ARKANSAS DEPARTMENT OF TRANSPORTATION

SUBSURFACE INVESTIGATION

STATE JOB NO. 061642

FEDERAL AID PROJECT NO. ACNHPP-9065(38)

HWY. 5 – HWY. 89 (WIDENING) (CABOT) (F)

STATE HIGHWAY 67 **SECTION** 11

IN LONOKE **COUNTY**

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RESULTS of GEOTECHNICAL INVESTIGATION
HWY. 67 OVER TWO PRAIRIE CREEK
ARDOT CA0613
JACKSONVILLE – CABOT (WIDENING & INTCHNG. IMPVTS) (SEL. SECS.) (F)
LONOKE COUNTY, ARKANSAS

INTRODUCTION

This report presents the results of the geotechnical investigation performed for the Highway 67 Replacement Bridge over Two Prairie Creek in Lonoke County, Arkansas. This project is designated as ARDOT Job No. CA0613, Jacksonville - Cabot (Widening & lntchng. lmpvts.) (Sel. Secs.) (F). This geotechnical investigation was authorized by the Garver LCC Subconsultant Agreement for Task Order No. 137 on January 6, 2020. Notice to proceed with the field studies was received on April 2, 2020. Preliminary results and design recommendations have been provided throughout the course of this study. An interim report was submitted on September 7, 2021.

We understand the replacement bridge will be a continuous W-beam unit with six (6) bents, five (5) spans, and a total length of approximately 352 feet. We also understand that a foundation system consisting of steel piles is planned for both the bridge ends and intermediate bents. Foundation loads of the new bridge are anticipated to be moderate. Simple slopes will be utilized at the bridge ends with end slopes at approximate 2-horizontal to 1-vertical (2H:1V) configurations and side slopes at 3-horizontal to 1-vertical (3H:1V) configurations. A preliminary bridge layout is provided in Appendix A.

The purposes of this geotechnical study were to explore subsurface conditions in the alignment of the replacement bridge and the approach embankments. The data developed through the field and laboratory studies were utilized to develop recommendations to guide design and

construction of foundations, embankments, and earthwork. These purposes have been accomplished by a multi-phased study that included the following.

- Drilling sample borings to evaluate subsurface conditions and to obtain samples for laboratory testing.
- Performing laboratory tests to establish pertinent engineering properties of the foundation and subgrade strata.
- Analyzing field and laboratory data to develop recommendations and conclusions for seismic site class, seismic design category/seismic performance zone, liquefaction potential, ground improvement, foundation design, embankment configurations, and construction considerations.

The relationship of these factors to design and construction of the replacement bridge has been considered in developing the recommendations and considerations discussed in the following report sections.

SUBSURFACE EXPLORATION

Subsurface conditions at the Two Prairie Creek Bridge replacement bridge location were investigated by drilling eight (8) sample and core borings to depths of 50 to 65 feet. The project location is shown on Plate 1. The approximate boring locations are shown on the Plan of Borings, Plate 2. The subsurface exploration program is summarized in the table below.

Table 1: Summary of Exploration Program

Boring No.	Approx Sta	Approx Offset, ft	Approx Surf El, ft	Completion Depth, ft
S1	147+65	75 Rt	270	60
S2	146+55	15 Rt	272	55
S3	145+25	15 Rt	272	50
S4	144+05	75 Rt	270	60
S5	147+70	70 Lt	271	55
S6	146+50	70 Lt	272	55
S7	145+45	75 Lt	270	60
S8	144+15	75 Lt	270	65

The boring logs, 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 18. The centerline station and offset of the boring locations and approximate ground surface elevation, as inferred from the layout and topographic information provided by the Engineer, is also shown on the logs. It must be recognized that the elevations shown are approximate and actual elevations may vary. Keys to the

terms and symbols used on the logs are presented as Plates 19 and 20. Two (2) generalized subsurface profiles in the bridge alignment are provided in Appendix B.

The borings were drilled with a truck-mounted SIMCO 2800 rotary-drilling rig and a track-mounted CME-850X rotary-drilling rig. A combination of dry-auger and rotary-wash drilling techniques was utilized to advance the borings. Soil samples were typically obtained using a 2-in.-diameter split-barrel sampler driven into the strata by blows of a 140-lb automatic hammer dropped 30 in. in accordance with Standard Penetration Test (SPT) procedures. The number of blows required to drive the standard split-barrel sampler the final 12 in. of an 18-in. total drive, or 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.

Representative samples of the shale bedrock were obtained using a 5-ft-long NQ_{WL}-size double-tube core barrel with a diamond bit. 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. 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 C.

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

The borings were advanced using dry-auger procedures to the extent possible to facilitate groundwater observations. Observations regarding groundwater are noted in the lower portion of each log and are discussed in subsequent sections of this report. The boreholes were backfilled after obtaining final water level readings.

LABORATORY TESTING

To evaluate pertinent physical and engineering characteristics of the foundation soil and rock, laboratory tests consisting of natural water content determinations and engineering index tests were performed on selected representative samples. A total of 16 natural water content determinations were performed to develop soil water content profiles for each boring. The results of these tests are plotted on the logs in accordance with the scale and symbols shown in the legend located in the upper-right corner.

To verify field classification and to evaluate soil plasticity, thirty-seven (37) liquid and plastic limit (Atterberg limits) determinations and thirty-eight (38) sieve analysis were performed on representative samples. The Atterberg limits are plotted on the logs as small pluses inter-connected with a dashed line using the water content scale. The percentage of soil passing through the No. 200 Sieve is noted in the "Minus No. 200" column on the appropriate log forms. Classification test results, as well as soil classification by the Unified Soil Classification System and AASHTO classification system, are summarized in Appendix D.

GENERAL SITE AND SUBSURFACE CONDITIONS

Site Conditions

The Two Prairie Creek bridge location is located on Hwy. 67, where the Two Prairie Creek channel crosses the highway south of Highway 89 in Lonoke County. The existing structure consists of two, 2-lane bridges with steel piling and concrete decks. The existing two-lane roadways are on embankment. The channel at this location is narrow and relatively shallow. The banks are fairly steep and lined with variable sparse to thick underbrush. The embankment slopes are covered in gravel. The project locale is primarily wooded and gently rolling. Surface drainage along the roadway is considered poor to fair.

Seismic Conditions

A Site-Specific Ground Motion Response Analysis was performed for the CA0613 project on behalf of ARDOT. The site-specific ground motion response analyses were performed by Geotechnology in accordance with Section 3.4.3.2 in 2012, 2014, and 2015 AASHTO Guide Specifications for LRFD Seismic Bridge Design 2nd Edition. Preliminary results of this study were submitted on April 2, 2021. Shear wave velocity profiles developed for the Site-Specific Ground Motion Response Analysis are provided in Appendix E. In light of the shear wave velocity profile, an average shear wave velocity in the top 100 ft of subsurface soil was calculated to be approximately 1500 ft per second. Consequently, a Seismic Site Class C (very dense soil and soft rock profile) is considered fitting for the Two Prairie Creek Bridge location.

Based on the results of the site-specific seismic hazard analysis, design earthquake spectral response accelerations of 0.31g for PGA (A_s), 0.728g for S_{DS}, and 0.119g for S_{D1} have been determined. These calculated design seismic accelerations utilize the site-specific procedure and are 67 percent or greater of the corresponding counterparts as determined using the code-based procedure. A plot of design response spectra, showing the design earthquake spectral response accelerations versus period for both code-based and site-specific values, is also included in

Appendix E. The design response spectra developed based on the results of the site-specific procedure are considered suitable for use in structural design.

Subsurface Conditions

The Geologic Map of Arkansas[1] indicates the project site is located in the mapped exposure of the Pennsylvanian Period Upper to Middle Atoka formation. Characteristically, the Atoka in this area is comprised of moderately dipping, interbedded shale and sandstone units, which are typically fractured and jointed. This formation has a large areal extent and is the predominant surface rock in the Boston Mountains and the Arkansas River Valley. The total thickness of the Upper Atoka is reported to range from about 6500 ft to more than 25,000 feet. It is conformable with the Johns Valley Shale in the Ouachita Mountains.

Based on the results of the borings, the subsurface stratigraphy may be generalized into five (5) primary strata as follows.

Stratum I: Existing embankment fill extends to depths of 4- to 6-ft at the plan bridge ends. The fill is comprised of brown, reddish brown, gray, tan, and reddish tan very soft to stiff fine sandy, silty clay and medium dense clayey fine sand with fine gravel and shale fragments. The on-site fill exhibits poor to fair compaction and moderate compressibility. The depth, content, and compaction of the on-site embankment fill is likely to vary across the site.

Stratum II: The embankment fill is underlain to 22- to 30-ft depth by natural very soft to very stiff tan, grayish tan, reddish brown, and gray silty clay and clayey silt with occasional fine sand, ferrous nodules and stains, and shale fragments. Occasional medium dense clayey fine gravel and fine sandy silt layers are present in this stratum. The silty clay has low plasticity and exhibits very low to moderate shear strength and moderate to high compressibility.

Stratum III: The Stratum II clayey soils are variably underlain by medium dense to dense tan, brownish gray, reddish brown, and gray silty fine sand to 33- to 40-ft depth. The silty sand contains silt pockets and layers, ferrous stains, and occasional shale fragments. The silty fine sand has low plasticity, moderate shear strength, and low compressibility.

Stratum IV: Moderately hard reddish brown, tan, and gray weathered shale with ferrous stains is below the overburden soils and extends to 30- to 44-ft depth. The weathered shale has poor rock quality but moderate to high shear strength and low compressibility.

Stratum V: The basal stratum encountered in the borings below 30- to 44-ft depth is moderately hard to hard dark gray shale. The basal shale is strong with fair rock quality, high shear strength, and low compressibility.

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

Groundwater was encountered in the borings at 19- to 20-ft depth in January 2021. However, groundwater levels and amounts will vary, depending on seasonal precipitation, surface runoff and infiltration, and stream levels in the nearby creek.

ANALYSES and RECOMMENDATIONS

Foundation Design

Foundations for the replacement Two Prairie Creek Bridge must satisfy two (2) basic and independent design criteria: a) foundations must have an acceptable factor of safety against bearing failure under maximum design loads, and b) foundation movement due to consolidation or swelling of the underlying strata should not exceed tolerable limits for the structures. Construction factors, such as installation of foundations, excavation procedures and surface and groundwater conditions, must also be considered.

In light of the results of the borings performed for this study, the anticipated moderate bridge foundation loads, and our understanding of the project, we recommend that foundation loads be supported on steel piling. Alternatively, the foundation loads at the interior bents (Bents 2 to 5) may be supported on drilled shaft foundations. Recommendations for foundations are discussed in the following report sections.

Piling Foundations

Driven steel HP12x53 or HP14x73 piles are recommended for support of the bridge foundation loads. Point-bearing steel piles driven to refusal should extend through the embankment fill, the natural overburden soils, and any low hardness highly weathered shale units into the moderately hard to hard shale. Piles should be driven to practical refusal. We recommend that all the steel piles be fitted with rock points. Other pile sizes or types may be evaluated if desired.

Bearing capacities of steel piles driven to refusal should be determined using the LRFD structural design procedure. We recommend that nominal resistance (P_n) of HP piles be determined based on the yield strength of steel H piles (f_y) and the net end area (A_{net}) of the section. An effective resistance factor (φ) of 0.50 is recommended for structural determination of factored compression bearing capacities. This effective resistance factor for H piles has been based on the assumption of severe driving conditions. It has been our experience that allowable pile capacities of 96 tons for HP 12x53 piles and 133 tons for HP 14x73 piles are common for f_y, 50 ksi steel. These capacities are based on allowable stress design (ASD). However, the appropriate factored bearing capacity must be determined by the Engineer. Post-construction settlement of piles driven to refusal will be negligible. We recommend a minimum pile penetration of 10 ft below natural grade. We also

recommend a minimum embedded pile length of 10 feet. Piles should have a minimum spacing of three (3) pile widths to limit capacity reductions due to group effects.

Estimated pile tip elevations are summarized below in the table below.

Table 2: Estimated Tip Elevations of Steel Piles Driven to Refusal

Bent No.	Estimated Pile Tip Elevation, ft	Comments
1 NB	231	Tip in moderately hard to hard shale
2 NB	231	Tip in moderately hard to hard weathered shale or shale
3 NB	234	Tip in moderately hard to hard weathered shale or shale
4 NB	241	Tip in moderately hard to hard weathered shale or shale
5 NB	242	Tip in moderately hard to hard weathered shale or shale
6 NB	241	Tip in moderately hard to hard weathered shale or shale
1 SB	231	Tip in moderately hard to hard shale
2 SB	233	Tip in moderately hard to hard weathered shale or shale
3 SB	236	Tip in moderately hard to hard weathered shale or shale
4 SB	242	Tip in moderately hard to hard weathered shale or shale
5 SB	242	Tip in moderately hard to hard weathered shale or shale
6 SB	240	Tip in moderately hard to hard weathered shale or shale

It should be noted that tip elevations shown in the above table are estimates only based on the results of the borings and the inferred surface elevations at the particular locations. Pile as-built length must be field verified.

Piles should be installed in compliance with Standard Specifications for Highway Construction, 2014 Edition, Section 805. Pre-boring is not expected to be required for pile installation. However, pre-boring will be required for penetration into the weathered shale/shale in excess of about 1 foot. Based on our experience, we recommend a hammer system capable of delivering at least 32,000 per blow for the steel piles at the bridge ends. A specific review and analysis of the pile-hammer system proposed by the Contractor should be performed by the Engineer or Department prior to hammer acceptance and start of driving. We have recommended that all piles be fitted with rock points. Battered piles can be utilized to resist lateral loads.

As a minimum, safe bearing capacity of production piles should be determined by Standard Specifications for Highway Construction, 2014 Edition, Section 805.09, Method A. Blow counts on steel piles should be limited to about 20 blows per inch. Practical pile refusal may be defined as a penetration of 0.5 in. or less for the final 10 blows. Driving records should be available for review by the Engineer during pile installation. determined.

Drilled Shaft Foundations – Bents 2 through 5

Drilled straight shafts are suitable for support of foundation loads at the interior bents, Bents 2 through 5. Drilled shafts should be founded with a minimum embedment of two (2) shaft diameters or 6 ft, whichever is greater, into the Stratum V moderately hard dark gray shale. Drilled shafts founded as recommended may be sized using a maximum nominal end-bearing pressure (P_n) of 150 kips per sq foot. A resistance factor (φ_{stat}) of 0.50 is recommended for drilled shaft end bearing. Total and differential settlement of properly installed drilled shafts founded in the competent moderately hard shale as recommended is expected to be negligible. We also recommend that drilled shafts be sized for axial compression loads based on end bearing alone.

Resistance to uplift loads will be developed by circumferential shaft friction. Drilled shafts will penetrate the overburden soils to bear in the competent moderately hard shale. Uplift resistance for all penetration through the overburden soils and the length of permanent casing should be neglected. For shaft penetration through the competent shale, a maximum nominal skin resistance value of 9 kips per sq ft is recommended. For evaluation of uplift capacity, a resistance factor (φ_{up}) of 0.40 is recommended for shaft skin friction.

A minimum shaft rock socket diameter of 36 in. and a minimum shaft rock socket length of two (2) shaft diameters or 6 ft, whichever is greater, are recommended for drilled shafts. The as-built shaft length will vary with location and depth of overburden. In general, the competent shale rock strata are 28 to 44 ft below the ground line at the bent locations. It is expected that permanent casing will extend to the top of rock and slightly into the rock. The estimated shaft length is based on the plan shaft diameter of 36 inches.

