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

P.O. Box 30970
Little Rock, Arkansas 72260-0970
#1 Trigon Place 72209
(501) 455-2536
FAX (501) 455-4137

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Bridgefarmer & Associates, Inc.
2350 Valley View Lane, 6th Floor
Dallas, Texas 75243

Attn: Mr. Shahriar Azad, P.E.

GEOTECHNICAL REPORT
I-30 BRIDGES over HWY. 70
ARDOT CA0601: HWY 70 – SEVIER ST (WIDENING) (S)
I-30 BRIDGE REPLACEMENTS, SALINE COUNTY, ARKANSAS

INTRODUCTION

This report provides the results of the geotechnical investigation performed relevant to the proposed I-30 Bridges over Hwy. 70 in Saline County, Arkansas. This project is an additional facet of the ArDOT Job CA0601: Hwy 70 – Sevier St (Widening) (S), on I-30 in Saline County, Arkansas. The results of the geotechnical investigation performed for the remainder of the CA0601 project have been previously submitted under separate cover. Recommendations for structure foundations and retaining walls were provided in April 2018. Those recommendations are confirmed herein.

ArDOT Job CA0601: Hwy 70 – Sevier St (Widening) (S), on I-30 in Saline County, Arkansas. We understand the replacement interchange twin bridges will be continuous composite plate girder units with five (5) bents, four (4) spans, and a total length of approximately 416 feet. We also understand that a foundation system consisting of steel piles is planned at the bridge ends (Bents 1 and 5). Initial plans were to utilize footings at the interior bents (Bents 2, 3, and 4). However, to facilitate constructability, drilled shaft foundations are now planned for the interior bents. Foundation loads of the new bridge are anticipated to be moderate. An MSE retaining wall (Wall AA) is planned at the north bridge end (Bent 5).

Recommendations for seismic site classification and bridge foundations for the planned twin bridges are discussed in the following report sections. Additionally, bearing capacity and global stability analyses have been performed for the plan MSE wall location and subgrade parameters

have been provided for pavement design. The results of the subsurface exploration program and laboratory test results are included in the attachments.

SUBSURFACE EXPLORATION

Subsurface conditions in the Hwy. 70 and Interstate 30 location were evaluated for this supplemental study by drilling six (6) sample borings to depths of 30 to 60 ft below existing grades in the structure areas, three (3) sample borings to depths of 13.5 to 24 ft in or near the plan wall alignments, and 13 sample borings to 10-ft depth in the plan roadway and ramp alignments. In addition, borings drilled previously for the interchange and I-30 main lanes were utilized where appropriate.

The site vicinity is shown on Plate 1 of Attachment 1. The approximate locations of the borings utilized for this project phase are shown on Plates 2 through 8 of Attachment 1. A summary of the subsurface exploration program is provided on Plate 9 of Attachment 1. Keys to the terms and symbols used on the logs are included as Plates 10 and 11 of Attachment 1. The results of the borings performed for the structures are provided as Plates 1 through 8 of Attachment 2. Logs of the borings performed in the retaining wall areas are provided as Plates 1 through 3 of Attachment 3. The logs of borings drilled in the plan roadway alignment are shown as Plates 1 through 13 of Attachment 4. Additionally, boring logs from the 2015 study that are relevant to the roadway and ramp alignments are provided in Attachment 5. The boring logs show soil and rock stratigraphy and the results of the field and laboratory tests. The approximate ground surface elevation at the boring locations, as inferred from the topographic information provided by the Engineer, is also shown on each log. It must be recognized that these elevations are approximate only and actual elevations may vary.

The borings were drilled with truck-mounted Mobile B-53 and SIMCO 2800 rotary-drilling rigs and a track-mounted CME 850 rotary-drilling rig. A combination of dry-auger and rotary-wash drilling techniques was utilized to advance the borings. Samples were obtained using a 2-in.-diameter split-barrel sampler driven into the strata by blows of a 140-lb safety hammer (Mobile B-53) or automatic hammer (SIMCO 2800 and CME 850) with 30-in. drop 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 a portion thereof, is defined as the Standard Penetration Number (N). Recorded N-values are shown on the boring

logs in the "Blows Per Ft" column. Where rock hardness precluded obtaining samples via the SPT, cuttings were obtained for use in visual classification.

Selected rock cores were recovered using a 5-ft-long, NQ_{wl}-size, double-walled 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 sound rock core greater than 4-inch length divided by the total length of the run and expressed in percent. Both these values are presented in the right hand column of the log forms, opposite the corresponding core run. Photographs of the rock cores are provided in Attachment 6.

All samples were examined and visually classified by a geotechnical engineer, geologist, or geotechnical technician. Representative samples were placed in appropriate containers to prevent moisture loss and/or change in condition during transfer to our laboratory for further examination and testing. Rock cores were removed from the core barrel and placed in waxed cardboard core boxes. All field logs, soil samples, and rock cores were reviewed by a GHBW geotechnical engineer.

The borings were drilled using dry-auger procedures to the extent possible in order to facilitate groundwater observations. Groundwater levels were measured during and at the completion of drilling operations. Observations regarding groundwater are noted in the lower-right portion of each log and are discussed in subsequent sections of this report.

LABORATORY TESTING

To evaluate pertinent physical and engineering characteristics of the foundation and subgrade soil and rock, laboratory tests consisting of natural water content determinations and classification tests were performed on selected representative soil and rock samples. A total of 126 natural water content determinations were performed to develop a water content profile for each boring. The results of these tests are plotted on the logs as solid circles, 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, 36 liquid and plastic (Atterberg) limit determinations and 35 sieve analyses were performed on selected 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 percent of soil passing the No. 200 Sieve is noted in the "Minus No. 200"

column on the log forms. Classification test results, as well as soil classification by the Unified Soil Classification System and AASHTO Soil Classification System, are summarized in Attachment 7.

The compressive strength of the shale and sandstone bedrock was evaluated by performing five (5) uniaxial compression tests on representative rock cores. The measured compressive strength is tabulated on the log forms, in lbs per sq in., at the appropriate depth. The total unit weight is also shown with the compression test results.

Two (2) laboratory moisture-density relationship (Proctor) tests were performed on bulk samples obtained in the ramp alignments. These tests were performed on fine-grained soils to evaluate the moisture-density relationship of potential subgrade or borrow. The Proctor test and bulk sample classification test results are provided in Attachment 8.

GENERAL SITE and SUBSURFACE CONDITIONS

Site Conditions

The project consists of the interchange of Interstate 30 and Highway 70, specifically the replacement of Bridges 3251 BW and 3251 AW and subsequent on- and off-ramps. The existing Interstate 30 is an interstate highway with two (2) traffic lanes in each direction and an asphalt concrete pavement section. Outside the existing roadway, the north and south sides of the roadway alignment are predominantly undeveloped woodlands with scattered residential and commercial developments. The roadway is bordered by both shallow ditches and steep hillsides. Surface drainage of the project area is highly variable. Surface drainage of the existing roadway is good and drainage of the surrounding terrain varies from poor to fair.

Site Geology

Geologically, the project extends primarily through the mapped exposure of the Ordovician Period Womble Shale Formation. The Womble Shale typically consists of black, graphitic shale with thin layers of limestone, numerous quartz veins, silty sandstone, and some chert. The shale can often be somewhat slatey. Depending upon the extent of weathering, the rock hardness can range from soft to hard. The highly folded and steeply dipping units of the formation contain numerous inactive faults, folds and fractures. The formation is reported to range from 500 to 1200 feet thick. It rests conformably on the Blakely Sandstone.

Additionally, the portion of the project southwest of Boring R34 is in a mapped exposure of Tertiary Period Midway Group. The Midway Group is of marine origin and is comprised typically

of silty clay, clay, sand, and silt units. Locally, high-plasticity clays are predominant in the Midway with marl-like calcareous clay units at depth. The formation also includes calcareous shale, arenaceous limestone, calcareous glauconitic sandstone, conglomerate, and clay shale units. Locally, limestone units often lie disconformably on Pennsylvanian sediments.

Seismic Conditions

In light of the results of the borings drilled at the Hwy. 70 location and the surface geology of the project locale, a Seismic Site Class C (very dense soil and soft rock profile) is considered applicable for the Interchange with respect to the criteria of the AASHTO LRFD Bridge Design Specifications Seventh Edition 2014[1].

