ARKANSAS DEPARTMENT OF TRANSPORTATION

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SUBSURFACE INVESTIGATION

STATE JOB NO. 040866

FEDERAL AID PROJECT NO. NHPP-0072(67)

BARON FORK & FLY CREEK STRS. & APPRS. (S)

STATE HIGHWAY 45 **SECTION** 3

IN WASHINGTON **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.

September 5, 2023

TO: Mr. Rick Ellis, Bridge Engineer

SUBJECT: Job No. 040866
Baron Fork & Fly Creek Strs. & Apprs. (S)
Washington County
Route 45, Section 3

INTRODUCTION

Submitted herein are results of the subsurface investigation and geotechnical recommendations developed for the proposed replacement bridges planned on Highway 45 over Baron Fork and Highway 45 over Fly Creek in Washington County.

The project consists of constructing two structures to replace the existing bridges spanning Baron Fork (Site 1) and Fly Creek (Site 2). The proposed structure at Site 1 will be 262 feet in length and consist of two 55 feet and two 75 feet Continuous W-Beam Unit. The proposed structure at Site 1 will have an out-to-out width of 32.5 feet. The proposed alignment will be located west of the existing bridge. The proposed structure at Site 2 will be 169 feet in length and consist of two 50 feet and one 68 feet Integral Continuous W-Beam Unit. The proposed structure at Site 2 will have an out-to-out width of 32.5 feet. The proposed alignment will be located north of the existing bridge.

Based on the geotechnical investigation request from Bridge Division, foundation loads are expected to be supported on spread footings or drilled shafts at the intermediate bents and 18-inch steel shell piles at the end bents. 3-Horizontal to 1-Vertical (3H:1V) side slopes and 2H:1V end slopes are planned at the proposed abutments for Site 1 and Site 2. Maximum embankment height varies from approximately 6 feet to 14 feet and 8 feet to 12 feet at Site 1 and Site 2, respectively. Dumped riprap will be utilized to protect abutment slopes for both structures.

FIELD INVESTIGATION

A subsurface investigation was requested on October 3, 2022 by Bridge Division to develop recommendations for bridge foundations and abutment slopes. Five (5) borings were requested at Site 1 and four (4) borings were requested at Site 2.

The approximate locations of the borings are presented in the Plan of Borings included in Attachment A. The borings were advanced with a track-mounted Acker Renegade rotary drill rig using a combination of hollow-stem auger, rotary wash and rock coring drilling methods. The boring logs, showing the subsurface conditions encountered in the borings, and the results of field and laboratory tests, are also included in Attachment A, immediately following the Plan of Borings. A legend is attached following the boring logs to describe the symbols, terms, and conventions used on logs. Standard Penetration Tests (SPT) were conducted in accordance with ASTM D1586 for field-testing and soil sampling. The correction factor for the hammer is indicated on the boring logs. Liners were not used inside the standard split-barrel samplers.

The number of blows required to drive the standard split-barrel sampler for each 6-inch increment of the total 18-inch drive were measured and recorded on the boring logs. SPT N-values are defined as the total number of blows required to advance the split barrel sampler the final 12 inches of the total 18-inch drive depth. The SPT N-values indicated on the logs are raw (uncorrected) blow counts measured in the field. Groundwater was also observed during the drilling process. Groundwater observations are noted on the logs.

Core samples of bedrock were retrieved by using NQ3-size triple-tube core barrels (rock core diameter of 1-3/4 in. and hole diameter of 3 in.) For each core run, Rock Quality Designation (RQD) was determined in the field by a logger and further evaluated by a licensed Professional Geologist (PG). RQD, expressed in percent, is defined as the sum of the intact core pieces that are longer than 4 inches divided by the total length of the core run. The RQD of each core run is indicated on the corresponding log. Core pictures for Sites 1 and 2 are also included in Attachment A.

LAB INVESTIGATION

All samples were brought to the Materials Division laboratory for further evaluation and testing. These samples were tested to evaluate index properties and to verify soil type and classification. Lab tests were performed on representative soil samples to determine moisture content, Atterberg limits, and gradation. Tested soils were classified by a licensed Professional Geologist in accordance with both USCS and AASHTO soil classification systems.

Rock cores were first examined by a licensed PG to verify Total Core Recovery (TCR) and Rock Quality Designation (RQD) measured in the field and to obtain parameters for determination of Geological Strength Index (GSI) and Rock Mass Rating (RMR). Compressive strength of rock cores was then determined by laboratory uniaxial compressive test on intact rock cores in accordance with ASTM D7012, Method C. Results of uniaxial compressive tests and Rock Mass Rating (RMR) are included in Attachment B.

These test results are plotted or indicated on the logs using appropriate denotation (symbols in accordance with scale, number, text, etc.). Table 1 lists the laboratory tests; their corresponding ASTM and AASHTO test methods, and respective denotation on logs.

Table 1: Summary of Laboratory Tests and Methods

Laboratory Test	ASTM	AASHTO	Denotation on Logs
Moisture Content	D2216	T 265	Solid Circle Symbol (●)
Grain Size Distribution	D6913	T 88	Whole Number in the "- No. 200 %" Column (e.g., 12)
Atterberg Limits	D4318	T 89	Plus Symbol (+) on the Right for Liquid Limit
		T 90	Plus Symbol (+) on the Left for Plastic Limit
Uniaxial Compression of Rock Cores	D7012, Method C		

D_{50} FOR SCOUR ANALYSIS

The particle size through which 50% of particles by weight passing, D_{50}, is summarized below in Table 2. Detailed particle size distribution curves used for D_{50} determination are included in Attachment C.

Table 2: Summary of D_{50} for Scour Analysis

Hydraulic Feature Name	Station	Sample Type	Location	D_{50} (mm)
Baron Fork	112+72, 75' LT of CL	Bulk	Creek Bank	0.35
Fly Creek	215+72, 18' RT of CL	Bulk	Creek Bank	0.14

SITE CONDITIONS

The existing bridge (No. 03096) at Site 1 is 196 feet long, 28 feet wide and consists of 28 feet long reinforced concrete slab spans supported by concrete columns on spread footings. The existing bridge is located approximately 45 feet east of the proposed bridge. The existing bridge (No. 03097) at Site 2 is 112 feet long, 26.5 feet wide and consist of 28 feet long reinforced concrete slab spans supported by concrete columns on spread footings. The existing bridge is located approximately 44 feet south of proposed bridge. Overhead power lines parallel the west side and south side of the existing bridges at Baron Fork and Fly Creek, respectively. Site pictures for Baron Fork and Fly Creek are included in Attachment D. Two structures were investigated for this project; Bridge 1 crosses Baron Fork Creek, and Bridge 2 crosses Fly Creek. Baron Fork Creek flows east to west. Fly Creek flows north and meets Baron Fork Creek a short distance from the roadway. The concrete in both structures shows excessive damage and deterioration. The new structures at Baron Fork Creek and Fly Creek are planned to be constructed to the west and to the north of the existing structures, respectively.

SITE GEOLOGY AND GENERAL SUBSURFACE CONDITIONS

At Site 1, rocks of the Boone Formation were encountered at depths ranging from 4.4 to 17.8 feet below ground level (bgl), and at Site 2, depths range from 3.7 to 16.6 feet bgl. The overlying soil consists of sand with silt to sandy clay to sandy clay with gravel to chert fragments.

In general, the Boone Formation consists of gray, fine- to coarse-grained fossiliferous limestone interbedded with chert. Some sections may be predominantly limestone or chert. The cherts are dark in color in the lower part of the sequence and light in the upper part. The quality of chert varies considerably both vertically and horizontally. The thickness of the Boone Formation is 300 to 350 feet in most of northern Arkansas, but as much as 390 feet has been reported (This thickness includes the underlying St. Joe Limestone). The bedrock encountered is part of the basal beds of the upper part of the Boone Formation. The rock in this zone is dominated by chert and tripolitic chert. The Boone Formation is well known for dissolutional features, such as sinkholes, caves, and enlarged fissures. A cavity was encountered in one boring at Site 1 from 22.1 to 22.6 feet below ground level.

A generalized Subsurface Profile for each site is included in Attachment E to aid in visualizing subsurface conditions and stratigraphy. The Generalized Subsurface Profiles divide the subsurface geotechnical materials into three (3) generalized strata: I. Overburden Soils; II. Incompetent Rock (highly weathered rock); and III. Competent Rock (slightly weathered to unweathered rock). The estimated elevations of the competent rock, as revealed by the borings, are indicated on the subsurface profiles. These elevations are also summarized in Table 3 and Table 4. In light of natural variations in stratigraphy and subsurface conditions, deviation from those illustrated on the profiles must be anticipated.

Table 3. Estimated Elevation of Competent Rock – Baron Fork

Boring No.	Boring Locations	Ground Surf. Elev. @ Boring Location, ft.	Depth to Competent Rock, ft.	Estimated Elev. Of Competent Rock, ft.
1	Sta. 110+18, 33’ LT.	1021.7	4.5	1017.2
2	Sta. 110+68, 38’ LT.	1022.0	5.5	1016.5
3	Sta. 113+15, 37.5’ LT.	1022.0	18.0	1004.0

Table 4. Estimated Elevation of Competent Rock – Fly Creek

Boring No.	Boring Locations	Ground Surf. Elev. @ Boring Location, ft.	Depth to Competent Rock, ft.	Estimated Elev. Of Competent Rock, ft.
4	Sta. 215+47, 12’ RT.	1028.8	17.0	1011.8
5	Sta. 217+36, 10’ RT.	1031.0	11.5	1019.5

SEISMIC CONDITIONS

Seismic Site Class and Seismic Performance Zone – In light of the average subsurface conditions as revealed by the borings, a **Seismic Site Class C (Very Dense Soil Profile)** was calculated for the proposed bridge over Baron Fork and Fly Creek. Utilizing the Seismic Site Class B and the approximate GPS coordinates of the project sites, the following design peak ground acceleration coefficient (A_S), design short-period spectral acceleration coefficient (S_{DS}), as well as design long-period spectral acceleration coefficient (S_{D1}), were determined. These seismic coefficients are summarized in Table 5. For the design long-period spectral acceleration coefficient (S_{D1}) of 0.050g, a **Seismic Performance Zone 1** is considered applicable.

Table 5: Design Ground Motion Acceleration Response Coefficients

Acceleration Coefficient	Value (g)	
	Site 1 (Baron Fork)	Site 2 (Fly Creek)
A_S (Site PGA)	0.061	0.061
S_{DS} (0.2 sec)	0.144	0.145
S_{D1} (1 sec)	0.085	0.085

Design Response Spectrums are presented in Attachment F.

APPROACH EMBANKMENTS

Embankment Configuration – As noted, 2H:1V end slopes and 3H:1V side slopes are planned for the embankments at Site 1 and Site 2. Maximum embankment height varies from 6 feet to 14 feet at Site 1 and 8 feet to 12 feet at Site 2.

Settlement Potential – The underlying soils at Site 1 and Site 2 mainly comprise of Sandy Clay, Sandy Clay with Gravel and Sandy Silt. It is anticipated that most of the settlement that occurs will be elastic settlement and take place shortly after loading is applied. Long-Term consolidation settlement is expected to be minimal.

Approach Stability – Due to relatively short abutment slopes and shallow rock at Site 1 and Site 2 stability analyses have been performed on the critical embankments at each site to evaluate the design abutment configuration. Slope stability analyses were performed utilizing a commercial computer program Slide2 (Version 2021) developed by RocScience. Spencer analysis method was utilized to analyze the south abutment at Site 1 and the west abutment at Site 2. Three (3) general loading conditions were analyzed with respect to slope stability: Short Term / End of Construction Condition, Long Term Condition, and Seismic / Pseudo-Static Condition. A horizontal acceleration coefficient (K_h) of 0.0305 (0.061 A_S/g) was utilized for analysis of the Seismic / Psuedo-Static Condition. A surcharge of 250 psf is used to model the live load in the Long Term Condition.

Slope stability analyses were performed on the 2H:1V end slopes at the south abutment (Bent 5) at Site 1 and the west abutment (Bent 1) at Site 2, to evaluate suitability of the plan configuration. Table 6 includes the results of the slope stability analyses with the plan embankment layout. Slope stability analysis results are included in Attachment G.

Table 6: Results of Slope Stability Analyses Utilizing Plan Configuration

Design Condition	Factor of Safety		Recommended Minimum Factor of Safety
	Baron Fork	Fly Creek	
	South Embankment	West Embankment	
End of Construction (Short Term)	3.52	4.92	1.3
Long Term	1.66	1.45	1.4
Pseudo-Static (Seismic)	3.20	4.50	1.1

Based on results from the slope stability analysis, plan configuration of the embankments at Site 1 and Site 2 are suitable.

FOUNDATION RECOMMENDATIONS

Based on the most recent plans with Bridge Division, spread footings or drilled shafts will be utilized to support the foundation loads at the intermediate bents at Site 1 (Bents 2 – 4) and Site 2 (Bents 2 and 3). Steel HP12x53 are planned at the abutment bents at Site 1 (Bents 1 and 5) and Site 2 (Bents 1 and 4).

Design Considerations-Steel H-Piles – Steel H-Piles should be driven to practical refusal and should penetrate through embankment fill, overburden soils, and highly weathered rock to bear into the competent slightly weathered to unweathered Chert. Preboring is expected to be required at Site 1 and Site 2 in order to achieve minimum pile penetration requirements and to facilitate socketing the steel H-piles into the competent chert as planned by the Structural Engineer. It is recommended prebore extend at least 1 foot below the competent rock surface.

Practical refusal is defined as a maximum penetration of 1.0 inch from 20 blows by a pile hammer. For estimating pile length, a pile penetration of 0.5 foot into slightly weathered/un-weathered rock is assumed. This estimated penetration is based on the results of the borings and our experience with similar foundation rock. The results of the borings indicated moderate to severe driving conditions are to be expected. Consequently, rock points are recommended for all H-Piles driven to refusal.

A minimum pile penetration of 10 feet, measured below natural ground surface is recommended. Based on the results of the borings and the required minimum pile length, the recommended shallowest prebore elevation and estimated shallowest pile tip elevation is summarized below in Table 7 and Table 8, for Site 1 and Site 2, respectively. Additional pile penetration may be required by lateral resistance as determined by the Structural Engineer.

