-	-	Hyperbolic	0.3	100 [A]	N/A
3[D]	Sandy Silt	Cohesionless	15.0	to	30.0	120	varies	19	1.1	0.30	Sand (O'Neill)	30	50	-	-				-	-	DS Gvly Sand	0.1 [A]	2	0.50	Hyperbolic	0.4	100 [A]	N/A
4	Sand	Cohesionless	30.0	to	50.0	120	varies	16	0.9	0.30	Sand (O'Neill)	32	50	-	-				-	-	DS Gvly Sand	0.1[A]	2	0.47	Hyperbolic	0.3	100[A]	N/A
5	Shale	Rock	50.0	to	See Elev Table	160	varies	-	-	0.09	Weak Rock			278.9	0.0005	-	-	-	153,944	50	Custom T-Z	-	-	-	Hyperbolic	127.9	9,033	Custom Q-Z

A. This low value was selected to account for permanent casing by limiting axial resistance and torsional resistance to half the value expected for a shaft without casing.
B. Custom Q-Z curve is based on the estimated shaft tip elevation and the presence of shale and sandstone below and within 2 socket diameters of the the socket tip.
This is a simplification, but use of softer more accurate Q-Z curves is not excpected to impact structural demands computed from FBMP analysis.
C. An RQD value of 50 is assigned to normalize the weak rock model (an appropriate simplification since RQD for shale is not a reliable indicator).
D. Reduce this layer thickness to adjust for top of rock elevation.

For 4.5-ft-diam sockets in Shale:

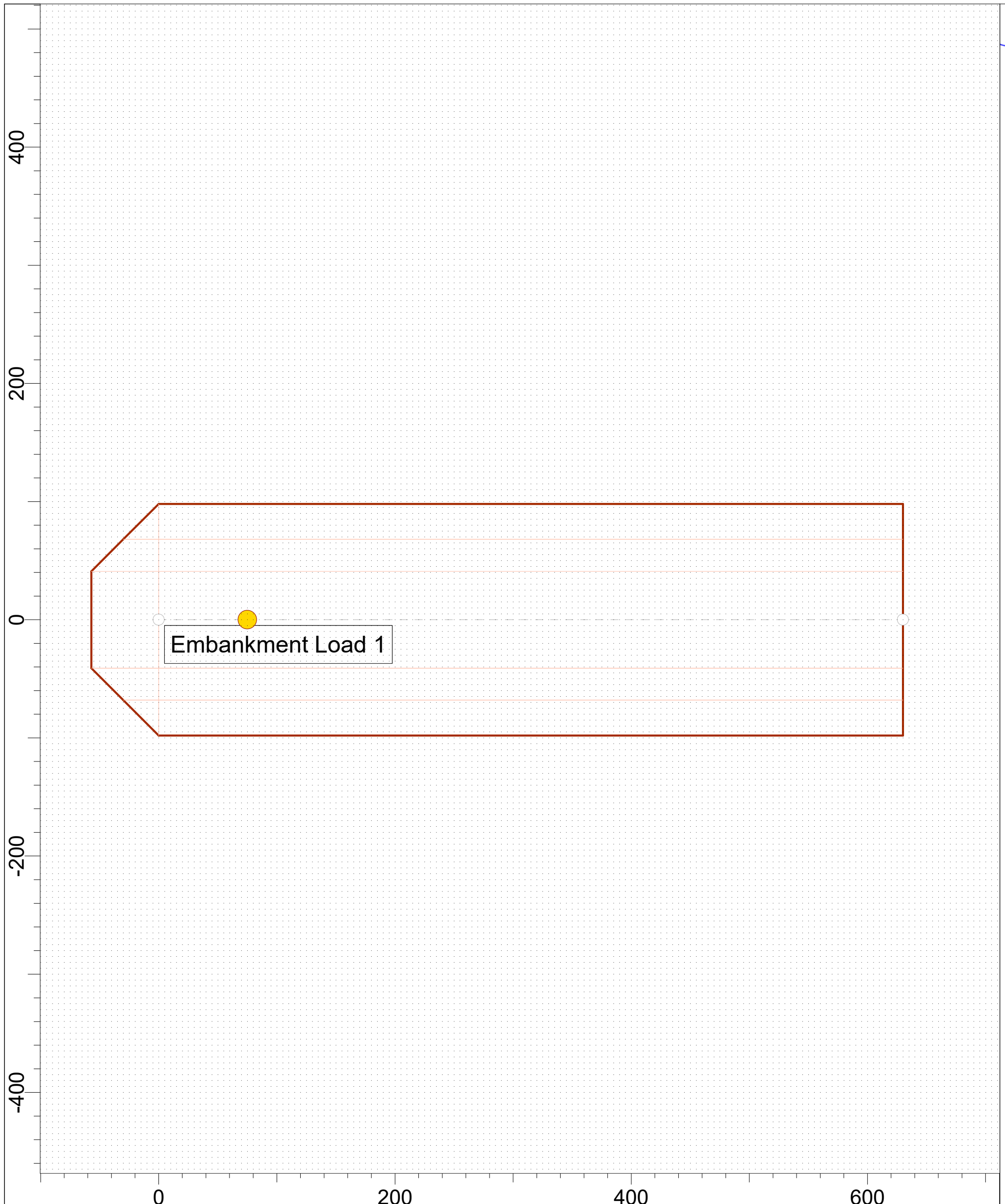
Custom T-Z Curve			Custom Q-Z Curve		
Point No.	Z (in)	T (psi)	Point No.	Z (in)	Q (psi)
1	0.00	0	1	0.00	0
2	0.27	100	2	2.70	1,340,837
3	2.70	100	3	6.50	1,340,837

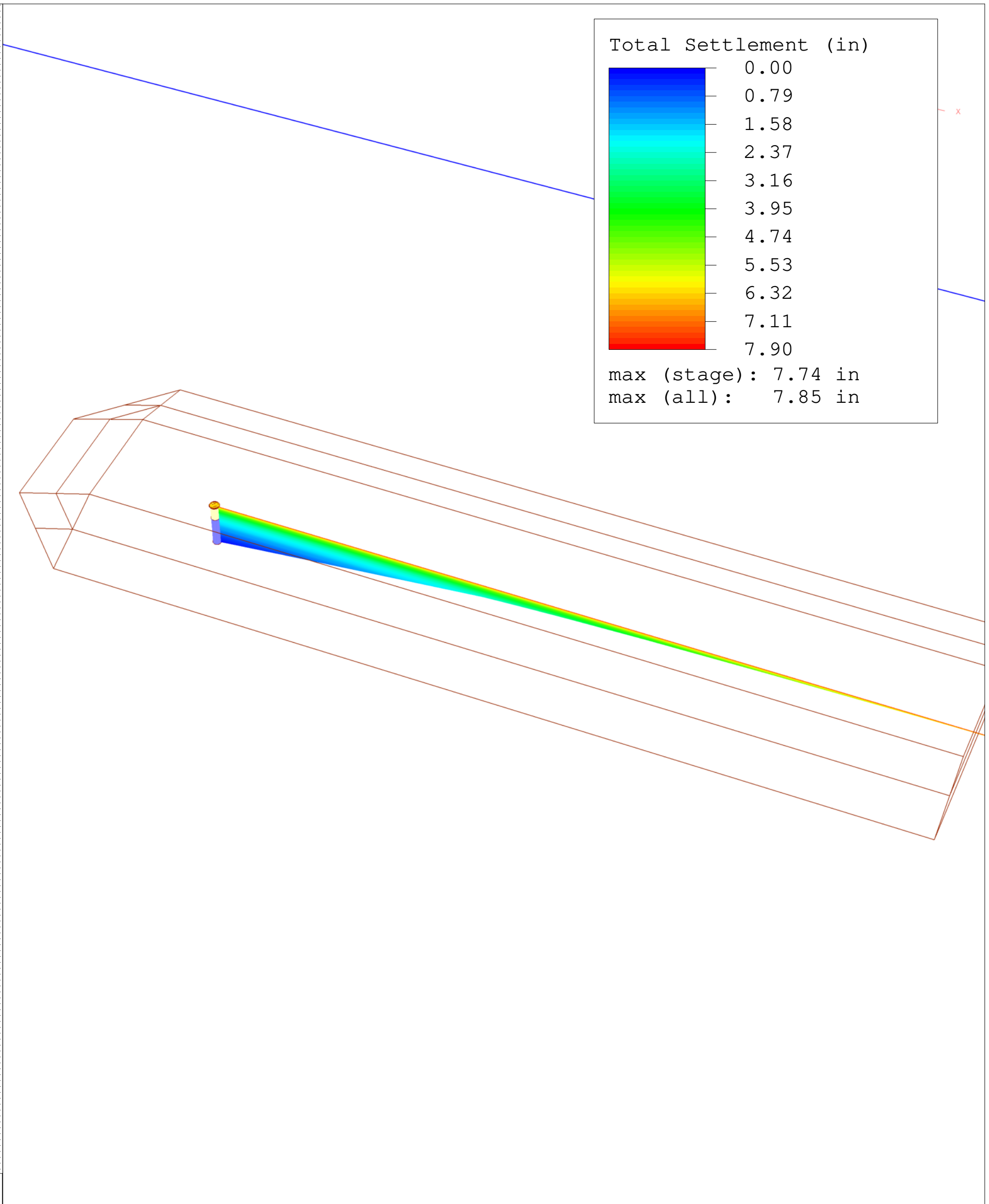
Superscript Notes:

1. Unit weight of Layer 2,3 and 4 is from available density tests. Unit weight of rock determined from rock core data.
2. N1,60 value estimated from available borings.
3. Elastic moduli for soils were interpolated from typical values provided in AASHTO Table C10.4.6.3-1.
4. Poisson's Ratio values for cohesionless and cohesive soil were interpolated from AASHTO Table C10.4.6.3-1. Poisson's Ratio for rock was selected from AASTHO Table C10.4.6.5-2.
5. Friction angle assigned using correlation to N1,60 presented in AASHTO LRFD Bridge Design Specifications, Table 10.4.6.2.4-1.
6. Subgrade modulus was determined from API RP 2A Figure 6.8.7-1 for cohesionless soils above and below the water table from friction angle.
7. Elastic modulus for rock mass was calculated using GSI-based ratio to intact modulus (AASHTO 10.4.6.5-1), and intact modulus was estimated from AASHTO Table C10.4.6.5-1
8. The following parameters are determined for cohesive layers:
   Undrained shear strength and average undrained shear strength are assigned to the Lateral, Axial and Torsional Models from available pocket penetrometer and compression test results.
   E50 values are determined from the LPILE Technical Manual Table 3.2 or from unconfined compression test results.
9. Unconfined compressive strength (UCS) for bedrock was selected from available laboratory test data.
10. Shear modulus was computed from elastic modulus (or rock mass modulus) and Poisson's ratio using the equation: G = E/(2*(1+v)).
11. Torsional shear stress values for all strata were assigned using engineering judgment. Torsional shear stress for rock was assumed to be 50% of ultimate side shear resistance in rock.

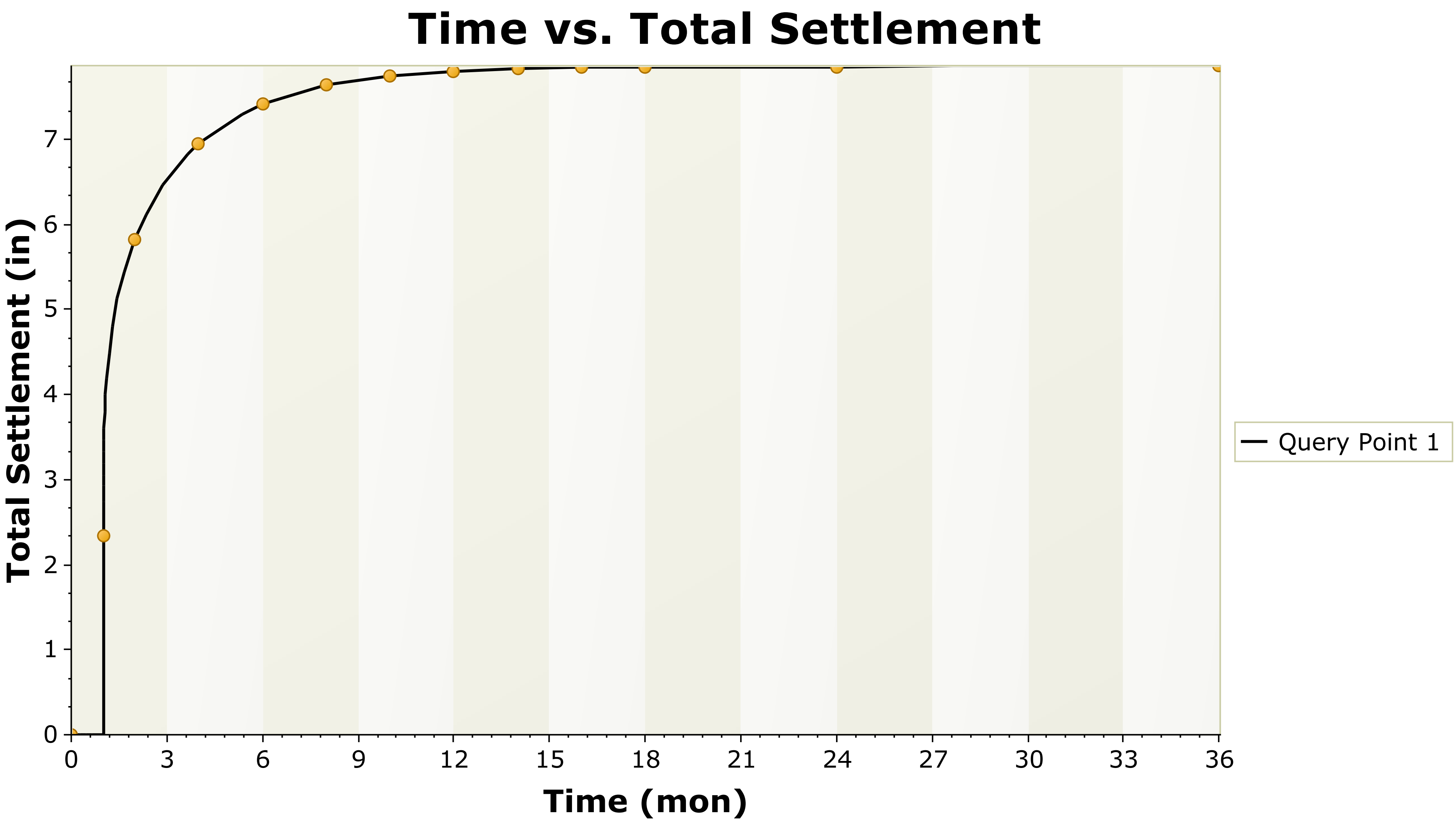
Appendix 4: Embankment Settlement Analysis

Bridge 1 South Approach
SETTLE3 Results



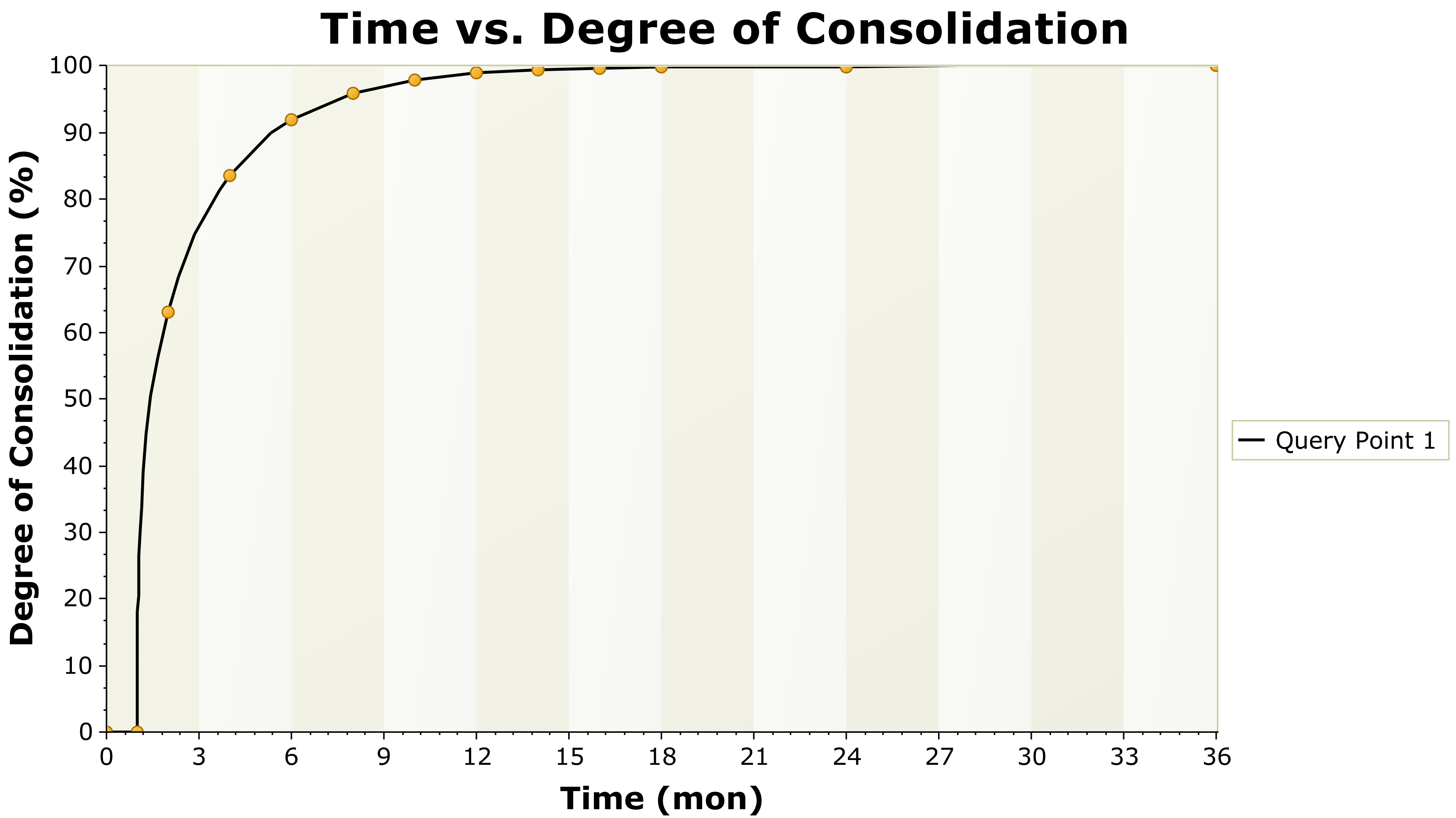


rocscience	*Project*	I-49 Arkansas	
	Analysis Description	South Approach Embankment Settlement - Bridge 1	
	Drawn By PA	*Company* HNTB	
SETTLE3 5.022	*Date* 11/27/2023, 8:32:18 AM	*File Name* South Approach Embankment_163+20 20231101.s3z	



Reference Stage: Before embankment = 0 mon
Total Settlement at Elevation = 392 ft

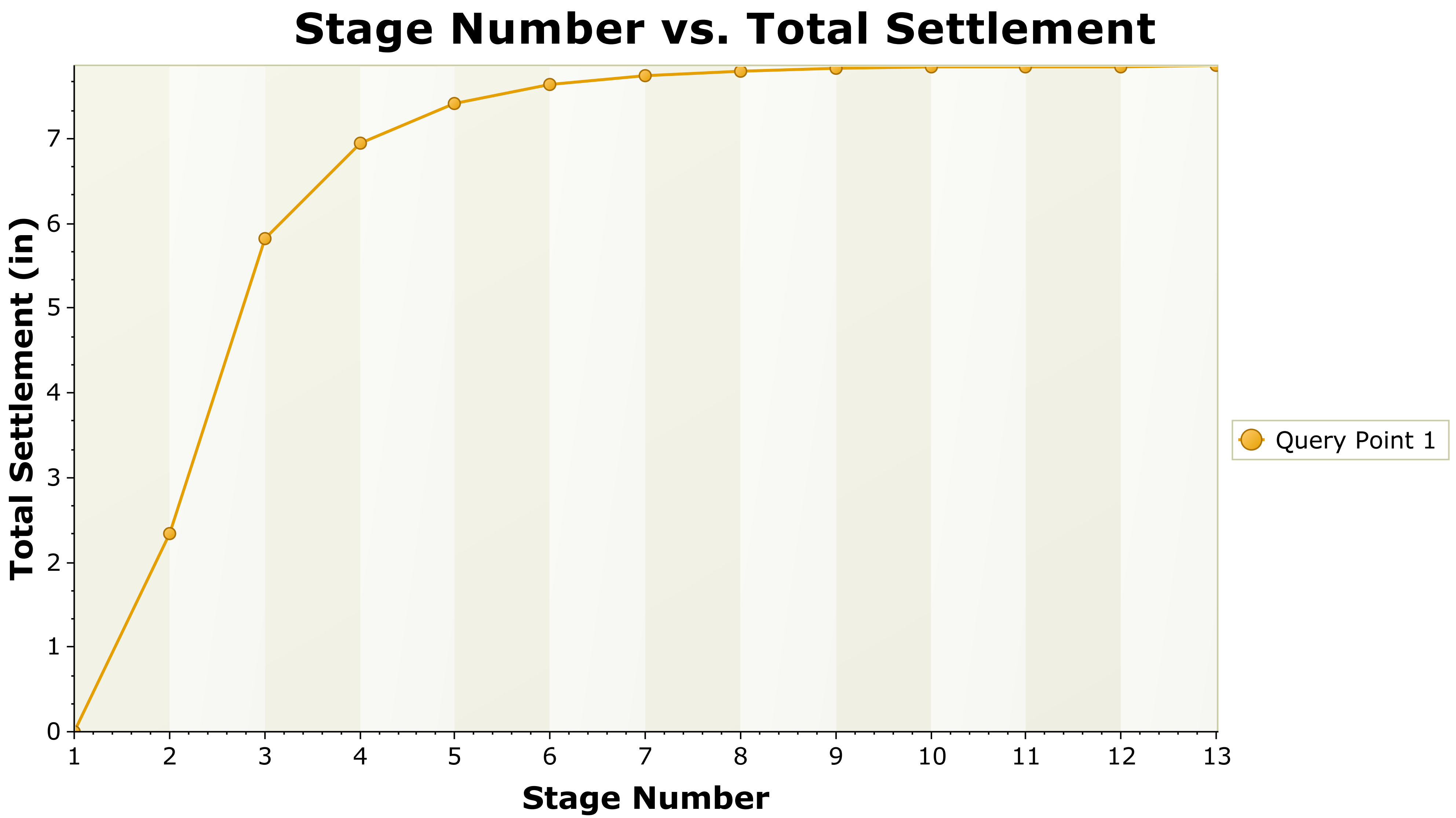
rocscience	Project	I-49 Arkansas	
	Analysis Description	South Approach Embankment Settlement - Bridge 1	
	Drawn By	PA	Company: HNTB
SETTLE3 5.022	Date	11/27/2023, 8:32:18 AM	File Name: South Approach Embankment_163+20 20231101.s3z



Reference Stage: Before embankment = 0 mon

Degree of Consolidation at Elevation = 392 ft

rocscience	Project	I-49 Arkansas	
	Analysis Description	South Approach Embankment Settlement - Bridge 1	
	Drawn By	PA	Company: HNTB
SETTLE3 5.022	Date	11/27/2023, 8:32:18 AM	File Name: South Approach Embankment_163+20 20231101.s3z

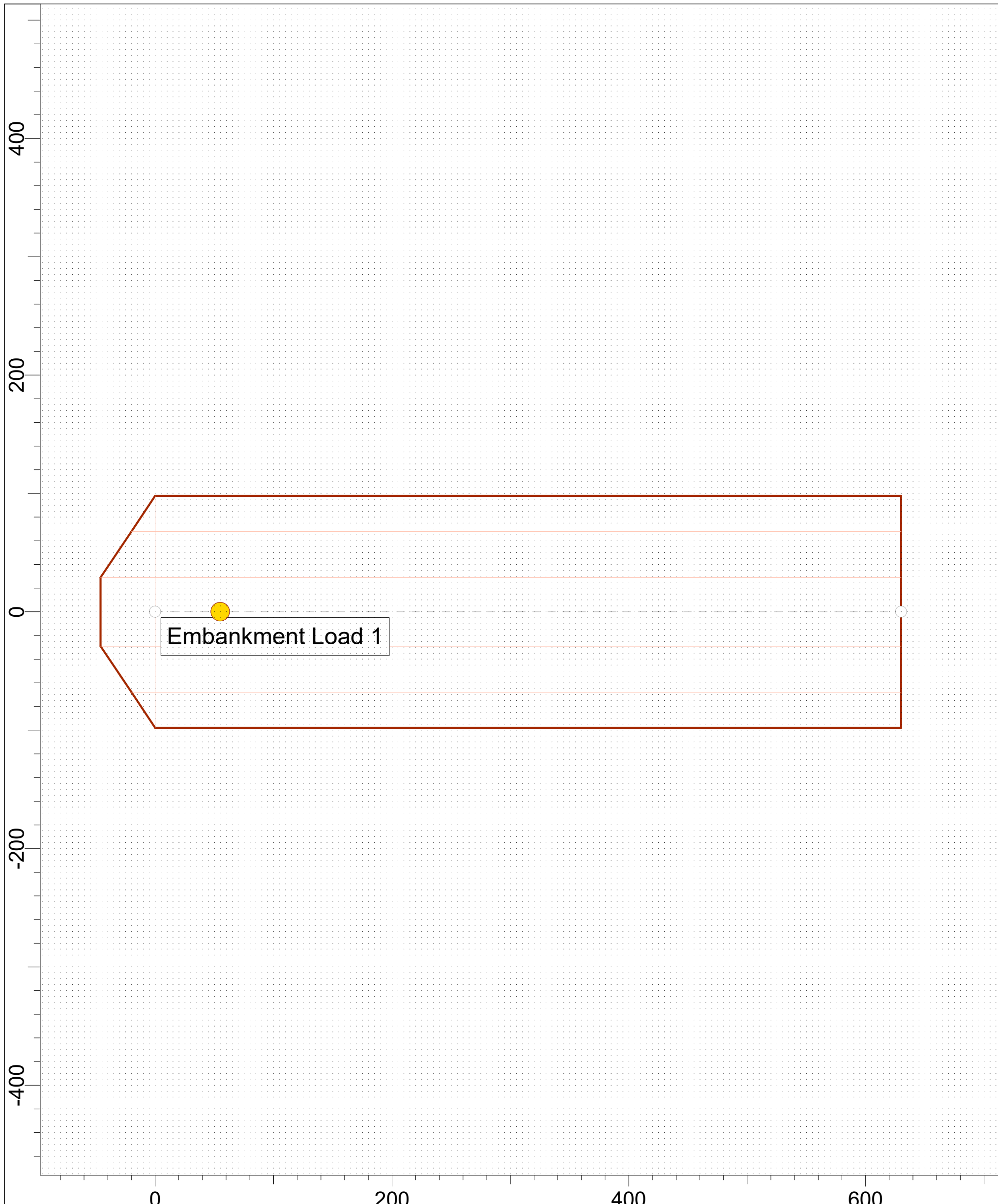


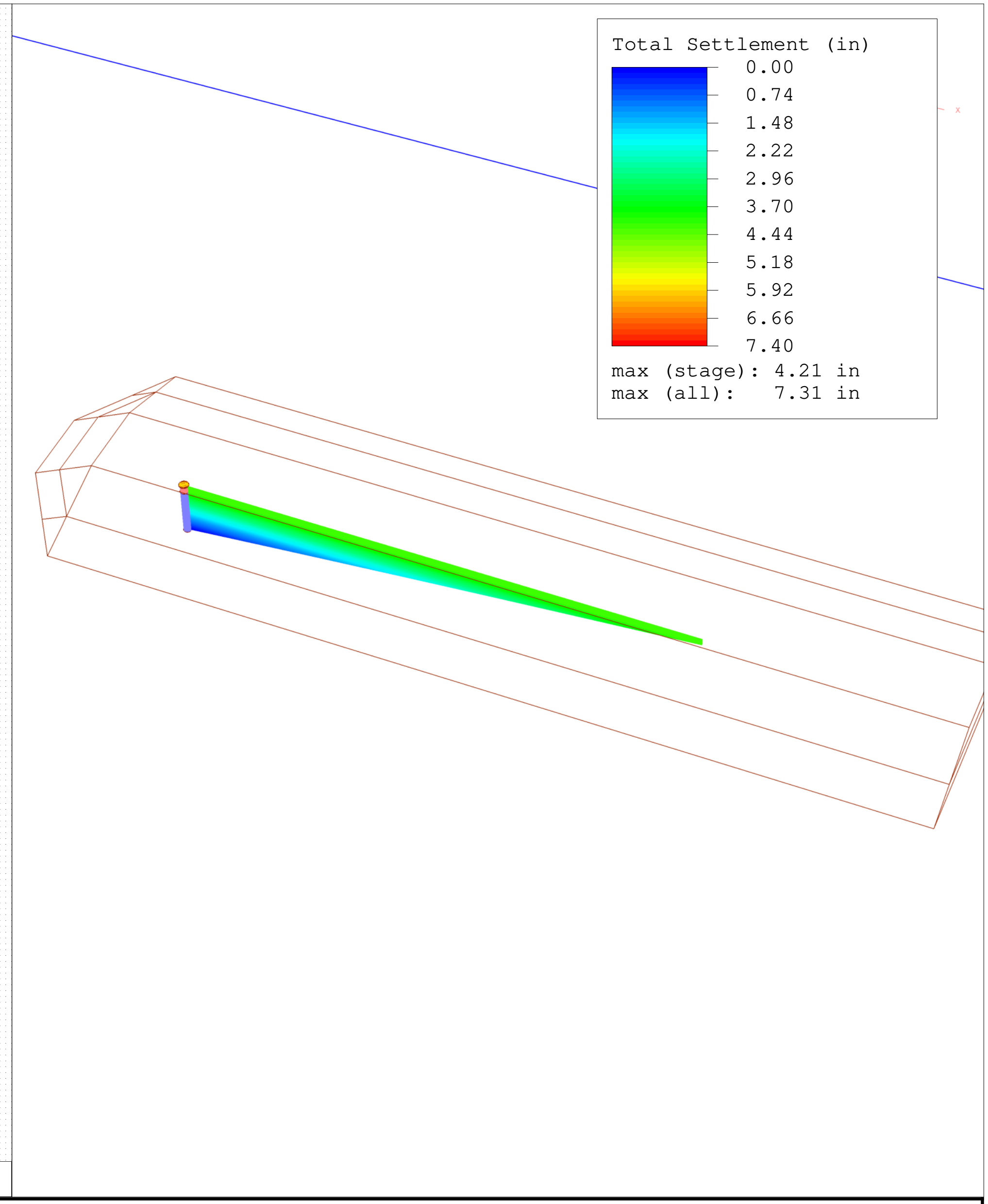
Reference Stage: Before embankment = 0 mon
Total Settlement at Elevation = 392 ft

rocscience	*Project* I-49 Arkansas		
	Analysis Description South Approach Embankment Settlement - Bridge 1		
	Drawn By PA	*Company* HNTB	
SETTLE3 5.022	*Date* 11/27/2023, 8:32:18 AM	*File Name* South Approach Embankment_163+20 20231101.s3z	

Bridge 1 North Approach

SETTLE3 Results





rocscience	*Project*	I-49 Arkansas	
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	Drawn By PA	*Company* HNTB	
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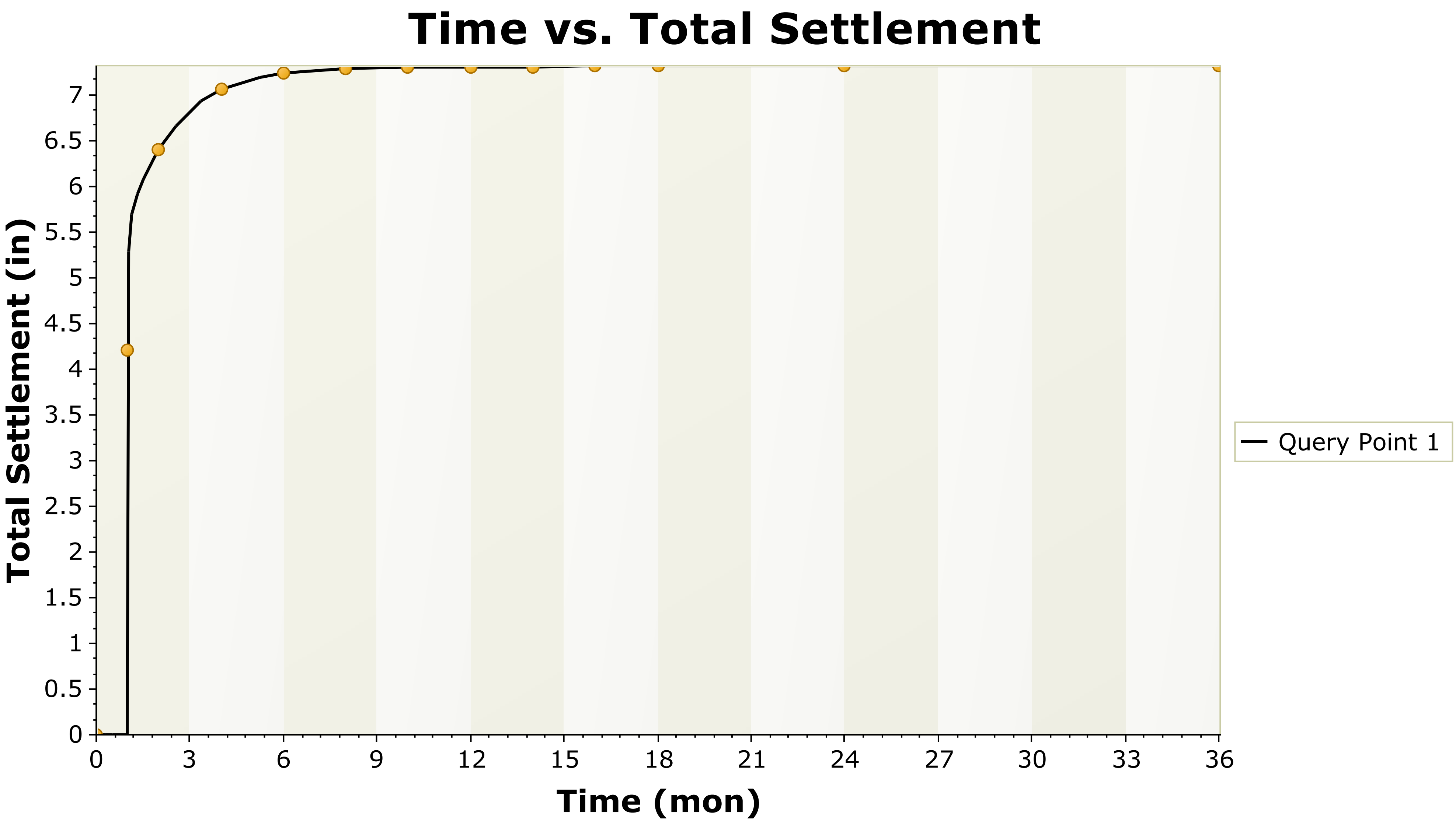
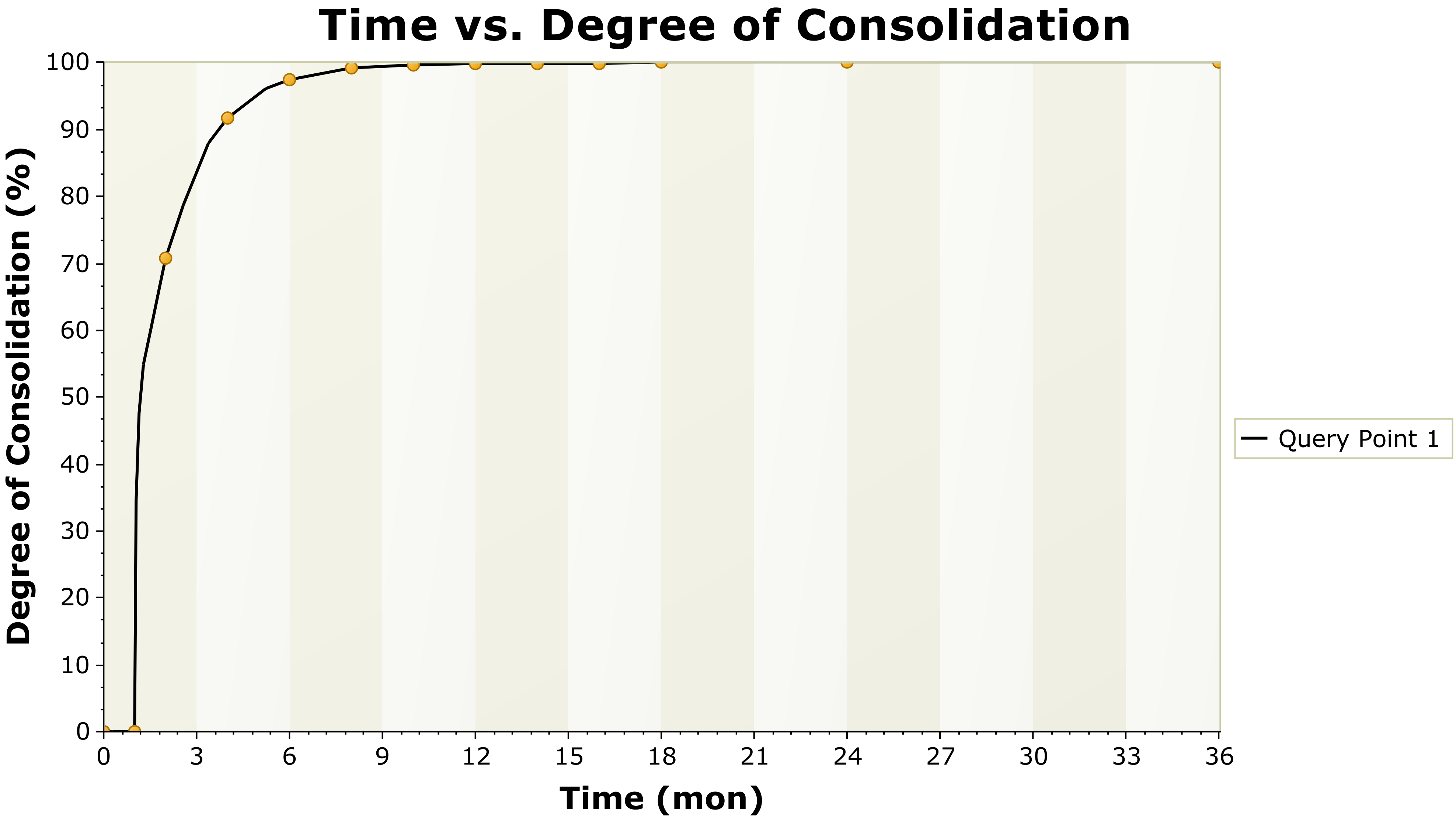


Reference Stage: Before embankment = 0 mon
Total Settlement at Elevation = 393 ft

rocscience	*Project* I-49 Arkansas		
	Analysis Description North Approach Embankment Settlement - Bridge 1		
	Drawn By PA	*Company* HNTB	
SETTLE3 5.022	*Date* 11/27/2023, 8:32:18 AM	*File Name* North Approach Embankment_216+04.17 20231101.s3z	



Reference Stage: Before embankment = 0 mon

Degree of Consolidation at Elevation = 393 ft

rocscience	*Project*	I-49 Arkansas		
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	Drawn By	PA	*Company*	HNTB
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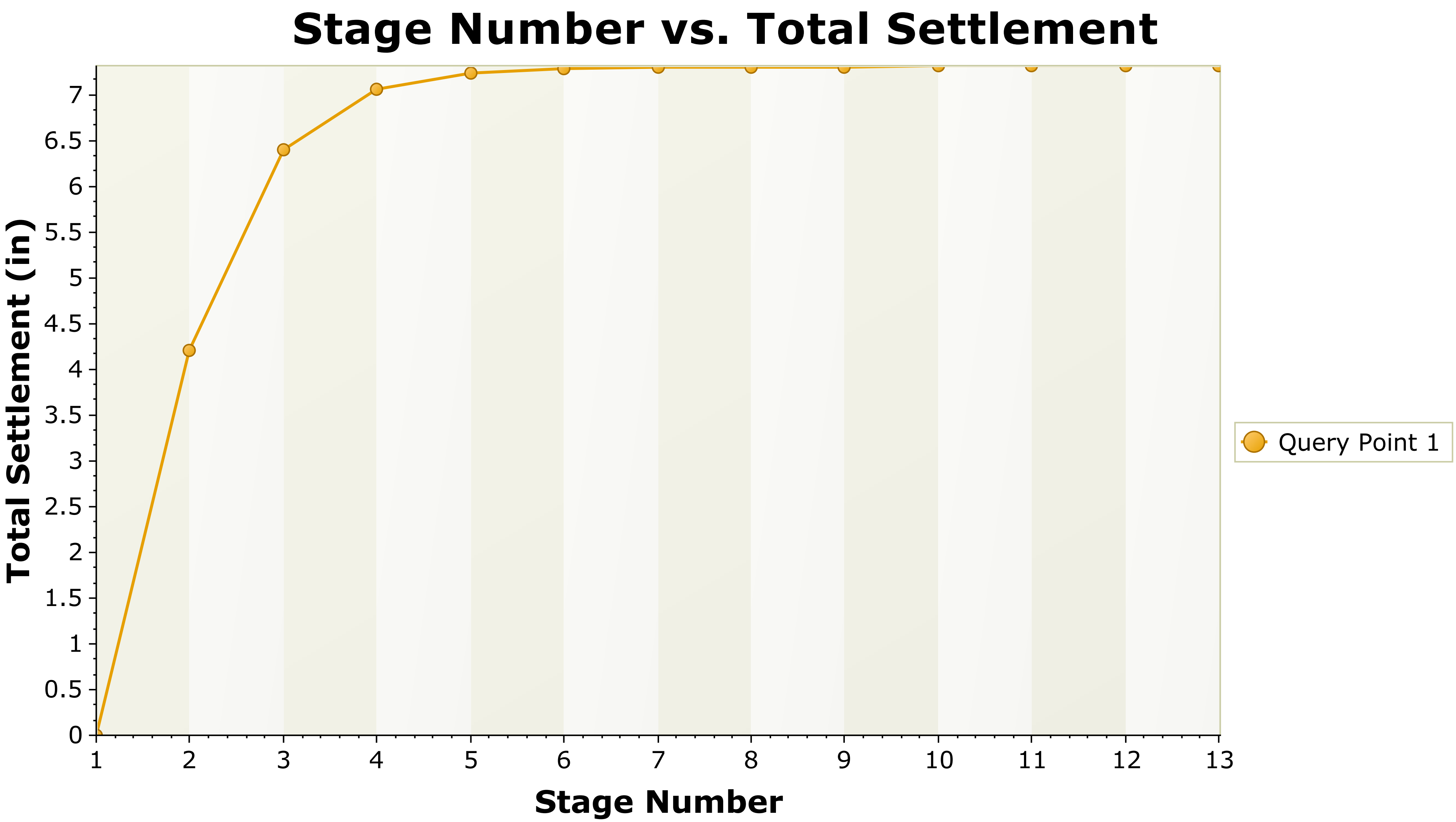
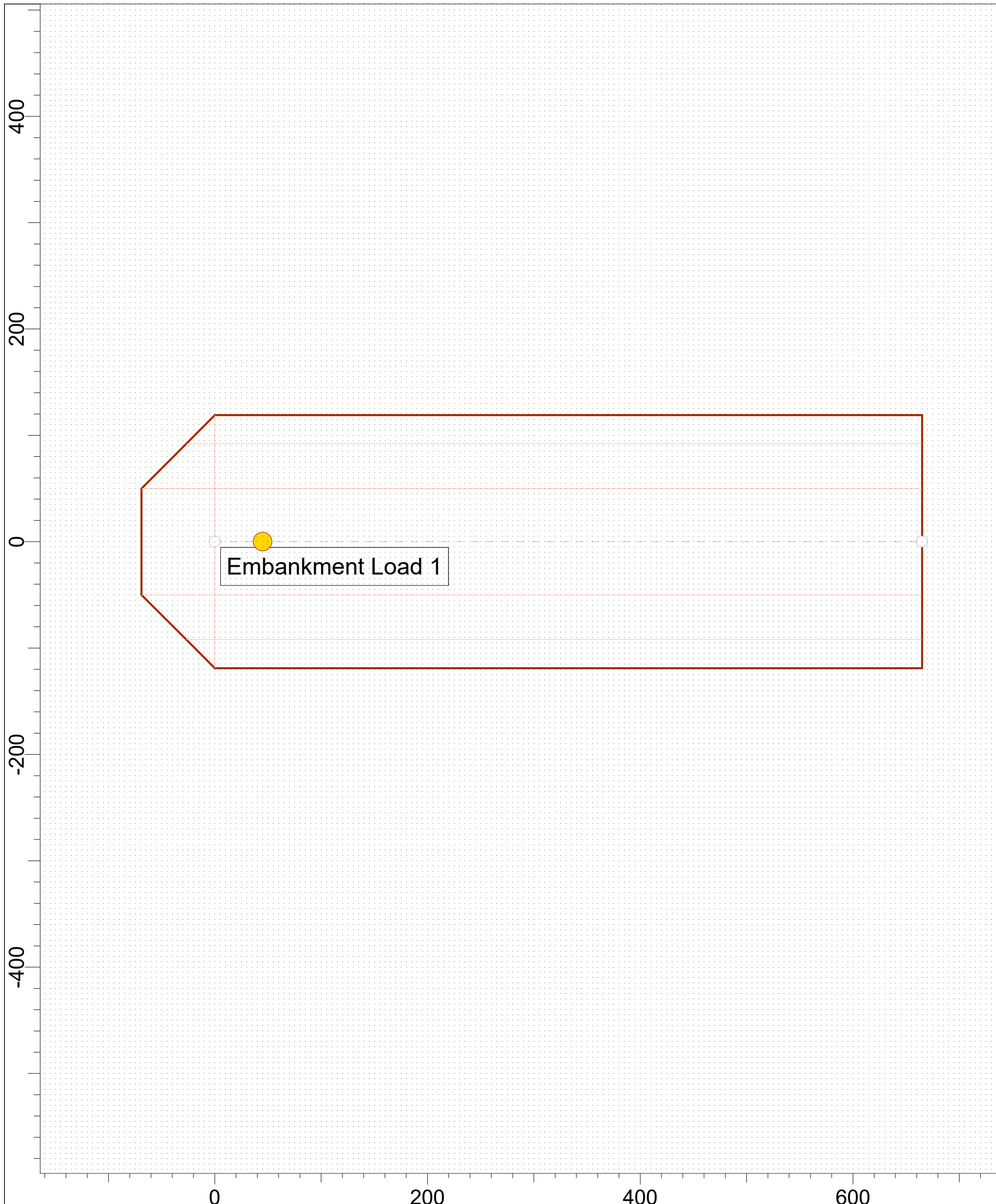


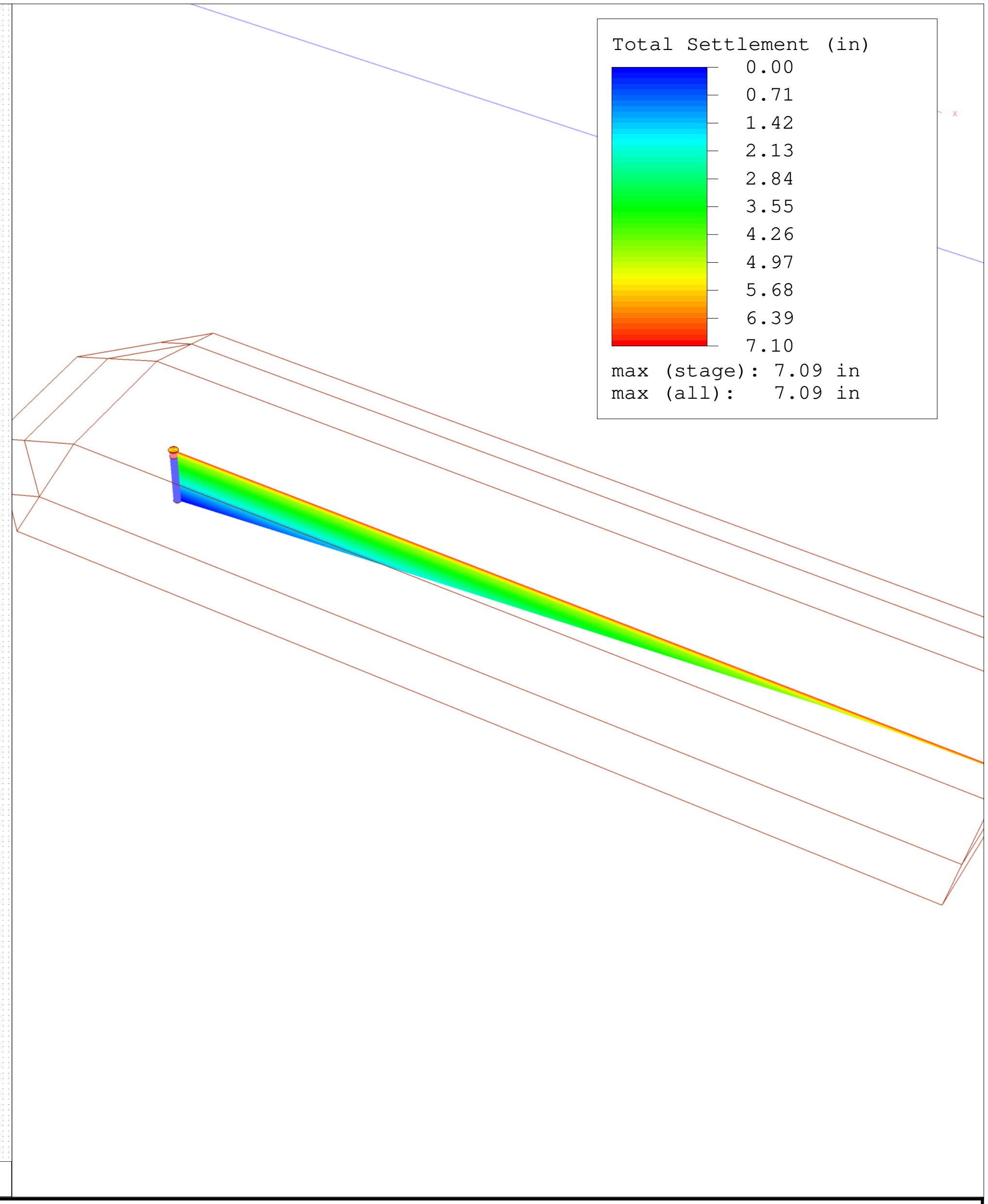
Reference Stage: Before embankment = 0 mon

Total Settlement at Elevation = 393 ft

rocscience	*Project* I-49 Arkansas		
	Analysis Description North Approach Embankment Settlement - Bridge 1		
	Drawn By PA	*Company* HNTB	
SETTLE3 5.022	*Date* 11/27/2023, 8:32:18 AM	*File Name* North Approach Embankment_216+04.17 20231101.s3z	

Bridge 16 South Approach SETTLE3 Results



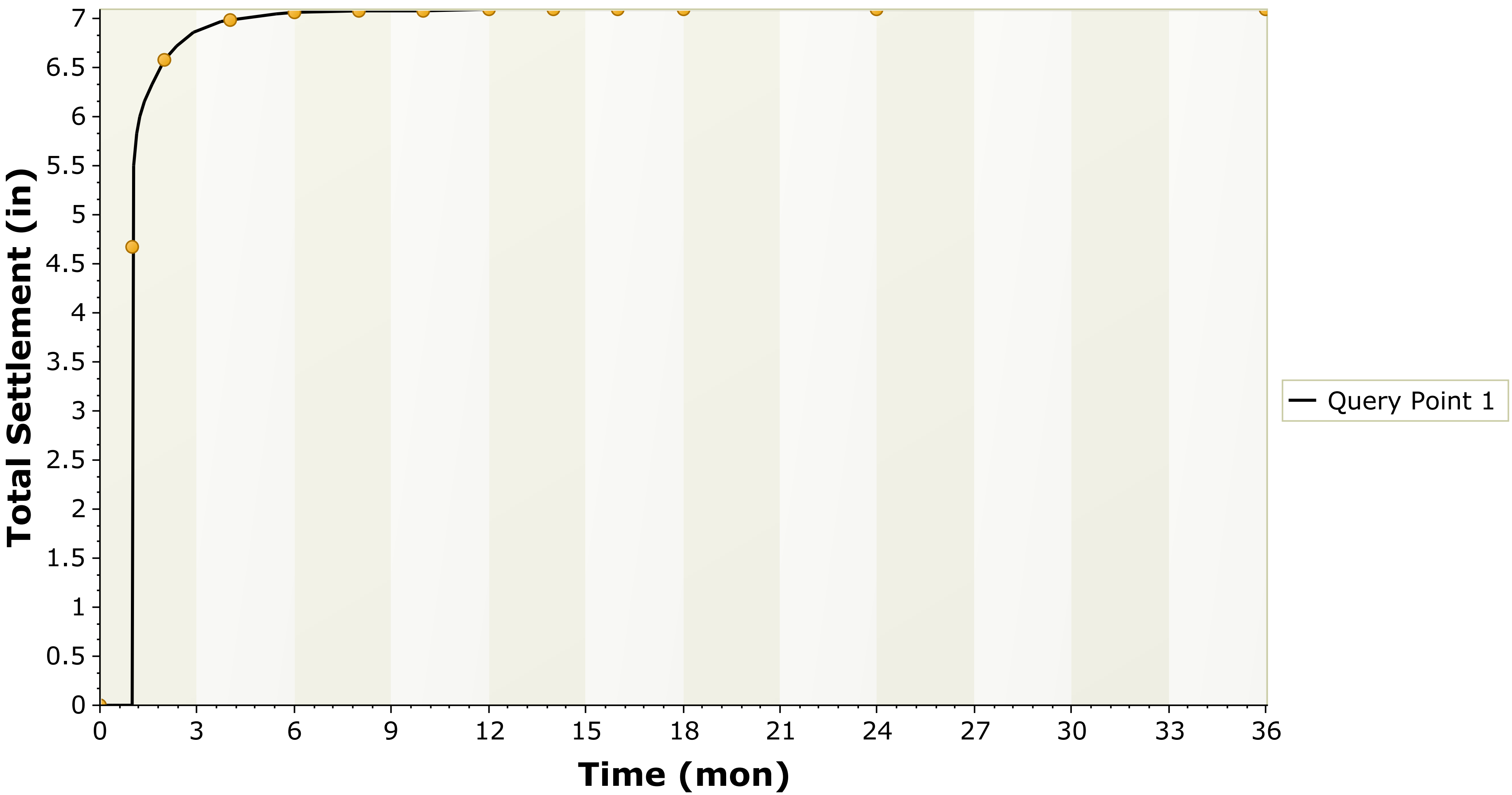


rocscience

SETTLE3 5.022

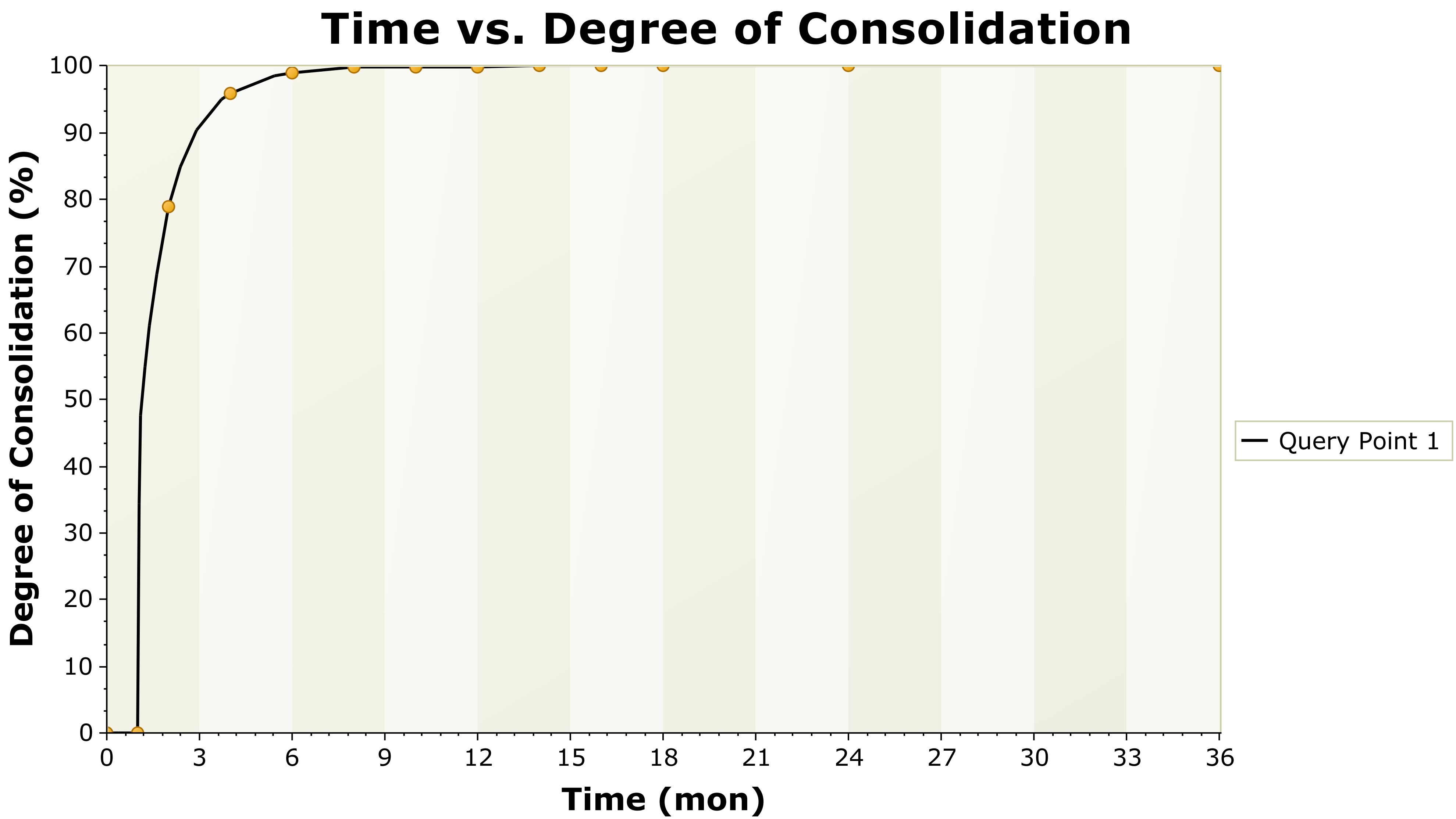
Project	I-49 Arkansas
Analysis Description	South Approach Embankment Settlement - Bridge 16
Drawn By	PA
Company	HNTB
Date	11/25/2023, 8:32:18 AM
File Name	South Approach Embankment_240+30 20231101.s3z

Time vs. Total Settlement



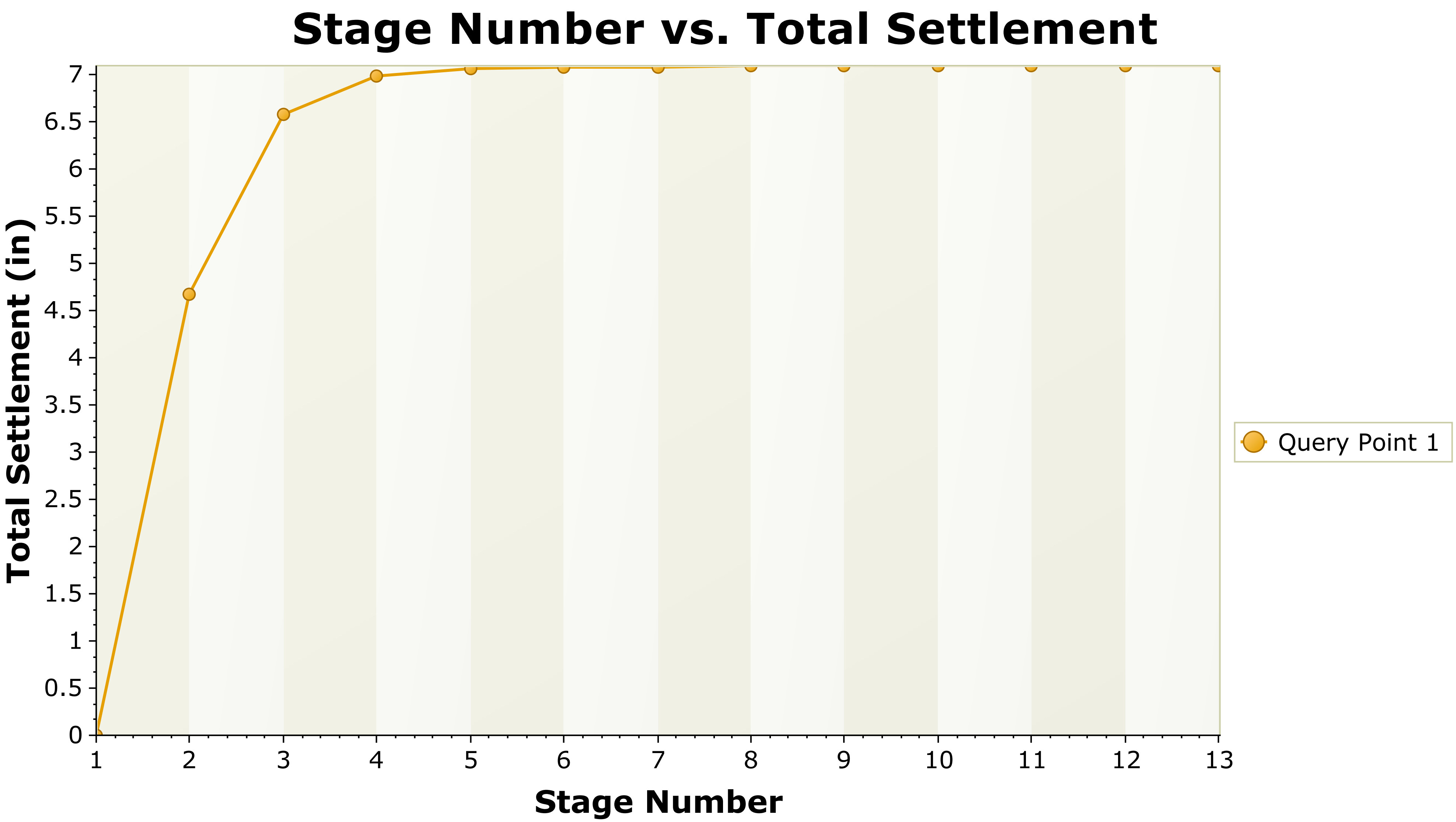
Reference Stage: Before Embankment = 0 mon
Total Settlement at Elevation = 394 ft

rocscience	*Project*	I-49 Arkansas	
	Analysis Description	South Approach Embankment Settlement - Bridge 16	
	Drawn By PA	*Company* HNTB	
SETTLE3 5.022	*Date* 11/25/2023, 8:32:18 AM	*File Name* South Approach Embankment_240+30 20231101.s3z	



Reference Stage: Before Embankment = 0 mon
Degree of Consolidation at Elevation = 394 ft

rocscience	Project	I-49 Arkansas	
	Analysis Description	South Approach Embankment Settlement - Bridge 16	
	Drawn By	PA	Company: HNTB
SETTLE3 5.022	Date	11/25/2023, 8:32:18 AM	File Name: South Approach Embankment_240+30 20231101.s3z



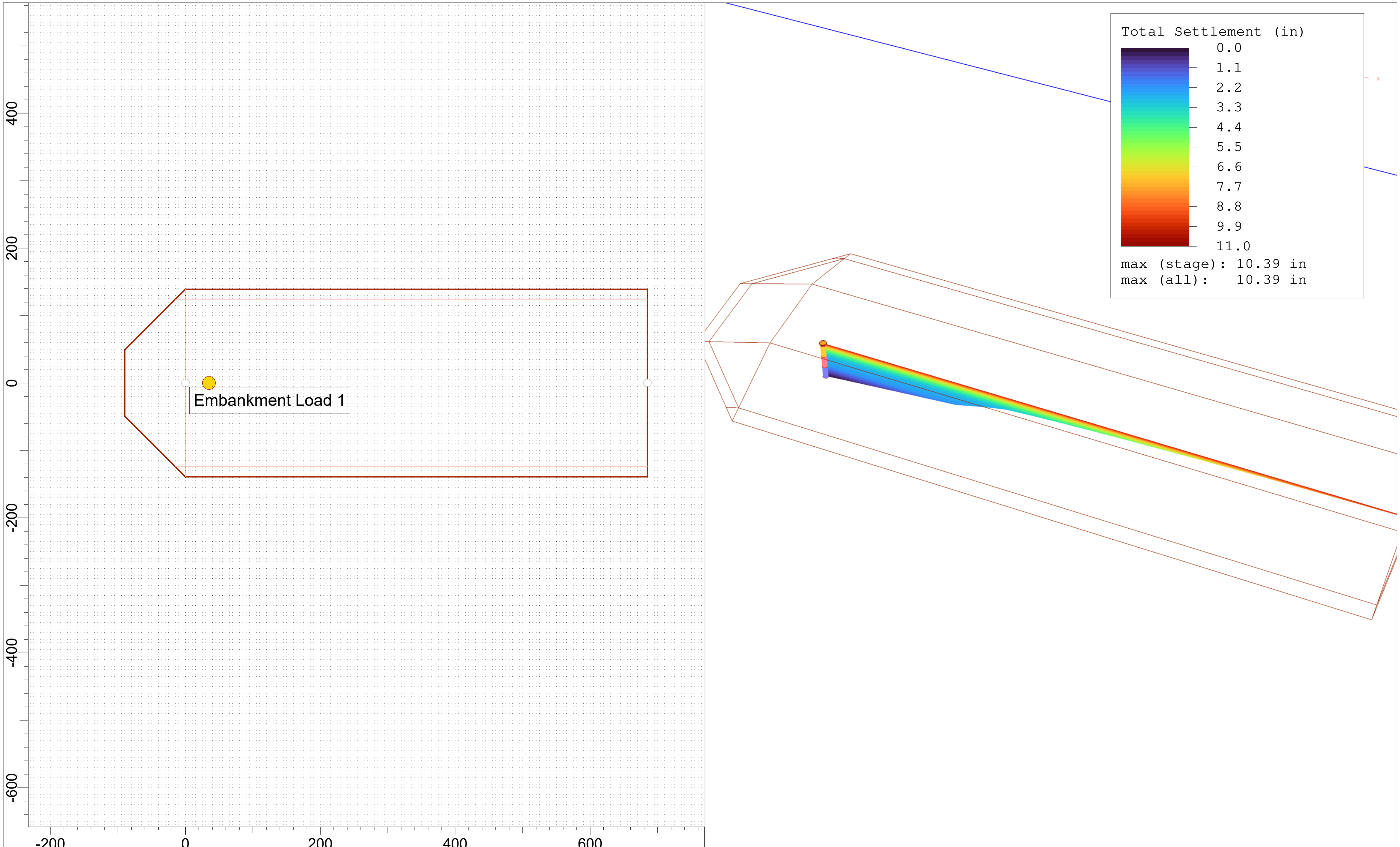
Reference Stage: Before Embankment = 0 mon

Total Settlement at Elevation = 394 ft

Project	I-49 Arkansas		
Analysis Description	South Approach Embankment Settlement - Bridge 16		
Drawn By	PA	Company	HNTB
Date	11/25/2023, 8:32:18 AM	File Name	South Approach Embankment_240+30 20231101.s3z