The 2014 edition of the AASHTO Guide Specifications indicates that the Peak Ground Acceleration (PGA) having a 7 percent chance of exceedance in 75 years (or mean return period of approximately 1000 years) for the bridge locations is predicted to be 0.103 for a Site Class C. Based on the Hwy. 70 bridge location, the short period spectral acceleration coefficient (S_{DS}) value is 0.276g and the 1-sec period spectral acceleration coefficient the 1.0-sec period spectral acceleration coefficient (S_{D1}) value is 0.129g. Table 3.10.6-1 indicates that a Seismic Performance Zone 1 is fitting for the bridge site.

Subsurface Conditions - Roadway

The subsurface conditions revealed by the ramp borings are shown in detail on the boring logs presented in Attachments 4 and 5. The surficial soils in the roadway alignment consist primarily of variable on-site fill. The fill ranges from a silty clay and shale blend to silty and clayey sand. The majority of the subgrade soils range from A-2-4 to A-2-7. The highly variable on-site fill exhibits poor to good compaction.

The on-site fill is underlain by variable firm to stiff clay, silty clay and fine sandy clay. The shear strength of the natural overburden soils is typically moderate to high. The predominant silty clay and fine sandy clay exhibit low plasticity strength and low compressibility. However, the localized clay units have high to very high plasticity.

The existing embankment fill and natural soils are underlain by weathered shale and sandstone at variable depths of 6 ft to in excess of 10-ft depth. The low hardness to moderately hard highly weathered shale exhibits low compressibility and moderate to high shear strength.

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[1] AASHTO LRFD Bridge Design Specifications, 7th Edition; AASHTO; 2014

Based on the results of the borings, the subgrade soils in the project alignment include A-2-4, A-2-6, A-2-7, A-4, and A-7-6 soils, which correlate with variable poor to excellent subgrade. Given these classifications, subgrade conditions are considered to vary from poor to good. In areas were grades are raised above existing pavements or granular on-site fill, the subgrade is generally good. Subgrade conditions must be assessed at the time of subgrade preparation.

The roadway borings were advanced by dry-auger procedures to facilitate observation of groundwater conditions. Shallow groundwater was not encountered in the borings in February and March 2018. Though not encountered in the borings, shallow perched groundwater could be present, particularly during wet seasons, in utility trenches, and under existing pavements. Groundwater conditions will vary with seasonal precipitation, surface runoff and infiltration, and water levels in nearby ponds, streams, and drainage features.

Subsurface Conditions – Bridges

The existing embankment fill at the I-30/US70 Bridge site is variable soft to stiff silty clay with a variable content of shale, sandstone, and quartz fragments. The embankment fill extends to variable depths. Compaction of the embankment fill varies from poor to good.

The natural overburden soils below the embankment fill are comprised of variable strata of firm to stiff clay, silty, and fine sandy clay with localized and discontinuous units of medium dense to dense clayey fine sand. Dense sandy fine to coarse gravel is locally present on top of the shale, apparently alluvial deposits. The natural overburden soils exhibit variable low to moderate shear strength and moderate compressibility.

The overburden soils lie on low hardness to moderately hard weathered shale and moderately hard to hard shale with sandstone seams, layers and strata. Quartz inclusions and veins are common. The predominant weathered shale and shale and subordinate sandstone are generally strong and competent and exhibit fair to good rock quality.

The bridge borings were advanced by dry-auger procedures to the extent possible to facilitate observation of groundwater conditions. Groundwater was locally encountered at 6- to 19-ft depth in February and March 2018. Perched water may be expected in the on-site fill and fractured zones of the weathered shale. Seasonal springs and seeps are likely as infiltrated surface water moves downgradient from areas of higher terrain. Groundwater conditions will vary with

seasonal precipitation, surface runoff and infiltration, and water levels in nearby ponds, streams, and drainage features.

ANALYSES and RECOMMENDATIONS

Foundation Design

Foundations for the replacement twin bridges 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 at the bridge locations, the anticipated moderate bridge foundation loads, and our understanding of the project, we recommend that foundation loads be supported on steel piling at the bridge ends (Bents 1 and 5) and on drilled shafts at the interior bents (Bent 2, 3, and 4). Recommendations for foundations are discussed in the following report sections.

Piling Foundations - Bents 1 and 5

We recommend that the foundation loads at the bridge ends be supported on steel piles. Steel HP12x53 or HP14x73 piles, or heavier sections, are recommended. Other pile sizes or types may be evaluated if desired. Piling at bridge ends should extend through the overburden embankment clay, silty clay, clayey sand, and weathered shale to bear in the moderately hard dark gray shale or moderately hard gray weathered fine-grained sandstone. At the north end, piles should extend through the MSE wall reinforced fill zone to bear in the recommended bearing strata. All piles should be driven to practical refusal. All steel piles should be fitted with rock points.

Bearing capacities of piles driven to refusal must be determined using the AASHTO Load and Resistance Factor Design (LRFD) structural design procedure. We recommend that nominal resistance (P_n) of steel piles be determined based on the yield strength of steel H piles (f_y) and the net end area (A_{net}) of the section. Given that the piles will be driven to refusal in hard rock with the potential for driving damage, we recommend a maximum allowable stress (σ_{all}) of 0.25 f_y. An

effective resistance factor (φ_b) of 0.50 is recommended for end bearing piles. This effective resistance factor for steel piles has been based on the assumption of difficult driving.

It has been our experience that allowable pile capacities of 96 tons for HP12x53 piles and 133 tons for HP14x73 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. It is expected that steel piles will be isolated from the north abutment reinforced backfill by casings. Post-construction downdrag loads due to settlement of embankment fill are expected to be negligible.

We recommend a minimum pile penetration of 10 ft below natural grade. We recommend a minimum pile length of 10 feet. Preboring is not expected to be required.

Estimated pile tip elevations are summarized in Table 1 below.

Table 1: Estimated Tip Elevations of Steel Piles Driven to Refusal

Bent No.	Estimated Pile Tip Elevation, ft
1 (South bridge end)	394
5 (North bridge end)	399

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 capacity and as-built depth must be field verified.

Piles should be installed in compliance with AHTD Standard Specifications Section 805. Based on local experience, we recommend a hammer system capable of delivering at least 22,000 ft-lbs per blow for the steel piles at the abutments. A specific review and analysis of the pile-hammer system proposed by the Contractor should be performed by the Engineer prior to hammer acceptance and start of pile installation.

As a minimum, safe bearing capacity of test piles and production piles should be determined by AHTD Standard Specifications 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.

Drilled Shaft Foundations – Bents 2, 3, and 4

Drilled straight shafts are recommended for support of the foundation loads at Bents 2, 3, and 4, the interior bents. Drilled shafts should be founded with a minimum embedment of 8 ft or two (2) shaft diameters into the moderately hard to hard dark gray shale and/or the moderately hard gray fine-grained sandstone, whichever depth is greater. Drilled shafts founded as recommended may be sized using a maximum nominal end-bearing pressure (R_n) of 155 kips per sq foot. A resistance factor (φ) 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 to hard shale or sandstone as described is expected to be negligible. We also recommend that drilled shafts be sized for axial compression loads based on end bearing alone.

Anticipated minimum shaft bottom elevations, based on an assumed 48-in.-diameter shaft (rock socket), are summarized in the table below.

Table 2: Estimated Minimum Shaft Bottom Elevations of 48-in.-diameter Drilled Shafts

Bent No.	Approximate Elevation of Moderately Hard to Hard Dark Gray Shale, ft	Estimated Minimum Shaft Bottom Elevation, ft
2	393	385
3	392	384
4	400	392

It must be recognized that the bearing strata and shaft bottom elevations shown above are estimates only which have been inferred from the results of the borings. Where shaft diameter varies from 48 in., minimum shaft length requirements will vary from those shown above. Final shaft bottom elevation will depend on shaft diameter, required uplift resistance, and specific subsurface conditions. Drilled shaft as-built depth and penetration into the bearing stratum must be field verified.

Resistance to uplift loads will be provided by the weight of the foundations and circumferential shaft friction. For calculation of uplift capacity, a maximum nominal skin resistance (R_n) value of 12.5 kips per sq ft may be used for shaft penetration into the moderately hard to hard shale and sandstone. For the calculation of uplift capacity, shaft penetration in the overburden soils and all highly weathered to moderately weathered shale units should be neglected. A resistance factor (φ) of 0.40 is recommended for evaluation of drilled shaft uplift capacity.