Table 7. Recommended Shallowest Prebore Elevation and Pile Tip Elevation – Baron Fork

Boring No.	Boring Location	Estimated Elev. Of Competent Rock, ft.	Recommended Shallowest Prebore Elev., ft.	Estimated Shallowest Pile Tip Elev., ft.	Comments
1	Sta. 110+18, 33' LT	1017.2	1011.7	1011.2	Preboring shall be extended 5' into competent rock to obtain a minimum pile penetration of 10 ft.
3	Sta. 113+15, 37.5' LT	1004.0	1003.0	1002.5	

Table 8. Recommended Shallowest Prebore Elevation and Pile Tip Elevation – Fly Creek

Boring No.	Boring Location	Estimated Elev. Of Competent Rock, ft.	Recommended Shallowest Prebore Elev., ft.	Estimated Shallowest Pile Tip Elev., ft.	Comments
4	Sta. 215+47, 12' RT	1011.3	1010.3	1009.8	
5	Sta. 217+36, 10' RT	1019.5	1018.5	1018.0	

The elevations summarized in Table 7 and Table 8 are recommended shallowest prebore elevations utilizing boring results and our engineering judgement. Actual subsurface conditions can vary from those encountered in the borings. As-constructed prebore elevation and pile tip elevation can vary and must be field verified. **Greater pile length/penetration may be warranted by lateral resistance demand and/or by scour requirements.**

For steel piling driven to refusal in competent rock, long-term, post-construction settlement is expected to be negligible. Nominal bearing capacity should be determined in accordance with "Method A – FHWA Modified Gates Formula" section in the most recent ARDOT Standard Specification.

<u>Axial Pile Capacities</u> – Nominal axial resistance of H piles driven to refusal in competent rock is governed by the structural capacity of the piles. Therefore, the nominal resistance should be determined by the Structural Engineer utilizing applicable AASHTO LRFD design procedures. It is recommended that nominal (ultimate) resistance of steel piles be determined based on the yield strength of steel piles (f_y) and the net cross-sectional area of the steel section (A_s). Selection of

structural resistance factor for calculating factored structural bearing resistance of h-piles should be based on the expectation of moderate to severe driving conditions.

For steel H piles with f_y of 50 ksi, the following allowable structural compression pile capacities are recommended for preliminary design. These allowable capacities include a factor of safety (load factor divided by resistance factor) of 4.0. Use of the allowable capacities as factored structural compression pile capacities are considered conservatively reasonable.

Table 9: Recommended Allowable Structural Compression Pile Capacity - f_y = 50 ksi

Pile Section	Net Cross-Sectional Area of Steel Section (A_s), in^2	Allowable Structural Compression Pile Capacity (P_{na}), ton
HP12x53	15.5	97

Geotechnical Input Parameters for Lateral Load Analysis Using LPile – Lateral load analysis will be performed by the Structural Engineer using the commercial computer program LPile. Located in Attachment H are the recommended geotechnical input parameters for Site 1 and Site 2 for use in LPile lateral load analysis.

Pile Installation – Piles should be installed in accordance with Section 805 (2014 Edition). Prior to the installation of piles, hammer systems furnished by the Contractor should be evaluated and approved by the Engineer.

Due to gravel, rock fragments and highly weathered chert, it is recommended prebore be performed to the depths as shown in Table 7 and Table 8. In addition, it is recommended that conical pile tips are utilized due to hard driving conditions. Piling should be observed and recorded by the Engineer. Test piles are not required, but the contractor may pursue the use of test piles for information purposes.

Design Consideration-Spread Footings – Spread footings are planned for intermediate bents where competent rock is shallow in depth. Spread footings are expected to be embedded 2 feet into competent rock. Recommended shallowest plan footing bottom elevations are summarized in Table 10 and Table 11 for Site 1 and Site 2, respectively. Other foundation types can be evaluated upon request.

Table 10: Summary of Recommended Footing Bottom Elevation – Baron Fork

Structure	Bent No.	Estimated Footing Bottom Elevation
Baron Fork	2	1014.5
Baron Fork	3	1002.5
Baron Fork	4	1002.5

Table 11: Summary of Recommended Footing Bottom Elevation – Fly Creek

Structure	Bent No.	Plan Footing Bottom Elevation
Fly Creek	2	1012.5
Fly Creek	3	1015.5

Subsurface conditions were not determined at intermediate bent locations due to accessibility issues. Based on interpretation from a Professional Geologist and engineering judgment, rock is expected to be shallow at intermediate bent locations at Site 1 and Site 2. Estimated footing bottom elevations listed in Table 10 and Table 11 were interpolated utilizing the subsurface profiles presented in Attachment E. It is recommended that these elevations are field verified.

It is recommended a maximum nominal bearing capacity of 45 ksf be utilized for spread footings embedded at least 2 feet into competent moderately hard slightly weathered to unweathered chert. A resistance factor (φ_b) of 0.45 is considered suitable for evaluation of factored bearing resistance of spread footings on competent rock. Consequently, a maximum factored bearing capacity of 20 ksf is suitable for competent rock. Post-construction settlement of spread footings founded in rock is expected to be negligible.

Lateral resistance of spread footings can be evaluated utilizing a maximum nominal coefficient of friction ($\tan\delta$) of 0.70 for concrete footings on clean rock and a resistance factor for sliding (φ_τ) of 0.85. Additional lateral resistance may be provided by passive resistance of foundation rock that is in hard contact with the spread footings and below scour depth. Passive resistance from any overburden soils, highly weather rock, and the upper 2 feet of foundation rock should be neglected from passive resistance evaluation. Factored passive resistance can be provided upon request. It is understood the footings will be embedded 2 feet into foundation rock. Consequently, passive resistance should be neglected in design.

It is recommended the water flow be diverted from the plan footing excavation areas before starting footing excavation. Any underground utilities in the plan footing excavation areas should be completely removed or relocated and properly backfilled to prevent seepage into excavation bottom. At a minimum, sump pumps should be utilized to remove any water seepage into the excavation bottom. Due to the foundation rock being very resistance, rock excavation techniques, other than ripping, will be expected to reach plan footing bottom elevation. Any footing over-excavation should be properly backfilled with Class S concrete.

If it is determined that drilled shafts are the preferred foundation for intermediate bents, Materials Division should be contacted for capacity and construction recommendations. If there are any questions concerning these recommendations, please contact the Materials Division.

Paul Tinsley

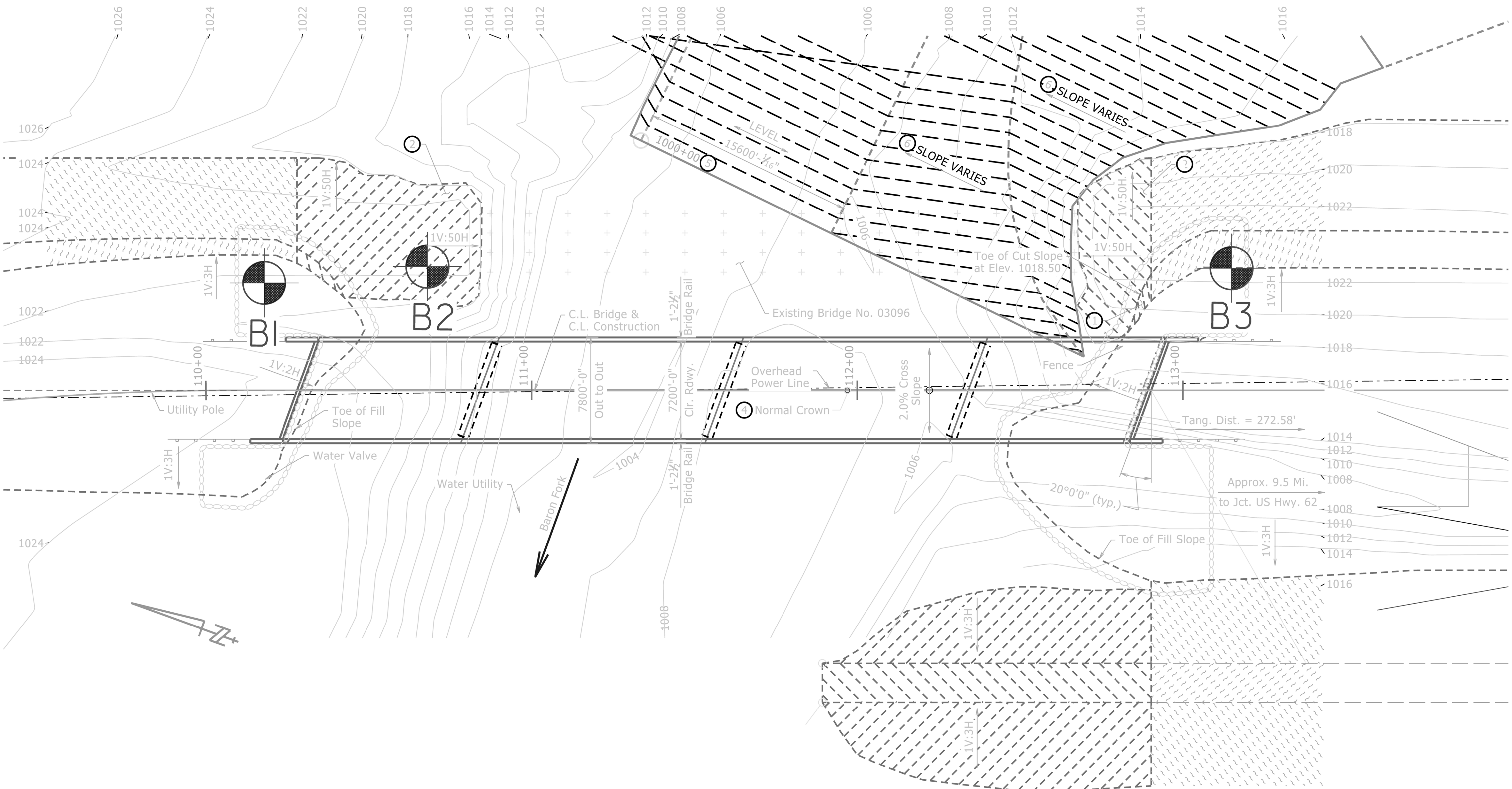
Paul Tinsley
Materials Engineer

PT:yz:pjt:cjs
cc: State Construction Engineer
District 4 Engineer
Roadway Design Engineer
G. C. File

Attachment A

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
6	AR			
JOB NO.	040866			

PLAN OF BORINGS - BARON FORK



PLAN OF BORINGS	
BARON FORK & FLY CREEK STRS. & APPRS. (S) ROUTE 45, SECTION 3 WASHINGTON COUNTY BARON FORK	
JOB NO. 040866	SITE 1/2
NOT TO SCALE	

ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION

BORING NO. 1
PAGE 1 OF 1

JOB NO. 040866 Washington County
JOB NAME: Baron Fork & Fly Creek Strs. & Apprs. (S)
Route 45, Section 3
STATION: 110+18
LOCATION: 33' Left of Construction Centerline
LOGGED BY: Jesse Burdine

DATE: May 24, 2023
TYPE OF DRILLING: Hollow Stem Auger - Diamond Core
EQUIPMENT: Acker 2
HAMMER CORRECTION FACTOR: 1.55

COMPLETION DEPTH: 24.1

SURFACE ELEVATION: 1021.7

DEPTH FT.	DESCRIPTION OF MATERIAL	SOIL GROUP	MOISTURE CONTENT (%)	PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	% TCR	% RQD
0–4.5	Moist, Very Stiff, Brown Sandy Clay with Gravel		● (approx. 12)	60	4 / 11-18		
4.5–9.1	CHERT - Slightly Weathered, Moderately Hard to Hard, Frequent Fractures, Gray				10 (1")	71	10
9.1–12.4	CHERT - Slightly Weathered, Moderately Hard to Hard, Occasional Fractures, Gray					96	52
12.4–19.1	CALCAREOUS CHERT WITH OCCASIONAL LIMESTONE SEAMS AND LAYERS - Unweathered, Moderately Hard to Hard, Gray					100	73
19.1–22.1	CALCAREOUS CHERT WITH OCCASIONAL LIMESTONE SEAMS AND LAYERS - Unweathered, Moderately Hard to Hard, Occasional Fractures, Gray					90	55
22.1–22.6	Cavity (22.1-22.6)						
22.6–24.1	CALCAREOUS CHERT WITH FREQUENT LIMESTONE LAYERS - Unweathered, Moderately Hard to Hard, Gray						

Boring Terminated

REMARKS: Baron Fork Creek

ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION

BORING NO. 2
PAGE 1 OF 1

JOB NO. 040866 Washington County
JOB NAME: Baron Fork & Fly Creek Strs. & Apprs. (S)
Route 45, Section 3
STATION: 110+68
LOCATION: 38' Left of Construction Centerline
LOGGED BY: Stanley Bates

DATE: May 23, 2023
TYPE OF DRILLING: Hollow Stem Auger - Diamond Core
EQUIPMENT: Acker 2
HAMMER CORRECTION FACTOR: 1.55

COMPLETION DEPTH: 24.2

DEPTH FT.	DESCRIPTION OF MATERIAL (SURFACE ELEVATION: 1022.0)	SOIL GROUP	MOISTURE CONTENT (%) PL ● LL (10 20 30 40 50 60 70)	PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	% TCR	% RQD
	Asphalt						
	Moist, Medium Stiff, Sandy Clay with Gravel				2 / 5-2		
5	Moist, Very Hard, Brown Sandy Clay with Gravel				10 (2")		
	CHERT						
	CHERT - Slightly Weathered, Moderately Hard, to Hard, Frequent Fractures, Gray*					72	38
10	CALCAREOUS CHERT - Slightly Weathered, Moderately Hard to Hard, Gray					90	14
15	CALCAREOUS CHERT WITH OCCASIONAL LIMESTONE SEAMS AND LAYERS - Unweathered, Moderately Hard to Hard, Gray					100	36
20	LIMESTONE - Unweathered, Moderately Hard, Gray					100	48
	CALCAREOUS CHERT - Unweathered, Moderately Hard to Hard, Gray						
25	LIMESTONE - Unweathered, Moderately Hard to Hard, Gray						
	Boring Terminated						
30							
35							

REMARKS: Baron Fork Creek
*Auger refusal at 5.3' bgl.

ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION

BORING NO. 3
PAGE 1 OF 1

JOB NO. 040866 Washington County
JOB NAME: Baron Fork & Fly Creek Strs. & Apprs. (S)
Route 45, Section 3
STATION: 113+15
LOCATION: 37.5' Left of Construction Centerline
LOGGED BY: Stanley Bates

DATE: May 17, 2023
TYPE OF DRILLING: Hollow Stem Auger - Diamond Core
EQUIPMENT: Acker 2
HAMMER CORRECTION FACTOR: 1.55

COMPLETION DEPTH: 29.2

SURFACE ELEVATION: 1022.0

MOISTURE CONTENT (%) ● PL ├──┤ LL (10 20 30 40 50 60 70)

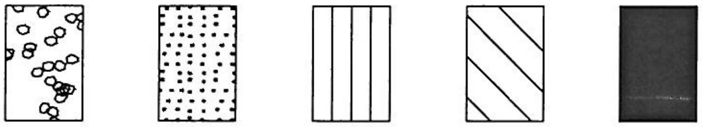
DEPTH FT.	DESCRIPTION OF MATERIAL	SOIL GROUP	PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	% TCR	% RQD
	Asphalt					
5	Moist, Medium Stiff, Brown Sandy Lean Clay with Some Gravel	- / CL / -	57	4 / 3-5		
	Moist, Dense, Brown Clayey Sand with Gravel	SC	38	2 / 6-27		
	Moist, Medium Dense, Brown Clayey Gravel with Sand	-	29	4 / 8-9		
10	Moist, Loose, Brown Silty Sand (Water encountered at 13.8' bgl)	SM / -	25	1 / 3-2		
15	Wet, Medium Dense, Brown Gravel with Silt and Sand	GW-GM	8	5 / 8-10		
	Wet, Very Dense, Brown Sand with Silt and Gravel			10 (2")		
20	CALCAREOUS CHERT WITH FREQUENT LIMESTONE LAYERS - Slightly Weathered, Moderately Hard to Hard, Frequent Fractures, Gray	-			91	48
25	CALCAREOUS CHERT WITH OCCASIONAL LIMESTONE LAYERS - Slightly Weathered, Moderately Hard to Hard, Frequent Fractures, Gray				78	34
30	CALCAREOUS CHERT WITH OCCASIONAL LIMESTONE LAYERS - Slightly Weathered, Moderately Hard to Hard, Gray				100	0
	Boring Terminated					
35						

REMARKS: Baron Fork Creek

LEGEND

SOIL TYPES

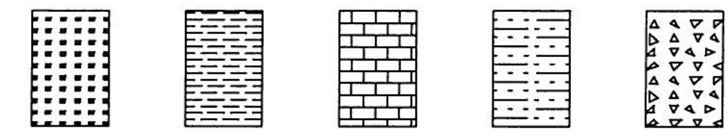
(SHOWN IN SYMBOL COLUMN)
(PREDOMINANT TYPE SHOWN HEAVY)



GRAVEL SAND SILT CLAY ORGANIC MATTER

ROCK TYPES

(SHOWN IN SYMBOL COLUMN)



SANDSTONE SHALE or SILTSTONE LIMESTONE or DOLOMITE ALTERNATING LAYERS of SHALE and SANDSTONE OTHER

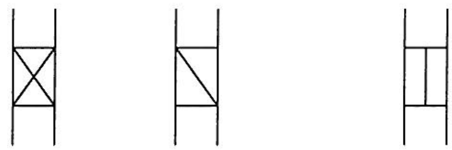
SAMPLER TYPES

(SHOWN IN SAMPLE COLUMN)

SHELBY TUBE

UNDISTURBED SAMPLE RECOVERY DISTURBED SAMPLE RECOVERY NO RECOVERY

SPLIT SPOON ROCK CORING



SAMPLE RECOVERY NO RECOVERY % RECOVERY INDICATED ON LOGS

TERMS DESCRIBING CONSISTENCY OR CONDITION

GRANULAR SOIL		CLAY		CLAY-SHALE		SHALE	
'N' Value	Density	'N' Value	Consistency	'N' Value	Consistency	'N' Value	Consistency
0-4	Very Loose	0-1	Very Soft	0-1	Very Soft		
5-10	Loose	2-4	Soft	2-4	Soft	31-60	Soft
11-30	Medium Dense	5-8	Medium Stiff	5-8	Medium Stiff	Over 60	
31-50	Dense	9-15	Stiff	9-15	Stiff	More than 2'	
Over 50	Very Dense	16-30	Very Stiff	16-30	Very Stiff	Penetration	
		31-60	Hard	31-60	Hard	in 60 Blows:	Medium Hard
		Over 60	Very Hard	Over 60	Very Hard	Less than 2'	
						Penetration	
						in 60 Blows:	Hard

1. Ground water elevations indicated on boring logs represent ground water elevations at date or time shown on boring log. Absence of water surface implies that no ground water data is available but does not necessarily mean that ground water will not be encountered at locations or within the vertical reaches of these borings.
2. Borings represent subsurface conditions at their respective locations for their respective depths. Variations in conditions between or adjacent to boring locations may be encountered.
3. Terms used for describing soils according to their texture or grain size distribution are in accordance with the Unified Soil Classification System.

Standard Penetration Test – Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6.0 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and performing the test are recorded for each 6 inches of penetration on the drill log. The field "N" Value (N_f) can be obtained by adding the bottom two numbers for example: $\frac{6}{8-9} \Rightarrow 8+9=17 blows/ft$. The "N" Value corrected to 60% efficiency (N_{60}) can be obtained by multiplying N_f by the hammer correction factor published on the boring log.

ROCK CORE PHOTO

Job No.: 040866
Job Name: Baron Fork & Fly Creek (S)

ROCK CORE PHOTO

Job No.: 040866
Job Name: Baron Fork & Fly Creek (S)

ROCK CORE PHOTO

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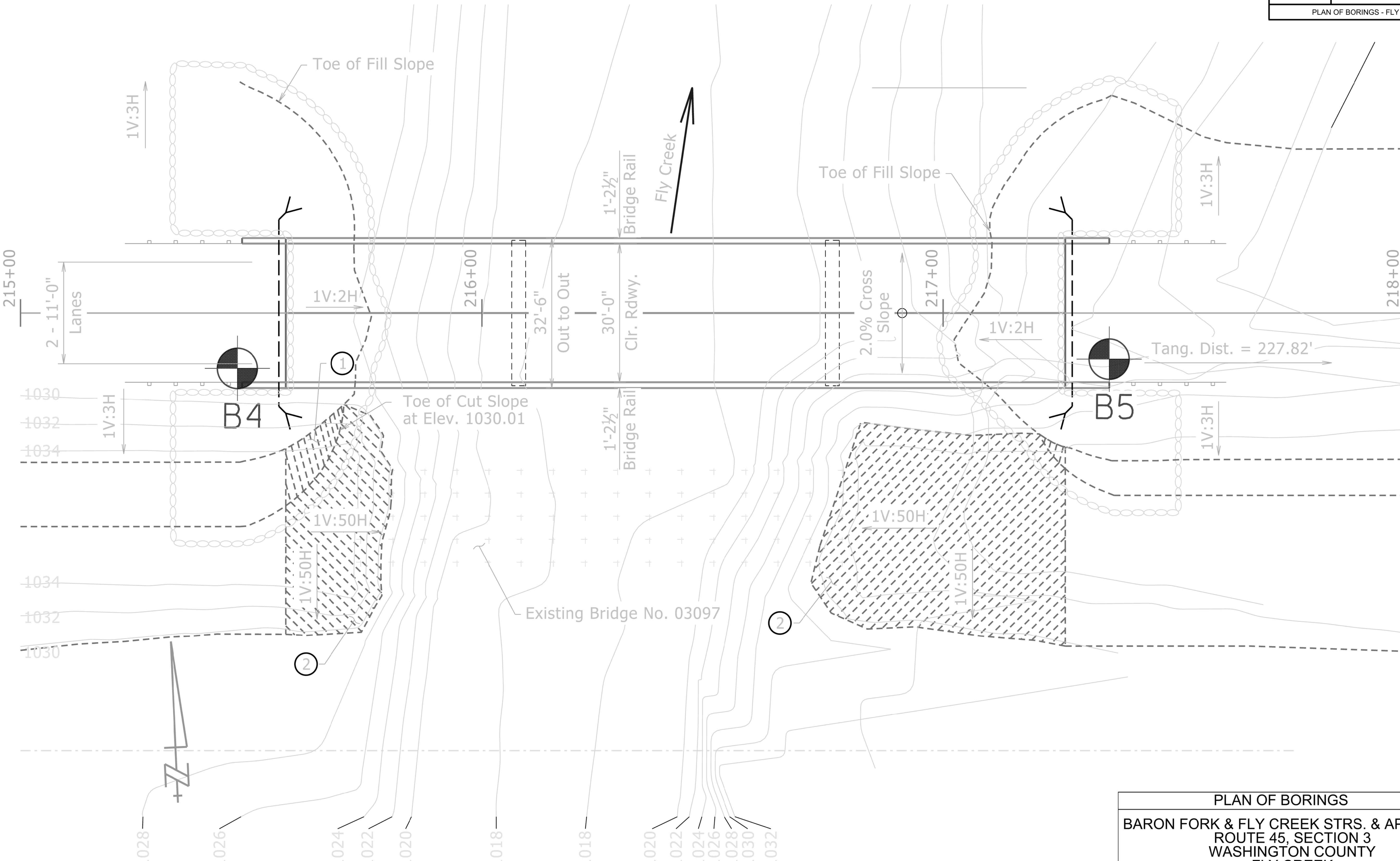
Job Name: Baron Fork & Fly Creek (S)

ROCK CORE PHOTO

Job No.: 040866
Job Name: Baron Fork & Fly Creek (S)

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
6	AR			
JOB NO.		040866		
PLAN OF BORINGS - FLY CREEK				



PLAN OF BORINGS	
BARON FORK & FLY CREEK STRS. & APPRS. (S) ROUTE 45, SECTION 3 WASHINGTON COUNTY FLY CREEK	
JOB NO. 040866	SITE 2/2
NOT TO SCALE	

ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION

BORING NO. 4
PAGE 1 OF 1

JOB NO. 040866 Washington County
JOB NAME: Baron Fork & Fly Creek Strs. & Apprs. (S)
Route 45, Section 3
STATION: 215+47
LOCATION: 12' Right of Construction Centerline
LOGGED BY: Stanley Bates

DATE: May 31, 2023
TYPE OF DRILLING: Hollow Stem Auger - Diamond Core
EQUIPMENT: Acker 2
HAMMER CORRECTION FACTOR: 1.55

COMPLETION DEPTH: 29.1

SURFACE ELEVATION: 1028.8

DEPTH FT.	DESCRIPTION OF MATERIAL	SOIL GROUP	MOISTURE CONTENT (%) ● / PL–LL	PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	% TCR	% RQD
0–5	Moist, Medium Stiff, Dark Brown Sandy Clay	-			2 / 2-3		
5–10	Moist, Loose, Dark Brown Clayey Sand with Gravel	SC		42	2 / 2-3		
		-			2 / 3-7		
10–15	Moist, Medium Dense, Brown Well Graded Gravel with Clay and Sand	GW-GC		6	7 / 7-11		
15–16.5	Wet, Very Dense, Light Gray Chert Fragments				60 (5")		
16.5–19.5	CHERT WITH OCCASIONAL LIMESTONE LAYERS - Slightly Weathered, Moderately Hard to Hard, Gray					60	0
19.5–24	CHERT INTERBEDDED WITH LIMESTONE - Slightly Weathered, Moderately Hard to Hard, Gray	-				96	55
24–29.1	CALCAREOUS CHERT WITH FREQUENT LIMESTONE LAYERS - Slightly Weathered, Moderately Hard to Hard, Gray					94	84
						90	90
29.1	Boring Terminated						

REMARKS: Fly Creek

ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SECTION

BORING NO. 5
PAGE 1 OF 1

JOB NO.	040866 Washington County	DATE:	June 6, 2023
JOB NAME:	Baron Fork & Fly Creek Strs. & Apprs. (S)	TYPE OF DRILLING:	
	Route 45, Section 3		Hollow Stem Auger - Diamond Core
STATION:	217+36	EQUIPMENT:	Acker 2
LOCATION:	10' Right of Construction Centerline		
LOGGED BY:	Jesse Burdine	HAMMER CORRECTION FACTOR:	1.55

COMPLETION DEPTH: 23.2

SURFACE ELEVATION: 1031.0

DEPTH FT.	DESCRIPTION OF MATERIAL	SOIL GROUP	MOISTURE CONTENT (%) PL–LL (10 20 30 40 50 60 70)	PERCENT PASSING NO. 200 SIEVE	NO. OF BLOWS PER 6-IN.	% TCR	% RQD
0–2.5	Moist, Brown Sandy Silt with Some Gravel						
2.5–4	Moist, Very Dense, Gray Chert Fragments with Some Sandy Silt*				7 / 36-60 (8")		
4–11.4	CHERT - Highly Weathered with Slightly Weathered Layers, Moderately Hard to Hard, Frequent Fractures, Gray					60	0
						58	18
11.4–14.5	LIMESTONE WITH FREQUENT CHERT LAYERS - Slightly Weathered with Weathered Layers, Moderately Hard, Gray						
14.5–18.2	CHERT WITH FREQUENT LIMESTONE LAYERS - Slightly Weathered, Moderately Hard to Hard, Frequent Fractures, Gray					92	50
18.2–23.2	CHERT WITH OCCASIONAL LIMESTONE LAYERS - Unweathered, Moderately Hard to Hard, Gray					92	60
	Boring Terminated						

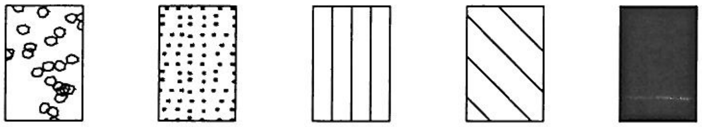
REMARKS: Fly Creek
*Auger refusal at 3.7' feet bgl

LEGEND

SOIL TYPES

(SHOWN IN SYMBOL COLUMN)