Table 3: Estimated Minimum Shaft Lengths

Bent No.	Proposed Surface Elevation, ft	Estimated Minimum Shaft Length, ft	Estimated Minimum Shaft Tip El, ft
2 NB	265	41	224
3 NB	265	38	227
4 NB	265	33	232
5 NB	265	32	233
2 SB	265	39	226

Bent No.	Proposed Surface Elevation, ft	Estimated Minimum Shaft Length, ft	Estimated Minimum Shaft Tip El, ft
3 SB	265	38	227
4 SB	265	36	229
5 SB	265	35	230

The depths to suitable rock strata are estimates only, and are based on the results of the borings, the inferred surface elevation at the particular bent location, and planned grades. Suitable bearing stratum and final shaft lengths must be field verified. Plan shaft lengths and shaft tip elevations must be based on the magnitude of foundation loads, specific subsurface conditions, and actual shaft diameters. Depending on specific subsurface conditions and rock quality, localized deepening or shortening of shaft depths can be warranted.

All drilled shaft excavations should be observed by the Engineer to verify suitable bearing and adequate penetration. Heavy-duty drilling equipment will be required to advance the shaft excavations. The moderately hard to hard shale bearing stratum will be resistant to drilling and rock drilling methods are expected to be required to achieve the required shaft penetration.

Embankment Slopes

The replacement bridge will include new end slope configurations on the south (Bent 1) and north (Bent 6) ends. Plan bridge end embankment configurations are 2-horizontal to 1-vertical (2H:1V) with 3-horizontal to 1-vertical (3H:1V) side slope configurations. The bridge end embankments will have maximum heights of about 13 feet.

To evaluate suitability of the end slope plan configurations, slope stability analyses have been performed. A 250 lbs per sq ft uniform surcharge from vehicles was included for the purposes of stability analyses. Stability analyses were performed using the computer program SLOPE/W 2020[2] and a Morgenstern-Price analysis. For the embankment slopes, four (4) general loading conditions were evaluated, i.e., End of Construction, Long Term, Rapid Drawdown, and Seismic Conditions. For analysis of the seismic condition, a horizontal seismic acceleration coefficient (k_h) of one-half the peak acceleration (A_s) was used, a value of 0.155. This $A_s/2$ value was developed as one-half of the peak ground acceleration (PGA) value from the site-specific seismic hazard analysis. For evaluation of the rapid drawdown condition, a water surface elevation drop from El 272 to El 259 was assumed.

[2] Slope/W 2020; GEO-SLOPE International; 2020.

Stability analyses results are summarized and presented graphically in Appendix F. The results of the stability analyses indicate that plan configurations of the embankment end slopes are acceptable with respect to stability of all loading conditions evaluated.

Subgrade Support

Based on the results of the borings and laboratory tests, the on-site subgrade soils are expected to be comprised primarily of embankment fill. The on-site soils are anticipated to predominantly classify by AASHTO M 145 as A-4 and A-6. These classifications correlate with fair to poor subgrade support for pavements. Locally-available borrow, which is likely to be used as unclassified embankment fill, is expected to have similar classification.

We recommend that any soils classifying as A-7-6 and soils with a plasticity index (PI) in excess of 18, if encountered during the work, be excluded from use within 12 in. of the plan subgrade elevation of the approach roads. The top 12 in. of subgrade soils should have a maximum plasticity index (PI) of 18. The as-built pavement subgrade should be evaluated by the Engineer. Areas of unstable or otherwise unsuitable subgrade should be improved by undercut and replacement or treatment with additives approved by the Engineer. The results of the borings indicate that localized undercuts on the order of 2 ft, more or less,

Based on the results of the borings and Standard Penetration Tests and correlation with the AASHTO classification of the anticipated subgrade soils, subgrade support for a properly-prepared subgrade is expected to be fair. The following parameters are recommended for use in pavement design.

- Resilient Modulus (M_R): 2800 lbs per sq inch
- R value: 8

The approach road pavement subgrade should be evaluated by the Engineer or Department at the time of construction. Areas of unstable or otherwise unsuitable subgrade should be improved by undercut and replacement or treatment with additives as approved by the Engineer. Depending on seasonal site conditions and final grading plans, localized undercuts or improvement depths on the order of 2 ft below existing grades, more or less, could be warranted to develop a stable subgrade.

Site Grading and Subgrade Preparation

Site grading and site preparation in the bridge alignments should include necessary clearing and grubbing of trees and underbrush and stripping the organic-containing surface soils in work areas. The depth of stripping will be variable, with deeper stripping depths in wooded areas, and less stripping required in open areas. In general, the stripping depth is estimated to be about 6 to 9

in. in cleared areas but may be 18 to 24 in. or more in areas with thick underbrush and/or trees. The zone of organic surface soils should be completely stripped in the embankment footprint areas and at least 5 ft beyond the projected embankment toe.

Where existing pavements are to be demolished, consideration may be given to utilizing the processed asphalt concrete and aggregate base for embankment fill. In this case, the demolished materials should be thoroughly blended and processed to a reasonably well-graded mixture with a maximum particle size of 2 in. as per ARDOT Standard Specifications for Highway Construction, 2014 Edition, Section 212. If abandoned pavements are within 3 ft of the plan subgrade elevation, the existing pavement surface should be scarified to a minimum depth of 6 inches. The scarified material should be recompacted to a stable condition.

Following required pavement demolition, clearing and grubbing, and stripping, and prior to fill placement or otherwise continuing with subgrade preparation, the extent of weak and/or unsuitable soils should be determined. Thorough proof-rolling should be performed to verify subgrade stability. Proof-rolling should be performed with a loaded tandem-wheel dump truck or similar equipment. Unstable soils exhibiting a tendency to rut and/or pump should be undercut and replaced with suitable fill. Care should be taken that undercuts, stump holes, or other excavations or low areas resulting from subgrade preparation are properly backfilled with compacted fill. Based on the results of the borings, localized undercuts of 2 ft, more or less, could be required to develop subgrade stability.

Subgrade preparation and mass undercuts should extend at least 5 ft beyond the embankment toes to the extent possible. Subgrade preparation in roadway areas should extend at least 3 ft outside pavement shoulder edges to the extent possible. Existing drainage features should be completely mucked out and all loose and/or organic soils removed prior to fill placement.

General fill and backfill may consist of unclassified borrow free of organics and other deleterious materials as per ARDOT Standard Specifications for Highway Construction, 2014 Edition, Subsection 210.06.

Subgrade preparation should comply with ARDOT Standard Specifications for Highway Construction, 2014 Edition, Section 212. Embankments should be constructed in accordance with ARDOT Standard Specifications for Highway Construction, 2014 Edition, Section 210. Fill and backfill should be placed in nominal 6- to 10-in.-thick loose lifts. All fill and backfill must be placed in horizontal lifts. Where fill is placed against existing slopes, short vertical cuts should be "notched" in the existing slope face to facilitate bonding of horizontal fill lifts. The in-place density

and water content should be determined for each fill lift and should be tested to verify compliance with the specified density and water content prior to placement of subsequent lifts.

CONSTRUCTION CONSIDERATIONS

Positive surface drainage should be established at the start of the work, be maintained during construction and following completion of the project to prevent surface water ponding and subsequent saturation of subgrade soils. Density and water content of all earthwork should be maintained until the bridge work is completed. Subgrade soils that become saturated by ponding water or runoff should be excavated to undisturbed soils. The embankment subgrade should be evaluated by the Engineer during subgrade preparation and prior to starting embankment construction.

Groundwater was encountered at 19 ft in January 2021. Minor seepage into excavations can probably be controlled by ditching or sump-and-pump methods. If seepage into excavations becomes a problem, backfill should consist of clean sand (ARDOT Standard Specifications Section 302, SM-1) or clean, crushed stone (ARDOT Standard Specifications Section 207). Sand or stone backfill should be vented to positive discharge at daylight or into storm drainage lines where possible. Where surface seeps or springs are encountered during site grading, we recommend the seepage be directed via French drains or blanket drains to positive discharge at daylight or to storm drainage lines.

Piles should be installed in compliance with ARDOT Standard Specifications Section 805. Piles should be carefully examined prior to driving and piles with structural defects should be rejected. Any splices in steel piles should develop the full cross-sectional capacity of un-spliced piles. Pile installation should be monitored by qualified personnel to maintain specific and complete driving records and observe pile installation procedures. Driving records should be available for review by the Engineer during pile installation.

Safe bearing capacity of all piles should be determined by ARDOT Standard Specifications Section 805.09, Method A. Driving records should be available for review by the Engineer during pile installation. We have recommended that all steel piles be fitted with rock points. Blow counts on steel piles should be limited to about 20 blows per inch. Practical pile refusal may be defined as a penetration of 0.5 in. or less for the final 10 blows.

As noted, groundwater was encountered in the borings at about 19- to 20-ft depth in January 2021. Groundwater could be encountered in drilled shaft excavations. Limited seepage into drilled shaft excavations can probably be controlled by close coordination of drilling, cleanup and concrete placement. We recommend that casing be on site in the event it is needed to control seepage and/or

caving into shaft excavations. Drilled shaft excavations should essentially be dry at the time of concrete placement. Where more than about 3 in. of water is present in shaft excavations, the excavation should be dewatered prior to concrete placement. Where shaft excavations cannot be dewatered, underwater concrete placement should be performed with a concrete pump fitted with a rigid end extension. A muck bucket or similar tools should be utilized to clean the shaft excavation bottom prior to underwater concrete placement.

Some hard drilling will be experienced when advancing drilled shaft excavations into the moderately hard to hard shale. Heavy-duty drilling equipment and rock drilling tools will be required to advance shaft excavations to the recommended minimum penetration into the dark gray shale. Where more resistant shale units or localized sandstone beds are encountered, coring or other rock excavation methods will be required to achieve the recommended penetration into the rock bearing stratum. All drilled shaft excavations should be observed by the Engineer or Department to verify suitable bearing and adequate penetration.

CLOSING

The Engineer or a designated representative thereof, should monitor site preparation, grading work, and all foundation construction. Subsurface conditions significantly at variance with those encountered in the borings should be brought to the attention of the Geotechnical Engineer. The conclusions and recommendations of this report should then be reviewed in light of the new information.

The following illustrations are attached and complete this report.

Plate 1	Site Vicinity Map
Plate 2	Plan of Borings
Plates 3 through 18	Boring Logs
Plates 19 and 20	Keys to Terms and Symbols
Appendix A	Preliminary Bridge Layout
Appendix B	Generalized Subsurface Profiles
Appendix C	Rock Core Photographs
Appendix D	Laboratory Test Results
Appendix E	Selected Results - Site-Specific Shear Wave Velocity Profile and Design Earthquake Response Spectra
Appendix F	Results of Stability Analyses

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

Sincerely,

GRUBBS, HOSKYN,
BARTON &WYATT, INC.

Velleta M. Scott

Velleta M. Scott, P.E.
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Mark E. Wyatt

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President

VMS/MEW:jw

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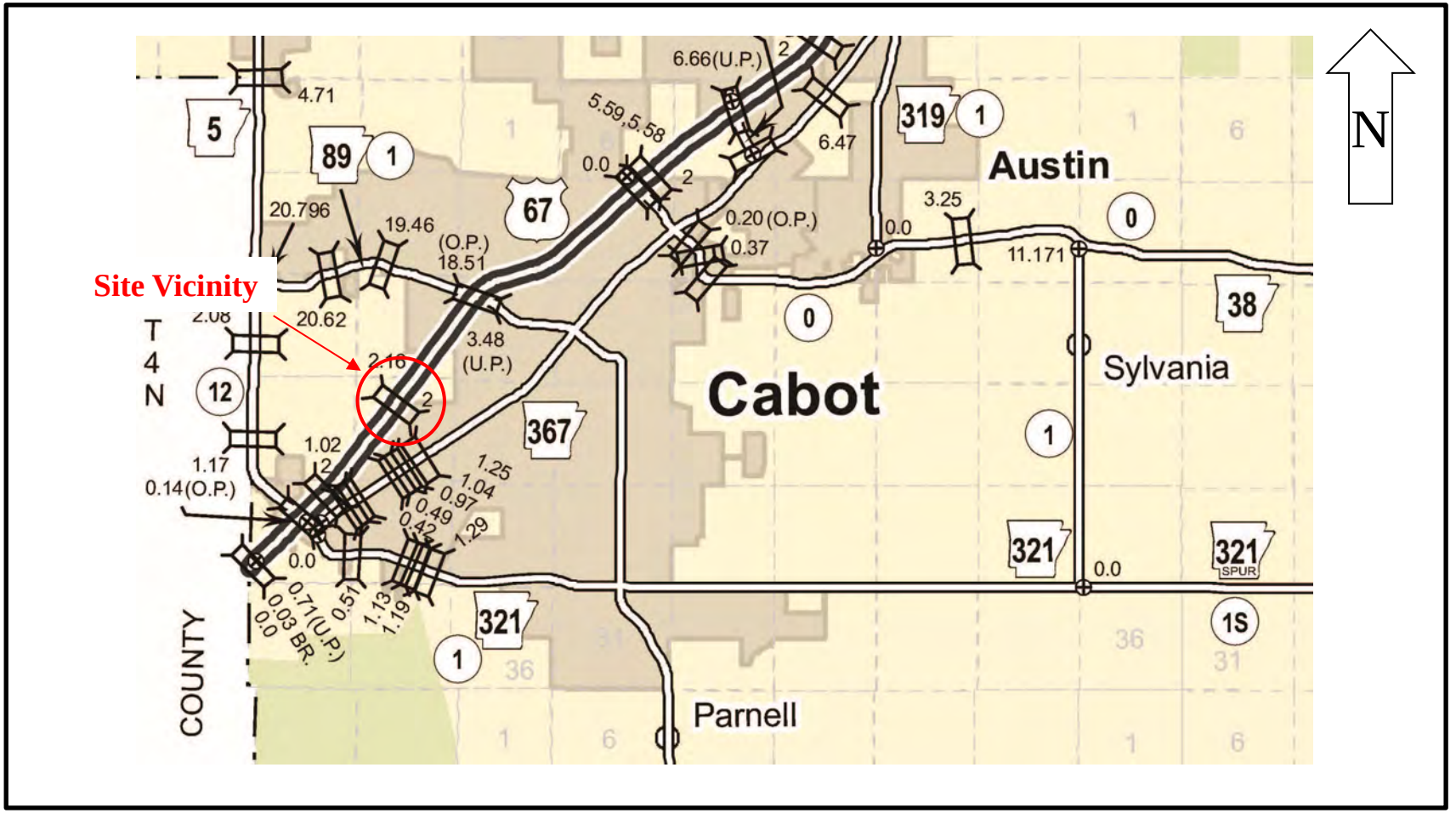
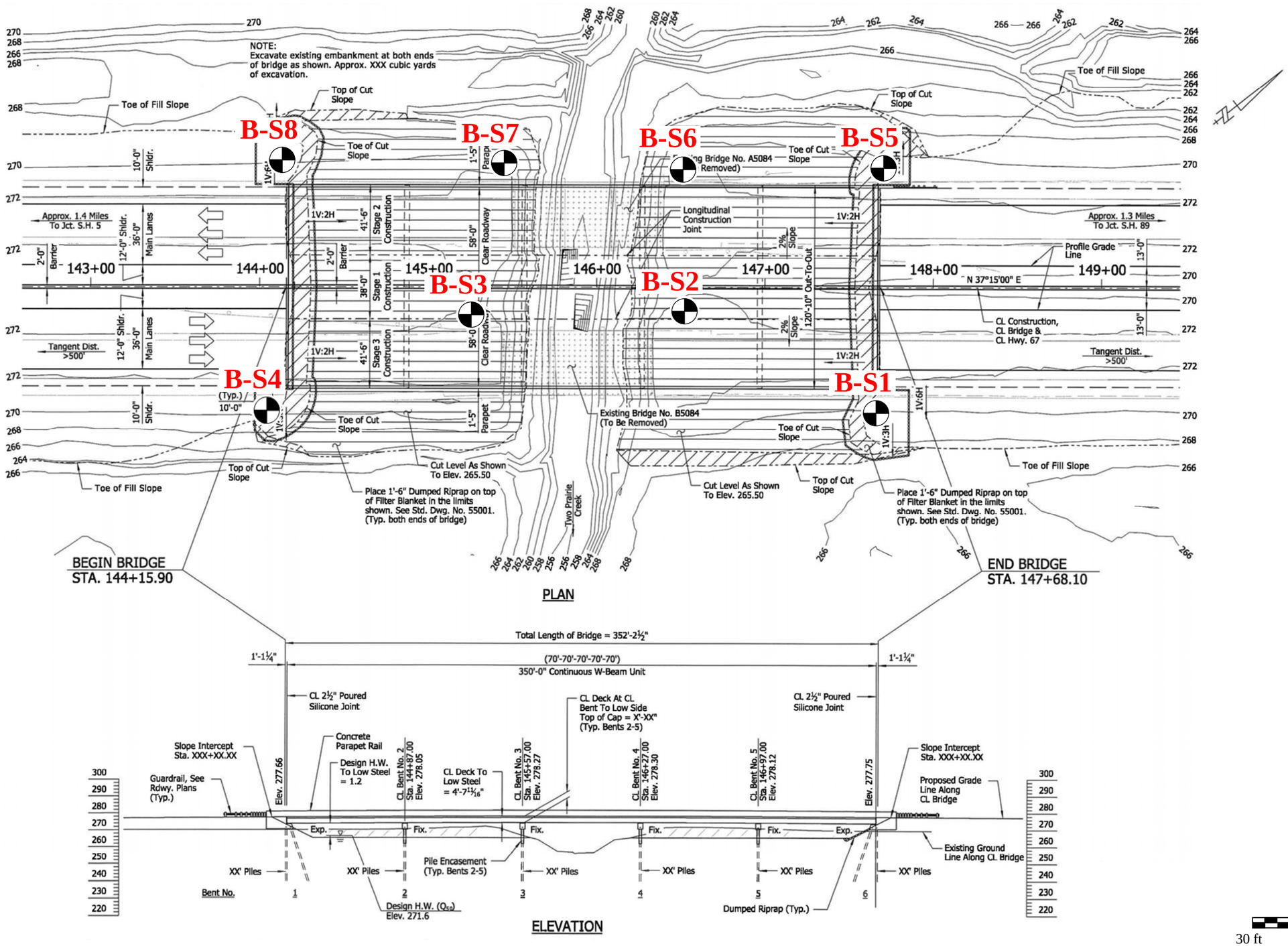


Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**SITE VICINITY MAP** **CA0613 Hwy. 67 over Two Prairie Creek** **Lonoke County, Arkansas**	**Job No. 20-136**	**Plate 1**



Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**PLAN OF BORINGS** **CA0613 Hwy. 67 over Two Prairie Creek** **Lonoke County, Arkansas**	**Scale: As shown**	**Job No. 20-136**	**PLATE 2**

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

LOG OF BORING NO. S1

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 147+65, 75 ft Rt

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
			SURF. EL: 270±						
			Medium dense reddish brown clayey fine sand w/some fine gravel (fill)	17					
				12			46		
			- loose below 4 ft						
5				7			72		
			Soft grayish tan and gray clayey silt, sandy w/ferrous stains and nodules and occasional silt pockets - very soft at 6 to 8 ft - stiff at 8 to 23 ft	0/WOH					
10				14			73		
15				20					
			- with more sand below 18 ft						
20				22					
			- very stiff below 23 ft						
25				33					
			Moderately hard gray and tan weathered shale w/ferrous stains in bedding planes	50/4"					
30			Moderately hard gray slightly weathered shale, dip ~10° - with very close low angle fractures with ferrous stains in fractures at 30 to 31 ft - high angle shears, slickensided at 32.6 ft and 33.4 ft					72	7

COMPLETION DEPTH: 60.0 ft
DATE: 1-13-21

DEPTH TO WATER IN BORING: Dry to 20 ft

DATE: 1/13/2021

RECRQDN200-2 20-136.GPJ 9-20-21

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

LOG OF BORING NO. S1

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 147+65, 75 ft Rt

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
			(continued)						
			- very close rehealed fractures below 32.7 ft - low hardness layer at 35 to 35.5 ft Moderately hard to hard dark gray shale, ± 10° dip - with high angle shears, slickensided at 35.5 ft, 43.7 ft, 47.1 ft, and 50 to 52 ft - with very close mechanical fractures at 39 to 40 ft			q_u = 470 psi		62	23
40								98	67
45								97	70
			- with very close high angle fractures at 48 to 49.5 ft						
50			- with very close pyrite inclusions below 50 ft					98	70
			- with very close high angle fractures at 53.5 to 55 ft						
55			- quartz vein at 56.6 ft					97	95
60									
65									

COMPLETION DEPTH: 60.0 ft
DATE: 1-13-21

DEPTH TO WATER
IN BORING: Dry to 20 ft

DATE: 1/13/2021

RECRQDN200-2 20-136.GPJ 9-20-21

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

LOG OF BORING NO. S2

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 146+55, 15 ft Rt

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
			SURF. EL: 272±						
			Very soft to soft brown and tan silty clay, slightly sandy w/numerous shale fragments (fill)	4					
			- stiff below 2 ft	21			28		
5				13					
			Soft tan, reddish brown and gray silty clay, sandy w/ferrous stains and nodules	5					
			- stiff below 8 ft	15			78		
10									
15				18					
			- with more reddish brown below 18 ft						
20				22					
25				20			83		
			Moderately hard gray and reddish brown weathered shale, dip ~ 10°	50/6"					
30									
			Moderately hard dark gray shale, ± 10° dip	25/0"					

COMPLETION DEPTH: 55.0 ft
DATE: 3-4-21

DEPTH TO WATER IN BORING: Dry to 20 ft

DATE: 3/4/2021

RECRQDN200-2 20-136.GPJ 9-20-21

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

LOG OF BORING NO. S2

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 146+55, 15 ft Rt

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
			(continued)						
						q_u= 1040 psi, TUW= 163 pcf		100	92
40			- with high-angle shears at 38 and 49.5 to 50 ft					72	45
45			- vertical fracture at 46.7 to 47 ft					93	77
50						q_u= 2070 psi, TUW= 163 pcf		98	92
55									
60									
65									

COMPLETION DEPTH: 55.0 ft
DATE: 3-4-21

DEPTH TO WATER
IN BORING: Dry to 20 ft

DATE: 3/4/2021

RECRQDN200-2 20-136.GPJ 9-20-21

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

LOG OF BORING NO. S3

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 25 ft /Wash

LOCATION: Approx Sta 145+25, 15 ft Rt

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
			SURF. EL: 272±						
			Stiff reddish brown and gray silty clay w/silt and fine sand (fill)	11					
				30			79		
5			- soft below 4 ft	5					
			Very soft gray clayey silt	1			95		
			Very stiff gray and tan silty clay w/fine sandy silt pockets, seams and layers and ferrous stains and nodules	28					
10									
			- stiff to very stiff below 13 ft		111		60		
15									
					105				
20									
			- with ferrous concretions below 23 ft	50/4"			85		
25									
			Dense tan and reddish brown silty fine sand w/silt pockets, seams and layers and ferrous stains			-NON-PLASTIC-	37		
30									
			- with some shale fragments below 33 ft						

COMPLETION DEPTH: 50.0 ft
DATE: 1-20-21

DEPTH TO WATER IN BORING: Dry to 25 ft

DATE: 1/21/2021

RECRQDN200-2 20-136.GPJ 9-20-21

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

LOG OF BORING NO. S3

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 25 ft /Wash

LOCATION: Approx Sta 145+25, 15 ft Rt

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
			(continued)						
			- with numerous shale fragments below 38 ft						
40			Moderately hard gray slightly weathered shale w/ferrous stains in fractures, dip ~ 15° - high-angle shear at 40.2 to 41.7 ft			q_u= 930 psi, TUW= 159 pcf		100	63
45			Moderately hard dark gray shale, dip ±15°			q_u= 2140 psi,TUW= 166 pcf		85	82
50									
55									
60									
65									

COMPLETION DEPTH: 50.0 ft
DATE: 1-20-21

DEPTH TO WATER
IN BORING: Dry to 25 ft

DATE: 1/21/2021

RECRQDN200-2 20-136.GPJ 9-20-21

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

LOG OF BORING NO. S4

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 144+05, 75 ft Rt

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
			SURF. EL: 270±						
			Medium dense reddish brown and tan clayey fine sand, silty w/some fine gravel and occasional ferrous nodules (fill)	22					
				21			39		
5			Stiff light gray silty clay w/ferrous nodules and stains	14					
			- very stiff below 6 ft	32		G_s= 2.67	92		
10				44					
15				47					
20			Stiff reddish brown and gray silty clay, sandy w/ferrous nodules and stains	17			71		
25				20					
30			Medium dense to dense reddish brown silty fine sand w/ferrous stains	30			38		
			- dense, reddish brown and gray below 33 ft	38		-NON-PLASTIC-	48		

COMPLETION DEPTH: 60.0 ft
DATE: 1-12-21

DEPTH TO WATER IN BORING: Dry to 20 ft
DATE: 1/11/2021

RECRQDN200-2 20-136.GPJ 9-20-21

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

LOG OF BORING NO. S4

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 144+05, 75 ft Rt

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
			(continued)						
			Moderately hard to hard gray shale, dip ± 10°						
40			- with low angle shears at 41.9 and 44.9 ft					100	98
45						q_u= 1070 psi, TUW= 166 pcf		100	80
			- high angle shear at 48.7 ft			q_u= 590 psi, TUW= 161 pcf			
50			- with high angle shears at 50.1 and 52.1 ft - with very close sandstone partings and seams at 51.7 to 52 ft and 58 to 58.6 ft			q_u= 1140 psi		98	88
55								92	87
60									
65									

COMPLETION DEPTH: 60.0 ft
DATE: 1-12-21

DEPTH TO WATER
IN BORING: Dry to 20 ft

DATE: 1/11/2021

RECRQDN200-2 20-136.GPJ 9-20-21

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

LOG OF BORING NO. S5

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 147+70, 70 ft Lt

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
			SURF. EL: 271±						
			Stiff brown silty clay, sandy w/ferrous nodules and a little crushed stone (fill)	22			69		
			- with numerous shale fragments below 2 ft	24			21		
5				17					
			Very loose gray silt, slightly sandy, wet	0"/WOH		-NON-PLASTIC-	84		
			Soft gray and tan silty clay, sandy w/ferrous stains and nodules	6					
10									
			- stiff below 13 ft						
15				19			70		
20				18					
25				21					
			Very stiff tan silty clay, sandy w/numerous shale fragments (completely weathered shale)	50/4"			34		
30			Moderately hard gray slightly weathered shale, dip ~ 15° - with very close fractures and ferrous stains in fractures to 35.5 ft					95	13

COMPLETION DEPTH: 55.0 ft
DATE: 1-15-21

DEPTH TO WATER IN BORING: Dry to 20 ft

DATE: 1/15/2021

RECRQDN200-2 20-136.GPJ 9-20-21

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

LOG OF BORING NO. S5

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 147+70, 70 ft Lt

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
			(continued)						
			Moderately hard dark gray shale, dip ~ 15°			q_u= 840 psi, TUW= 160 pcf		93	80
40			- with high-angle shears at 38 and 39.5 ft - with slickensides at 40.1, 51.9 ft and 54 to 54.8 ft - with high-angle shears at 41.9 and 43 ft			q_u= 850 psi, TUW= 160 pcf		90	73
45			- with very close fractures with slickensides at 45 to 46 ft			q_u= 990 psi, TUW= 160 pcf		100	82
50						q_u= 1160 psi, TUW= 160 pcf		100	87
55									
60									
65									

COMPLETION DEPTH: 55.0 ft
DATE: 1-15-21

DEPTH TO WATER
IN BORING: Dry to 20 ft

DATE: 1/15/2021

RECRQDN200-2 20-136.GPJ 9-20-21

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

LOG OF BORING NO. S6

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 146+50, 70 ft Lt

SURF. EL: 272±

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
			Medium dense yellowish brown clayey fine sand w/some fine gravel and occasional ferrous nodules (fill)	18 16			39		
5			Soft grayish brown silty clay w/decayed organics	6					
			Soft tan and gray silty clay, slightly sandy w/ferrous stains and occasional silt pockets - very soft to soft at 6 to 8 ft - stiff, brownish yellow and gray at 8 to 13 ft	4 21			88		
15			- very stiff, tan and gray, more silty below 13 ft	28			81		
20			- with silt seams and layers below 18 ft	30					
25				35					
30			Moderately hard gray slightly weathered shale, dip ~ 10° - with very close fractures with ferrous stains in fractures at 30 to 32.2 ft	50/3"				95	50

q_u= 1290 psi, TUW= 160 pcf

COMPLETION DEPTH: 55.0 ft
DATE: 1-14-21

DEPTH TO WATER
IN BORING: Dry to 20 ft

DATE: 1/14/2021

RECRQDN200-2 20-136.GPJ 9-20-21

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

LOG OF BORING NO. S6

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 146+50, 70 ft Lt

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
			(continued)						
			Moderately hard dark gray shale, dip ~ 10° - with very close low-angle fractures at 36.8 and 39.1 ft			q_u= 1440 psi, TUW= 210 pcf		82	72
40						q_u= 1300 psi, TUW= 170 pcf		100	100
45			- low-angle fracture at 45.1 ft			q_u= 1640 psi, TUW= 180 pcf		98	98
50						q_u= 1690 psi, TUW= 160 pcf		100	100
55									
60									
65									

COMPLETION DEPTH: 55.0 ft
DATE: 1-14-21

DEPTH TO WATER
IN BORING: Dry to 20 ft

DATE: 1/14/2021

RECRQDN200-2 20-136.GPJ 9-20-21

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

LOG OF BORING NO. S7

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 145+45, 75 ft Lt

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
			SURF. EL: 270±						
			Firm tan and gray fine sandy clay w/silt pockets and ferrous stains	8			52		
			Medium dense reddish tan and gray clayey fine gravel, silty	17			33		
5				18					
				18			42		
			Stiff tan and gray fine sandy clay, silty	20			66		
10									
			- very stiff at 13 to 18 ft - w/silt seams and layers below 13 ft	28					
15									
			- stiff below 18 ft	22			71		
20									
			Medium dense light brownish gray and tan silty fine sand w/silt seams and layers	12		-NON-PLASTIC-	37		
25									
			- slightly clayey below 28 ft	16			26		
30									
			Moderately hard to hard tan and gray weathered shale	25/0"					