A minimum embedment length of either 8 ft or two (2) shaft diameters into the moderately hard shale, whichever is greater, a minimum shaft length of 10 ft, and a minimum shaft diameter of 30 in. are recommended for drilled shafts. Drilled shaft excavations should be observed by the Engineer or Department to verify suitable bearing and adequate shaft penetration. Depending on the degree and extent of weathering and rock quality, localized deepening or shortening of shaft depths could be warranted.

Minor seepage may be encountered in shaft excavations, but can probably be controlled by expedient shaft construction. Nevertheless, temporary casing should be on site in the event it is required to control caving or seepage inflow.

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/sandstone. Where more resistant shale units or localized sandstone beds and quartz inclusions are encountered, coring or other rock excavation methods will be required to achieve the recommended penetration into the rock bearing stratum.

General Wall Design Considerations

The US70 Interchange project phase includes Wall AA on the north bridge end of the I-30 bridges over Hwy 70. It should be noted that the CA0601 project has two (2) MSE walls designated as "AA." The other Wall "AA" is located near Ramp 3 of the southbound I-30 lane at the Hwy 70 interchange. Recommendations for the other Wall AA are discussed in our submittal of November 8, 2016.

It is understood that MSE walls will be designed by Others on behalf of the Contractor. MSE wall backfill in the reinforced zone must comply with the Designer's specifications. As a minimum, we recommend that the reinforced zone backfill comply with AHTD Standard Specifications Section 302, SM-1. Consequently, the reinforced backfill should have a minimum total unit weight (γ) of 125 lbs per cu ft and a minimum angle of internal friction (ϕ) of 28°.

The wall layout drawings indicate the MSE wall subgrade elevations are planned at El 414± to El 416±. Suitable bearing for Wall AA is the low hardness to moderately hard weathered shale at 1 to 3 ft, more or less, below the plan wall bottom. Consequently, undercuts of 1 to 3 ft, more or less, are anticipated for the wall. Wall bearing will be in compacted crushed stone base undercut backfill placed on competent weathered shale. The wall layout and profile are shown in Attachment 9. Wall recommendations are summarized in the table provided in Attachment 9.

Wall Bearing

Analyses related to bearing capacity have been performed assuming a strap length of 70 percent of the wall height (0.7H) or a minimum length of 8 ft, whichever is greater. Based on the results of the borings, it is expected that walls will bear in crushed stone base (Class 7) placed over weathered low hardness to moderately hard weathered shale. We do recommend that undercut backfill consist of crushed stone base (AHTD Standard Specifications Section 303, Class 7), select granular fill (#57 stone - AASHTO M43), or an alternate approved by the Engineer or Department. Where clean stone is utilized for backfill, i.e., select granular fill, drainage should be provided for discharge of infiltrated surface water and groundwater.

We recommend a nominal bearing resistance (q_{ult}) value of 17,400 lbs per sq ft for bearing in the crushed stone base wall undercut backfill. We also recommend a minimum embedment of 2 ft for the retaining wall. Suitability of the MSE wall bearing stratum must be field verified by the Engineer or Department at the time of construction. Undercuts should extend at least 5 ft outside the reinforced zone to the extent possible.

For MSE wall design, a resistance factor (φ_b) of 0.65 is recommended with respect to bearing. Long-term post-construction settlement of the crushed stone base undercut backfill placed over weathered shale is expected to be negligible.

Resistance to MSE wall sliding can be evaluated using a nominal friction factor (tan δ) value of 0.45 for the recommended bearing strata. This value is based on sliding on the weathered shale bearing stratum below the relatively thin zone of undercut backfill. A resistance factor (φ_τ) of 1.0 is recommended for evaluation of sliding resistance.

Global Stability – End Slopes and Wall AA

Stability analyses were performed to verify the global stability of the end slope of the south bridge end embankment and Wall AA. For the bridge end, a simple slope with 3-horizontal to 1-vertical (3H:1V) configuration with a maximum height of 39 ft was analyzed. The wall cross section at Sta 6+40, where the MSE wall is expected to be highest, was selected for evaluation in stability analyses. A uniform surcharge of 250 lbs per sq ft was included at the top of the slope and top of the wall to account for vehicle traffic load surcharge.

To model the lower strength boundary of unclassified embankment fill (outside the reinforced zone), a cohesion value of 750 lbs per sq ft and an internal friction angle (ϕ) of 0° were assumed. It is understood that MSE walls will be designed by Others on behalf of the Contractor.

MSE wall backfill in the reinforced zone must comply with the Designer's specifications. As a minimum, the reinforced zone backfill is expected to comply with AHTD Standard Specifications Section 302, SM-1 or Section 303, Class 7. Consequently, the reinforced backfill should have a minimum total unit weight (γ) of 125 lbs per cu ft and a minimum angle of internal friction (ϕ) of 28°. For the purposes of stability analyses, the foundation soil properties were modeled based on the results of the borings and our experience with similar soils.

Stability analyses were performed using the computer program SLOPE/W 2007[2] and a Morgenstern-Price analysis. End of construction, long-term, and seismic conditions were analyzed. For the seismic condition, a horizontal acceleration coefficient (k_h) value equal to one-half the design peak ground acceleration value (A_s) was utilized in the stability analyses. Groundwater was not encountered in the borings and was not considered in the stability analyses.

The results of the stability analyses performed for the end slope and wall are provided in Attachment 10. These results indicate acceptable stability for all conditions analyzed for both the bridge end slope and the wall.

Pavement Subgrade Support

Site grading is expected to both raise grades and cut in the new ramp and roadway alignments. Based on the results of the borings, the on-site subgrade soils are expected to be predominantly variable on-site fill comprised predominantly of silty clay and shale fragment blends, clayey sand, and silty sand with various amounts of rock fragments. The predominant subgrade soil classifications will be AASHTO A-2-4, A-2-6, A-2-7, A-4, and A-7-6. Locally available borrow used for unclassified embankment fill is expected to be comprised predominantly of A-2-4, A-6, and A-2-6 soils.

Based on the results of the laboratory tests and correlation with the AASHTO classification of the on-site and anticipated subgrade soils, both for this project phase and prior study in the I-30 alignment for CA0601, subgrade support in the ramp alignments is expected to be fair to good. Subgrade conditions in the studied alignment are similar to previously investigated areas (see submittal of November 20, 2015). In light of this, our recommendations provided in the submittal of November 20, 2015 apply to areas studied in this submittal. As per our submittal of November 20, 2015, our previous recommendations for subgrade support

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[2] Slope/W 2007; GEO-SLOPE International; March 2008.

parameters are considered appropriate and are repeated below.

- Effective resilient modulus (M_R): 5100 lbs per sq in.
- Modulus of subgrade reaction (k): 130 lb per sq in. per in.
- R value: 21

Subgrade preparation and site grading should be performed in accordance with AHTD criteria (AHTD Standard Specifications Sections 210 and 214) and the recommendations of the Site Grading and Subgrade Preparation section of this report. We recommend that soils classifying as A-7-5 or A-7-6 with a plasticity index (PI) in excess of 18 be excluded from use as subgrade within 18 in. of the plan subgrade elevation. The top 18 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 unsuitable subgrade should be improved by undercut and replacement or addition of stabilization additives.

Based on the results of the borings, the depth of weak subgrade soils is expected to vary from minimal to 10 ft, or more or less, below existing grades. The average undercut depths range from minimal to approximately 3 ft below existing grades. The estimated depths of weak soils that will warrant undercut or improvement are summarized in Table 3 below.