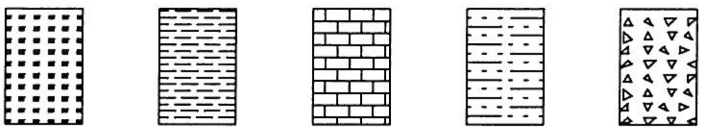
(PREDOMINANT TYPE SHOWN HEAVY)



GRAVEL SAND SILT CLAY ORGANIC MATTER

ROCK TYPES

(SHOWN IN SYMBOL COLUMN)



SANDSTONE SHALE or SILTSTONE LIMESTONE or DOLOMITE ALTERNATING LAYERS of SHALE and SANDSTONE OTHER

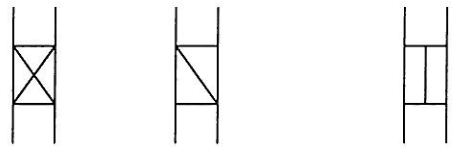
SAMPLER TYPES

(SHOWN IN SAMPLE COLUMN)

SHELBY TUBE

UNDISTURBED SAMPLE RECOVERY DISTURBED SAMPLE RECOVERY NO RECOVERY

SPLIT SPOON ROCK CORING



SAMPLE RECOVERY NO RECOVERY % RECOVERY INDICATED ON LOGS

TERMS DESCRIBING CONSISTENCY OR CONDITION

GRANULAR SOIL		CLAY		CLAY-SHALE		SHALE	
'N' Value	Density	'N' Value	Consistency	'N' Value	Consistency	'N' Value	Consistency
0-4	Very Loose	0-1	Very Soft	0-1	Very Soft		
5-10	Loose	2-4	Soft	2-4	Soft	31-60	Soft
11-30	Medium Dense	5-8	Medium Stiff	5-8	Medium Stiff	Over 60	
31-50	Dense	9-15	Stiff	9-15	Stiff	More than 2'	
Over 50	Very Dense	16-30	Very Stiff	16-30	Very Stiff	Penetration	
		31-60	Hard	31-60	Hard	in 60 Blows:	Medium Hard
		Over 60	Very Hard	Over 60	Very Hard	Less than 2'	
						Penetration	
						in 60 Blows:	Hard

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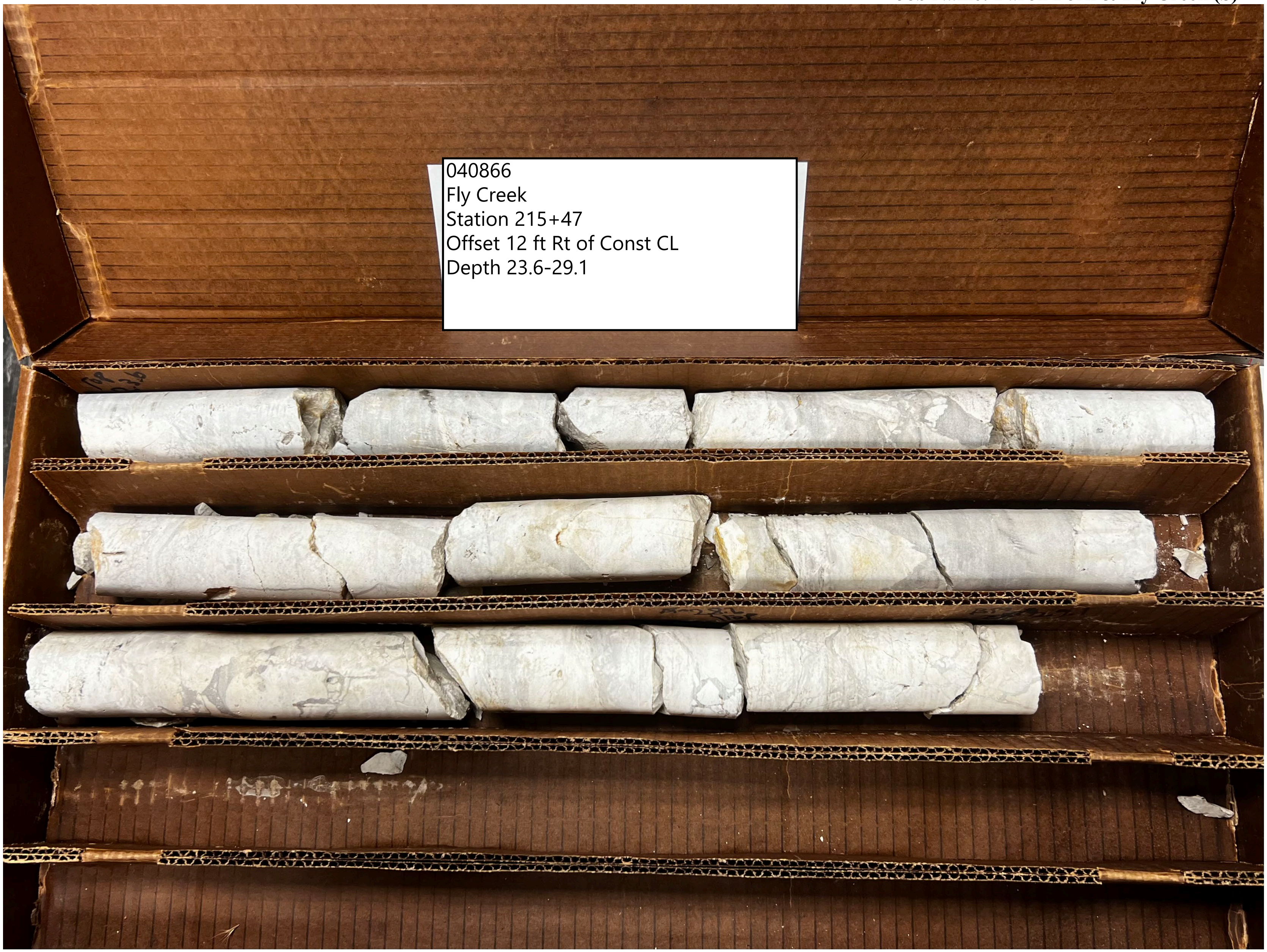
ROCK CORE PHOTO

Job No.: 040866
Job Name: Baron Fork & Fly Creek (S)

ROCK CORE PHOTO

Job No.: 040866
Job Name: Baron Fork & Fly Creek (S)



ROCK CORE PHOTO

Job No.: 040866
Job Name: Baron Fork & Fly Creek (S)

ROCK CORE PHOTO

Job No.: 040866
Job Name: Baron Fork & Fly Creek (S)

Attachment B

Rock Core Unconfined Compression Test Summary

Project Number: 040866 - Baron Fork
Project Name: Baron Fork & Fly Creek Strs. & Apprs (S)
Date Tested:

Station	Location	Sample No.	Depth (ft.)	Diameter (in)	Height (in)	Total Load (lbs.)	Correction Factor	Stress (psi)
110+18	33' LT	1	13.8	1.75	3.50	25,760		10,709
110+18	33' LT	2	16.8	1.75	3.50	30,450		12,659
110+18	33' LT	3	23.8	1.75	3.50	18,860		7,841
110+68	38' LT	4	8.2	1.75	3.50	12,960		5,388
110+68	38' LT	5	16.6	1.75	3.50	17,630		7,329
110+68	38' LT	6	23.4	1.75	3.50	25,130		10,447
113+15	37.5' LT	7	21.2	1.75	3.50	18,530		7,703

* Please note any broken samples, fractures or other characteristics of sample in Remarks.

GSI Rating = 70

ROCK MASS RATING SUMMARY

JOB # 040866 Baron Fork Creek

SAMPLE #1

Station/Location	110+18/33' Lt
Depth (ft)	13.8
	Relative Rating
Uniaxial Compressive Strength	7
RQD	13
Spacing of Joints	10
Condition of Joints	20
Groundwater Conditions	7
Sum	*57*
Class Number	**III**
Description	**FAIR ROCK**

SAMPLE #2

Station/Location	110+18/33' Lt
Depth (ft)	16.8
	Relative Rating
Uniaxial Compressive Strength	7
RQD	13
Spacing of Joints	20
Condition of Joints	20
Groundwater Conditions	7
Sum	*67*
Class Number	**II**
Description	**GOOD ROCK**

SAMPLE #3

Station/Location	110+18/33' Lt
Depth (ft)	23.8
	Relative Rating
Uniaxial Compressive Strength	7
RQD	13
Spacing of Joints	20
Condition of Joints	20
Groundwater Conditions	7
Sum	*67*
Class Number	**II**
Description	**GOOD ROCK**

SAMPLE #4

Station/Location	110+68/38' Lt
Depth (ft)	8.2
	Relative Rating
Uniaxial Compressive Strength	4
RQD	3
Spacing of Joints	10
Condition of Joints	20
Groundwater Conditions	7
Sum	*44*
Class Number	**III**
Description	**FAIR ROCK**

SAMPLE #5

Station/Location	110+68/38' Lt
Depth (ft)	16.6
	Relative Rating
Uniaxial Compressive Strength	4
RQD	8
Spacing of Joints	20
Condition of Joints	20
Groundwater Conditions	7
Sum	*59*
Class Number	**III**
Description	**FAIR ROCK**

SAMPLE #6

Station/Location	110+68/38' Lt
Depth (ft)	23.4
	Relative Rating
Uniaxial Compressive Strength	7
RQD	8
Spacing of Joints	20
Condition of Joints	20
Groundwater Conditions	7
Sum	*62*
Class Number	**II**
Description	**GOOD ROCK**

SAMPLE #7

Station/Location	113+15/37.5' Lt
Depth (ft)	21.2
	Relative Rating
Uniaxial Compressive Strength	7
RQD	8
Spacing of Joints	10
Condition of Joints	20
Groundwater Conditions	7
Sum	*52*
Class Number	**III**
Description	**FAIR ROCK**

SAMPLE

Station/Location	
Depth (ft)	
	Relative Rating
Uniaxial Compressive Strength	
RQD	
Spacing of Joints	
Condition of Joints	
Groundwater Conditions	
Sum	
Class Number	
Description	

Rock Core Unconfined Compression Test Summary

Project Number: 040866 - Fly Creek
Project Name: Baron Fork & Fly Creek Strs. & Apprs (S)
Date Tested:

Station	Location	Sample No.	Depth (ft.)	Diameter (in)	Height (in)	Total Load (lbs.)	Correction Factor	Stress (psi)
215+47	12' RT	1	19.8	1.75	3.50	15,240		6,336
215+47	12' RT	2	26.4	1.75	3.50	11,610		4,826
217+36.5	10' RT	3	11.5	1.75	3.50	15,180		6,311
217+36.5	10' RT	4	19.4	1.75	3.50	24,880		10,343

* Please note any broken samples, fractures or other characteristics of sample in Remarks.

GSI Rating = 70

ROCK MASS RATING SUMMARY

JOB # 040866 Fly Creek

SAMPLE #1

Station/Location	215+47/12' Rt
Depth (ft)	19.8
	Relative Rating
Uniaxial Compressive Strength	4
RQD	13
Spacing of Joints	10
Condition of Joints	20
Groundwater Conditions	7
Sum	*54*
Class Number	**III**
Description	**FAIR ROCK**

SAMPLE #2

Station/Location	215+47/12' Rt
Depth (ft)	26.4
	Relative Rating
Uniaxial Compressive Strength	4
RQD	17
Spacing of Joints	20
Condition of Joints	20
Groundwater Conditions	7
Sum	*68*
Class Number	**II**
Description	**GOOD ROCK**

SAMPLE #3

Station/Location	217+36.5/10' Rt
Depth (ft)	11.5
	Relative Rating
Uniaxial Compressive Strength	4
RQD	8
Spacing of Joints	10
Condition of Joints	20
Groundwater Conditions	7
Sum	*49*
Class Number	**III**
Description	**FAIR ROCK**

SAMPLE #4

Station/Location	217+36.5/10' Rt
Depth (ft)	19.4
	Relative Rating
Uniaxial Compressive Strength	7
RQD	13
Spacing of Joints	20
Condition of Joints	20
Groundwater Conditions	7
Sum	*67*
Class Number	**II**
Description	**GOOD ROCK**

SAMPLE

Station/Location	
Depth (ft)	
	Relative Rating
Uniaxial Compressive Strength	
RQD	
Spacing of Joints	
Condition of Joints	
Groundwater Conditions	
Sum	
Class Number	
Description	

SAMPLE

Station/Location	
Depth (ft)	
	Relative Rating
Uniaxial Compressive Strength	
RQD	
Spacing of Joints	
Condition of Joints	
Groundwater Conditions	
Sum	
Class Number	
Description	