SETTLE3 5.022

Bridge 16 North Approach
SETTLE3 Results



rocscience	*Project*	I-49 Arkansas	
	Analysis Description	North Approach Emankment Settlement - Bridge 16	
	Drawn By	PA	*Company* HNTB
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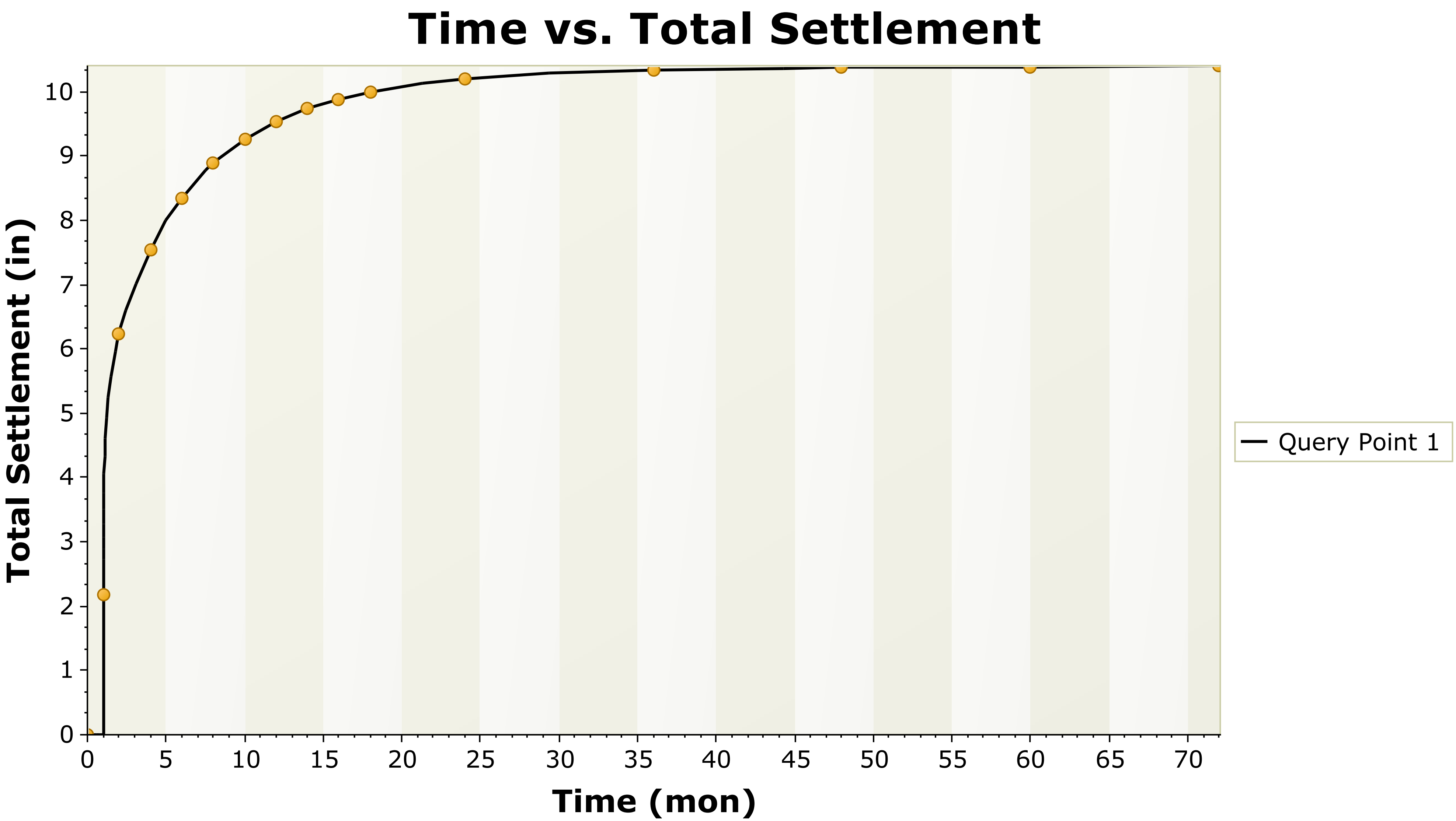
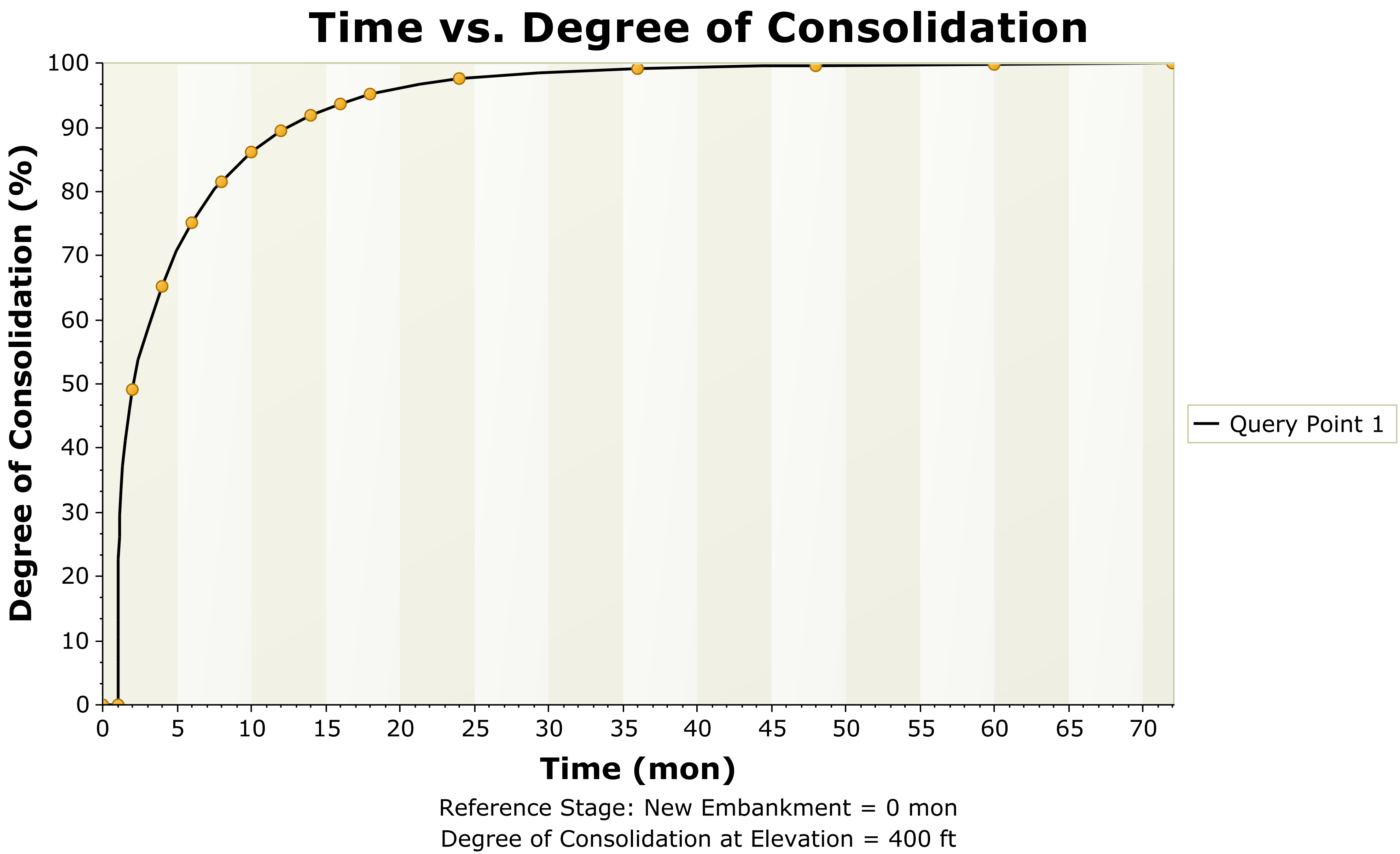


Reference Stage: New Embankment = 0 mon

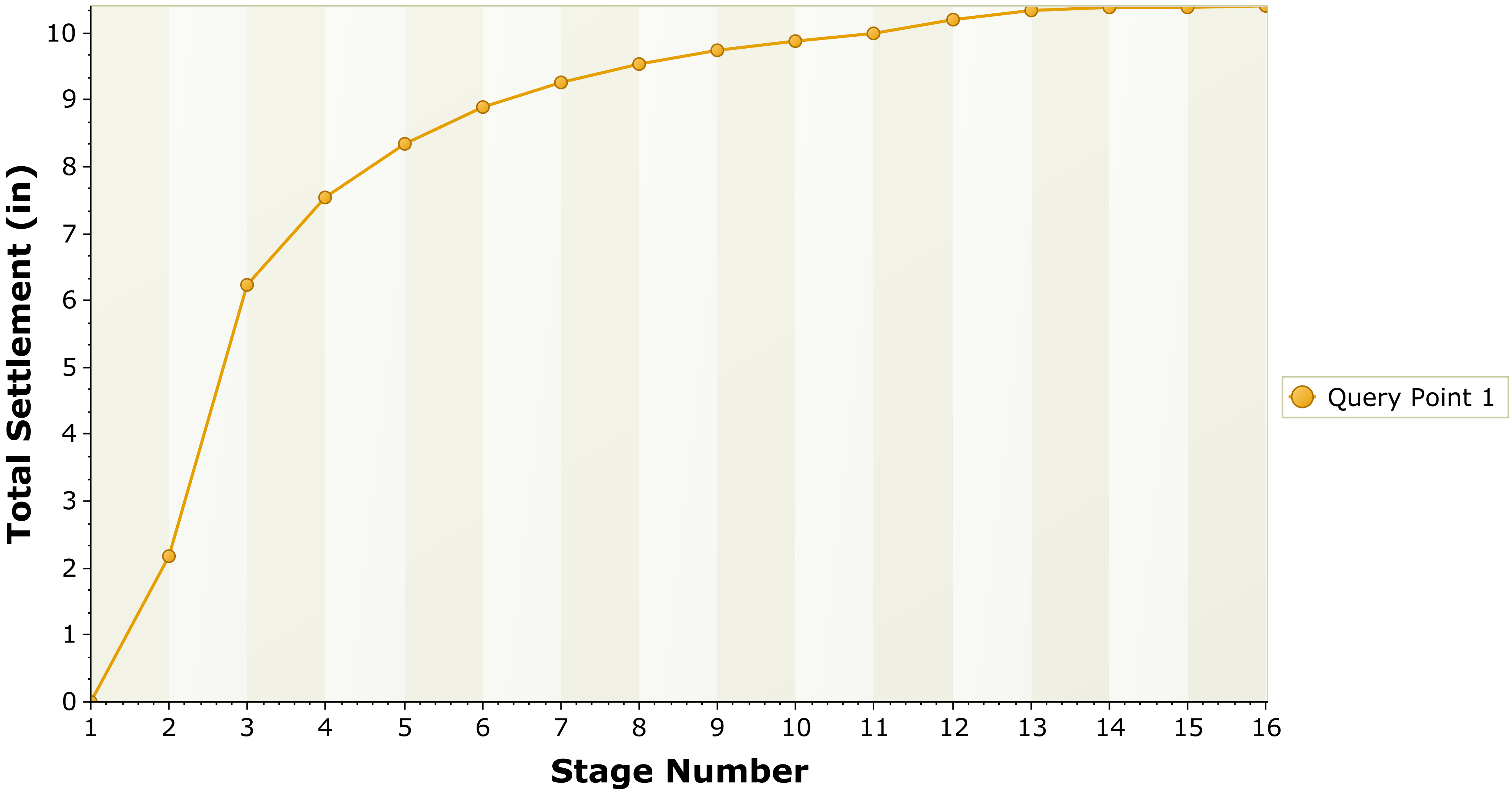
Total Settlement at Elevation = 400 ft

rocscience	*Project* I-49 Arkansas		
	Analysis Description North Approach Emankment Settlement - Bridge 16		
	Drawn By PA	*Company* HNTB	
SETTLE3 5.022	*Date* 11/25/2023, 8:32:18 AM	*File Name* North Approach Embankment_259+00 20231115.s3z	



rocscience	*Project* I-49 Arkansas		
	Analysis Description North Approach Emankment Settlement - Bridge 16		
	Drawn By PA	*Company* HNTB	
SETTLE3 5.022	*Date* 11/25/2023, 8:32:18 AM	*File Name* North Approach Embankment_259+00 20231115.s3z	

Stage Number vs. Total Settlement



Reference Stage: New Embankment = 0 mon

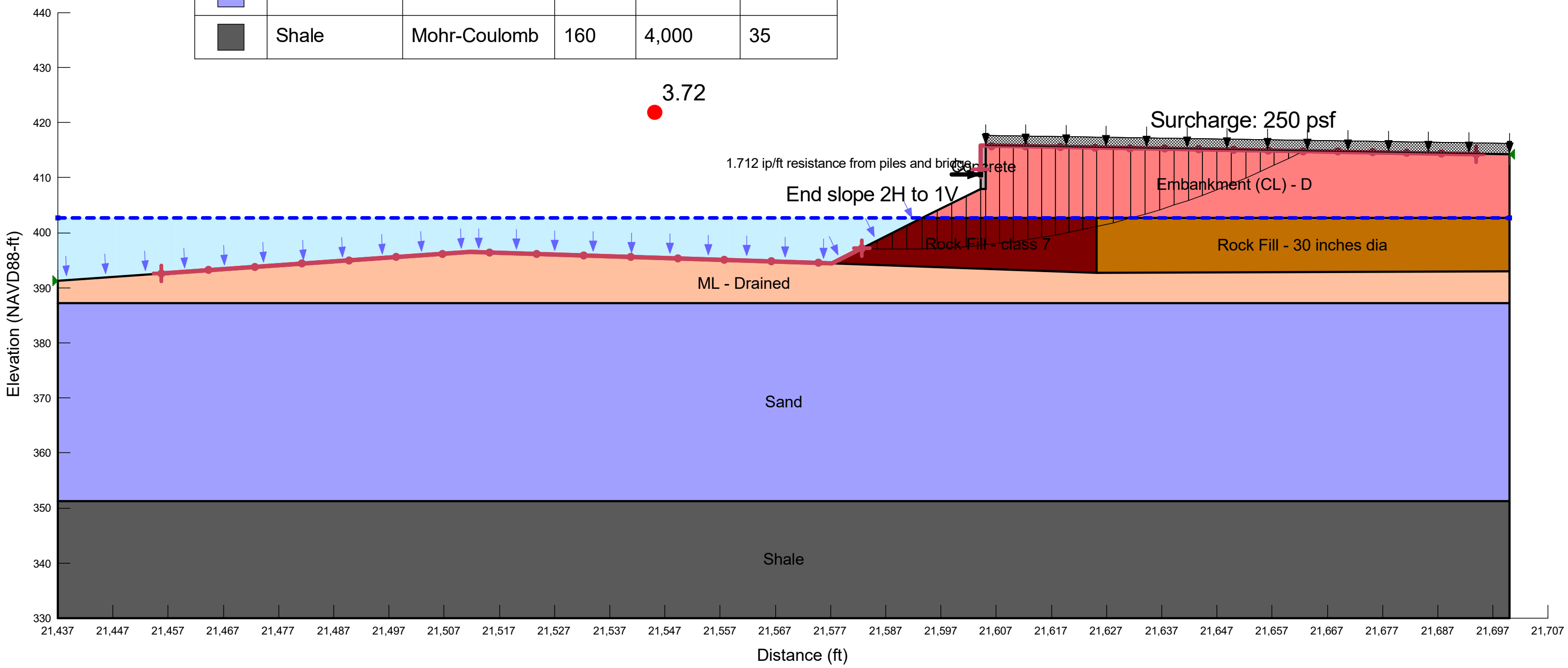
Total Settlement at Elevation = 400 ft

rocscience	*Project* I-49 Arkansas		
	Analysis Description North Approach Emankment Settlement - Bridge 16		
	Drawn By PA	*Company* HNTB	
SETTLE3 5.022	*Date* 11/25/2023, 8:32:18 AM	*File Name* North Approach Embankment_259+00 20231115.s3z	

Appendix 5: Global Stability Analysis Results

North Approach End slope SLOPE/W results

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	ML - Drained	Mohr-Coulomb	120	0	26
	Concrete	High Strength	0.01		
	Embankment (CL) - D	Mohr-Coulomb	125	160	26
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40
	Rock Fill - class 7	Mohr-Coulomb	135	0	40
	Sand	Mohr-Coulomb	125	0	33
	Shale	Mohr-Coulomb	160	4,000	35



ARDOT ARKANSAS DEPARTMENT OF TRANSPORTATION HNTB

	Project	I-49 Crawford County	
	Analysis Description	Bridge 1 North End Slopes Long Term	
	Designer/Author PA	*Station* 216+04.08	
Project Number 63136	*Date* 11/10/2023	*File Name* 1_North Approach End slope_20231110.gsz	

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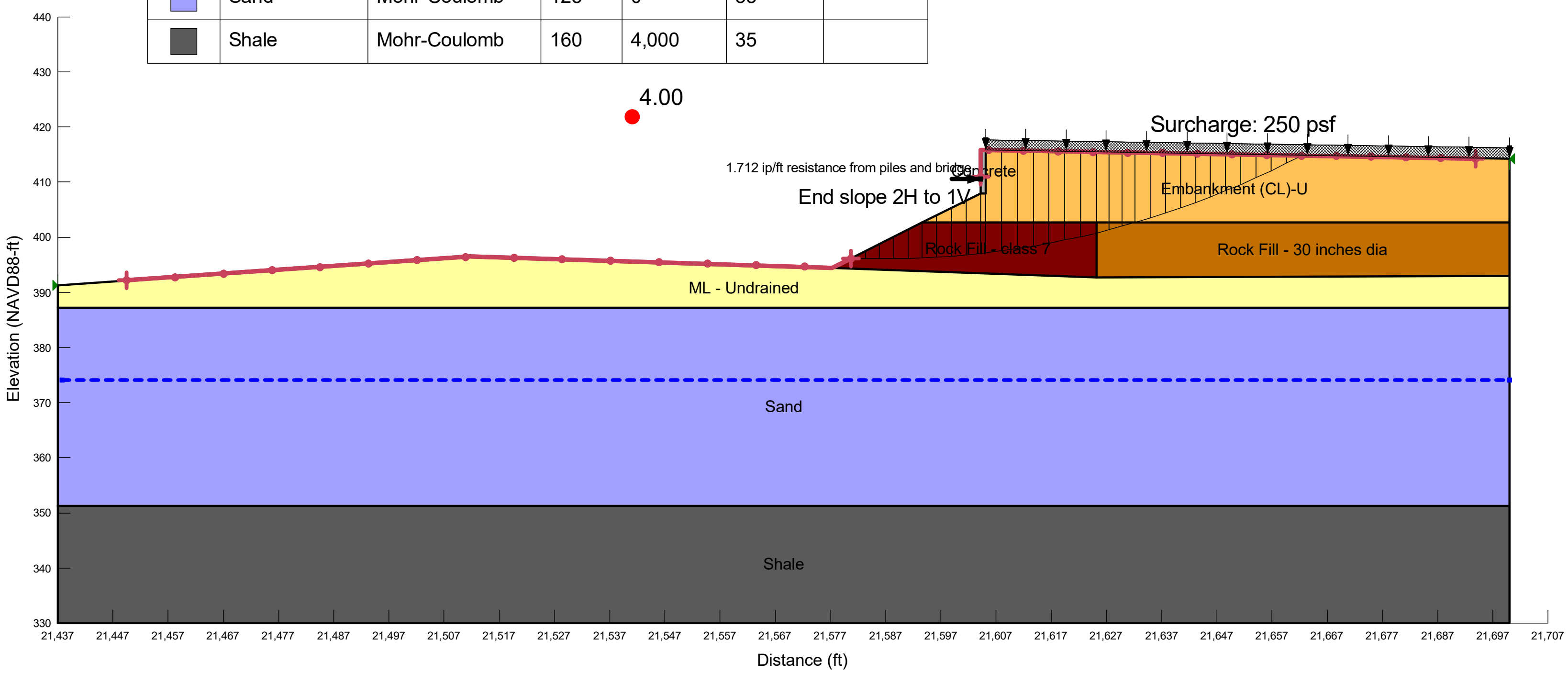
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Total Cohesion (psf)
	ML - Undrained	Undrained (Phi=0)	120			500
	Concrete	High Strength	0.01			
	Embankment (CL)-U	Undrained (Phi=0)	125			800
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40	
	Rock Fill - class 7	Mohr-Coulomb	135	0	40	
	Sand	Mohr-Coulomb	125	0	33	
	Shale	Mohr-Coulomb	160	4,000	35	



ARDOT HNTB	*Project*	I-49 Crawford County	
	Analysis Description	Bridge 1 North End Slopes Short Term	
	Designer/Author PA	*Station* 216+04.08	
Project Number 63136	*Date* 11/10/2023	*File Name* 1_North Approach End slope_20231110.gsz	

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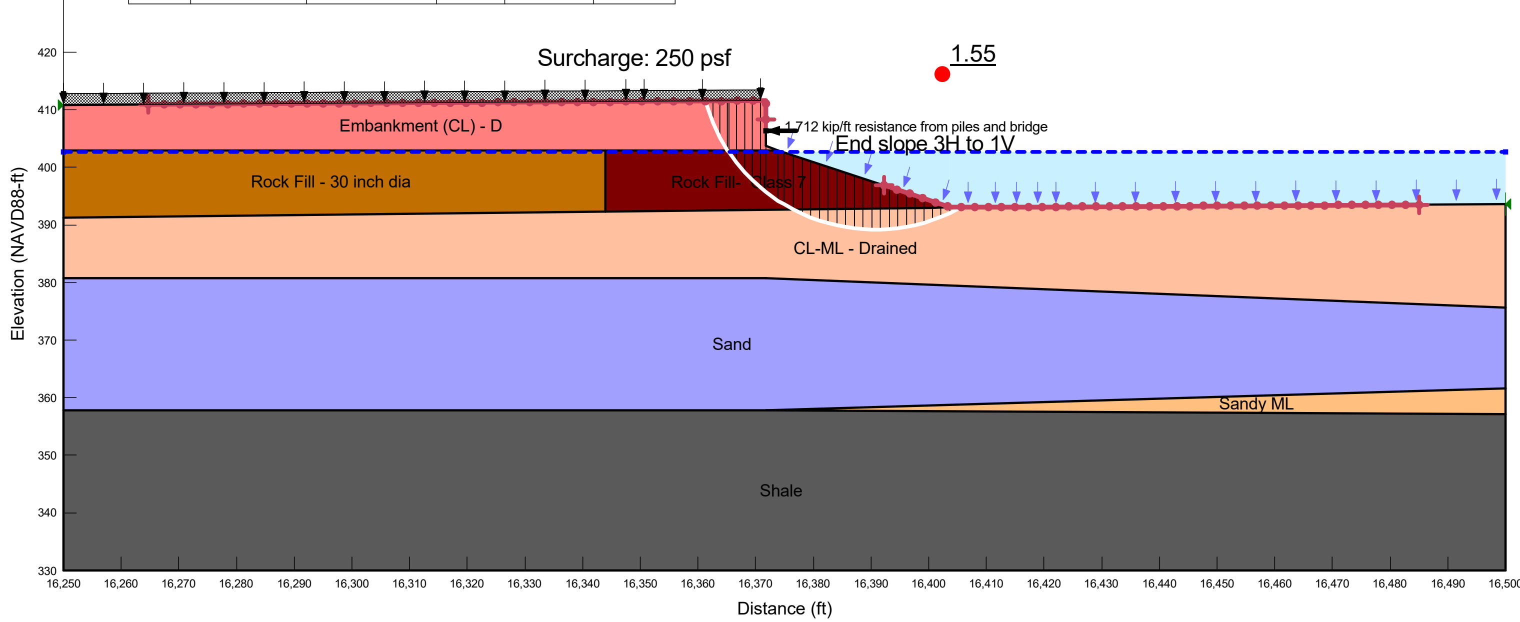
South Approach End slope SLOPE/W results

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	CL-ML - Drained	Mohr-Coulomb	120	0	26
	Embankment (CL) - D	Mohr-Coulomb	125	160	26
	Rock Fill - 30 inch dia	Mohr-Coulomb	145	0	40
	Rock Fill-Class 7	Mohr-Coulomb	135	0	40
	Sand	Mohr-Coulomb	125	0	33
	Sandy ML	Mohr-Coulomb	125	0	29
	Shale	Mohr-Coulomb	160	4,000	35



ARDOT HNTB

	Project I-49 Crawford County		
	Analysis Description Bridge 1 South End Slopes — Long Term		
	Designer/Author PA	*Station* 163+71.92	
Project Number 63136	*Date* 11/10/2023	*File Name* 1_South Approach End slope_20231109.gsz	

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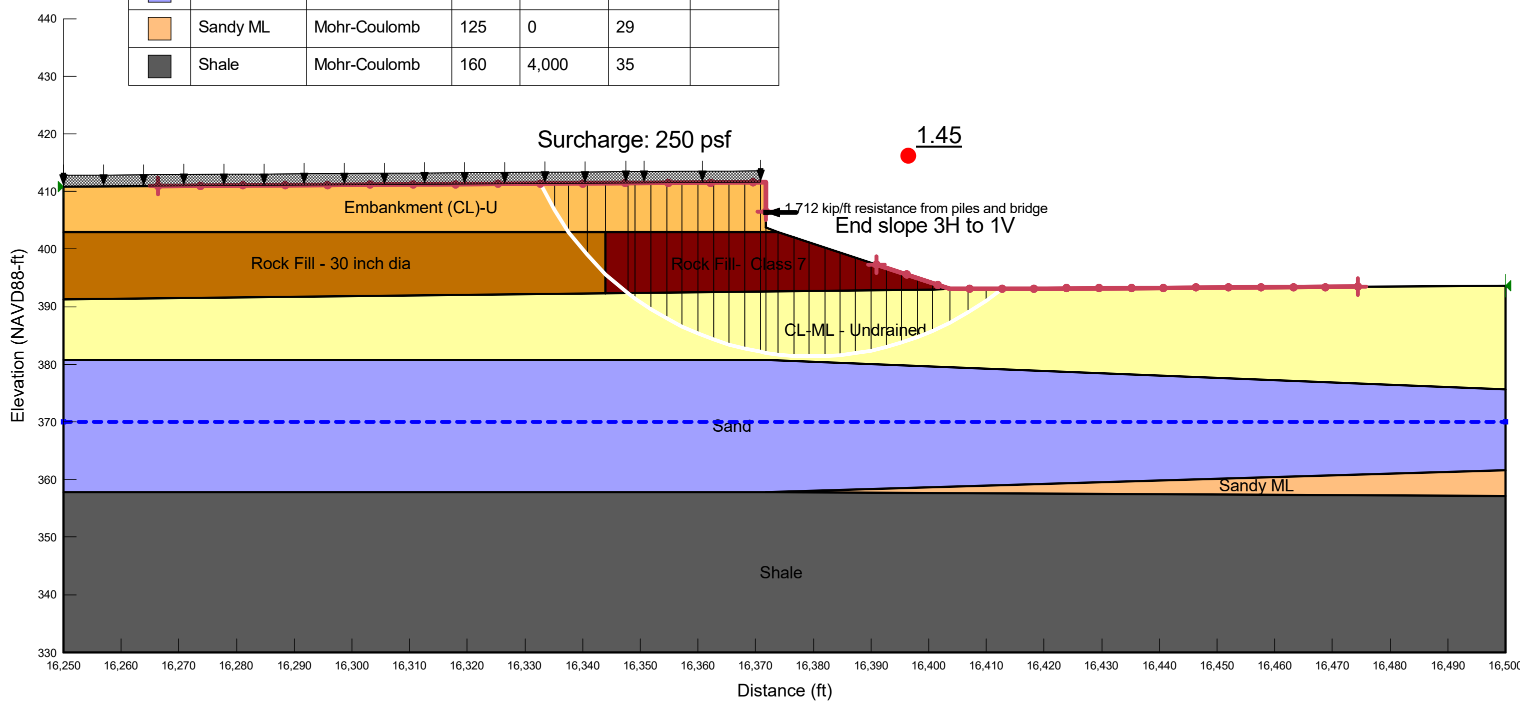
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Total Cohesion (psf)
	CL-ML - Undrained	Undrained (Phi=0)	120			500
	Embankment (CL)-U	Undrained (Phi=0)	125			800
	Rock Fill - 30 inch dia	Mohr-Coulomb	145	0	40	
	Rock Fill- Class 7	Mohr-Coulomb	135	0	40	
	Sand	Mohr-Coulomb	125	0	33	
	Sandy ML	Mohr-Coulomb	125	0	29	
	Shale	Mohr-Coulomb	160	4,000	35	



ARDOT HNTB	*Project*	I-49 Crawford County	
	Analysis Description	Bridge 1 South End Slopes	Short Term
	Designer/Author PA	*Station* 163+71.92	
Project Number 63136	*Date* 11/10/2023	*File Name* 1_South Approach End slope_20231109.gsz	

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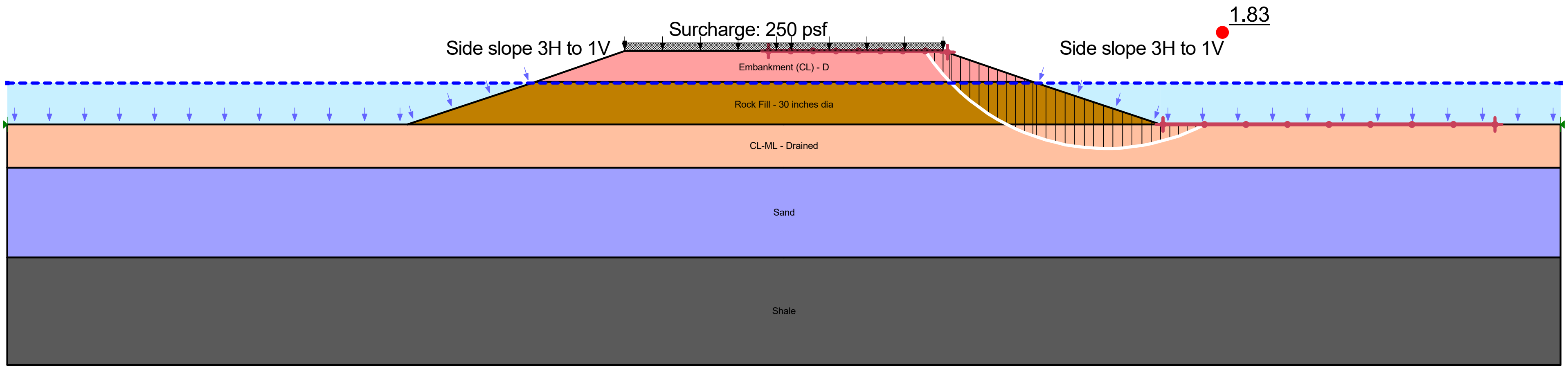
SLOPE/W South Approach Side slope

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	CL-ML - Drained	Mohr-Coulomb	120	0	26
	Embankment (CL) - D	Mohr-Coulomb	125	160	26
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40
	Sand	Mohr-Coulomb	125	0	33
	Shale	Mohr-Coulomb	160	4,000	35



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	Analysis Description	Bridge 1 South Approach Side Slopes Long Term	
	Designer/Author: PA	Station: 163+20	
Project Number: 63136	Date: 11/13/2023	File Name: 1_South Approach side slope_20230605.gsz	

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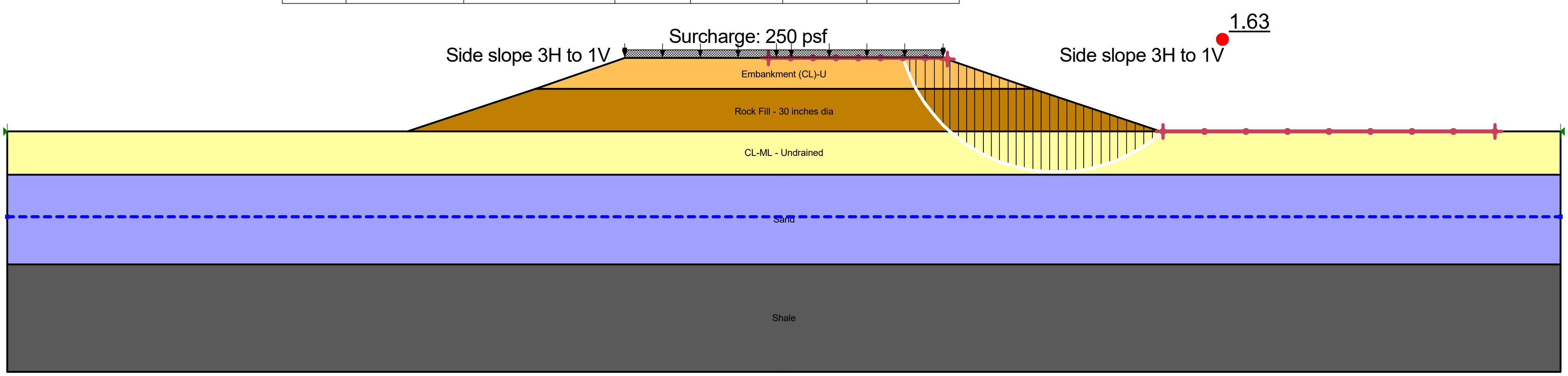
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Total Cohesion (psf)
	CL-ML - Undrained	Undrained (Phi=0)	120			500
	Embankment (CL)-U	Undrained (Phi=0)	125			800
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40	
	Sand	Mohr-Coulomb	125	0	33	
	Shale	Mohr-Coulomb	160	4,000	35	



Project	I-49 Crawford County
Analysis Description	Bridge 1 South Approach Side Slopes — Short Term
Designer/Author	PA
Station	163+20
Project Number	63136
Date	11/13/2023
File Name	1_South Approach side slope_20230605.gsz

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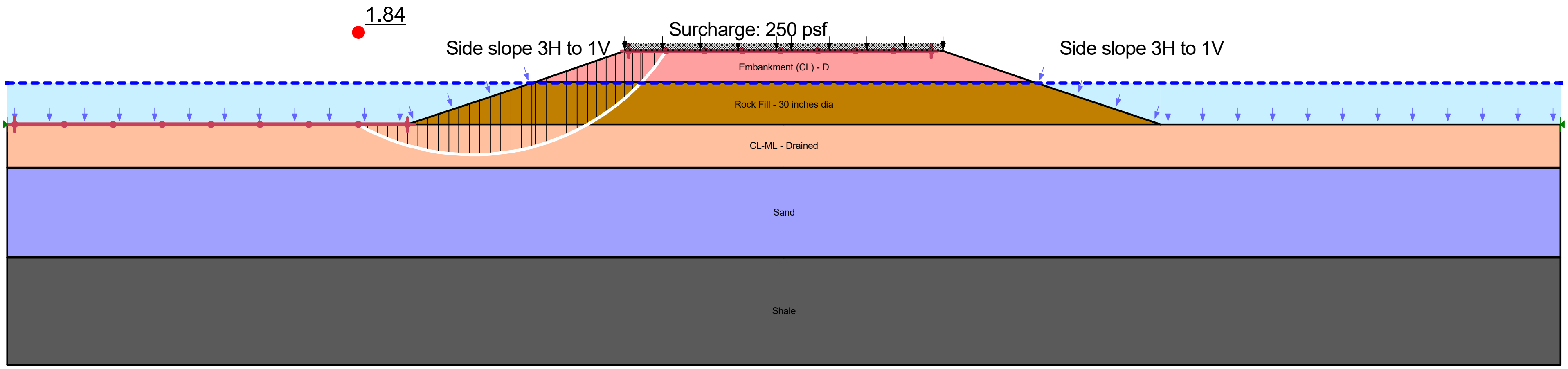
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	CL-ML - Drained	Mohr-Coulomb	120	0	26
	Embankment (CL) - D	Mohr-Coulomb	125	160	26
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40
	Sand	Mohr-Coulomb	125	0	33
	Shale	Mohr-Coulomb	160	4,000	35



Project	I-49 Crawford County		
Analysis Description	Bridge 1 South Approach Side Slopes Long Term		
Designer/Author	PA	Station	163+20
Date	11/13/2023	File Name	1_South Approach side slope_20230605.gsz

Project Number 63136

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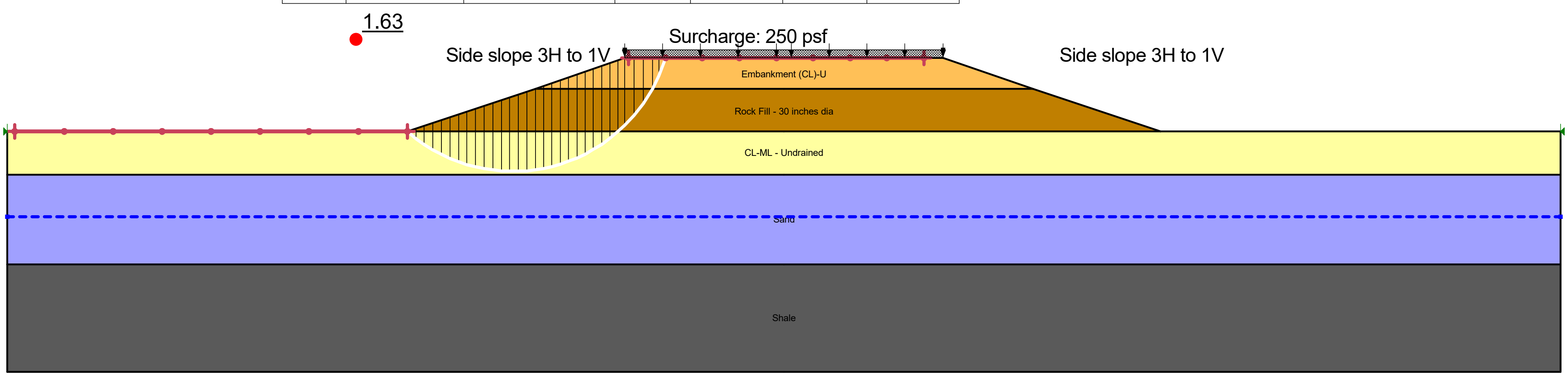
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Total Cohesion (psf)
	CL-ML - Undrained	Undrained (Phi=0)	120			500
	Embankment (CL)-U	Undrained (Phi=0)	125			800
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40	
	Sand	Mohr-Coulomb	125	0	33	
	Shale	Mohr-Coulomb	160	4,000	35	



	Project I-49 Crawford County		
	Analysis Description Bridge 1 South Approach Side Slopes Short Term		
	Designer/Author PA	*Station* 163+20	
Project Number 63136	*Date* 11/13/2023	*File Name* 1_South Approach side slope_20230605.gsz	

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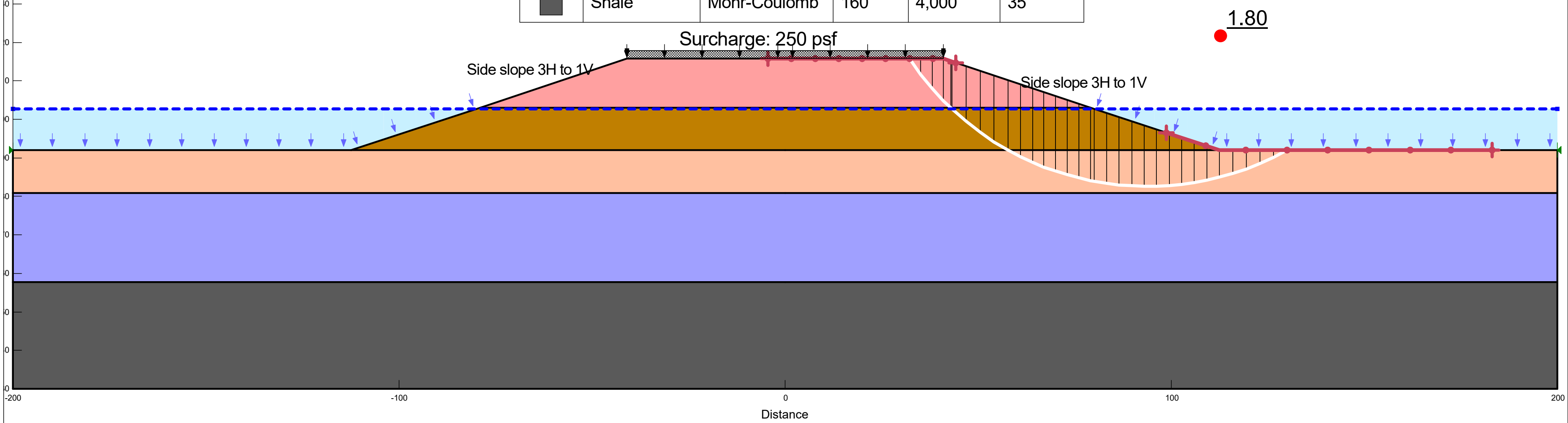
SLOPE/W North Approach Side slope

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	ML - Drained	Mohr-Coulomb	120	0	26
	Embankment (CL) - D	Mohr-Coulomb	125	160	26
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40
	Sand	Mohr-Coulomb	125	0	33
	Shale	Mohr-Coulomb	160	4,000	35



Project	I-49 Crawford County
Analysis Description	Bridge 1 North Approach Side Slopes Long Term
Designer/Author	PA
Station	216+25
Project Number	63136
Date	11/10/2023
File Name	1_North Approach side slope_20231110.gsz

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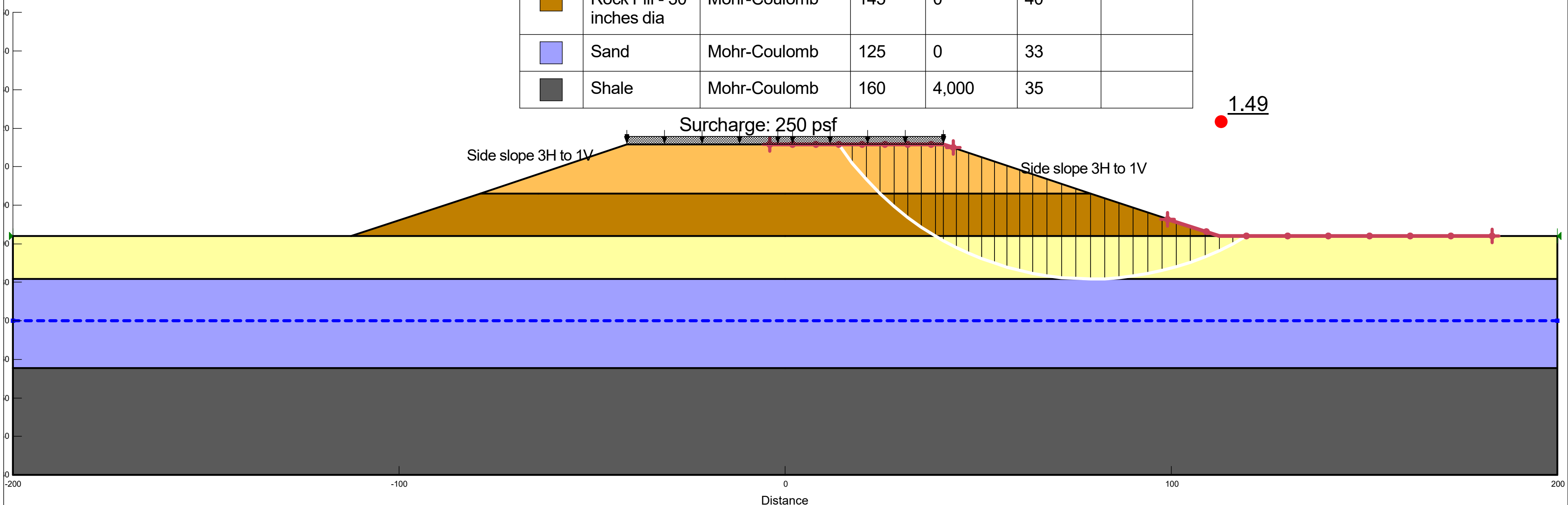
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Total Cohesion (psf)
	ML - Undrained	Undrained (Phi=0)	120			500
	Embankment (CL)-U	Undrained (Phi=0)	125			800
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40	
	Sand	Mohr-Coulomb	125	0	33	
	Shale	Mohr-Coulomb	160	4,000	35	



Project	I-49 Crawford County
Analysis Description	Bridge 1 North Approach Side Slopes Short Term
Designer/Author	PA
Station	216+25
Project Number	63136
Date	11/10/2023
File Name	1_North Approach side slope_20231110.gsz

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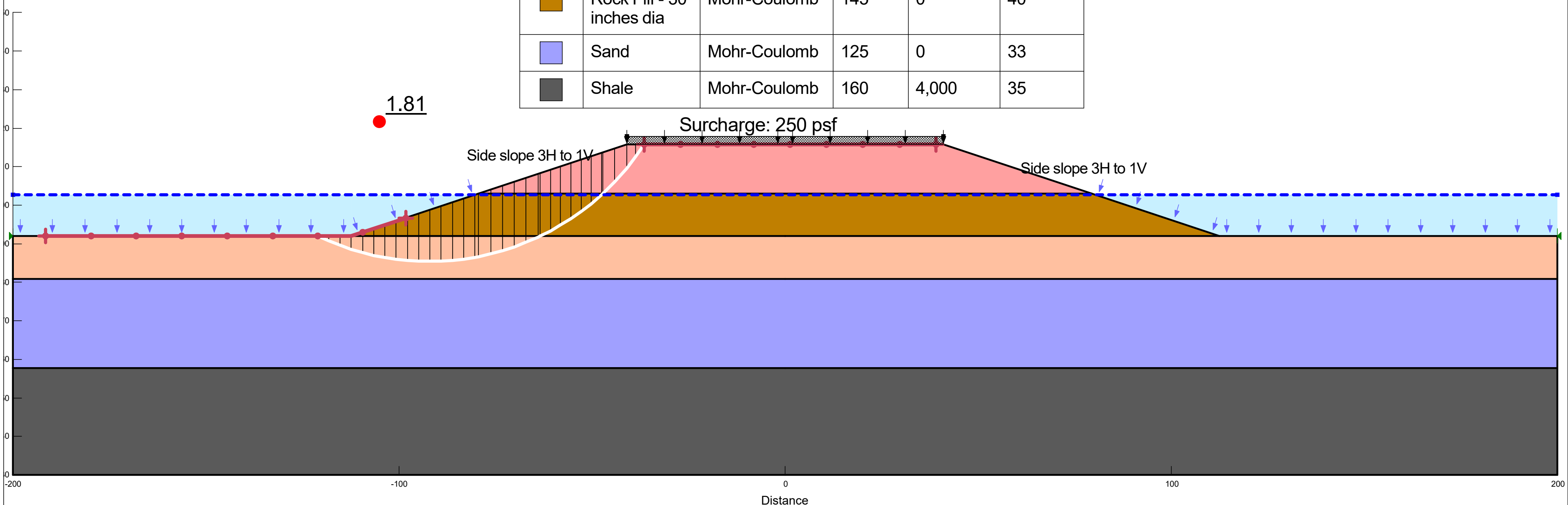
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	ML - Drained	Mohr-Coulomb	120	0	26
	Embankment (CL) - D	Mohr-Coulomb	125	160	26
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40
	Sand	Mohr-Coulomb	125	0	33
	Shale	Mohr-Coulomb	160	4,000	35



ARDOT HNTB	*Project* I-49 Crawford County		
	Analysis Description Bridge 1 North Approach Side Slopes Long Term		
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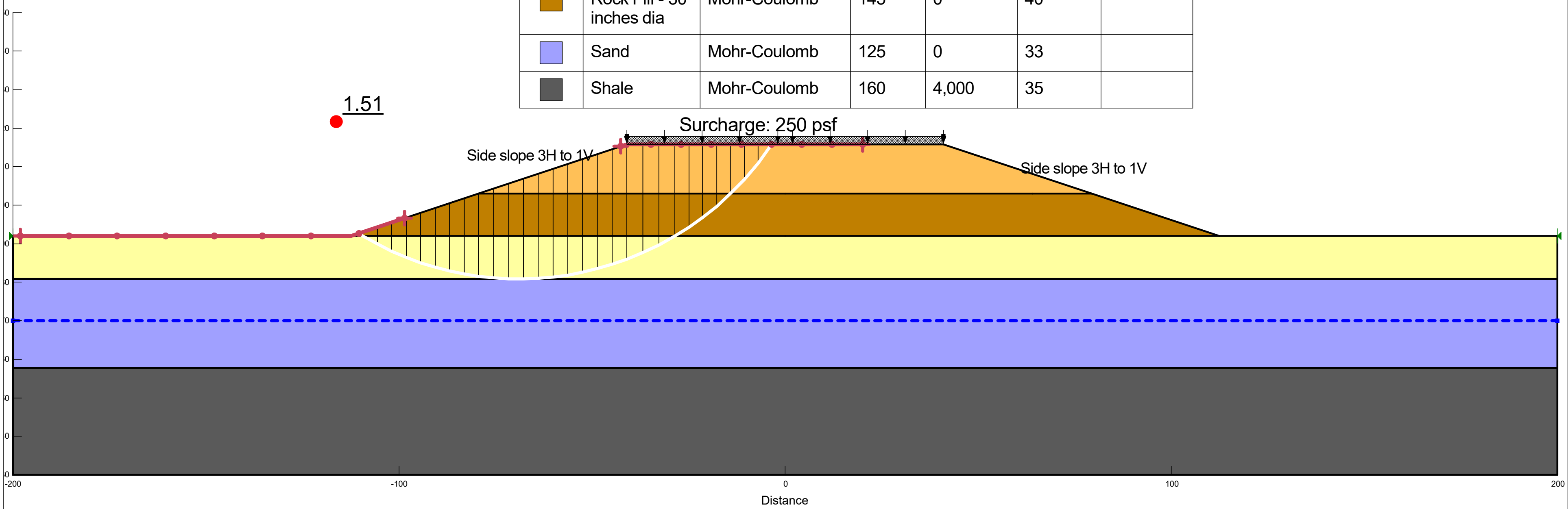
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Total Cohesion (psf)
	ML - Undrained	Undrained (Phi=0)	120			500
	Embankment (CL)-U	Undrained (Phi=0)	125			800
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40	
	Sand	Mohr-Coulomb	125	0	33	
	Shale	Mohr-Coulomb	160	4,000	35	



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	Analysis Description	Bridge 1 North Approach Side Slopes Short Term	
	Designer/Author: PA	Station: 216+25	
Project Number: 63136	Date: 11/10/2023	File Name: 1_North Approach side slope_20231110.gsz	

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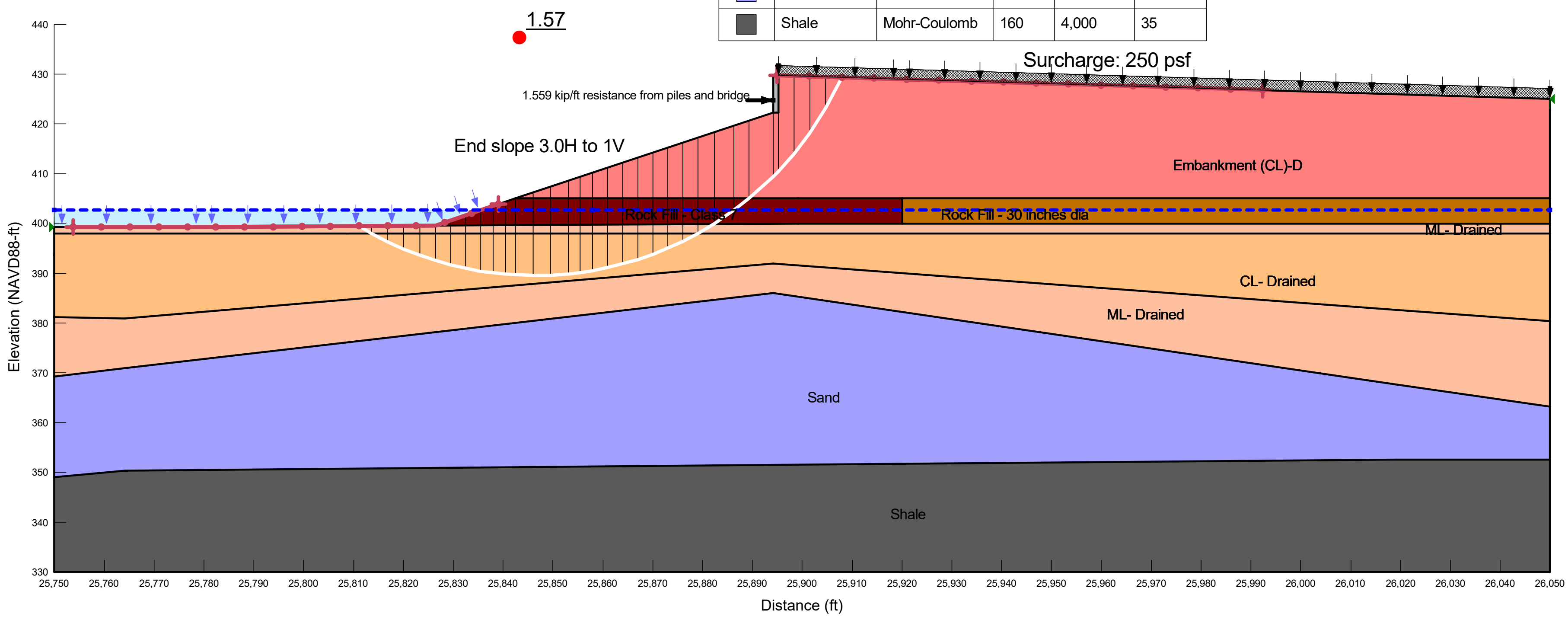
SLOPE/W North Approach End slope

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	CL - Drained	Mohr-Coulomb	120	0	26
	Concrete	High Strength	0.01		
	Embankment (CL) - D	Mohr-Coulomb	125	160	26
	ML -Drained	Mohr-Coulomb	125	0	26
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40
	Rock Fill - class 7	Mohr-Coulomb	135	0	40
	Sand	Mohr-Coulomb	125	0	30
	Shale	Mohr-Coulomb	160	4,000	35



Project	I-49 Crawford County
Analysis Description	Bridge 16 North End Slopes Long Term
Designer/Author	**PA**
Station	258+94.08
Project Number	63136
Date	11/10/2023
File Name	16_North Approach End slope_20231106.gsz

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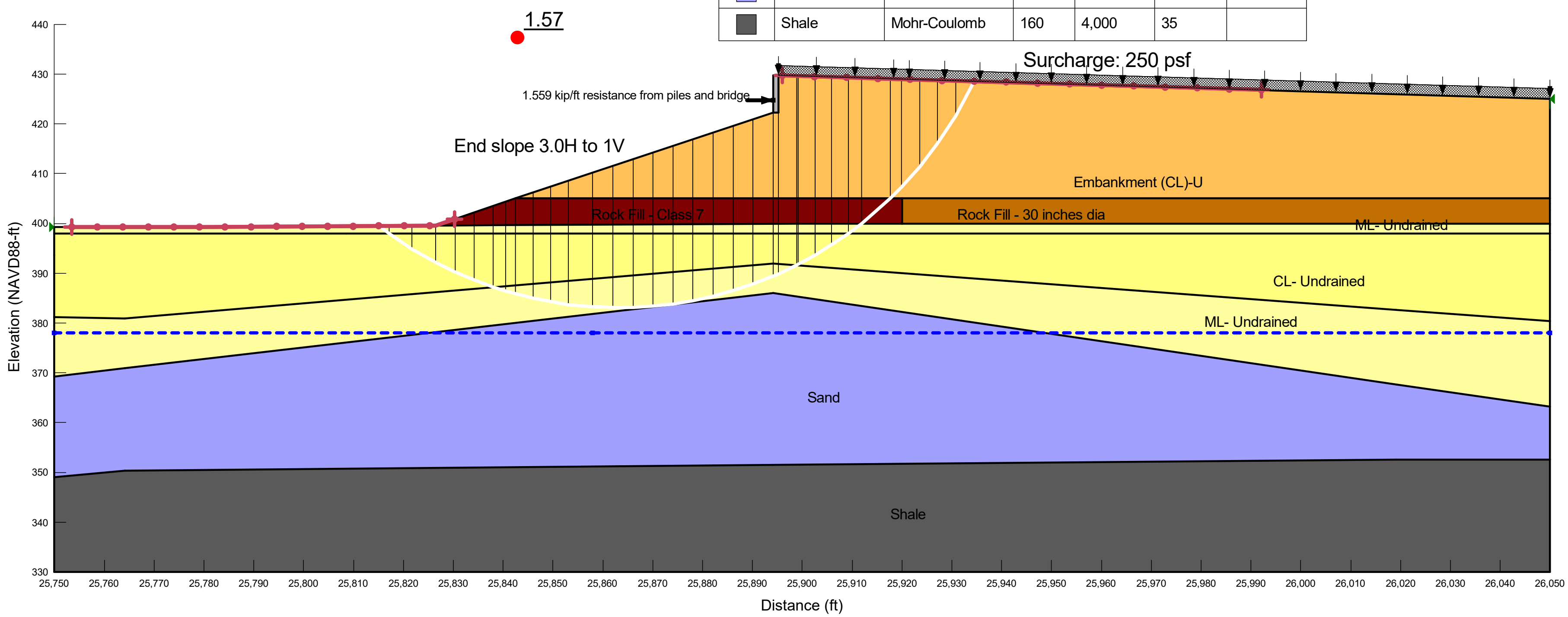
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Total Cohesion (psf)
	CL - Undrained	Undrained (Phi=0)	120			1,000
	Concrete	High Strength	0.01			
	Embankment (CL)-U	Undrained (Phi=0)	125			800
	ML - Undrained	Undrained (Phi=0)	125			850
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40	
	Rock Fill - class 7	Mohr-Coulomb	135	0	40	
	Sand	Mohr-Coulomb	125	0	30	
	Shale	Mohr-Coulomb	160	4,000	35	



	Project	I-49 Crawford County	
	Analysis Description	Bridge 16 North End Slopes Short Term	
	Designer/Author PA	*Station* 258+94.08	
Project Number 63136	*Date* 11/10/2023	*File Name* 16_North Approach End slope_20231106.gsz	

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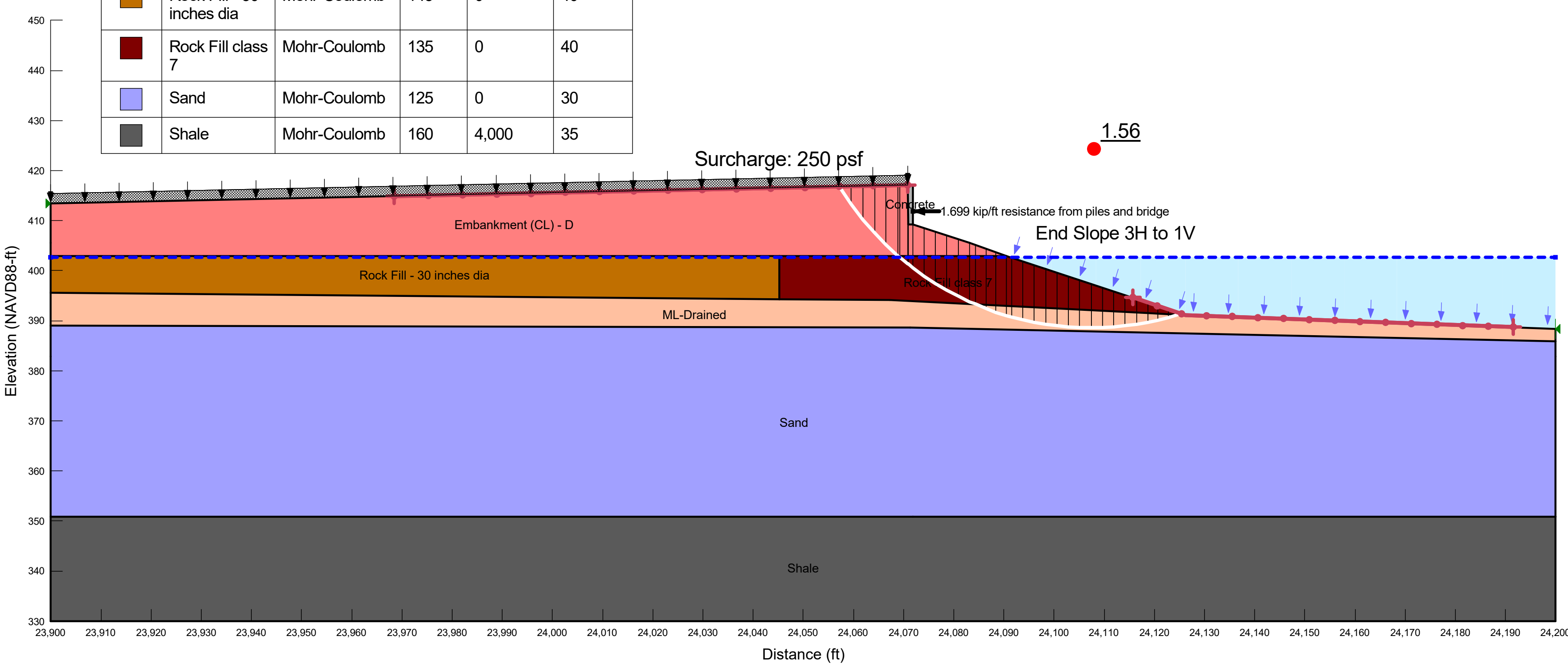
SLOPE/W South Approach End slope

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Concrete	High Strength	0.01		
	Embankment (CL) - D	Mohr-Coulomb	125	160	26
	ML-Drained	Mohr-Coulomb	120	0	26
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40
	Rock Fill class 7	Mohr-Coulomb	135	0	40
	Sand	Mohr-Coulomb	125	0	30
	Shale	Mohr-Coulomb	160	4,000	35



ARDOT HNTB	*Project*	I-49 Crawford County	
	Analysis Description	Bridge 16 South End Slopes Long Term	
	Designer/Author PA	*Station* 240+71.92	
Project Number 63136	*Date* 11/10/2023	*File Name* 16_South Approach End slope_20231130.gsz	

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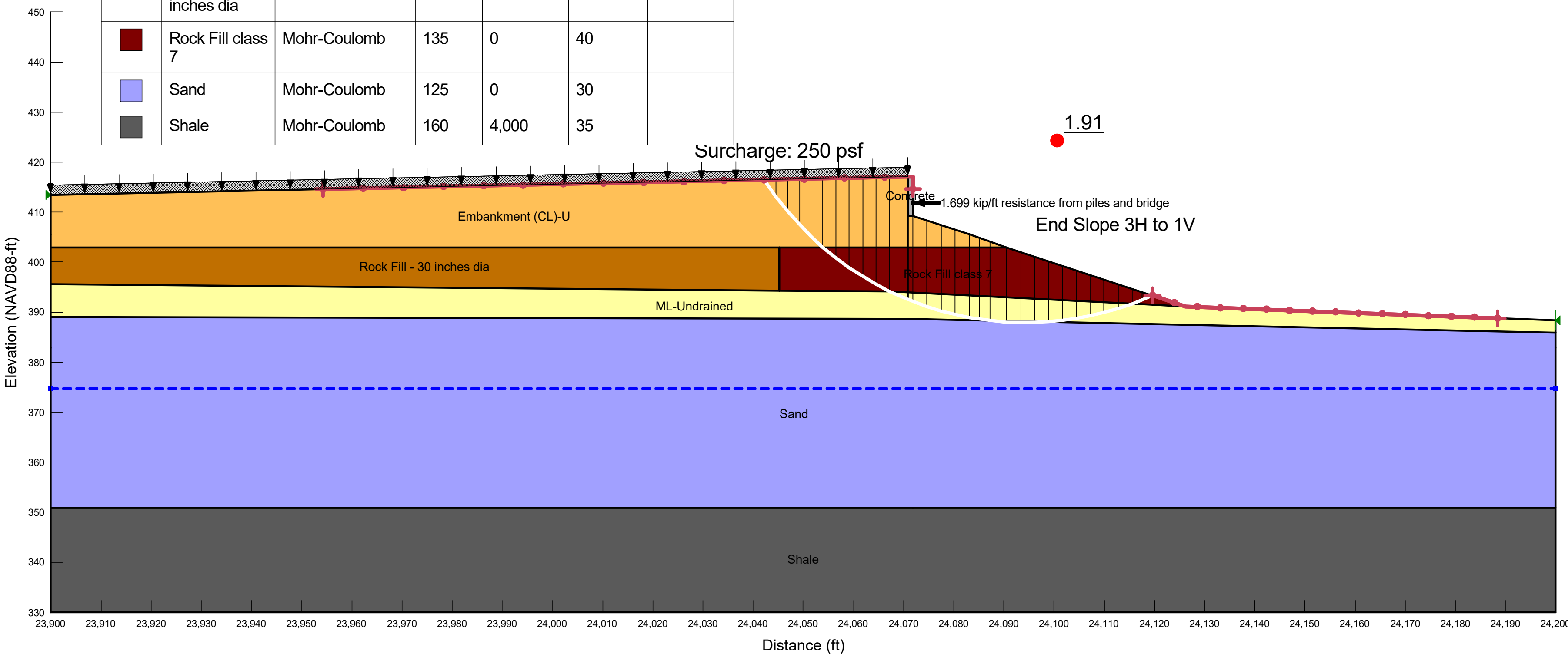
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Total Cohesion (psf)
	Concrete	High Strength	0.01			
	Embankment (CL)-U	Undrained (Phi=0)	125			800
	ML-Undrained	Undrained (Phi=0)	120			500
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40	
	Rock Fill class 7	Mohr-Coulomb	135	0	40	
	Sand	Mohr-Coulomb	125	0	30	
	Shale	Mohr-Coulomb	160	4,000	35	



	Project	I-49 Crawford County
	Analysis Description	Bridge 16 South End Slopes Short Term
	Designer/Author PA	Station 240+71.92
Project Number 63136	Date 11/10/2023	File Name 16_South Approach End slope_20231130.gsz

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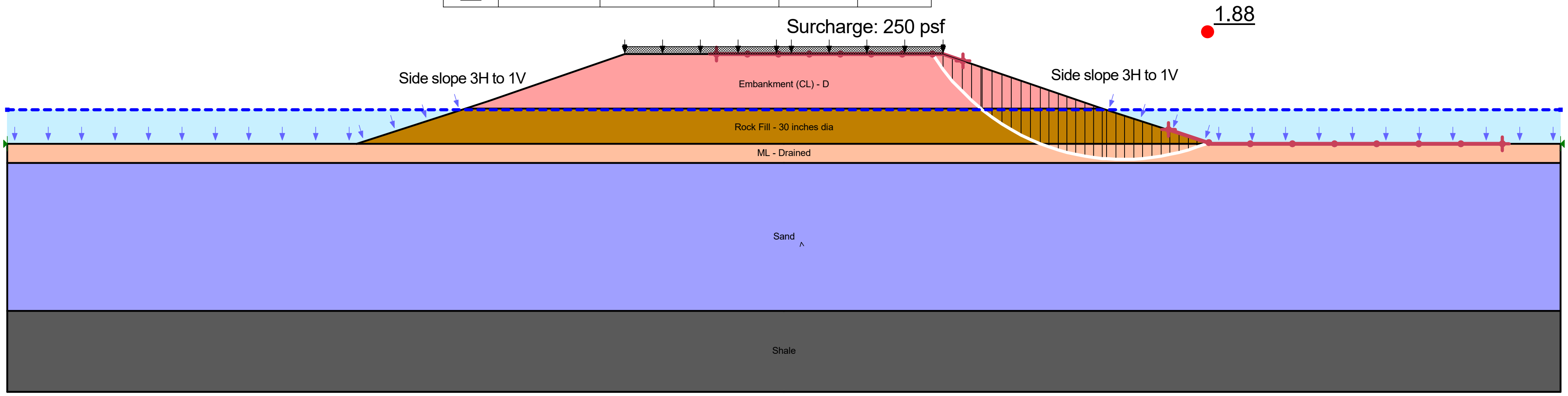
SLOPE/W South Approach Side slope

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Embankment (CL) - D	Mohr-Coulomb	125	160	26
	ML - Drained	Mohr-Coulomb	120	0	26
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40
	Sand	Mohr-Coulomb	125	0	30
	Shale	Mohr-Coulomb	160	4,000	35



	Project	I-49 Crawford County	
	Analysis Description	Bridge 16 South Approach Side Slopes	Long Term
	Designer/Author PA	*Station* 240+30	
Project Number 63136	*Date* 11/10/2023	*File Name* 16_South Approach side slope_20231130.gsz	

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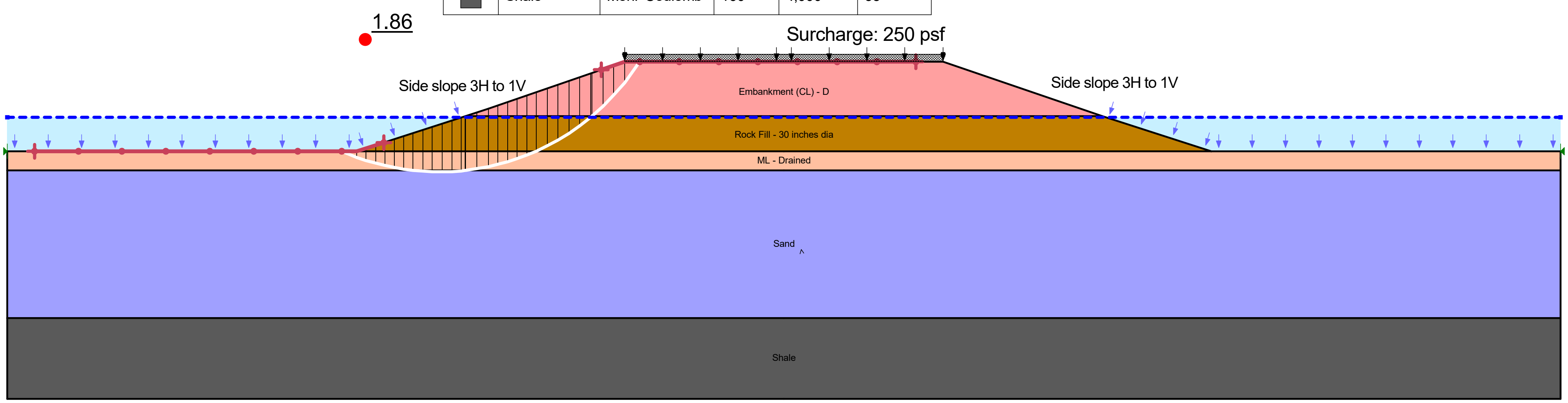
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Embankment (CL) - D	Mohr-Coulomb	125	160	26
	ML - Drained	Mohr-Coulomb	120	0	26
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40
	Sand	Mohr-Coulomb	125	0	30
	Shale	Mohr-Coulomb	160	4,000	35



	Project	I-49 Crawford County	
	Analysis Description	Bridge 16 South Approach Side Slopes	Long Term
	Designer/Author PA	Station 240+30	
Project Number 63136	Date 11/10/2023	File Name 16_South Approach side slope_20231130.gsz	

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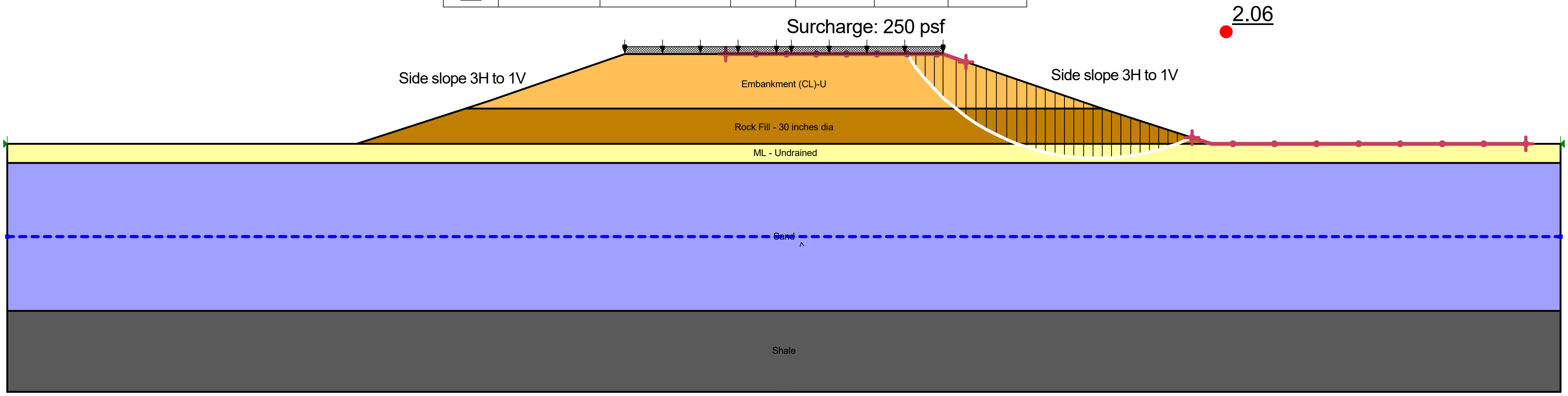
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Total Cohesion (psf)
	ML - Undrained	Undrained (Phi=0)	120			500
	Embankment (CL)-U	Undrained (Phi=0)	125			800
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40	
	Sand	Mohr-Coulomb	125	0	30	
	Shale	Mohr-Coulomb	160	4,000	35	