Table 3. Estimated Depth of Undercut or Improvement

Project Facet	Estimated Undercut Depth[1], ft (from existing grade)	Approximate Station (CL)[2]	Representative borings
Ramp 1	Minimal to none	105+00 to 111+60	B-1, B-R22, and B-R21
	±3	111+60 to 115+25	B-R26
	Minimal to none	115+25 to 118+70	B-R20
	±2	118+70 to 123+50	B-R27
	Minimal to none	123+50 to 134+20	B-R28 and B-R23
Ramp 2	Minimal to none	200+00 to 224+50	B-R23 and B-R28
	±2	224+50 to 231+75	B-R27
	±3	231+75 to 238+50	B-R26
	Minimal to none	238+50 to 250+85	B-R25
Ramp 3	Minimal to none	300+00 to 330+56	B-2, B-3, B-R24, B-R31, B-R32
Ramp 4	Minimal to none	402+29 to 442+98	B-R29, B-R30, B-R33, B-R34, and B-

Project Facet	Estimated Undercut Depth[1], ft (from existing grade)	Approximate Station (CL)[2]	Representative borings
			R35
Highway	Minimal to none	221+25 to ~278+00	B-1, B-3, B-R22, B-R36, and B-R37

1 Depth estimated from the borings drilled in 2015 and February and March 2018. Actual unstable soil zone depth must be field verified.

2 Stationing refers to job facet station.

The undercut/improvement depths summarized in the table above are provided for estimation purposes only. The depths summarized above have been based on the results of the borings drilled in 2015 and February and March 2018. The required depth of improvement will vary with seasonal site conditions and final grading plans and must be field verified.

The as-built undercut or improvement depth requirements will vary with specific site conditions, seasonal precipitation, and construction methods. During dry periods of the year, it is feasible that the depth of unstable soils will be reduced. Undercut of localized low-lying areas and abandoned drainage features is considered likely even during dry conditions. All roadway subgrade should be evaluated by the Engineer or Department during site grading operations. Specific improvement requirements must be field verified. Subgrade improvement, including any undercut, should extend at least 5 ft outside pavement limits to the extent possible.

Site Grading and Earthwork Considerations

Site preparation will begin with clearing and grubbing the trees or underbrush (if any) in the wall alignment areas and stripping the organic-containing surface soils. Site preparation should include the entire reinforced zone footprint. Tree stumps should be completely excavated and properly backfilled. The depth of stripping will be variable, with deeper stripping depths in the low-lying, poorly drained, and/or heavily wooded areas, and less stripping required on hillsides and in the areas of higher terrain. In general, the stripping depth is estimated to be about 6 to 12 in. in open areas, but may be 18 to 24 in. or more in wooded areas. Subgrade preparation, including required undercuts or soil treatment, should extend at least 5 ft beyond the roadway shoulder edges and embankment toes to the extent possible. Site preparation is expected to include demolition of some existing pavements. All areas where abandoned utilities or culverts are removed should be properly backfilled.

Where the existing pavements are abandoned and will be covered with fill, the existing pavement surface should be scarified to a minimum depth of 6 inches. The scarified and processed pavement material should be recompacted to a stable condition. Where 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 inches.

Following demolition, stripping, and any cut, and prior to placing fill or otherwise continuing with subgrade preparation, the extent of weak and/or unsuitable soils should be determined. Proof-rolling is recommended to evaluate subgrade stability. Proof-rolling should be performed with a pneumatic-tired roller, loaded tandem-wheel dump truck, or similar equipment. Soft soils or soils exhibiting a tendency to rut and/or pump should be undercut, processed, and re-compacted or replaced with embankment fill, whichever is appropriate. Care must be taken that undercuts, stump holes, etc. are properly backfilled with controlled fill. Based on the results of the borings, soil in the upper 2 to 6 ft, more or less, are locally unstable. The extent of unstable soils will be greater during wet seasons of the year.

At locations where excavations or undercuts encounter shallow water or seepage, backfill should be comprised of clean sand (AHTD Standard Specifications Section 302, SM-1), stone backfill (AHTD Standard Specifications Section 207), or an approved alternate placed to an elevation above the inflow of seepage.

Undercutting or improvement by stabilization of unsuitable surface soils in the roadway alignments will be required in some alignment areas. Actual undercut or improvement requirements will depend on seasonal site conditions and final site grading plans.

Embankment fill may consist of the on-site soils free of significant amounts of organics and debris as per AHTD Standard Specifications Section 210.06. We recommend that the top 18 in. of embankment fill comprising the roadway subgrade is low-plasticity soils with a maximum plasticity index (PI) of 18. Where highly-plastic clay, i.e., with a PI of 25 or more, is encountered at the subgrade elevation, we recommend that it be undercut as required to provide at least 18 in. of pavement subgrade with a PI of 18 or less. Alternatively, lime treatment or other suitable additive may be utilized to develop a stable, low-plasticity subgrade.

In areas of deeper fill, the potential exists for use of thick initial lifts ("bridging"), as per AHTD criteria. Bridge lifts will be subject to some consolidation. Settlement of a primarily granular fill suitable for use in bridging would be expected to be relatively rapid and long-term post-construction settlement would not be expected to be a significant concern. Where clayey soils are placed in thick lifts, long term settlement will be more significant. We recommend that the use of "bridging" techniques be limited to granular borrow soils, i.e., sand, gravel, or crushed stone. Where fill amounts are limited to less than about 3 ft, bridging will be less effective and the need for undercut is considered more likely. Use of bridging techniques and thickened fill lifts should be specifically approved by the Engineer.

General site grading, including fill and backfill, should be performed as per AHTD Standard Specifications Subsection 210. Subgrade preparation should comply with AHTD Standard Specifications, Section 212. Embankments should be constructed in accordance with AHTD criteria (AHTD Standard Specifications, Section 210). Fill and backfill for undercuts and retained fill should be placed in nominal 6- to 8-in.-thick loose lifts. All fill and backfill must be placed in horizontal lifts. Thinner lifts may be required for retaining wall backfill. The in-place density and water content should be determined for each lift and should be tested to verify compliance with the specified density and water content prior to placement of subsequent lifts. Fill placement against existing slope should be benched to facilitate horizontal fill placements.

Suitability of the retaining wall bearing strata must be field verified by the Engineer or Department at the time of construction. For MSE walls which require the higher bearing value of moderately hard weathered shale, all undercuts should be backfilled with crushed stone aggregate base (AHTD Standard Specifications Section 303, Class 7) or any alternate approved by the Engineer or Department. For MSE walls utilizing the lower bearing values for SM-1 or stiff silty clay, all undercuts should be backfilled with selected material (AHTD Standard Specifications Section 302, SM-1), select granular fill (AASHTO M43), or an approved alternate. For all MSE walls, we recommend that undercuts extend at least 5 ft outside the reinforced zone to the extent possible.

CONSTRUCTION CONSIDERATIONS

Positive surface drainage should be established at the start of construction and maintained throughout the project. Water should not be allowed to pond in subgrade areas. Subgrade soils that

become saturated or otherwise disturbed should be excavated, processed and recompacted, replaced with approved fill, or stabilized with additives approved by the Engineer and compacted to the recommended water content range and density.

Shallow groundwater was locally encountered at 6- to 19-ft depth in February and March 2018. The majority of borings did not encounter groundwater. The variable depth and volume of groundwater is indicative of locally perched water or water from nearby waterways. Additionally, seasonal seeps and springs could be locally present as infiltrated water migrates from areas of higher terrain through the upper fractured zones of the shale. Groundwater levels will vary, depending on seasonal precipitation, surface runoff and infiltration, and water levels in nearby ditches and waterways. If seepage into excavations becomes a problem, undercut backfill should consist of clean crushed stone (AHTD Standard Specifications Section 207 or AASHTO M43 #57 stone), clean aggregate (AHTD Standard Specifications Subsections 403.01 and 403.02 Class 3 mineral aggregate), or an approved alternate to an elevation above the inflow of seepage. In areas of seepage infiltration, the granular fill should be fully encapsulated with a filter fabric complying with AHTD Standard Specifications Subsection 625.02, Type 2 and vented to positive discharge.

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. We also recommend that blanket drains be constructed in all existing drainage features prior to fill placement, to direct groundwater seepage to positive discharge. Blanket drains should consist of at least 8 to 12 in. of clean aggregate (AHTD Standard Specifications Section 403, Class 3 Mineral Aggregate or an approved alternate) fully encapsulated by a filter fabric (AHTD Standard Specifications Subsection 625.02, Type 2 or an approved alternate). Drains should direct water to positive discharge at daylight or into storm drain lines.

The results of the borings indicate that the sandy/silty clay and clayey/silty sand overburden soils can be excavated with conventional heavy-duty excavation equipment. The low hardness to moderately hard weathered shale can also typically be excavated with conventional heavy-duty excavation equipment. There can be harder zones within the weathered shale that are more resistant. There are also localized and discontinuous seams and layers of hard sandstone in the weathered shale which could require rock excavation methods.