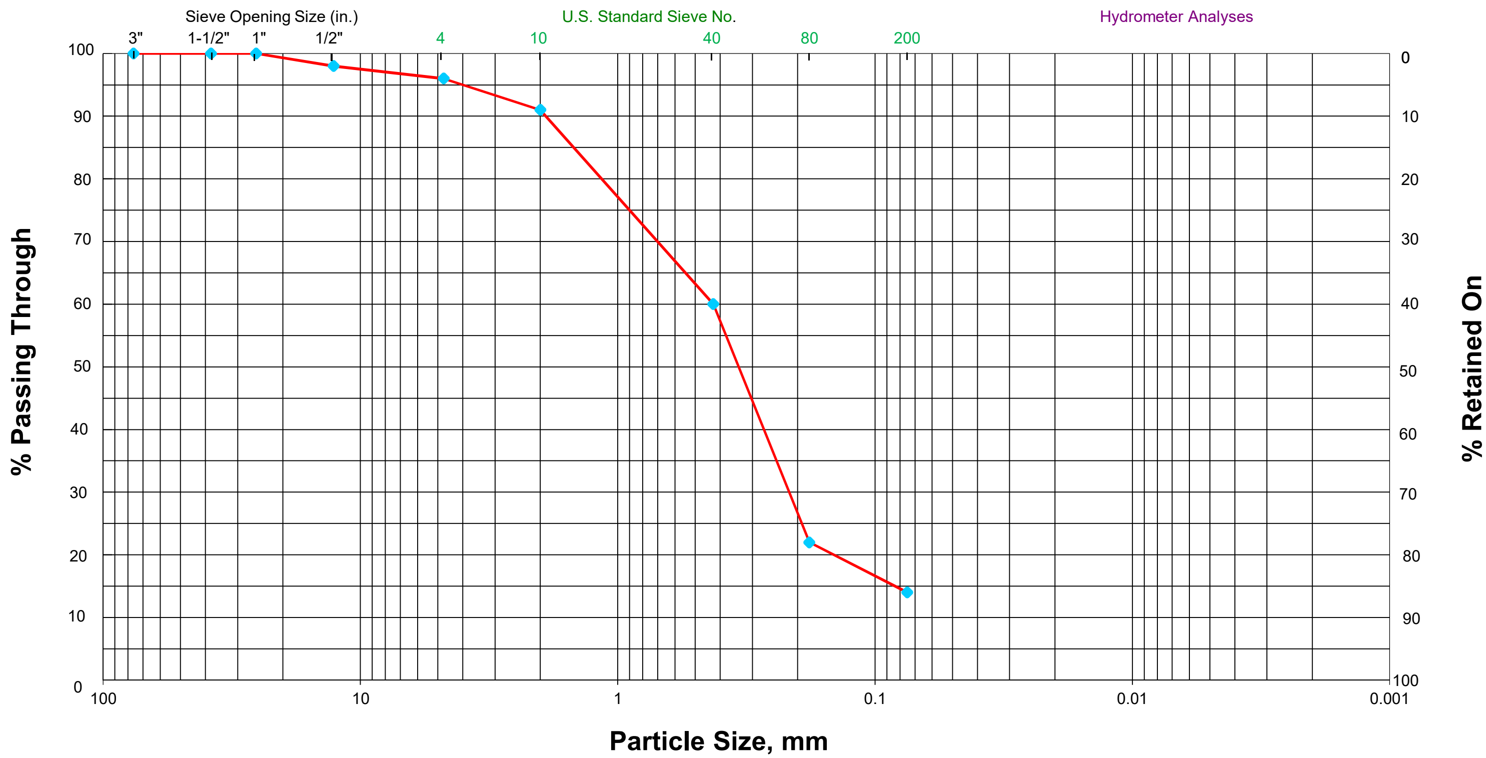
SAMPLE

Station/Location	
Depth (ft)	
	Relative Rating
Uniaxial Compressive Strength	
RQD	
Spacing of Joints	
Condition of Joints	
Groundwater Conditions	
Sum	
Class Number	
Description	

SAMPLE

Station/Location	
Depth (ft)	
	Relative Rating
Uniaxial Compressive Strength	
RQD	
Spacing of Joints	
Condition of Joints	
Groundwater Conditions	
Sum	
Class Number	
Description	

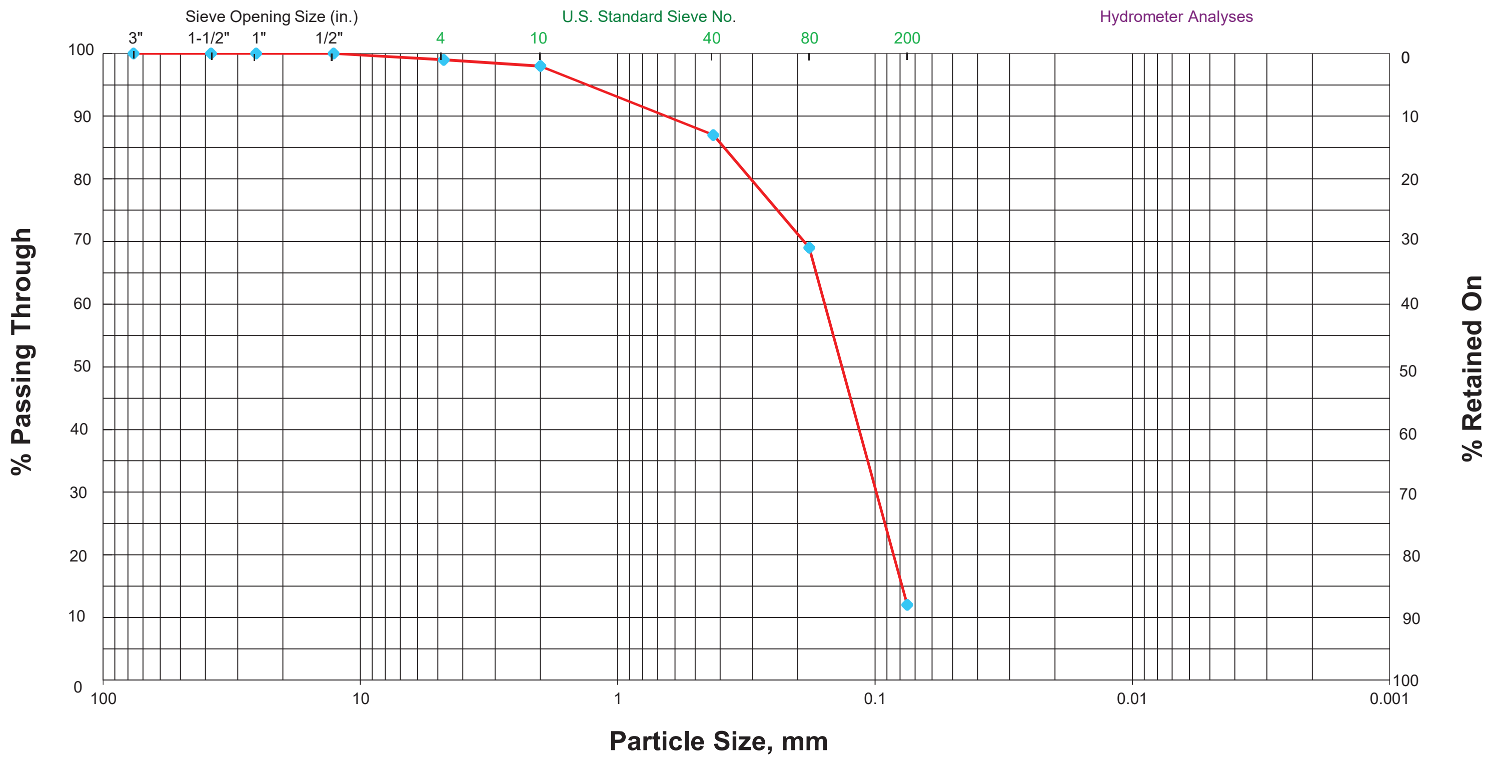
Attachment C



Particle Size Distribution Curve

Baron Fork - Station 112+72/75' LT of CL

ARDOT



Particle Size Distribution Curve

Fly Creek - Station 215+72/18' RT of CL

Attachment D

SITE PICTURES

Job No.: 040866
Job Name: Baron Fork & Fly Creek Strs. & Apprs. (S)
Washington County
Route 45, Section 3

Looking northwest from the south Baron Fork Creek Bridge end (June 2023)

SITE PICTURES

Job No.: 040866
Job Name: Baron Fork & Fly Creek Strs. & Apprs. (S)
Washington County
Route 45, Section 3

Looking northwest at the east side of the Baron Fork Creek bridge (June 2023)

SITE PICTURES

Job No.: 040866
Job Name: Baron Fork & Fly Creek Strs. & Apprs. (S)
Washington County
Route 45, Section 3

West side of Baron Fork Creek Bridge (June 2023)

SITE PICTURES

Job No.: 040866
Job Name: Baron Fork & Fly Creek Strs. & Apprs. (S)
Washington County
Route 45, Section 3

Looking west from the east Fly Creek Bridge end (June 2023)

SITE PICTURES

Job No.: 040866
Job Name: Baron Fork & Fly Creek Strs. & Apprs. (S)
Washington County
Route 45, Section 3

Looking northwest at the south side of the Fly Creek Bridge (June 2023)

SITE PICTURES

Job No.: 040866
Job Name: Baron Fork & Fly Creek Strs. & Apprs. (S)
Washington County
Route 45, Section 3

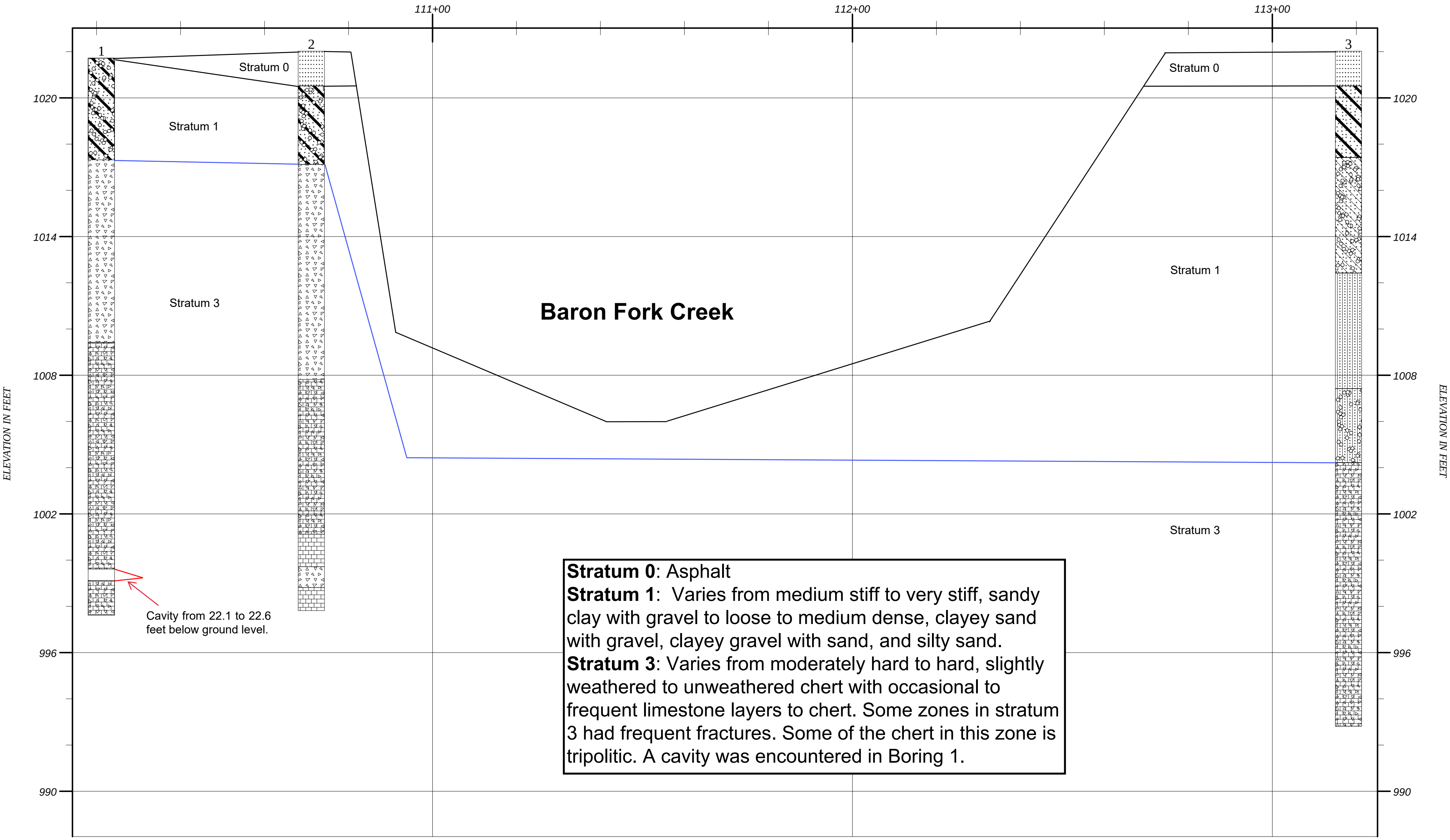
Looking west at north side of Fly Creek Bridge (June 2023)

SITE PICTURES

Job No.: 040866
Job Name: Baron Fork & Fly Creek Strs. & Apprs. (S)
Washington County
Route 45, Section 3

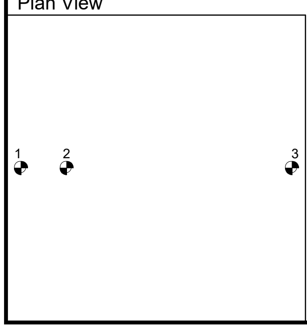
Looking north at the Fly Creek channel from under the bridge (June 2023)

Attachment E



Stratum 0: Asphalt
Stratum 1: Varies from medium stiff to very stiff, sandy clay with gravel to loose to medium dense, clayey sand with gravel, clayey gravel with sand, and silty sand.
Stratum 3: Varies from moderately hard to hard, slightly weathered to unweathered chert with occasional to frequent limestone layers to chert. Some zones in stratum 3 had frequent fractures. Some of the chert in this zone is tripolitic. A cavity was encountered in Boring 1.