Project I-49 Crawford County

Analysis Description

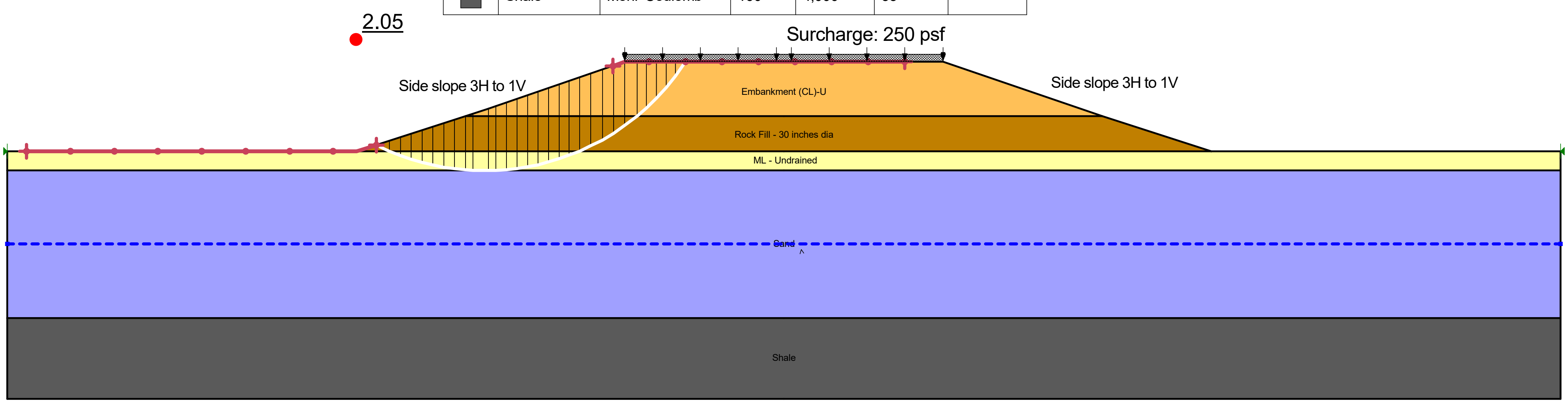
Bridge 16 South Approach Side Slopes — Short Term

Designer/Author **PA** | *Station* 240+30

Project Number 63136 | *Date* 11/10/2023 | *File Name* 16_South Approach side slope_20231130.gsz

Y:\63136\Design\Geotech\Analysis\1-Embankments\Bridge 16SB-NB Final\16_South Approach side slope_20231130.gsz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Total Cohesion (psf)
	ML - Undrained	Undrained (Phi=0)	120			500
	Embankment (CL)-U	Undrained (Phi=0)	125			800
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40	
	Sand	Mohr-Coulomb	125	0	30	
	Shale	Mohr-Coulomb	160	4,000	35	



Project	I-49 Crawford County		
Analysis Description	Bridge 16 South Approach Side Slopes	Short Term	
Designer/Author	PA	*Station*	240+30
Project Number 63136	*Date* 11/10/2023	*File Name*	16_South Approach side slope_20231130.gsz

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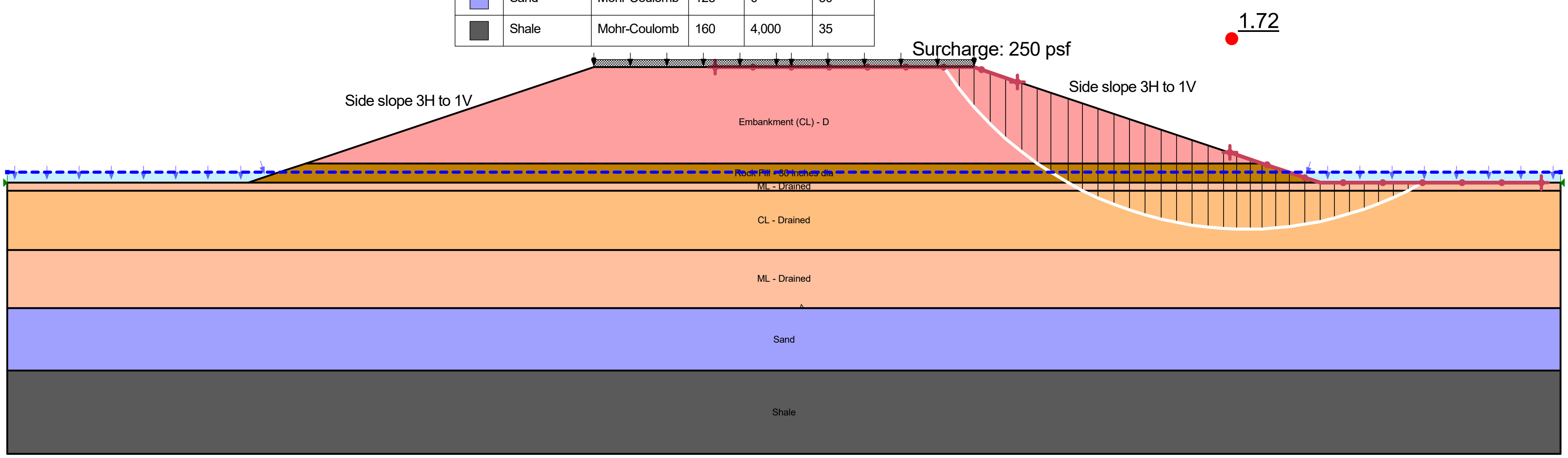
SLOPE/W North Approach Side slope

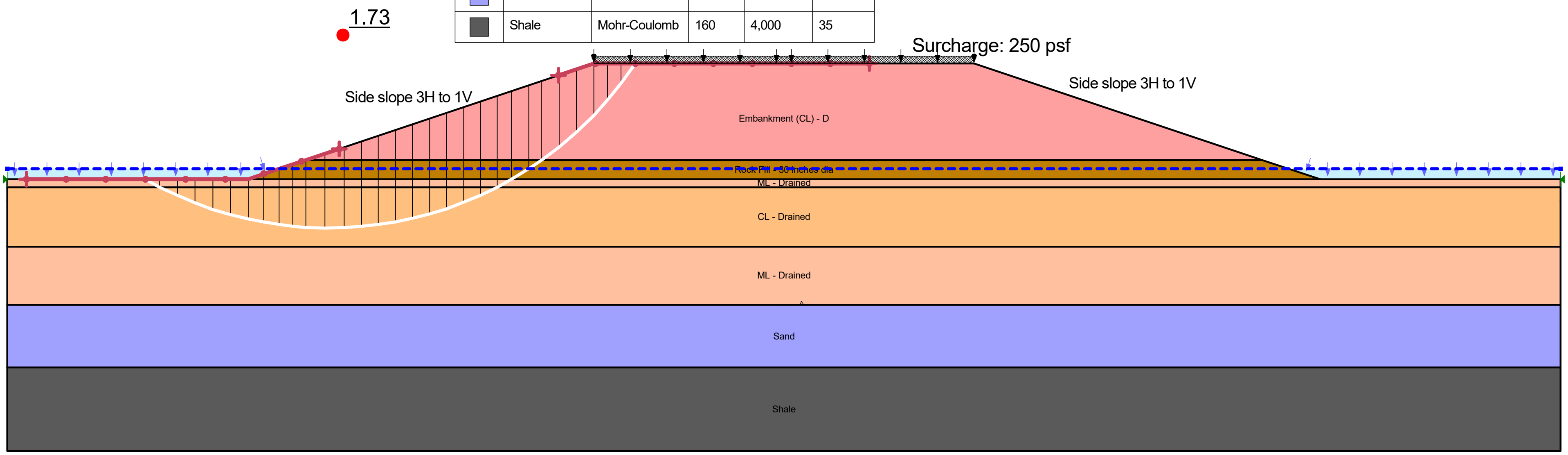
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	CL - Drained	Mohr-Coulomb	120	0	26
	Embankment (CL) - D	Mohr-Coulomb	125	160	26
	ML - Drained	Mohr-Coulomb	125	0	26
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40
	Sand	Mohr-Coulomb	125	0	30
	Shale	Mohr-Coulomb	160	4,000	35



Project	I-49 Crawford County	
Analysis Description	Bridge 16 North Approach Side Slopes	Long Term
Designer/Author	**PA**	*Station* 260+00
Project Number 63136	*Date* 11/10/2023	*File Name* 16_North Approach side slope_20231109.gsz

Y:\63136\Design\Geotech\Analysis\1-Embankments\Bridge 16SB-NB Final\16_North Approach side slope_20231109.gsz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	CL - Drained	Mohr-Coulomb	120	0	26
	Embankment (CL) - D	Mohr-Coulomb	125	160	26
	ML - Drained	Mohr-Coulomb	125	0	26
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40
	Sand	Mohr-Coulomb	125	0	30
	Shale	Mohr-Coulomb	160	4,000	35



Project	I-49 Crawford County
Analysis Description	Bridge 16 North Approach Side Slopes — Long Term
Designer/Author	PA
Station	260+00
Project Number	63136
Date	11/10/2023
File Name	16_North Approach side slope_20231109.gsz

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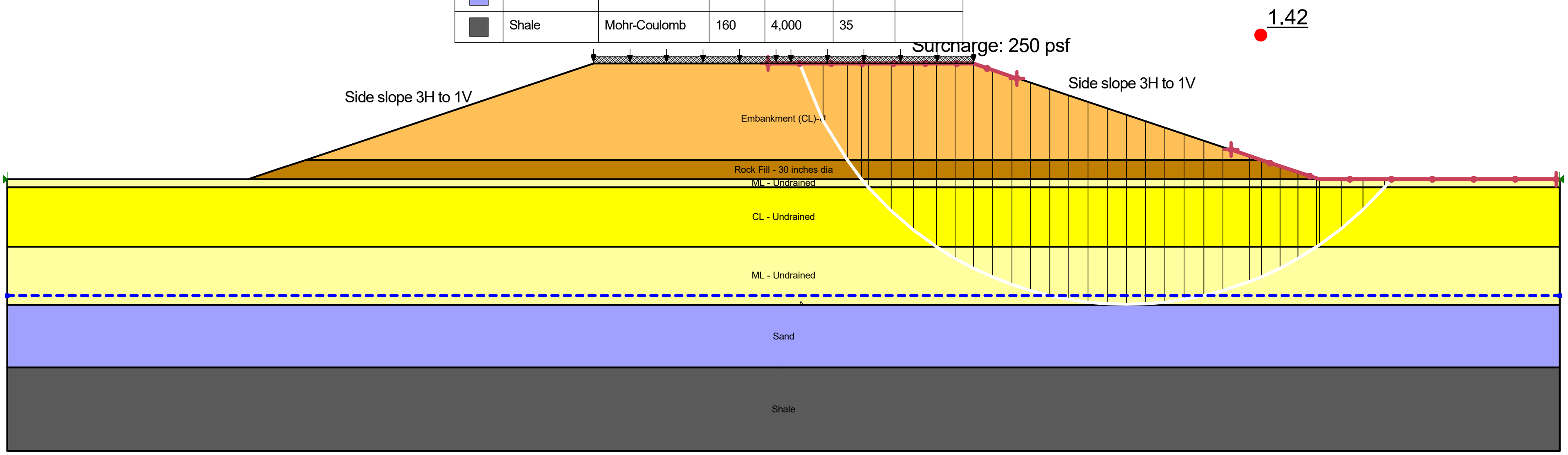
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Total Cohesion (psf)
	CL - Undrained	Undrained (Phi=0)	120			1,000
	Embankment (CL)-U	Undrained (Phi=0)	125			800
	ML - Undrained	Undrained (Phi=0)	125			850
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40	
	Sand	Mohr-Coulomb	125	0	30	
	Shale	Mohr-Coulomb	160	4,000	35	



ARDOT ARKANSAS DEPARTMENT OF TRANSPORTATION HNTB

Project I-49 Crawford County

Analysis Description Bridge 16 North Approach Side Slopes Short Term

Designer/Author PA *Station* 260+00

Project Number 63136 *Date* 11/10/2023 *File Name* 16_North Approach side slope_20231109.gsz

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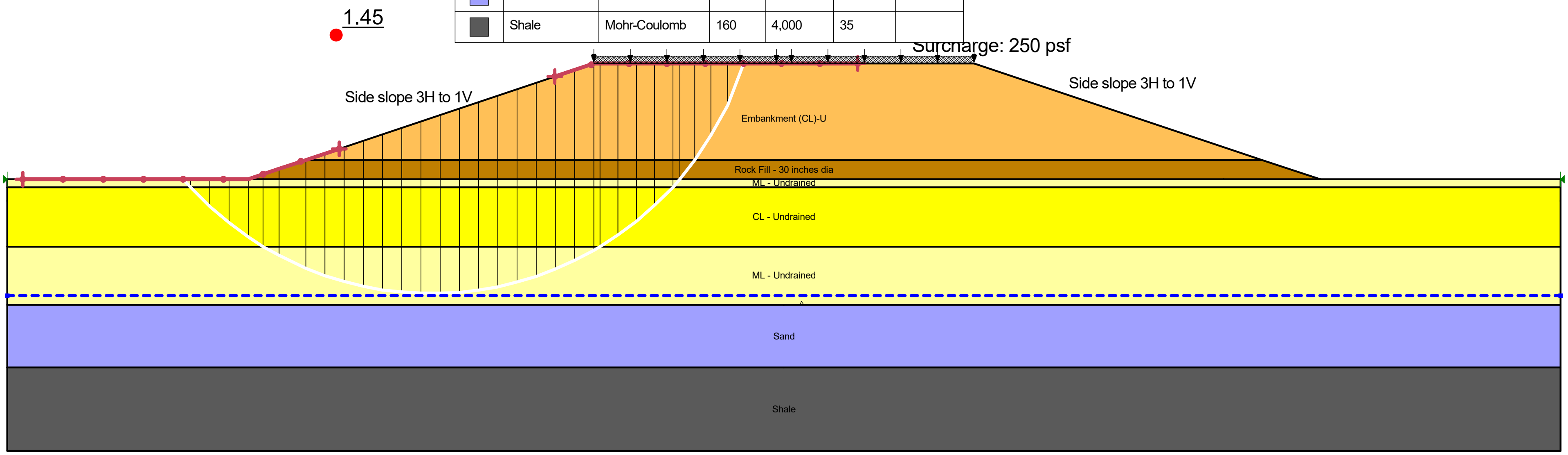
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Total Cohesion (psf)
	CL - Undrained	Undrained (Phi=0)	120			1,000
	Embankment (CL)-U	Undrained (Phi=0)	125			800
	ML - Undrained	Undrained (Phi=0)	125			850
	Rock Fill - 30 inches dia	Mohr-Coulomb	145	0	40	
	Sand	Mohr-Coulomb	125	0	30	
	Shale	Mohr-Coulomb	160	4,000	35	



	Project	I-49 Crawford County	
	Analysis Description	Bridge 16 North Approach Side Slopes	Short Term
	Designer/Author PA	*Station* 260+00	
Project Number 63136	*Date* 11/10/2023	*File Name* 16_North Approach side slope_20231109.gsz	

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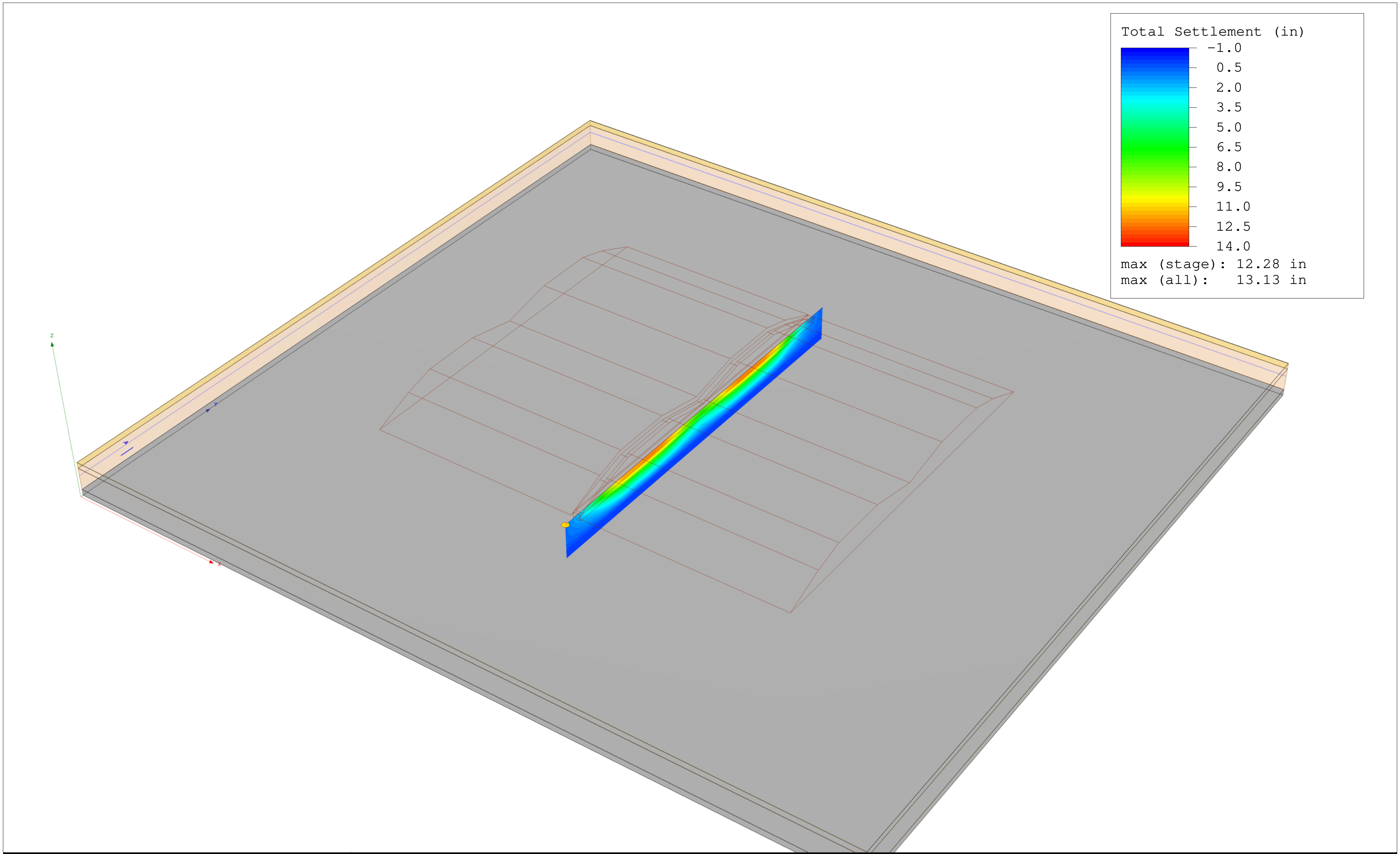
Appendix 6: Culvert Settlement Analysis

Proposed Structures

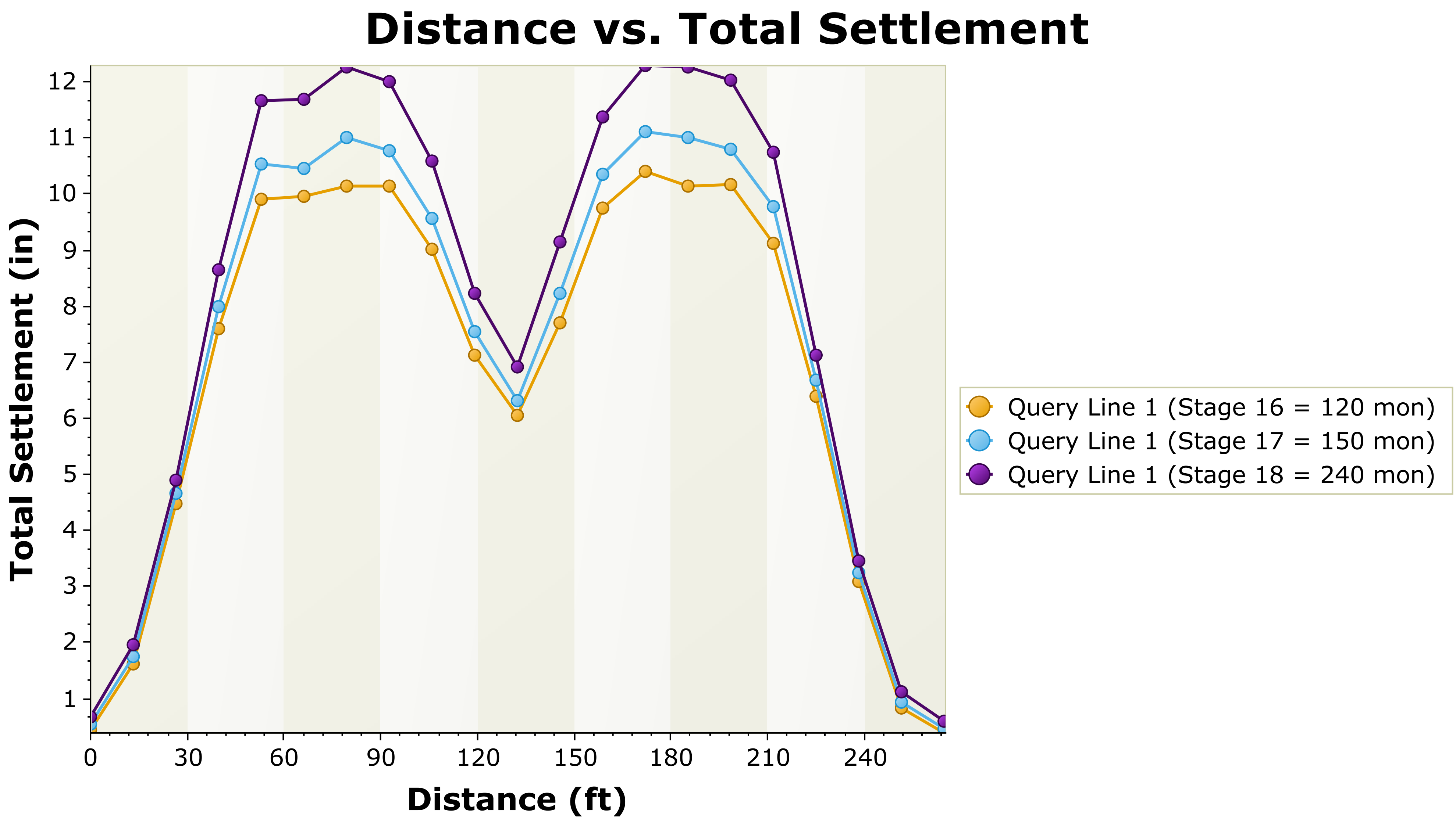
Culvert	Proposed Structure	Proposed Q_{50} WSEL (ft)	Proposed Q_{50} Outlet Velocity (ft/s)
106+60	2-8'x4' MBC	412.17	5.52
129+65	4'4' SBC	415.44	8.67
145+98	2-24" RCP	411.63	4.50
218+50	24" RCP	392.84	6.07
221+18	2-24" RCP	396.08	9.25
225+00	24" RCP	392.48	5.88



rocscience

SETTLE3 5.022

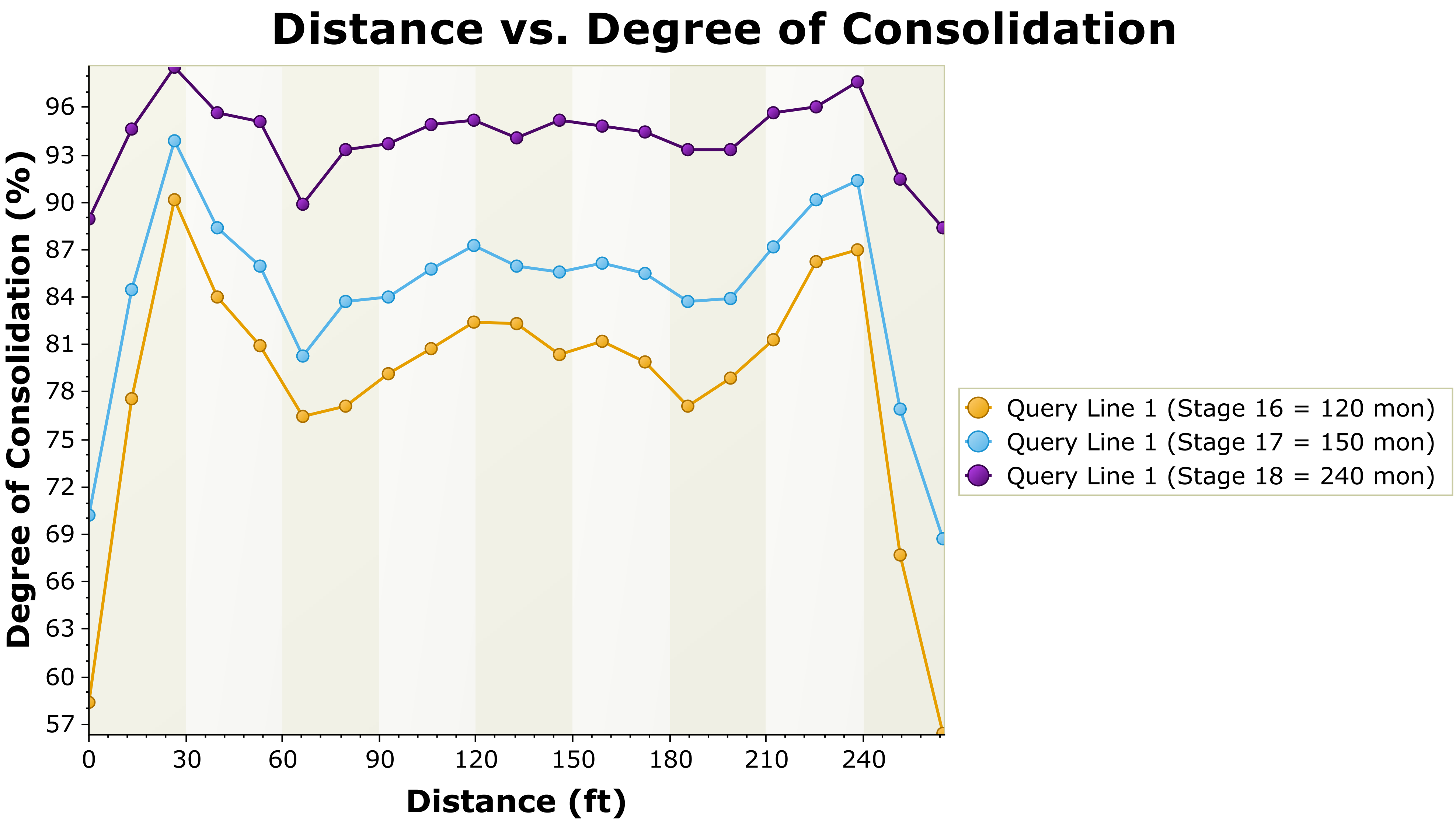
Project	I-49 Arkansas		
Analysis Description	Culvert Settlement 106+60		
Drawn By	Pradip Adhikari	Company	HNTB
Date	12/11/2023, 8:15:03 AM	File Name	Culvert 106+60 (existing ground 410.3) 20231128.s3z



Reference Stage: None

Total Settlement at Elevation = 410.3 ft

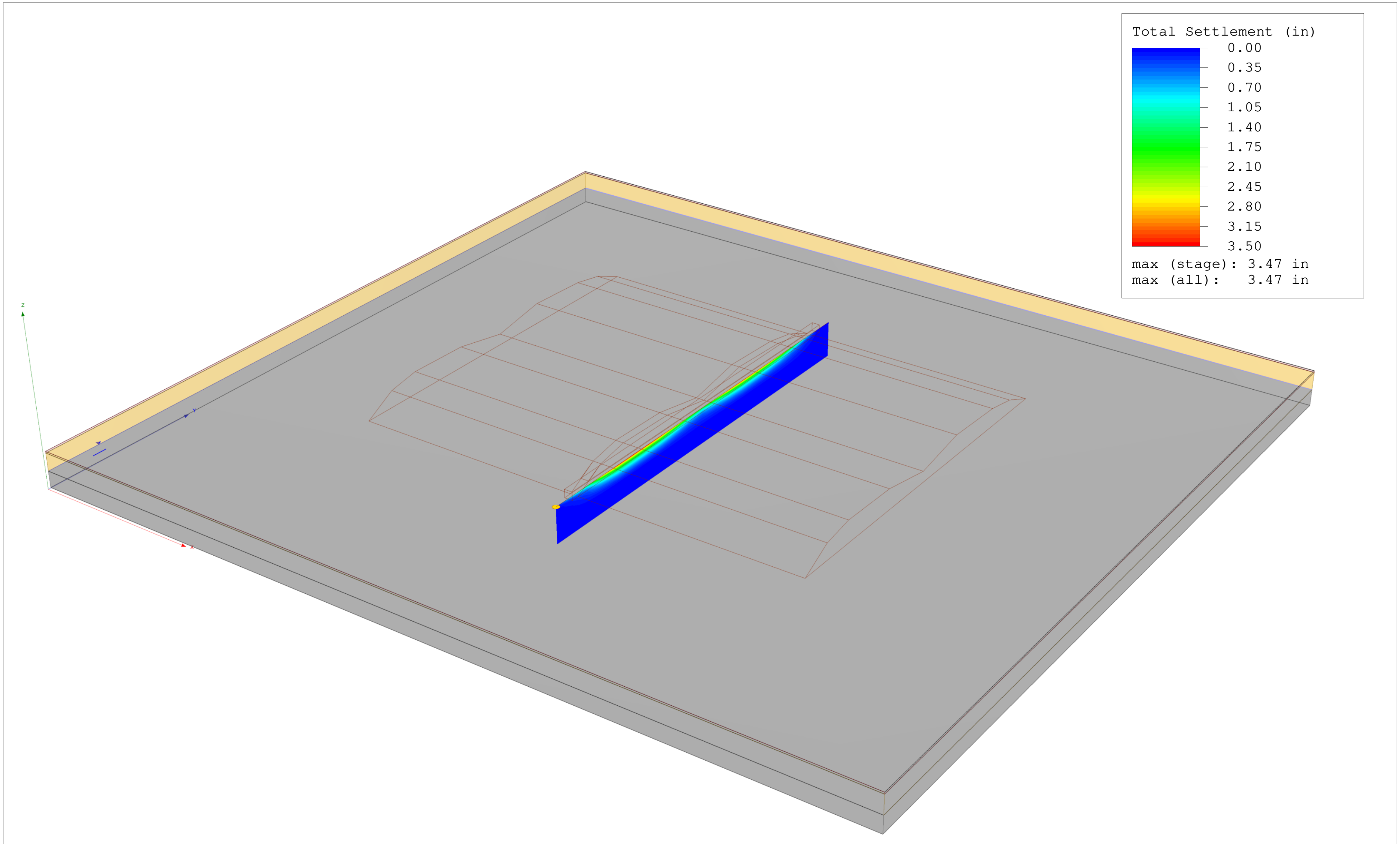
rocscience	Project: I-49 Arkansas		
	Analysis Description: Culvert Settlement 106+60		
	Drawn By: Pradip Adhikari	Company: HNTB	
SETTLE3 5.022	Date: 12/11/2023, 8:15:03 AM	File Name: Culvert 106+60 (existing ground 410.3) 20231128.s3z	



Reference Stage: None

Degree of Consolidation at Elevation = 410.3 ft

rocscience	Project: I-49 Arkansas		
	Analysis Description: Culvert Settlement 106+60		
	Drawn By: Pradip Adhikari	Company: HNTB	
SETTLE3 5.022	Date: 12/11/2023, 8:15:03 AM	File Name: Culvert 106+60 (existing ground 410.3) 20231128.s3z	



rocscience	Project	I-49 Arkansas	
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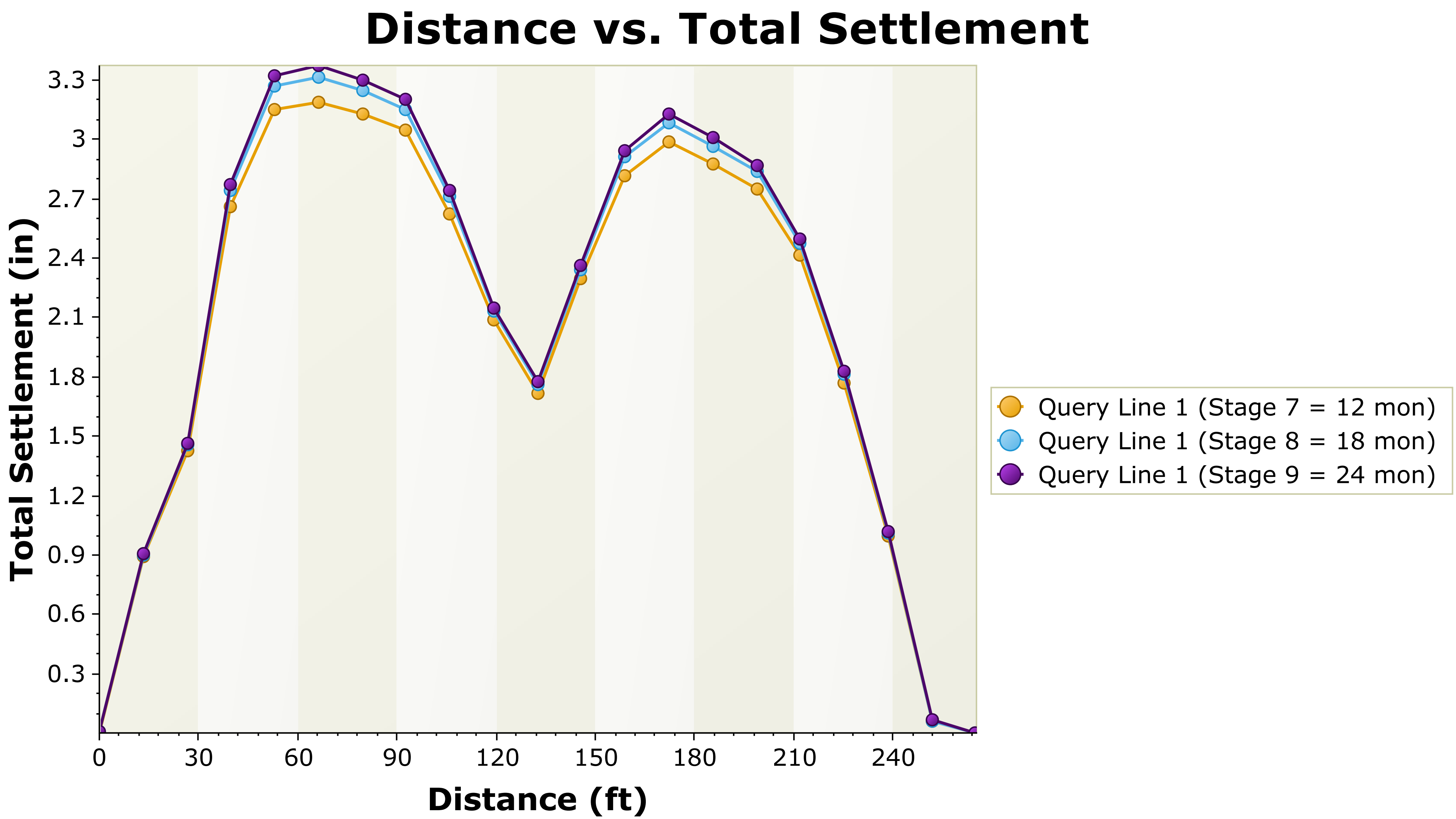
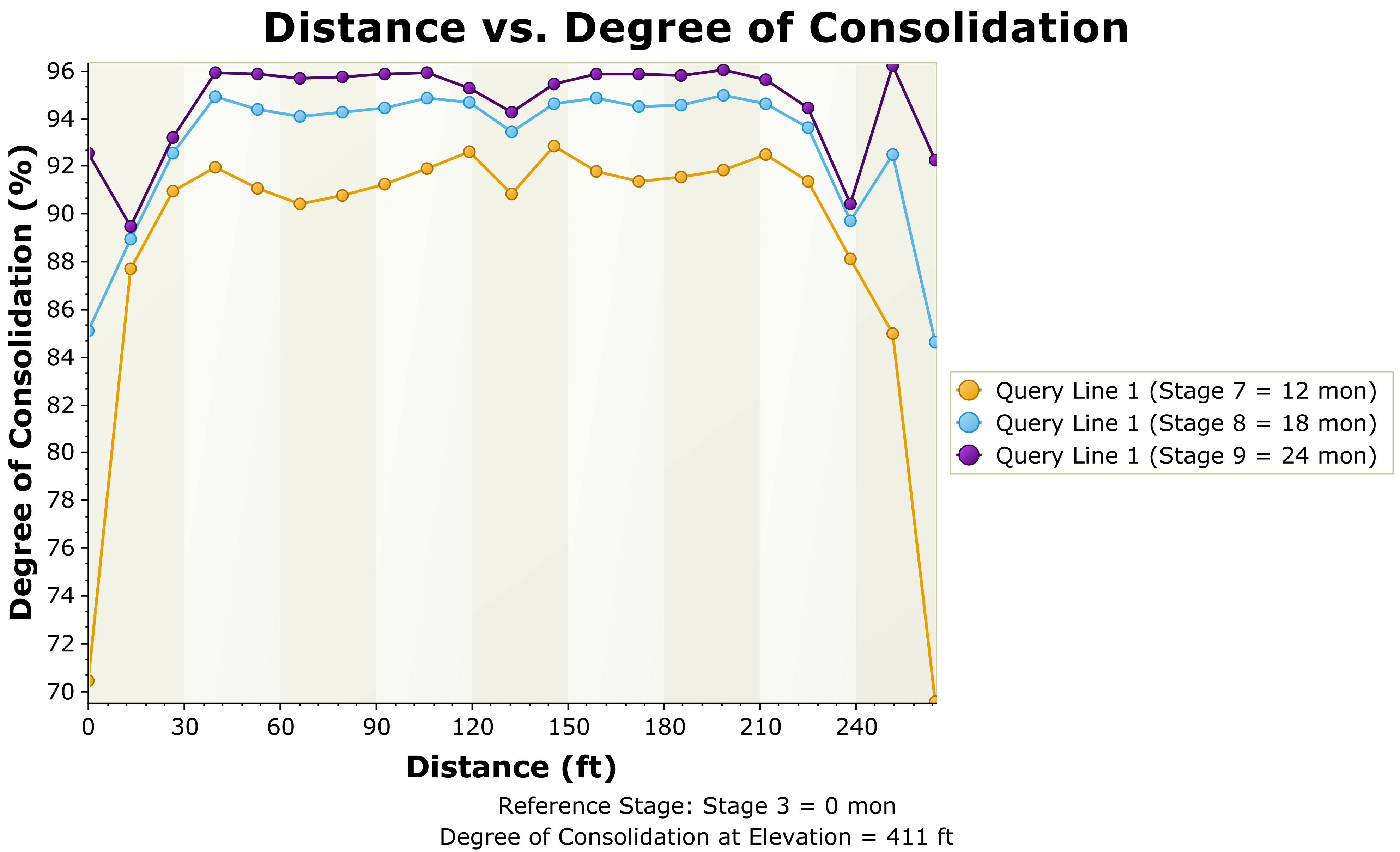
	Drawn By: Pradip Adhikari	Company: HNTB	
SETTLE3 5.022	Date: 12/11/2023, 8:15:03 AM	File Name: Culvert 129+65 (existing ground 411) 20231128.s3z	

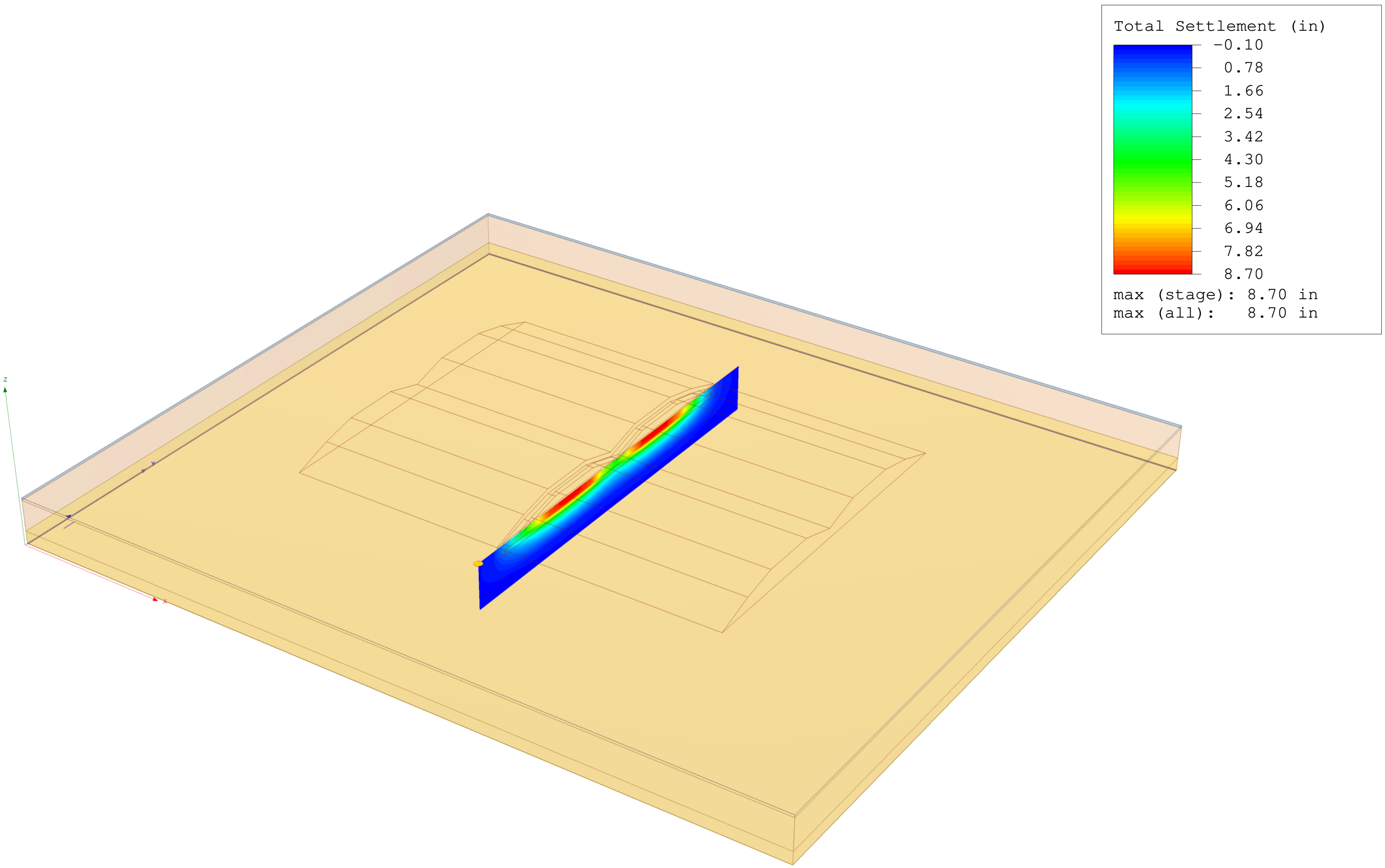


Reference Stage: Stage 3 = 0 mon
Total Settlement at Elevation = 411 ft

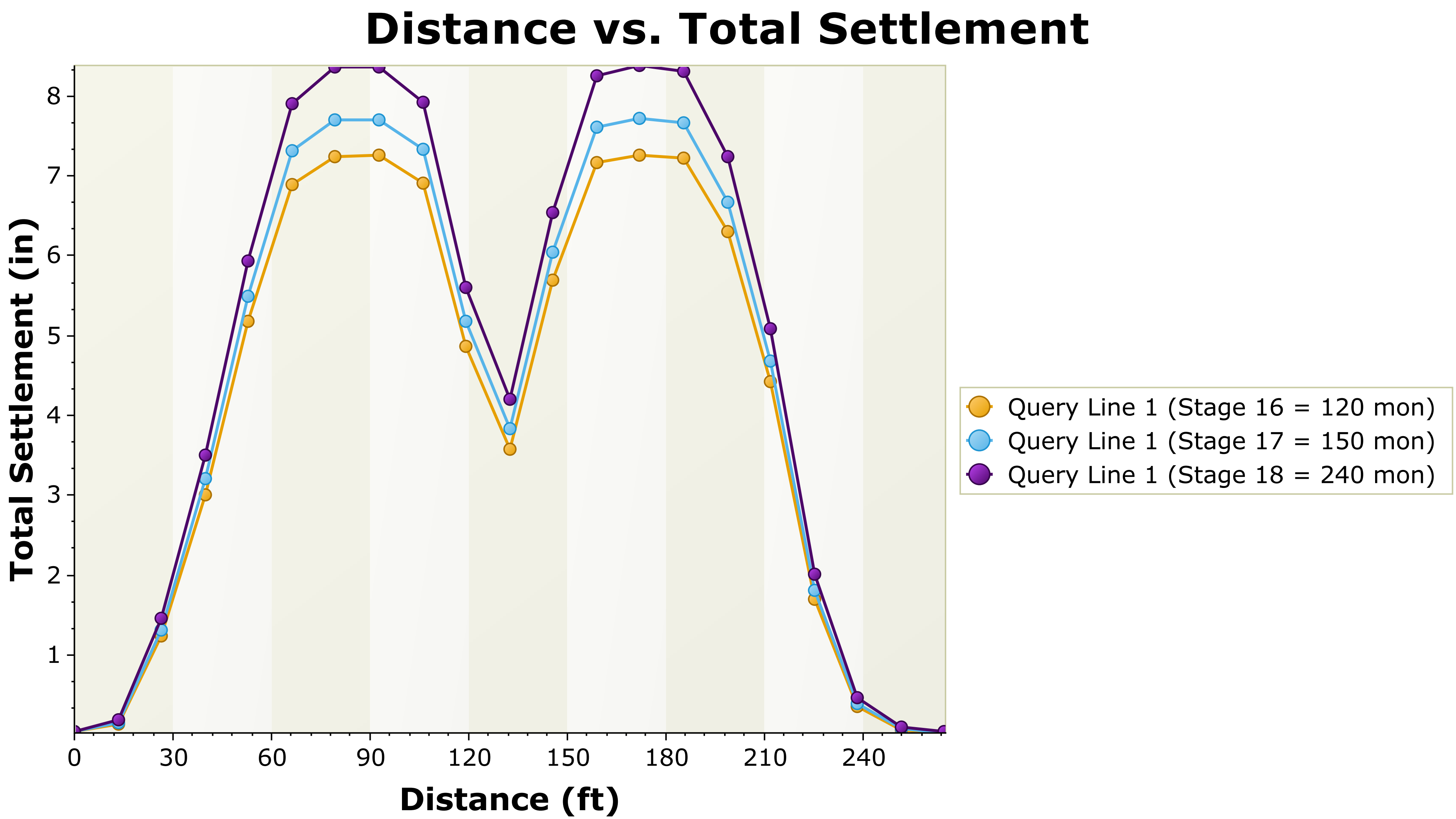
rocscience	*Project*	I-49 Arkansas	
	Analysis Description	Culvert Settlement 129+65	
	Drawn By Pradip Adhikari	*Company* HNTB	
SETTLE3 5.022	*Date* 12/11/2023, 8:15:03 AM	*File Name* Culvert 129+65 (existing ground 411) 20231128.s3z	



rocscience	Project	I-49 Arkansas	
	Analysis Description	Culvert Settlement 129+65	
	Drawn By	Pradip Adhikari	Company: HNTB
SETTLE3 5.022	Date	12/11/2023, 8:15:03 AM	File Name: Culvert 129+65 (existing ground 411) 20231128.s3z



rocscience	*Project*	I-49 Arkansas	
	Analysis Description	Culvert Settlement 145+98	
	Drawn By Pradip Adhikari	*Company* HNTB	
SETTLE3 5.022	*Date* 12/11/2023, 8:15:03 AM	*File Name* Culvert 145+98 (existing ground 412.2) 20231128.s3z	

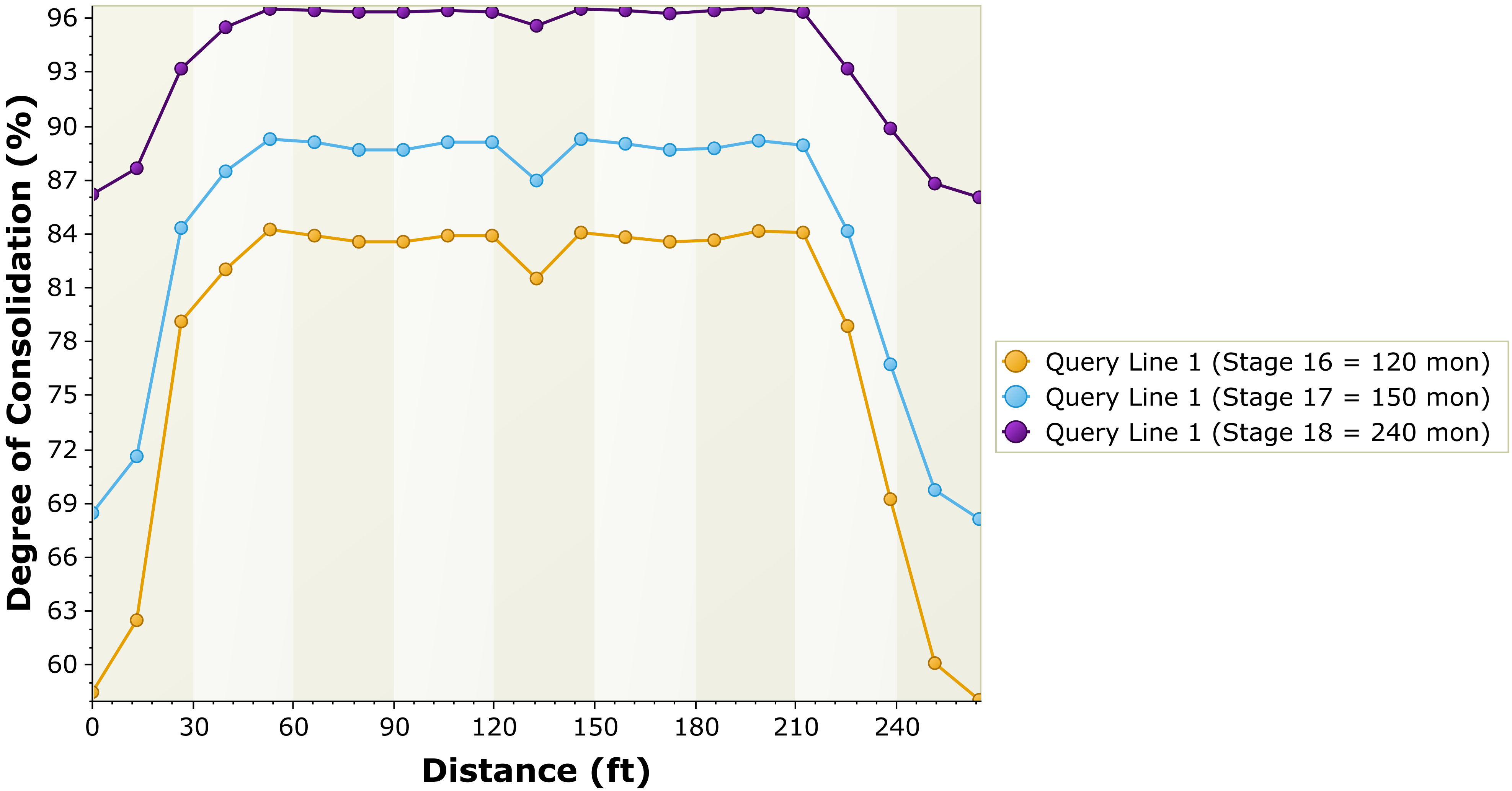


Reference Stage: None

Total Settlement at Elevation = 412.2 ft

rocscience	Project	I-49 Arkansas	
	Analysis Description	Culvert Settlement 145+98	
	Drawn By: Pradip Adhikari	Company: HNTB	
SETTLE3 5.022	Date: 12/11/2023, 8:15:03 AM	File Name: Culvert 145+98 (existing ground 412.2) 20231128.s3z	

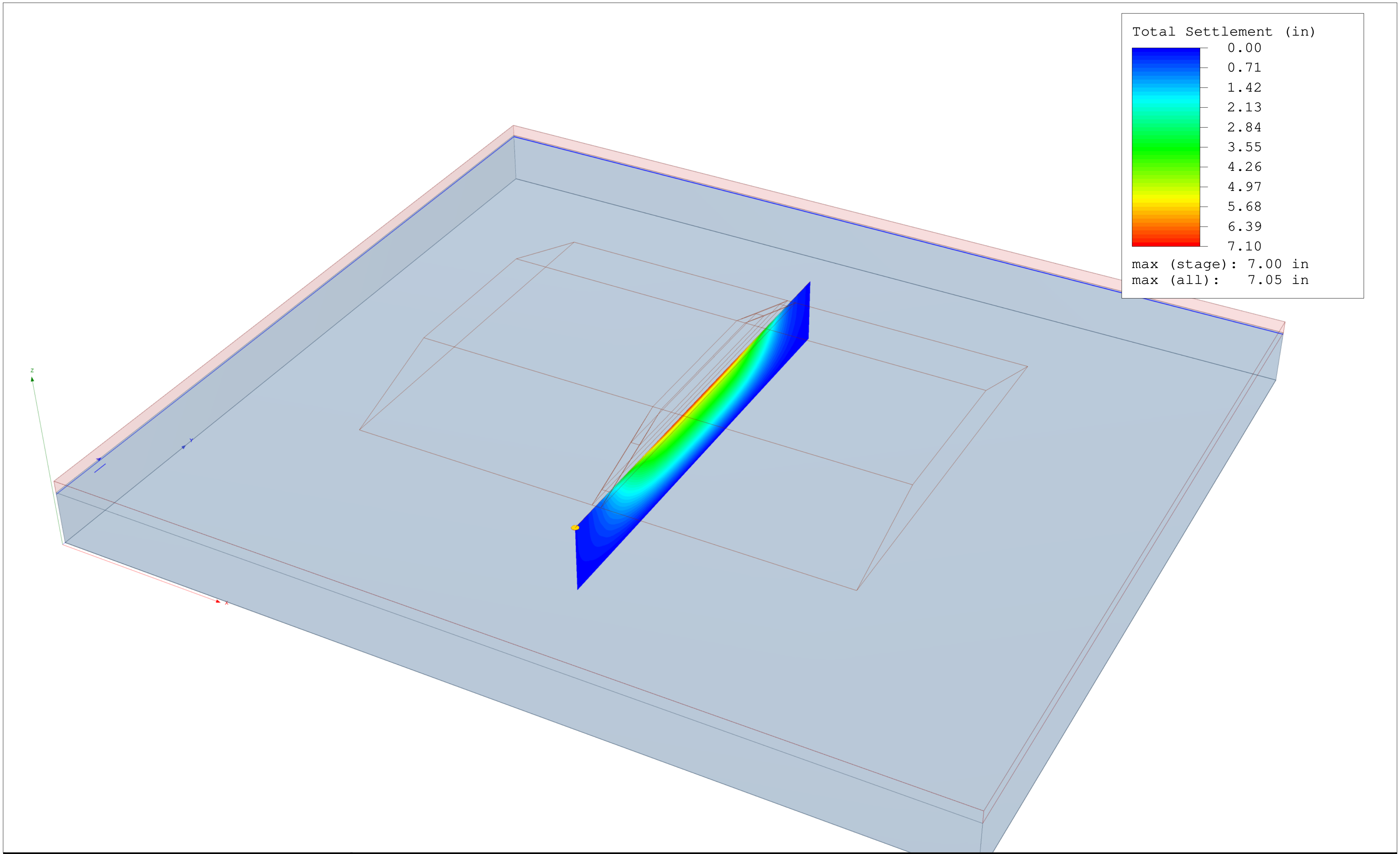
Distance vs. Degree of Consolidation



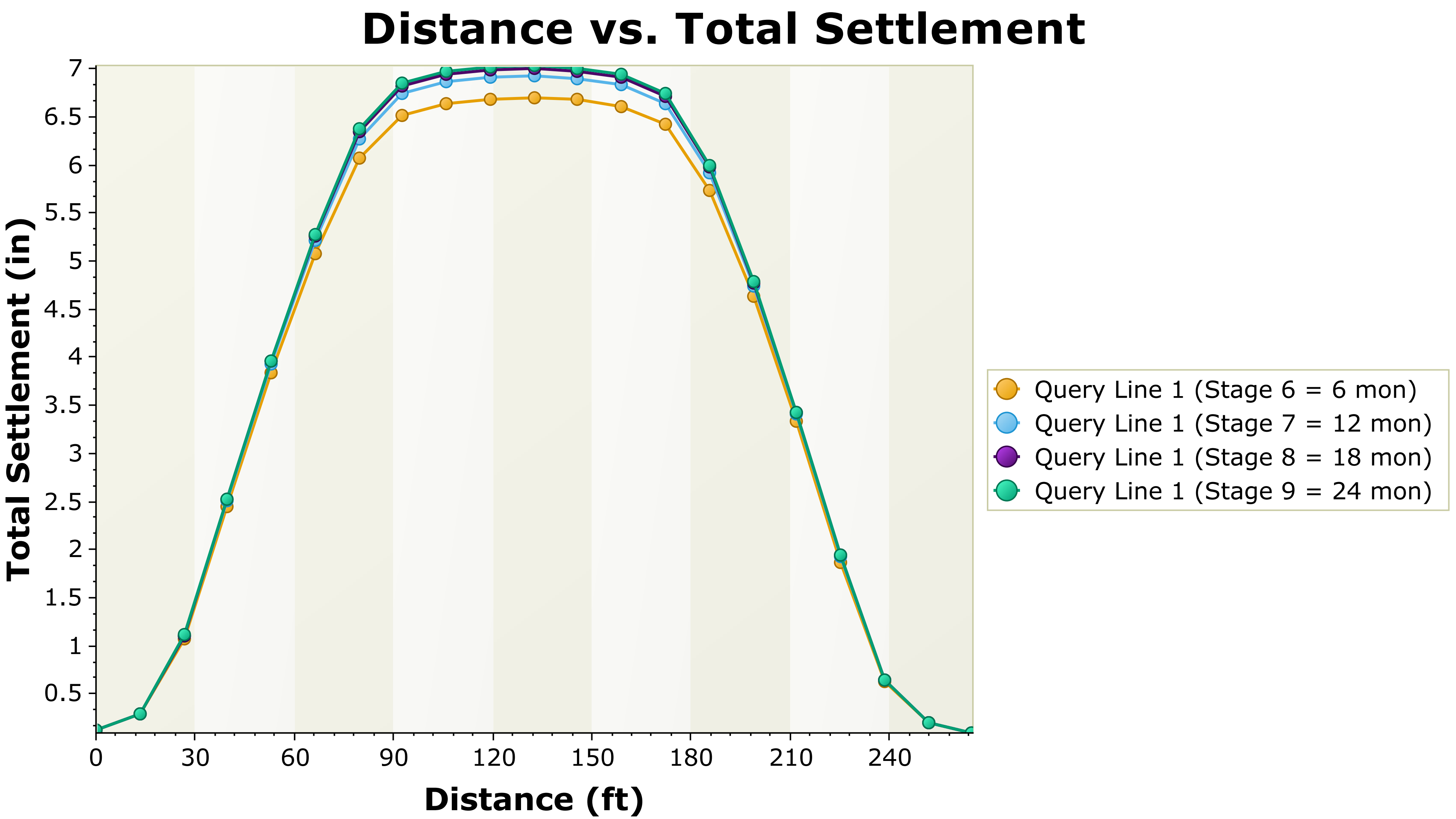
Reference Stage: None

Degree of Consolidation at Elevation = 412.2 ft

rocscience	Project	I-49 Arkansas	
	Analysis Description	Culvert Settlement 145+98	
	Drawn By: Pradip Adhikari	Company: HNTB	
SETTLE3 5.022	Date: 12/11/2023, 8:15:03 AM	File Name: Culvert 145+98 (existing ground 412.2) 20231128.s3z	



rocscience	Project	I-49 Arkansas	
	Analysis Description	Culvert Settlement 218+50	
	Drawn By: Pradip Adhikari	Company: HNTB	
SETTLE3 5.022	Date: 12/11/2023, 8:15:03 AM	File Name: Culvert 218+50 (existing ground 390) 20231207.s3z	

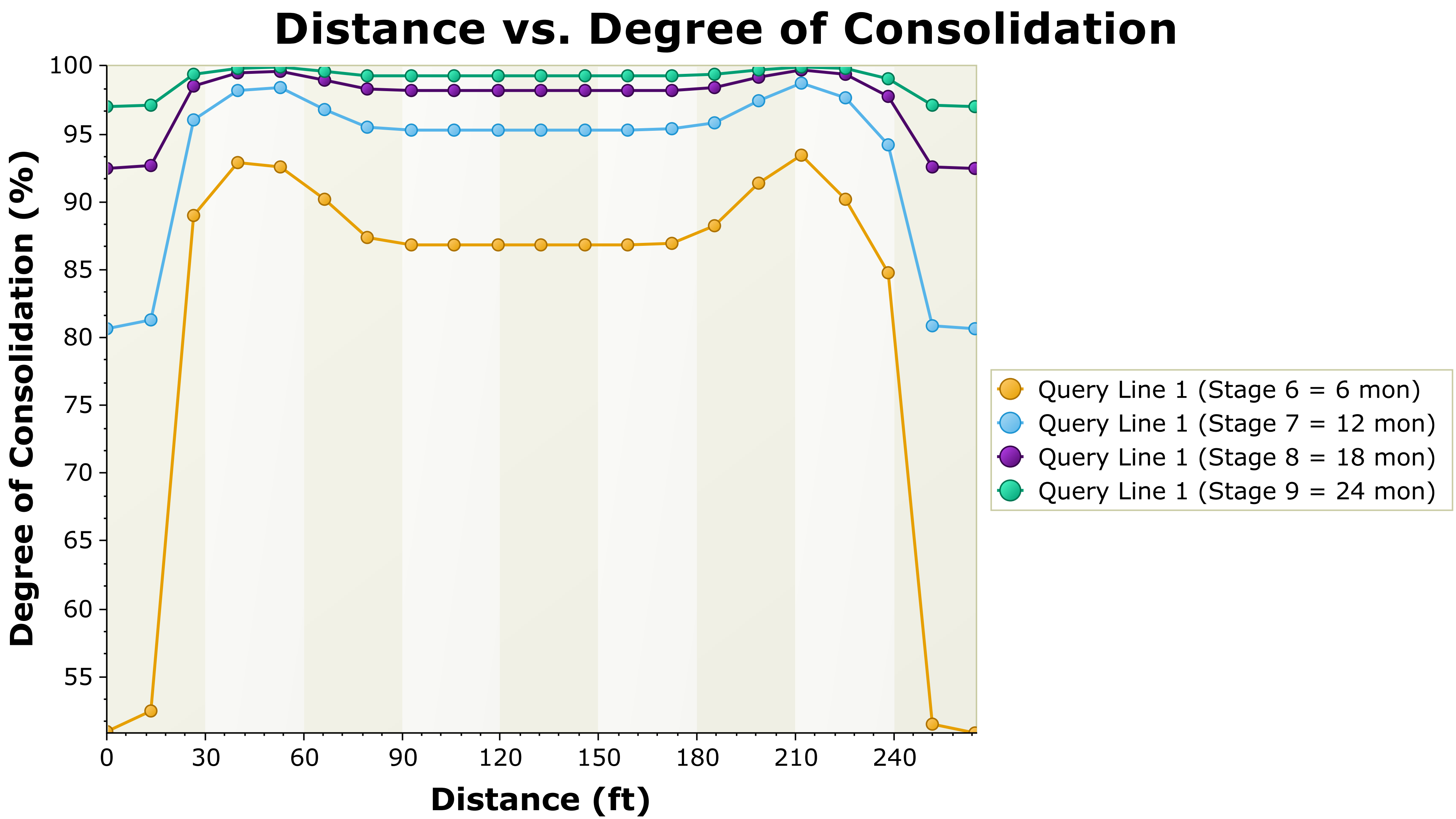


Reference Stage: None

Total Settlement at Elevation = 390 ft

rocscience			
Project	I-49 Arkansas		
Analysis Description	Culvert Settlement 218+50		
Drawn By	Pradip Adhikari	Company	HNTB
Date	12/11/2023, 8:15:03 AM	File Name	Culvert 218+50 (existing ground 390) 20231207.s3z

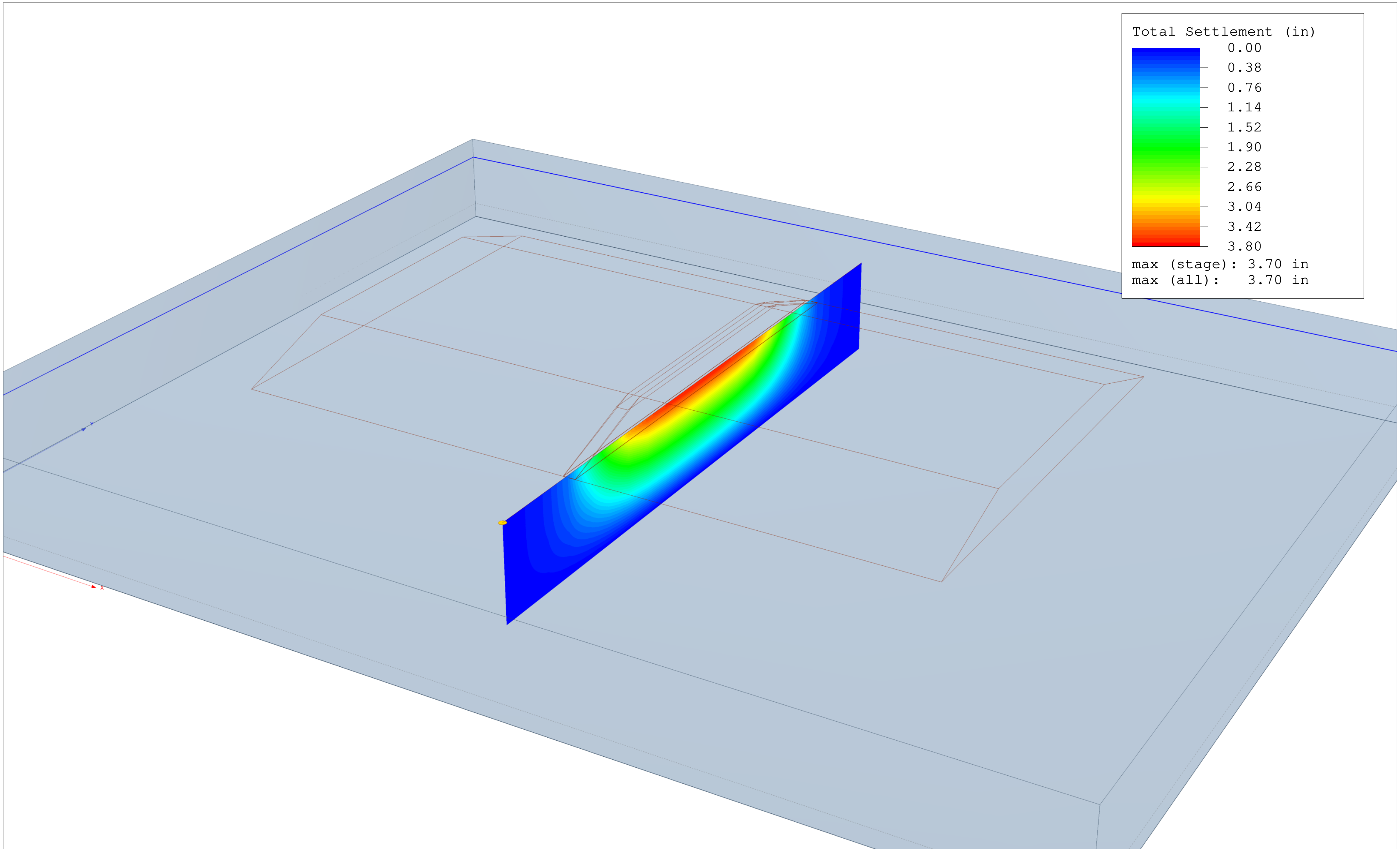
SETTLE3 5.022



Reference Stage: None

Degree of Consolidation at Elevation = 390 ft

rocscience	*Project*	I-49 Arkansas	
	Analysis Description	Culvert Settlement 218+50	
	Drawn By	Pradip Adhikari	*Company* HNTB
SETTLE3 5.022	*Date*	12/11/2023, 8:15:03 AM	*File Name* Culvert 218+50 (existing ground 390) 20231207.s3z



rocscience	Project	I-49 Arkansas	
	Analysis Description	Culvert Settlement 225+00	
	Drawn By	Pradip Adhikari	Company: HNTB
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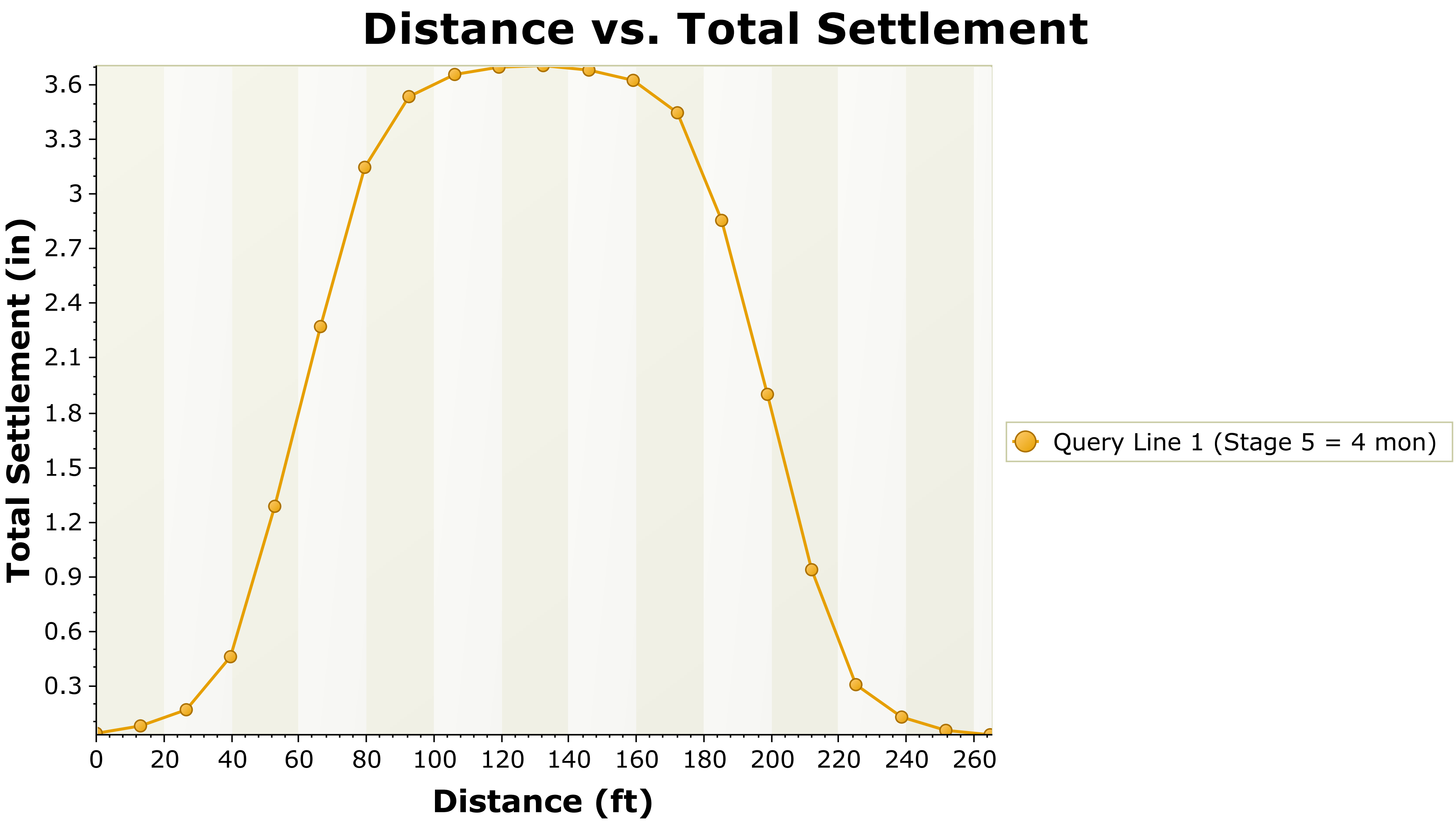

Reference Stage: None

Total Settlement at Elevation = 391 ft

rocscience	Project: I-49 Arkansas		
	Analysis Description: Culvert Settlement 225+00		
	Drawn By: Pradip Adhikari	Company: HNTB	
SETTLE3 5.022	Date: 03/25/2024, 8:15:03 AM	File Name: Culvert 225+00 (existing ground 391) 20240325.s3z	

Appendix 7: Site-Specific Ground Motion Analysis (SSGMRA) Report

Site-Specific Seismic Ground Motion Response Analysis (SSGMRA)
ArDOT Job No. 040748
Hwy. 22 - I-40 (Arkansas River) (F)
Crawford and Sebastian Counties, Arkansas

Prepared for:

Grubbs, Hoskyn, Barton & Wyatt, LLC
Little Rock, Arkansas

Prepared by:

Geotechnology, LLC
Memphis, Tennessee

Date:

June 2, 2023

Geotechnology Project No.:

J042652.01

SAFETY
QUALITY
INTEGRITY
PARTNERSHIP
OPPORTUNITY
RESPONSIVENESS

GEOTECHNOLOGY
A UES Company

June 2, 2023

Mr. Mark Wyatt, PE
Grubbs, Hoskyn, Barton & Wyatt, LLC
1 Trigon Place
Little Rock, Arkansas 72209

Re: Site-Specific Seismic Ground Motion Response Analysis (SSGMRA)
ArDOT Job No. 040748
Crawford and Sebastian Counties, Arkansas
Hwy. 22 - I-40 (Arkansas River) (F)
Geotechnology Project No. J042652.01

Dear Mr. Wyatt:

Presented in this report are the results of site-specific seismic ground motion response analyses completed for the referenced project based on the provided geotechnical data, measured shear-wave velocity data, and provisions of the AASHTO LRFD Bridge Design Specifications. Our services were performed in general accordance with the scope of work under Task Order No G008. Our services were authorized under the existing on-call contract with ArDOT.