CLOSURE

The Engineer or Department or a designated representative thereof should monitor site preparation, grading work and all wall 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 attachments are included and complete this submittal.

Attachment 1	Site Vicinity
	Plans of Borings
	Exploration Summary
	Keys to Terms and Symbols
Attachment 2	Bridge Boring Logs
Attachment 3	Wall Boring Logs
Attachment 4	Ramp Boring Logs
Attachment 5	Boring Logs from 2015 Study
Attachment 6	Rock Core Photographs
Attachment 7	Laboratory Test Results
Attachment 8	Moisture-Density Relationship Test Results
Attachment 9	Summary of Retaining Wall AA Recommendations
Attachment 10	Results of Stability Analyses

* * * * *

We appreciate the opportunity to be of continued 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, please call on us.

Sincerely,

GRUBBS, HOSKYN,
BARTON &WYATT, INC.

Ben Davis, E.I.
Staff Engineer

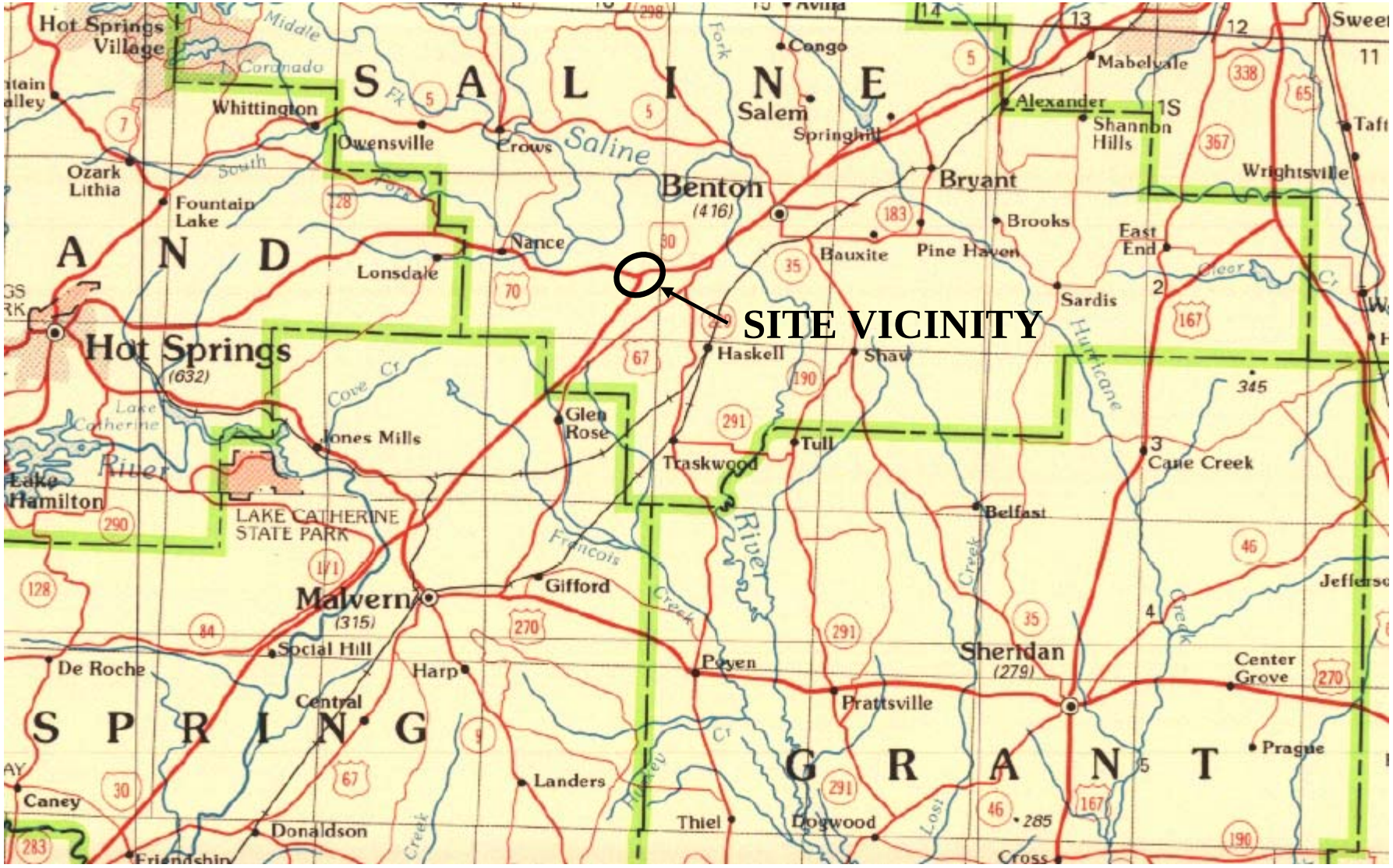
Mark E. Wyatt, P.E.
President

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

BJD/MEW:jw

Copies Submitted: Bridgefarmer & Associates, Inc.
Attn: Mr. Shahriar Azad, P.E. (2+electronic)
Attn: Mr. Stephen Smiley, P.E. (1-email)