COMPLETION DEPTH: 60.0 ft
DATE: 1-4-21

DEPTH TO WATER IN BORING: 19 ft

DATE: 1/4/2021

RECRQDN200-2 20-136.GPJ 9-20-21

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

LOG OF BORING NO. S7

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 145+45, 75 ft Lt

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
			(continued)						
			Moderately hard to hard dark gray shale, flat bedded						
				25/0"					
40						q_u= 1650 psi, TUW= 161 pcf		95	88
45						q_u= 1410 psi, TUW= 167 pcf		97	82
50								98	98
55								87	87
60									
65									

COMPLETION DEPTH: 60.0 ft
DATE: 1-4-21

DEPTH TO WATER IN BORING: 19 ft

DATE: 1/4/2021

RECRQDN200-2 20-136.GPJ 9-20-21

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

LOG OF BORING NO. S8

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 144+15, 75 ft Lt

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
			SURF. EL: 270±						
			Stiff gray and reddish brown fine sandy clay w/a little crushed stone (fill)	17					
			- very stiff below 2 ft	42			48		
5			Soft brown and gray silty clay, slightly sandy w/ferrous stains	6			85		
			- stiff below 6 ft	16					
10			Medium dense to dense yellowish tan and gray fine sandy silt, slightly clayey w/silty fine sand seams and layers	30			51		
15			- dense below 13 ft	31					
20			Firm to stiff tan and gray silty clay, slightly sandy	10			84		
25			Stiff brown and gray fine sandy clay, silty	13			76		
30			Medium dense brown and gray silty fine sand, slightly clayey	16			41		
				21					

COMPLETION DEPTH: 65.0 ft
DATE: 12-17-20

DEPTH TO WATER IN BORING: 19.6 ft

DATE: 12/17/2020

RECRQDN200-2 20-136.GPJ 9-20-21

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

LOG OF BORING NO. S8

CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 144+15, 75 ft Lt

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
			Moderately hard to hard dark gray shale, flat bedded	25/0"					
40									
						TCP 50/2" - 50/1.5"			
45								100	100
						q_u= 1460 psi, TUW= 160 pcf			
50								96	96
55								100	100
60								95	95
65									

COMPLETION DEPTH: 65.0 ft
DATE: 12-17-20

DEPTH TO WATER IN BORING: 19.6 ft

DATE: 12/17/2020

RECRQDN200-2 20-136.GPJ 9-20-21

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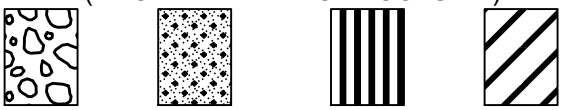
SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

(SHOWN IN SYMBOLS COLUMN)

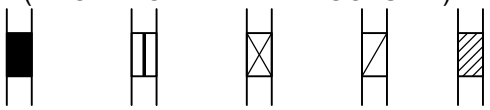


Gravel Sand Silt Clay

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 9-20-21

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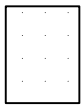
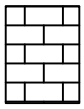
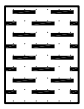
BORING LOG TERMS – ROCK

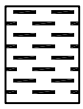
ROCK TYPES
(SHOWN IN SYMBOLS COLUMN)


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

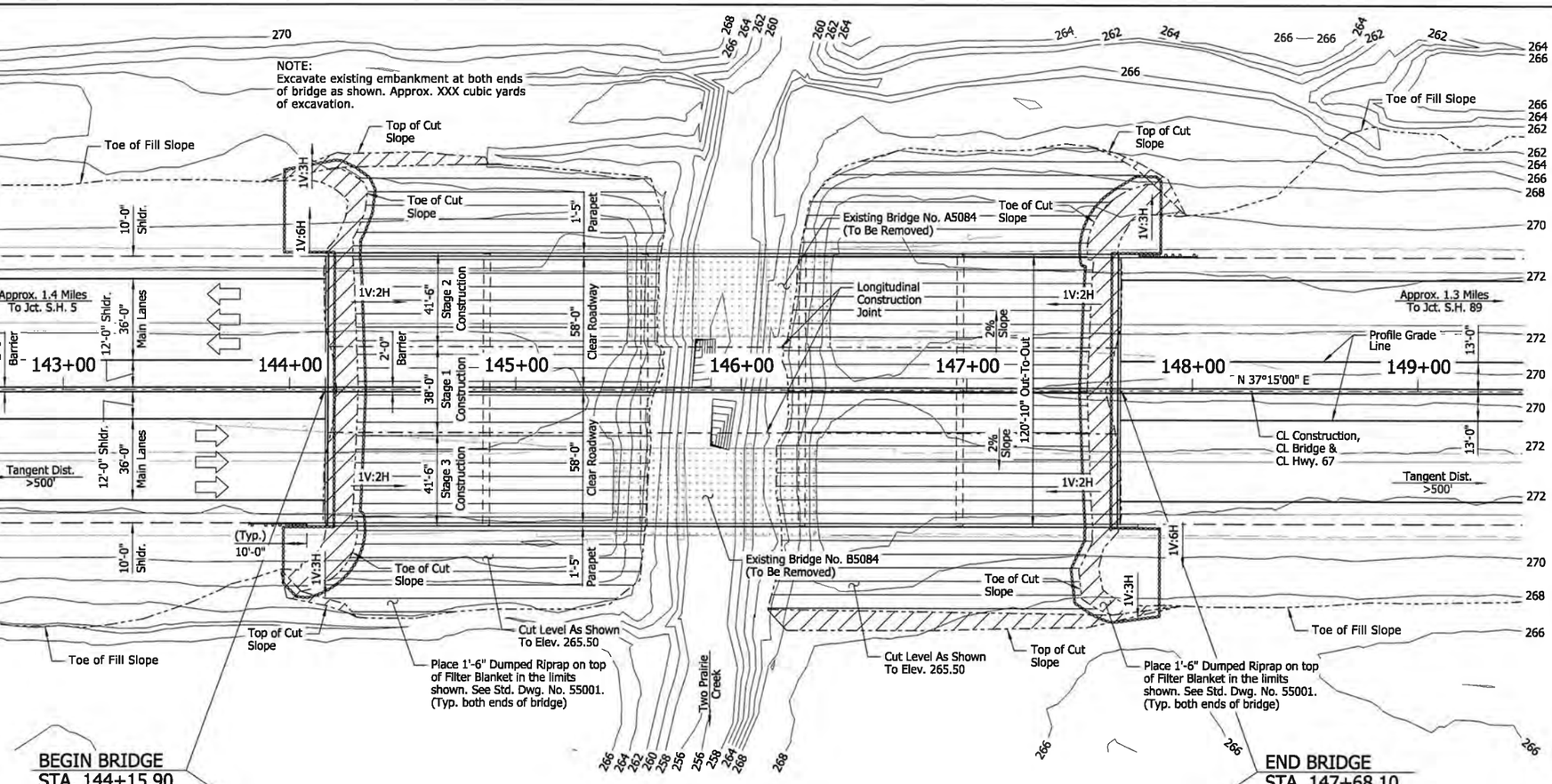
Rock Quality Designation (RQD) –

RQD (Percent)	Diagnostic Description
Greater than 90	Excellent
75 – 90	Good
50 – 75	Fair
25 – 50	Poor
Less than 25	Very Poor

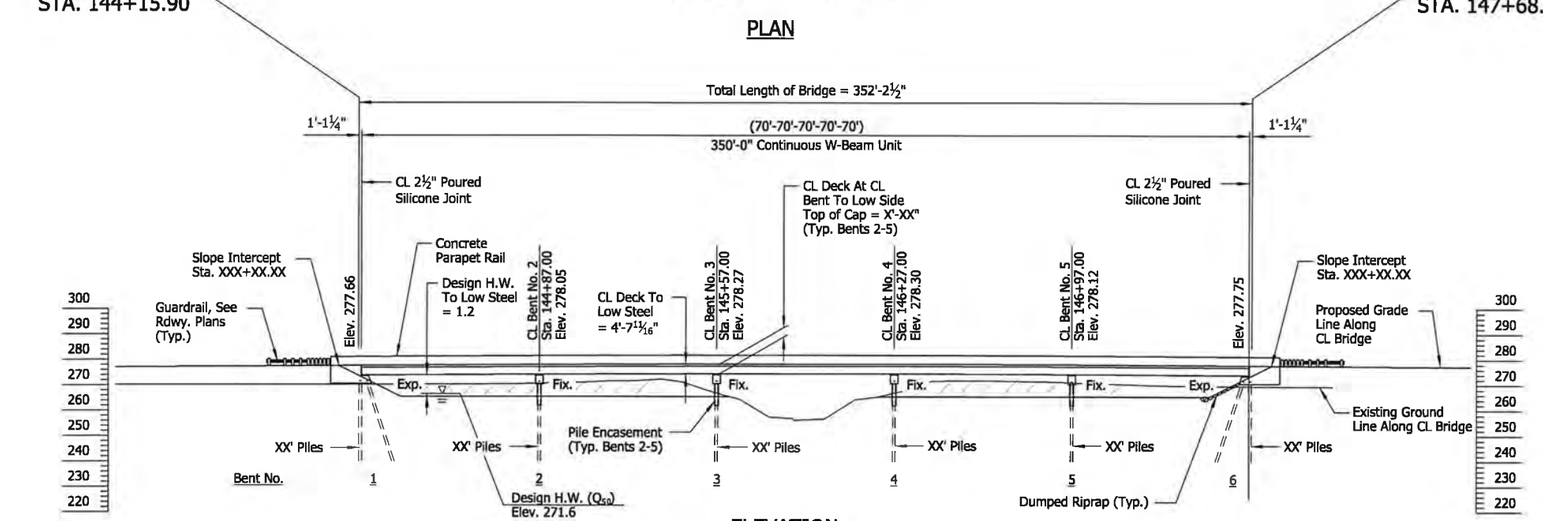
KEYROCK FHWA 3-2-12

APPENDIX A

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.			
				JOB NO.		CA0613	$SN1101$	ST
				① $BN01$		LAYOUT		$DN1101$



PLAN



ELEVATION

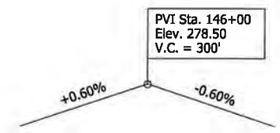
NOTE:
Stations shown are along CL Construction. Elevations shown are theoretical working point elevations at CL Bridge. Any vertical dimension referenced to CL Deck is based on theoretical working point elevation at CL Bridge. See "ROUNDING DETAIL" on Std. Dwg. No. 55007 for additional information.

FOR R/W DATA, SEE ROADWAY PLANS

NOTE:
The proposed bridge has been positioned to avoid interference with the existing piling. The Contractor shall verify measurements before driving any piling. Any adjustments necessary to fit the proposed bridge to the existing bridge location shall be submitted for the Engineer's approval.

NOTES:
Use Type 1 Special Approach Gutters and Type 1 & 2 Special Approach Slabs at both ends of the Bridge, see Dwg. No. $DNXXXX$.

For "ELEVATION OF SOIL BORINGS", "GENERAL NOTES", "BORING LEGENDS", and "N-VALUES", see Dwg. No. $DNXXXX$.



VERTICAL CURVE DATA

Hwy. 67
(Profile Grade 13'-0" Lt. & Rt. of CL Construction)

HYDRAULIC DATA

FLOOD DESCRIPTION	FREQUENCY	DISCHARGE	① NATURAL WATER SURFACE ELEVATION	WATER SURFACE ELEVATION WITH BACKWATER
	YEARS	CFS	FEET	FEET
DESIGN	50	5,548	269.7	271.6
BASE	100	6,395	269.9	272.0
EXTREME	500	8,527	270.4	272.9
OVERTOPPING	N/A	N/A	N/A	N/A

① Unconstricted water surface elevation without structure or roadway approaches

Q100 backwater elevation for existing structure = 272.6

Proposed Low Bridge Chord Elev. = 272.77 (Sta. 144+19.40)

Drainage Area = 14.4 square miles
Historical high water Elev. = XXX.XX.

SOIL BORINGS NOT AVAILABLE AT TIME OF PRINTING

PRELIMINARY NOT FOR CONSTRUCTION

BRIDGE ENGINEER

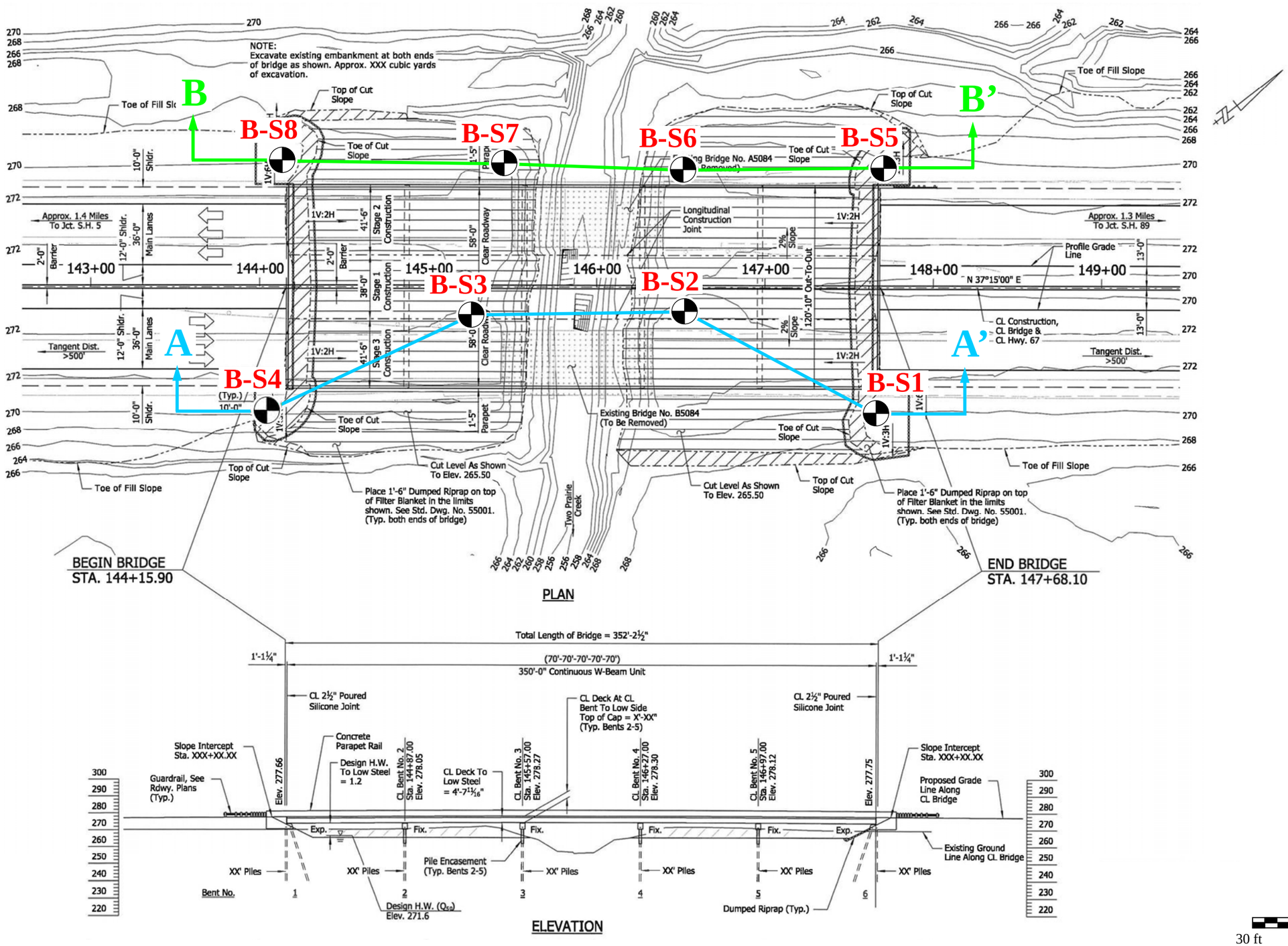
SHEET 1 OF 2
LAYOUT OF BRIDGE OVER TWO PRAIRIE CREEK
JACKSONVILLE - CABOT (WIDENING & INTCHNG. IMPVTS.) (SEL. SECS.) (F)
LONOKE COUNTY
ROUTE 67 SEC. 11