We appreciate the opportunity to provide geotechnical services for this project. If you have any questions regarding this report, or if we can be of any additional service to you, please do not hesitate to contact us.

Respectfully submitted,
GEOTECHNOLOGY, LLC.

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No. 19074
DUNCAN BLAKE ADRIAN

Duncan Adrian, P.E.
Geotechnical Manager

6-2-23

DBA/RTF/ASE:dba

Copies submitted: Client (email)

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EXECUTIVE SUMMARY

The following executive summary is provided solely for the purpose of overview. A party who relies on this report should read each section.

- The project includes the construction of a new bridge over the Arkansas River for the future alignment of I-49 in Crawford and Sebastian Counties, Arkansas.
- Our scope of services included shear wave velocity testing on the north and south sides of the Arkansas River and performing site-specific seismic ground motion response analyses to develop seismic design accelerations for the bridge.
- The site-specific seismic ground motion response analysis includes interpretation of the soil conditions based on provided soil information and developing general soil profiles for use in the seismic response analysis. If additional subsurface information is available, please provide this information to Geotechnology for review. Geotechnology may recommend revising the analysis if the additional subsurface information results in discrepancies in our interpretation of the soil conditions.
- Presented in Table 1 below is a summary of the results of code-based acceleration parameters for each site. Presented in Table 2 is a summary of the site-specific response results. Note that these values are based on the measured shear wave velocities and the provided boring information near the Multichannel Analysis of Surface Waves (MASW) testing locations. Soil and rock conditions may vary along the bridge alignment resulting in varying ground surface response accelerations.

Table 1. Summary of Seismic Parameters Based on AASHTO Mapped Values

Parameter	Value	
Average V_{s100} (ft/s)	North Side – 935	South Side – 920
AASHTO Site Class (Sec. 3.10.3.1 of AASHTO)	Site Class D	
A_s (g) (Site-adjusted PGA)	0.088	
S_{DS} (g) (0.2 sec)	0.208	
S_{D1} (g) (1 Sec)	0.126	
Seismic Performance Zone	1	

Table 2. Summary of Site-Specific Response Results

Period	North Side	South Side
A_s (g) (Site-adjusted PGA)	0.124	0.147
S_{DS} (g) (0.2 sec)	0.302	0.386
S_{D1} (g) (1 Sec)	0.115	0.115
Seismic Performance Zone	1	1

SITE-SPECIFIC SEISMIC GROUND MOTION RESPONSE ANALYSIS (SSGMRA)
HWY. 22 - I-40 (ARKANSAS RIVER) (F)
CRAWFORD AND SEBASTIAN COUNTIES, ARKANSAS
June 2, 2023 | Geotechnology Project No. J042652.01

1.0 INTRODUCTION AND SCOPE OF WORK

Geotechnology, LLC prepared this site-specific ground motion response analysis (SSGMRA) for the Grubbs, Hoskyn, Barton & Wyatt, LLC for Hwy. 22 - I-40 (Arkansas River) (F), located in Crawford and Sebastian Counties, Arkansas. The project includes the construction of a new bridge over the Arkansas River for the future alignment of I-49 southeast of Fort Smith, Arkansas.

In general, the purpose of our services was to perform a site-specific seismic ground motion response analysis (SSGMRA) by developing shear wave velocity profiles on each side of the Arkansas River, interpreting the soil conditions based on provided information, developing a target response spectrum using probabilistic seismic hazard analysis methods, selecting ground motions for use in a site response model of the site, and performing a one-dimensional ground motion analysis to determine the seismic response at the ground surface. It is our understanding the project will be designed in accordance with the AASHTO LRFD Bridge Design Specifications, herein referred to as AASHTO. Geotechnology has conducted the analysis based on the provided soil information, and our experience with the current state of practice for site-specific ground motion response analyses. The reader should refer to the references in Section 7.0 for more details about the procedures used in this analysis.

A copy of "Important Information about This Geotechnical-Engineering Report," published by the Geotechnical Business Council (GBC) of the Geoprofessional Business Association (GBA), is included in Appendix A for your review. The publication discusses report limitations and ways to manage risk associated with subsurface conditions.

2.0 PROJECT AND SITE DESCRIPTION

The project site is located along the Arkansas River southeast of Fort Smith in Crawford and Sebastian County, Arkansas as shown in Figure 1 in Appendix B. The project includes construction of a new bridge over the Arkansas River for the future alignment of I-49. Site-specific seismic accelerations were requested for design of the new bridge.

3.0 GEOTECHNICAL INFORMATION

3.1 General Geology

Based on publicly available information from the USGS and Arkansas.gov websites, the physiographic region of the project site is the Arkansas River Valley. Based on general geologic maps of the area, the geology consists of alluvium, the Savanna Formation, the McAlester Formation, clays, sands and gravels and undifferentiated clays and sands that overlay bedrock.

3.2 Provided Subsurface and Groundwater Information

Based on the provided preliminary boring logs, the general soil profile at the project site consists of alluvial deposits of generally silty sand and sandy silt underlain by very loose to medium dense sand which, in turn, is underlain by shale and sandstone. The provided boring logs are presented in Appendix C. Field and laboratory test results presented on the preliminary boring logs included SPT blow counts, recovery ratio and RQD of rock core samples, moisture content, Atterberg limits or an indication soil plasticity, and compressive strength.

Groundwater was encountered generally at depths ranging from 18 to 35 feet in the borings. Groundwater levels will vary over time because of seasonal variations in precipitation, influence of the Arkansas River, and other factors.

3.3 Shear-Wave Velocity Profile

Our field services included performing a Multichannel Analysis of Surface Waves (MASW) survey. MASW surveying is a surface geophysical method used to determine a shear wave velocity profile. For this project a weighted average shear wave velocity profile was calculated to a depth of approximately 100 feet (Vs_{100}). This information was then used to assign a seismic Site Class per Section 3.10.3.1 of AASHTO LRFD Bridge Design Specifications. The MASW survey was performed by recording surface seismic energy (in the form of Raleigh waves) produced by an “active” source (sledgehammer impact) and using ambient “passive” sources such as vehicle traffic. The surface waves are detected by geophones and recorded using a seismograph. A shear wave velocity profile was constructed by analyzing plots of surface wave phase velocities versus frequencies through an inversion process. Geotechnology performed the MASW surveys on April 18 and 19, 2023 on the north and south sides of the Arkansas River as shown in Figures 2 and 3 in Appendix B.

The surveys consisted of collecting active and passive data with a linear array of 24 geophones. For the active data, the seismic array consisted of geophone spacings of 2,4, and 10 feet, with active shot locations at 0 to 48 feet measured from each end of the geophone array. For the passive data, the seismic array consisted of a 10 ft-foot geophone spacing and measured seismic energy from ambient sources.

The MASW data were processed and modeled using ParkSEIS software. Based on the processed MASW data, the AASHTO weighted average shear wave velocities measured for the south and north sides of the Arkansas River are presented in Table 3.

Table 3. Average Shear Wave Velocity and AASHTO Site Classification

Location	Average Shear Wave Velocity	AASHTO Site Class
North Side of Arkansas River	935	D
South Side of Arkansas River	920	D

Presented in Appendix B are the measured shear wave velocity profiles and average shear wave velocity in the upper 100 feet.

4.0 SEISMIC BACKGROUND

The project site is generally an area of low seismicity, located within the North American Plate in an area where faults are not known to exist. Natural seismic activity occurs in intraplate seismic zones and generally tend to be related to deep tension of compressing stresses. Based on the 2018 National Seismic Hazard Model (NSHM) of the Conterminous United States, the primary contributor to seismic hazard is the New Madrid Seismic Zone (NMSZ) located in northeast Arkansas and southeast Missouri approximately 430 km east of the site. The NMSZ was the source of several earthquakes that caused major destruction between December 16, 1811 and February 7, 1812. The estimated magnitudes of three of the major earthquakes near New Madrid, Missouri range from 6.8 to 8.1 (Bakun and Hopper). These three earthquakes are considered some of the largest since North America was settled.

Large earthquakes have occurred at intervals of approximately 200 to 800 years dating back to 900 A.D. based on sand blows, artifacts and radiocarbon dating, and other conditions studied in the NMSZ area (Tuttle). The recurrence period for large earthquakes in the NMSZ is estimated to be approximately 200 to 500 years. As such, the next occurrence of large earthquakes in the NMSZ could occur during the life of existing structures and structures currently being constructed. Additionally, the NSHM 2018 model indicates potential seismic activity for lower magnitude earthquakes (<5.5) generally between 20 and 50 km from the site.

5.0 RESPONSE SPECTRUM BASED ON AASHTO MAPPED VALUES

It is our understanding the proposed construction will be designed in accordance with AASHTO LRFD Bridge Design Specifications. AASHTO stipulates bridges be designed based an earthquake event with a probability of exceedance of 7% in 75 years (approximately 1,000-year return period). Based on the borings and the average shear wave velocity from the shear wave velocity surveys, the site can be classified as Site Class D. Seismic parameters based on mapped values from AASHTO are presented in Table 4.

Table 4. Published Site Class and Seismic Parameters – Site Class D

Category/ Parameter	AASHTO Code Values Site Class D
PGA	0.055
F_{PGA}	1.6
As	0.088
SS	0.13
Fa	1.6
S_{DS}	0.208
S1	0.053
F_v	2.4
S_{D1}	0.126
S_{DC}	A
Seismic Performance zone (AASHTO Table 3.10.6-1)	Zone 1
T_s	0.605
T_0	0.121

6.0 SITE-SPECIFIC ANALYSIS AND RESULTS

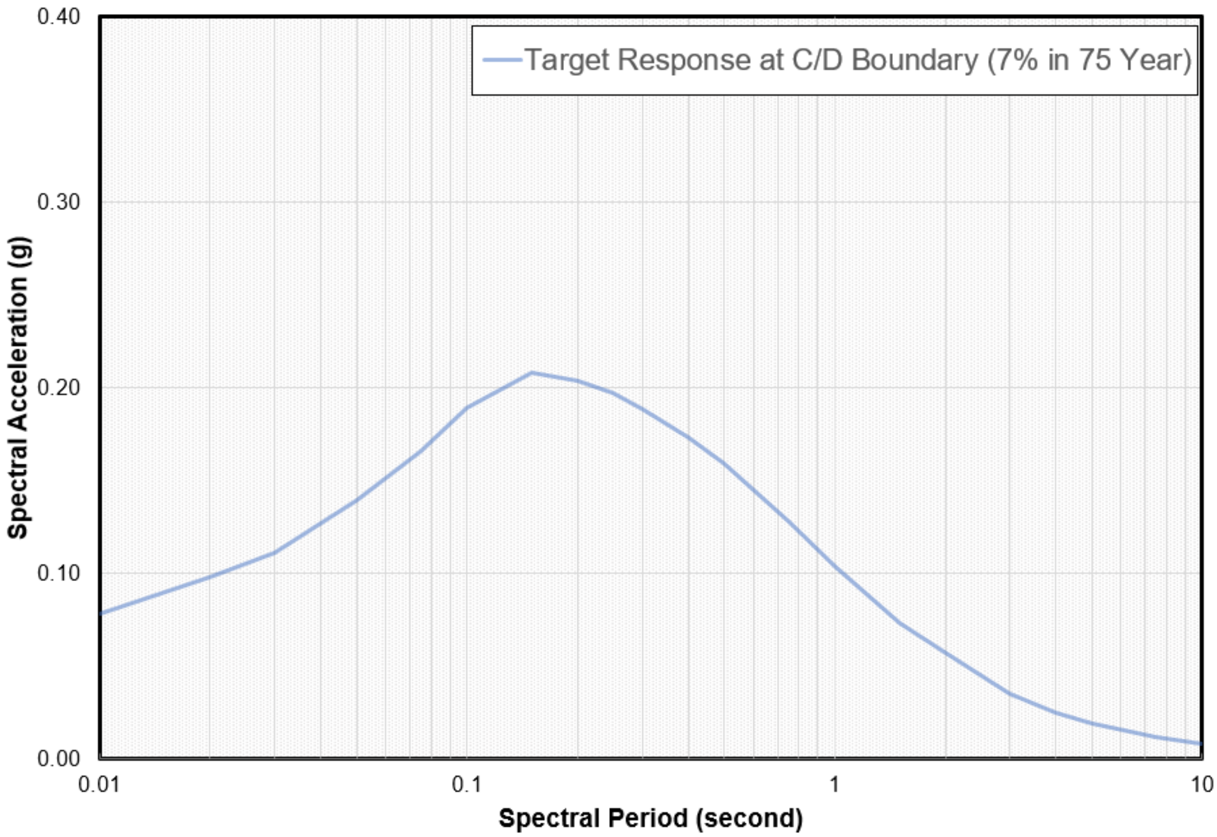
6.1 Overview

The AASHTO 2020 was used as the reference procedure for the site response analysis. Generally, the site-specific response analysis procedures in the AASHTO includes development of a target base response spectrum, selecting recorded time histories and scaling and spectrally matching them to the target spectrum, and then calculating the surface response from base motions propagated by the soil profile. A general soil profile was developed based on our interpretation of the provided boring logs, laboratory test data, review of local geologic information, the measured shear-wave velocity data, and our experience and judgement.

6.2 Target Spectrum Development

The site-specific target response spectrum was developed using the Unified Hazard Tool on the USGS website and the data developed for the AASHTO code. The site coordinates 35.34754, -94.280790 were used for the target spectrum. A 7% in 75-year return period was used per AASHTO. Per AASHTO Guide Specifications for LRFD Seismic Bridge Design, the input ground motions should be defined either at the top of rock or at the top of a layer where a significant stiffness contrast occurs. For this project the C/D boundary, corresponding to a shear-wave velocity of 1,200 feet per second, was used as the reference site condition to obtain the target response. The target spectrum is shown in Figure 1.

Figure 1. Target Response Spectrum at C/D Boundary – 1,000 Year Return Period



6.3 Hazard Analysis

Concentrated seismic activity occurs within seismic zones. From a probabilistic standpoint, small, infrequent earthquakes can occur at any given location, regardless of proximity to a seismic zone. For this analysis, probabilistic seismic hazard is considered to be the controlling hazard over the deterministic seismic hazard. The USGS Earthquake Hazard Toolbox provides probabilistic seismic hazard analysis (PSHA) data, which represents the earthquake distance and magnitude combinations for a given site and probability of exceedance. Based on disaggregation data and 7 percent probability of exceedance in 75 years (1,033 return period required by AASHTO), the New Madrid Seismic Zone (NMSZ) is the primary contribution to seismic hazards, and generally includes earthquakes with a magnitude 7.5 to 7.7 at a distance of about 330 to 440 kilometers. However, for spectral periods less than about 0.1 seconds, earthquakes with magnitudes ranging from approximately 5 to 5.5 at distances of about 20 to 50 kilometers contributed to the seismic hazard. Presented in Table 5 is an example of the disaggregation data for bridge site for selected periods. Figure 2 through Figure 6 represent USGS PSHA disaggregation data for selected periods.

Table 5. Representative Disaggregation Data

Period	Magnitude			Distance (km)		
	Mean	Mode (m-r)	Mode (m-r-ε)	Mean	Mode (m-r)	Mode (m-r-ε)
PGA	6.94	7.76	7.5	278.15	432.12	331.84
0.02	6.77	7.5	7.5	255.29	331.46	331.46
0.2	7.14	7.5	7.5	312.65	331.47	331.42
1	7.47	7.76	7.53	376.07	432.11	441.93
2	7.55	7.76	7.53	385.7	432.12	441.84
5	7.61	7.76	7.76	390.94	432.13	432.07

Figure 2. Disaggregation Data for PGA

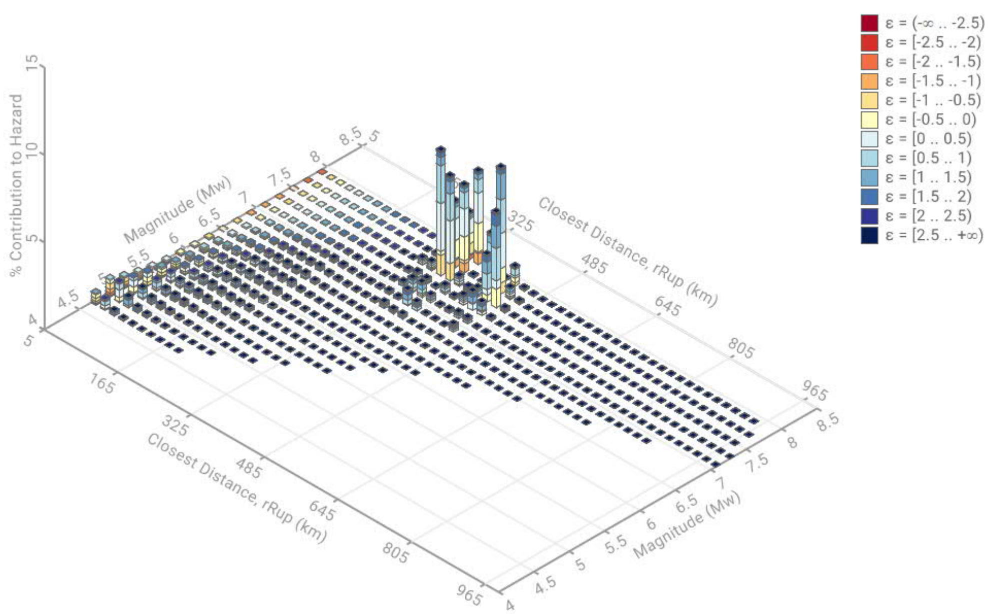


Figure 3. Disaggregation Data for 0.02-Second Period

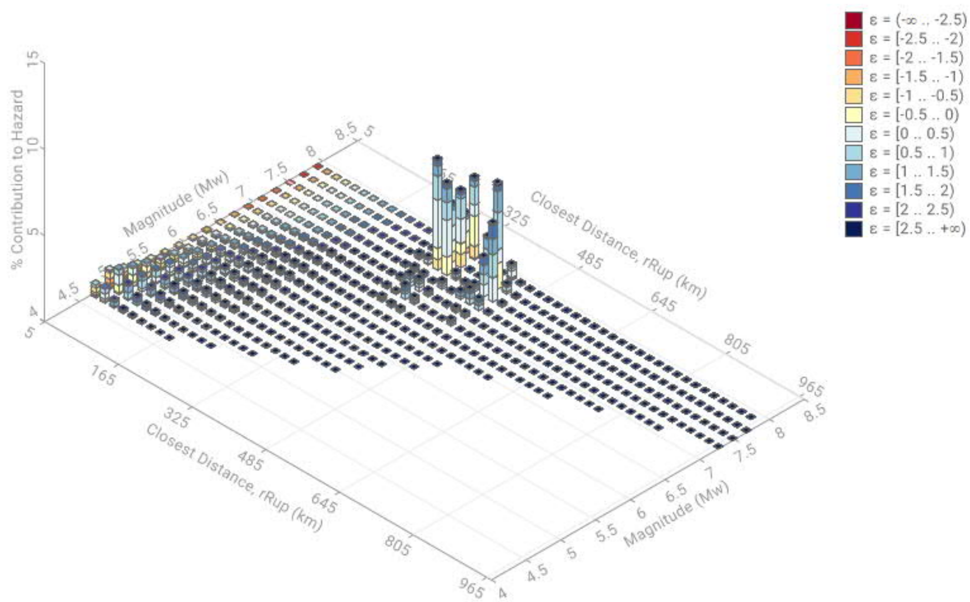


Figure 4. Disaggregation Data for 0.2-Second Period

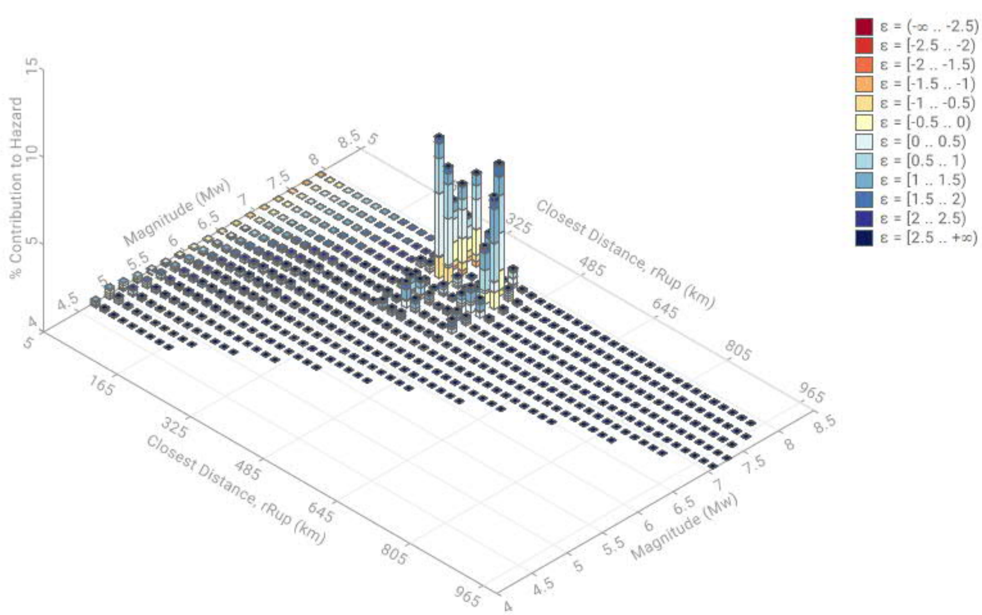


Figure 5. Disaggregation Data for 0.5-Second Period

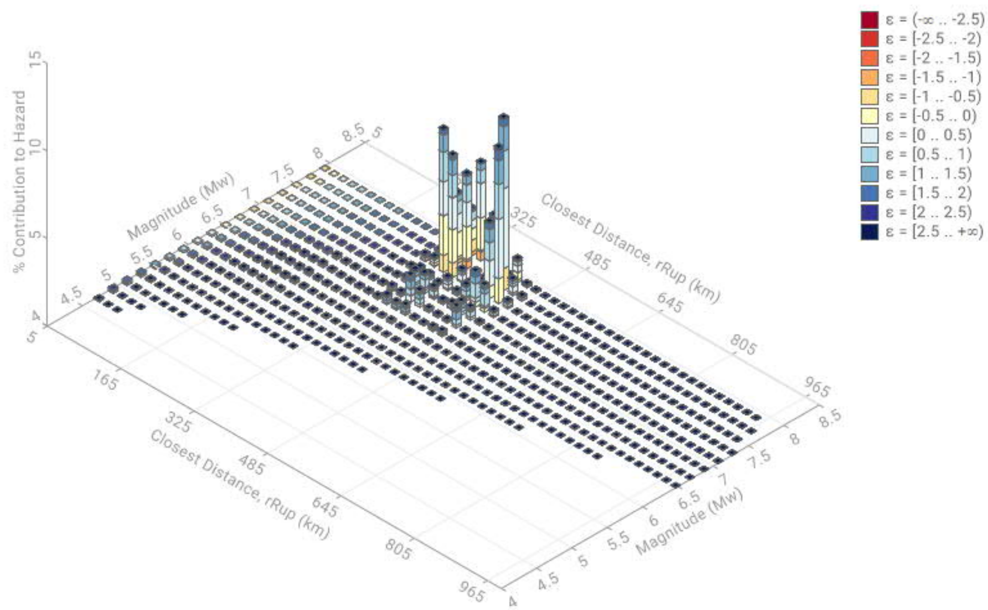
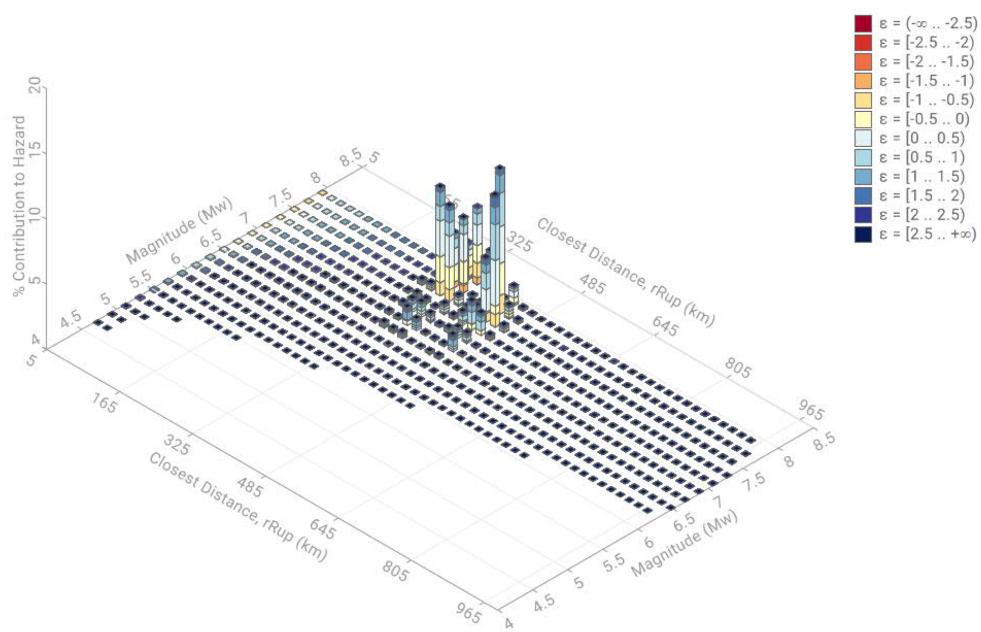


Figure 6. Disaggregation Data for 1.0-Second Period



6.4 Time History Selection, Scaling and Matching

Time Histories. Seven earthquake records consisting of orthogonal direction pairs of acceleration time histories (e.g. north-south and east-west direction records) were selected based on the target spectrum and the disaggregation data. The ground motions were selected using the Pacific Earthquake Engineering Research Center NGA West-2 and NGA East ground motion databases. Strong ground motion time histories for the magnitude and distance combinations for central and eastern United States sites near the NMSZ have not been recorded. Therefore, the NGA West-2 database is typically used to select time histories with similar characteristics to the governing earthquake at each period as determined from the disaggregation data discussed in the previous section. To account for the impact of lower magnitude, shorter distance earthquakes that contribute to the seismic hazard at spectral periods less than about 0.1 sec, we selected three earthquake records with magnitudes ranging from 5.0 to 5.5 at distances of 20 to 40 km. The remaining five records were selected based on the large magnitude, longer distance earthquakes that were the primary contributor to the seismic hazard at all of the spectral periods. Selected ground motions were from earthquakes with magnitudes ranging from 6.5 to 7.2 at distances of 350 to 410 km. A summary of the selected time histories is provided in Table 6.

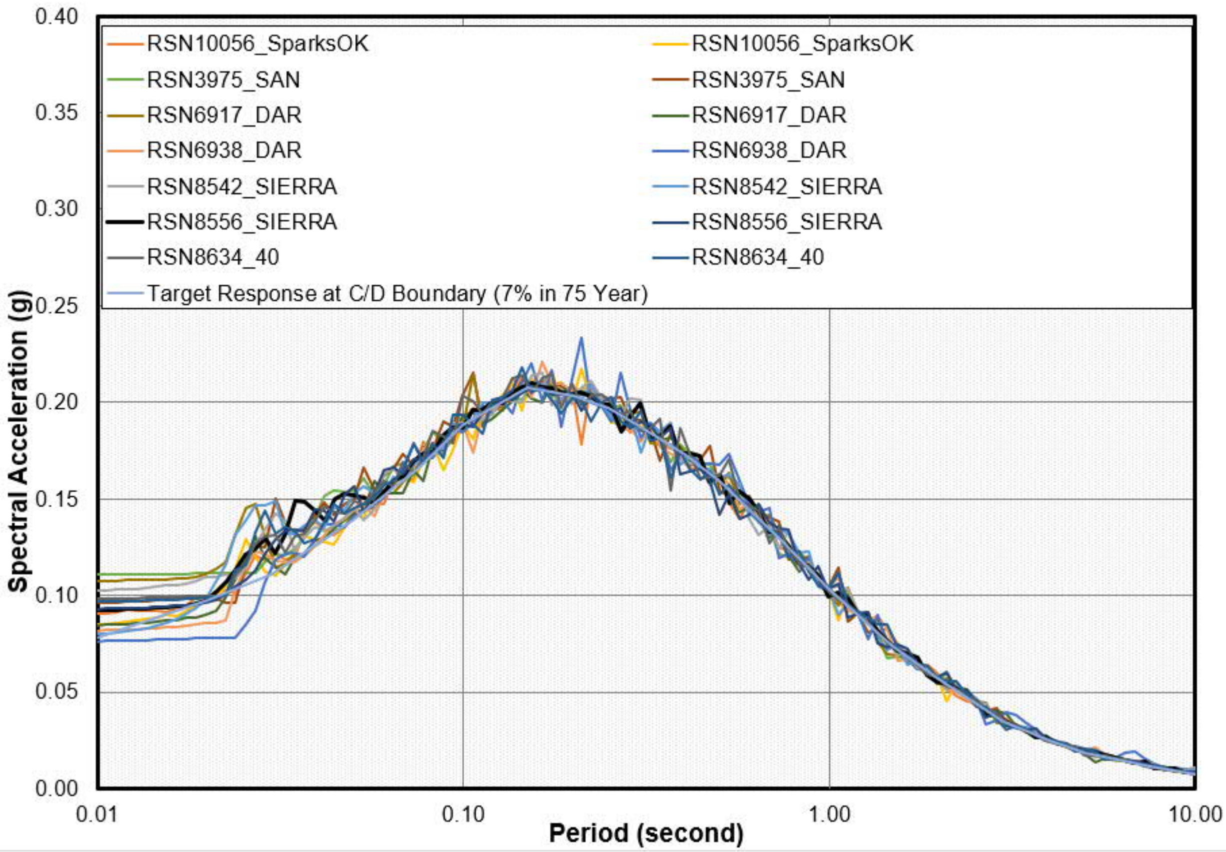
Table 6. Input Time Histories

Database	Event	Mag.	Distance (km)[a]	PGA (g)	Acceleration Record filename
NGA East	Sparks_2011-22-06	5.68	39.84	0.02	RSN10056_SparksOK11-11-06_GS.OK005.HNE.01
				0.03	RSN10056_SparksOK11-11-06_GS.OK005.HNN.01
NGA West-2	40204628	5.45	25.74	0.02	RSN8634_40204628_N1799HNE
				0.02	RSN8634_40204628_N1799HNN
	San Simeon CA	6.52	408.57	<.01	RSN3975_SANSIMEO_CAB090
				<.01	RSN3975_SANSIMEO_CAB360
	Darfield New Zealand	7.0	408.32	0.01	RSN6917_DARFIELD_ICCSN55E
				0.01	RSN6917_DARFIELD_ICCSS35E
	Darfield New Zealand	7.0	358.26	0.01	RSN6938_DARFIELD_MOSSN26E
				0.01	RSN6938_DARFIELD_MOSSN64W
	El Mayor Cucapah Mexico	7.2	353.11	<.01	RSN8542_SIERRA.MEX_CILDRHNE
				<.01	RSN8542_SIERRA.MEX_CILDRHNN
	El Mayor Cucapah Mexico	7.2	343.65	0.01	RSN8556_SIERRA.MEX_CIMOPHNE
				<.01	RSN8556_SIERRA.MEX_CIMOPHNN

[a] Joyner-Boore Distance

Time histories were scaled and spectrally matched to the target spectrum. The displacement, velocity, and acceleration time histories of the original and matched motions were evaluated to check that reasonable matching was obtained. Presented in Figure 7 are the spectrally matched motions with the design target spectrum shown for reference.

Figure 7. Scaled and Spectrally Matched Input Motions to Target Spectrum



6.5 Site Response Analysis

Site Response Analysis. The one-dimensional site response computer software DEEPSOIL v7 was used to compute site response of input motions. Equivalent linear analyses were used to determine the response accelerations at the surface. Nonlinear analysis methods were also performed using DEEPSOIL; however, equivalent linear methods were considered more appropriate for this site as large strains are not anticipated based on the stiffness of the soil profile and relatively low seismic input motions. Per Kramer (1996), for sites where the anticipated strain levels remain low, i.e. sites with stiff soil profiles and/or relatively weak input motions, equivalent linear analyses can produce reasonable estimates of the ground response. Additionally, per Cox, Ellis and Griffiths (2012), nonlinear analyses are preferred when large strains are expected.

Soil Properties. Geotechnology reviewed the provided soil information and developed generalized soil profiles for each bridge site. The soil properties required for the analysis depend on the soil type and the selected normalized modulus reduction and damping curves, but typically include unit weight, shear wave velocity, shear strength parameters, plasticity index (PI) (for clay/silt), overconsolidation Ratio (OCR), and at-rest earth pressure coefficient. Modulus reduction and damping ratio curves developed by Darendeli (2001) were used for sands and non-plastic silt. In DEEPSOIL, the GQ/H model was selected which performs implied shear strength corrections using a shear-strain dependent curve-fitting function (Groholski et. Al. 2015 and 2016).

Shear Wave Velocity Profiles. Presented in Appendix D are the generalized shear wave velocity profiles for the north and south side of the bridge used in the SSGMRA, indicated as the mean profile. Also, 60 randomized shear wave velocity profiles and the logmean of the random profiles are included in Appendix D. The random profiles were generated using the Toro (1995) model. The depth to the C/D Boundary was selected based on our interpretation of the provided boring logs and the measured shear wave velocities. Presented in Table 7 is the depth to the C/D boundary used in the analyses.

Table 7. Estimated Depth to C/D Boundary for SSGMR

Location	**Estimated Depth to C/D Boundary (V_s = 1,200 ft/s) (feet)**
North Side	34
South Side	44

The software output represents surface ground motions after amplification effects of input motions by the soil column. Sixty profiles with randomized shear wave velocities and layer thicknesses were considered in our analysis (refer to Appendix D). The Toro (1995) method is used in the DEEPSOIL software to model randomization of layer thickness and shear wave velocity.

Site-Specific Results. Per the procedure outlined in AASHTO Guide Specifications for Seismic Bridge Design, the results of the equivalent linear analysis at each bridge were used to calculate spectral ratios of the input motions and the ground surface motions. The average spectral ratios were then multiplied by the Site Class C/D acceleration response spectrum to calculate the site-specific seismic response spectrum. Based on Section 3.10.2.2 of AASHTO LRFD, the design values shall not be lower than two-thirds of the code-based design response spectra. The design response spectrum for the north and south sides are shown in Figure 8 and Figure 9, respectively. At spectral periods less than approximately 0.6 seconds, the soil column amplifies the input accelerations resulting in spectral acceleration values at the ground surface greater than the mapped accelerations. At spectral periods greater than approximately 0.6 seconds, the spectral acceleration values at the ground surface were calculated to be slightly less than the mapped accelerations.

Per Section C3.4.3.2 of AASHTO Guide Specification for LRFD Seismic bridge Design, when the thickness of soil over rock is less than 40 to 50 feet, significant amplification of ground motions can occur at periods for less than 0.5 seconds. The soil profiles used for these analyses were between 30 and 45 feet and indicate relatively significant amplification at periods less than about 0.6 seconds. **Note that these values are based on the measured shear wave velocities and the provided boring information near the MASW locations. Soil conditions and the depth to the top of rock, or a layer where a significant stiffness contrast occurs, may vary along the bridge alignment and could result in varying ground surface response accelerations.**

Figure 8. Response Spectrum – North Side – Site Class D

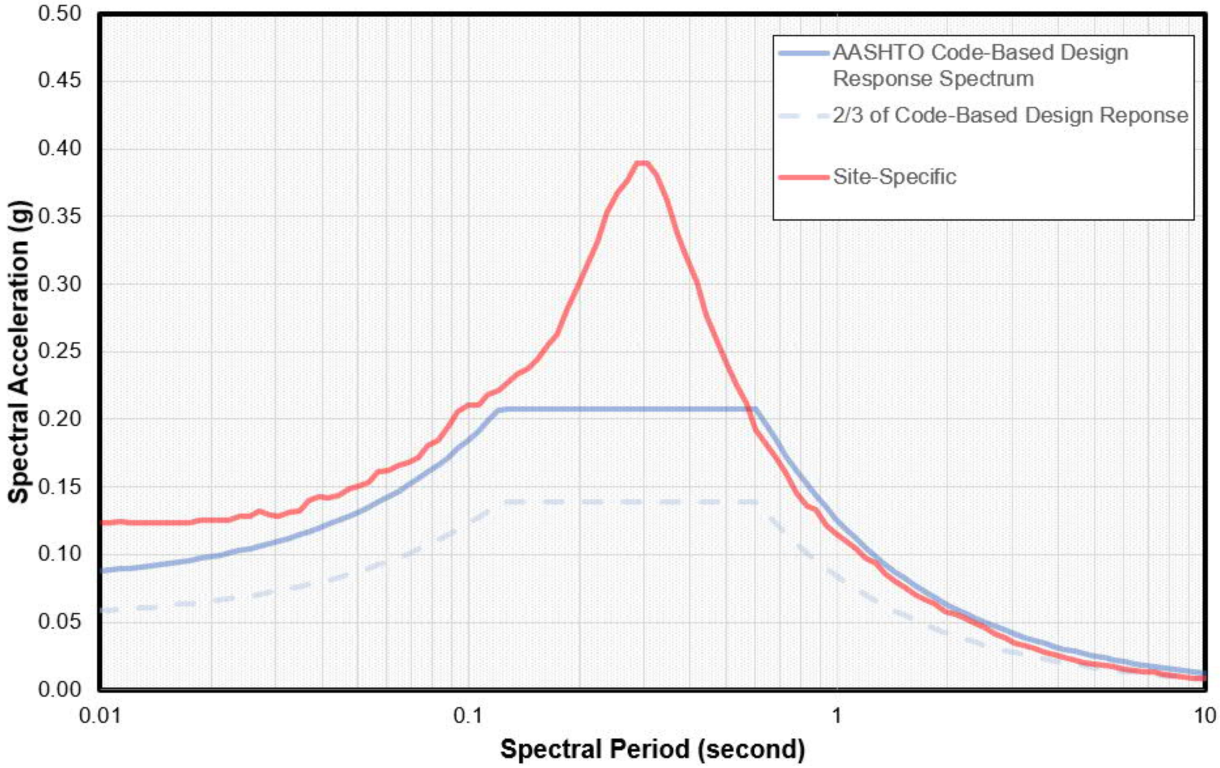
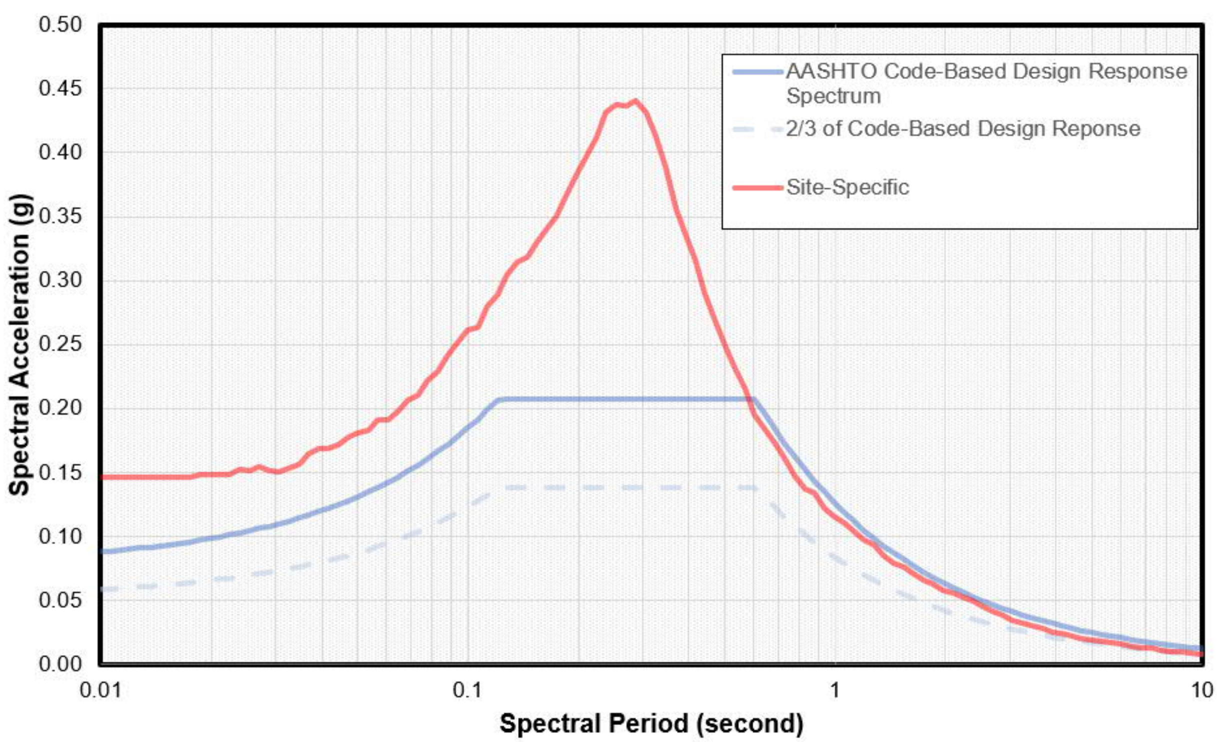


Figure 9. Response Spectrum – South Side – Site Class D



The AASHTO LRFD spectra, two-thirds of the AASHTO LRFD spectra, and the site-specific spectra for the north and south sides are presented in Table 8.

Seismic Performance Zone. Note that the AASHTO Seismic Performance Zone is based on the S_{D1} value. Based on the AASHTO mapped values and the site-specific S_{D1} values, the bridge is classified as Zone 1.

Table 8. Site-Specific Response Spectrum – North and South Side

Period (s)	AASHTO Site Class D Spectrum (g)	2/3 AASHTO Spectrum (g)	North Side Site-Specific Spectrum (g)	South Side Site-Specific Spectrum (g)
A_s	0.088	0.059	0.124	0.147
0.02	0.099	0.066	0.126	0.148
0.03	0.110	0.073	0.128	0.151
0.04	0.120	0.080	0.143	0.169
0.05	0.131	0.087	0.150	0.181
0.07	0.153	0.102	0.169	0.207
0.10	0.185	0.123	0.211	0.262
0.15	0.208	0.139	0.242	0.325
0.20 (S_{ds})	0.208	0.139	0.302	0.386
0.25	0.208	0.139	0.364	0.436
0.30	0.208	0.139	0.389	0.434
0.40	0.208	0.139	0.313	0.329
0.50	0.208	0.139	0.241	0.249
0.75	0.168	0.112	0.154	0.155
1.00 (S_{d1})	0.126	0.084	0.115	0.115
1.50	0.084	0.056	0.077	0.077
2.00	0.063	0.042	0.058	0.058
3.00	0.042	0.028	0.036	0.036
4.00	0.032	0.021	0.025	0.025
5.00	0.025	0.017	0.019	0.019
7.50	0.017	0.011	0.012	0.012
10.00	0.013	0.008	0.008	0.008

7.0 REFERENCES

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APPENDIX A – IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT

DRAFT

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

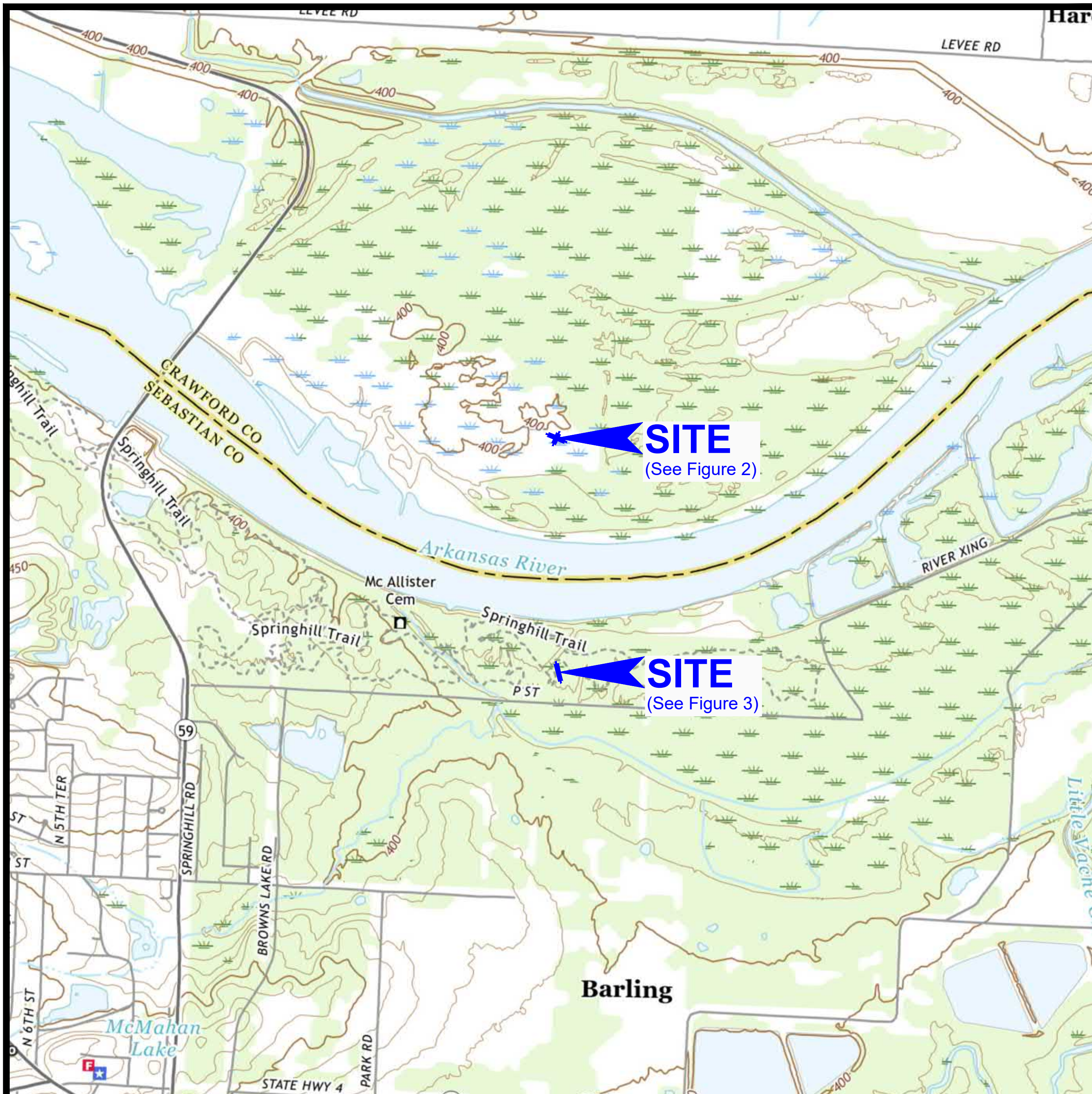
Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GBC GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org

APPENDIX B – FIGURES

DRAFT



NOTES

1. Plan adapted from a 7.5 minute U.S.G.S. map for Barling, Arkansas quadrangle, last revised in 2020.

0 2,000 4,000

SCALE IN FEET

N

Drawn By: WAH	Ck'd By: DLD	App'vd By: DBA
Date: 4-28-23	Date: 5-1-23	Date: 5-1-23

GEOTECHNOLOGY
A Universal Engineering Sciences Company

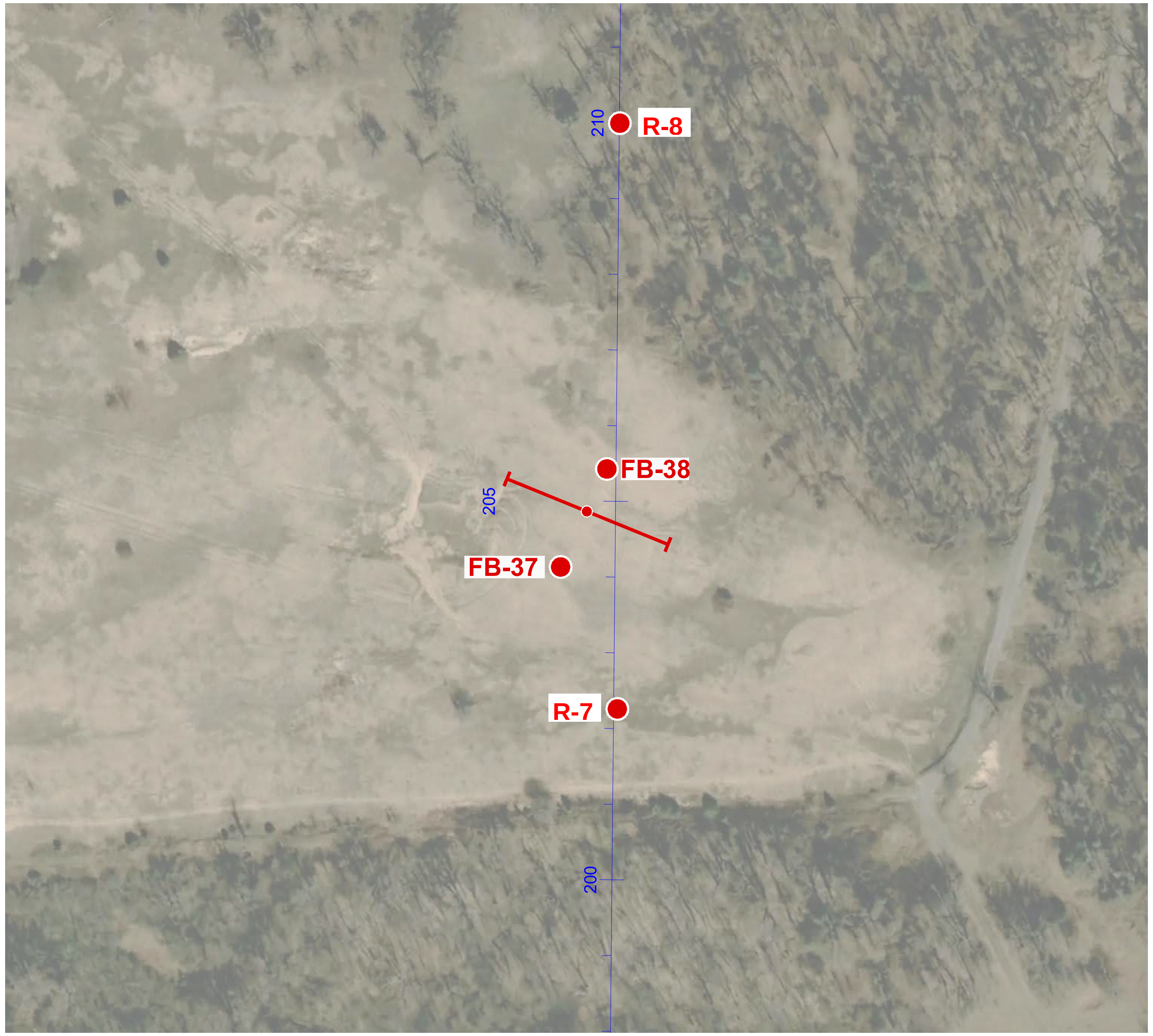
Hwy. 22 - I-40 (Arkansas River) (I-49)
Crawford and Sebastian Counties, Arkansas

SITE LOCATION AND TOPOGRAPHY

Project Number
J042652.01

FIGURE 1

DRAFT



AERIAL PHOTOGRAPH OF DETAIL AREA 1 - NORTH SIDE, BORING AND MASW LINE LOCATIONS

NOTES

1. Plan adapted from a March 5, 2021 aerial photograph courtesy of Google Earth.

2. Boirngs and MASW lines were located in the field with reference to site features and are shown approximate only.

3. See Figure 4 for MASW data.

LEGEND

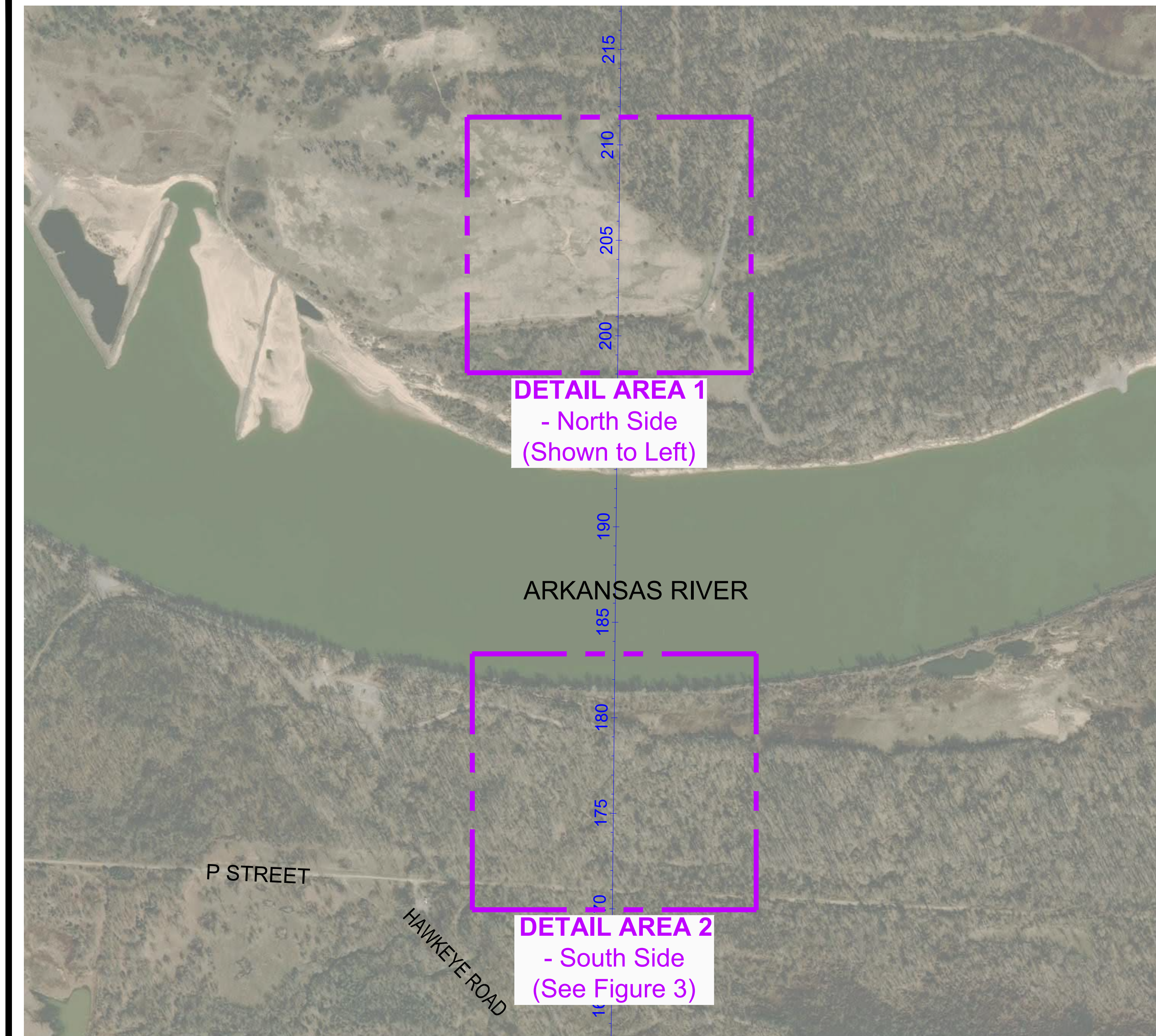
MASW Survey

Boring Location

0 200 400

SCALE IN FEET

N



AERIAL PHOTOGRAPH OF DETAIL AREAS

NOTES

1. Plan adapted from a March 5, 2021 aerial photograph courtesy of Google Earth.

0 400 800 1,600

SCALE IN FEET

N

Drawn By: WAH	Ck'd By: DLD	App'vd By: DBA
Date: 4-28-23	Date: 5-1-23	Date: 5-1-23

GEOTECHNOLOGY
A Universal Engineering Sciences Company

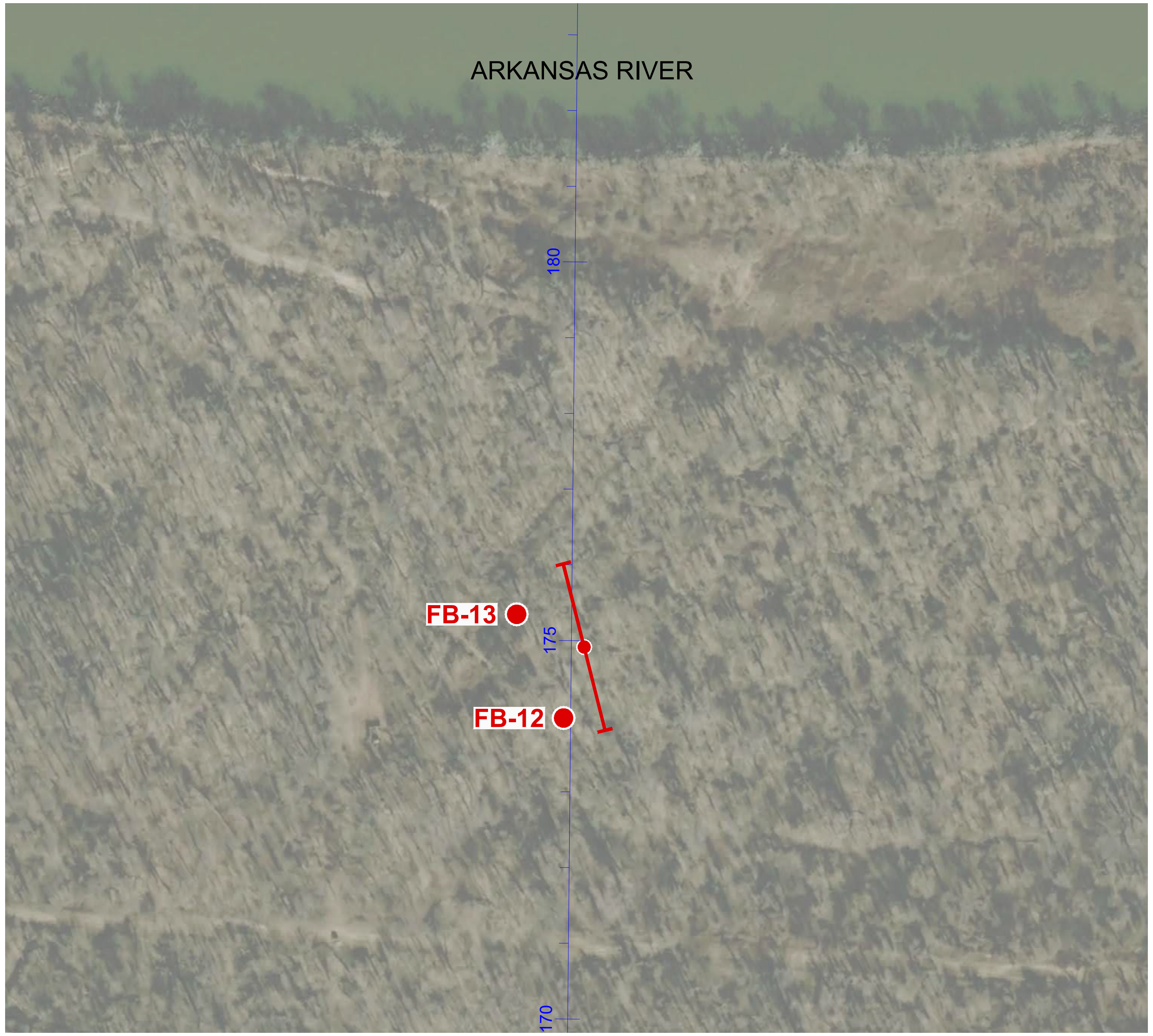
Hwy. 22 - I-40 (Arkansas River) (I-49)
Crawford and Sebastian Counties, Arkansas

AERIAL PHOTOGRAPH OF SITES, BORING AND MASW LINE LOCATIONS

Project Number J042652.01

FIGURE 2

DRAFT



AERIAL PHOTOGRAPH OF DETAIL AREA 2 - SOUTH SIDE, BORING AND MASW LINE LOCATIONS

NOTES

1. Plan adapted from a March 5, 2021 aerial photograph courtesy of Google Earth.

2. Boirngs and MASW lines were located in the field with reference to site features and are shown approximate only.

3. See Figure 5 for MASW data.

LEGEND

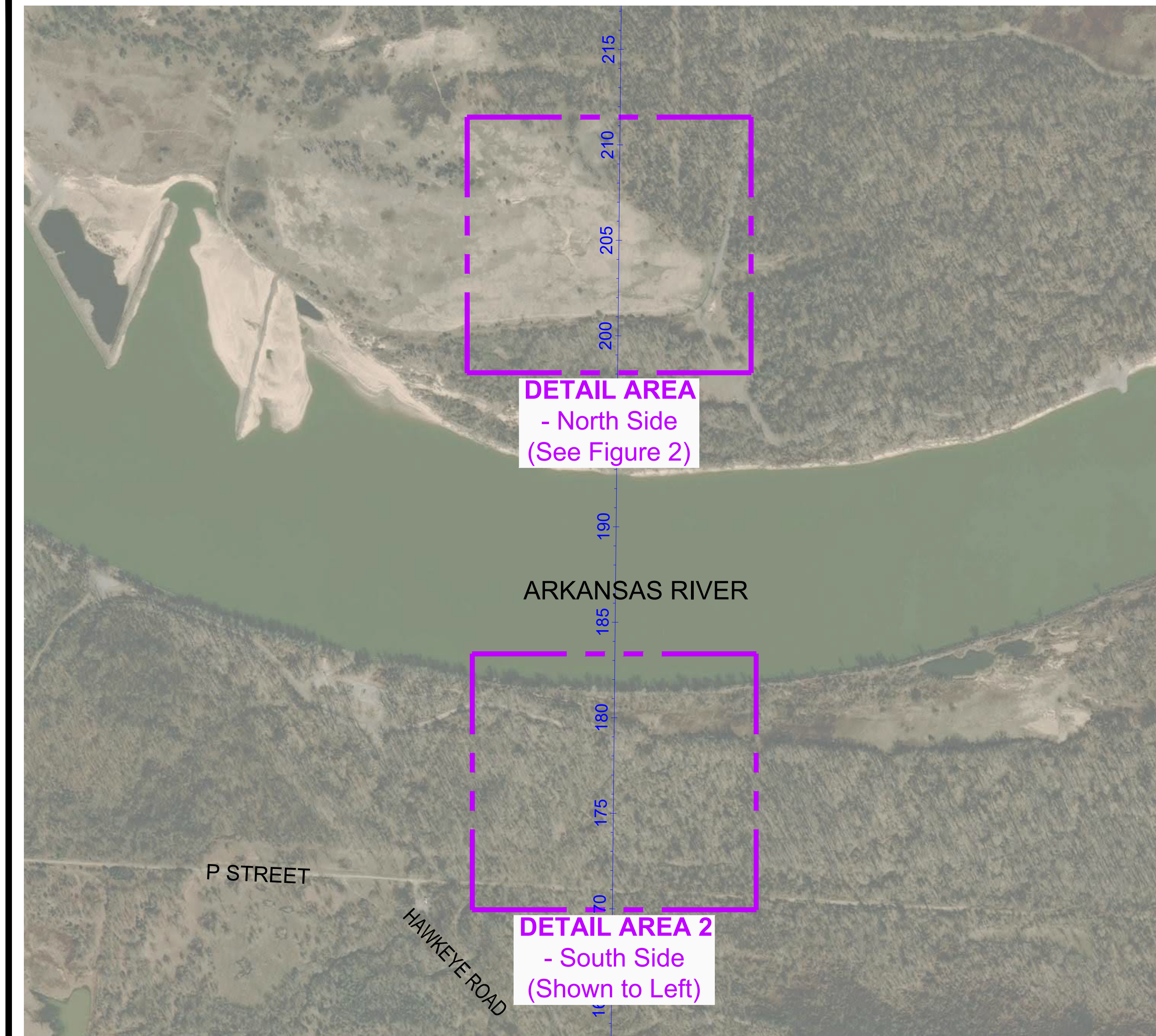
MASW Survey

Boring Location

0 200 400

SCALE IN FEET

N



AERIAL PHOTOGRAPH OF DETAIL AREAS

NOTES

1. Plan adapted from a March 5, 2021 aerial photograph courtesy of Google Earth.

0 400 800 1,600

SCALE IN FEET

N

Drawn By: WAH	Ck'd By: DLD	App'vd By: DBA
Date: 4-28-23	Date: 5-1-23	Date: 5-1-23

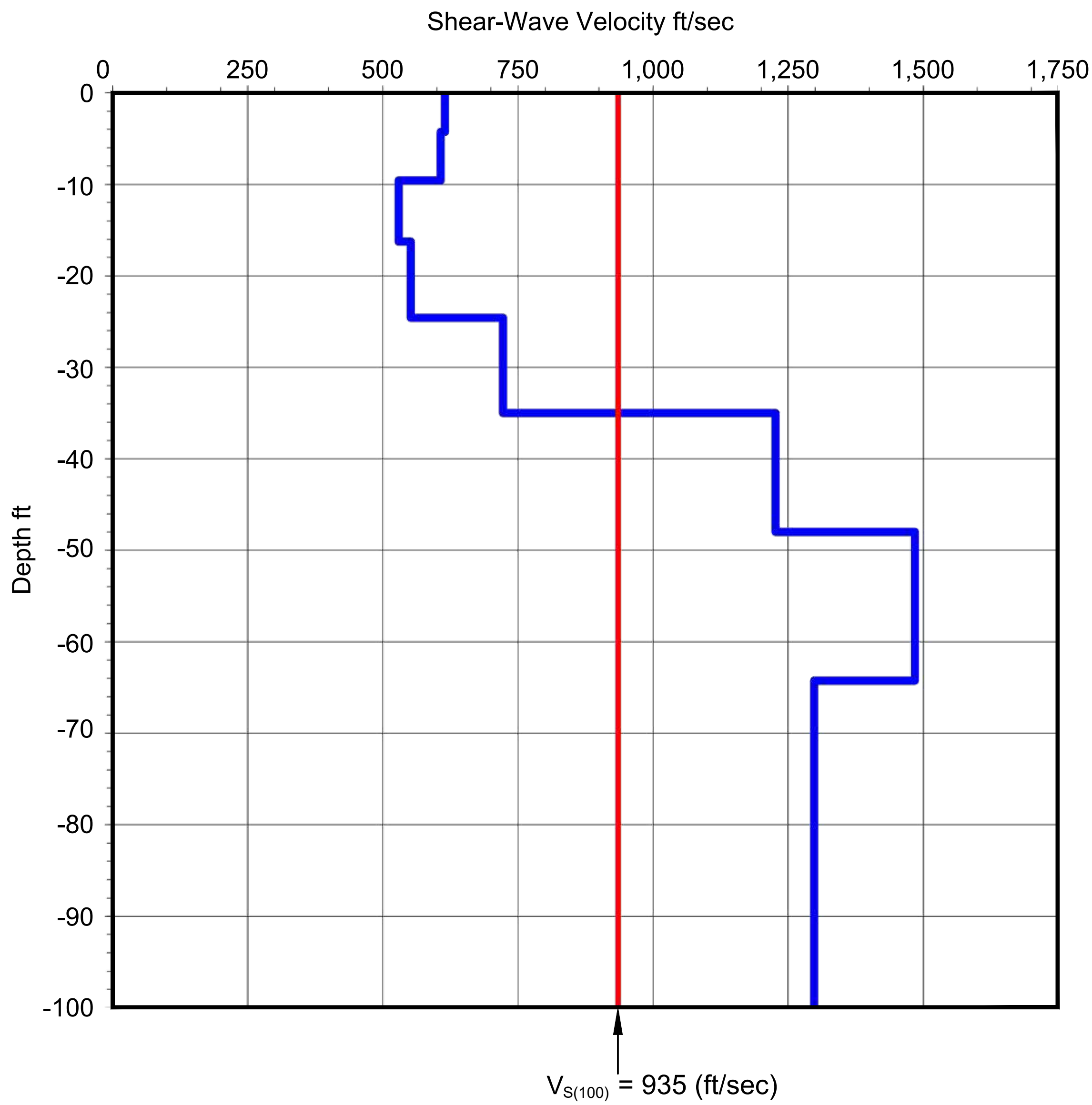
GEOTECHNOLOGY
A Universal Engineering Sciences Company