ATTACHMENT 1

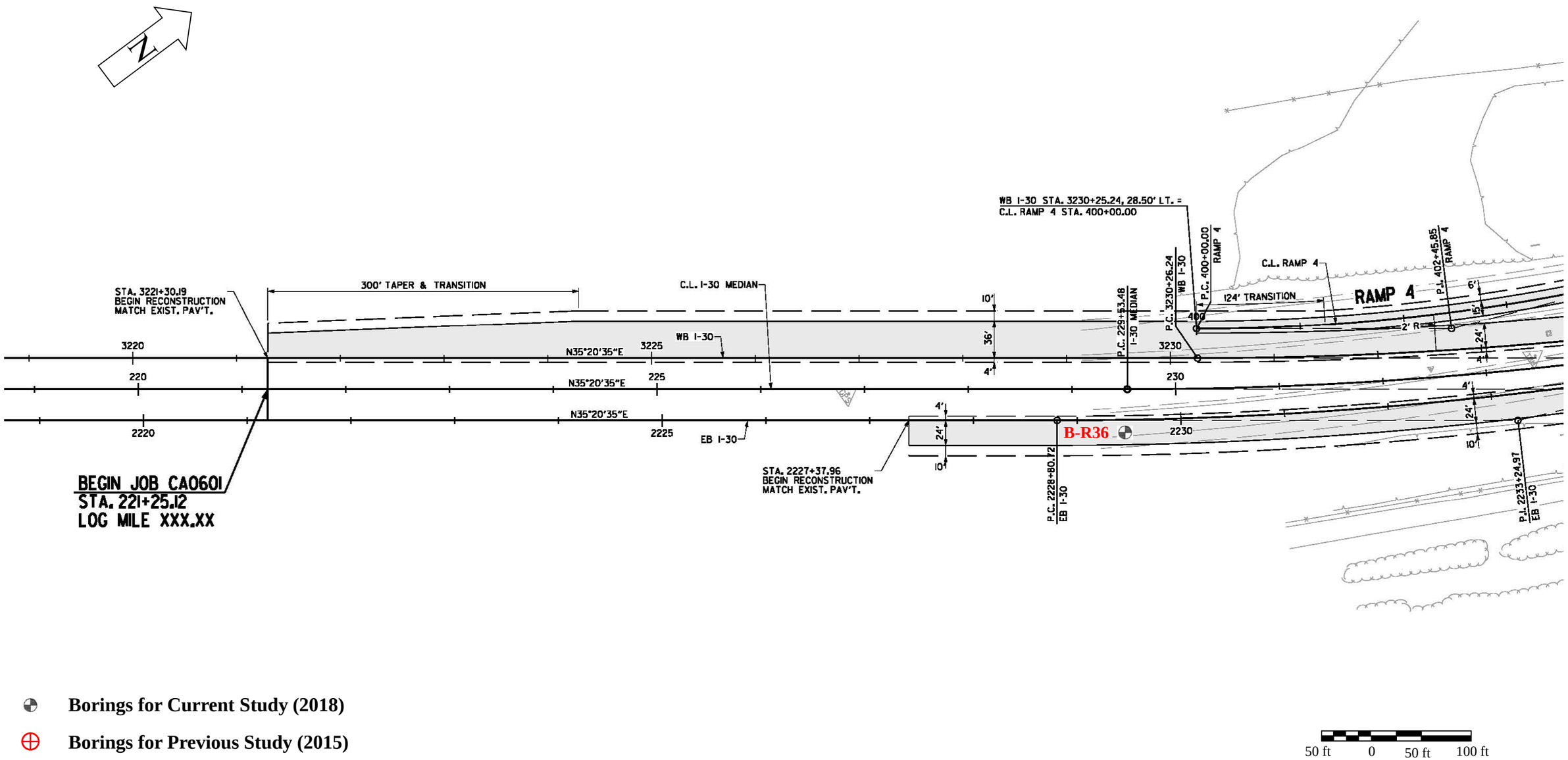


Grubbs, Hoskyn, Barton & Wyatt, INC.
CONSULTING ENGINEERS

Site Vicinity Map
CA0601: Hwy 70 –I-30 Interchange
Saline County, Arkansas

Job No. 15-019

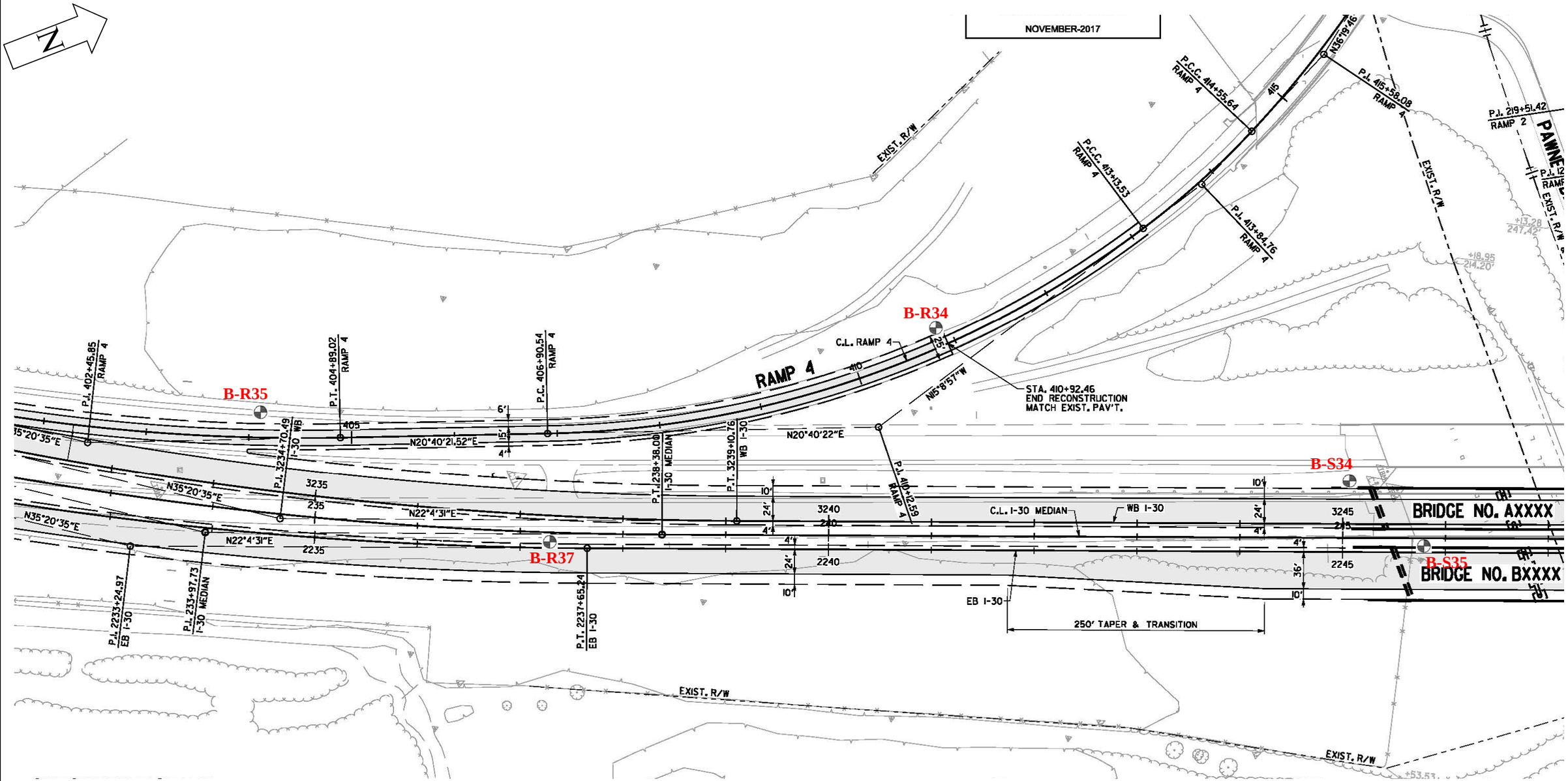
Plate 1



Borings for Current Study (2018)

Borings for Previous Study (2015)

Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**PLAN TO BORINGS** **CA0601: Hwy 70 – I-30 Interchange** **Saline County, Arkansas**	**Scale: As Shown** **Date: February 2018**	**Job No. 15-019**	**PLATE 2**

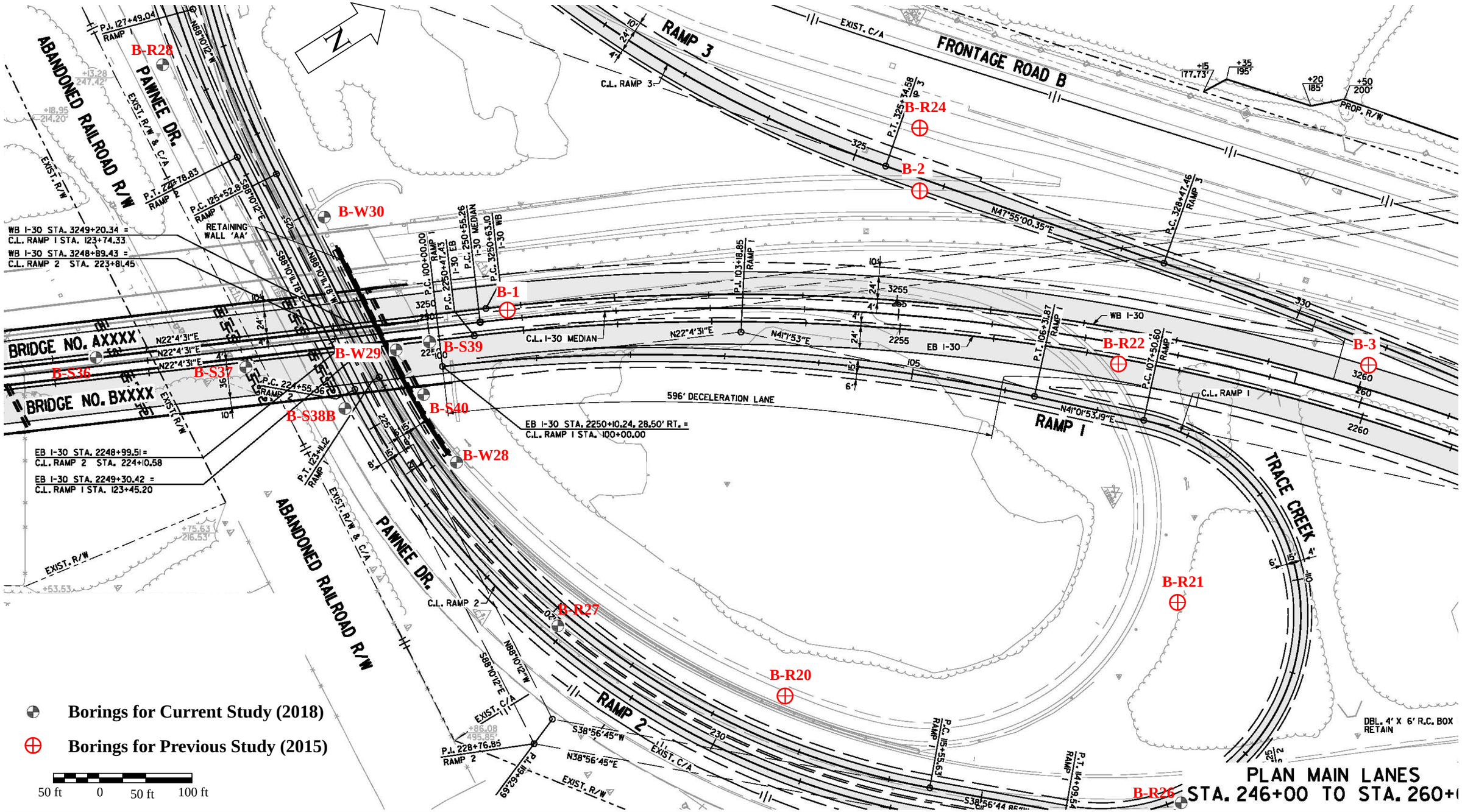


Borings for Current Study (2018)