Plan View



Strata symbols

- sandy clay with gravel
- chert
- limestone with chert layers/ chert with limestone layers
- cavity/No Recovery
- asphalt
- limestone
- sandy clay
- clayey sand and gravel
- silty sand
- silty sand with gravel

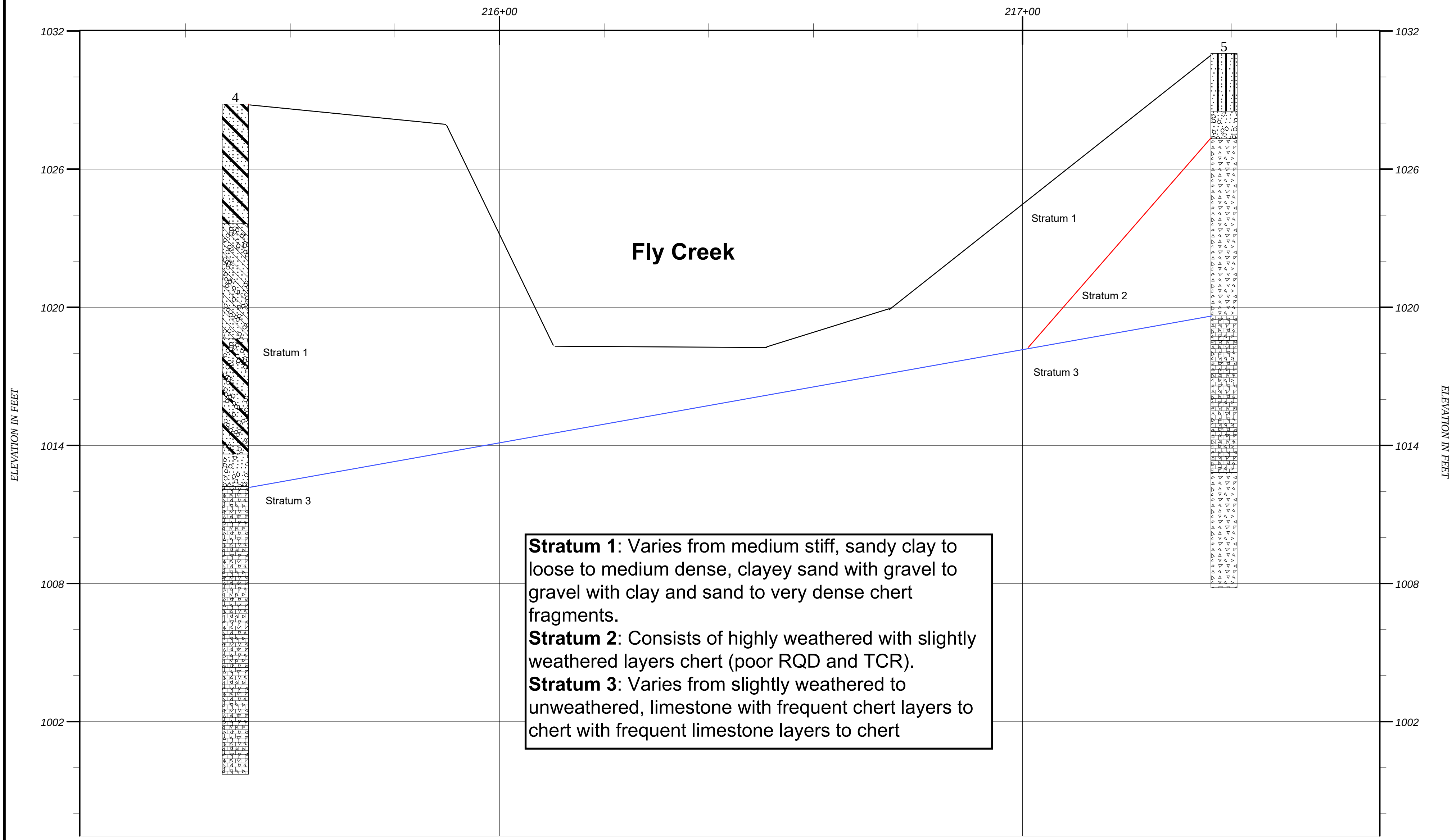
Arkansas Department of Transportation
Generalized Subsurface Profile

HORIZONTAL SCALE: Not to scale	DRAWN BY/APPROVED BY	DATE DRAWN
VERTICAL SCALE: Not to scale		7/18/2023

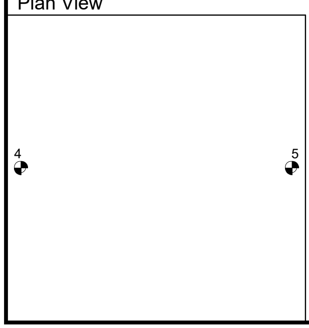
Baron Fork & Fly Creek Strs. & Apprs. (S)
Route 45, Section 3

PROJECT NO. 040866
Washington County

FIGURE NUMBER



Plan View



Strata symbols

- sandy clay
- clayey sand and gravel
- sandy clay with gravel
- sand and gravel
- limestone interbedded with chert/ chert interbedded with limestone
- sandy silt
- chert

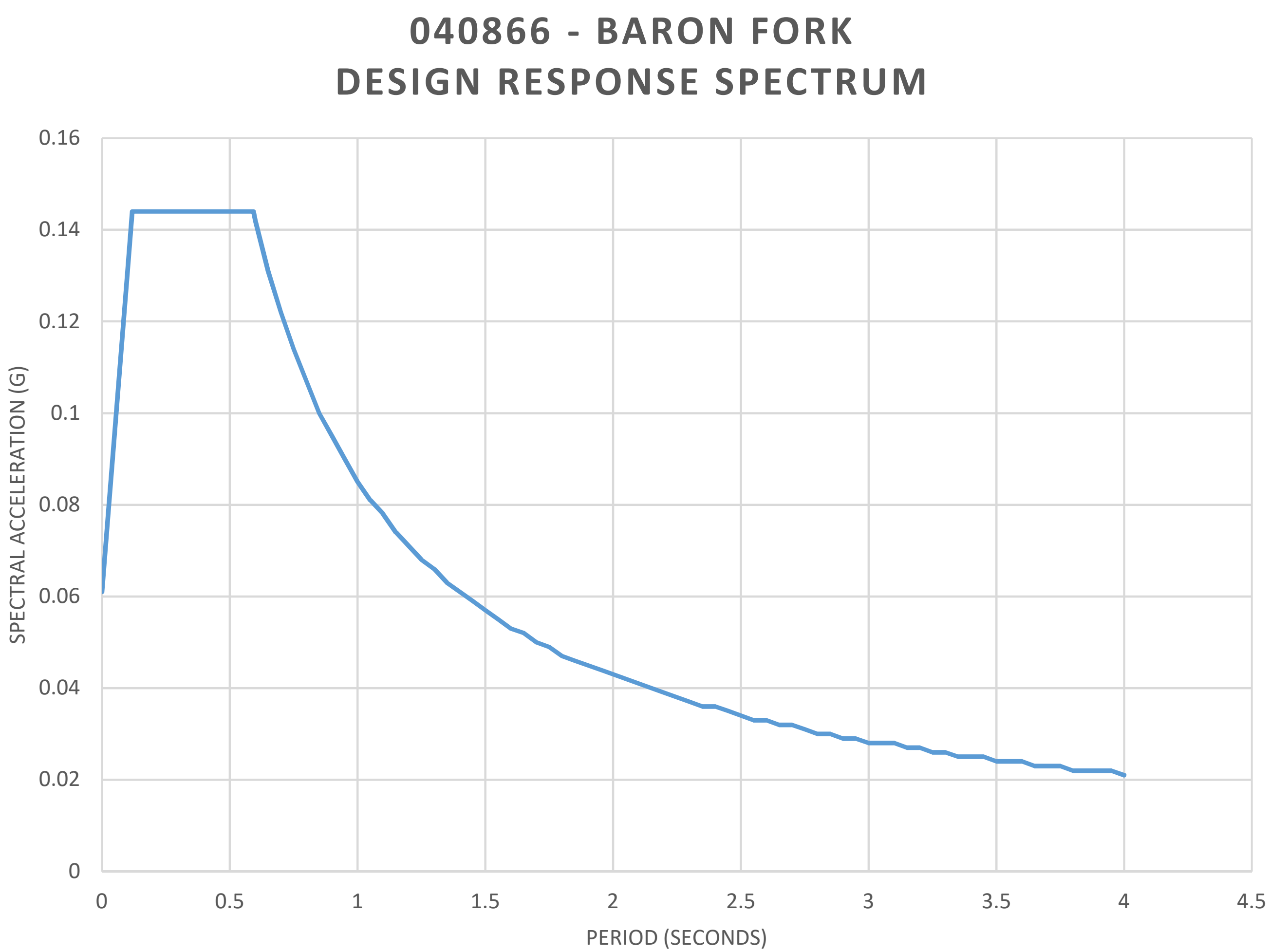
Arkansas Department of Transportation Generalized Subsurface Profile		
HORIZONTAL SCALE: Not to scale VERTICAL SCALE: Not to scale	DRAWN BY/APPROVED BY	DATE DRAWN 7/18/2023
Baron Fork & Fly Creek Strs. & Apprs. (S) Route 45, Section 3		
PROJECT NO. 040866 Washington County		FIGURE NUMBER

Attachment F

Title:	040866 - Baron Fork
Latitude:	35.876685
Longitude:	-94.468402
Site Class	C

Get USGS Data

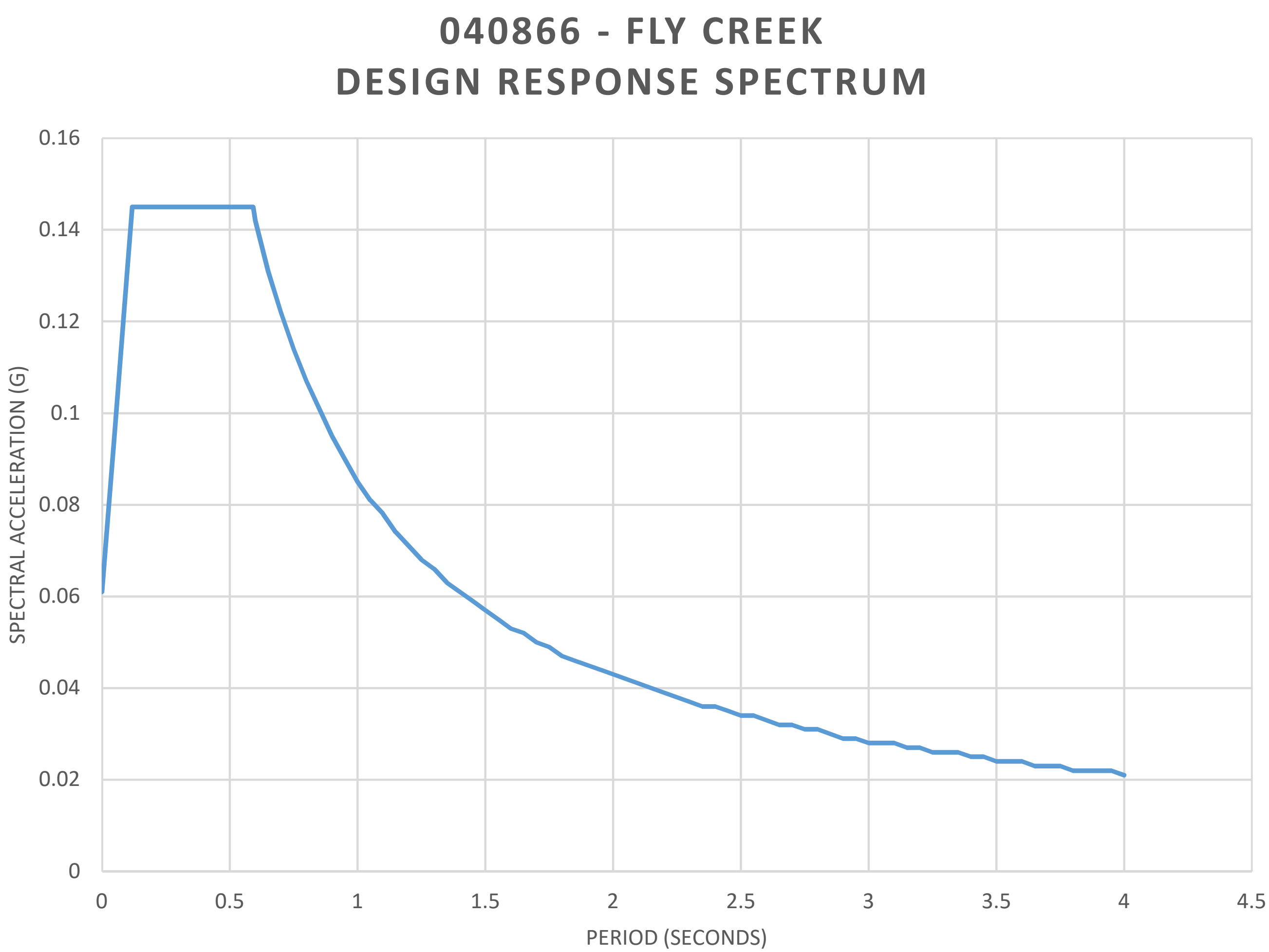
PGA:	0.051
F_{PGA}:	1.200
A_S:	0.061
S_S:	0.120
F_A:	1.200
S_{DS}:	0.144
S_1:	0.050
F_V:	1.700
S_{D1}:	0.085
S_{Dc}:	A
T_S:	0.592
T_0:	0.118



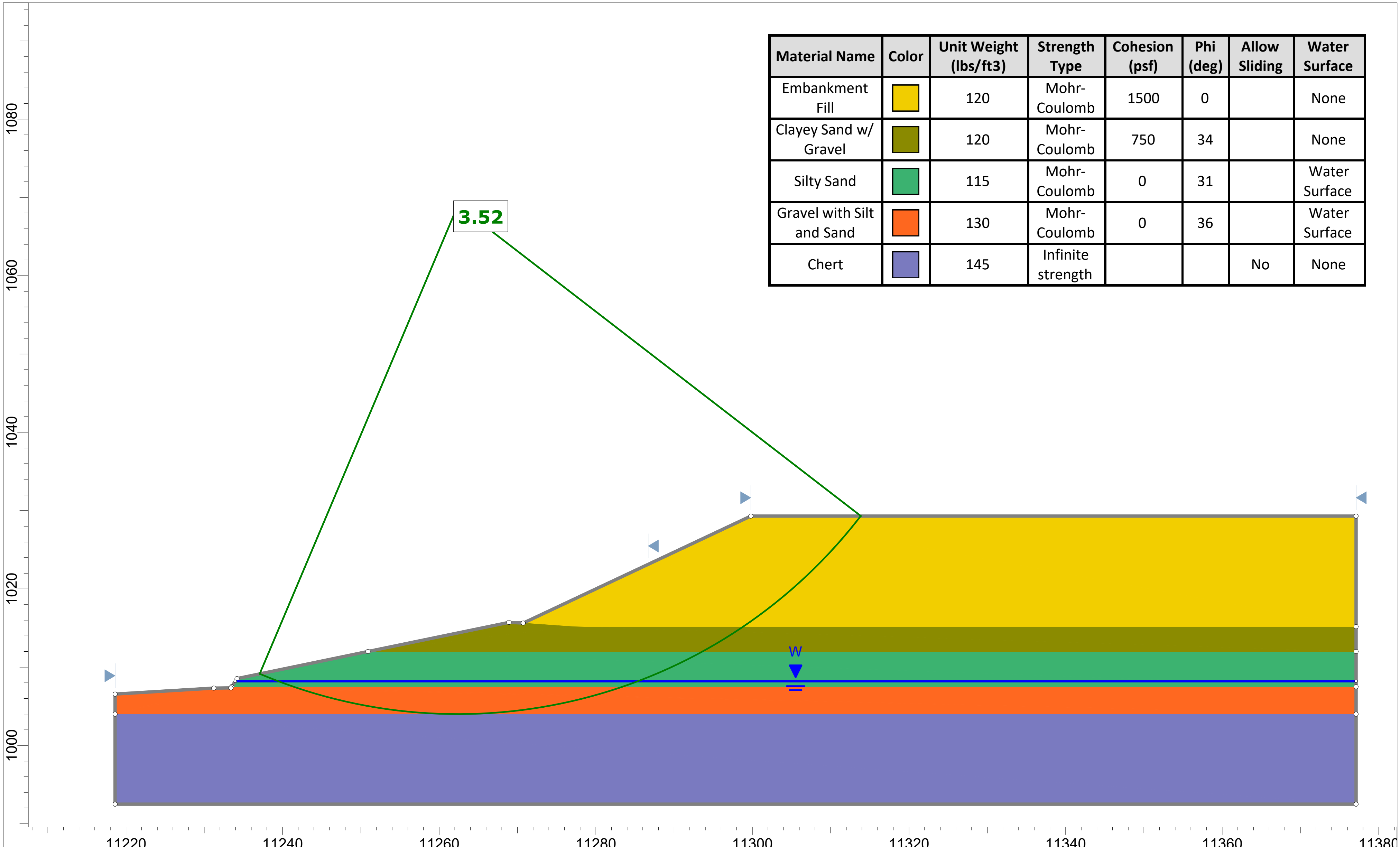
Title:	040866 - Fly Creek
Latitude:	35.872446
Longitude:	-94.456985
Site Class	C