Hwy. 22 - I-40 (Arkansas River) (I-49)
Crawford and Sebastian Counties, Arkansas

AERIAL PHOTOGRAPH OF SITES, BORING AND MASW LINE LOCATIONS

Project Number J042652.01	FIGURE 3

DRAFT



LEGEND

Shear Wave Velocity Profile

AASHTO Weighted Average Shear Wave Velocity for Top 100 Feet

Drawn By: WAH	Ck'd By: DLD	App'vd By: DBA
Date: 4-28-23	Date: 5-1-23	Date: 5-1-23

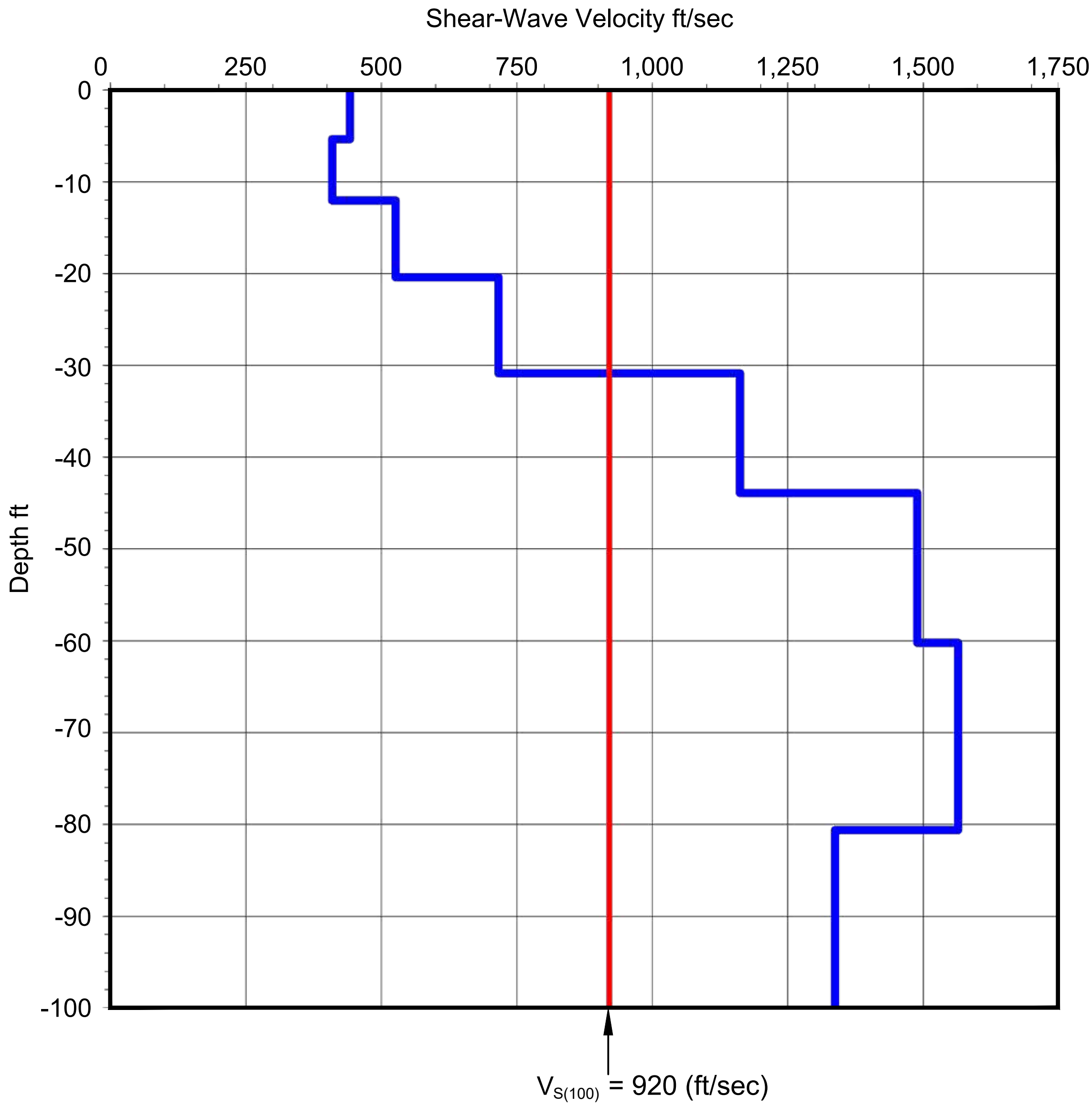
GEOTECHNOLOGY
A Universal Engineering Sciences Company

Hwy. 22 - I-40 (Arkansas River) (I-49)
Crawford and Sebastian Counties, Arkansas

SHEAR WAVE VELOCITY PROFILE
NORTH SIDE

Project Number J042652.01	FIGURE 4

DRAFT



LEGEND

Shear Wave Velocity Profile

AASHTO Weighted Average Shear Wave Velocity for Top 100 Feet

Drawn By: WAH	Ck'd By: DLD	App'vd By: DBA
Date: 4-28-23	Date: 5-1-23	Date: 5-1-23

GEOTECHNOLOGY
A Universal Engineering Sciences Company

Hwy. 22 - I-40 (Arkansas River) (I-49)
Crawford and Sebastian Counties, Arkansas

SHEAR WAVE VELOCITY PROFILE
SOUTH SIDE

Project Number J042652.01	FIGURE 5

APPENDIX C – PROVIDED BORING LOGS

DRAFT

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-12

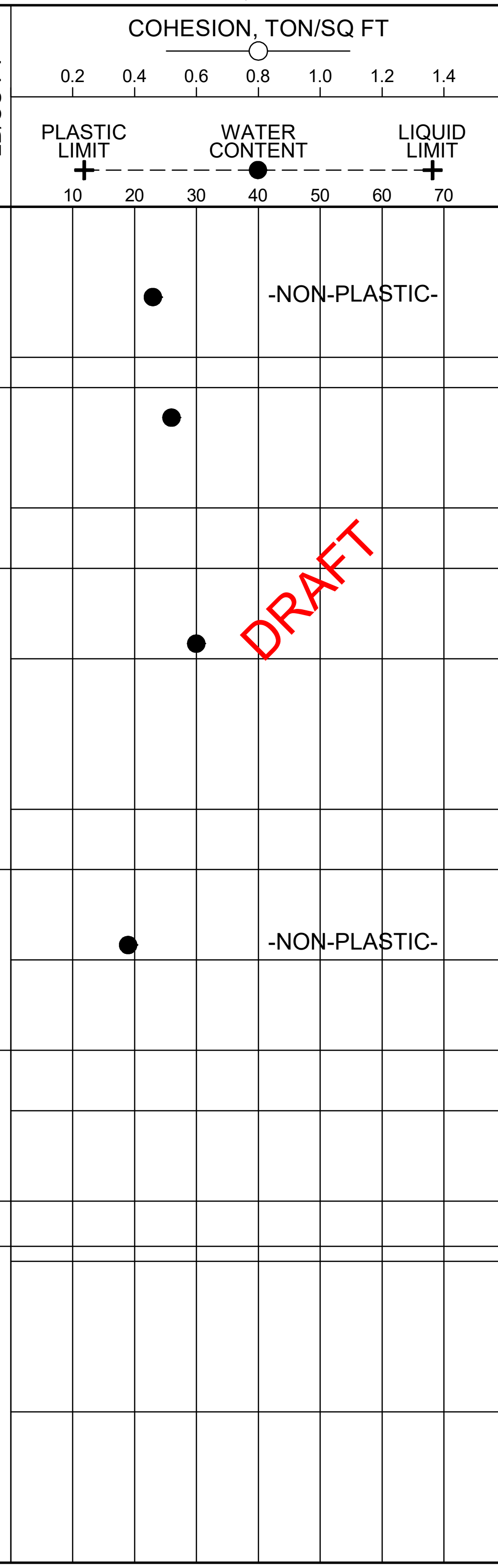
040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 20 ft /Wash 35 ft /NQ Core-Diedrich D-50

LOCATION: 35.339837°N, -94.280426°E

SURF. EL: 390.6

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0	Very loose reddish tan fine sandy silt (ML)	3				
		3				
5	- slightly clayey below 4.5 ft	3				
	Very loose reddish brown silt w/clay seams and layers	6				
10	- loose below 9 ft	8				
	Loose reddish tan silty fine sand (SM)					
15		6				
	- wash at 18 ft - very loose below 18 ft					
20		3				
	Medium dense tan and gray silty fine to medium sand (SM)					
25		12				
	Medium dense tan and gray fine to coarse sand (SW) w/occasional fine gravel					
30		11				
	Moderately hard dark gray weathered shale	50/5"				
35	Moderately hard dark gray shale w/occasional gray fine-grained sandstone partings, horizontal bedding				100	15
40					96	85



COMPLETION DEPTH: 85.0 ft
DATE: 2-21-23

DEPTH TO WATER IN BORING: 18 ft

DATE: 2/20/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-12

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 20 ft /Wash 35 ft /NQ Core-Diedrich D-50

LOCATION: 35.339837°N, -94.280426°E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
45–52	- with more sandstone partings below 45 ft					100	100
52–62	Moderately hard dark gray shale, horizontal bedding					97	97
	- with pyrite inclusions at 55 to 56.5 ft					93	85
62–85	Moderately hard dark gray shale w/interbedded very close, very thin gray fine-grained sandstone partings, horizontal bedding					100	85
						100	100
						100	100
						98	98
						98	98

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4. Water content scale: 10, 20, 30, 40, 50, 60, 70.

NOTE 1: Backfilled with cuttings.
NOTE 2: Drilled by D.T.
NOTE 3: Logged by DRM.

COMPLETION DEPTH: 85.0 ft
DATE: 2-21-23

DEPTH TO WATER IN BORING: 18 ft

DATE: 2/20/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 4-4-23

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-13

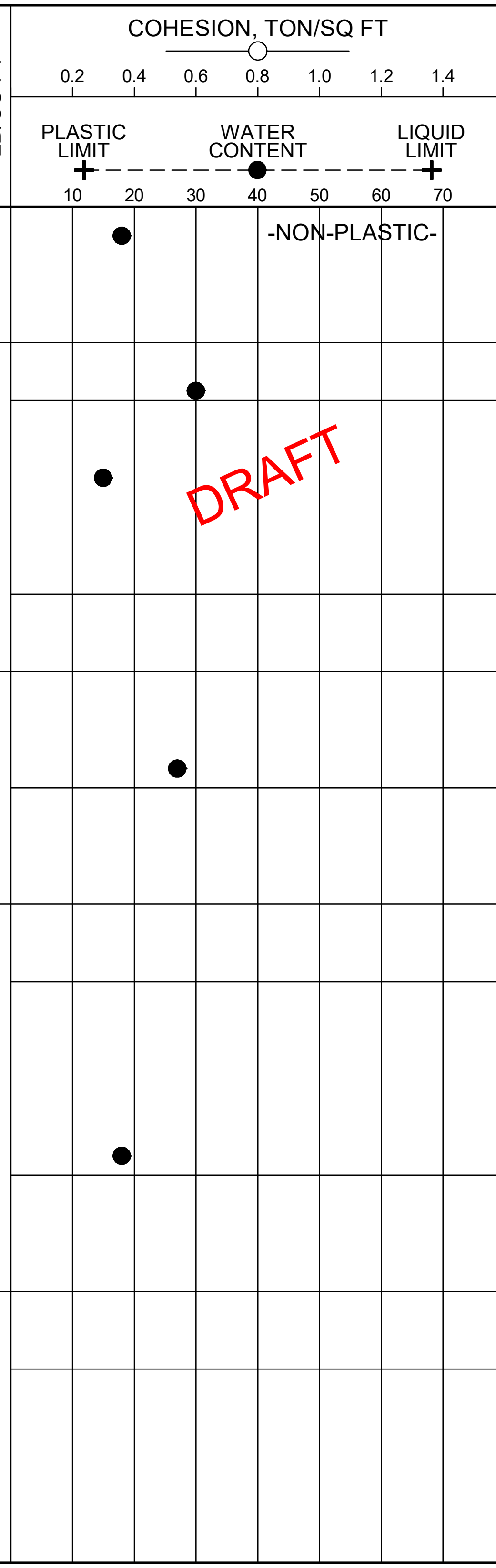
040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 25 ft /Wash 35 ft /NQ Core-Diedrich D-50
LOCATION: 35.340192°N, -94.280633°E

SURF. EL: 391.7

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
Very loose tan and brown fine sandy silt (ML)	2		72		
	2				
Very loose tan and brown silt, slightly sandy (ML)	2		94		
- loose to medium dense from 6 to 8 ft	10	84	97		
- loose below 8.5 ft	6				
Loose brown silty fine sand (SM)	6				
Very loose brown fine to medium sand (SP)	2				
	7				
Loose gray and brown fine to coarse sand w/fine to coarse gravel	9				
- dense below 34 ft	42				

Depth scale, ft: 5, 10, 15, 20, 25, 30



COMPLETION DEPTH: 85.0 ft
DATE: 2-20-23

DEPTH TO WATER IN BORING: 18.3 ft

DATE: 2/6/2023

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-13

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 25 ft /Wash 35 ft /NQ Core-Diedrich D-50

LOCATION: 35.340192°N, -94.280633°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 – 1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 – 70)	- No. 200 %	% Recovery	% RQD
			Moderately hard dark gray shale w/occasional gray fine-grained sandstone partings, horizontal bedding					90	67
40								100	93
45								100	94
50								95	95
55								100	93
			Moderately hard gray fine-grained sandstone w/interbedded, very close, very thin dark gray shale partings, horizontal bedding						
60								95	95
65								100	98

COMPLETION DEPTH: 85.0 ft
DATE: 2-20-23

DEPTH TO WATER
IN BORING: 18.3 ft

DATE: 2/6/2023

DRAFT

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. FB-13

040748 Hwy 22 to I-40 (Arkansas River)
Crawford & Sebastian Co., Arkansas

TYPE: 3.25 in. HSA to 25 ft /Wash 35 ft /NQ Core-Diedrich D-50
LOCATION: 35.340192°N, -94.280633°E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT	- No. 200 %	% Recovery	% RQD
								98	98
75									
			Moderately hard dark gray shale w/some very thin gray fine-grained sandstone partings, horizontal bedding					100	95
80									
								98	98
			- with more sandstone partings below 84 ft						
85									
			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by JT. NOTE 3: Logged by DJM.						
90									
95									
100									

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
Water content scale: 10, 20, 30, 40, 50, 60, 70

DRAFT

COMPLETION DEPTH: 85.0 ft
DATE: 2-20-23

DEPTH TO WATER
IN BORING: 18.3 ft

DATE: 2/6/2023

RECRQDN200-2 21-071_FB LOGS.GPJ 2-23-23

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R-7

040748 Hwy 22 to I-40 (Arkansas River)
Crawford County, Arkansas

TYPE: 4.25 in. HSA 35 ft /Wash 45 ft /NQ Core-CME-850 LOCATION: 35.347621°N -94.280512° E

SURF. EL: 398.7

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
0	Loose tan fine to coarse sand w/some fine gravel and trace silt (SM-SP)	8				
	- medium dense below 2.5 ft	13				
5		22		6		
		20				
8.5	Loose tan fine to medium sand w/organic stains, slightly silty (SM-SP)	7				
	- medium dense below 13 ft	17		5		
	- with some fine to coarse gravel below 16 ft	20				
23	Medium dense tan fine to medium sand w/occasional fine gravel (SP)	27				
	- dense at 28 to 34 ft - with more fine to coarse gravel below 29 ft	50		3		
	- medium dense below 34 ft	16				

DRAFT

COMPLETION DEPTH: 75.0 ft
DATE: 3-23-22

DEPTH TO WATER IN BORING: 35 ft

DATE: 3/22/2022

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R-7

040748 Hwy 22 to I-40 (Arkansas River)
Crawford County, Arkansas

TYPE: 4.25 in. HSA 35 ft /Wash 45 ft /NQ Core-CME-850 LOCATION: 35.347621°N -94.280512° E

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION / LAB TESTS	% Recovery	% RQD
40	- dense, gray and tan with decayed organics below 39 ft	30				
45	Low hardness dark gray shale w/very close, very thin gray fine-grained sandstone partings, horizontal bedding - low hardness to moderately hard below 45 ft	21			93	80
50	Moderately hard gray fine-grained sandstone w/interbedded very close, very thin dark gray shale partings, horizontal bedding			q_u= 8350 psi, TUW= 166 pcf q_u= 6360 psi, TUW= 162 pcf	90	87
55	- vertical fracture at 55 to 55.3 ft - with some shale seams from 56 to 61 ft			q_u= 3330 psi, TUW= 165 pcf q_u= 6670 psi, TUW= 165 pcf	100	87
60			155	q_u= 1400 psi, TUW= 164 pcf q_u= 6480 psi, TUW= 162 pccf	100	100
65	Moderately hard dark gray shale w/very close, very thin gray fine-grained sandstone partings				100	100

Chart scale: COHESION, TON/SQ FT 0.2 0.4 0.6 0.8 1.0 1.2 1.4; PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT 10 20 30 40 50 60 70; - No. 200 %

COMPLETION DEPTH: 75.0 ft
DATE: 3-23-22

DEPTH TO WATER IN BORING: 35 ft

DATE: 3/22/2022

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R-7

040748 Hwy 22 to I-40 (Arkansas River)
Crawford County, Arkansas

TYPE: 4.25 in. HSA 35 ft /Wash 45 ft /NQ Core-CME-850 LOCATION: 35.347621°N -94.280512° E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
75						q_u= 5260 psi, TUW= 165 pcf		95	87
80			NOTE 1: Boring terminated due to cave in above bedrock interface. NOTE 2: Backfilled with cuttings. NOTE 3: Drilled by AD. NOTE 4: Logged by QE.						
85									
90									
95									
100									

DRAFT

COMPLETION DEPTH: 75.0 ft
DATE: 3-23-22

DEPTH TO WATER
IN BORING: 35 ft

DATE: 3/22/2022

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R-8

040748 Hwy 22 to I-40 (Arkansas River)
Crawford County, Arkansas

TYPE: 3.25 in. HSA 24 ft /Wash 50 ft /NQ Core - CME-55
LOCATION: 35.349772° N -94.280563° E

SURF. EL: 400.5

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10 20 30 40 50 60 70

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	- No. 200 %
0–4	Very loose tan fine to medium sand w/some fine to coarse gravel (SP)	3	
	- loose below 2 ft	9	
4–22	Very loose to loose reddish tan silty fine sand w/occasional organics (SM)	4	18
	- loose at 6 to 17 ft	8	
		9	13
	- with occasional silt and silty clay seams and layers below 12 ft	7	
	- medium dense below 17 ft	13	
22–35	Medium dense tan fine to medium sand w/some coarse sand and fine to coarse gravel (SP)	22	2
	- with less gravel from 27 to 32 ft	21	
		23	

DRAFT

COMPLETION DEPTH: 100.0 ft
DATE: 4-8-22

DEPTH TO WATER IN BORING: 24.5 ft

DATE: 4/5/2022

RECRQDN200-2 21-071_R LOGS.GPJ 5-24-22

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R-8

040748 Hwy 22 to I-40 (Arkansas River)
Crawford County, Arkansas

TYPE: 3.25 in. HSA 24 ft /Wash 50 ft /NQ Core - CME-55 LOCATION: 35.349772° N -94.280563° E

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

DEPTH, FT	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	Remarks	- No. 200 %	% Recovery	% RQD
35–47		22					
47–54	Moderately hard gray fine-grained sandstone w/very close, very thin dark gray shale partings					100	95
54–69	Moderately hard dark gray shale w/very close, very thin gray fine-grained sandstone partings, horizontal bedding			q_u= 5520 psi, TUW= 164 pcf		70	0
	- with more mechanical breaks along shale beds below 60 ft					98	98
	- highly weathered shale layer from 65.7 to 65.9 ft			q_u= 4660 psi, TUW= 162 pcf		100	95
69–	Moderately hard gray						

DRAFT

COMPLETION DEPTH: 100.0 ft
DATE: 4-8-22

DEPTH TO WATER IN BORING: 24.5 ft

DATE: 4/5/2022

21-071

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. R-8

040748 Hwy 22 to I-40 (Arkansas River)
Crawford County, Arkansas

TYPE: 3.25 in. HSA 24 ft /Wash 50 ft /NQ Core - CME-55 LOCATION: 35.349772° N -94.280563° E

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10–70)	- No. 200 %	% Recovery	% RQD
70–75			fine-grained sandstone w/very close, very thin dark gray shale partings, horizontal bedding - with dark gray shale seams from 70 to 88 ft					100	98
75–80						q_u= 2030 psi, TUW= 162 pcf q_u= 3580 psi, TUW= 167 pcf		96	96
80–85								100	100
85–90								100	100
90–95			- shale less frequent below 90 ft			q_u= 4070 psi, TUW= 163 pcf		100	100
95–100								100	100
100			NOTE 1: Backfilled with cuttings. NOTE 2: Drilled by KD. NOTE 3: Logged by DM.						

DRAFT

COMPLETION DEPTH: 100.0 ft
DATE: 4-8-22

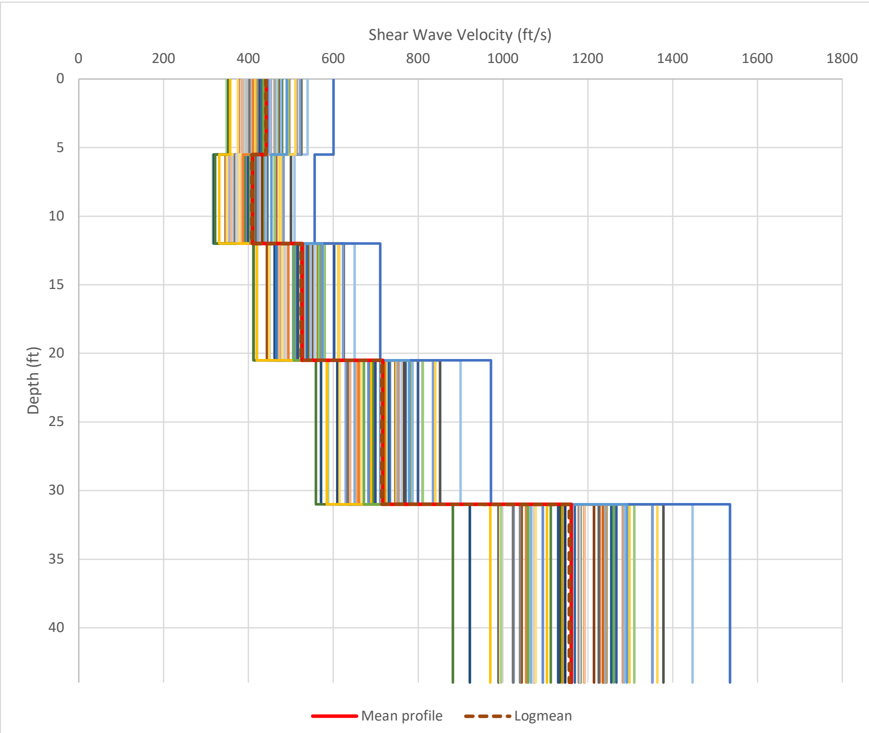
DEPTH TO WATER IN BORING: 24.5 ft

DATE: 4/5/2022

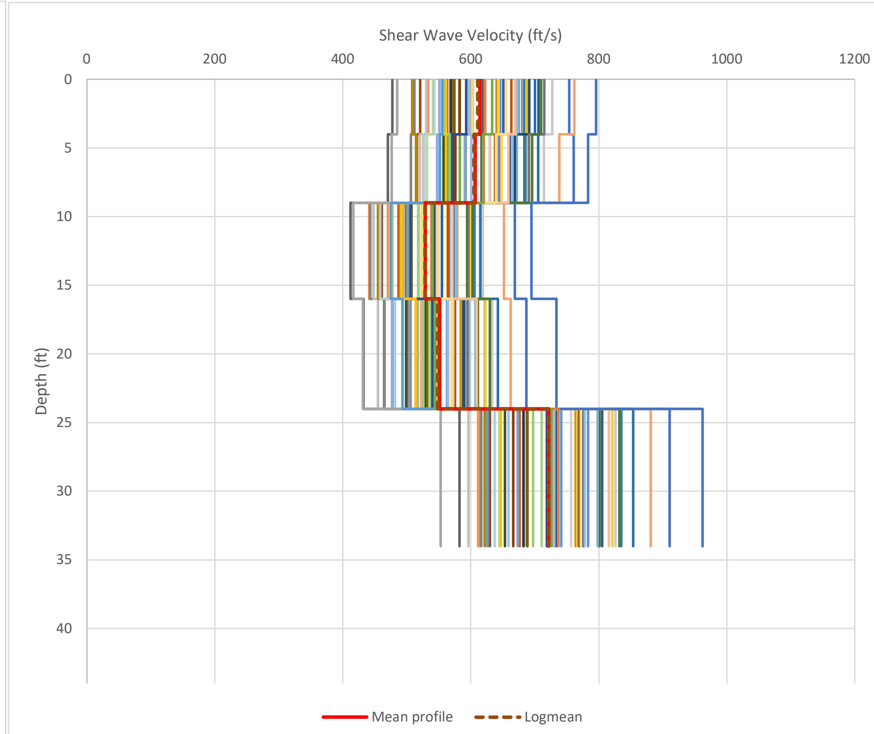
APPENDIX D – GENERALIZED SHEAR WAVE VELOCITY PROFILE / RANDOMIZED SHEAR WAVE VELOCITY PROFILES

ArDOT 040748
Geotechnology Project No. J042652.01

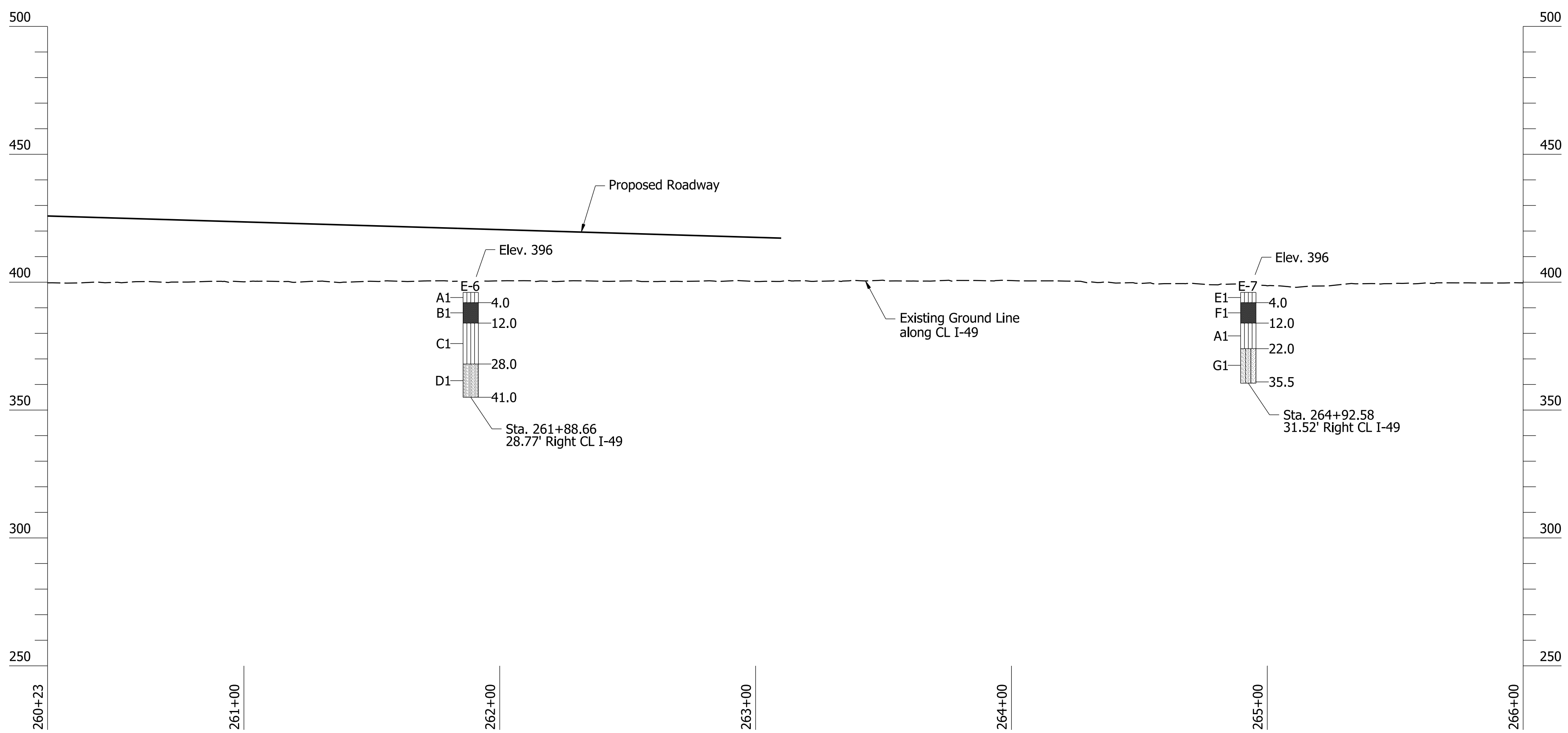
South Side of Arkansas River - Generalized Shear Wave Profile / Randomized Profiles



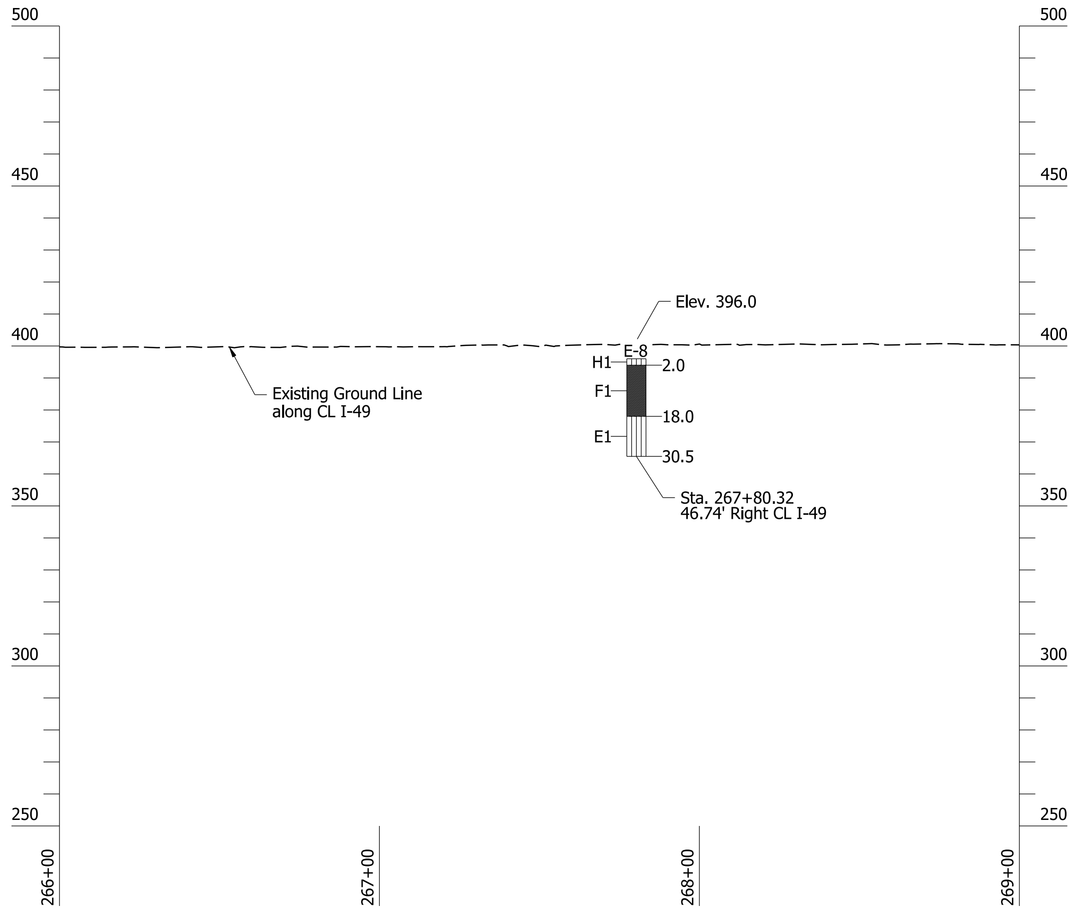
North Side of Arkansas River Generalized Shear Wave Profile / Randomized Profiles



Appendix 8: Alignment Subsurface Profile



ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS

"N" VALUES

E-6 - Sta. 261+88.66, 28.77' Right of CL I-49

0.5-1.5	N=5
2.5-3.5	N=13
4.5-5.5	N=11
9.0-10.0	N=11
14.0-15.0	N=9
19.0-20.0	N=8
24.0-25.0	N=14
29.0-30.0	N=10
34.0-35.0	N=18
39.0-40.0	N=20

E-7 - Sta. 264+92.58, 31.52' Right of CL I-49

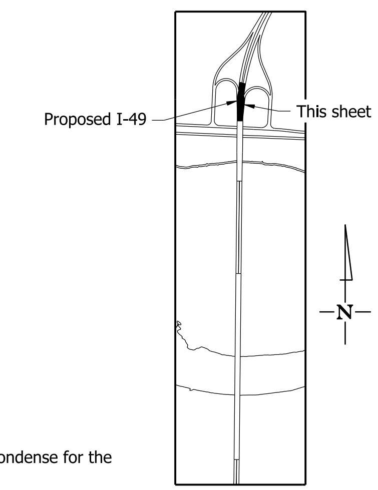
0.5-1.5	N=3
2.5-3.5	N=11
4.5-5.5	N=9
9.0-10.0	N=3
14.0-15.0	N=5
19.0-20.0	N=4
24.0-25.0	N=6
29.0-30.0	N=22
34.0-35.0	N=11

E-8 - Sta. 267+80.32, 46.74' Right of CL I-49

0.5-1.5	N=5
2.5-3.5	N=8
6.5-7.5	N=10
9.0-10.0	N=13
14.0-15.0	N=10
19.0-20.0	N=2
24.0-25.0	N=4
29.0-30.0	N=11

BORING LEGEND

A1 - ML-Loose reddish brown fine sandy silt w/trace clay
B1 - CL-Stiff reddish brown silty clay, slightly sandy
C1 - ML-Loose reddish tan fine sandy silt
D1 - SP-Medium dense reddish tan fine sand
E1 - ML-Very loose reddish brown fine sandy silt
F1 - CL-Firm reddish brown silty clay
G1 - SM-Loose reddish tan silty fine sand
H1 - ML-Loose brown to reddish brown clayey silt



SITE PLAN
No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

ALTERNATE NO. 1 & ALTERNATE NO. 2
SHEET 1 OF 1
LAYOUT OF SOIL BORINGS

I-49
GUN CLUB RD RAMP - BRIDGE 0XXX16 (F)
CRAWFORD COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: BNG DATE: 12/14/23 FILENAME: Aft BR16 SB Layout.dgn
CHECKED BY: XXX DATE: XX/XX/XX SCALE: 1" = 30'
DESIGNED BY: XXX DATE: XX/XX/XX
BRIDGE NO. 07685 DRAWING NO. $BR085$

PRINT DATE: 1/4/2024

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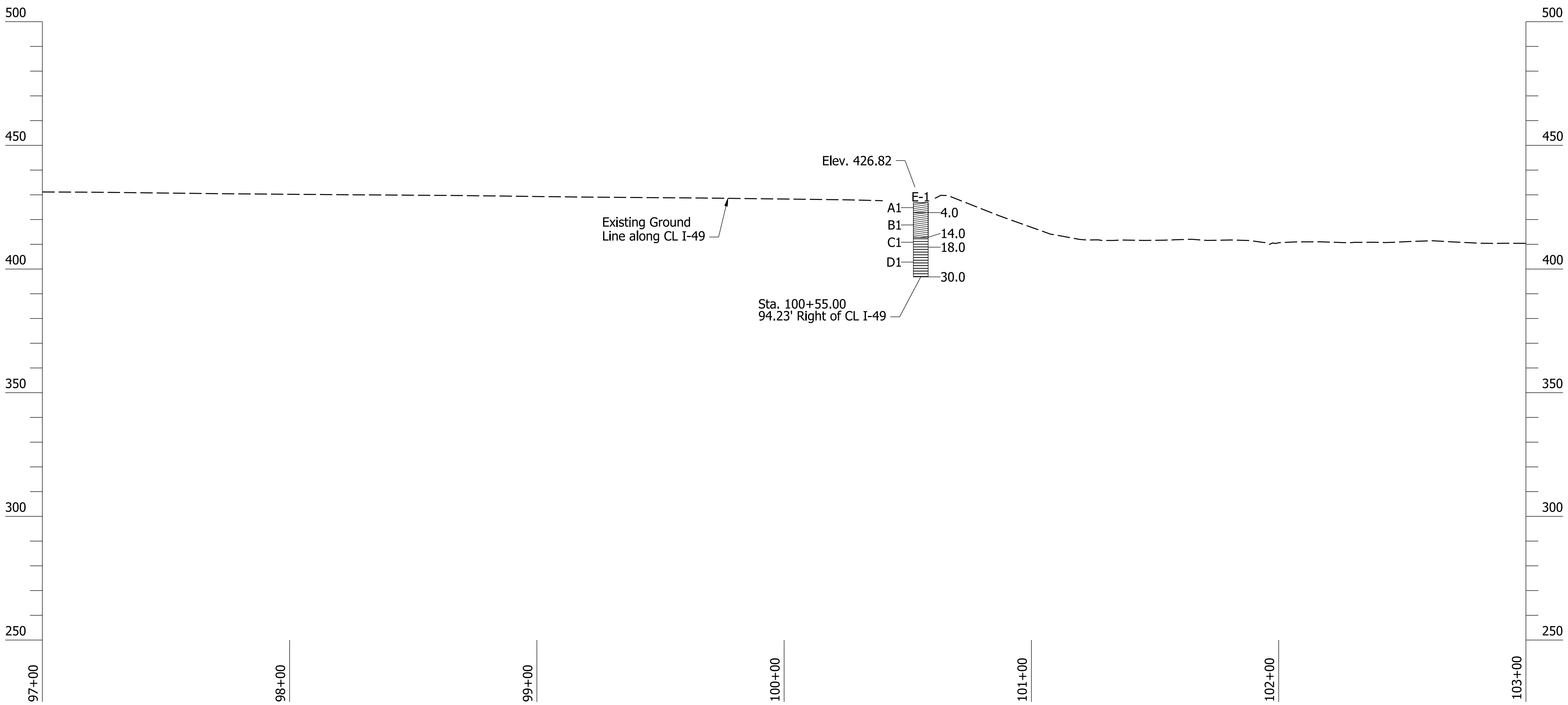
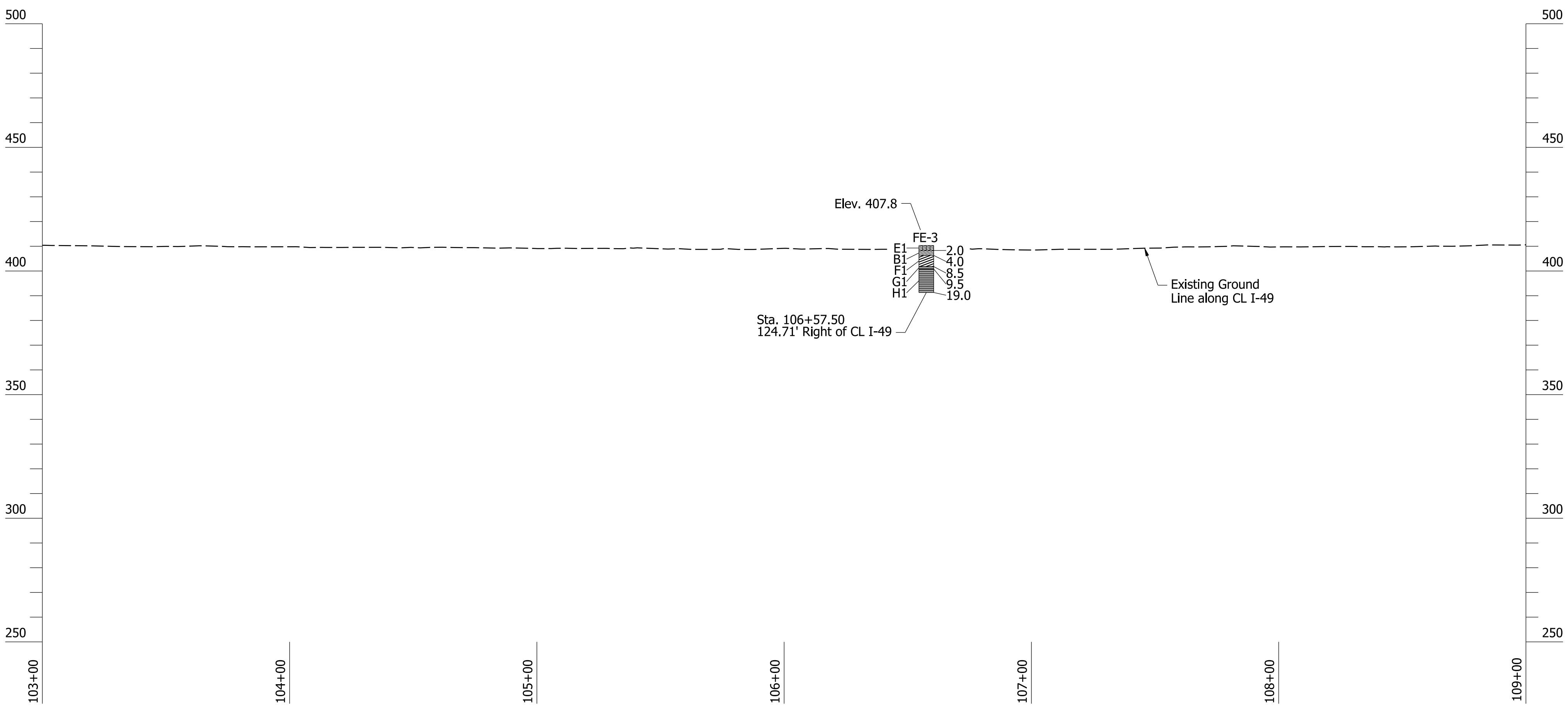


ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS

"N" VALUES

E-1 - Sta. 100+55.0, 94.23' 94.23' Left of CL I-49

0.5-1.5	N=7
2.5-3.5	N=3
4.5-5.5	N=5
6.5-7.5	N=8
9.0-10.0	N=27
14.0-15.0	N=23
19.0-20.0	N=50
24.0-25.0	N=50
29.0-30.0	N=50"

FE-3 - Sta. 106+12.81, 123.99' Right of CL I-49

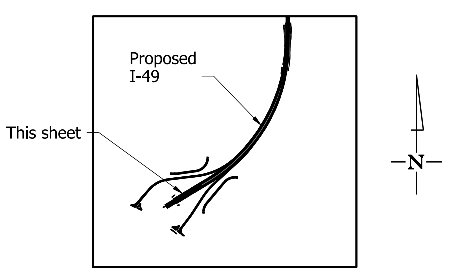
0.5-1.5	N=4
2.5-3.5	N=6
4.5-5.5	N=20
8.5-9.5	N=50/1"

BORING LEGEND

A1 - CL-Firm tan and gray silty clay
B1 - CL-Soft tan and gray silty clay
C1 - SHALE-Low hardness tan and dark gray highly weathered shale
D1 - SHALE-Low hardness to moderately hard dark gray weathered shale
E1 - CL-ML-Very soft brown and gray clayey silt
F1 - CH-Stiff gray and tan clay
G1 - SHALE-Low hardness dark gray shale, slightly weathered, horizontal bedding
H1 - SHALE-Moderately hard dark gray shale w/interbeded very close sandstone partings

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.



SITE PLAN
No Scale

SHEET 1 OF 5
LAYOUT OF SOIL BORINGS
I-49
HWY. 22 - BRIDGE 07684 (F)
SEBASTIAN COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

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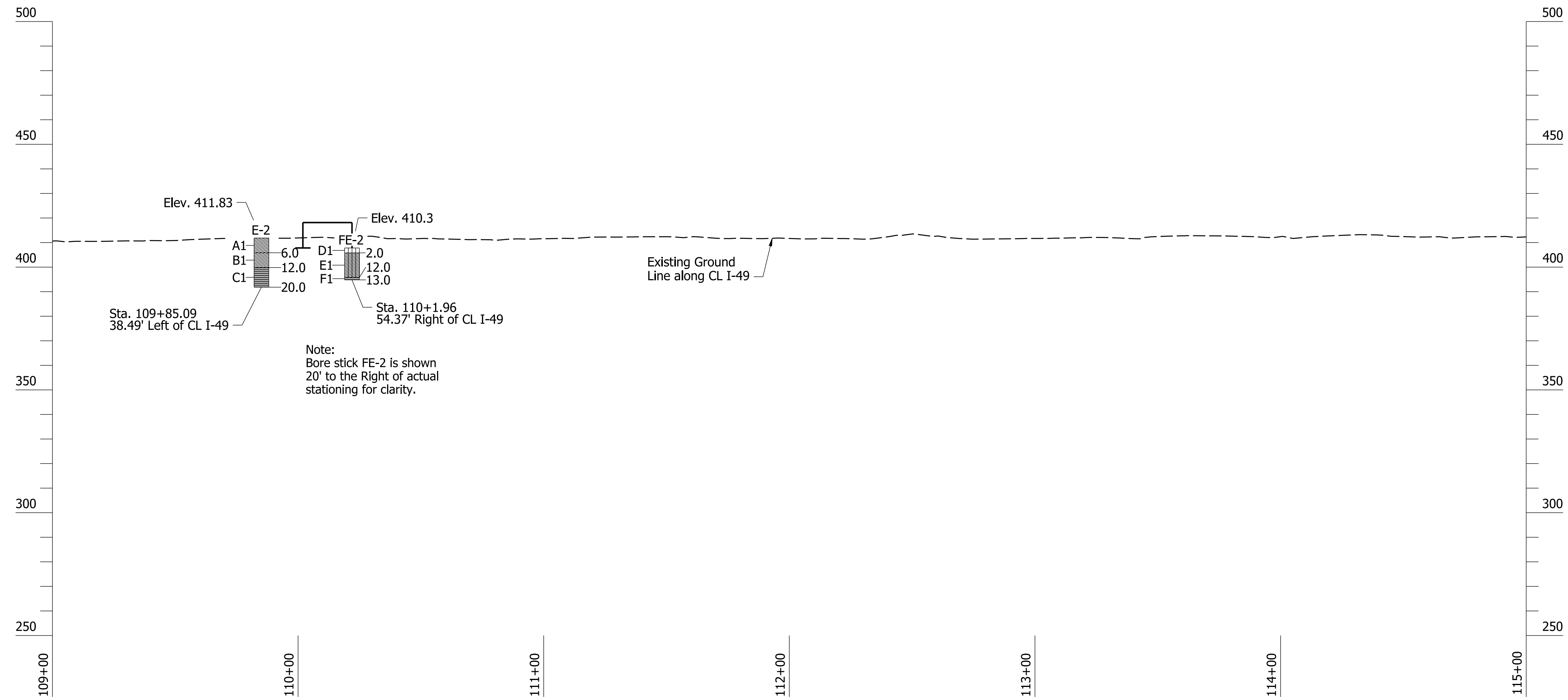
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07684 DRAWING NO.

PRINT DATE: 1/2/2024



ELEVATION OF SOIL BORINGS

"N" VALUES

FE-2 - Sta. 109+56.17, 53.56' Right of CL I-49

0.5-1.5	N=2
2.5-3.5	N=17
4.5-5.5	N=13
6.5-7.5	N=13
9.0-10.0	N=28
12.0-13.0	N=25/0"

E-2 - Sta. 109+85.09, 38.49' Left of CL I-49

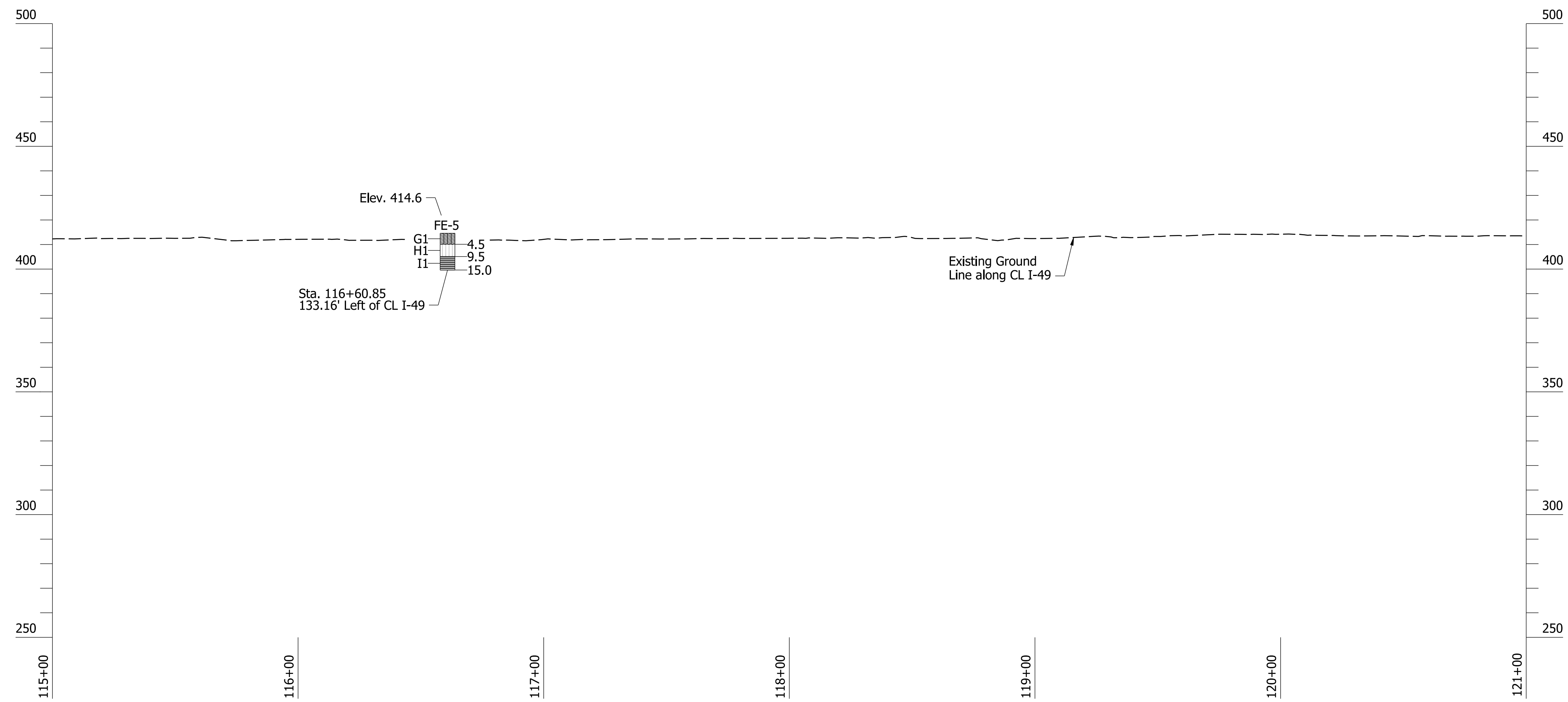
0.5-1.5	N=5
2.5-3.5	N=0
4.5-5.5	N=14
6.5-7.5	N=14
9.0-10.0	N=50/6"
14.0-15.0	N=50/2"
19.0-20.0	N=50/2"

FE-5 - Sta. 116+14.91, 138.43' Left of CL I-49

0.5-1.5	N=3
2.5-3.5	N=8
4.0-5.0	N=50/10"

BORING LEGEND

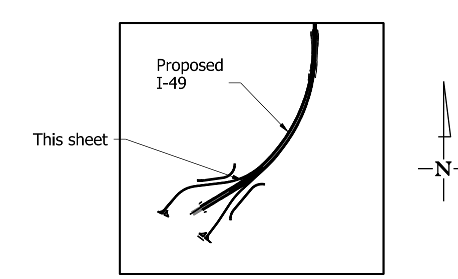
A1 - CL-Soft tan silty clay, sandy
B1 - CL-Stiff gray and reddish tan silty clay w/ferrous stains
C1 - SHALE-Low hardness to moderately hard dark gray shale w/ferrous stains
D1 - ML-Very loose brown silt, slightly clayey
E1 - CL-ML-Stiff tan and brown clayey silt with ferrous nodules
F1 - SHALE-Low hardness to moderately hard dark gray weathered shale
G1 - CL-ML-Very soft tan and brown clayey silt, sandy
H1 - SANDSTONE-Low hardness to moderately hard tan and brown fine-grained sandstone w/ferrous stains
I1 - SHALE-Moderately hard dark gray shale w/interbeded very close sandstone partings



ELEVATION OF SOIL BORINGS

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.



SITE PLAN
No Scale

SHEET 2 OF 5
LAYOUT OF SOIL BORINGS
I-49
HWY. 22 - BRIDGE 07684 (F)
SEBASTIAN COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: BNG DATE: 12/07/23 FILENAME: Bfr BR1 SB Layout 2.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07684 DRAWING NO.

PRINT DATE: 1/2/2024

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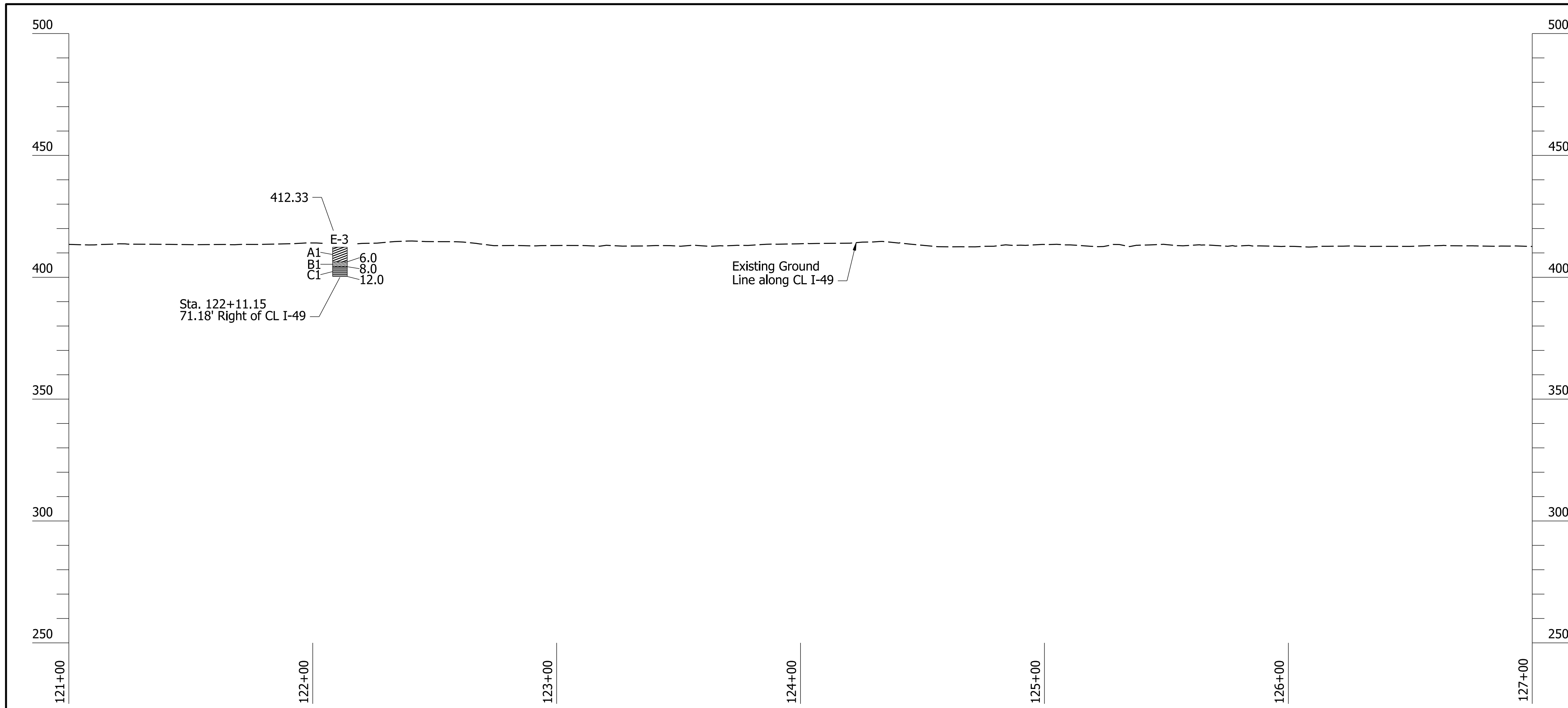
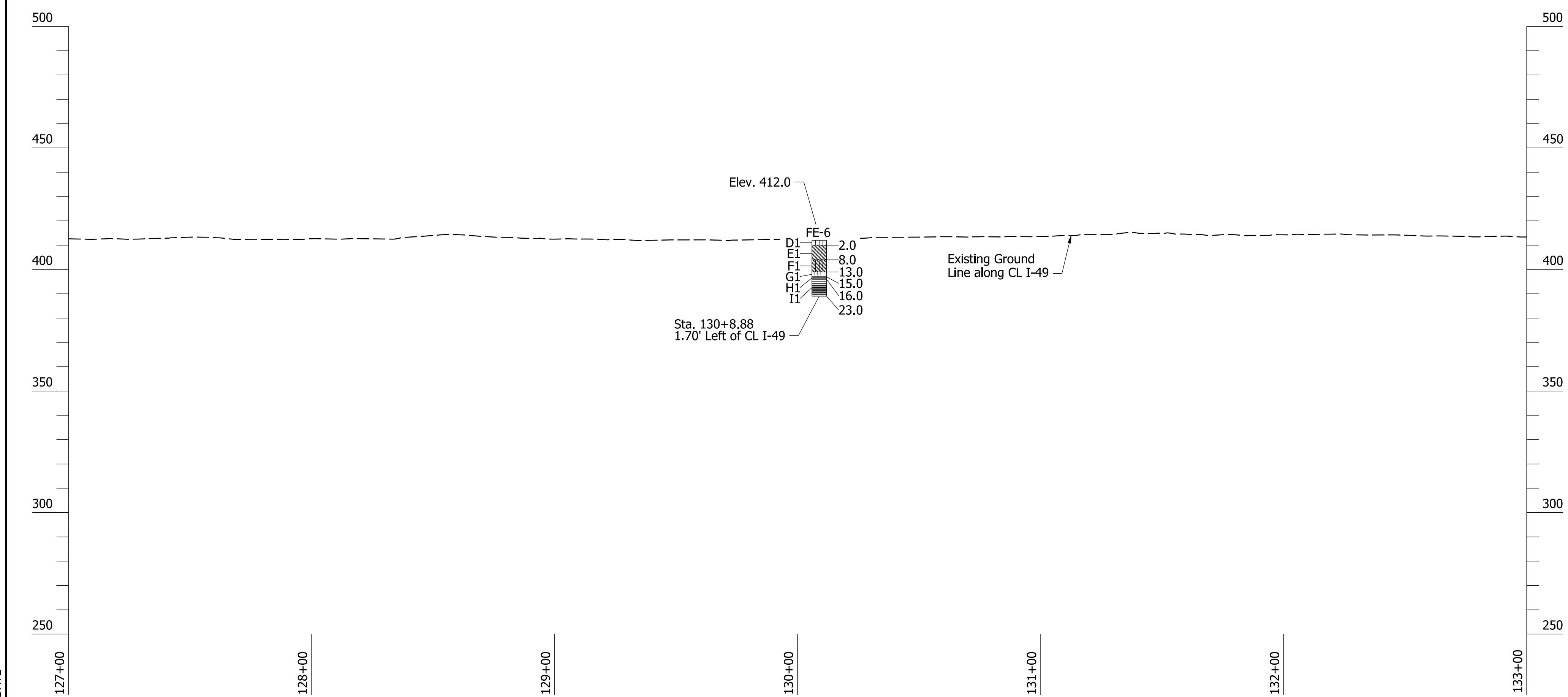


ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS

"N" VALUES

E-3 - Sta. 122+11.15, 71.18' Right of CL I-49

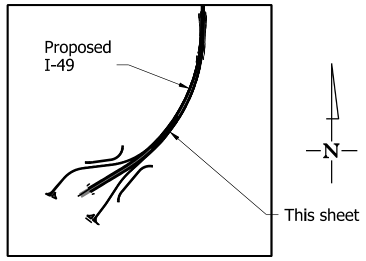
0.5-1.5	N=3
4.5-5.5	N=5
6.5-7.5	N=17
9.0-10.0	N=50/6"
11.0-12.0	N=25/0"

FE-6 - Sta. 129+67.80, 19.90' Left of CL I-49

0.5-1.5	N=12
2.5-3.5	N=10
6.5-7.5	N=10
9.0-10.0	N=18
12.5-13.5	N=50/3"

BORING LEGEND

A1 - CH-Very soft tan and gray clay
B1 - CL-Stiff reddish tan and gray fine sandy clay
C1 - SHALE-Low hardness tan and gray weathered shale w/ferrous stains and sandstone partings
D1 - ML-Medium dense brown silt (fill)
E1 - CL-Stiff gray and reddish tan silty clay
F1 - CL-ML-Stiff brown clayey silt with ferrous nodules and shale fragments
G1 - SANDSTONE-Moderately hard tan and brown fine-grained sandstone
H1 - SHALE-Moderately hard dark gray shale, slightly weathered, horizontal bedding
I1 - SHALE-Moderately hard dark gray shale w/interbeded very close sandstone partings



SITE PLAN
No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 3 OF 5
LAYOUT OF SOIL BORINGS
I-49
HWY. 22 - BRIDGE 07684 (F)
SEBASTIAN COUNTY

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

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BRIDGE NO. 07684 DRAWING NO.

PRINT DATE: 1/2/2024

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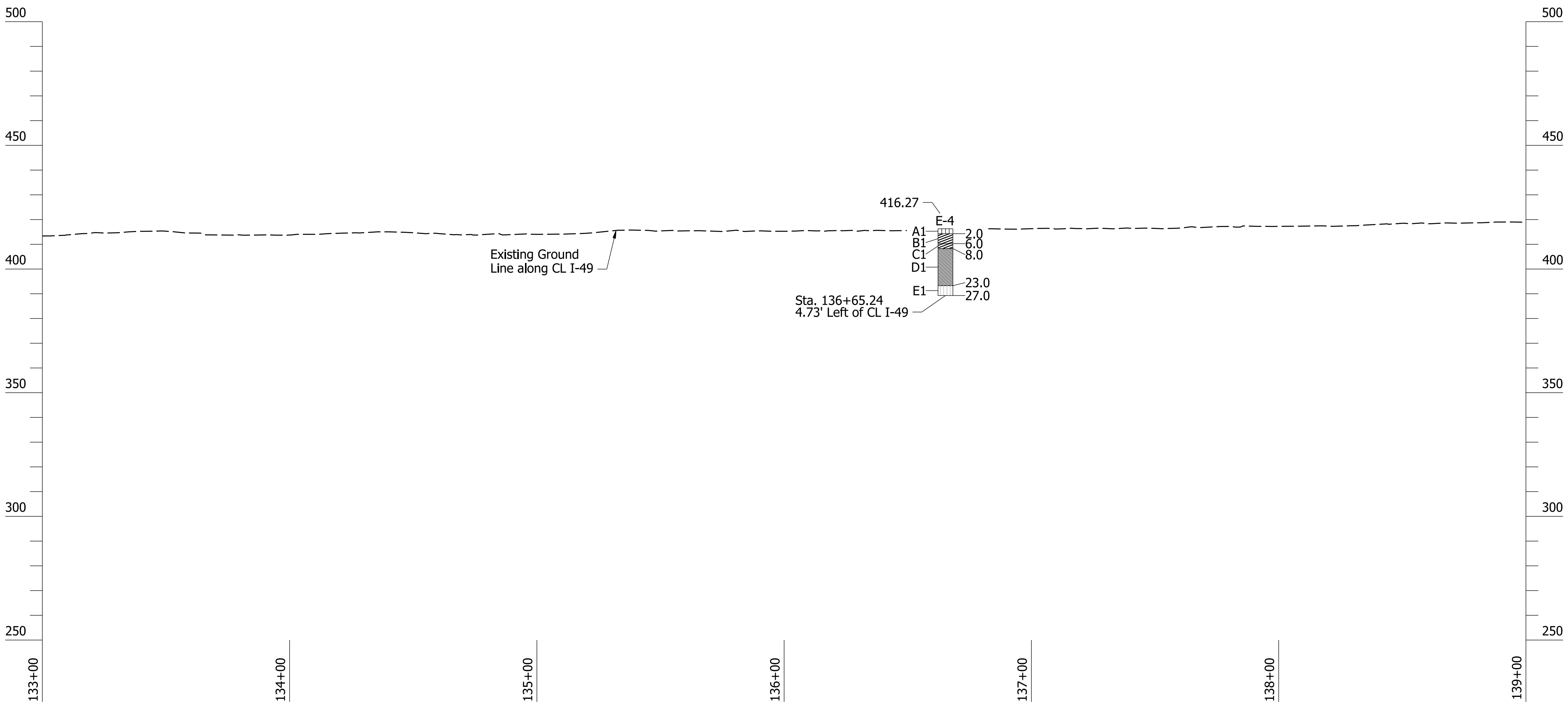
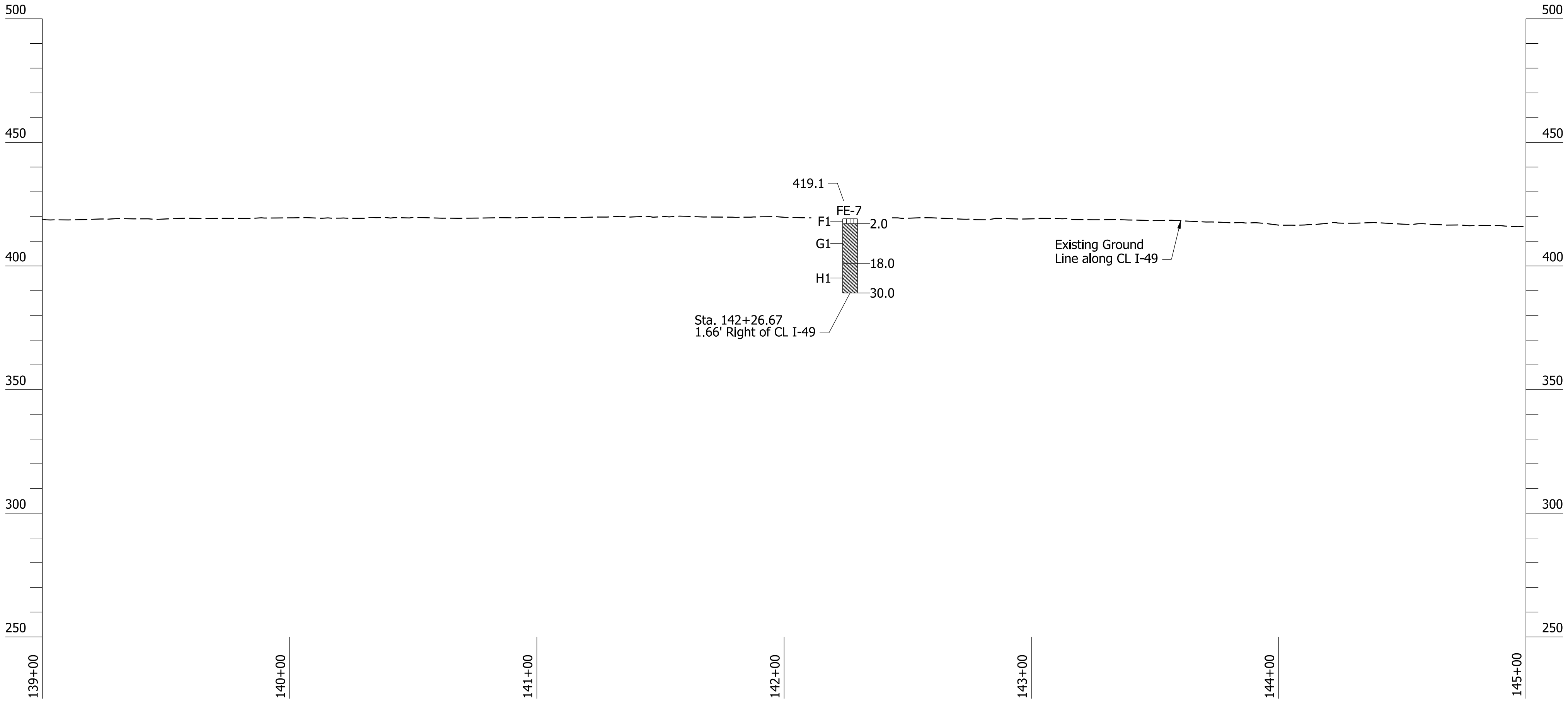


ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS

"N" VALUES

E-4 - Sta. 136+65.24, 4.73' Left of CL I-49

0.5-1.5	N=5
2.5-3.5	N=7
6.5-7.5	N=19
9.0-10.0	N=11
14.0-15.0	N=18
19.0-20.0	N=14
24.0-25.0	N=50/3"
26.0-27.0	N=50/2"

FE-7 - Sta. 141+91.70, 26.67' Left of CL I-49

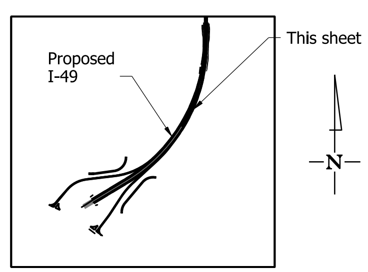
0.5-1.5	N=3
2.5-3.5	N=7
4.5-5.5	N=10
9.0-10.0	N=17
14.0-15.0	N=13
19.0-20.0	N=6
24.0-25.0	N=5
29.0-30.0	N=14

BORING LEGEND

A1 - ML-Soft brown clayey silt
B1 - CH-Firm tan and gray clay
C1 - CH-Stiff reddish brown and tan clay
D1 - CL-Stiff yan silty clay, slightly sandy
E1 - SANDSTONE-Low hardness tan and reddish tan weathered fine-grained sandstone
F1 - ML-Very loose brown silt (fill)
G1 - CL-Firm gray and tan silty clay
H1 - CL-Soft tan silty clay

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.