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

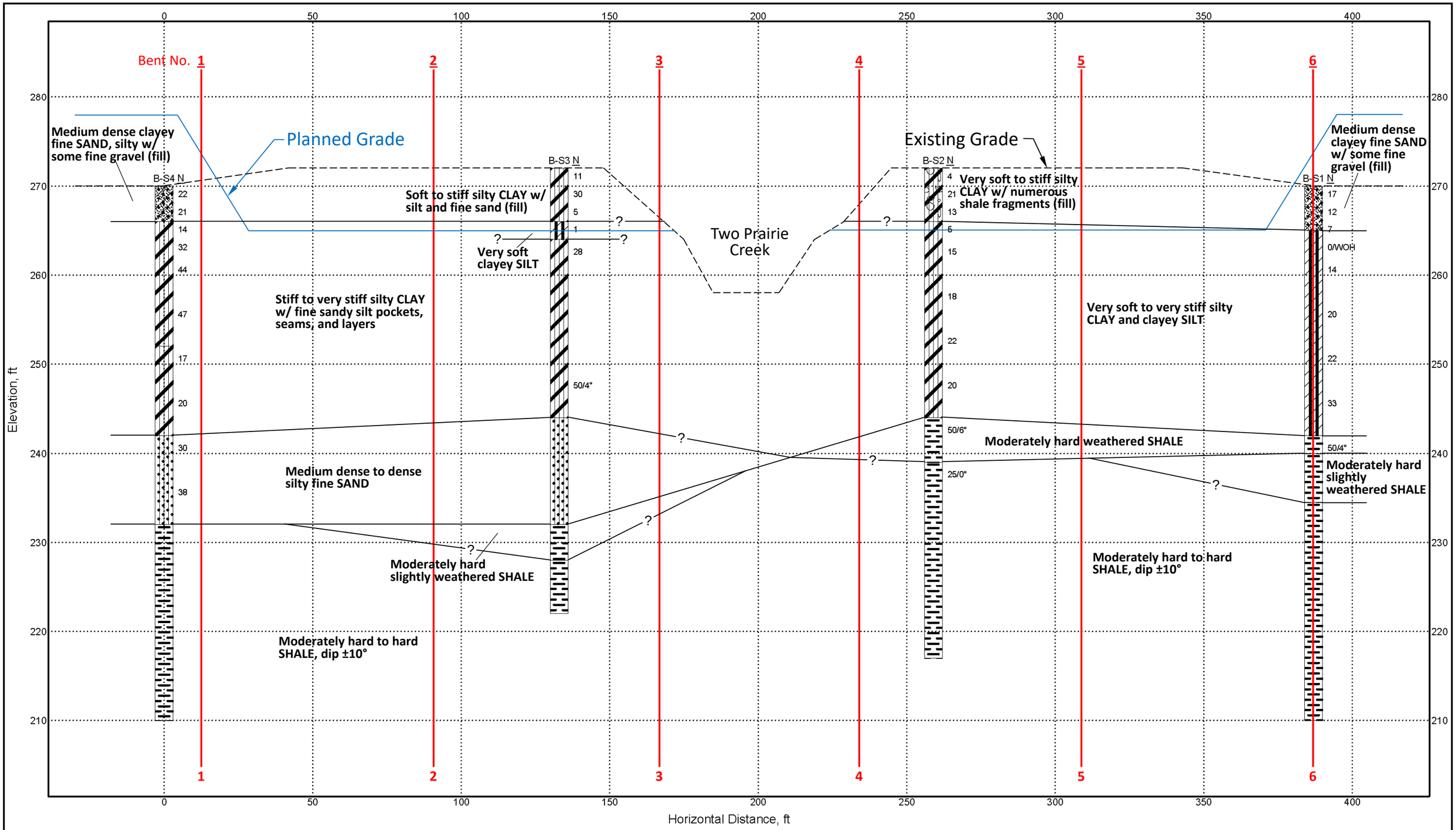
DRAWN BY: HEW DATE: AUG. 2020 FILENAME: BCA0613_L1.DGN
CHECKED BY: DRG DATE: SEPT. 2020 SCALE: 1" = 30'-0"
DESIGNED BY: RAK DATE: AUG. 2020
BRIDGE NO. $BN01$ DRAWING NO. $DN1101$

CSWyle 10/26/2020 2:19:27 PM
WORKSPACE: ARDOT Bridge (2019)
L:\2017\17012575 - 061599 Hwy 5 - White Co Line\Drawings\061599-S101-LO.dgn
REVISED DATE:

APPENDIX B



Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**PLAN OF PROFILES** **CA0613 Hwy. 67 over Two Prairie Creek** **Lonoke County, Arkansas**	**Scale: As shown**	**Job No. 20-136**	**PLATE 2**



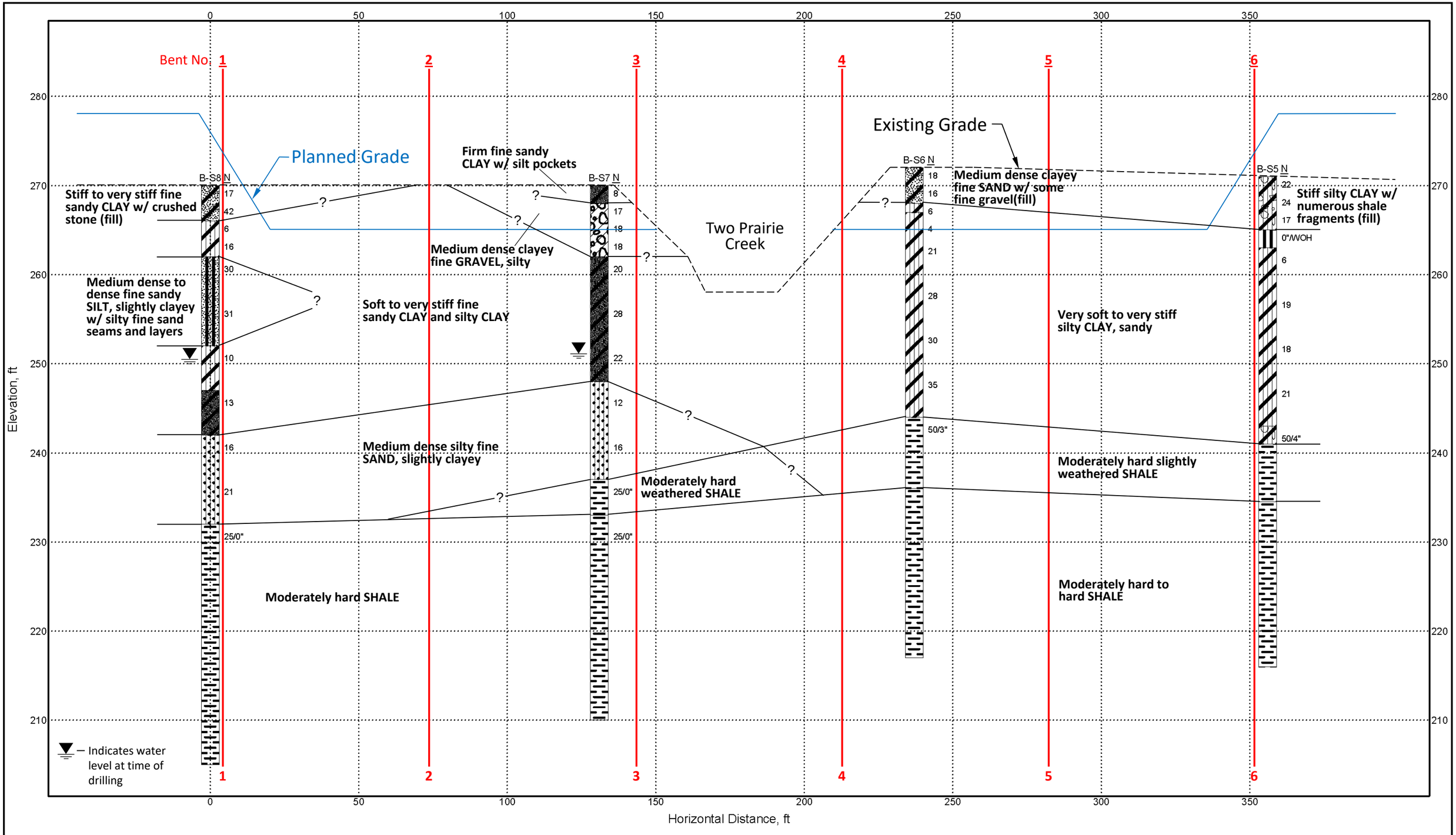
Grubbs, Hoskyn, Barton & Wyatt, Inc.

NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

SCALE:
1" = 30' Horizontal
1" = 10' Vertical

Generalized Subsurface Profile A-A'
CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

Project Number: 20-136



Grubbs, Hoskyn, Barton & Wyatt, Inc.

NOTES:
1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

SCALE:
1" = 30' Horizontal
1" = 10' Vertical

Generalized Subsurface Profile B-B'
CA0613 Hwy 67 over Two Prairie Creek
Lonoke County, Arkansas

Project Number: 20-136

APPENDIX C


20-136
BS1
Run1: 30-35'
Run2: 35-40'
Grubbs, Hoskyn,
Barton & Wyatt


20-136
B-S1
RUN 3: 40-45'
RUN 4: 45-50'
Grubbs, Hoskyn, Barton & Wyatt INC.
CONSULTING ENGINEERS


20-136
B-S1
RUN 5: 50-55'
RUN 6: 55-60'
Grubbs, Hoskyn,
Barton & Wyatt


20-136
B-S2
RUN 1: 35-40'
RUN 2: 40-45'
Grubbs, Hoskyn,
Barton & Wyatt INC.
CONSULTING ENGINEERS


20-136
B-52
RUN 3: 45-50'
RUN 4: 50-55'
Grubbs, Hoskyn,
Barton & Wyatt, INC.
CONSULTING ENGINEERS


20-136
B-S3
RUN 1: 40-45'
RUN 2: 45-50'
Grubbs, Hoskyn,
Barton & Wyatt, INC.
CONSULTING ENGINEERS


20-136
B-54
Run 1: 40-45'
Run 2: 45-50'
Grubbs, Hoskyn,
Barton & Wyatt Inc
CONSULTING ENGINEERS


20-036
B-54
Run 3 : 50-55'
Run 4: 55-60'
Grubbs, Hoskyn,
Barton & Wyatt INC
CONSULTING ENGINEERS


20-136
B-55
RUN 1: 30-35'
RUN 2: 35-40'
Grubbs, Hoskyn,
Barton & Wyatt INC
CONSULTING ENGINEERS


20-136
B-55
RUN 3: 40-45'
RUN 4: 45-50'
Grubbs, Hoskyn,
Barton & Wyatt INC
CONSULTING ENGINEERS


20-136
B-55
RUN 5 : 50-55'
Grubbs, Hoskyn,
Barton & Wyatt INC
CONSULTING ENGINEERS


20-136
B-S6
RUN 1: 30-35'
RUN 2: 35-40'
Grubbs, Hoskyn,
Barton & Wyatt
55 →


20-136
B-56
RUN 3: 40-45'
RUN 4: 45-50'
Grubbs, Hoskyn,
Barton & Wyatt


20-136
B-56
RUN 5: 50-55'
Grubbs, Hoskyn,
Barton & Wyatt


20-136
B-57
Run1: 40'-45'
Run2: 45'-50'
Grubbs, Hoskyn,
Barton & Wyatt INC.
CONSULTING ENGINEERS


20-136
B-57
Run 3: 50'-55'
Run 4: 55'-60'
Grubbs, Hoskyn, Barton & Wyatt INC.
CONSULTING ENGINEERS


20-136
B-58
Run1: 45'-50'
Run2: 50'-55'
Grubbs, Hoskyn, Barton & Wyatt, INC.
CONSULTING ENGINEERS


20-136
B-58
Run 3: 55'-60'
Run 4: 60'-65'
Grubbs, Hoskyn, Barton & Wyatt, INC.
CONSULTING ENGINEERS

APPENDIX D

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: CA0613 Highway 67 over Two Prairie Creek
LOCATION: Lonoke County, Arkansas
GHBW JOB NUMBER: 20-136

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING						USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	3/4 in.	3/8 in.	#4	#10	#40	#200		
S1	2.5-3.5	14	28	22	6	---	---	72	---	---	46	SM-SC	A-4
S1	4.5-5.5	29	26	21	5	---	---	91	---	---	72	ML-CL	A-4
S1	9-10	20	23	19	4	---	---	99	---	---	73	ML-CL	A-4
S2	2.5-3.5	12	28	20	8	---	---	70	---	---	28	SC	A-2-4
S2	9-10	20	26	17	9	---	---	99	---	---	78	CL	A-4
S2	24-25	20	37	19	18	---	---	100	---	---	83	CL	A-6
S3	2.5-3.5	16	28	21	7	---	---	96	---	---	79	ML-CL	A-4
S3	6.5-7.5	24	25	21	4	---	---	100	---	---	95	ML-CL	A-4
S3	14-15	18	21	20	1	---	---	100	---	---	60	ML	A-4
S3	24-25	22	35	18	17	---	---	100	---	---	85	CL	A-6
S3	29-30	20	NON-PLASTIC			---	---	99	---	---	37	SM	A-2-4
S4	2.5-3.5	16	25	20	5	---	---	72	---	---	39	SM-SC	A-4
S4	6.5-7.5	18	34	19	15	100	100	100	100	98	92	CL	A-6
S4	19-20	25	32	18	14	---	---	100	---	---	71	CL	A-6
S4	29-30	20	---	---	---	---	---	100	---	---	38	SM-SC	A-4
S4	34-35	24	NON-PLASTIC			---	---	100	---	---	48	SM	A-4
S5	0.5-1.5	16	29	20	9	---	---	94	---	---	69	CL	A-4
S5	2.5-3.5	11	35	22	13	---	---	46	---	---	21	GC	A-2-6
S5	6.5-7.5	23	NON-PLASTIC			---	---	99	---	---	84	ML	A-4

Grubbs, Hoskyn,
Barton & Wyatt, Inc.
CONSULTING ENGINEERS

PLATE

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: CA0613 Highway 67 over Two Prairie Creek
LOCATION: Lonoke County, Arkansas
GHBW JOB NUMBER: 20-136