Get USGS Data

PGA:	0.051
F_{PGA}:	1.200
A_S:	0.061
S_S:	0.120
F_A:	1.200
S_{DS}:	0.145
S_1:	0.050
F_V:	1.700
S_{D1}:	0.085
S_{Dc}:	A
T_S:	0.591
T_0:	0.118



Attachment G

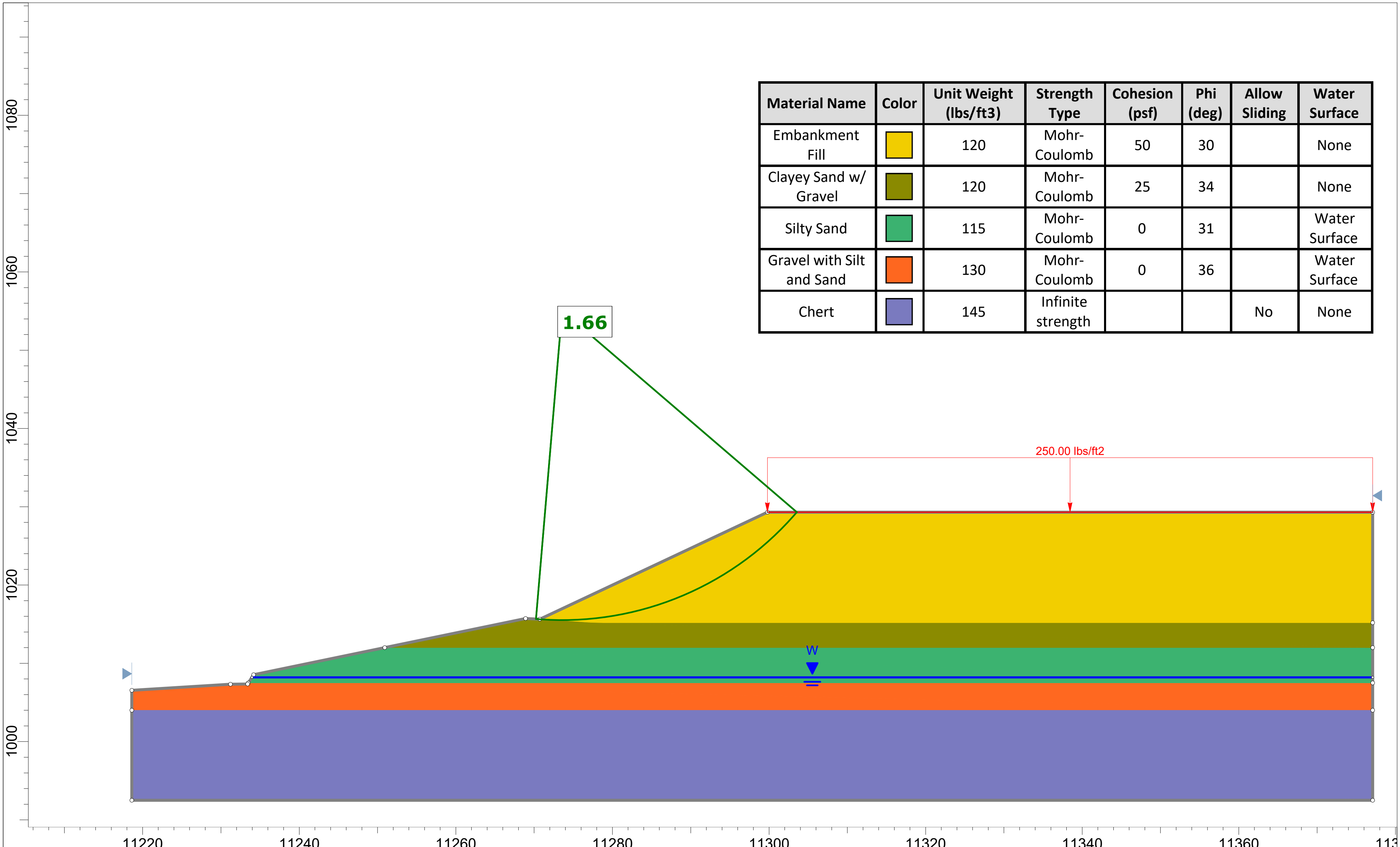


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Allow Sliding	Water Surface
Embankment Fill		120	Mohr-Coulomb	1500	0		None
Clayey Sand w/ Gravel		120	Mohr-Coulomb	750	34		None
Silty Sand		115	Mohr-Coulomb	0	31		Water Surface
Gravel with Silt and Sand		130	Mohr-Coulomb	0	36		Water Surface
Chert		145	Infinite strength			No	None

rocscience

SLIDEINTERPRET 9.020

Project	040866 - Baron Fork & Fly Creek Strs. & Apprs. (S)		
Site	Hwy. 45 over Baron Fork	Analysis Type	Short Term / End of Construction
Analyzed By	PT	Configuration	South Embankment
Date	8/14/2023		



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Allow Sliding	Water Surface
Embankment Fill		120	Mohr-Coulomb	50	30		None
Clayey Sand w/ Gravel		120	Mohr-Coulomb	25	34		None
Silty Sand		115	Mohr-Coulomb	0	31		Water Surface
Gravel with Silt and Sand		130	Mohr-Coulomb	0	36		Water Surface
Chert		145	Infinite strength			No	None

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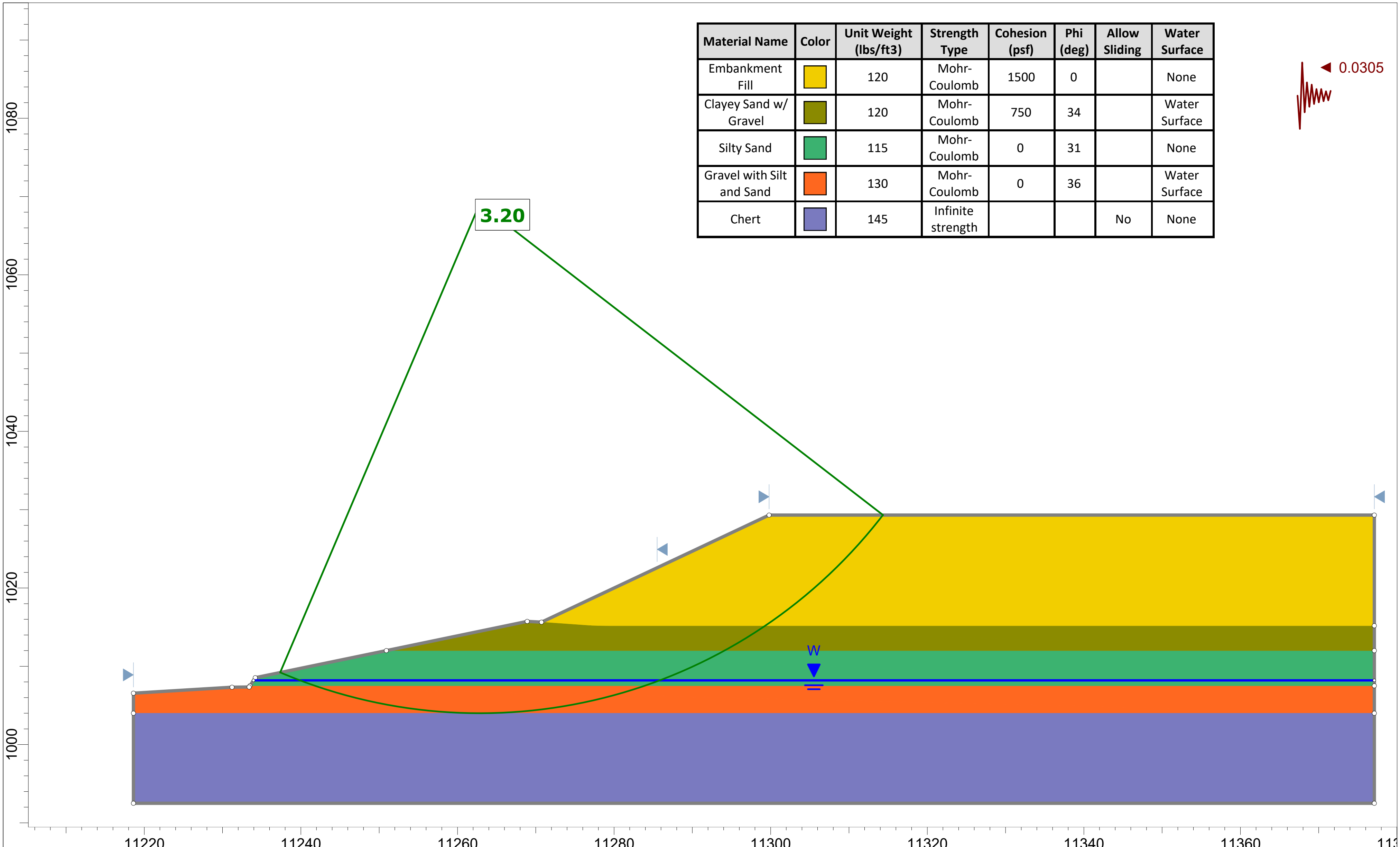
SLIDEINTERPRET 9.020

Project	040866 - Baron Fork & Fly Creek Strs. & Apprs. (S)		
Site	Hwy. 45 over Baron Fork	Analysis Type	Long Term
Analyzed By	PT	Configuration	South Embankment
Date	8/14/2023		



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Allow Sliding	Water Surface
Embankment Fill		120	Mohr-Coulomb	1500	0		None
Clayey Sand w/ Gravel		120	Mohr-Coulomb	750	34		Water Surface
Silty Sand		115	Mohr-Coulomb	0	31		None
Gravel with Silt and Sand		130	Mohr-Coulomb	0	36		Water Surface
Chert		145	Infinite strength			No	None

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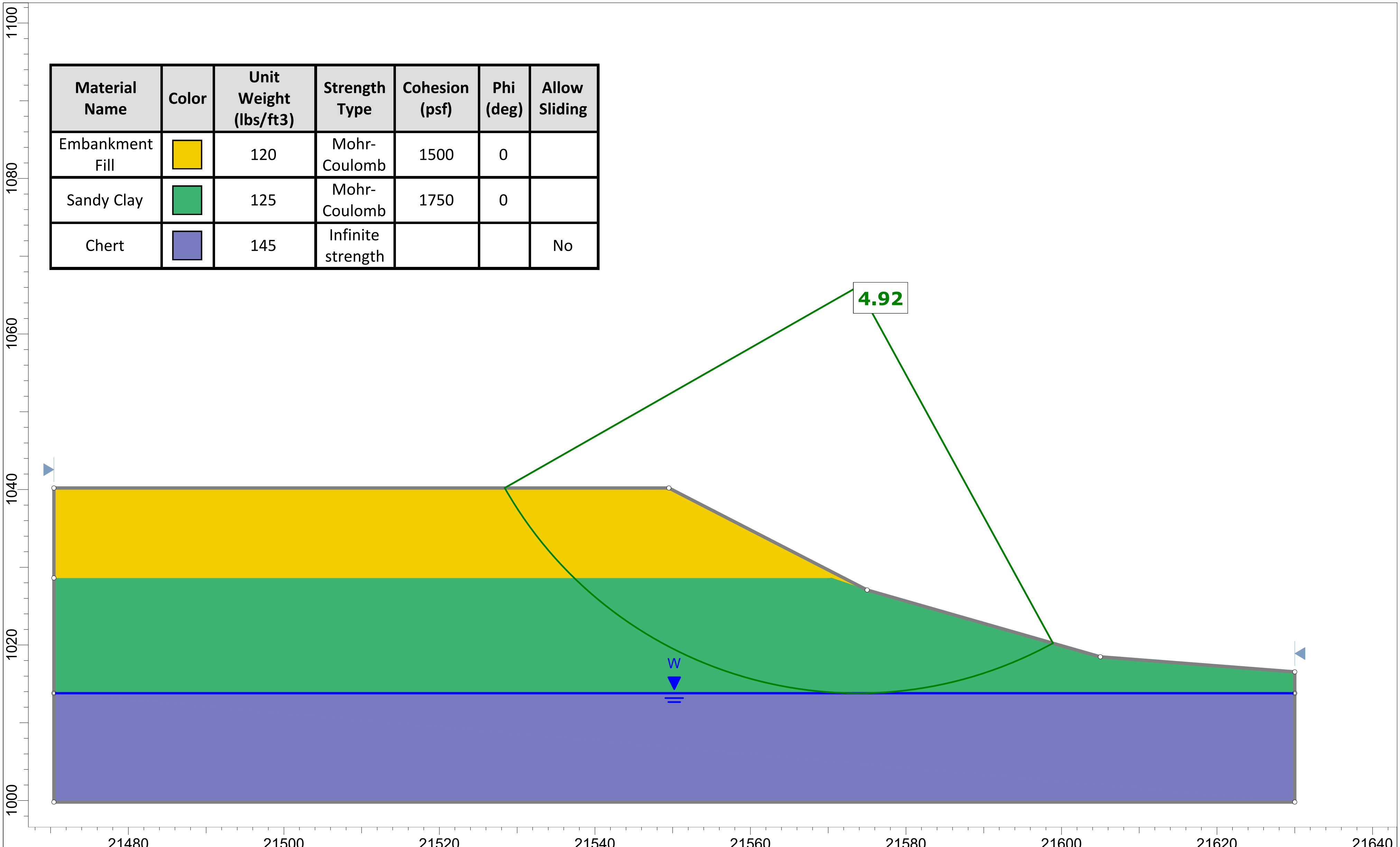
SLIDEINTERPRET 9.020