SITE PLAN
No Scale

SHEET 4 OF 5
LAYOUT OF SOIL BORINGS
I-49
HWY. 22 - BRIDGE 07684 (F)
SEBASTIAN COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

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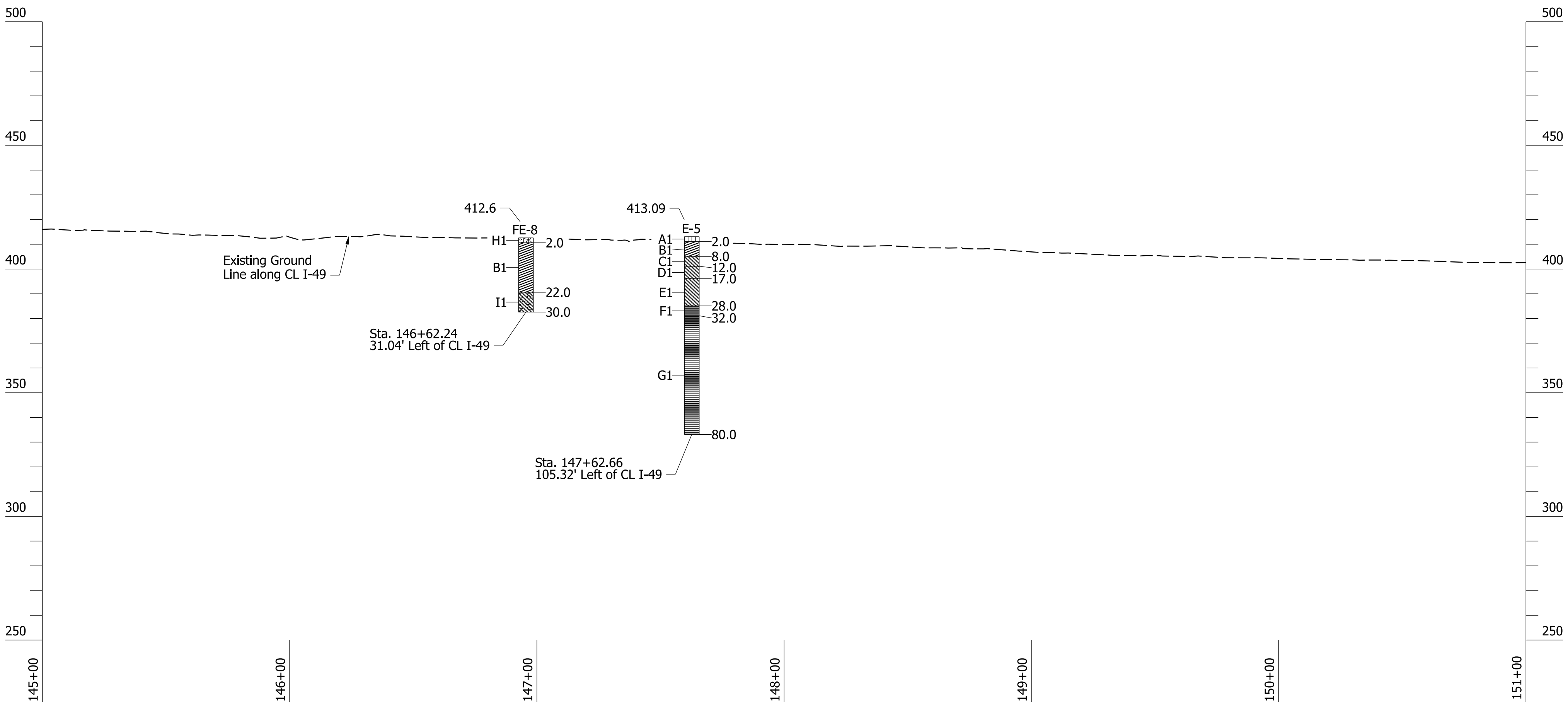
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07684 DRAWING NO.

PRINT DATE: 1/2/2024



ELEVATION OF SOIL BORINGS

"N" VALUES

FE-8 - Sta. 146+52.24, 31.04 Left of CL I-49

0.5-1.5	N=7
2.5-3.5	N=9
6.5-7.5	N=16
9.0-10.0	N=18
14.0-15.0	N=17
19.0-20.0	N=18
24.0-25.0	N=16
29.0-30.0	N=25
34.0-35.0	N=50/1"

E-5 - Sta. 147+62.66, 105.32' Left of CL I-49

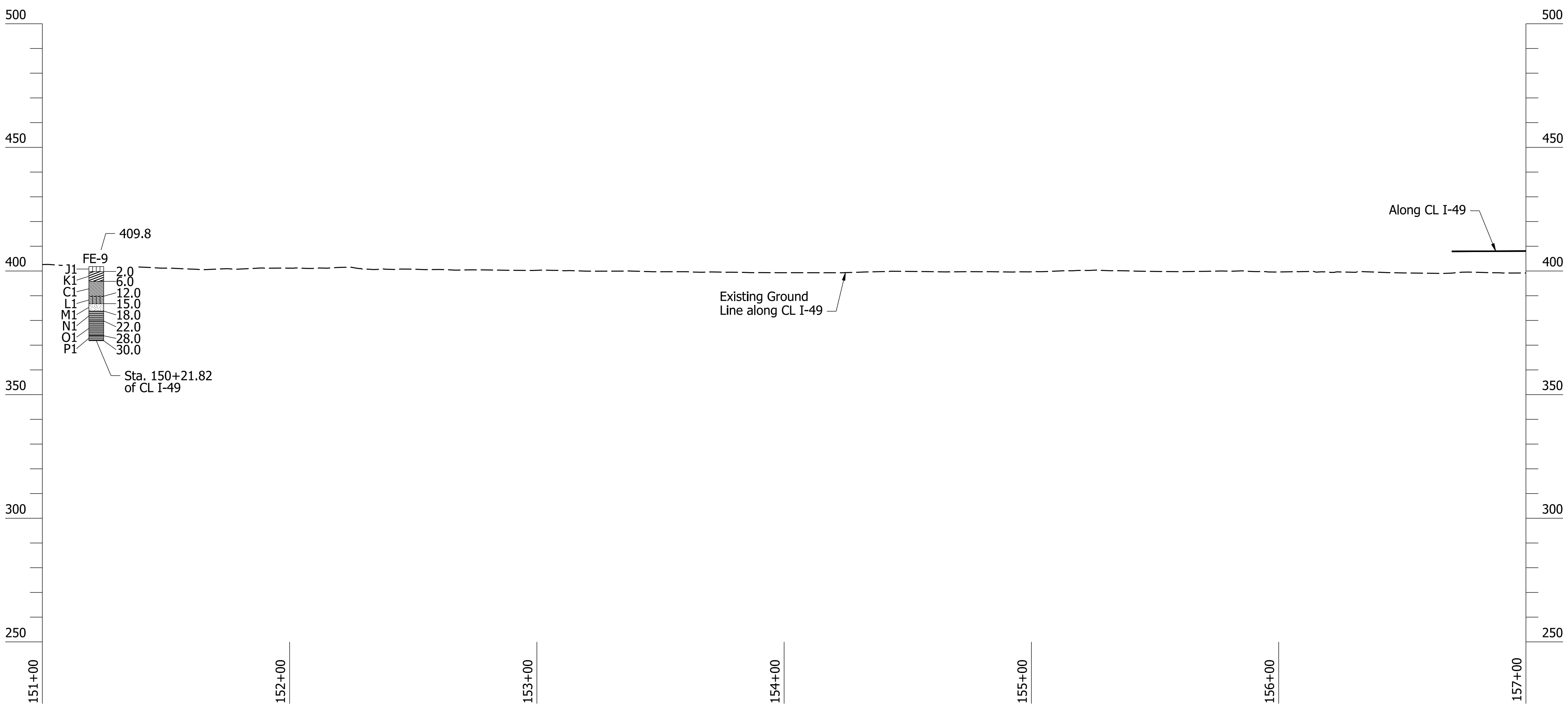
0.5-1.5	N=16
2.5-3.5	N=7
6.5-7.5	N=13
9.0-10.0	N=18
14.0-15.0	N=20
19.0-20.0	N=23
24.0-25.0	N=22
29.0-30.0	N=17

FE-9 - Sta. 150+40.31, 24.84' Left of CL I-49

0.5-18.5	N=2
2.5-20.5	N=20
6.5-24.0	N=19
9.0-27.0	N=15
14.0-32.0	N=19
19.0-37.0	N=50/9"
24.0-42.0	N=50/5"
29.0-47.0	N=50/3"

BORING LEGEND

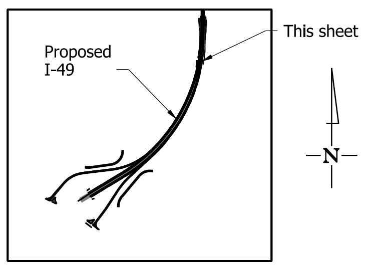
A1 - ML-Firm tan clayey silt
B1 - CH-Firm tan clay
C1 - CL-Stiff gray and brown silty clay
D1 - CL-Stiff reddish brown silty clay w/occasional ferrous stains
E1 - CL-Stiff reddish brown and tan silty clay w/some shale fragments
F1 - SHALE-Low hardness gray and tan weathered shale w/ferrous stains
G1 - SHALE-Moderately hard gray shale w/occasional sandstone partings and seams
H1 - GM-Medium dense dark brown silty fine sand w/numerous crushed stone
I1 - CLG-Stiff tan silty clay w/shale fragments
J1 - ML-Very loose brown silt, slightly clayey
K1 - CH-Stiff grayish brown clay
L1 - CL-ML-Medium dense reddish tan clayey silt
M1 - SP-Medium dense tan fine sand
N1 - SHALE-Moderately hard gray and tan weathered shale
O1 - SHALE-Moderately hard dark gray slightly weathered shale
P1 - SHALE-Moderately hard dark gray shale



ELEVATION OF SOIL BORINGS

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.



SITE PLAN
No Scale

SHEET 5 OF 5
LAYOUT OF SOIL BORINGS
I-49
HWY. 22 - BRIDGE 07684 (F)
SEBASTIAN COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

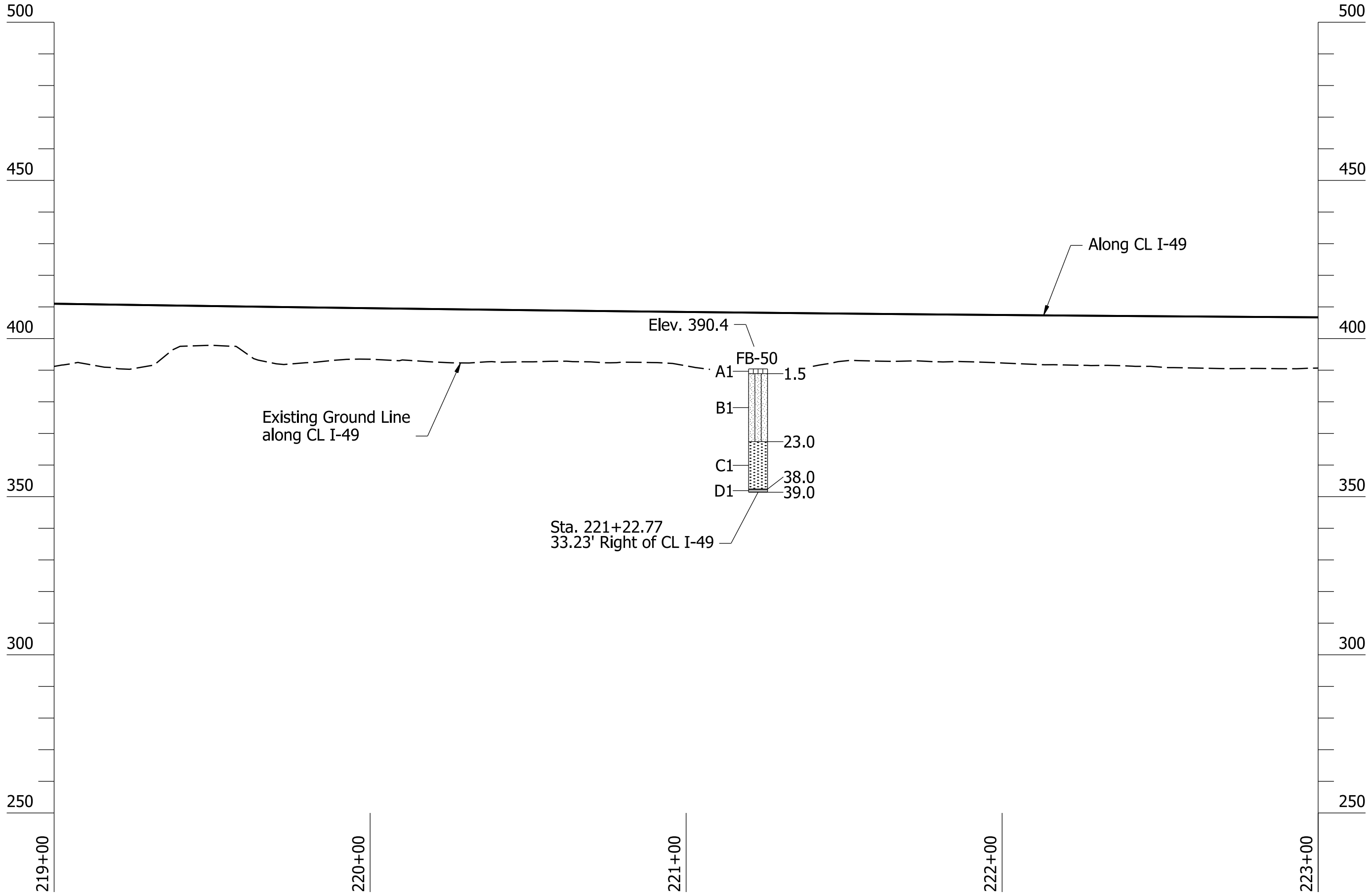
PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: BNG DATE: 12/07/23 FILENAME: Bfr BR1 SB Layout 5.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07684 DRAWING NO.

PRINT DATE: 1/2/2024

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	040901	$PAGE#$	248
		0XXX1 - GEO PLAN LAYOUTS - XXX				



ELEVATION OF SOIL BORINGS

"N" VALUES

FB-50 - Sta. 220+99.31, 5.76 Left of CL I-49

0.5-1.5	N=3
2.5-3.5	N=5
4.5-5.5	N=8
6.5-7.5	N=7
9.0-10.0	N=15
14.0-15.0	N=5
19.0-20.0	N=11
24.0-25.0	N=11
29.0-30.0	N=15
34.0-35.0	N=15
38.0-39.0	N=50/6"

FB-53 - Sta. 224+88.94, 71.59 Left of CL I-49

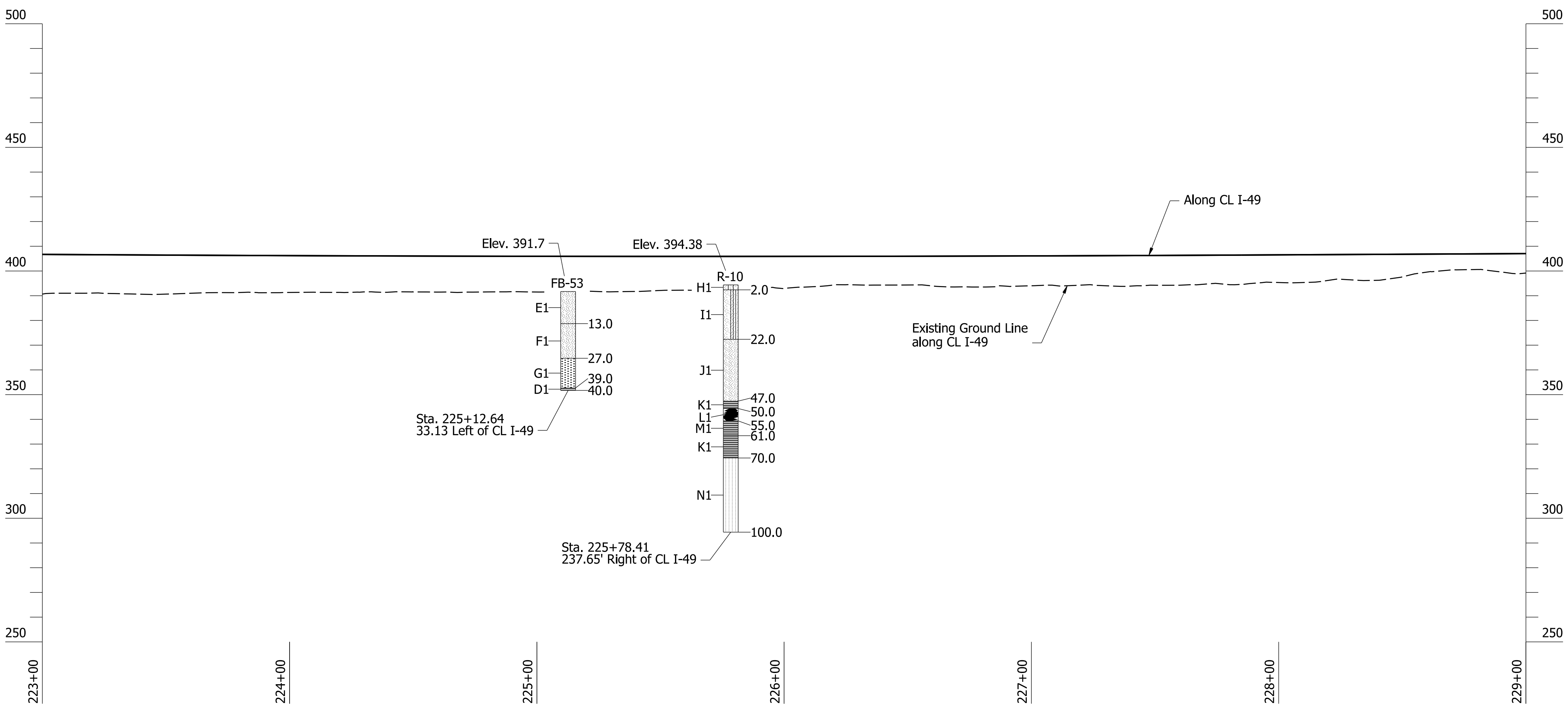
0.5-1.5	N=6
2.5-3.5	N=4
4.5-5.5	N=7
6.5-7.5	N=10
9.0-10.0	N=13
14.0-15.0	N=9
19.0-20.0	N=11
24.0-25.0	N=22
29.0-30.0	N=8
34.0-35.0	N=15
39.0-40.0	N=50/2"

R-10 - Sta. 225+78.41, 237.65 Right of CL I-49

0.5-1.5	N=3
2.5-3.5	N=4
4.5-5.5	N=5
6.5-7.5	N=14
9.0-10.0	N=8
14.0-15.0	N=9
19.0-20.0	N=22
24.0-25.0	N=24
29.0-30.0	N=9
34.0-35.0	N=27
39.0-40.0	N=24
44.0-45.0	N=50/10"
49.0-50.0	N=50/2"

BORING LEGEND

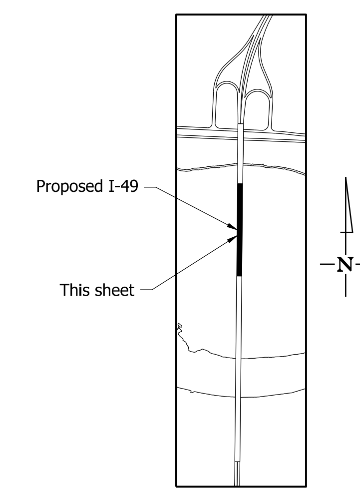
A1 - ML-Very soft reddish fine sandy silt
B1 - SM-Loose reddish tan and tan silty fine sand
C1 - SW-Medium dense tan fine to coarse sand
D1 - SHALE-Moderately hard dark gray shale
E1 - SP-Loose dark brown and tan fine sand
F1 - SP-Loose tan fine to medium sand
G1 - SW-Loose tan and gray fine to coarse sand
H1 - SM-Very loose reddish tan silty fine sand
I1 - SP-SM-Very loose to loose tan and reddish tan fine sand
J1 - SP-Medium dense gray and tan fine to medium sand
K1 - SHALE-Moderately hard dark gray shale, slightly weathered, horizontal bedding
L1 - COAL-Low hardness coal, little recovery
M1 - SHALE-Moderately hard dark gray shale, horizontal bedding w/occasional highly weathered seams
N1 - SANDSTONE-Moderately hard light gray fine-grained sandstone, horizontal bedding



ELEVATION OF SOIL BORINGS

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.



SITE PLAN
No Scale

SHEET 1 OF 1
LAYOUT OF SOIL BORINGS
I-49 OVER ARKANSAS RIVER
HWY. 22 - GUN CLUB RD. (F)
CRAWFORD & SEBASTIAN COUNTIES

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
No. 23098

4/18/24

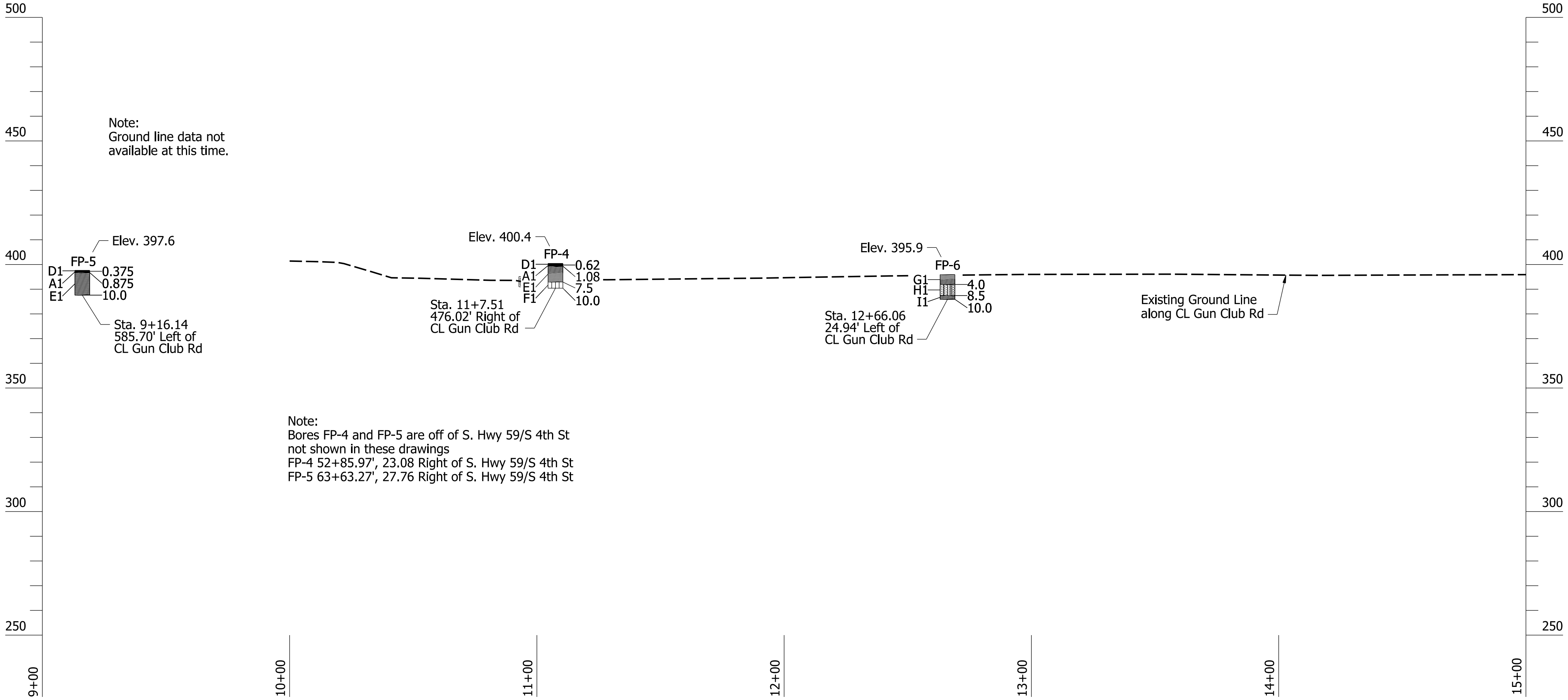
BRIDGE ENGINEER

ROUTE 549 SEC. 6
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

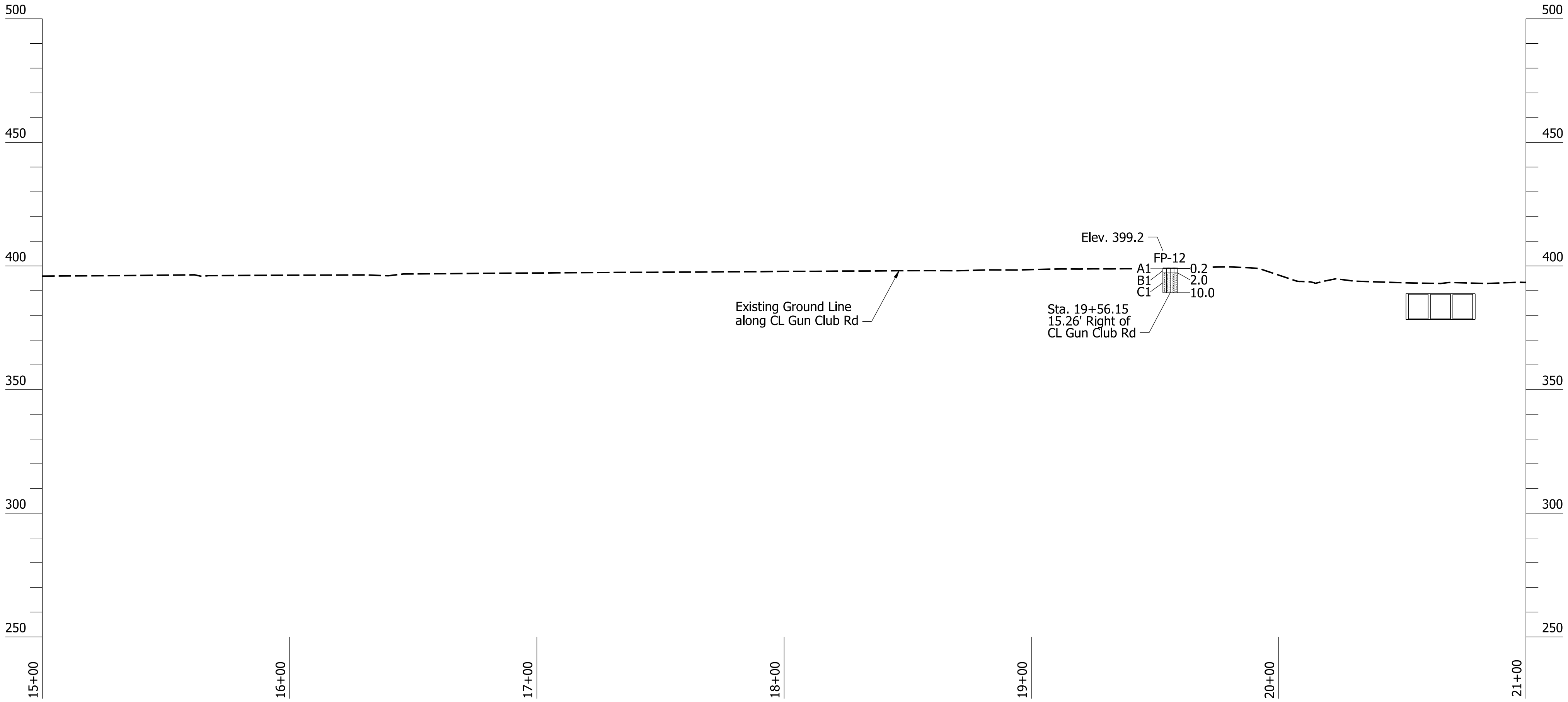
DRAWN BY: BNG DATE: 12/13/23 FILENAME: Btw1&16 SB Layout 1.dgn
CHECKED BY: XXX DATE: XX/XX/XX SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/XX
BRIDGE NO. 07684 DRAWING NO. ____

PRINT DATE: 1/2/2024

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	040901	$PAGE#$	248
		01 - GEO PLAN LAYOUTS -				



ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS

"N" VALUES

FP-5 - Sta. 10+6.43, 585.70' Left of CL Gun Club Rd

1.0-2.0	N=18
2.5-3.5	N=17
4.5-5.5	N=14
6.5-7.5	N=7
8.5-9.5	N=5

FP-4 - Sta. 11+7.51, 476.02' Right of CL Gun Club Rd

1.0-2.0	N=11
2.5-3.5	N=6
4.5-5.5	N=11
6.5-7.5	N=10
8.5-9.5	N=12

FP-6 - Sta. 12+66.06, 24.94' Left of CL Gun Club Rd

0.5-1.5	N=6
2.5-3.5	N=5
4.5-5.5	N=6
6.5-7.5	N=4
8.5-9.5	N=11

FP-12 - Sta. 19+56.15, 15.26' Right of CL I-49

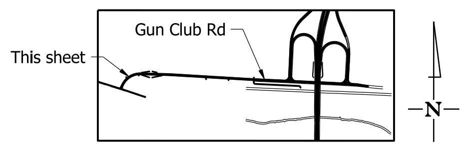
0.5-1.5	N=18
2.5-3.5	N=12
4.5-5.5	N=5
6.5-7.5	N=7
8.5-9.5	N=5

BORING LEGEND

A1 - FILL-Dense crushed stone (fill)
B1- ML-Dense brown silt, slightly clayey
C1 - MLS-Medium dense reddish tan fine sandy silt
D1 - ASPHALT
E1 - CL-Stiff brown silty clay w/some silt partings
F1 - ML-Medium dense reddish brown silt, slightly clayey
G1 - CL-Soft brown silty clay w/some fine sandy silt partings
H1 - MLS-Loose redish brown fine sandy silt
I1 - CL-Stiff brown silty clay

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.



SITE PLAN
No Scale

SHEET 1 OF 7
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD - BRIDGE 07685 (F)
CRAWFORD COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: BNG DATE: 01/02/24 FILENAME: GCRoad SB Layout 1.dgn
CHECKED BY: XXX DATE: XX/XX/24 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/24
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 1/9/2024

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
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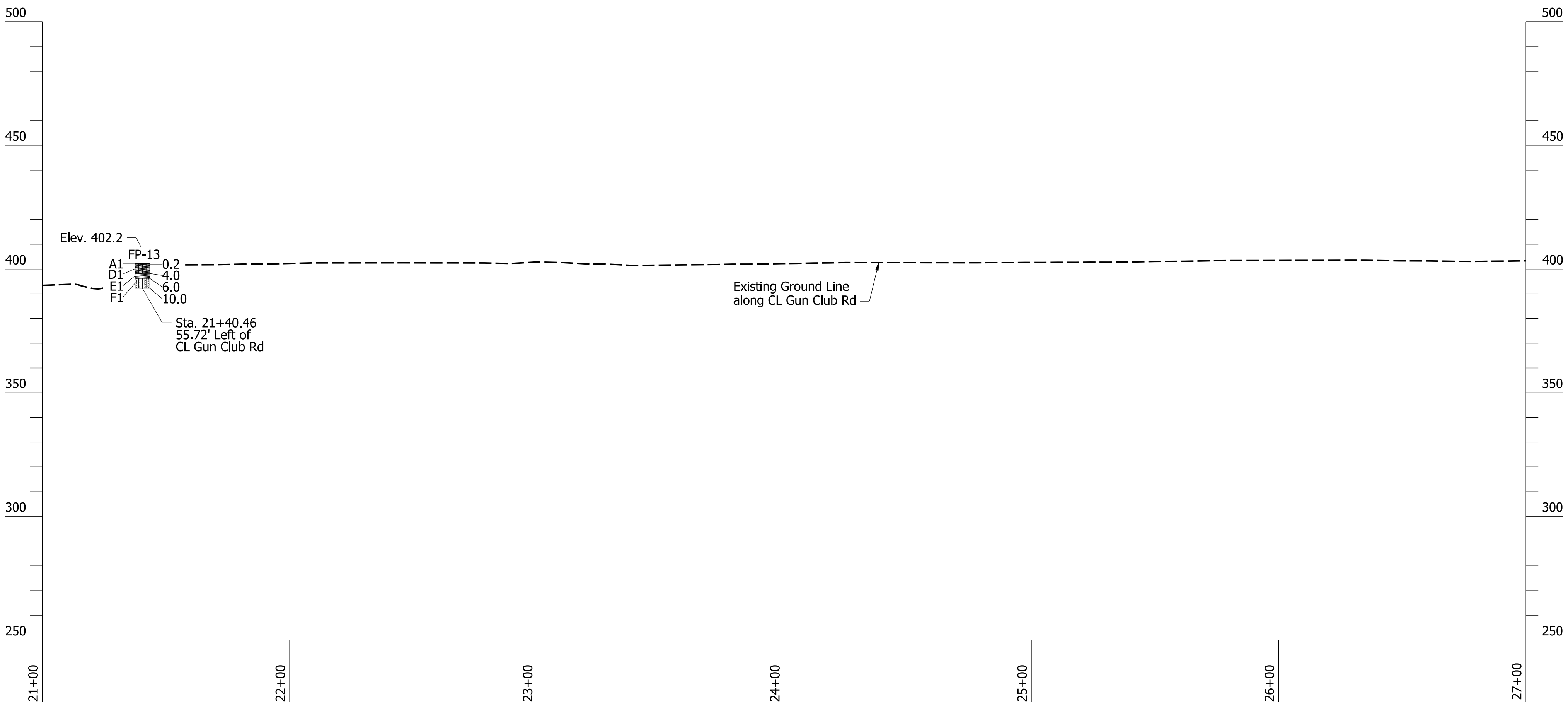


ELEVATION OF SOIL BORINGS

"N" VALUES

FP-13 - Sta. 21+40.46, 55+.72' Left of CL Gun Club Rd

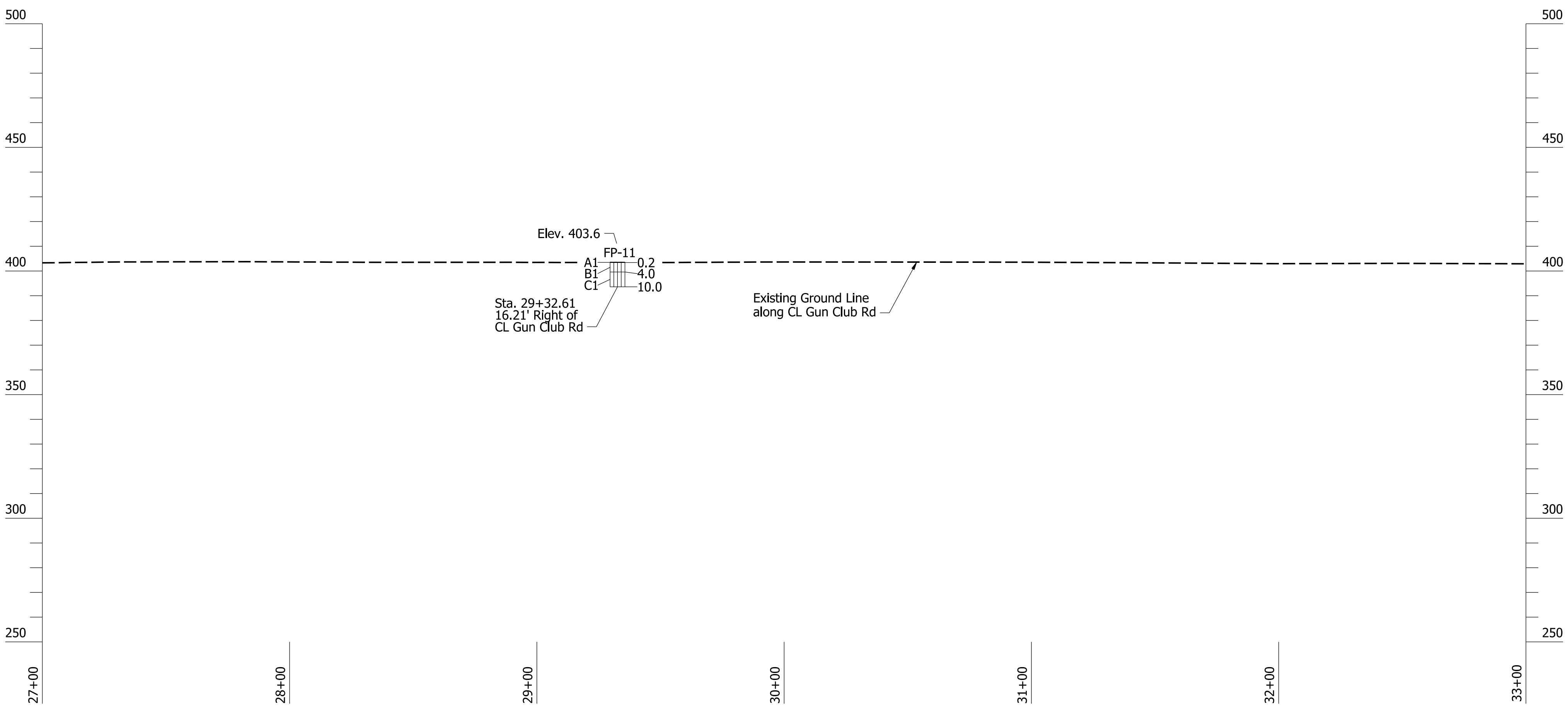
0.5-1.5	N=13
2.5-3.5	N=12
4.5-5.5	N=7
6.5-7.5	N=9
8.5-9.5	N=8

FP-11 - Sta. 29+32.61, 16.21' Right of CL Gun Club Rd

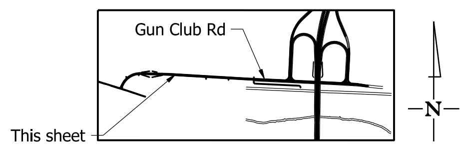
0.5-1.5	N=14
2.5-3.5	N=7
4.5-5.5	N=5
6.5-7.5	N=4
8.5-9.5	N=3

BORING LEGEND

A1 - FILL-Dense crushed stone (fill)
B1- ML-Medium dense reddish tan silt, slightly clayey
C1 - ML-Loose reddish tan silt
D1 - CL-ML-Medium dense brown clayey silt
E1 - CL-Firm reddish brown silty clay
F1 - MLS-Loose reddish tan fine sandy silt



ELEVATION OF SOIL BORINGS



SITE PLAN

No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 2 OF 7
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD - BRIDGE 07685 (F)
CRAWFORD COUNTY

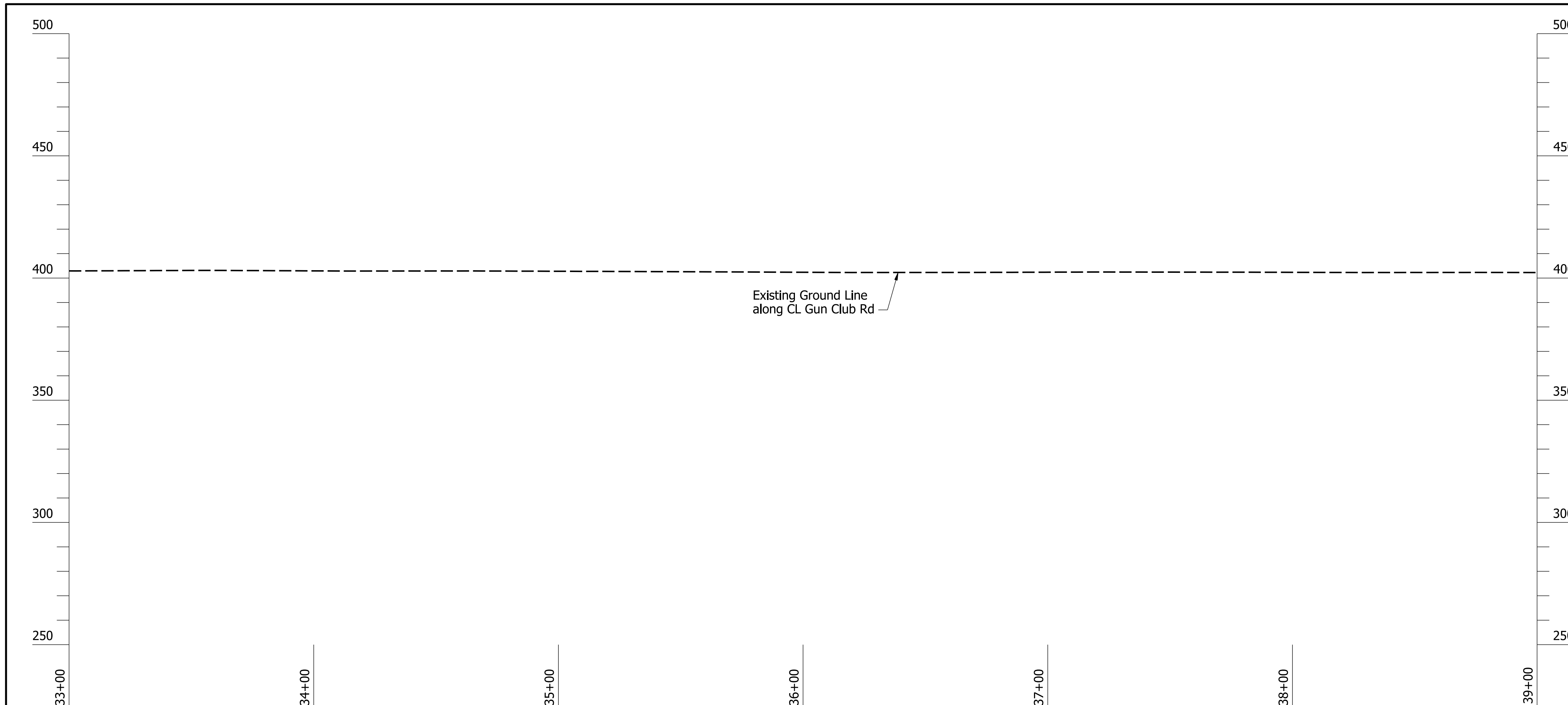
ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

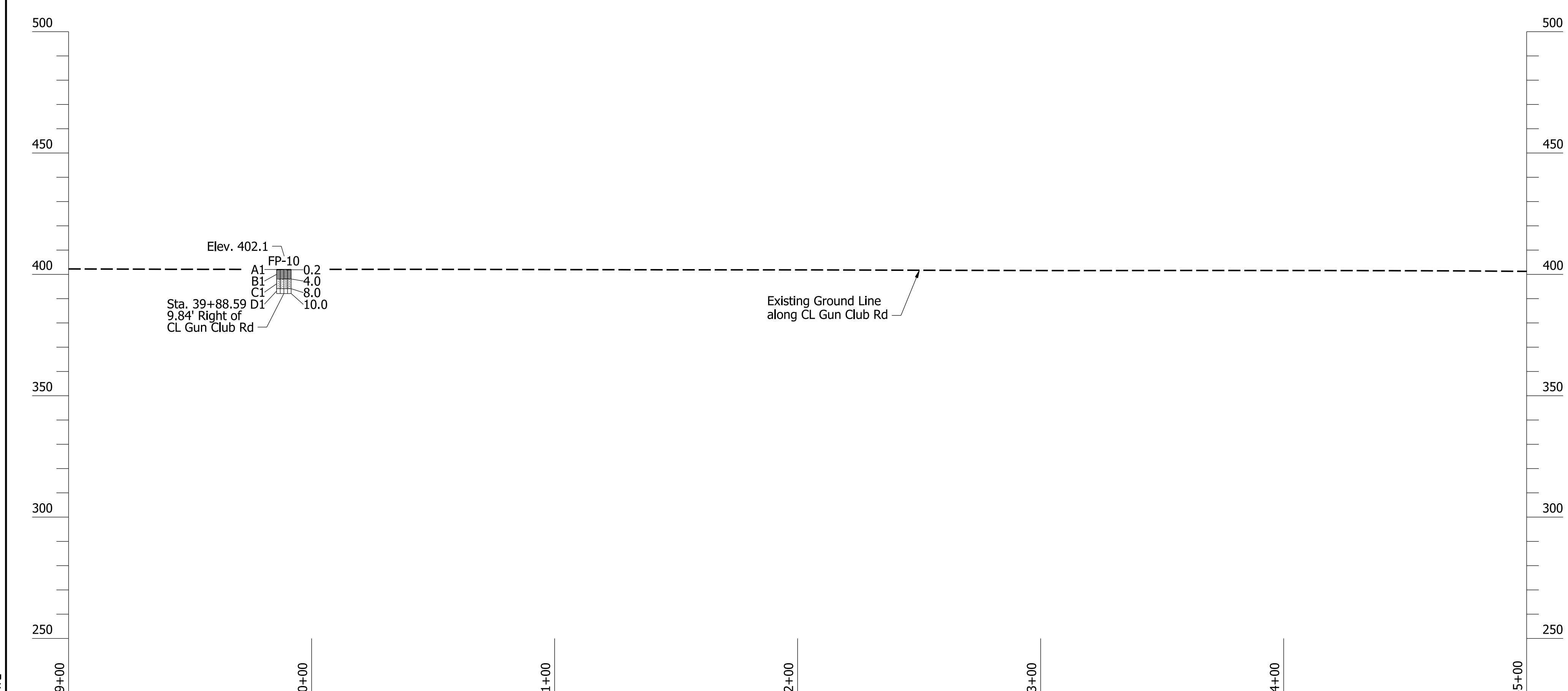
BRIDGE ENGINEER

DRAWN BY: BNG DATE: 01/02/24 FILENAME: GCRoad SB Layout 2.dgn
CHECKED BY: XXX DATE: XX/XX/24 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/24
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 1/4/2024



ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS

"N" VALUES

FP-10 - Sta. 39+88.59, 9.84' Right of CL Gun Club Rd

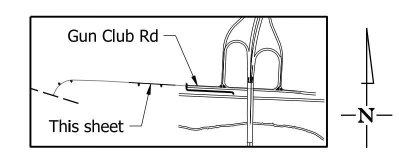
0.5-1.5	N=13
2.5-3.5	N=7
4.5-5.5	N=8
6.5-7.5	N=3
8.5-9.5	N=3

BORING LEGEND

A1 - FILL-Dense crushed stone (fill)
B1- CL-ML-Medium dense brown silt, slightly clayey
C1 - MLS-Loose reddigh brown fine sandy silt
D1 - ML-Very loose reddish tan silt, slightly clayey

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.



SITE PLAN
No Scale

SHEET 3 OF 7
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD - BRIDGE 07685 (F)
CRAWFORD COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: BNG DATE: 01/02/24 FILENAME: GCRoad SB Layout 3.dgn
CHECKED BY: XXX DATE: XX/XX/24 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/24
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 1/4/2024

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
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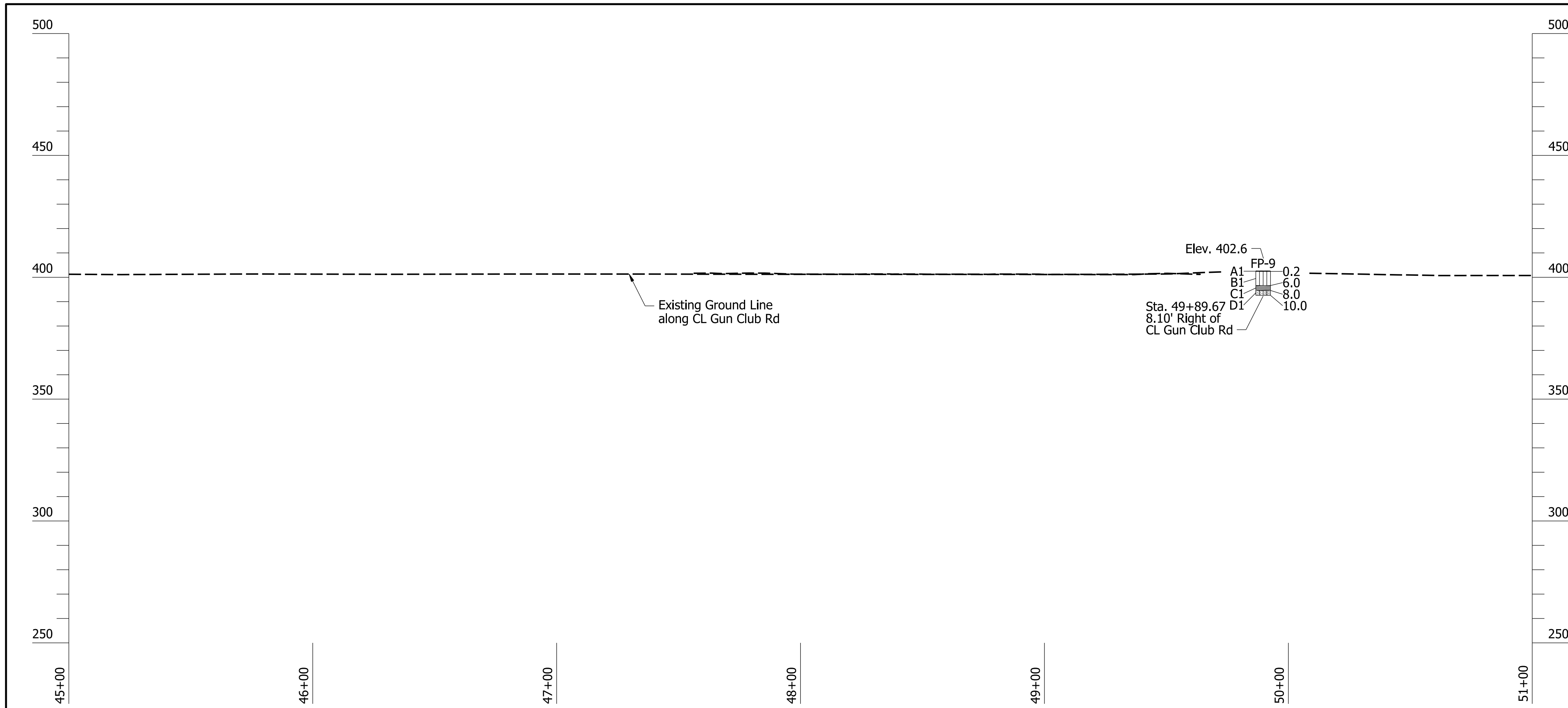
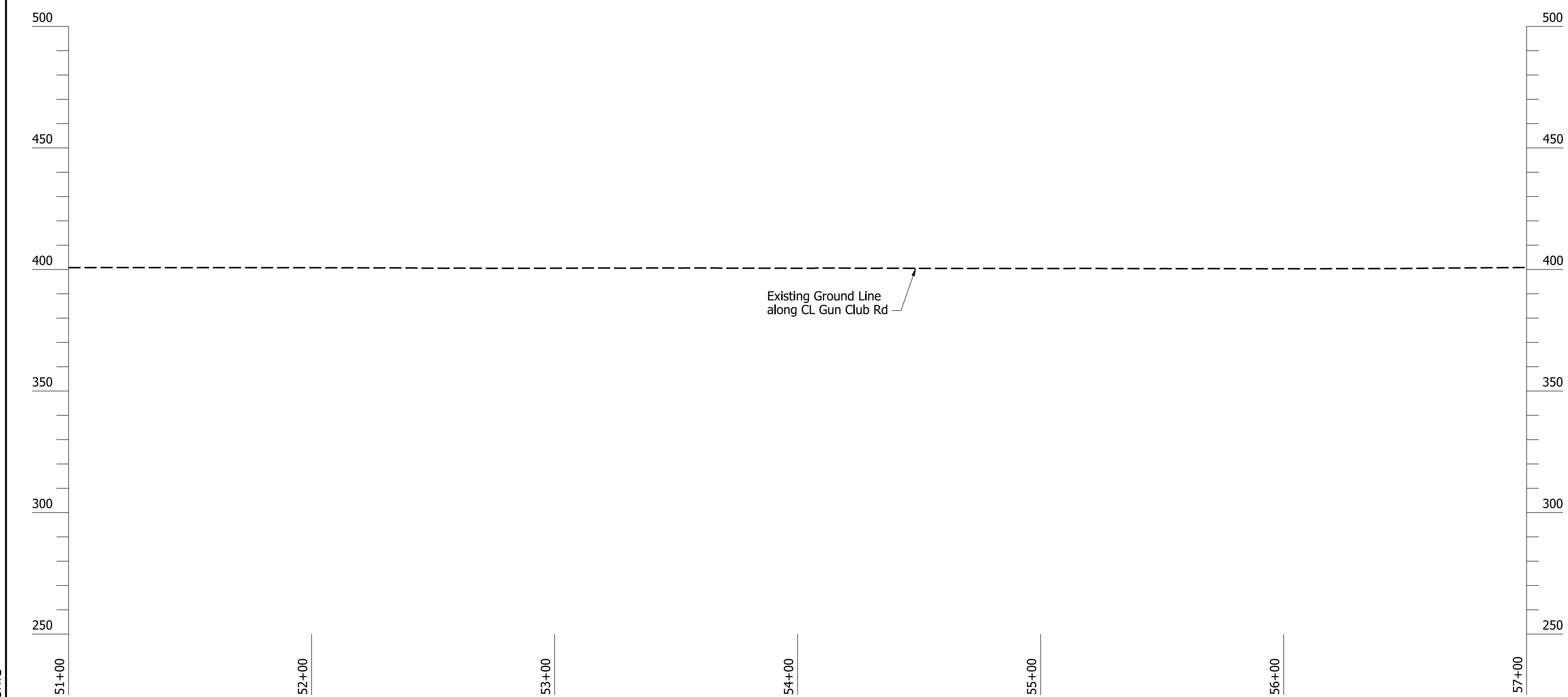


ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS

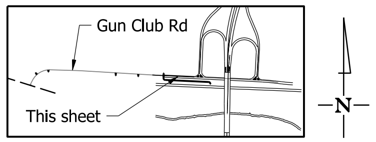
"N" VALUES

FP-9 - Sta. 49+89.67, 8.10' Right of CL Gun Club Rd

0.5-1.5	N=12
2.5-3.5	N=8
4.5-5.5	N=8
6.5-7.5	N=5
8.5-9.5	N=4

BORING LEGEND

A1 - FILL-Dense crushed stone (fill)
B1- ML-Medium dense brown silt
C1 - CL-Soft reddish brown silty clay
D1 - MLS-Very loose reddish brown fine sandy silt



SITE PLAN
No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 4 OF 7
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD - BRIDGE 07685 (F)
CRAWFORD COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: BNG DATE: 01/02/24 FILENAME: GCRoad SB Layout 4.dgn
CHECKED BY: XXX DATE: XX/XX/24 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/24
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 1/4/2024

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
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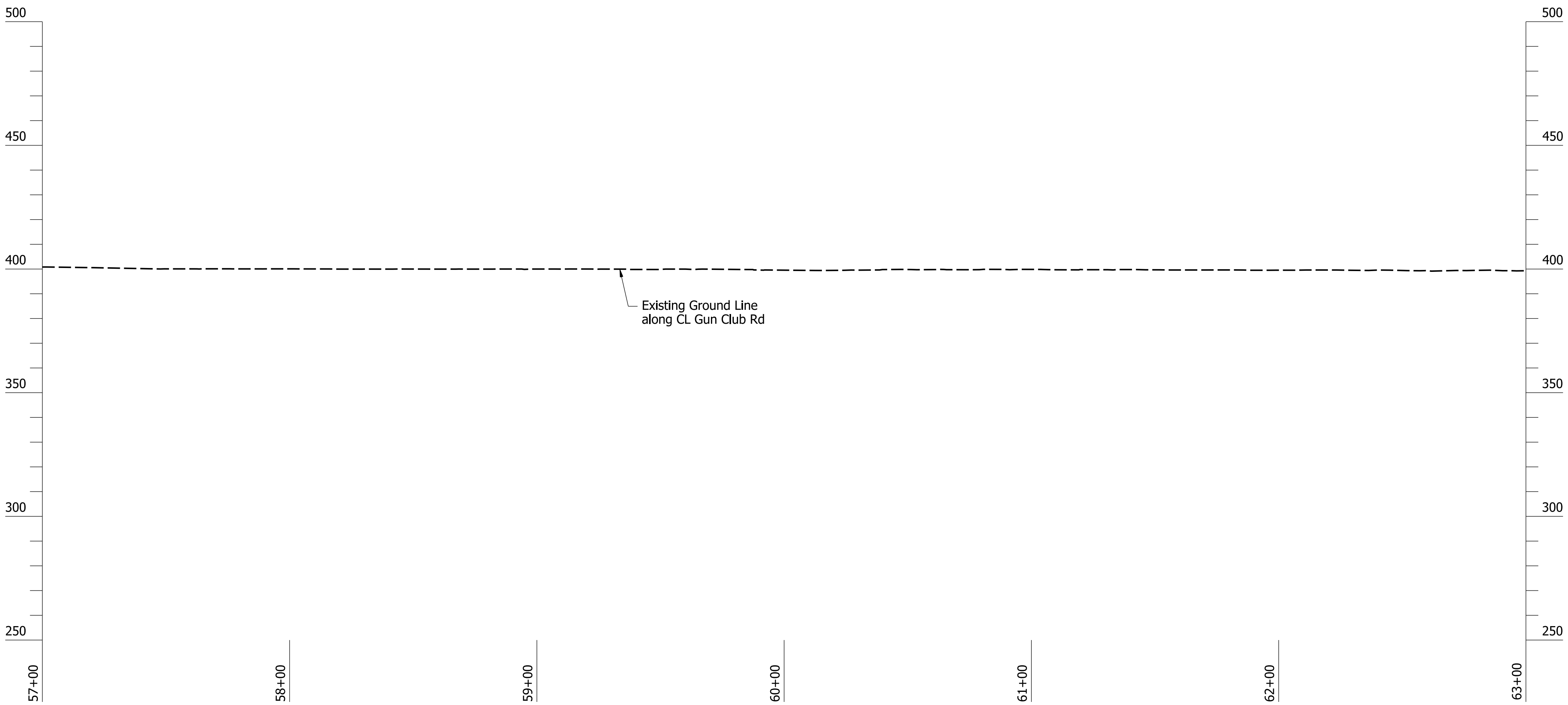
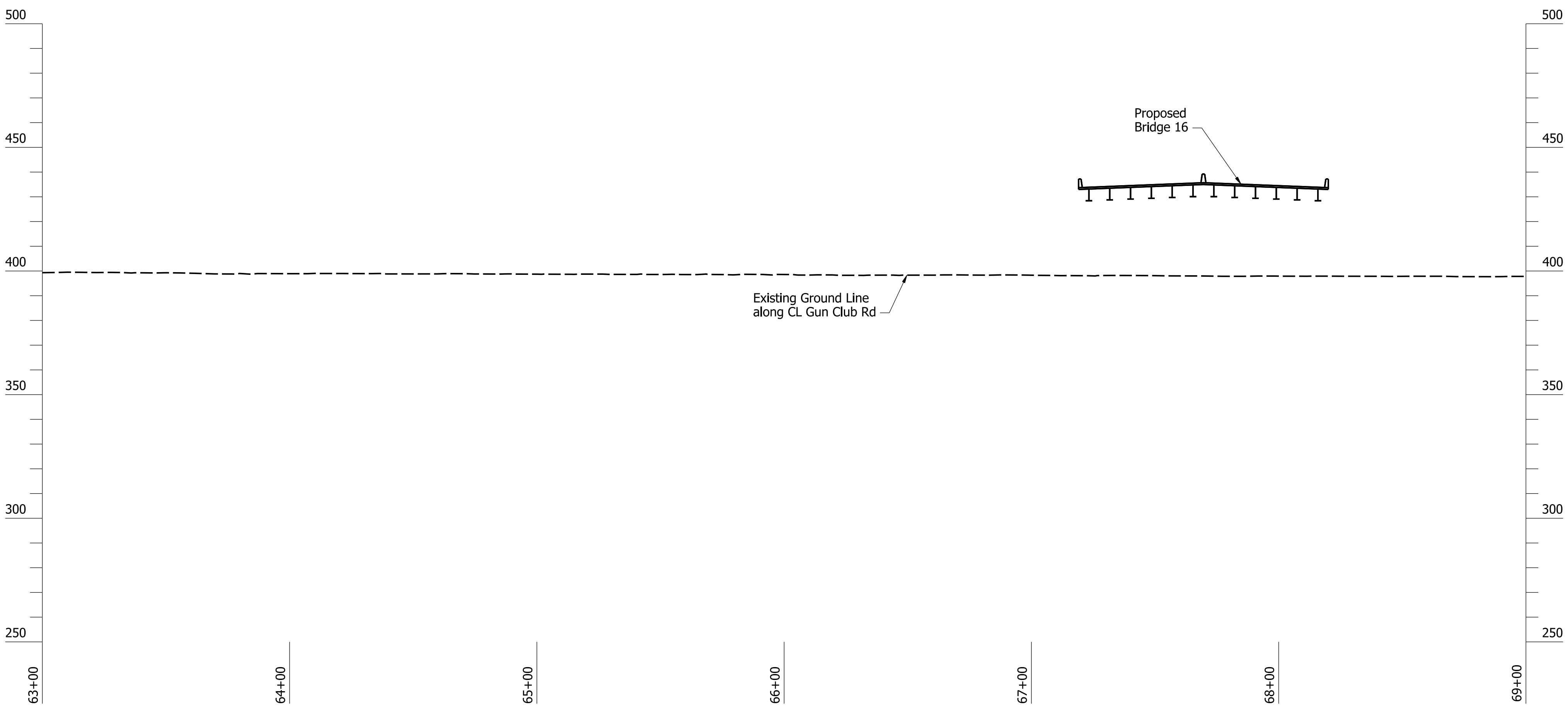
		01 - GEO PLAN LAYOUTS -				



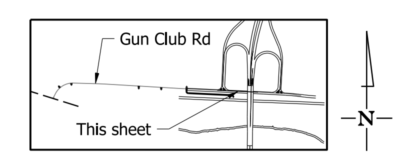
ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.



SITE PLAN
No Scale

SHEET 5 OF 7
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD - BRIDGE 07685 (F)
CRAWFORD COUNTY

PRELIMINARY
NOT FOR CONSTRUCTION

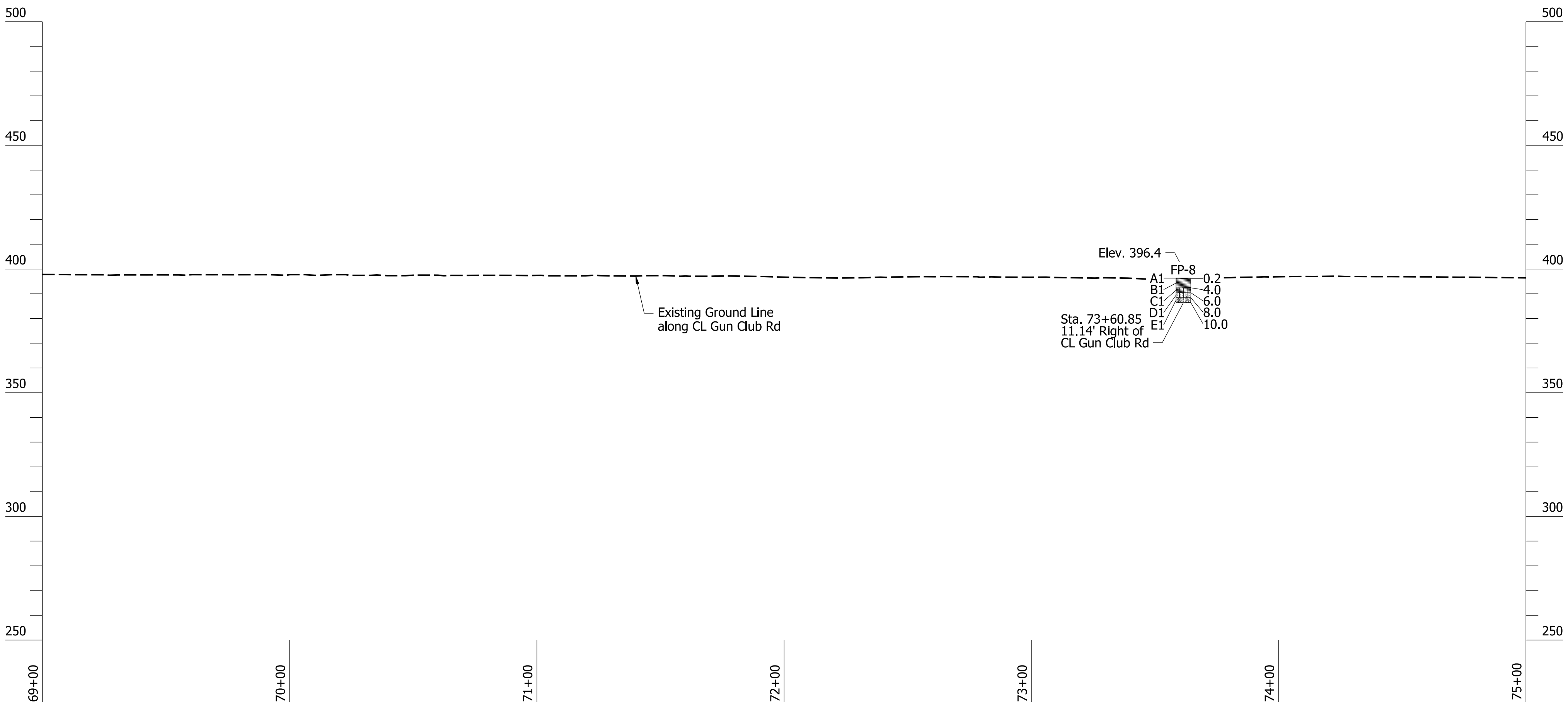
BRIDGE ENGINEER

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: BNG DATE: 01/02/24 FILENAME: GCRoad SB Layout 5.dgn
CHECKED BY: XXX DATE: XX/XX/24 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/24
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 1/4/2024

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	040901	$PAGE#$	248
		01 - GEO PLAN LAYOUTS -				



ELEVATION OF SOIL BORINGS

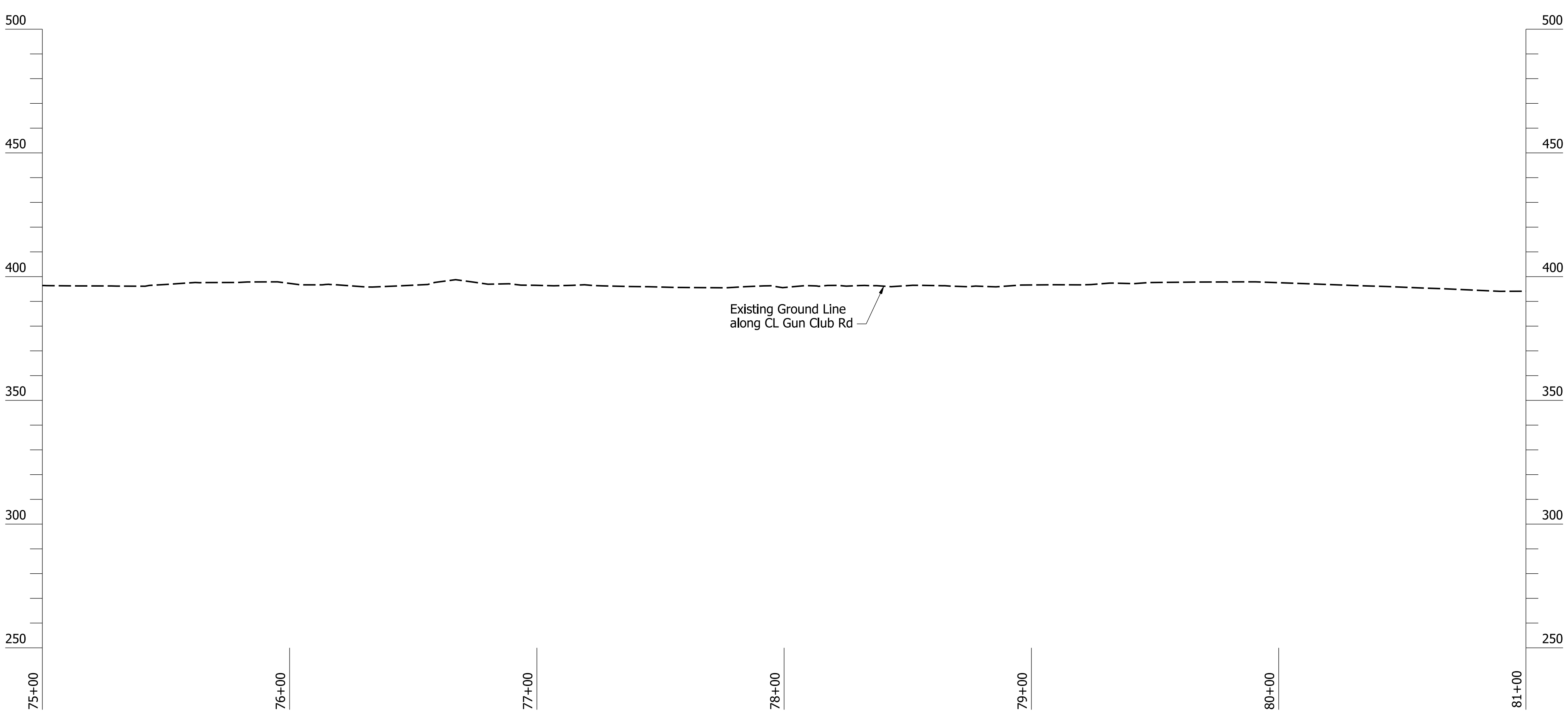
"N" VALUES

FP-8 - Sta. 73+60.85, 11.14' Right of CL Gun Club Rd

0.5-1.5	N=14
2.5-3.5	N=9
4.5-5.5	N=6
6.5-7.5	N=7
8.5-9.5	N=9

BORING LEGEND

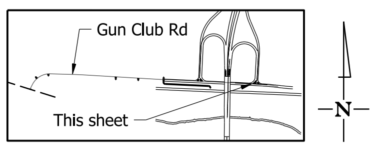
A1 - FILL-Dense crushed stone (fill)
B1- CL-Stiff reddish brown silty clay
C1 - CL-ML-Soft brown clayey silt
D1 - MLS-Loose reddish tan fine sandy silt
E1 - SM-Loose tan silty fine sand



ELEVATION OF SOIL BORINGS

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.