BORING No.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING						USCS CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	3/4 in.	3/8 in.	#4	#10	#40	#200		
S5	14-15	22	27	16	11	---	---	93	---	---	70	CL	A-6
S5	29-30	20	37	25	12	---	---	90	---	---	34	SM	A-2-6
S6	2.5-3.5	12	34	23	11	---	---	76	---	---	39	SC	A-6
S6	6.5-7.5	20	25	18	7	---	---	100	---	---	88	CL-ML	A-4
S6	14-15	18	24	19	5	---	---	100	---	---	81	CL-ML	A-4
S7	0.5-1.5	16	30	20	10	---	---	80	---	---	52	CL	A-4
S7	2.5-3.5	13	25	21	4	---	---	63	---	---	33	SM-SC	A-2-4
S7	4.5-5.5	6	26	24	2	---	---	11	---	---	8	GP-GM	A-2-4
S7	6.5-7.5	12	25	21	4	---	---	68	---	---	42	SM-SC	A-4
S7	9-10	18	24	19	5	---	---	100	---	---	66	CL-ML	A-4
S7	19-20	20	24	18	6	---	---	100	---	---	71	CL-ML	A-4
S7	24-25	21	NON-PLASTIC			---	---	100	---	---	37	SM	A-2-4
S7	29-30	20	17	15	2	100	100	99	98	61	26	SM	A-2-4
S8	2.5-3.5	13	30	26	4	100	87	79	69	59	48	SM	A-4
S8	4.5-5.5	22	24	20	4	---	---	99	---	---	85	CL-ML	A-4
S8	9-10	16	21	19	2	---	---	---	---	---	51	ML	A-4
S8	19-20	23	26	20	6	---	---	---	---	---	84	CL-ML	A-4
S8	24-25	22	23	18	5	---	---	99	---	---	76	CL-ML	A-4
S8	29-30	19	17	15	2	---	---	99	---	---	41	ML	A-4

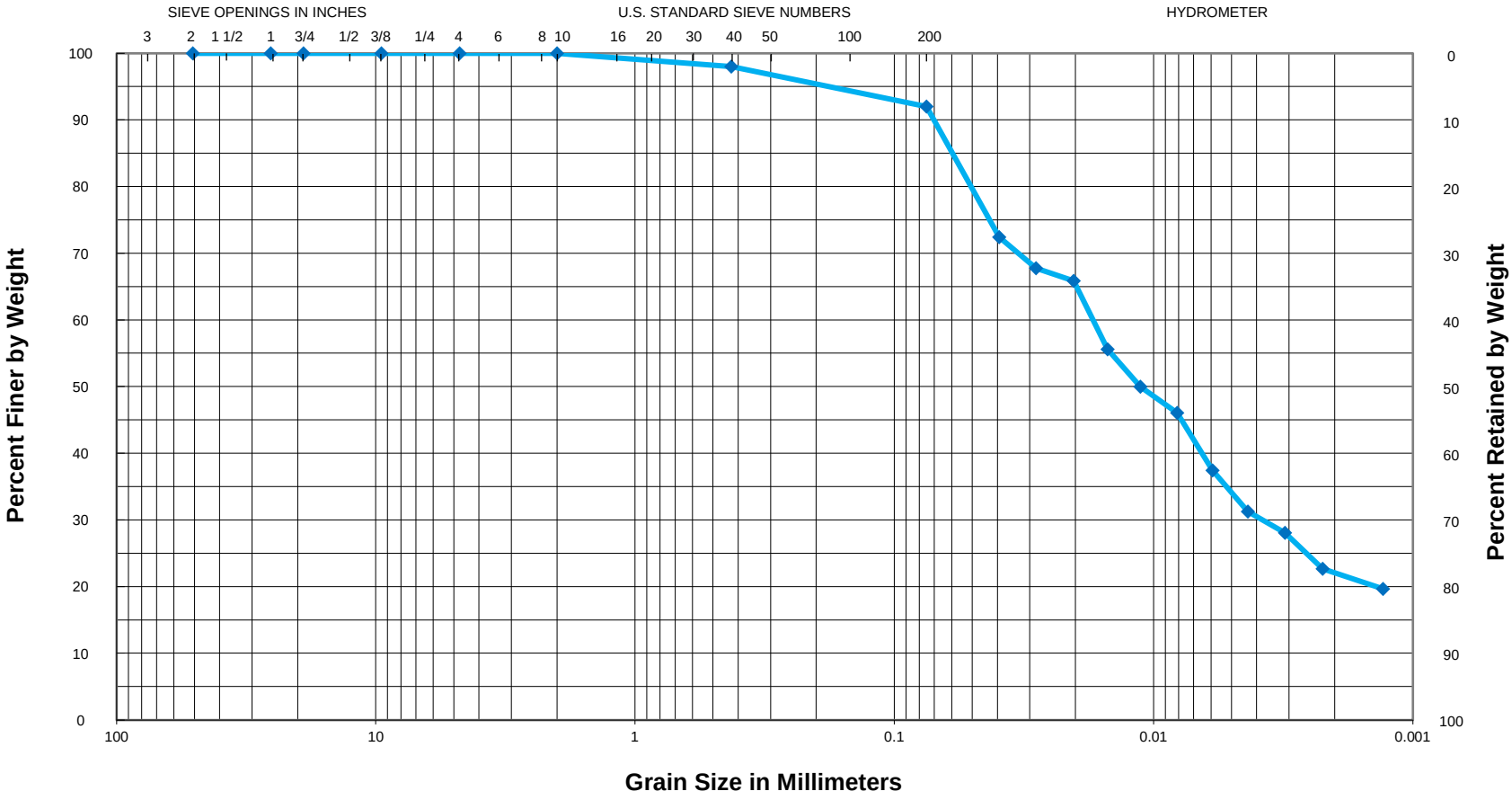
Grubbs, Hoskyn,
Barton & Wyatt, Inc.
CONSULTING ENGINEERS

PLATE

20-136

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, INC.
CONSULTING ENGINEERS



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

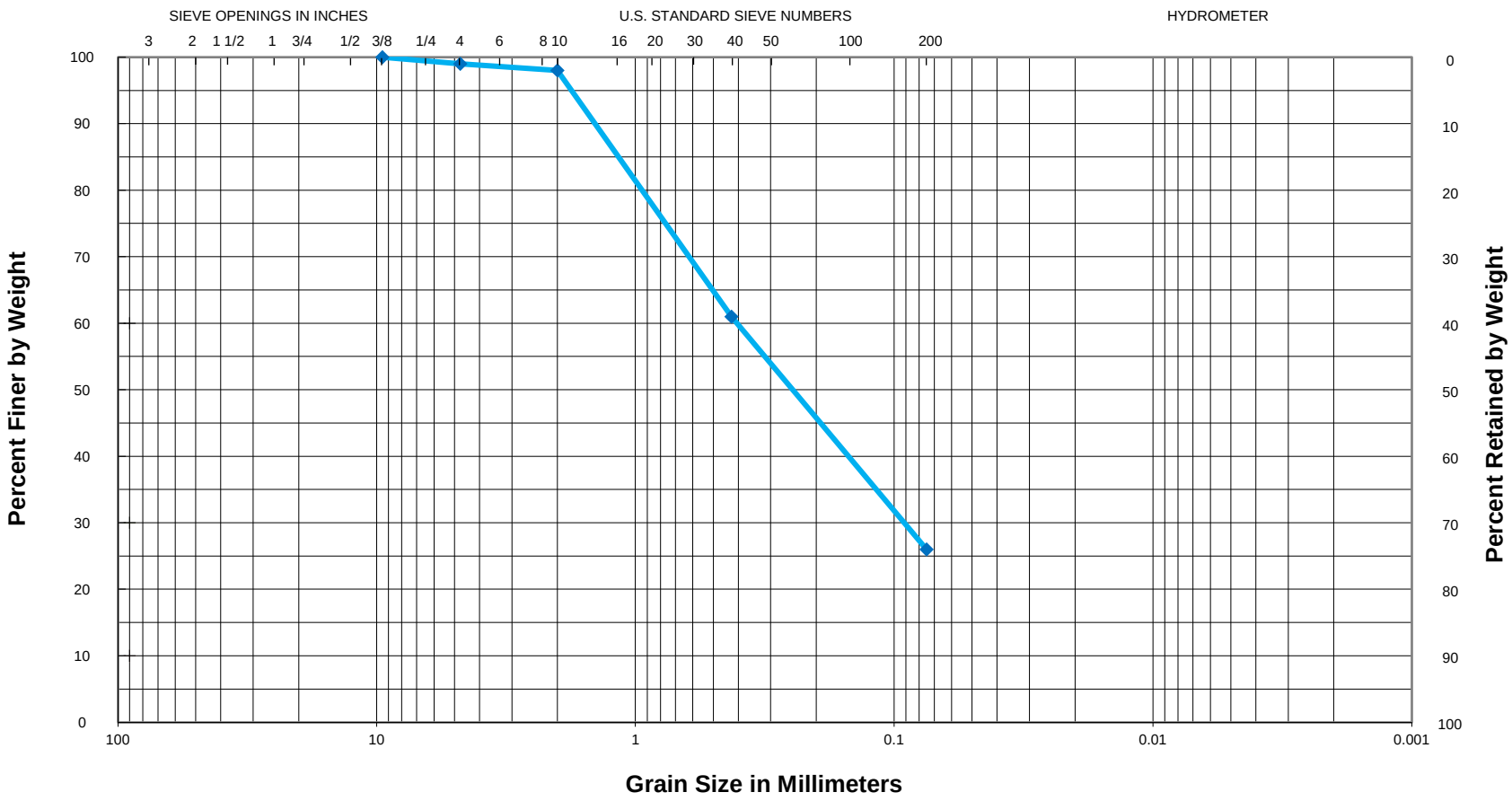
Sample: Boring S4, 6.5-7.5 ft; LL = 34, PL = 19, PI = 15
Description: Light gray silty CLAY

USCS Classification = CL
AASHTO Classification = A-6

20-136

GRAIN SIZE CURVE

Grubbs, Hoskyn, Barton & Wyatt, INC.
CONSULTING ENGINEERS



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring S7, 29-30 ft; LL = 17, PL = 15, PI = 2
Description: Light brownish gray and tan silty fine to medium SAND, slightly clayey

USCS Classification = SM
AASHTO Classification = A-2-4

20-136

GRAIN SIZE CURVE

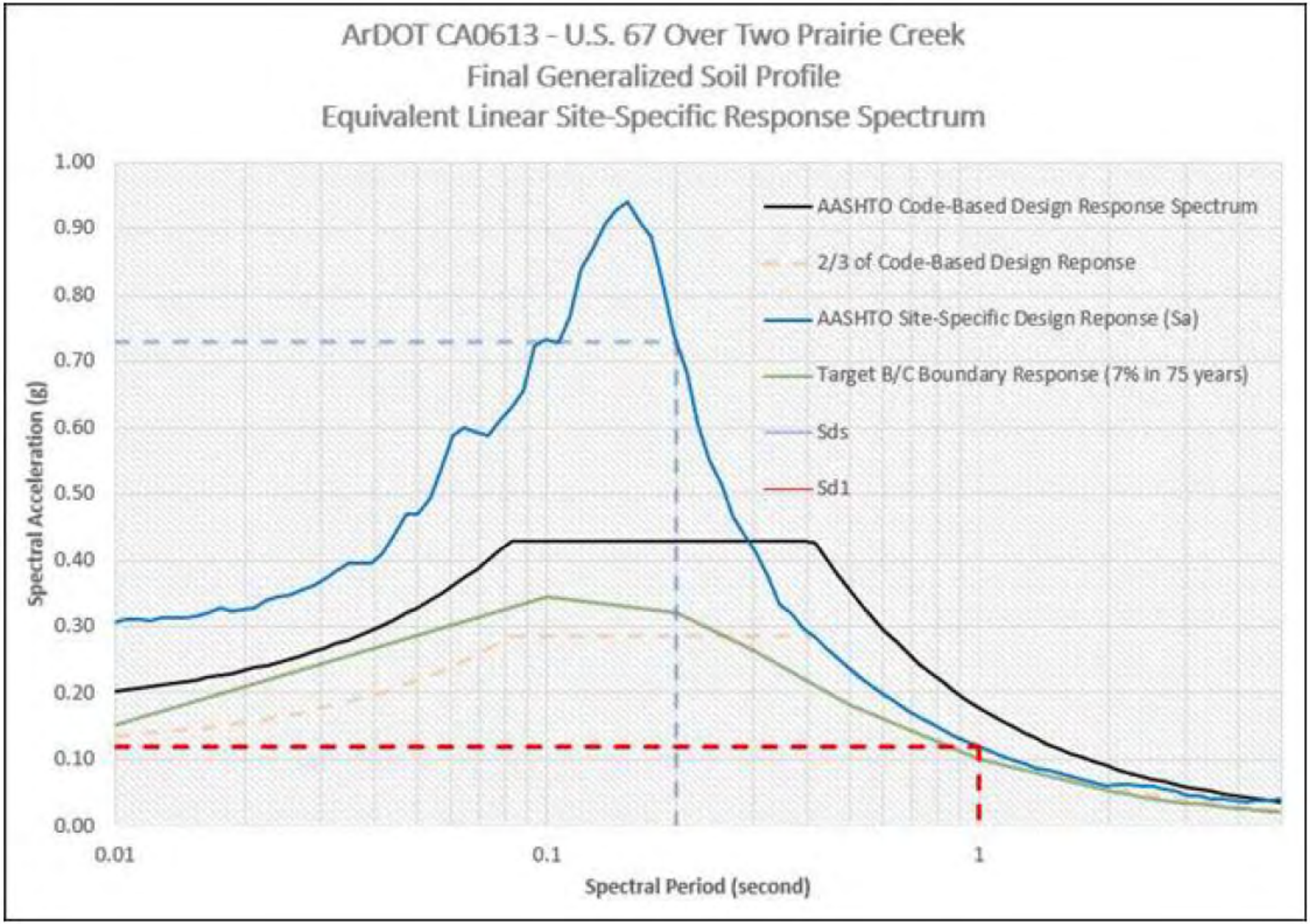
Grubbs, Hoskyn, Barton & Wyatt, INC.
CONSULTING ENGINEERS