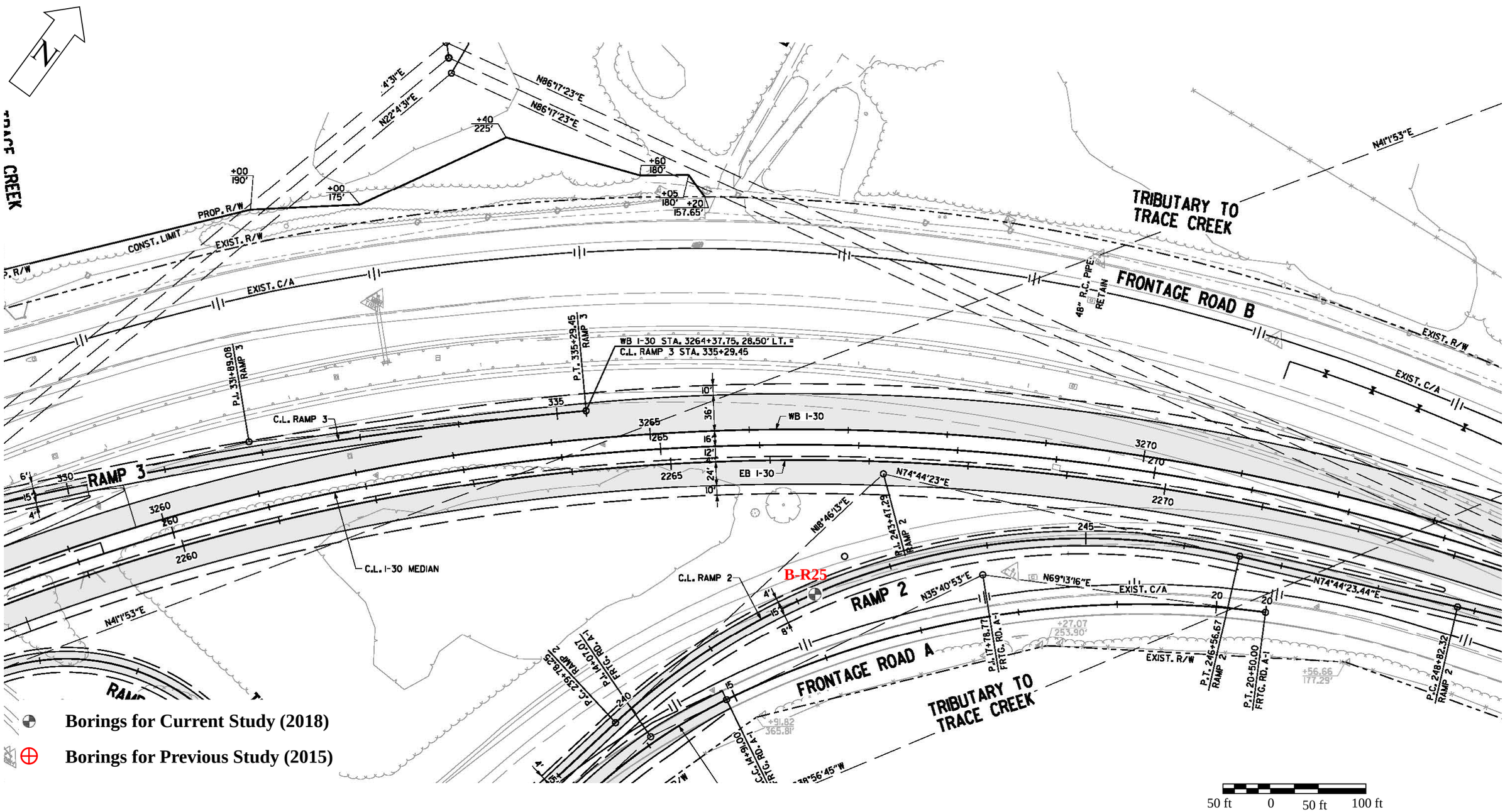
Borings for Previous Study (2015)

50 ft 0 50 ft 100 ft

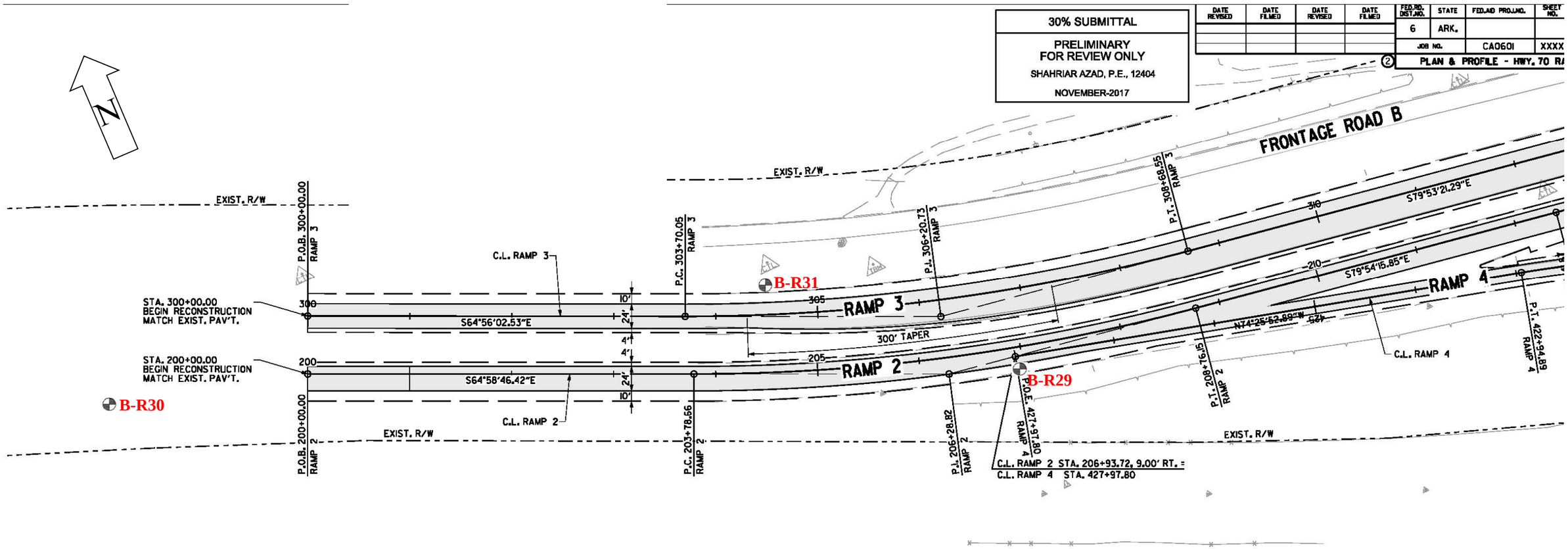
Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**PLAN TO BORINGS** **CA0601: Hwy 70 – I-30 Interchange** **Saline County, Arkansas**	**Scale: As Shown** **Date: February 2018**	**Job No. 15-019**	**PLATE 3**



Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**PLAN TO BORINGS** **CA0601: Hwy 70 – I-30 Interchange** **Saline County, Arkansas**	**Scale: As Shown** **Date: February 2018**	**Job No. 15-019**	**PLATE 4**



Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**PLAN TO BORINGS** **CA0601: Hwy 70 – I-30 Interchange** **Saline County, Arkansas**	**Scale: As Shown** **Date: February 2018**	**Job No. 15-019**	**PLATE 5**



Borings for Current Study (2018)

Borings for Previous Study (2015)