SITE PLAN
No Scale

SHEET 6 OF 7
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD - BRIDGE 07685 (F)
CRAWFORD COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: BNG DATE: 01/02/24 FILENAME: GCRoad SB Layout 6.dgn
CHECKED BY: XXX DATE: XX/XX/24 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/24
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 1/4/2024

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
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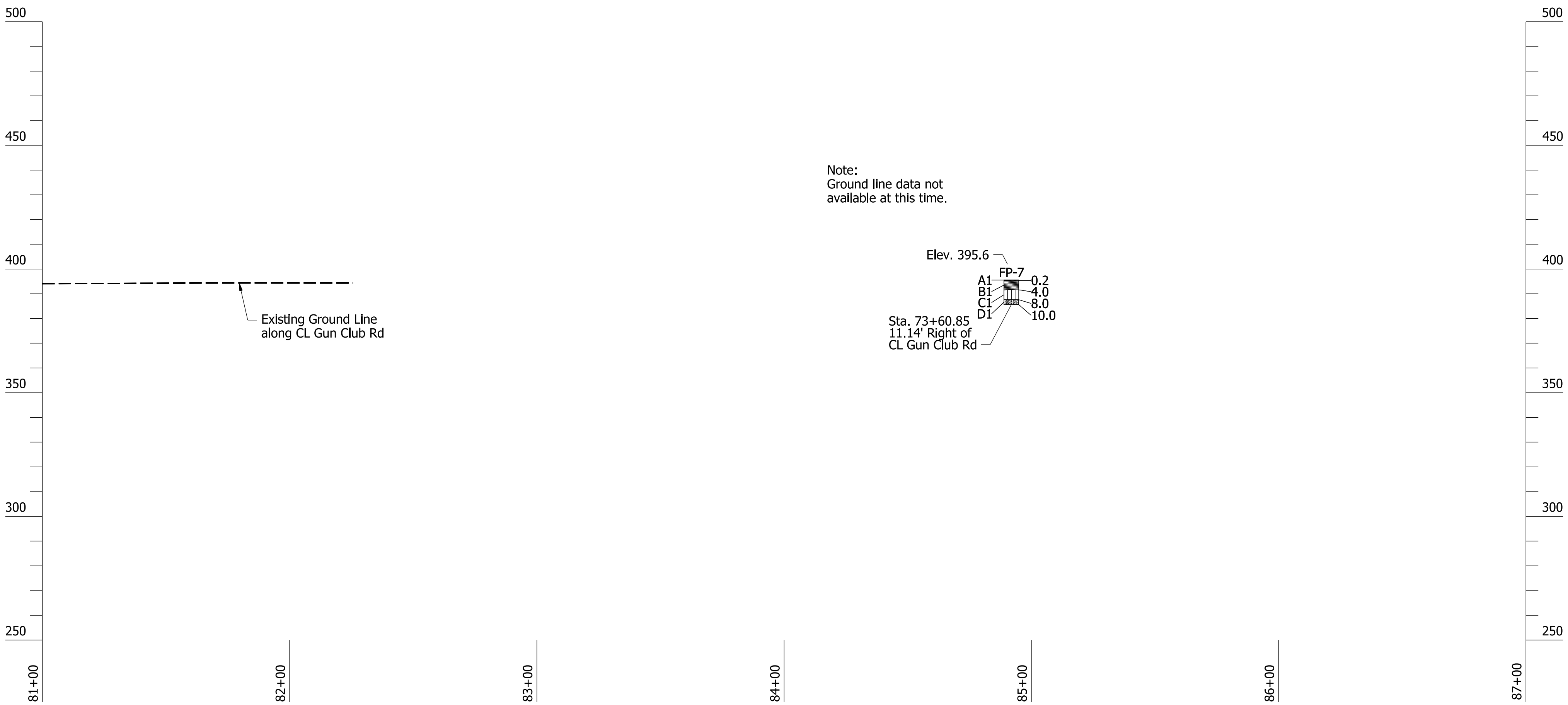


ELEVATION OF SOIL BORINGS

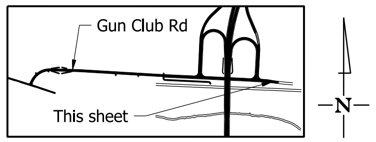
"N" VALUES

FP-7 - Sta. 84+91.25, 19.58' Right of CL Gun Club Rd

0.5-1.5	N=14
2.5-3.5	N=9
4.5-5.5	N=6
6.5-7.5	N=7
8.5-9.5	N=9

BORING LEGEND

A1 - FILL-Dense crushed stone (fill)
B1 - CL-Stiff brown silty clay
C1 - ML-Loose reddish brown silt
D1 - SM-Loose tan silty fine sand



SITE PLAN
No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 7 OF 7
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD - BRIDGE 07685 (F)
CRAWFORD COUNTY

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: BNG DATE: 01/02/24 FILENAME: GCRoad SB Layout 7.dgn
CHECKED BY: XXX DATE: XX/XX/24 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/24
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 1/9/2024

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	040901	$PAGE#$	248
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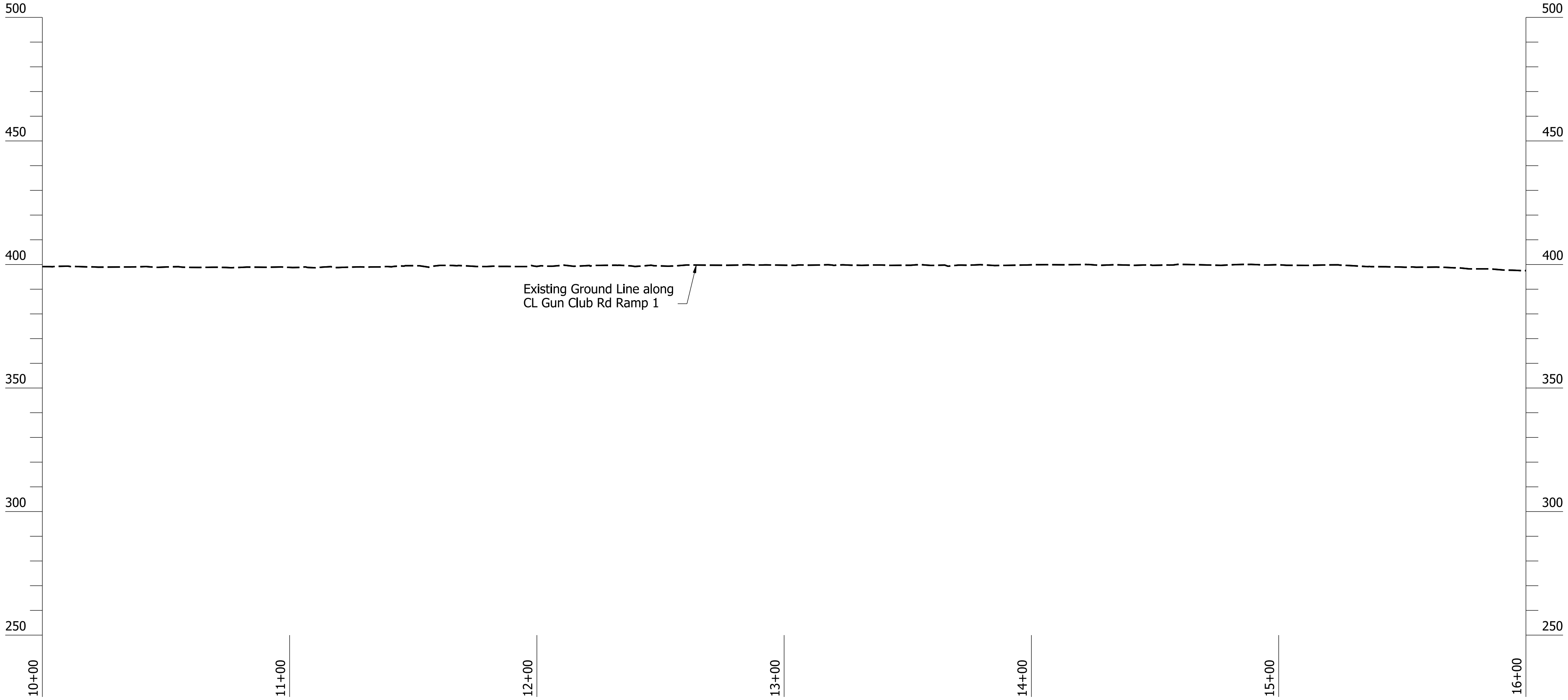
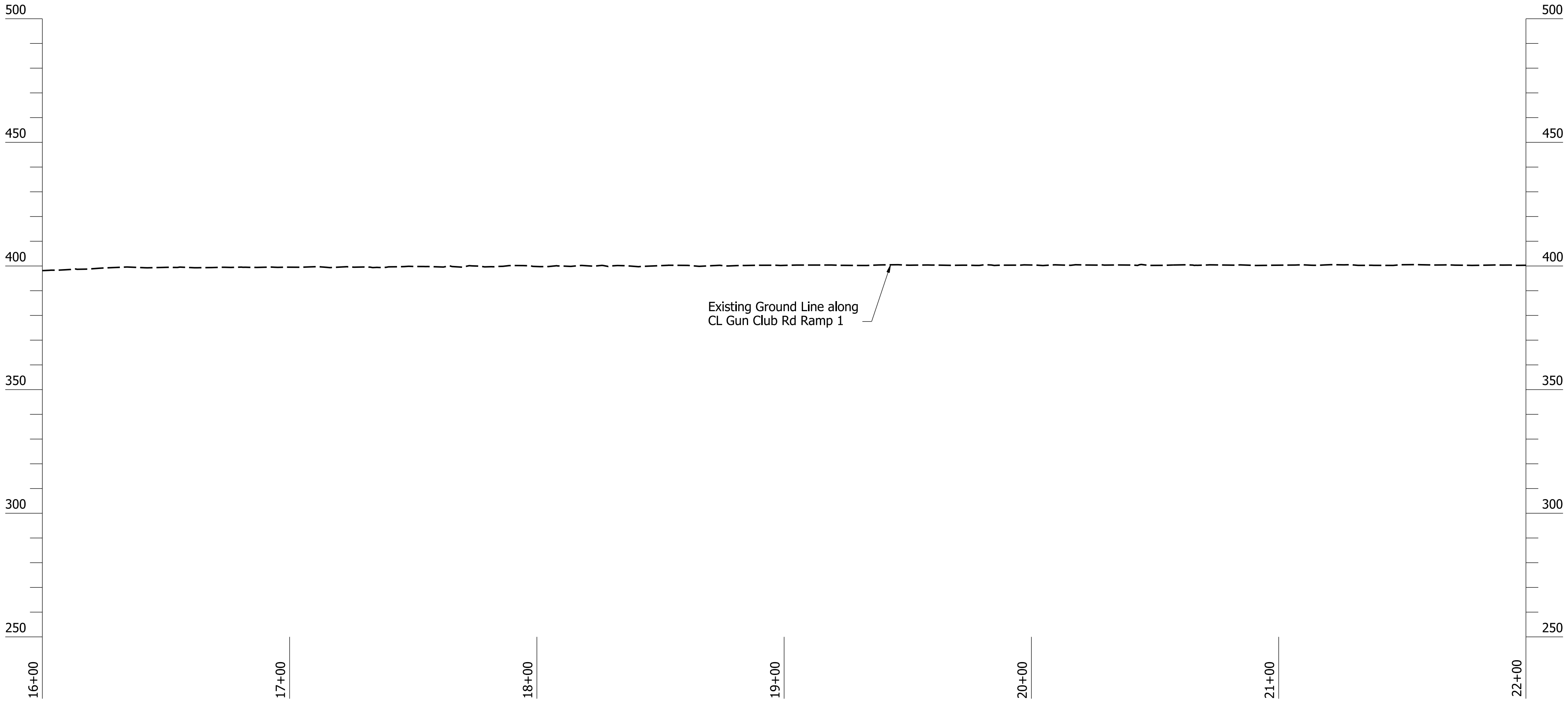
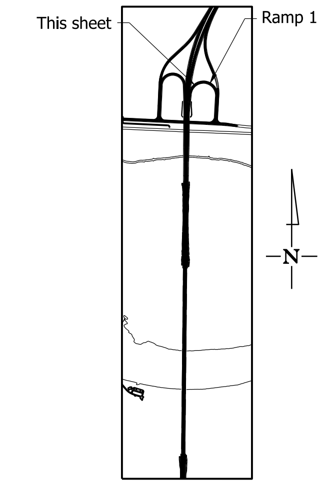


ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS



SITE PLAN
No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 1 OF 3
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD RAMP - BRIDGE 0XXX16 (F)
CRAWFORD COUNTY

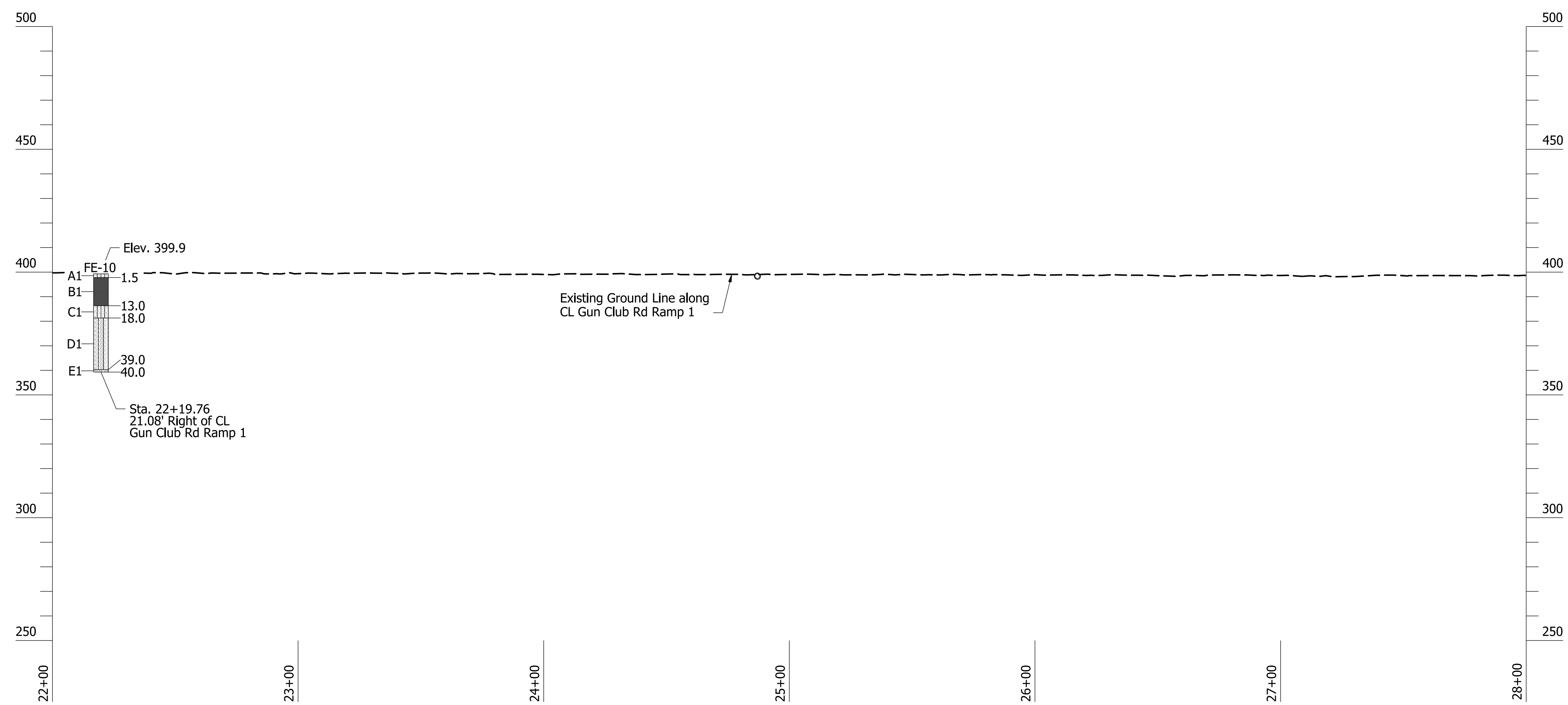
ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: BNG DATE: 12/07/23 FILENAME: GCRp1 SB Layout 1.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 1/2/2024



ELEVATION OF SOIL BORINGS

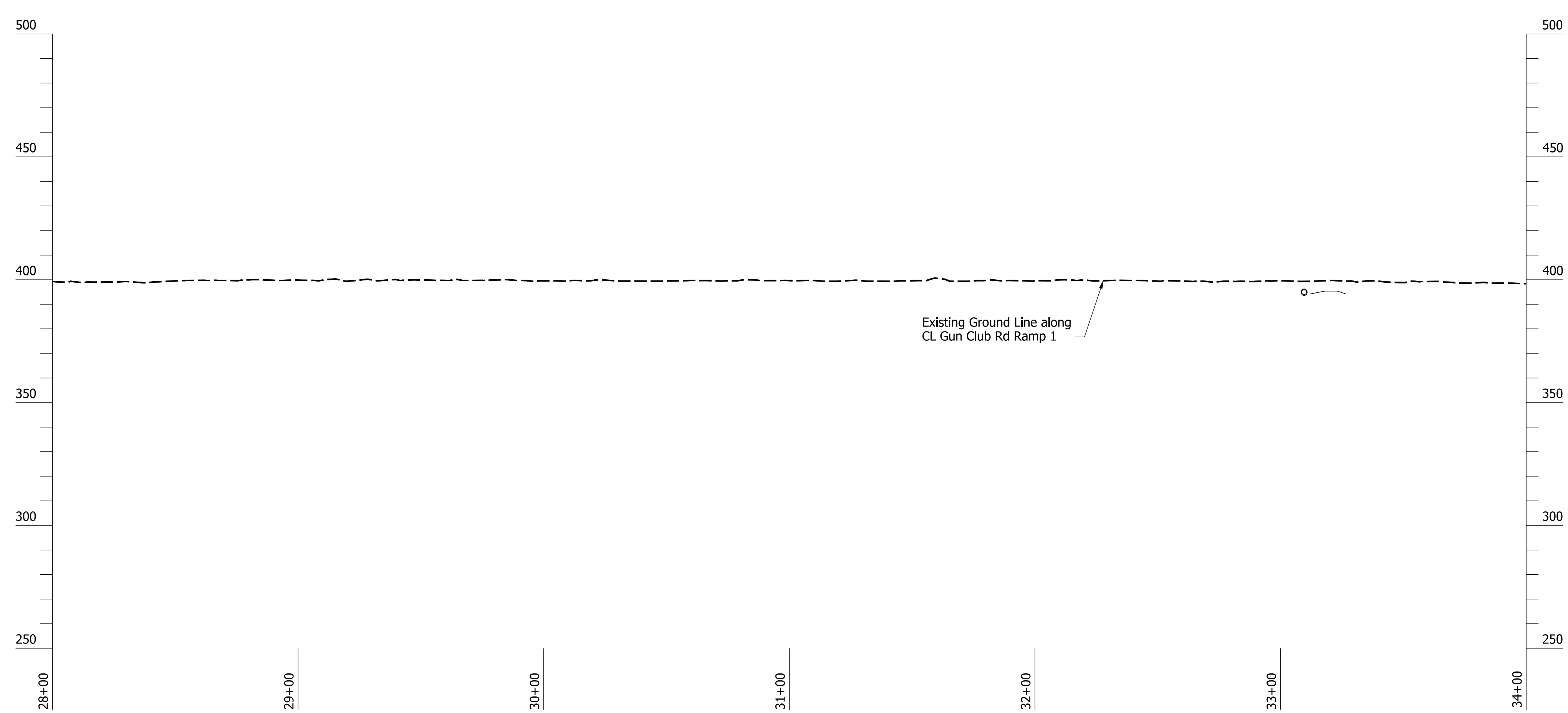
"N" VALUES

FE-10 - Sta. 21+78.65, 47.05' Right of CL Gun Club Rd Ramp 1

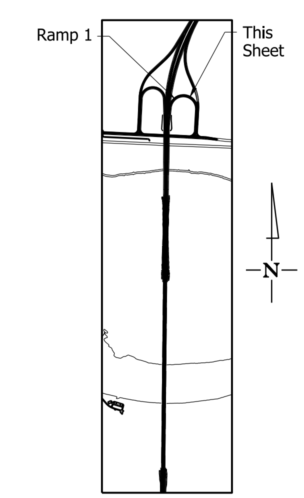
0.5-1.5	N=4
4.5-5.5	N=15
6.5-7.5	N=10
9.0-10.0	N=10
14.0-15.0	N=10
19.0-20.0	N=8
24.0-25.0	N=8
29.0-30.0	N=5
34.0-35.0	N=13
39.0-40.0	N=30

BORING LEGEND

A1 - ML-Loose brown fine sandy silt
B1- CL- Soft dark brown silty clay
C1 - ML-Medium dense reddish brown and tan fine sandy silt
D1 - SM-Loose reddish tan and brown silty fine sand
E1 - Medium dense tan fine to coarse sand



ELEVATION OF SOIL BORINGS



SITE PLAN
No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 2 OF 3
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD RAMP - BRIDGE 0XXX16 (F)
CRAWFORD COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

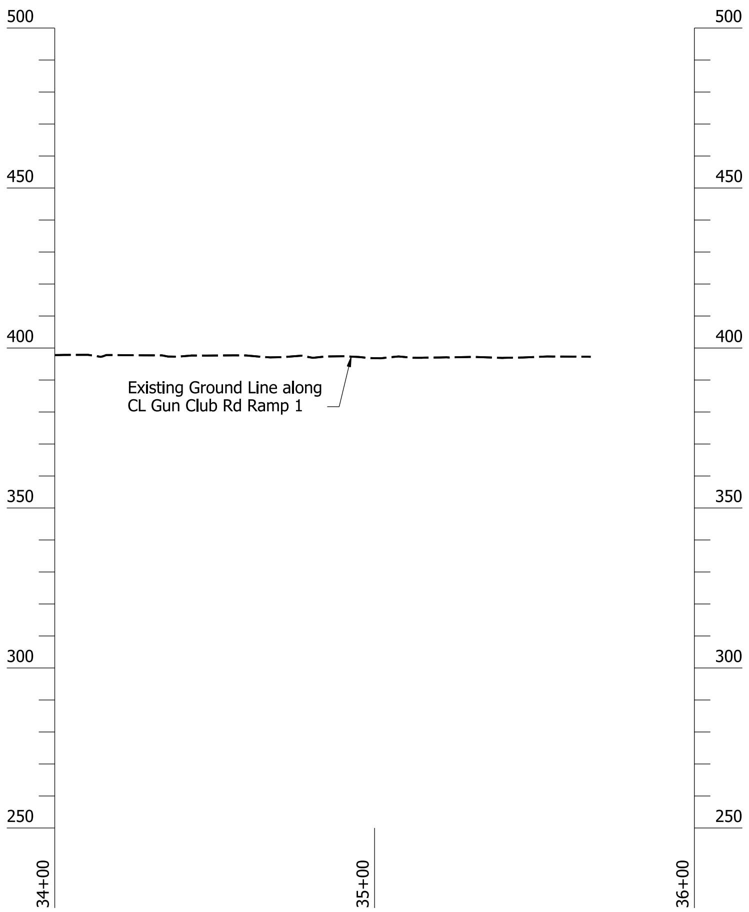
PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

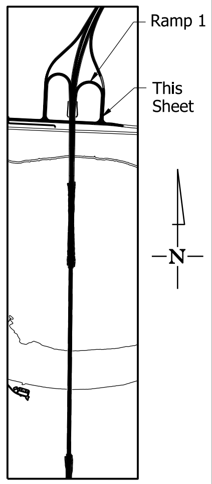
DRAWN BY: BNG DATE: 12/07/23 FILENAME: GCRp1 SB Layout 2.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 1/3/2024

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	040901	$PAGE#$	248
		01 - GEO PLAN LAYOUTS -				



ELEVATION OF SOIL BORINGS



SITE PLAN

No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 3 OF 3
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD RAMP - BRIDGE 0XXX16 (F)
CRAWFORD COUNTY

PRELIMINARY
NOT FOR CONSTRUCTION

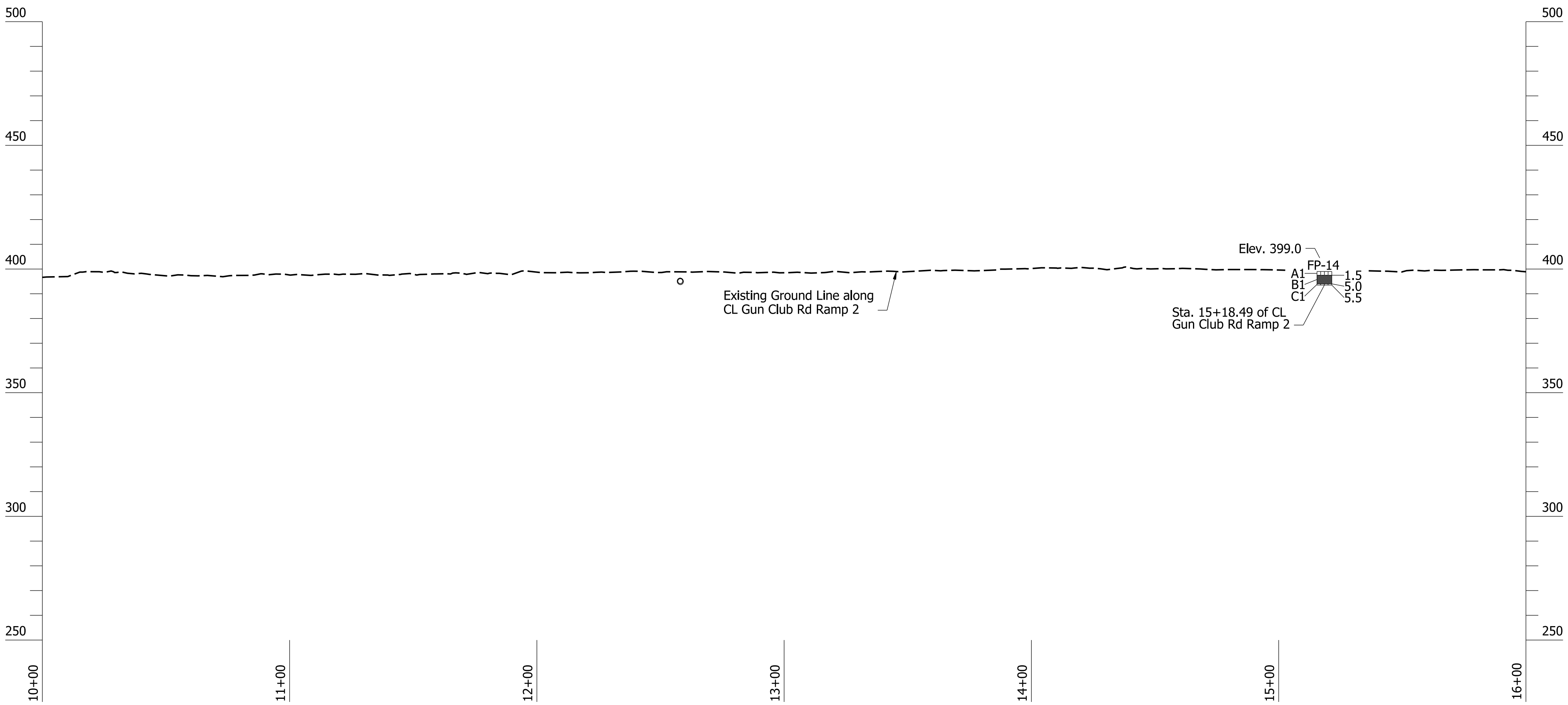
BRIDGE ENGINEER

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: BNG DATE: 12/07/23 FILENAME: GCRp1 SB Layout 3.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 12/27/2023

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	040901	$PAGE#$	248
		01 - GEO PLAN LAYOUTS -				



ELEVATION OF SOIL BORINGS

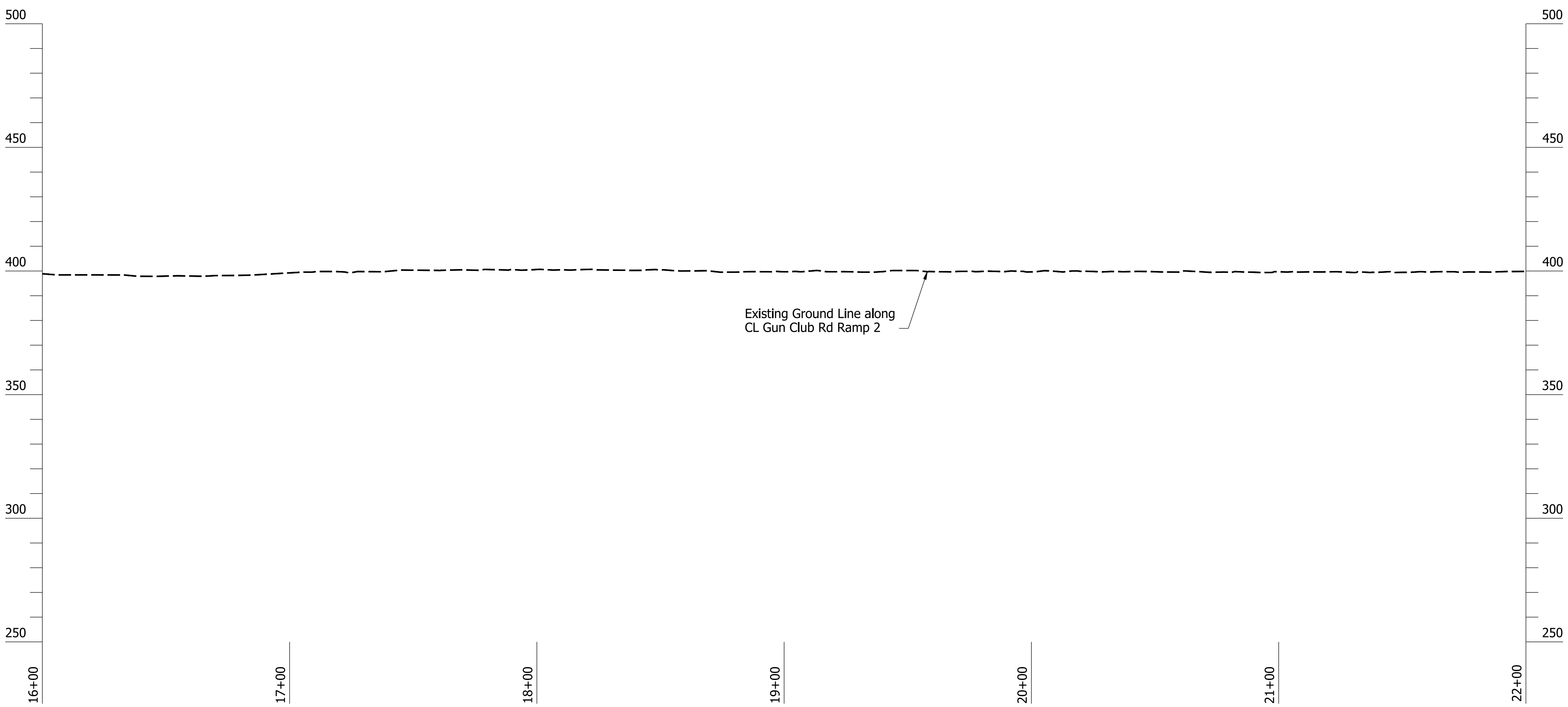
"N" VALUES

FP-14 - Sta. 15+18.49, of CL I-49

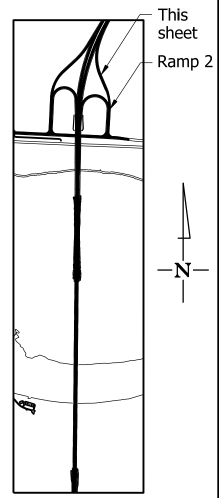
0.5-1.5	N=4
4.5-5.5	N=10

BORING LEGEND

A1 - ML-Very soft brown clayey silt
B1 - CL-Soft brown silty clay
C1 - ML-Firm to stiff brown clayey silt



ELEVATION OF SOIL BORINGS



SITE PLAN
No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 1 OF 3
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD RAMP - BRIDGE 0XXX16 (F)
CRAWFORD COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

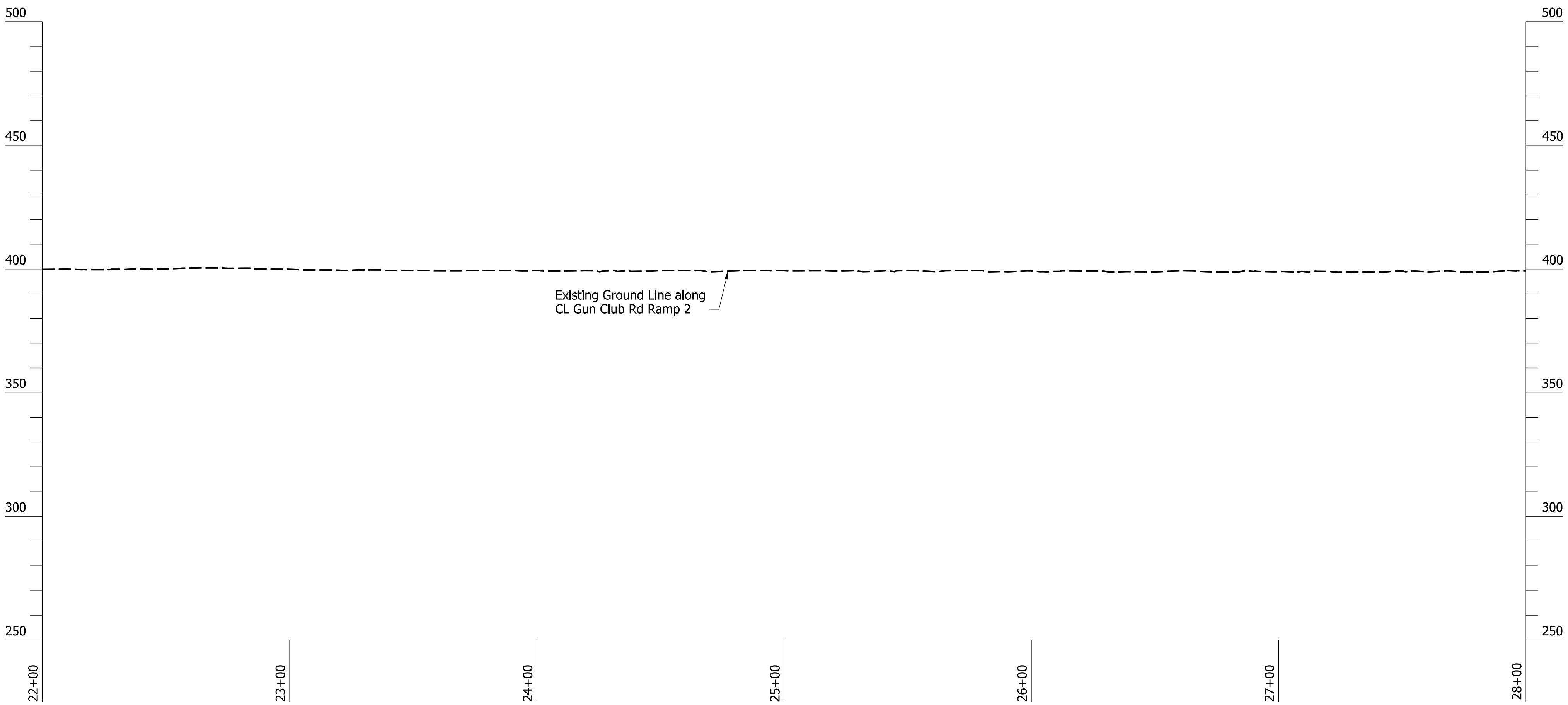
PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

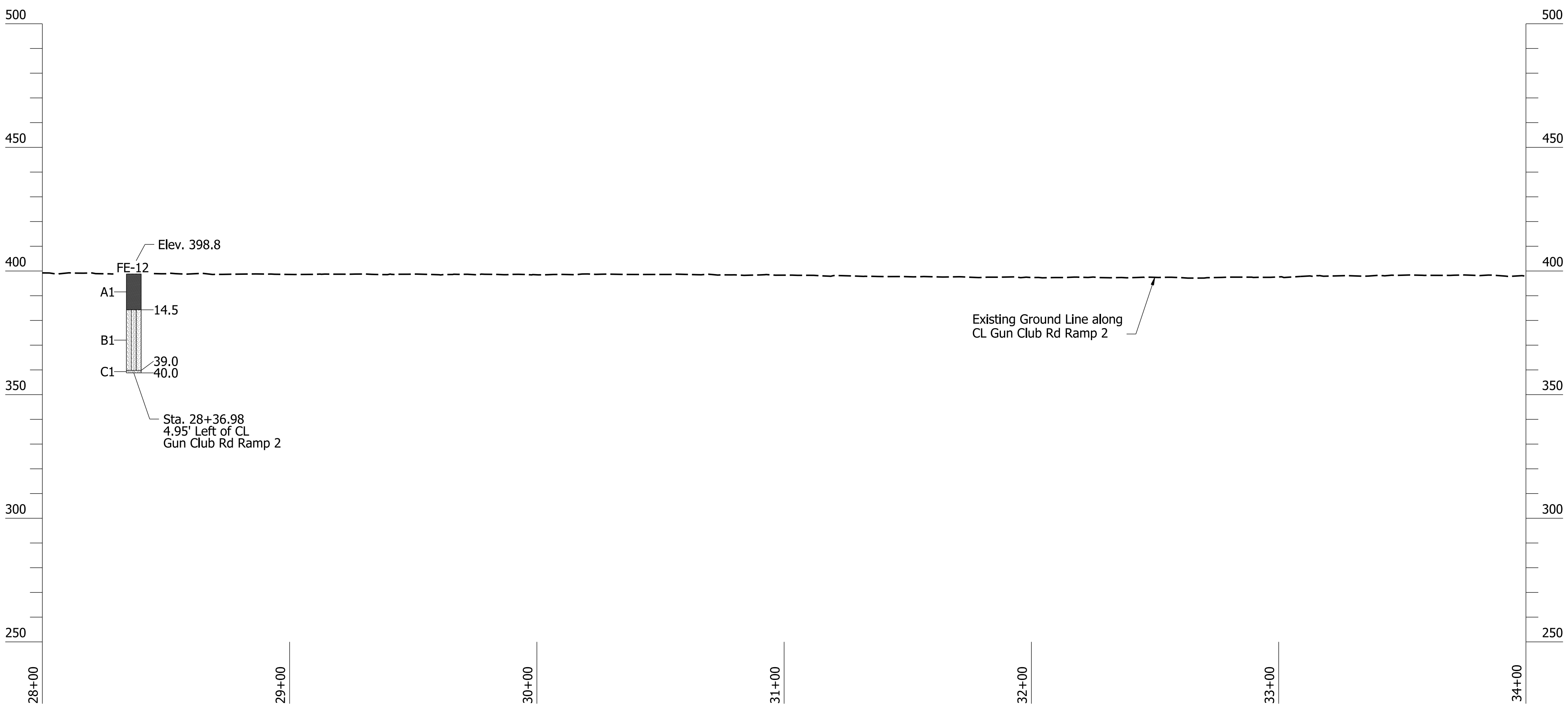
DRAWN BY: BNG DATE: 12/07/23 FILENAME: GCRp2 SB Layout 1.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 1/2/2024

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	040901	$PAGE#$	248
		01 - GEO PLAN LAYOUTS -				



ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS

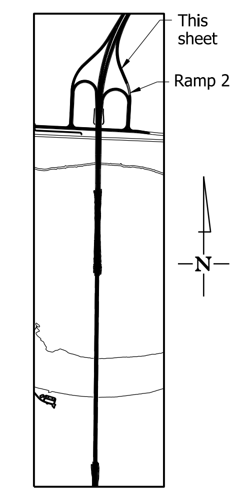
"N" VALUES

FE-12 - Sta. 28+30.30, 49.74' Left of CL Gun Club Rd Ramp 2

2.5-3.5	N=7
4.5-5.5	N=10
6.5-7.5	N=8
9.0-10.0	N=8
14.0-15.0	N=14
19.0-20.0	N=9
24.0-25.0	N=8
29.0-30.0	N=2
34.0-35.0	N=2
39.0-40.0	N=16

BORING LEGEND

A1 - ML-Very soft brown clayey silt
B1 - CL-Soft brown silty clay
C1 - ML-Firm to stiff brown clayey silt



SITE PLAN
No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 2 OF 3
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD RAMP - BRIDGE 0XXX16 (F)
CRAWFORD COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

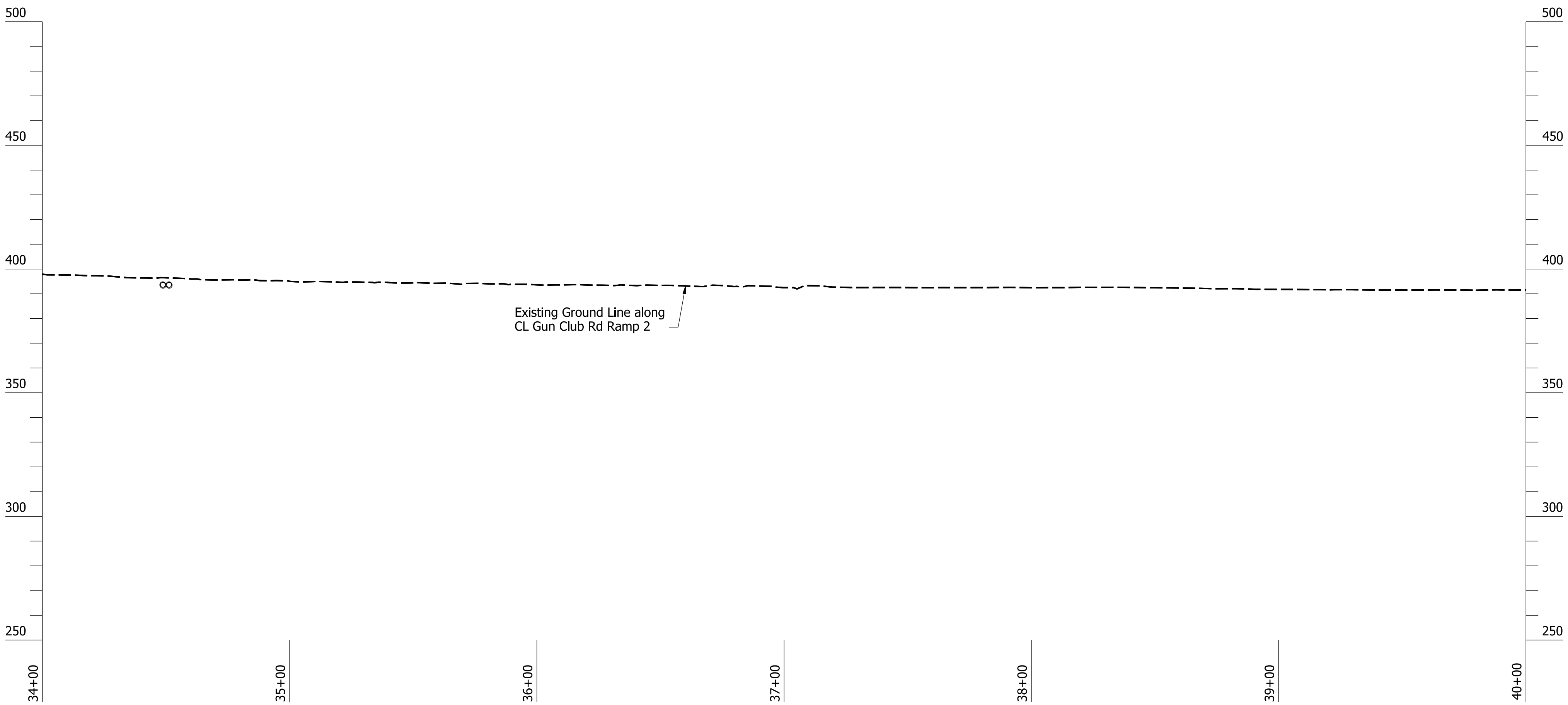
PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

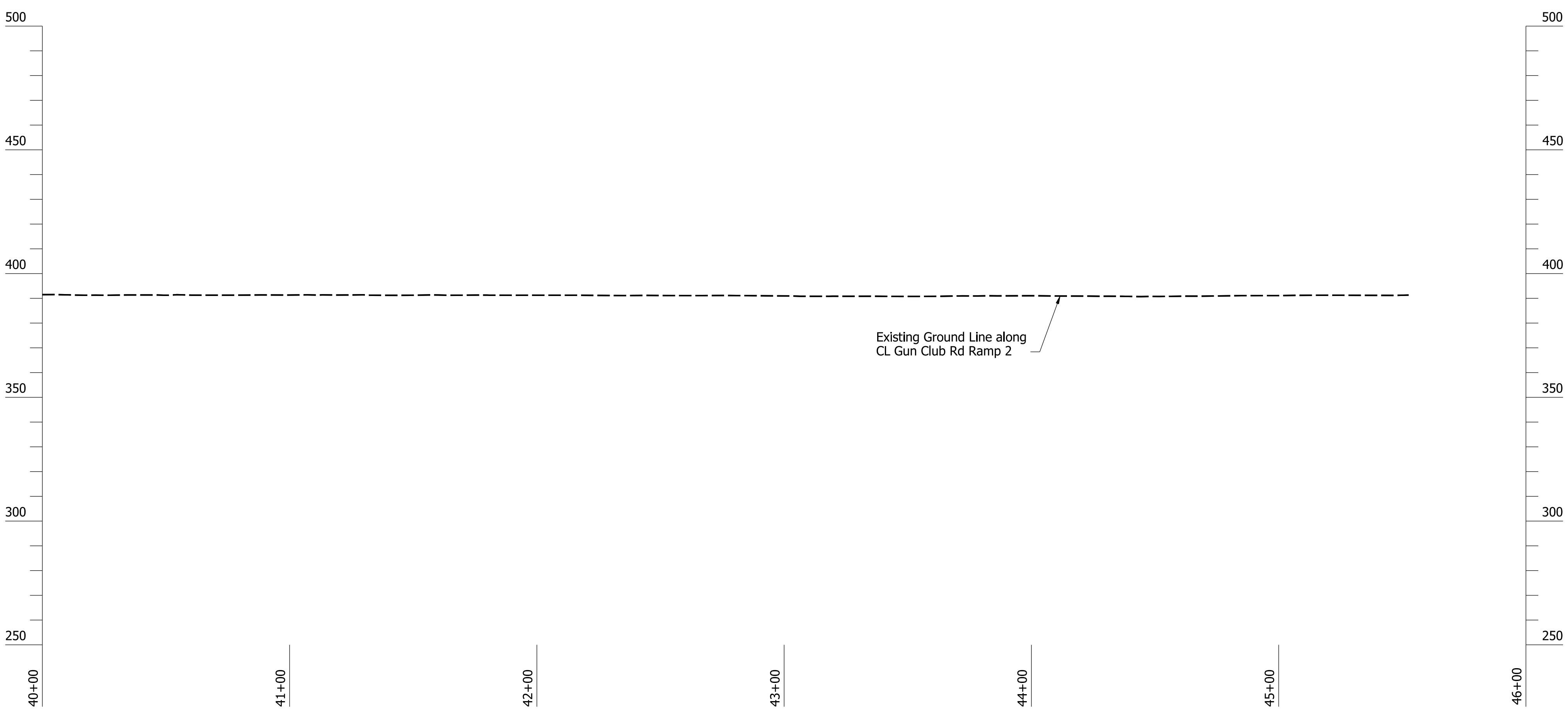
DRAWN BY: BNG DATE: 12/07/23 FILENAME: GCRp2 SB Layout 2.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 1/3/2024

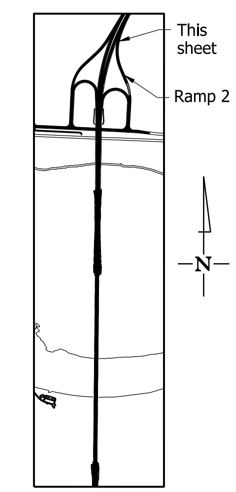
DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	040901	$PAGE#$	248
		01 - GEO PLAN LAYOUTS -				



ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS



SITE PLAN
No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 3 OF 3
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD RAMP - BRIDGE 0XXX16 (F)
CRAWFORD COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

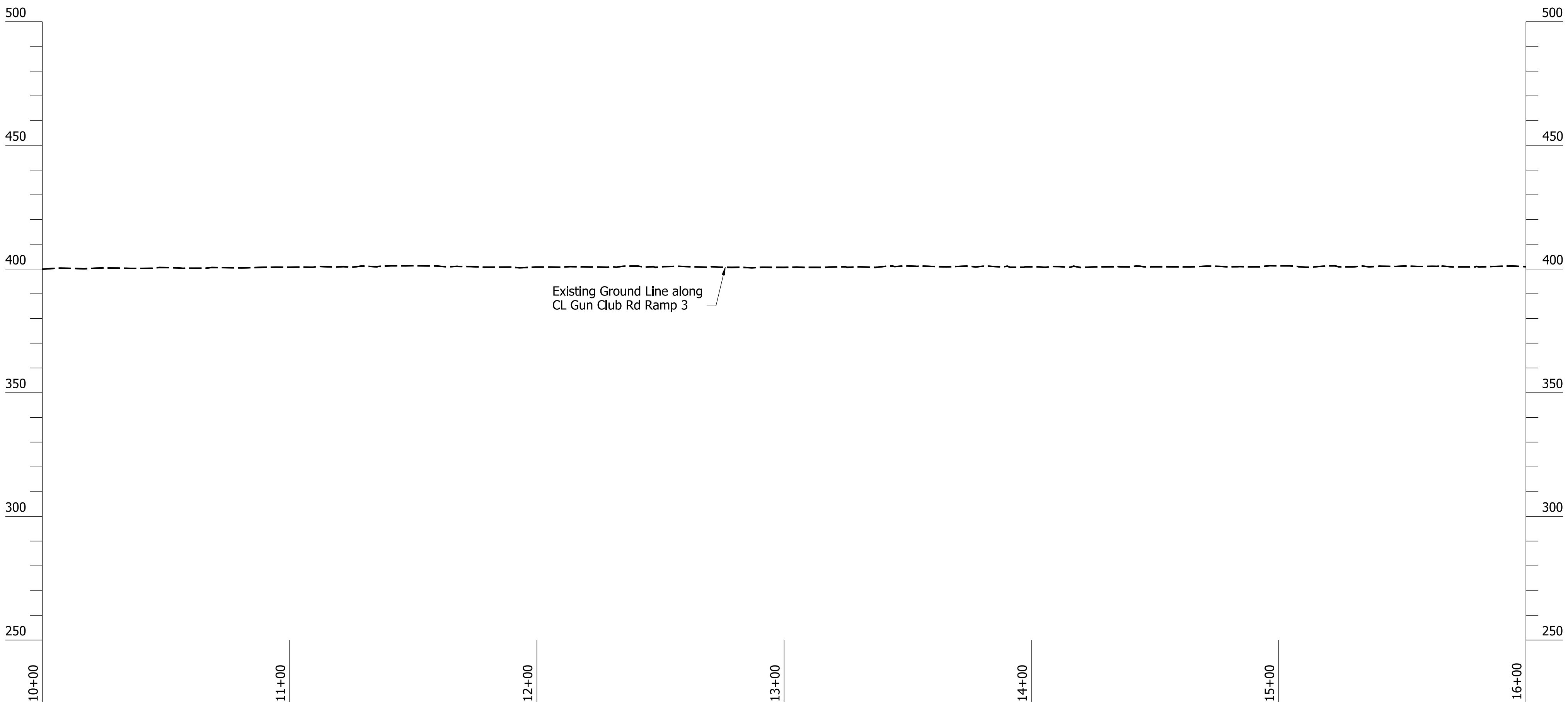
PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

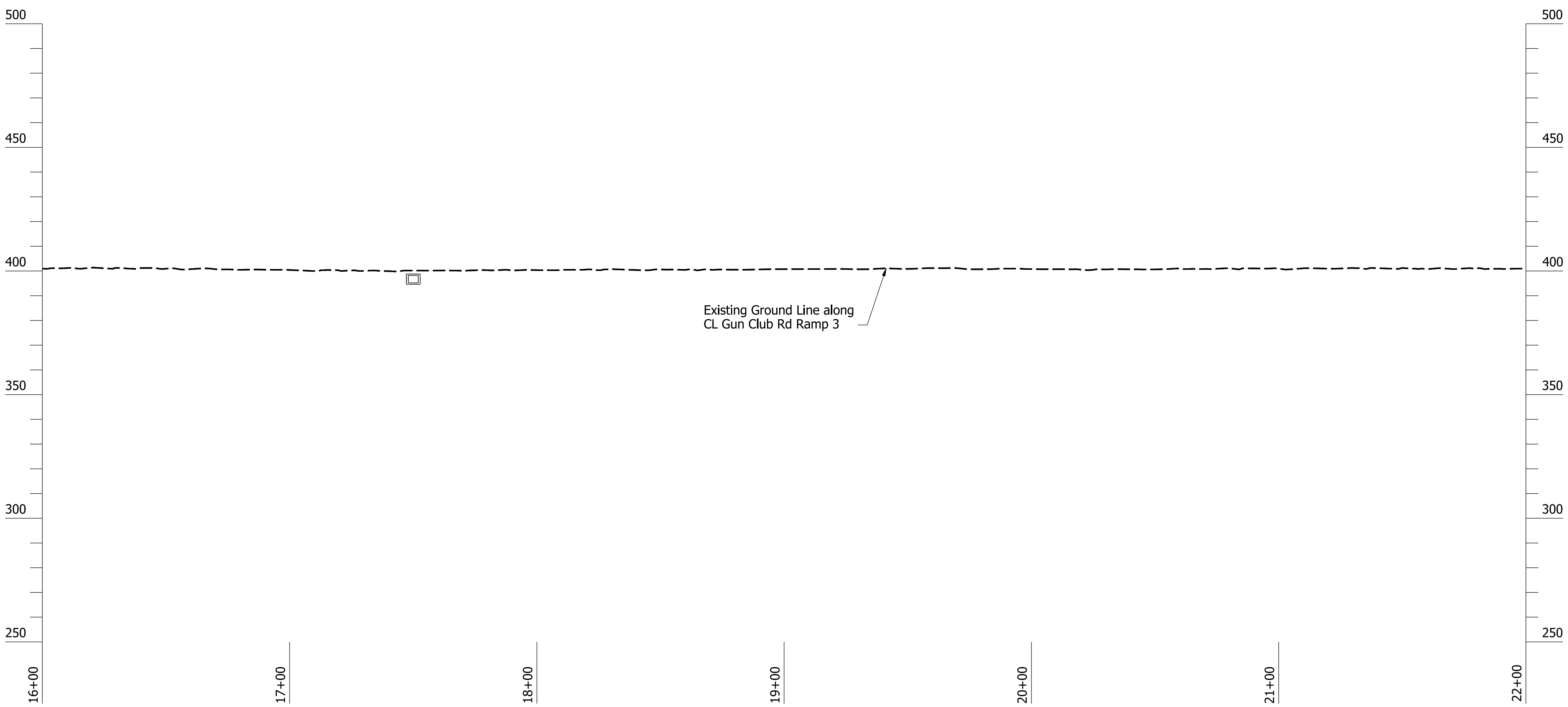
DRAWN BY: BNG DATE: 12/07/23 FILENAME: GCRp2 SB Layout 3.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 1/2/2024

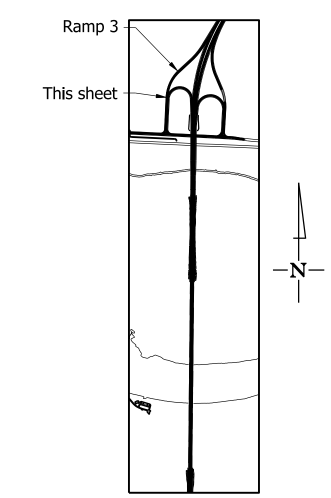
DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	040901	$PAGE#$	248
		01 - GEO PLAN LAYOUTS -				



ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS



SITE PLAN
No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 1 OF 3
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD RAMP - BRIDGE 0XXX16 (F)
CRAWFORD COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: BNG DATE: 12/07/23 FILENAME: GCRp3 SB Layout 1.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 1/2/2024

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	040901	$PAGE#$	248
		01 - GEO PLAN LAYOUTS -				

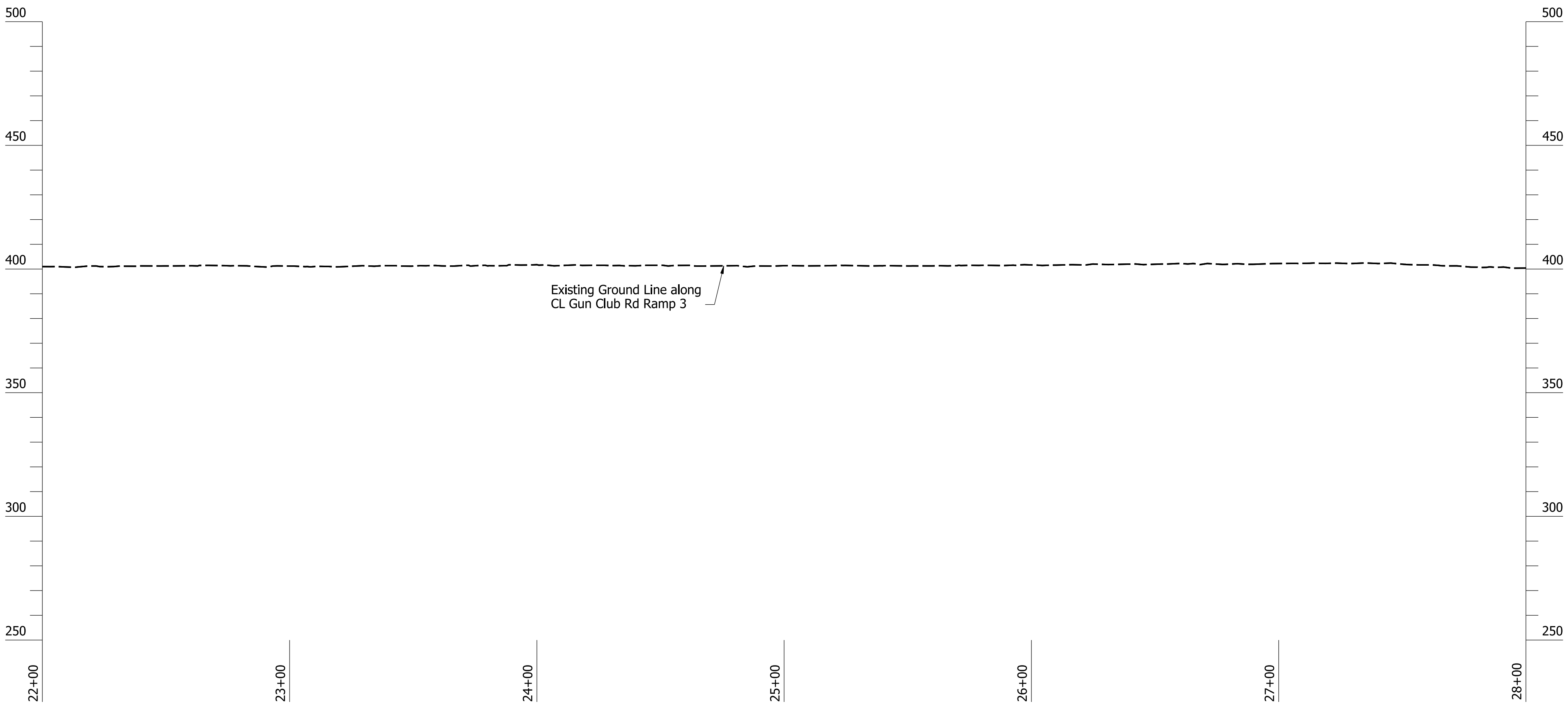
"N" VALUES

FE-13 - Sta. 29+5.48, 8.17, Right of CL Gun Club Ramp 3

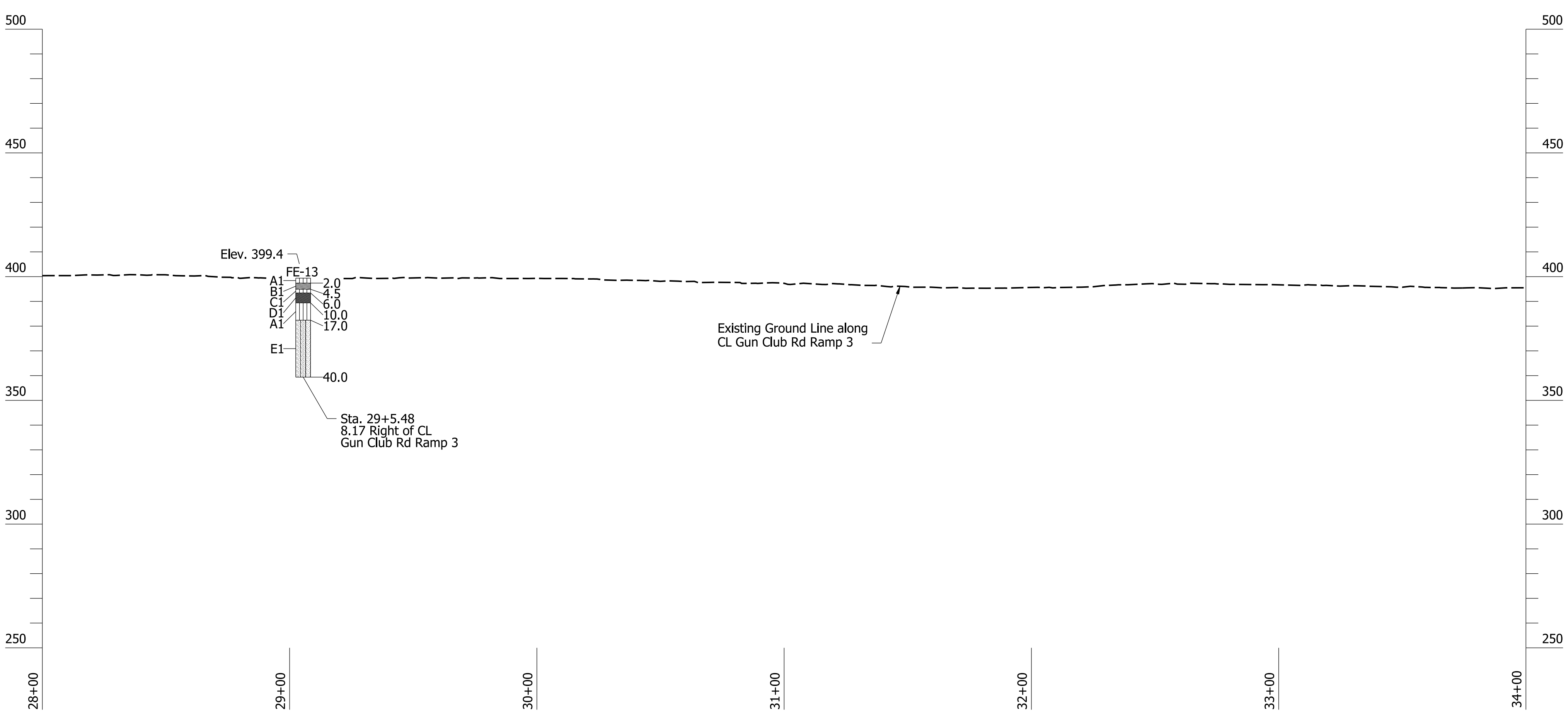
0.0-1.0	N=6
4.5-5.5	N=8
6.5-7.5	N=6
14.0-15.0	N=7
19.0-20.0	N=10
24.0-25.0	N=4
29.0-30.0	N=5
34.0-35.0	N=13
39.0-40.0	N=7

BORING LEGEND

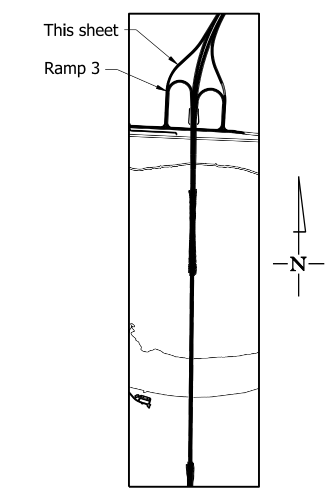
A1 - ML-Soft brown clayey silt
B1 - CH-Soft brown clay
C1 - ML-Firm reddish brown clayey silt
D1 - CL-Soft reddish brown silty clay w/silt partings and seams
E1 - SM-Loose to medium dense tan silty fine sand



ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS



SITE PLAN
No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 2 OF 3
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD RAMP - BRIDGE 0XXX16 (F)
CRAWFORD COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: BNG DATE: 12/07/23 FILENAME: GCRp3 SB Layout 2.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07685 DRAWING NO.

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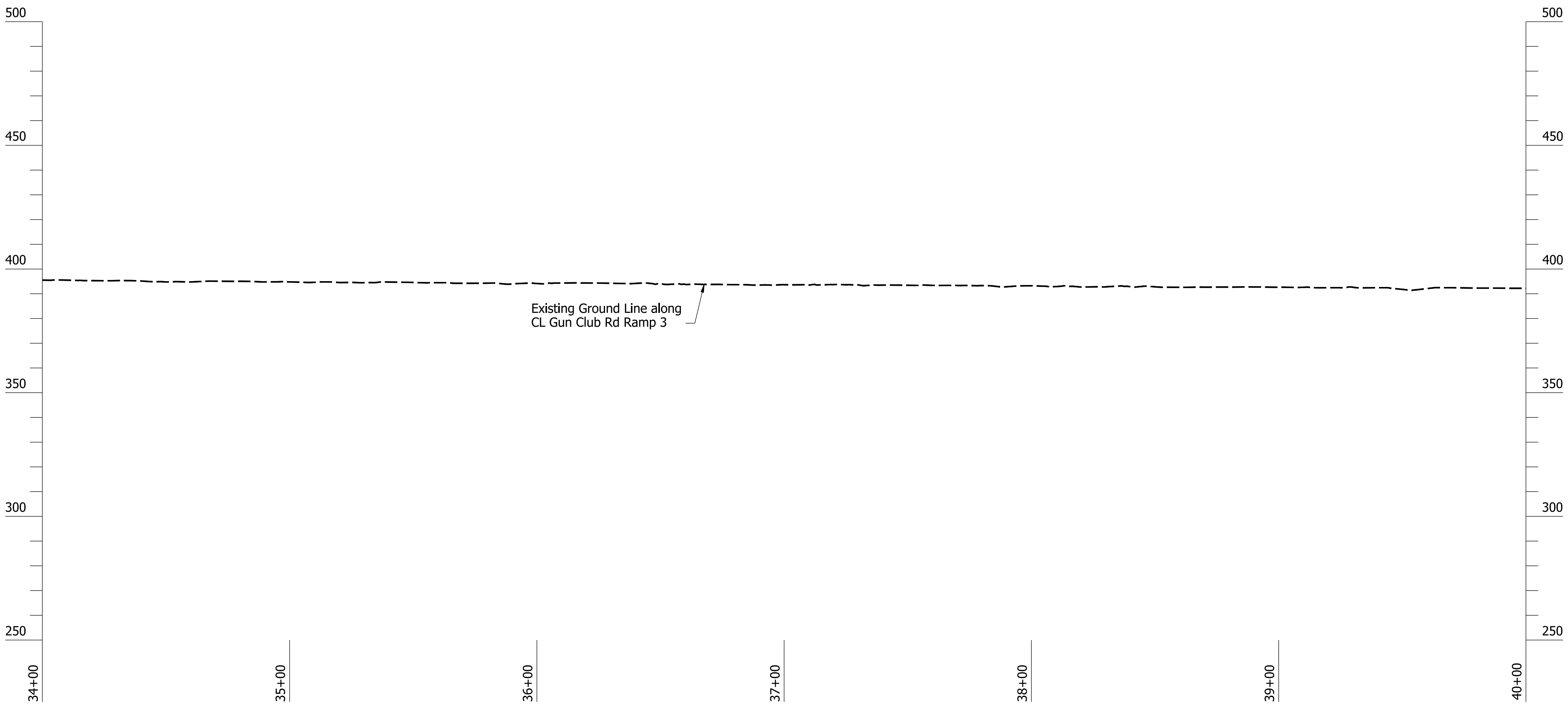
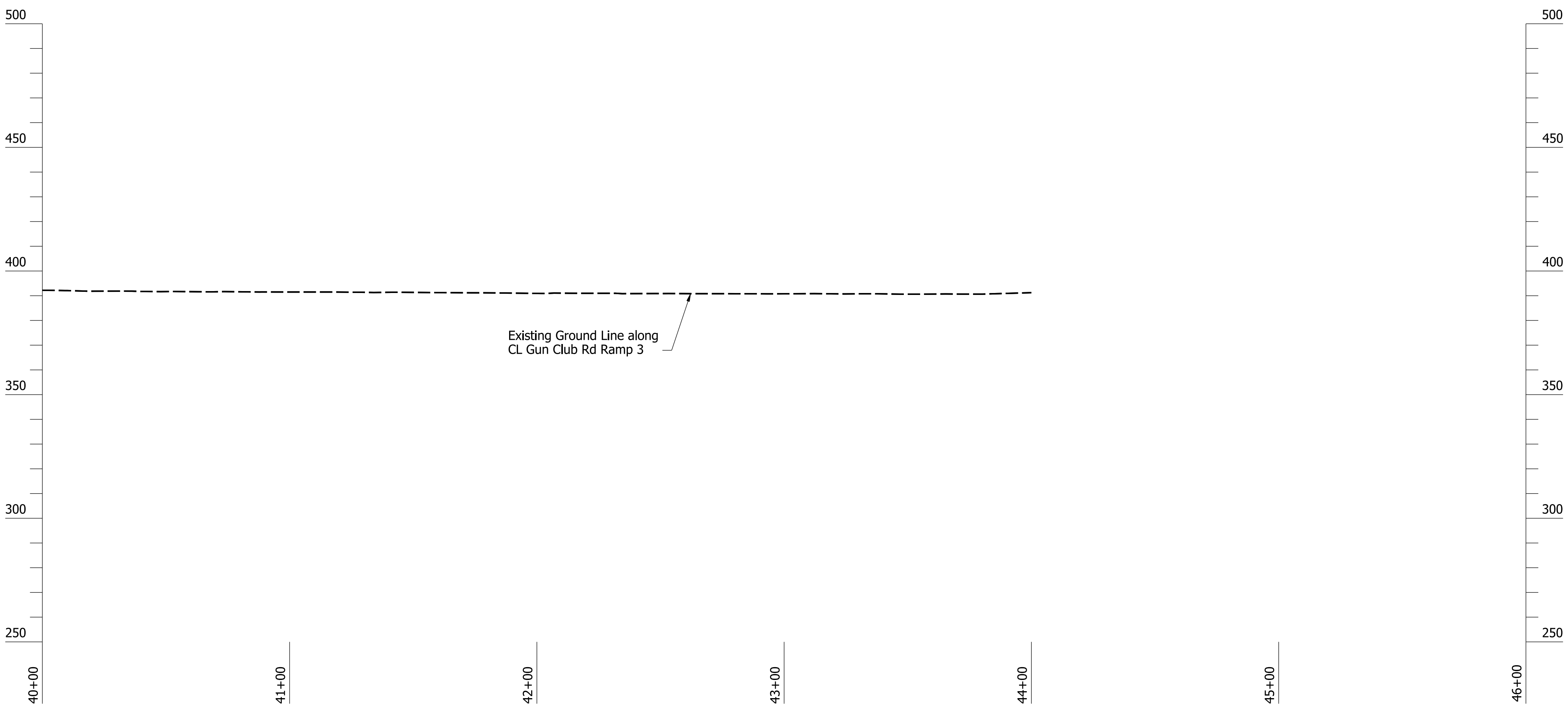
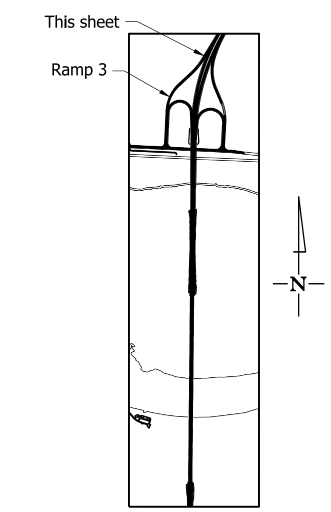


ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS



SITE PLAN
No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 3 OF 3
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD RAMP - BRIDGE 0XXX16 (F)
CRAWFORD COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: BNG DATE: 12/07/23 FILENAME: GCRp3 SB Layout 3.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
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BRIDGE NO. 07685 DRAWING NO.