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

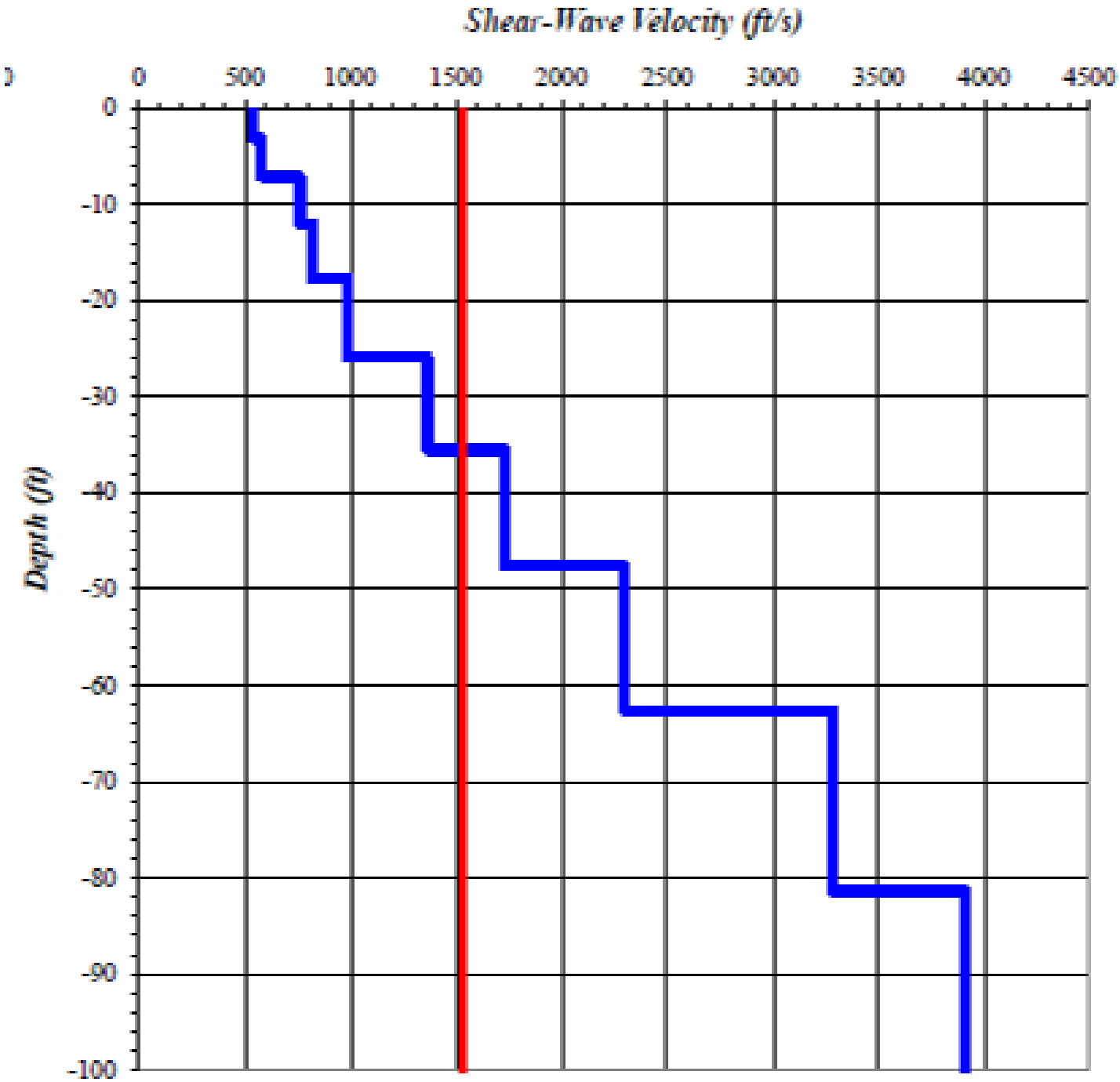
Sample: Boring S8, 2.5-3.5 ft; LL = 30, PL = 26, PI = 4
Description: Gray and reddish brown fine sandy CLAY w/ a little crushed stone (fill)

USCS Classification = SM
AASHTO Classification = A-4

APPENDIX E


ArDOT CA0613 - U.S. 67 Over Two Prairie Creek
Final Generalized Soil Profile
Equivalent Linear Site-Specific Response Spectrum
AASHTO Code-Based Design Response Spectrum
2/3 of Code-Based Design Reponse
AASHTO Site-Specific Design Reponse (Sa)
Target B/C Boundary Response (7% in 75 years)
Sds
Sd1
Spectral Acceleration (g)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.01
0.1
1
Spectral Period (second)

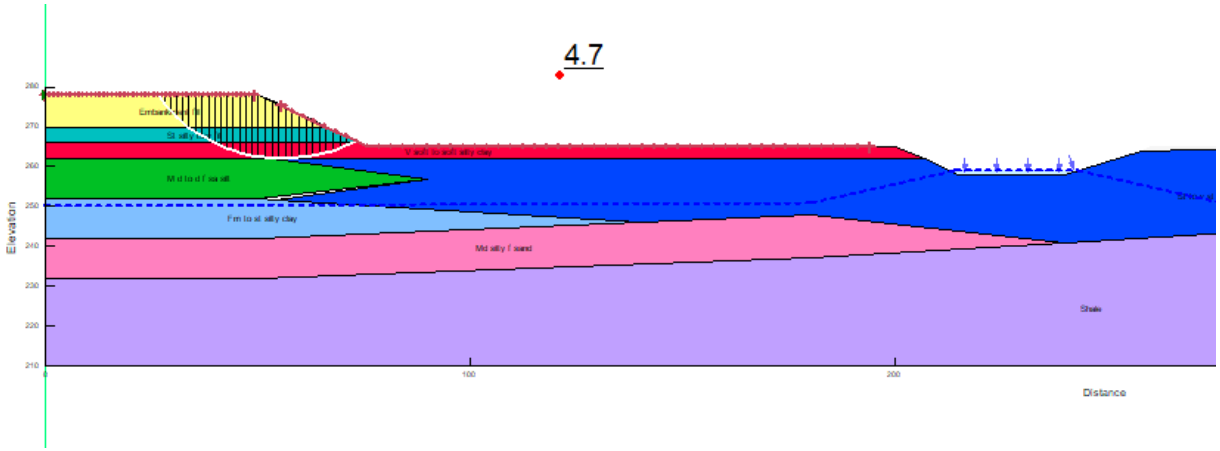
U.S. 67 Over Two Prairie Creek



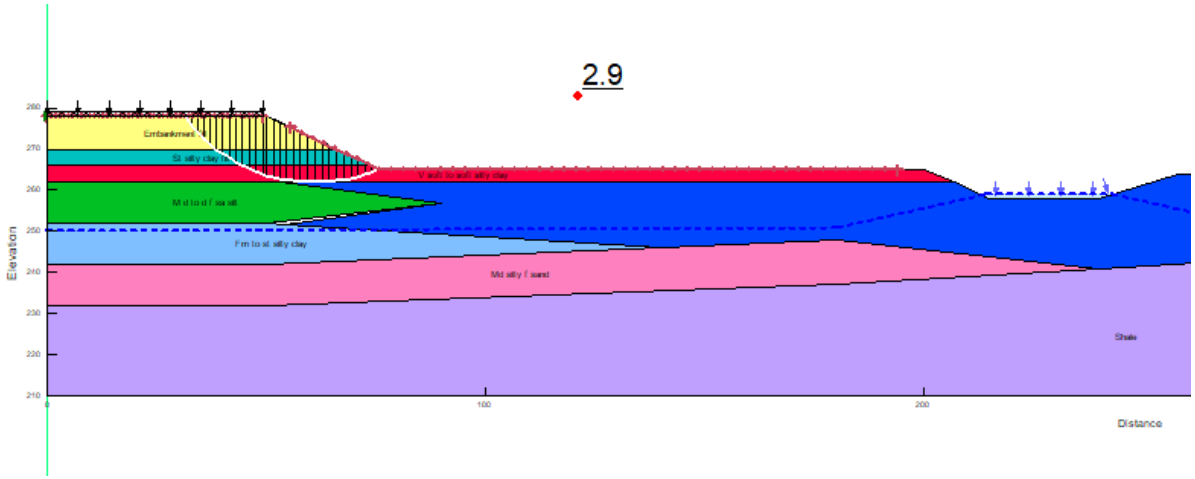
APPENDIX F

Summary of Stability Analysis Results
CA 0613 Hwy 67 over Two Prairie Creek
GHBW Job No. 20-136
Lonoke County, Arkansas

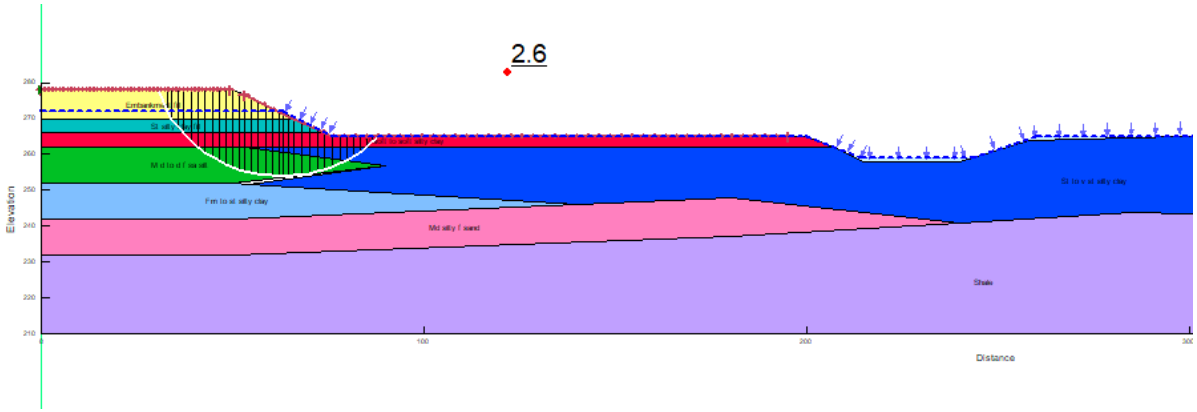
	Design Loading Condition	Calculated Minimum Factor of Safety
South End Slope (Bent 1) (2H:1V)	End of Construction	4.7
	Long Term	2.9
	Rapid Drawdown from El 272 to El 259	2.6
	Seismic ($k_h = A_S/2 = 0.155$)	2.2
South End Side Slope (Bent 1) (3H:1V)	End of Construction	5.1
	Long Term	2.7
	Rapid Drawdown from El 272 to Existing Grade	3.0
	Seismic ($k_h = A_S/2 = 0.155$)	2.1
North End Slope (Bent 6) (2H:1V)	End of Construction	3.6
	Long Term	2.3
	Rapid Drawdown from El 272 to El 259	2.5
	Seismic ($k_h = A_S/2 = 0.155$)	1.8
North End Side Slope (Bent 6) (3H:1V)	End of Construction	3.5
	Long Term	2.4
	Rapid Drawdown from El 272 to Existing Grade	2.3
	Seismic ($k_h = A_S/2 = 0.155$)	1.8



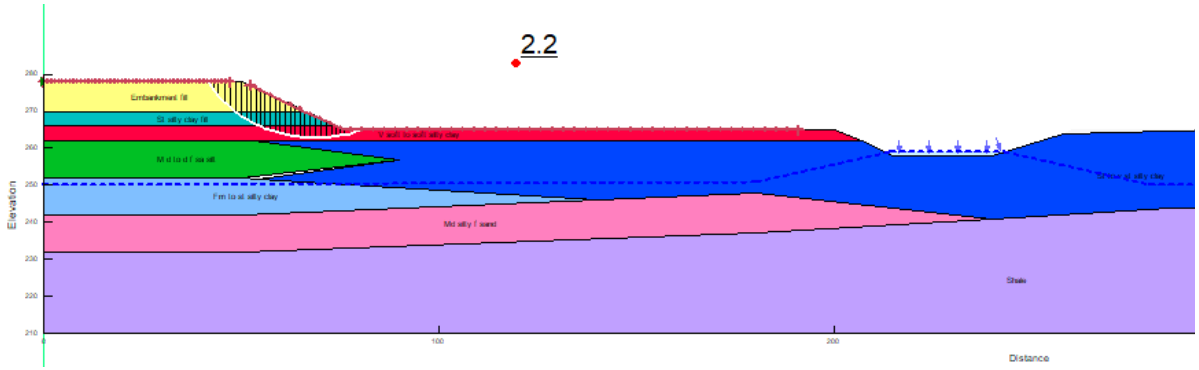
Results of Stability Analyses – End of Construction
Bent 1 End Slope
2H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek



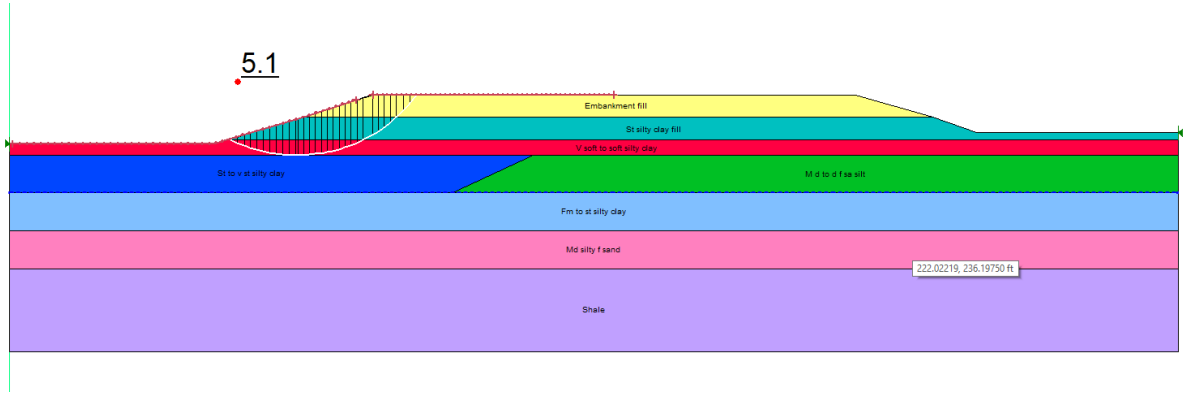
Results of Stability Analyses – Long Term Condition
Bent 1 End Slope
2H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek



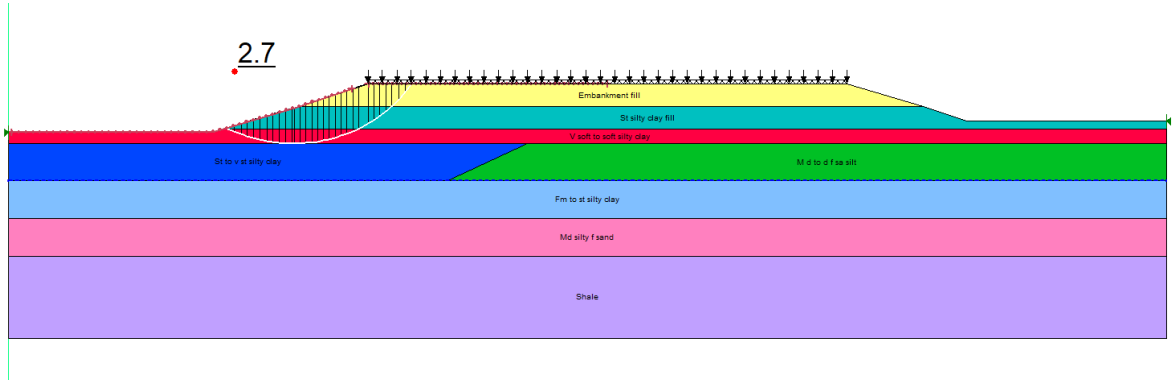
Results of Stability Analyses – Rapid Drawdown Condition from El 272 to El 259
Bent 1 End Slope
2H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek



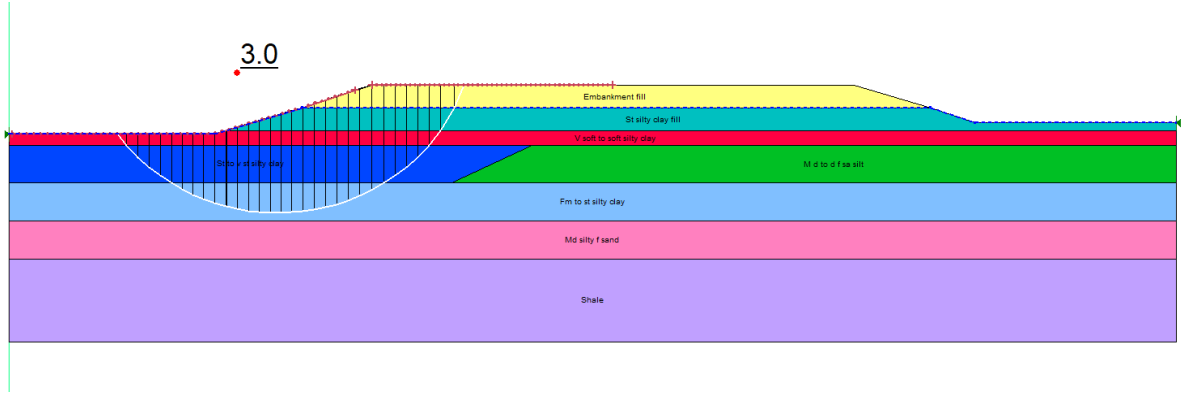
Results of Stability Analyses – Seismic Condition ($k_h = A_S /2 = 0.155$)
Bent 1 End Slope
2H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek



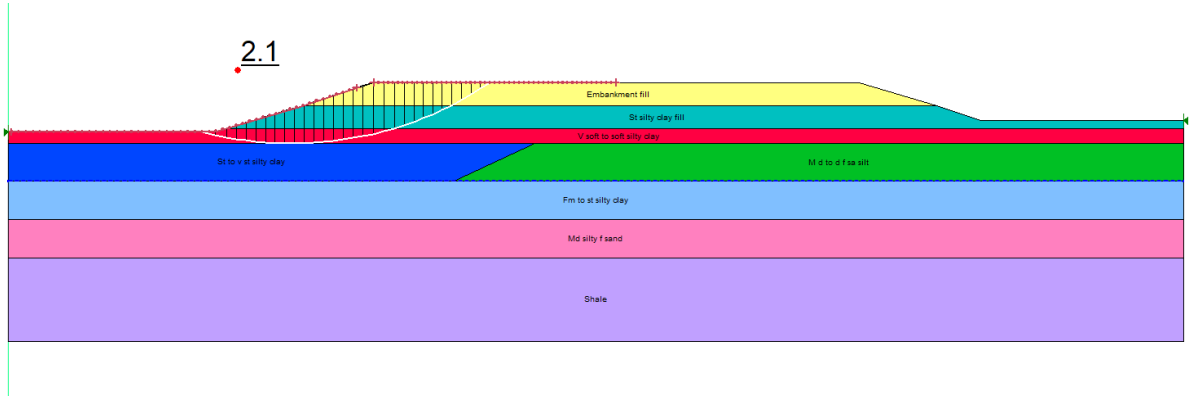
Results of Stability Analyses – End of Construction
Bent 1 Side Slope
3H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek



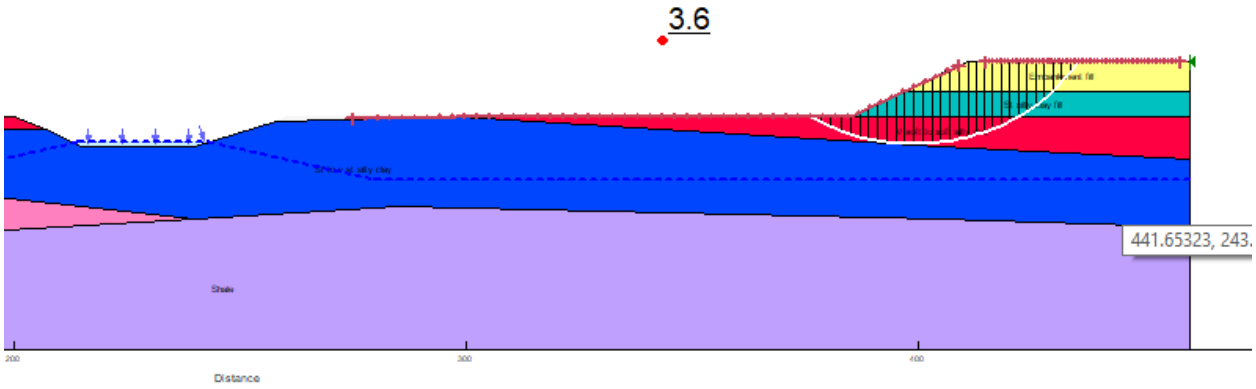
Results of Stability Analyses – Long Term Condition
Bent 1 Side Slope
3H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek



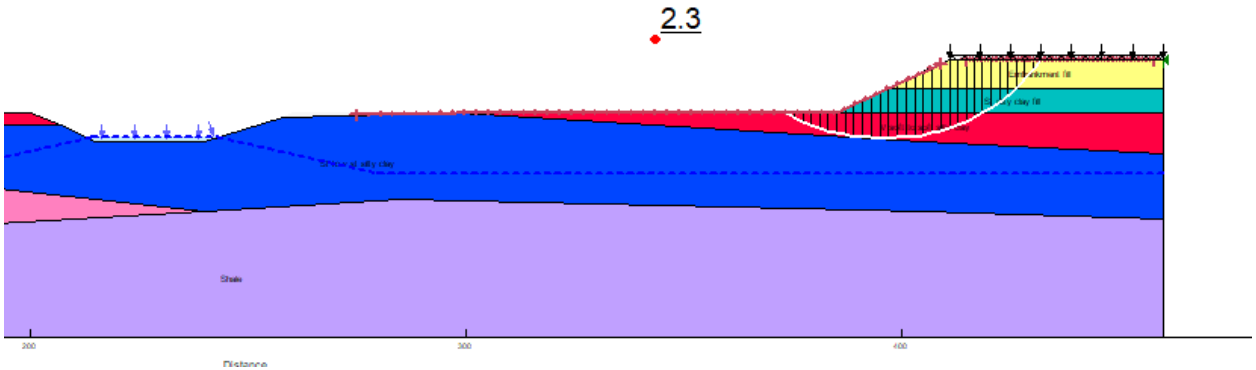
Results of Stability Analyses – Rapid Drawdown Condition from El 272 to Existing Grade
Bent 1 Side Slope
3H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek



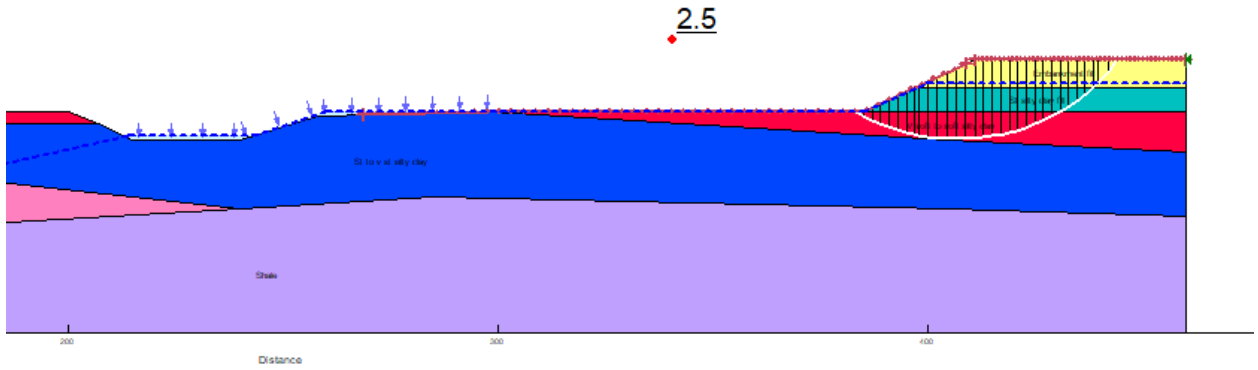
Results of Stability Analyses – Seismic Condition ($k_h = A_S /2 = 0.155$)
Bent 1 Side Slope
3H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek



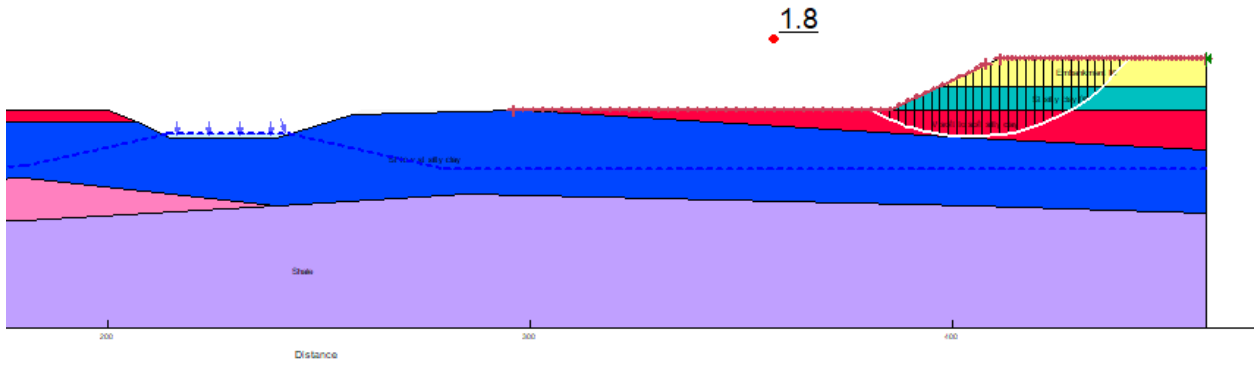
Results of Stability Analyses – End of Construction
Bent 6 End Slope
2H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek



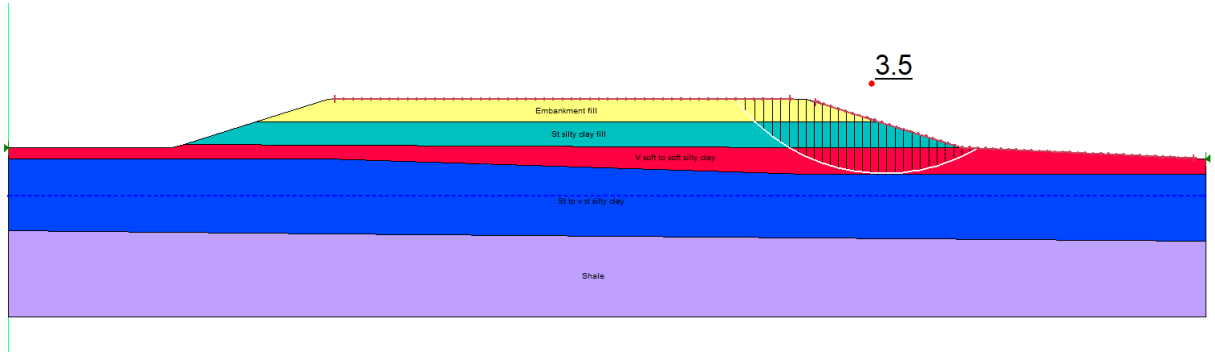
Results of Stability Analyses – Long Term Condition
Bent 6 End Slope
2H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek



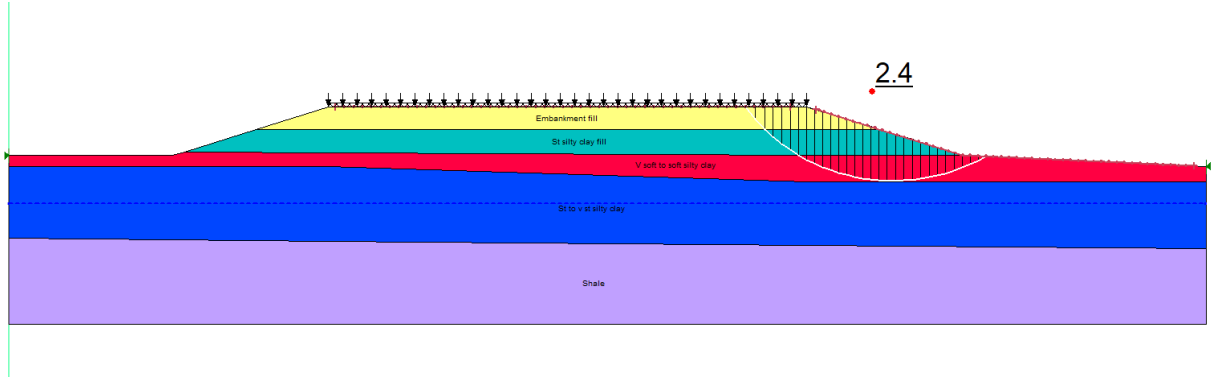
Results of Stability Analyses – Rapid Drawdown Condition from El 272 to El 259
Bent 6 End Slope
2H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek



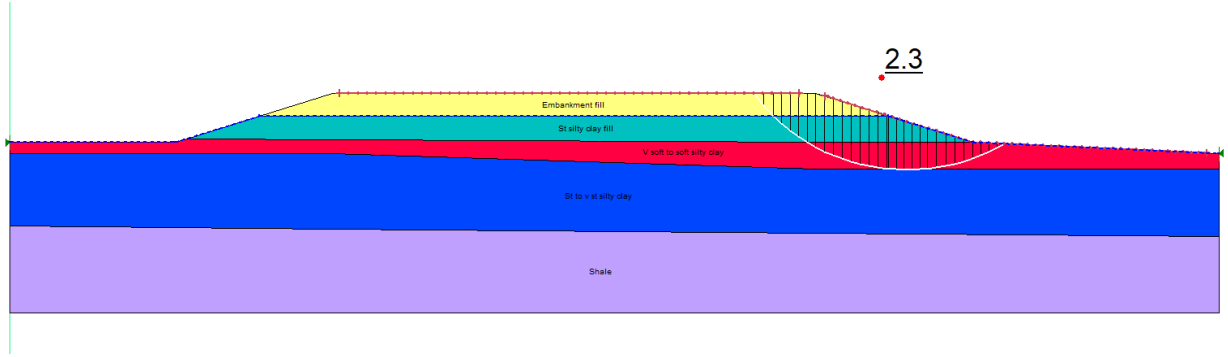
Results of Stability Analyses – Seismic Condition ($k_h = A_S /2 = 0.155$)
Bent 6 End Slope
2H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek



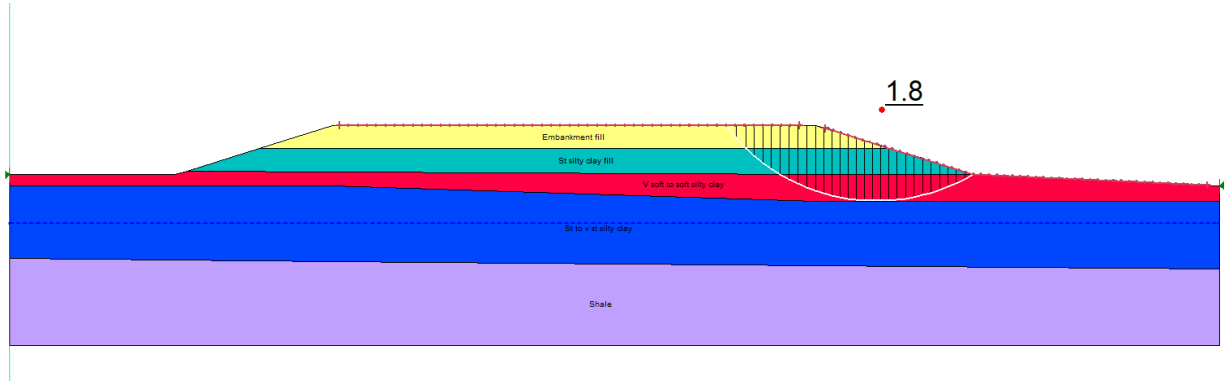
Results of Stability Analyses – End of Construction
Bent 6 Side Slope
3H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek



Results of Stability Analyses – Long Term Condition
Bent 6 Side Slope
3H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek



Results of Stability Analyses – Rapid Drawdown Condition from El 272 to Existing Grade
Bent 6 Side Slope
3H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek



Results of Stability Analyses – Seismic Condition ($k_h = A_S /2 = 0.155$)
Bent 6 Side Slope
3H:1V Slope, H=13 ft ±
20-136 – CA 0613 Hwy 67 over Two Prairie Creek