Project	040866 - Baron Fork & Fly Creek Strs. & Apprs. (S)		
Site	Hwy. 45 over Baron Fork	Analysis Type	Seismic
Analyzed By	PT	Configuration	South Embankment
Date	8/28/2023		

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Allow Sliding
Embankment Fill		120	Mohr-Coulomb	1500	0	
Sandy Clay		125	Mohr-Coulomb	1750	0	
Chert		145	Infinite strength			No



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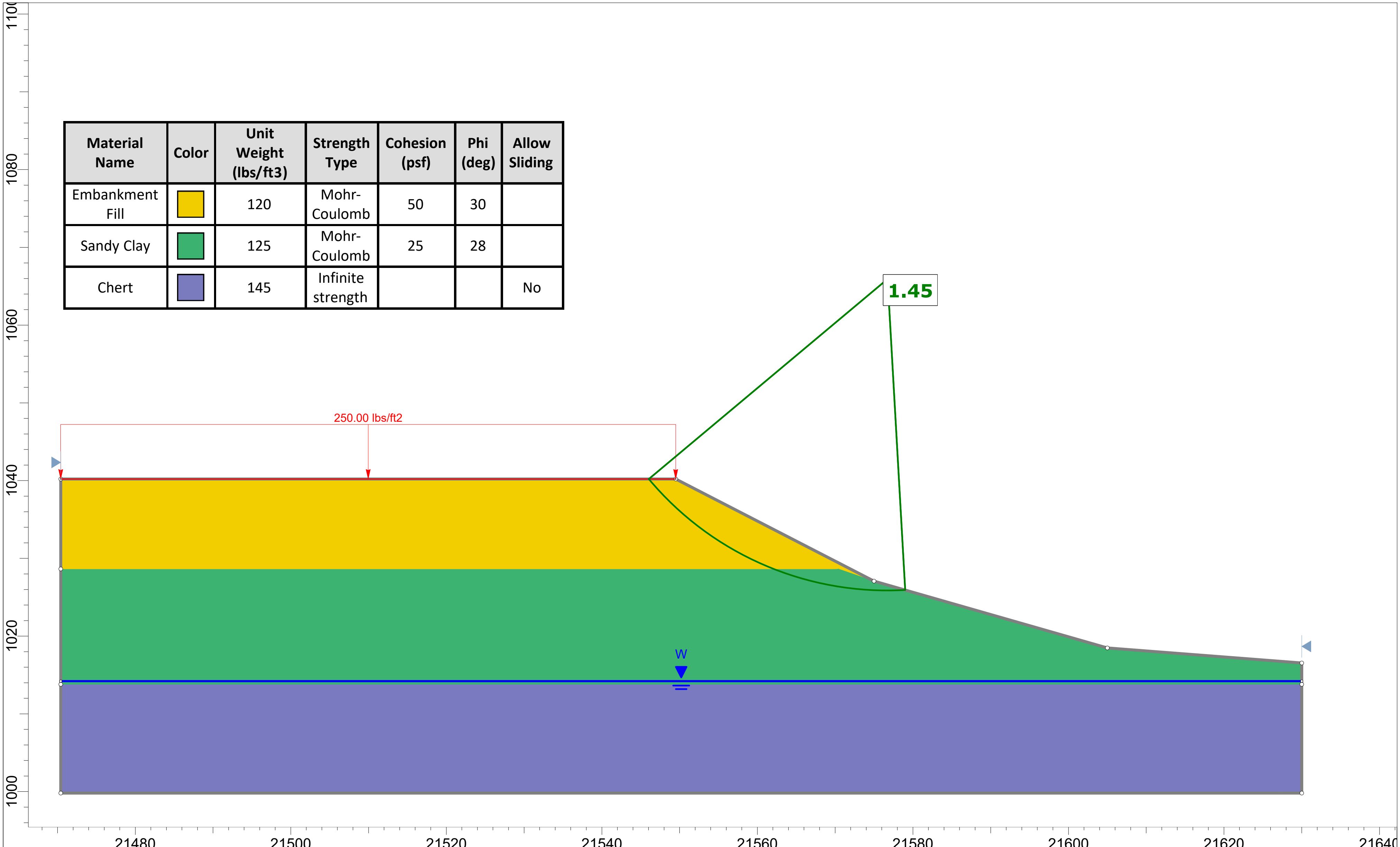
SLIDEINTERPRET 9.020

Project	040866 - Baron Fork & Fly Creek Strs. & Apprs. (S)		
Site	Hwy. 45 over Fly Creek	Analysis Type	Short Term / End of Construction
Analyzed By	PT	Configuration	West Embankment
Date	8/14/2023		

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Allow Sliding
Embankment Fill		120	Mohr-Coulomb	50	30	
Sandy Clay		125	Mohr-Coulomb	25	28	
Chert		145	Infinite strength			No



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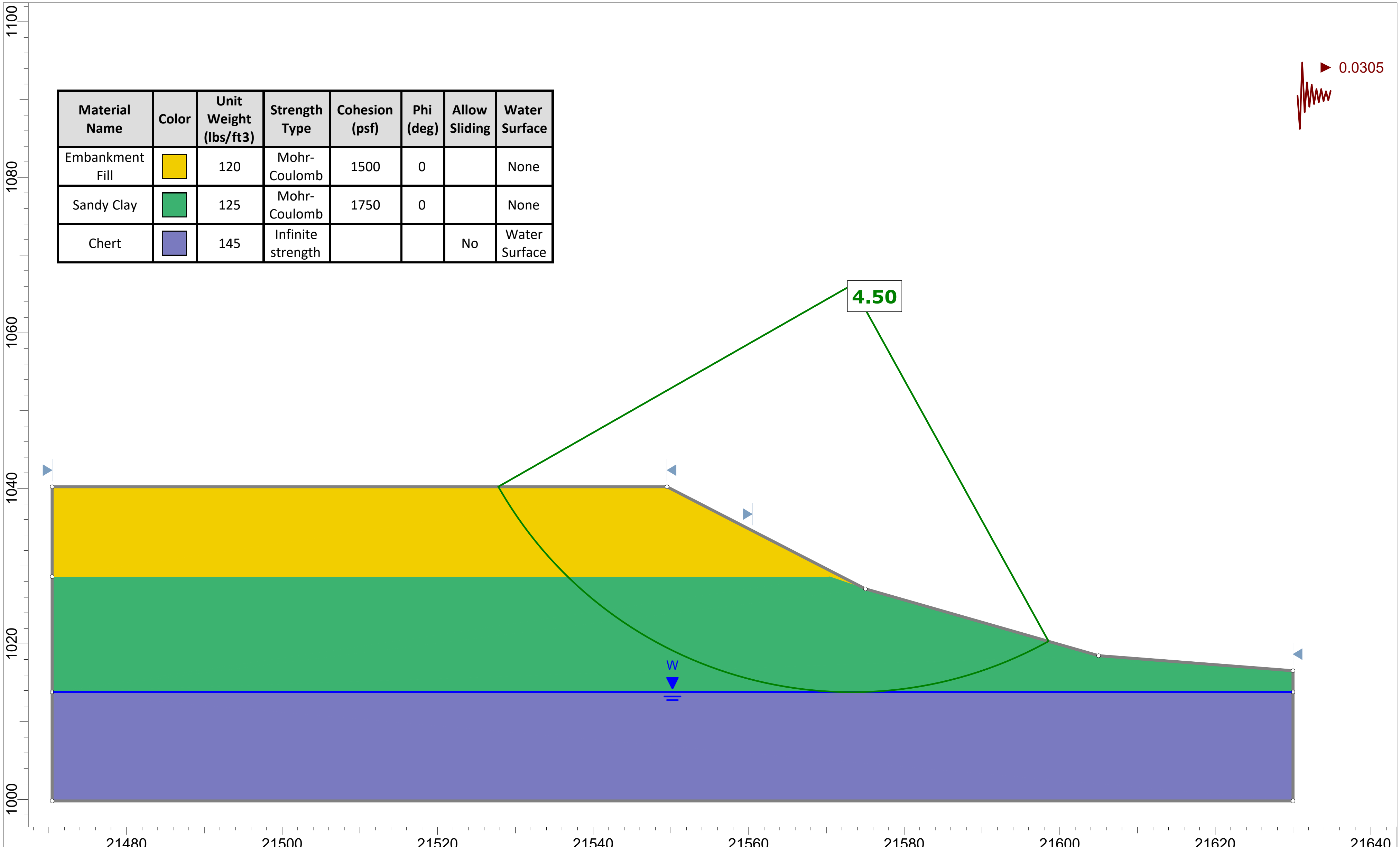
SLIDEINTERPRET 9.020

Project	040866 - Baron Fork & Fly Creek Strs. & Apprs. (S)		
Site	Hwy. 45 over Fly Creek	Analysis Type	Long Term
Analyzed By	PT	Configuration	West Embankment
Date	8/14/2023		

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Allow Sliding	Water Surface
Embankment Fill		120	Mohr-Coulomb	1500	0		None
Sandy Clay		125	Mohr-Coulomb	1750	0		None
Chert		145	Infinite strength			No	Water Surface



rocscience	Project	040866 - Baron Fork & Fly Creek Strs. & Apprs. (S)	
	Site	Hwy. 45 over Fly Creek	Analysis Type: Seismic
	Analyzed By	PT	Configuration: West Embankment
SLIDEINTERPRET 9.020	Date	8/28/2023	

Attachment H

Job No.:	040866
Site No.:	Baron Fork

Input by:	PT	7/24/2023
Checked by:		
Back-checked by:		

Bent 1

Elevation, ft		Material	Model	Effective Unit Weight, γ',pcf	Undrained Shear Strength of Soil (C_u) (psf)	Strain Factor (ε_{50} for Soil) / k_m for Rock)	Friction Angle, ϕ, °	Soil Modulus, k, pci	Uniaxial Compressive Strength, q_u, psi	Rock Mass Modulus, E_{rm}, 10^6 psi	RQD, %
Top	Bottom										
Above Ground Surface		Fill	Soft Clay (Matlock)	120	750	0.0100	NA	NA	NA	NA	NA
Ground	1017	Overburden Soil	Stiff Clay w/ Free Water	55	1250	0.0070	NA	500	NA	NA	NA
1017	1010	Slightly Weathered Chert	Weak Rock	83	NA	0.0005	NA	NA	10709.0	1.9	31.0
Below 1010		Unweathered Chert	Weak Rock	93	NA	0.0005	NA	NA	10250.0	3.4	64.0

Bent 5

Elevation, ft		Material	Model	Effective Unit Weight, γ',pcf	Undrained Shear Strength of Soil (C_u) (psf)	Strain Factor (ε_{50} for Soil) / k_m for Rock)	Friction Angle, ϕ, °	Soil Modulus, k, pci	Uniaxial Compressive Strength, q_u, psi	Rock Mass Modulus, E_{rm}, 10^6 psi	RQD, %
Top	Bottom										
Above Ground Surface		Fill	Soft Clay (Matlock)	120	750	0.0100	NA	NA	NA	NA	NA
Ground	1012	Overburden Soil	Sand (Reese)	115	NA	NA	31.0	35	NA	NA	NA
1012	1007	Overburden Soil	Sand (Reese)	63	NA	NA	34.0	67	NA	NA	NA
1007	1004	Overburden Soil	Sand (Reese)	68	NA	NA	36.0	93	NA	NA	NA
Below 1004		Slightly Weathered Shale	Weak Rock	83	NA	0.0005	NA	NA	7703	4.0	28

Job No.:	040866			
Site No.:	Fly Creek			

Input by:	PT	7/24/2023
Checked by:		
Back-checked by:		

Bent 1

Elevation, ft		Material	Model	Effective Unit Weight, γ',pcf	Undrained Shear Strength of Soil (C_u) (psf)	Strain Factor (ε_{50} for Soil) / k_m for Rock)	Friction Angle, ϕ, °	Soil Modulus, k, pci	Uniaxial Compressive Strength, q_u, psi	Rock Mass Modulus, E_{rm}, 10^6 psi	RQD, %
Top	Bottom										
Above Ground Surface		Fill	Soft Clay (Matlock)	120	750	0.0100	NA	NA	NA	NA	NA
Ground	1024	Overburden Soil	Stiff Clay	110	1000	0.0100	NA	NA	NA	NA	NA
1024	1019	Overburden Soil	Sand (Reese)	115	NA	NA	31.0	34	NA	NA	NA
1019	1012	Overburden Soil	Sand (Reese)	73	NA	NA	36.0	93	NA	NA	NA
Below 1012		Unweathered Chert	Weak Rock	83	NA	0.0005	NA	NA	5581.0	2.5	58.0

Bent 4

Elevation, ft		Material	Model	Effective Unit Weight, γ',pcf	Undrained Shear Strength of Soil (C_u) (psf)	Strain Factor (ε_{50} for Soil) / k_m for Rock)	Friction Angle, ϕ, °	Soil Modulus, k, pci	Uniaxial Compressive Strength, q_u, psi	Rock Mass Modulus, E_{rm}, 10^6 psi	RQD, %
Top	Bottom										
Above Ground Surface		Fill	Soft Clay (Matlock)	120	750	0.0100	NA	NA	NA	NA	NA
Ground	1027	Overburden Soil	Sand (Reese)	130	NA	NA	34.0	102	NA	NA	NA
1027	1020	Highly Weathered to Slightly Weathered Chert	Sand (Reese)	68	NA	NA	34.0	102	NA	NA	NA
Below 1020		Slightly Weathered Shale	Weak Rock	83	NA	0.0005	NA	NA	10343.0	3.4	55.0