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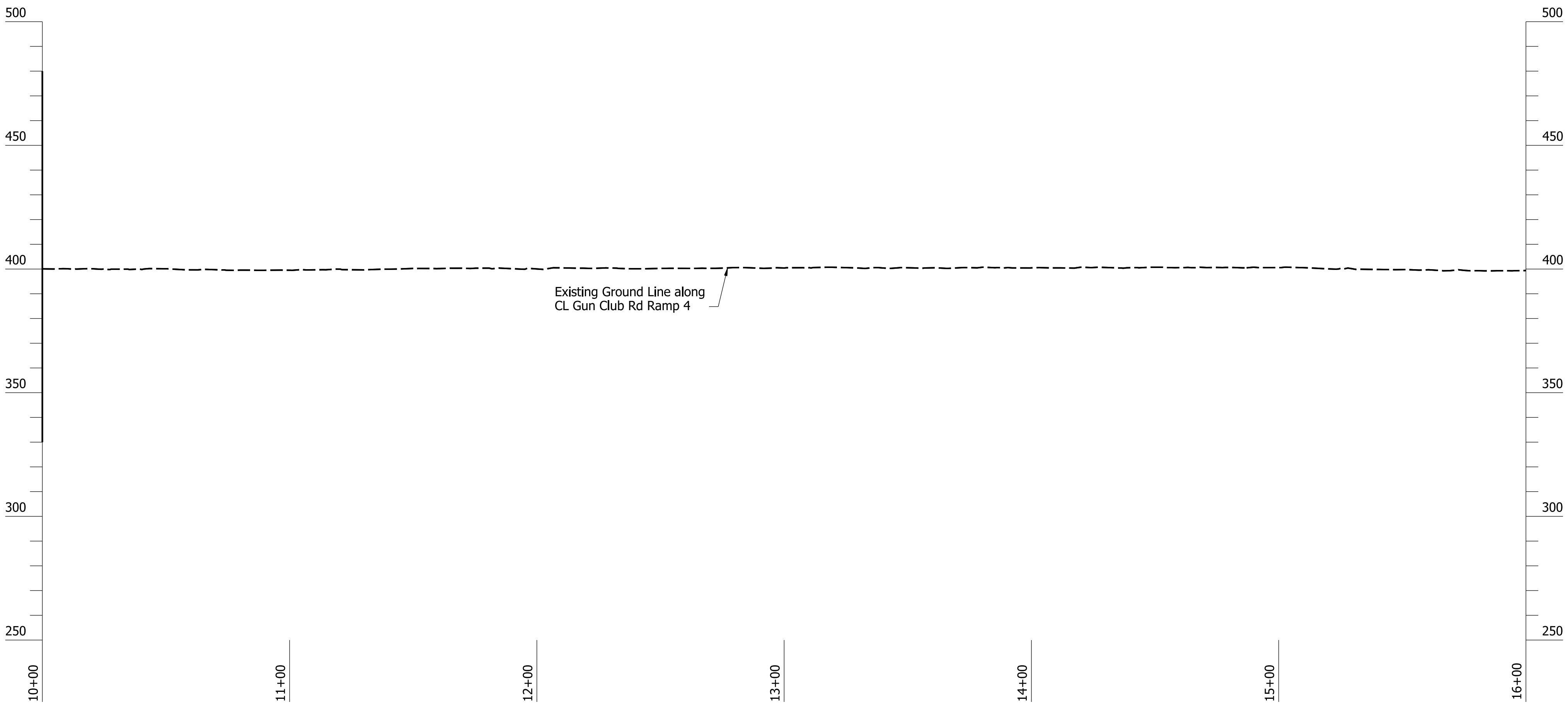
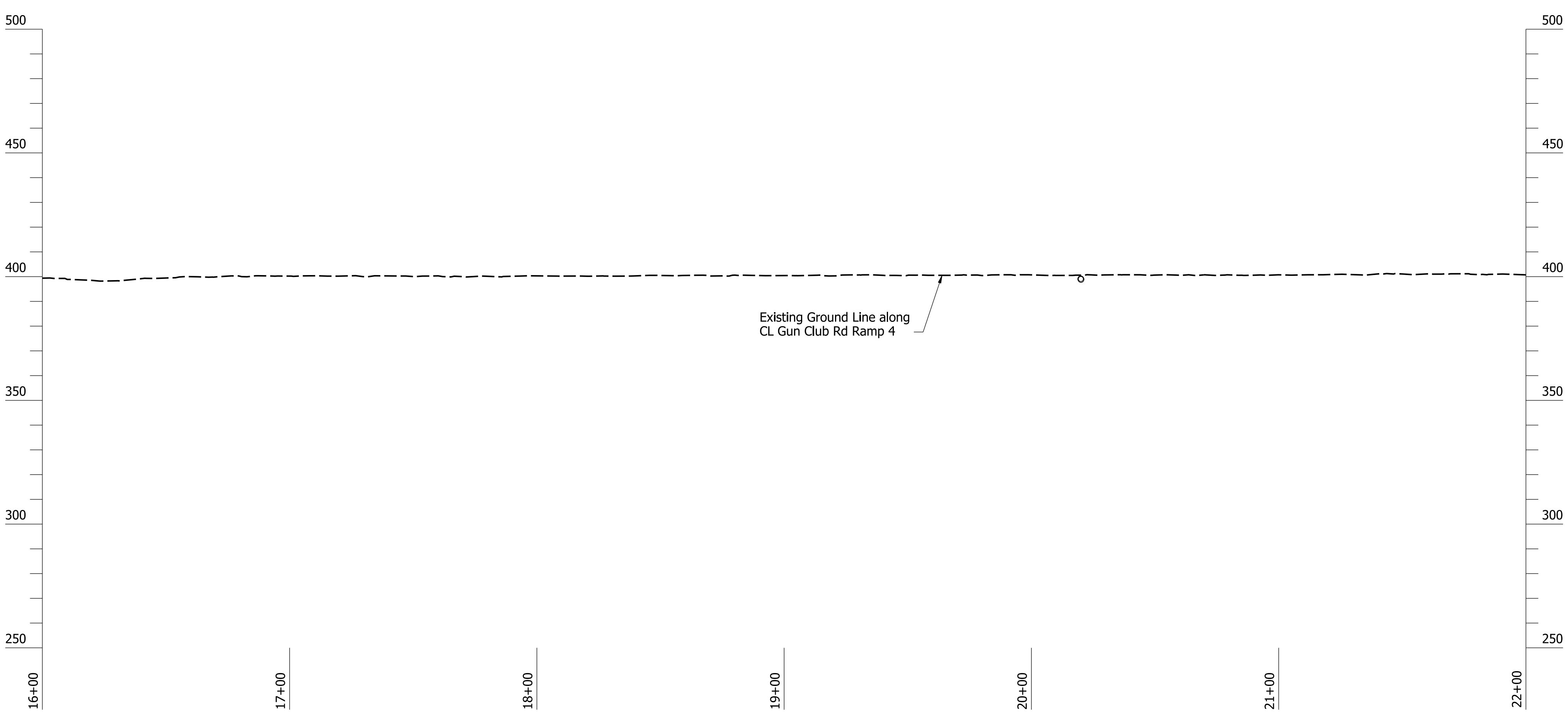
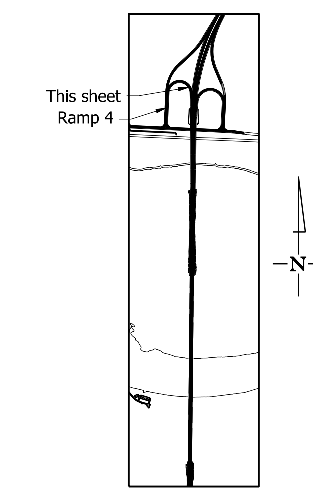
		01 - GEO PLAN LAYOUTS -				



ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS



SITE PLAN
No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 1 OF 3
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD RAMP - BRIDGE 0XXX16 (F)
CRAWFORD COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

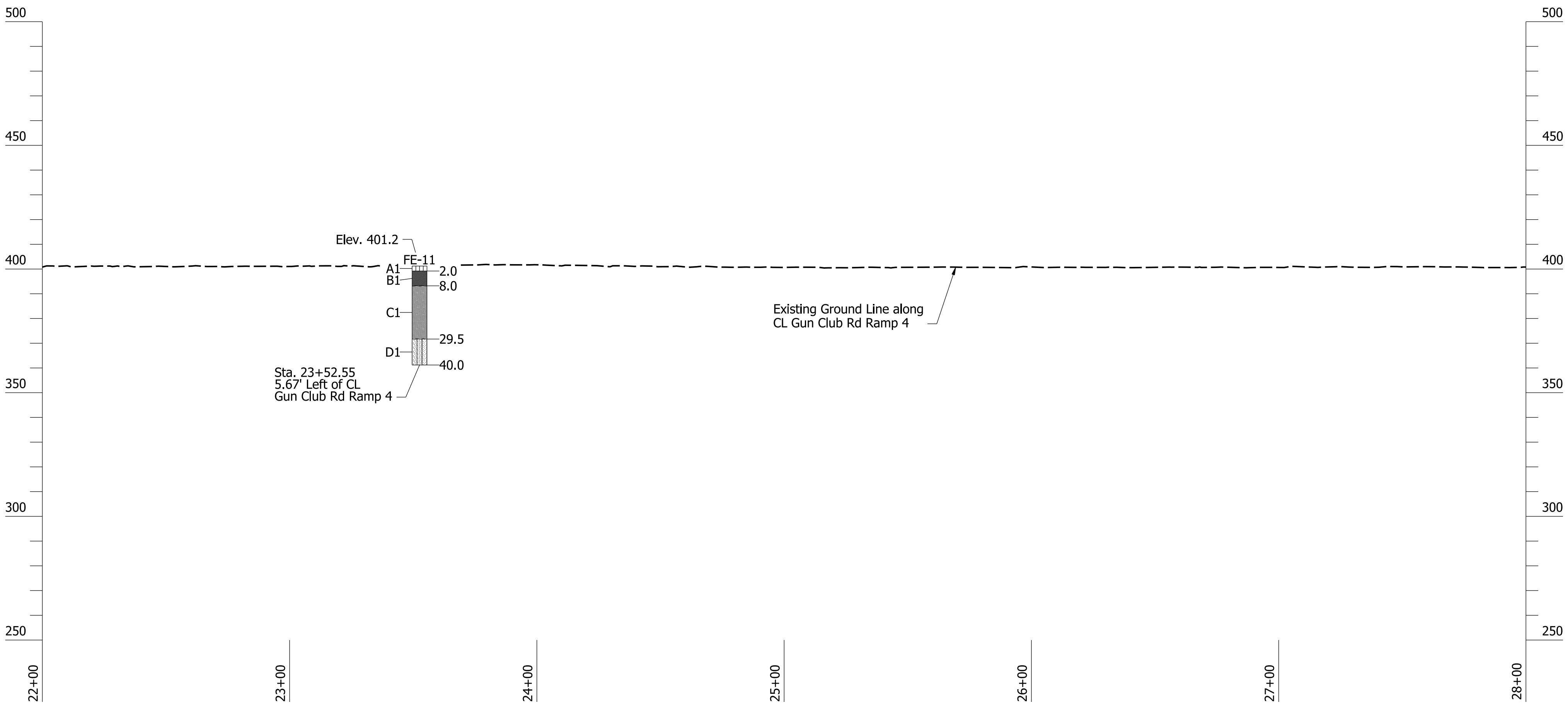
PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: BNG DATE: 12/07/23 FILENAME: GCRp4 SB Layout 1.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 12/27/2023

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	040901	$PAGE#$	248
		01 - GEO PLAN LAYOUTS -				



ELEVATION OF SOIL BORINGS

"N" VALUES

FE-11 - Sta. 23+52.55, 5.67' Left of CL Gun Club Rd Ramp 4

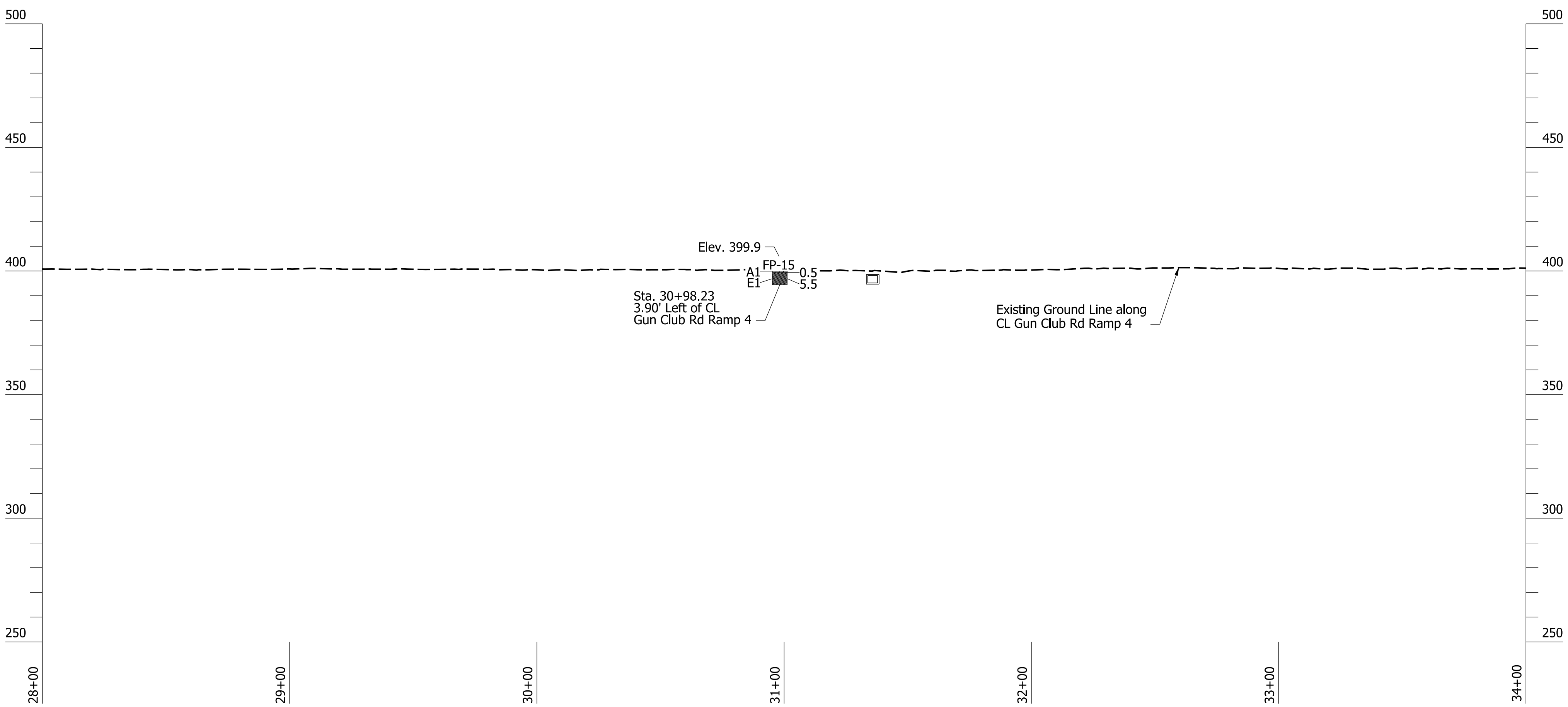
0.5-1.5	N=5
2.5-3.5	N=3
4.5-5.5	N=7
9.0-10.0	N=6
14.0-15.0	N=6
19.0-20.0	N=7
24.0-25.0	N=4
29.0-30.0	N=3
34.0-35.0	N=9
39.0-40.0	N=9

FP-15 - Sta. 30+98.23, 3.90' Left of CL Gun Club Rd Ramp 4

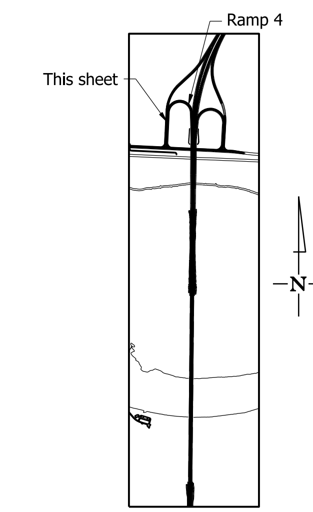
0.5-1.5	N=8
2.5-3.5	N=7
4.5-5.5	N=13

BORING LEGEND

A1 - ML-Soft brown clayey silt
B1 - CL-Very soft dark brown silty clay
C1 - CH-Soft reddish tan and brown clay
D1 - SM-Very loose tan silty fine sand
E1 - CL-Firm brown silty clay



ELEVATION OF SOIL BORINGS



SITE PLAN
No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 2 OF 3
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD RAMP - BRIDGE 0XXX16 (F)
CRAWFORD COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: BNG DATE: 12/07/23 FILENAME: GCRp4 SB Layout 2.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07685 DRAWING NO.

PRINT DATE: 1/3/2024

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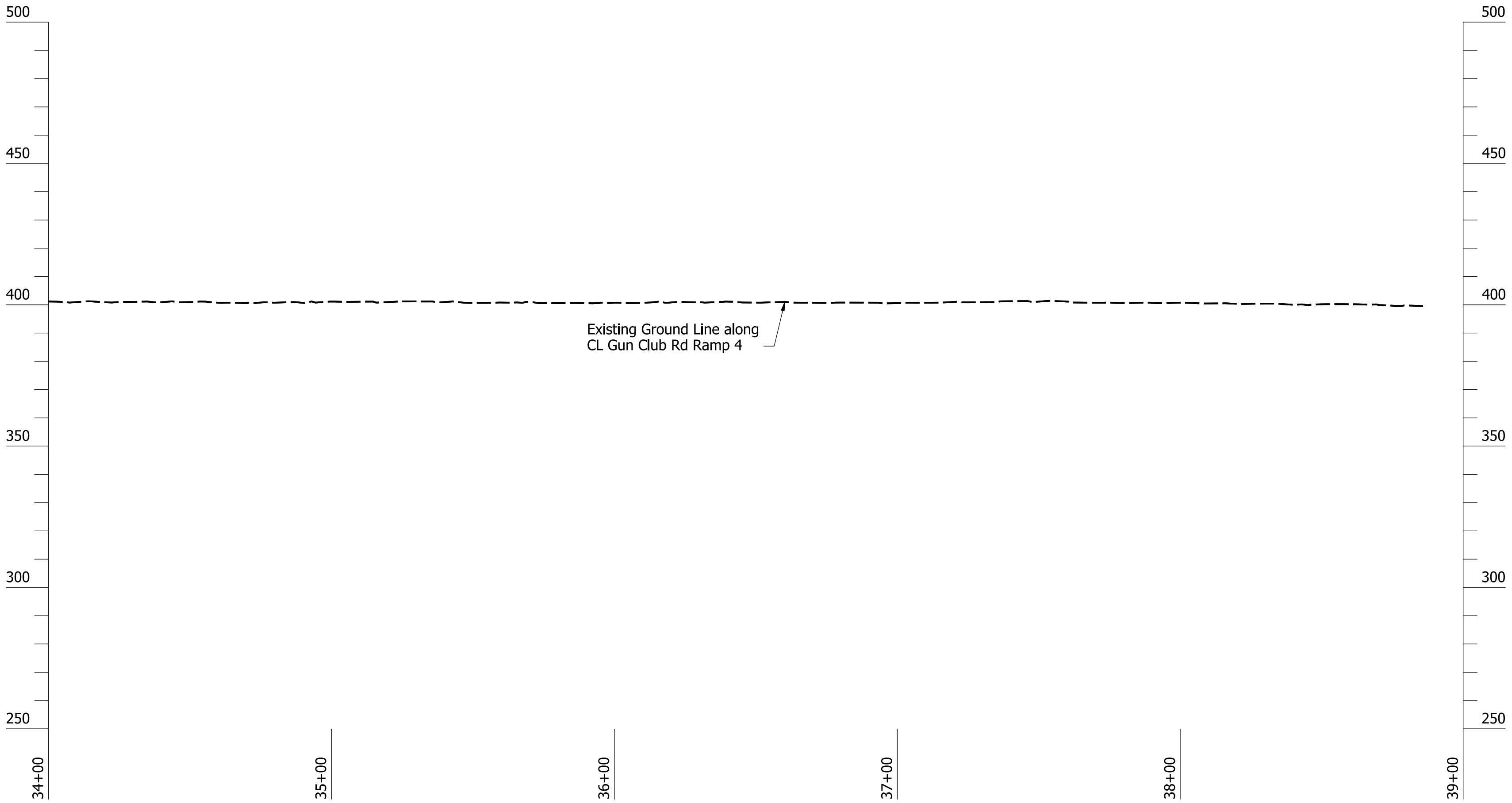
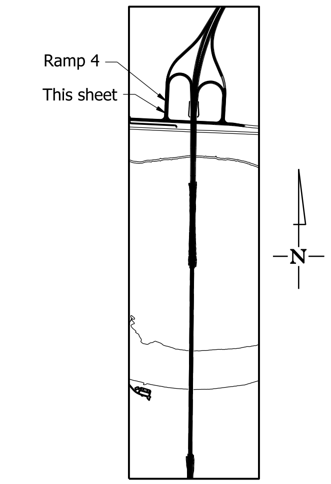
		01 - GEO PLAN LAYOUTS -				



ELEVATION OF SOIL BORINGS



SITE PLAN
No Scale

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.

SHEET 3 OF 3
LAYOUT OF SOIL BORINGS
I-49
GUN CLUB RD RAMP - BRIDGE 0XXX16 (F)
CRAWFORD COUNTY

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: BNG DATE: 12/07/23 FILENAME: GCRp4 SB Layout 3.dgn
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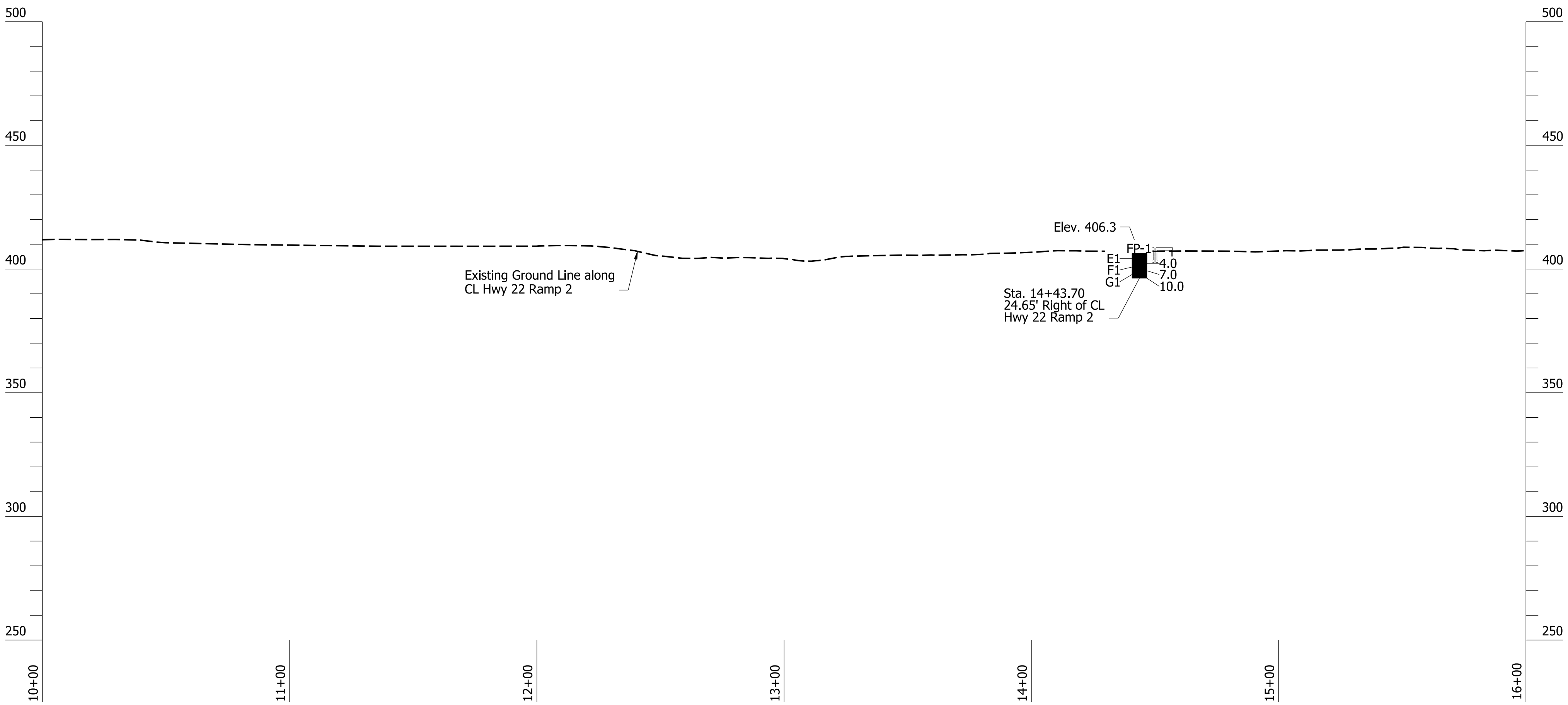
		01 - GEO PLAN LAYOUTS -				



ELEVATION OF SOIL BORINGS

"N" VALUES

FP-1 - Sta. 14+43.70, 24.65' Right of CL Hwy 22 Ramp 2

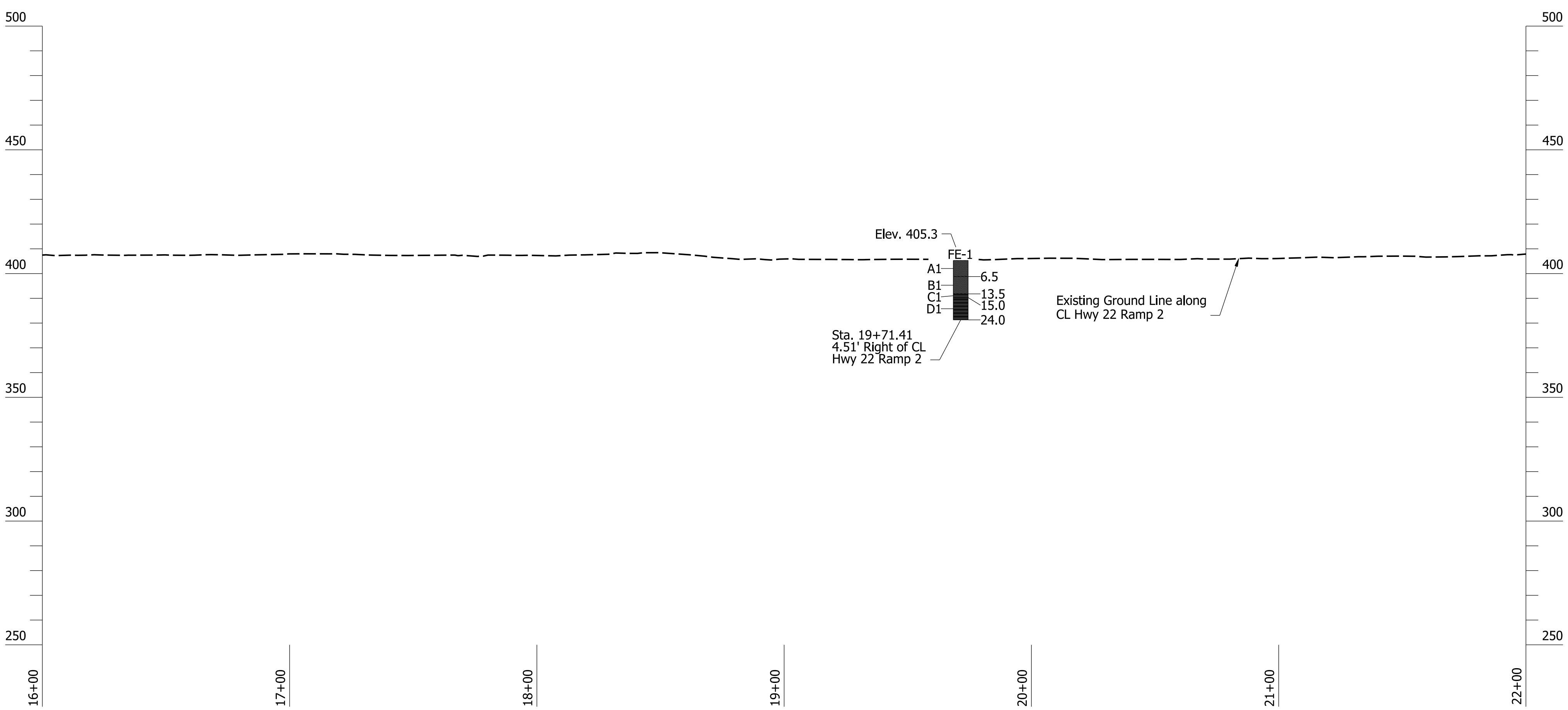
0.5-1.5	N=3
2.5-3.5	N=18
6.5-7.5	N=5
13.5-14.5	N=x50/4"

FE-1 - Sta. 19+71.41, 4.51' Right of CL Hwy 22 Ramp 2

0.5-1.5	N=4
2.5-3.5	N=19
4.5-5.5	N=31
6.5-7.5	N=45
13.5-14.5	N=50/7"

BORING LEGEND

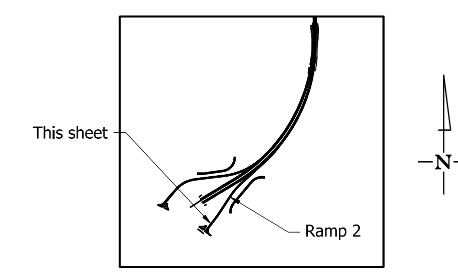
A1 - CL-Very soft gray, brown and tan silty clay
B1 - CL-Very soft to soft tan and brown clay
C1 - SHALE-Low hardness to moderately hard dark gray weathered shale, horizontal bedding
D1 - SHALE-Moderately hard dark gray shale w/ sandstone partings, horizontal bedding
E1 - CL-ML-Soft brown and dark brown clayey silt w/some fine sand, ferrous nodules and stains
F1 - CL-Very stiff gray and brown silty clay w/occassional shale fragments
G1 - SHALE-Low hardness dark gray weathered shale w/occassional silty clay laminations and ferrous stains



ELEVATION OF SOIL BORINGS

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.



SITE PLAN
No Scale

SHEET 1 OF 3
LAYOUT OF SOIL BORINGS
I-49
HWY. 22 - BRIDGE 07684 (F)
SEBASTIAN COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

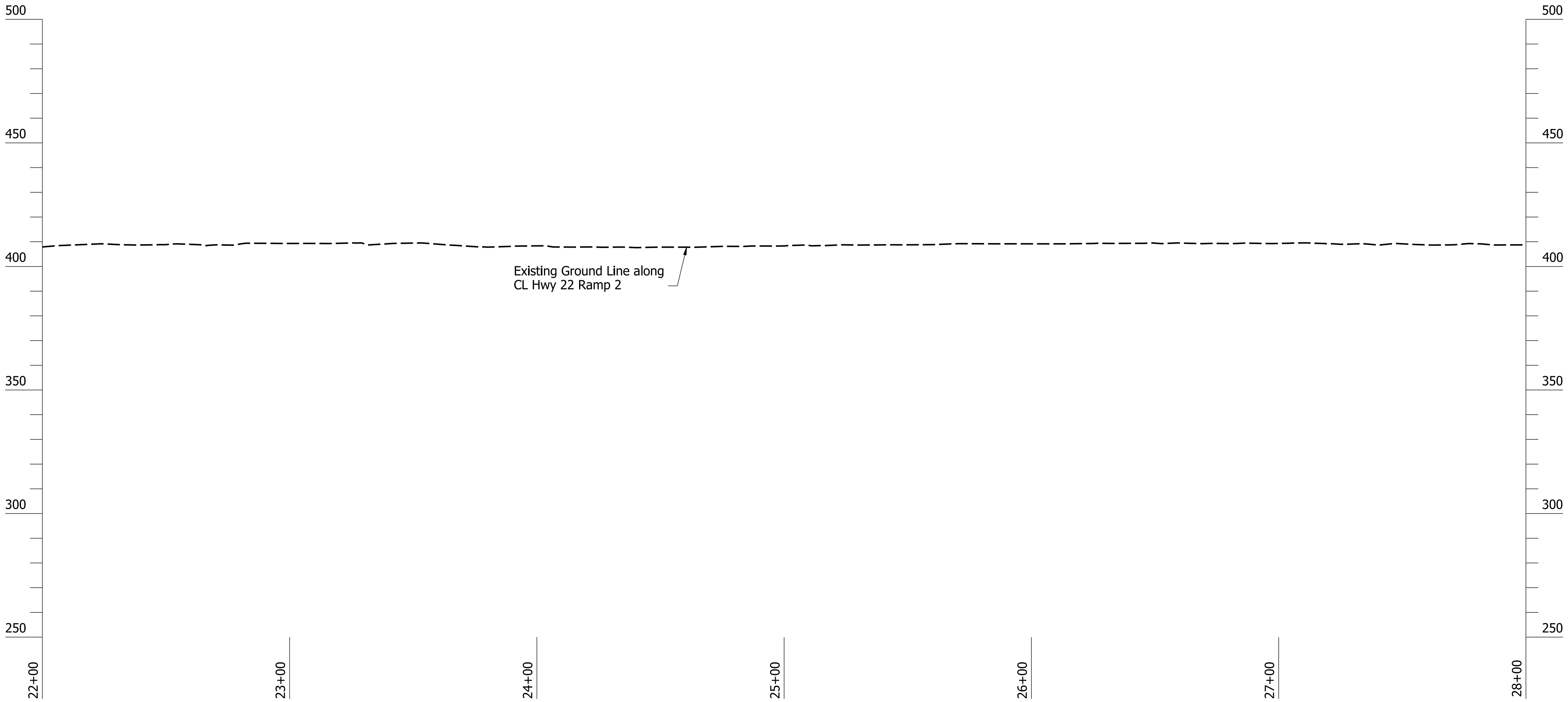
PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

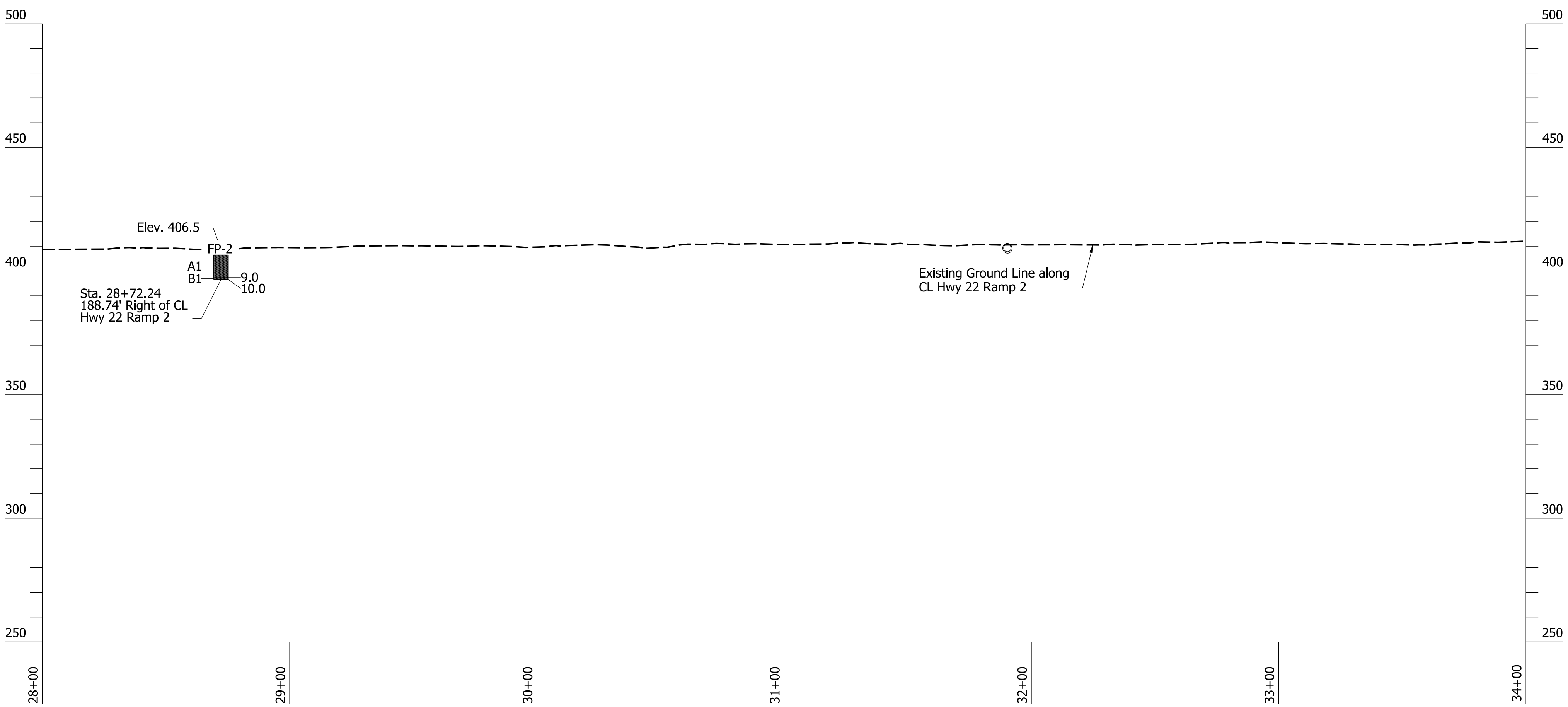
DRAWN BY: BNG DATE: 12/07/23 FILENAME: H22 Rp2 SB Layout 1.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07684 DRAWING NO.

PRINT DATE: 1/3/2024

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	040901	$PAGE#$	248
		01 - GEO PLAN LAYOUTS -				



ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS

"N" VALUES

FP-2 - Sta. 28+72.24, 188.74' Right of CL Hwy 22 Ramp 2

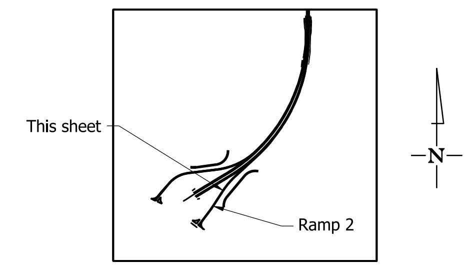
0.5-1.5	N=3
2.5-3.5	N=6
4.5-5.5	N=6
6.5-7.5	N=3
9.0-10.0	N=19

BORING LEGEND

A1 - CL-Very soft dark brown and tan silty clay
B1 - CL-Stiff tan and gray silty clay with weathered shale seams

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.



SITE PLAN
No Scale

SHEET 2 OF 3
LAYOUT OF SOIL BORINGS
I-49
HWY. 22 - BRIDGE 07684 (F)
SEBASTIAN COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: BNG DATE: 12/07/23 FILENAME: H22 Rp2 SB Layout 2.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07684 DRAWING NO.

PRINT DATE: 4/11/2024

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
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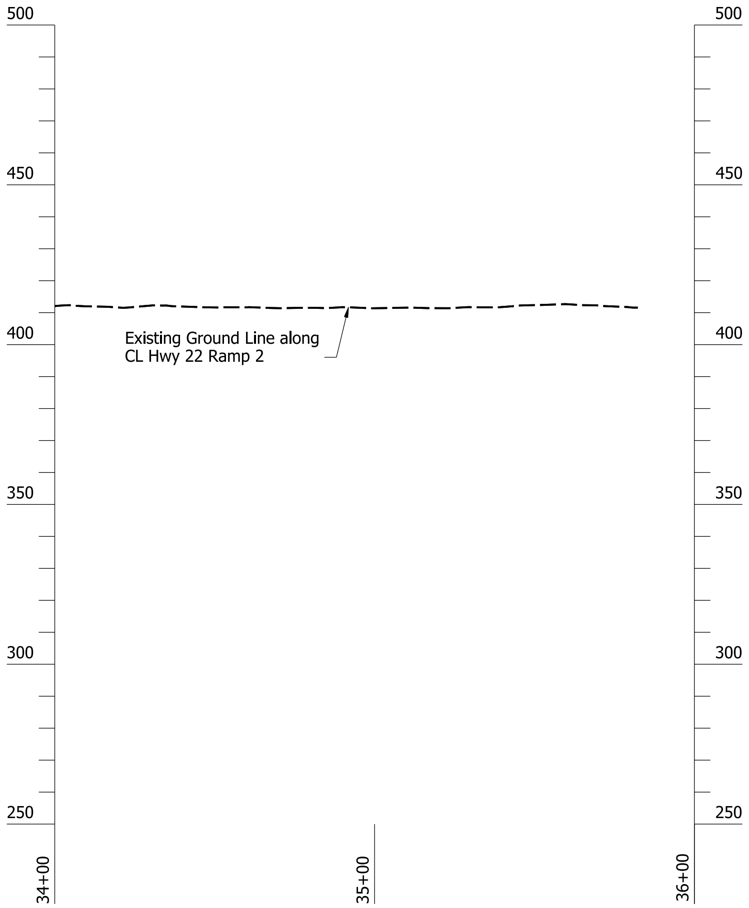
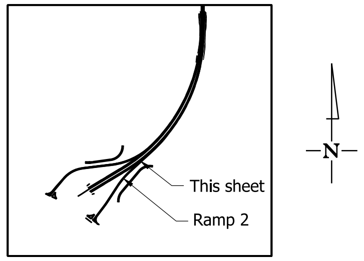
		01 - GEO PLAN LAYOUTS -				



ELEVATION OF SOIL BORINGS



SITE PLAN
No Scale

SHEET 3 OF 3
LAYOUT OF SOIL BORINGS

I-49
HWY. 22 - BRIDGE 07684 (F)
SEBASTIAN COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

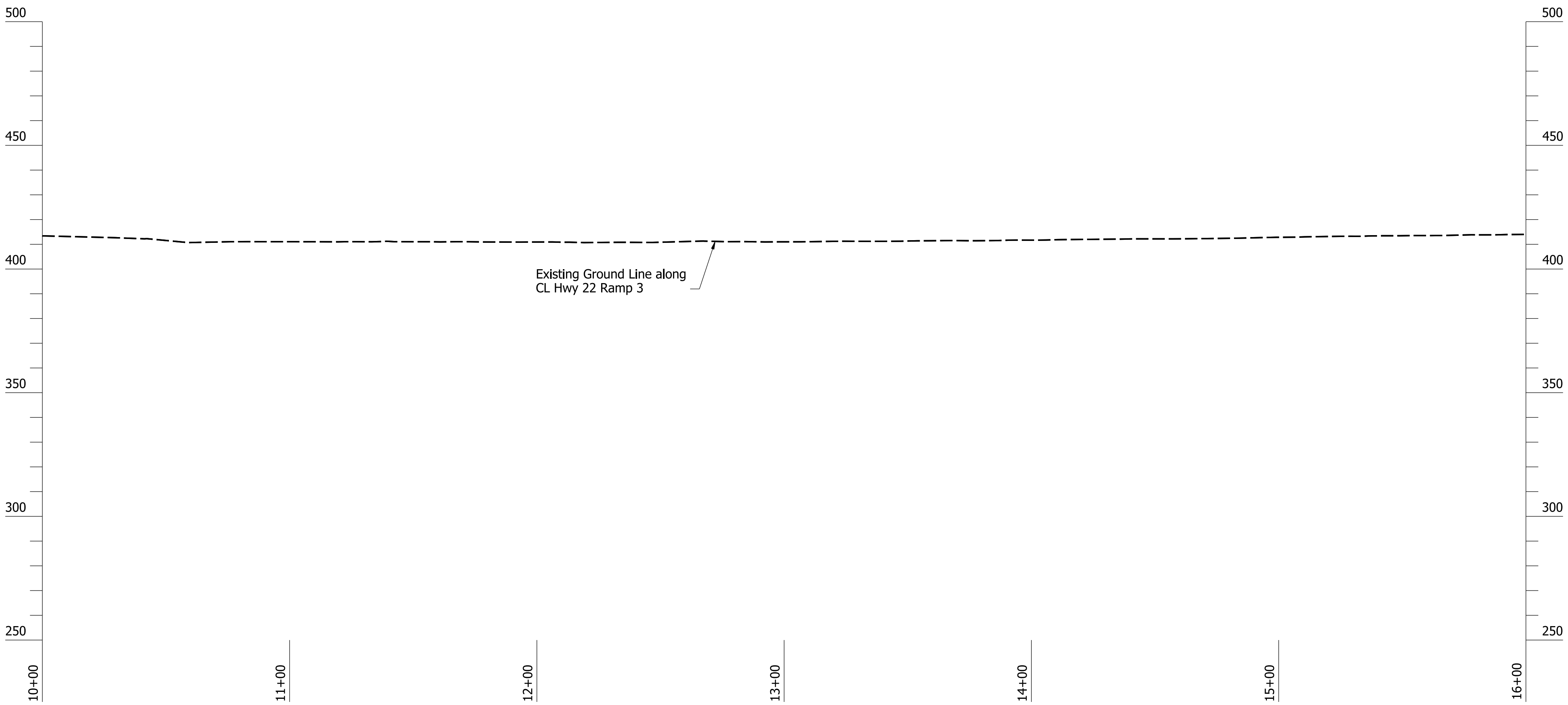
PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

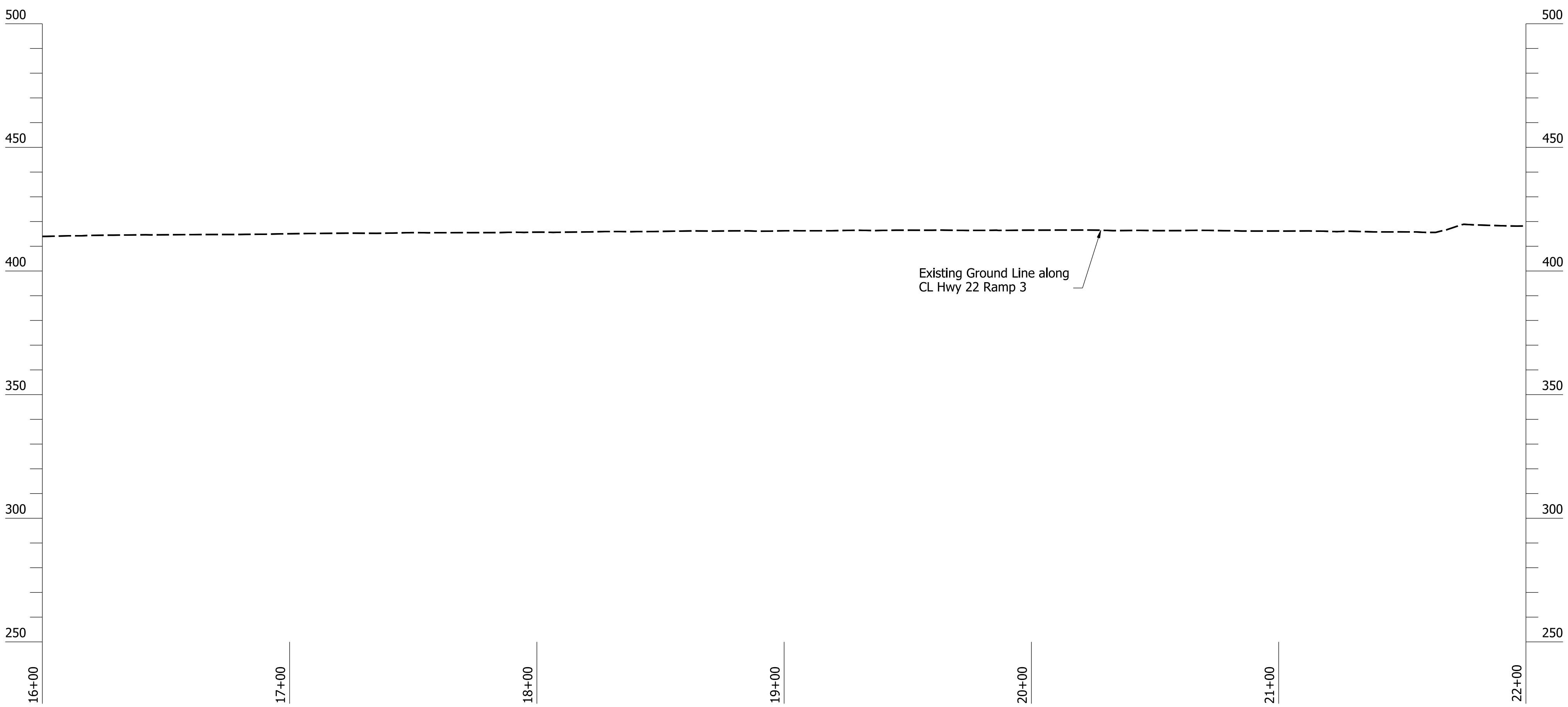
DRAWN BY: BNG DATE: 12/07/23 FILENAME: H22 Rp2 SB Layout 3.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07684 DRAWING NO.

PRINT DATE: 12/27/2023

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	040901	$PAGE#$	248
		01 - GEO PLAN LAYOUTS -				



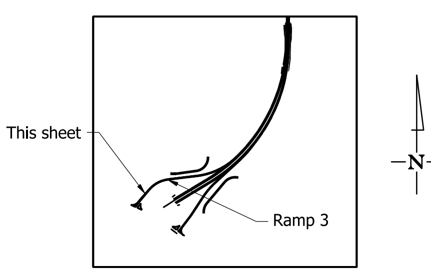
ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.



SITE PLAN
No Scale

SHEET 1 OF 3
LAYOUT OF SOIL BORINGS
I-49
HWY. 22 - BRIDGE 07684 (F)
SEBASTIAN COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

PRELIMINARY
NOT FOR CONSTRUCTION

BRIDGE ENGINEER

DRAWN BY: BNG DATE: 12/07/23 FILENAME: H22 Rp3 SB Layout 1.dgn
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07684 DRAWING NO.

PRINT DATE: 12/27/2023

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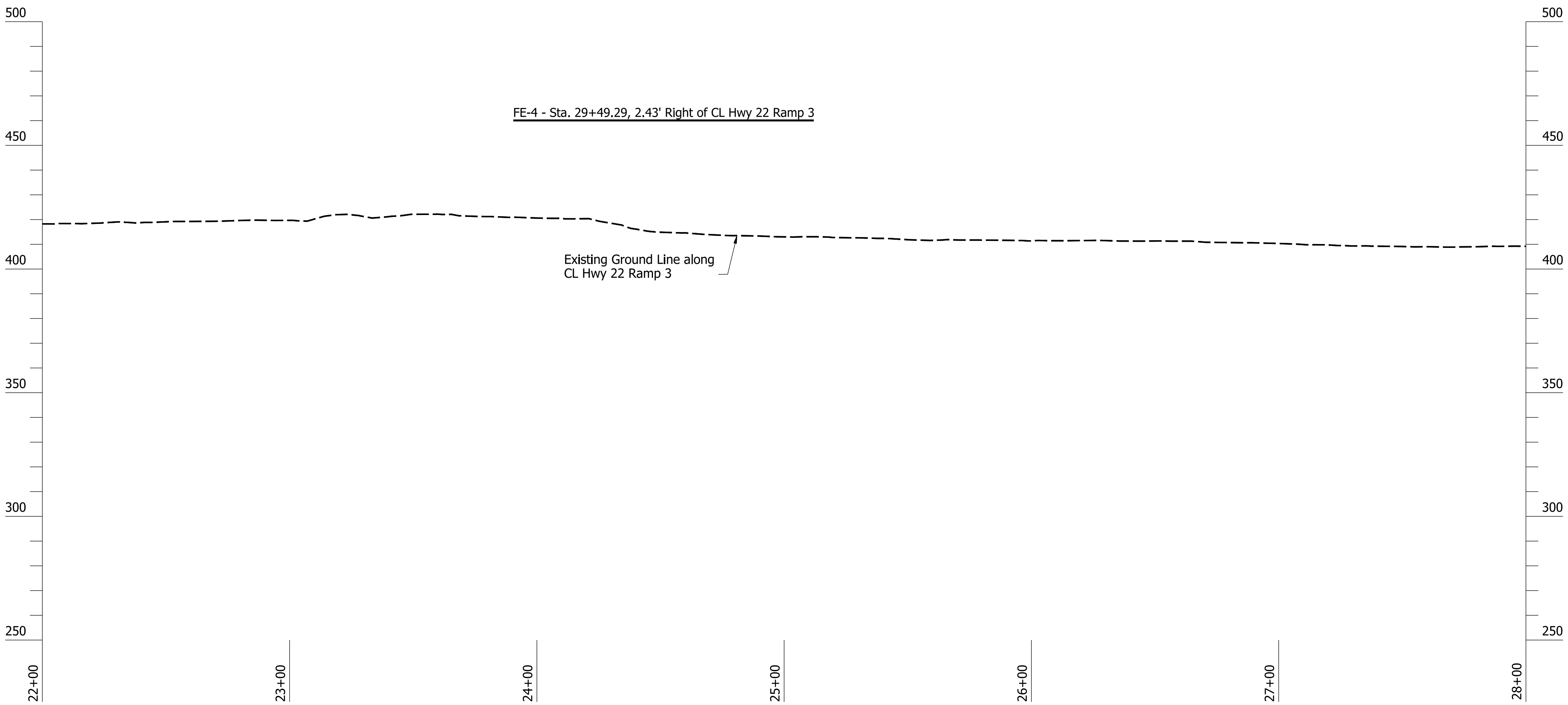
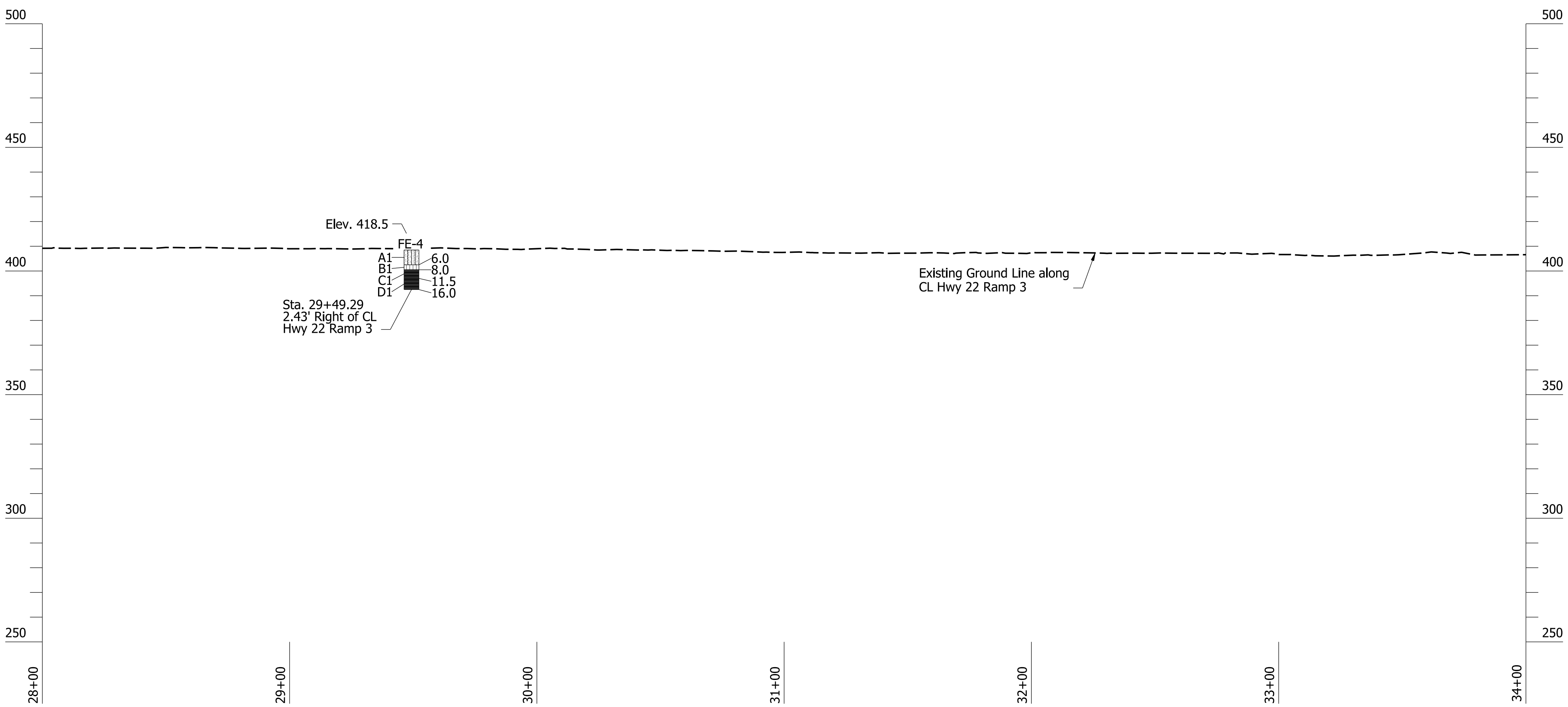
		6	ARK.	040901	$PAGE#$	248
		01 - GEO PLAN LAYOUTS -				



ELEVATION OF SOIL BORINGS



ELEVATION OF SOIL BORINGS

"N" VALUES

FE-4 - Sta. 29+49.29, 2.43' Right of CL Hwy 22 Ramp 3

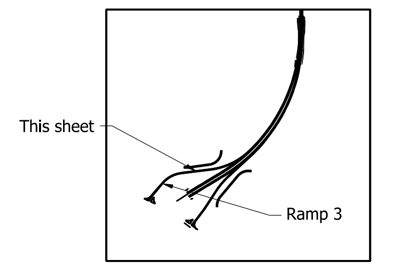
0.5-1.5	N=3
2.5-3.5	N=3
4.5-5.5	N=32

BORING LEGEND

A1 - ML-Loose Brown fine sandy silt
B1 - SANDSTONE-Low hardness to moderately hard tan and brown fine-grained sandstone, slightly weathered
C1 - SHALE-Moderately hard dark gray shale w/some gray fine-grained sandstone partings, horizontal bedding
D1 - SHALE-Moderately hard dark gray shale w/interbeded very close, thin to very thin sandstone partings, horizontal bedding

Note:
Soil descriptions have been condense for the purposes of this drawing.

See Final Geotechnical Report for additional information on individual borings.



SITE PLAN
No Scale

SHEET 2 OF 3
LAYOUT OF SOIL BORINGS
I-49
HWY. 22 - BRIDGE 07684 (F)
SEBASTIAN COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

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BRIDGE ENGINEER

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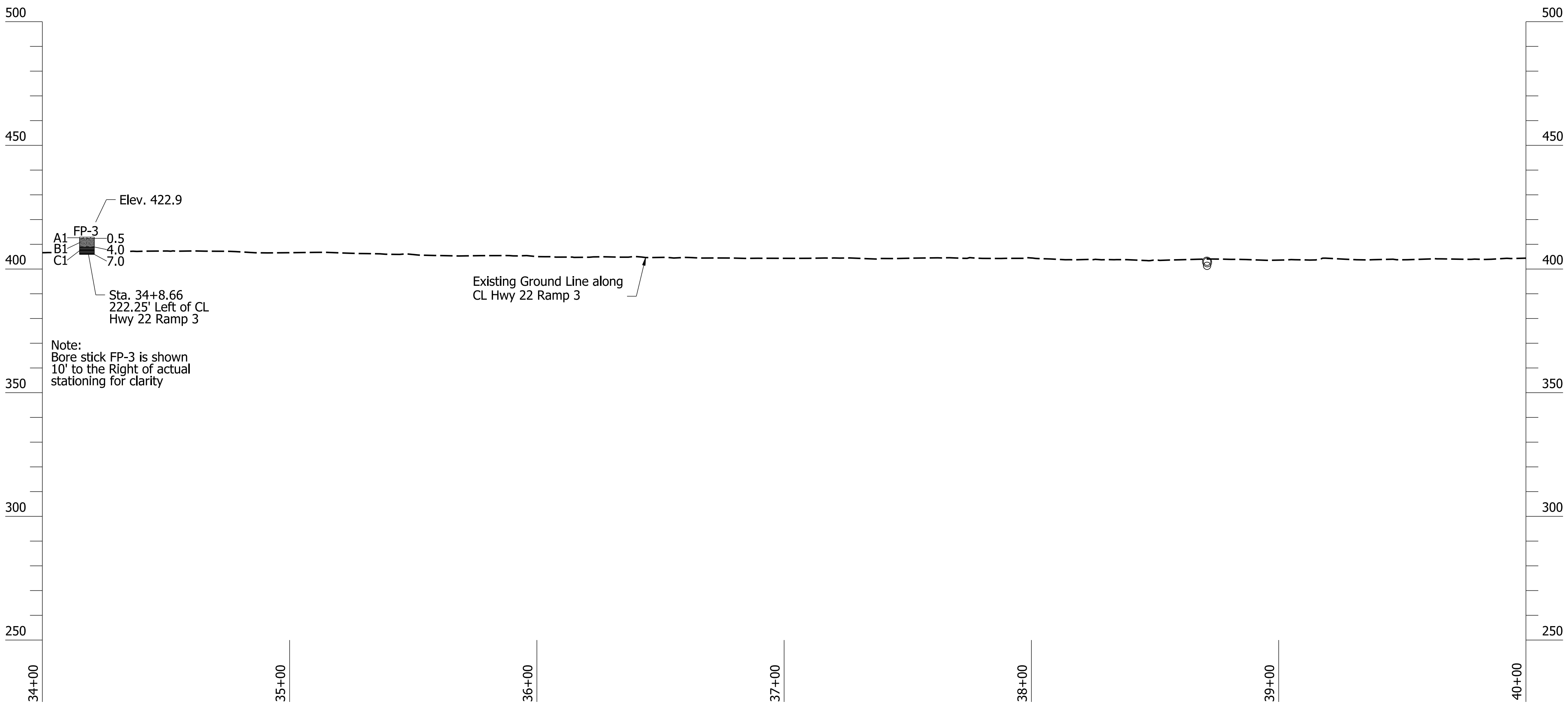
CHECKED BY: XXX DATE: XX/XX/23 SCALE: 1" = 30'-0"
DESIGNED BY: XXX DATE: XX/XX/23
BRIDGE NO. 07684 DRAWING NO.

PRINT DATE: 1/2/2024

DATE REVISED	DATE REVISED	FED. RD. DIST. NO.	STATE	JOB NO.	SHEET NO.	TOTAL SHEETS
		6	ARK.	040901	$PAGE#$	248
		01 - GEO PLAN LAYOUTS -				



ELEVATION OF SOIL BORINGS

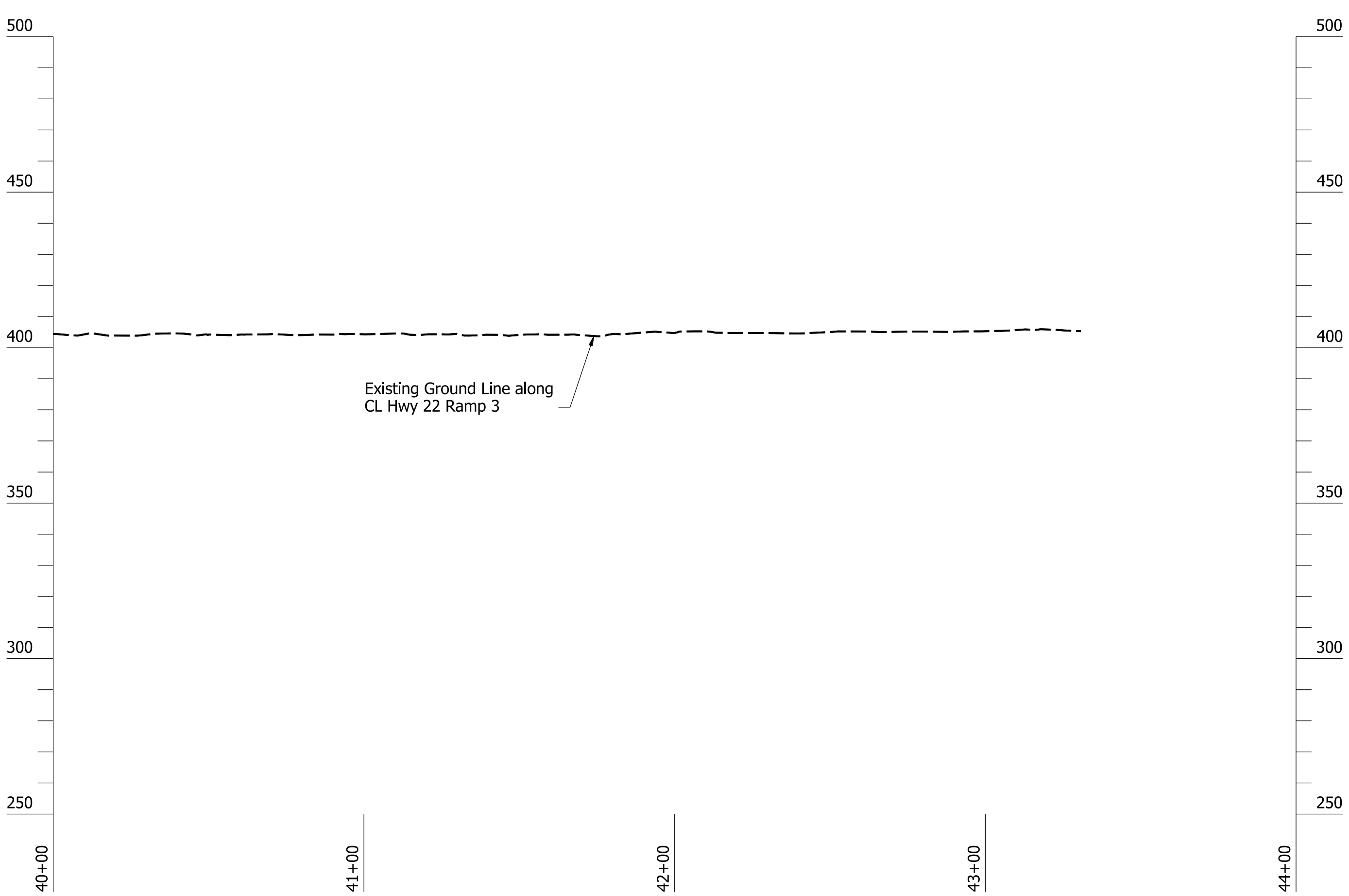
"N" VALUES

FP-3 - Sta. 34+8.66, 222.25' Left of CL Hwy 22 Ramp 3

0.5-1.5	N=20
2.5-3.5	N=34
4.5-5.5	N=25/0"
6.5-7.5	N=25/0"

BORING LEGEND

A1 - ML-Loose brown silt w/organics
B1 - SC-Medium dense reddish brown, gray and yellowish tan clayey fine sand
C1 - SHALE-Low hardness to moderately hard tan and brown weathered shale



ELEVATION OF SOIL BORINGS

Note:
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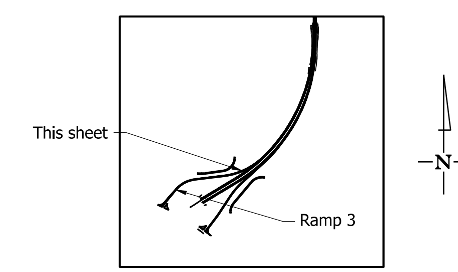

SITE PLAN
No Scale

SHEET 3 OF 3
LAYOUT OF SOIL BORINGS
I-49
HWY. 22 - BRIDGE 07684 (F)
SEBASTIAN COUNTY

ROUTE I-49 SEC. XX
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

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