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CONSULTING ENGINEERS

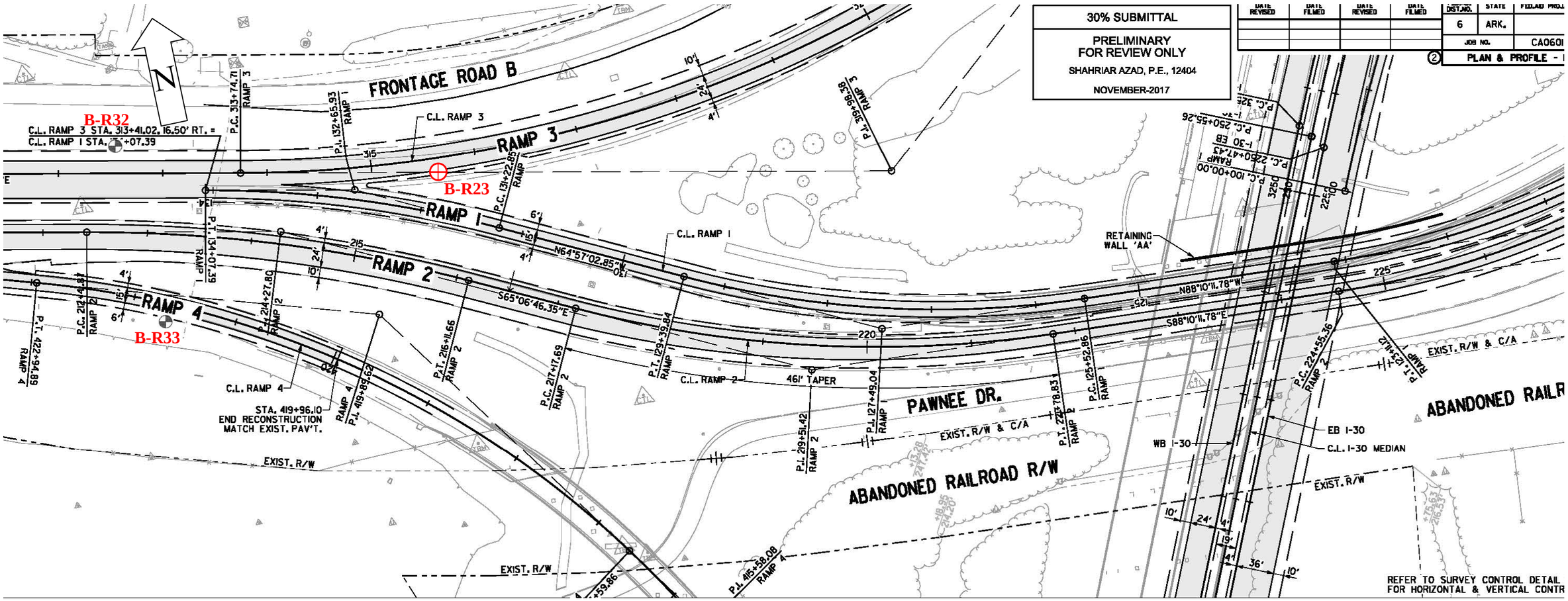
PLAN TO BORINGS
CA0601: Hwy 70 – I-30 Interchange
Saline County, Arkansas

Scale: As Shown

Date: February 2018

Job No. 15-019

PLATE 6

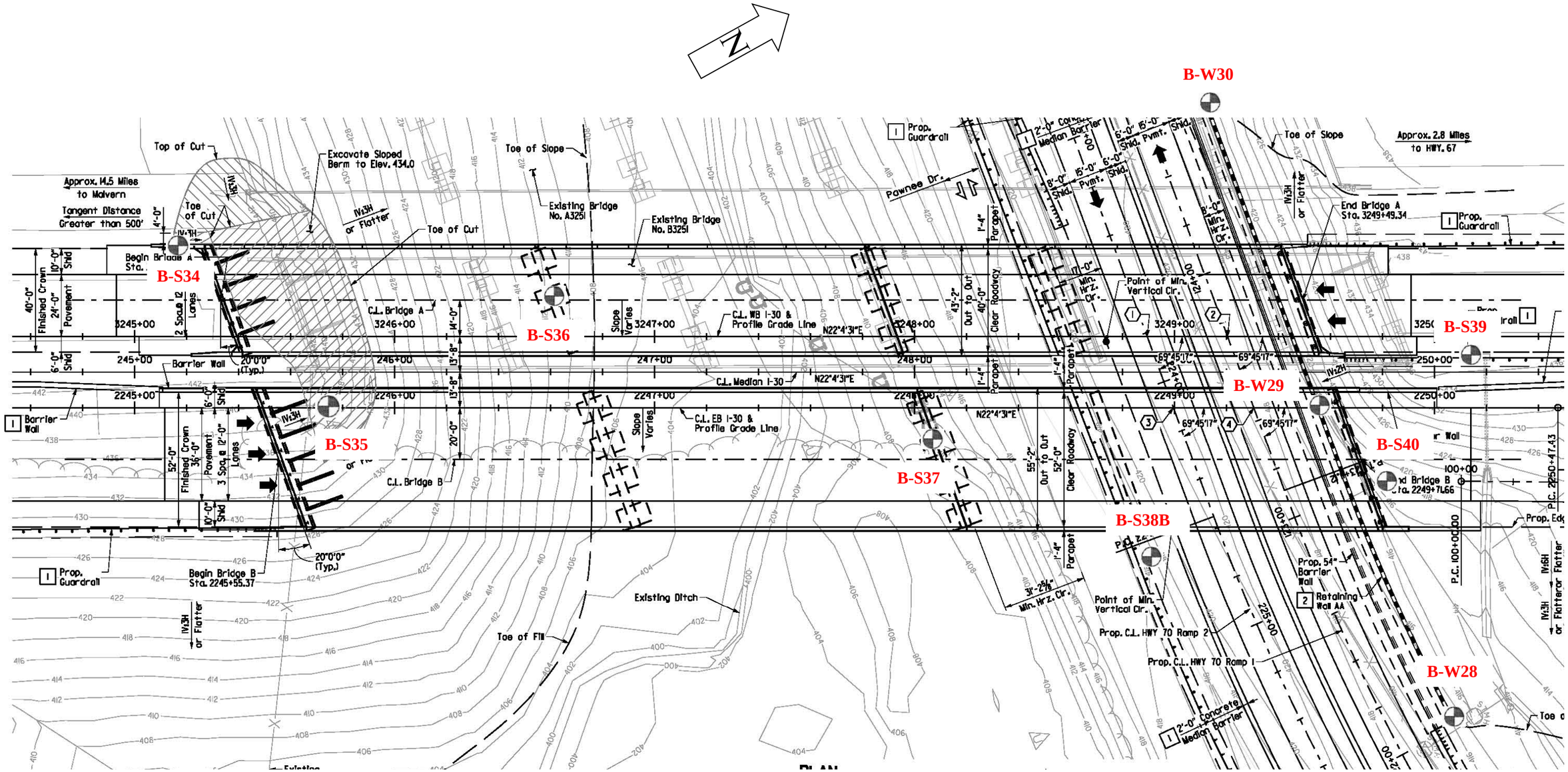


Borings for Current Study (2018)

Borings for Previous Study (2015)

50 ft 0 50 ft 100 ft

Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**PLAN TO BORINGS** **CA0601: Hwy 70 – I-30 Interchange** **Saline County, Arkansas**	**Scale: As Shown** **Date: February 2018**	**Job No. 15-019**	**PLATE 7**



Borings for Current Study (2018)

Borings for Previous Study (2015)

Note: Boring S39 not accessible and not drilled

200ft 0 20 ft 40 ft

Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**PLAN TO BORINGS** **CA0601: Hwy 70 – I-30 Interchange** **Saline County, Arkansas**	**Scale: As Shown** **Date: February 2018**	**Job No. 15-019**	**PLATE 8**

SUMMARY of SUBSURFACE EXPLORATION

PROJECT: CA0601 Highway 70 - Interstate 30 Interchange
LOCATION: Highway 70 - Saline County, Arkansas
GHBW JOB No.: 15-019

Boring No.	Station Reference	Approx Sta	Approx Offset, ft	Approx Surf El, ft	Completion Depth, ft
S34	WB I-30	3245+20	35 Lt	443	60
S35	EB I-30	2245+75	CL	439	55
S36	WB I-30	3246+65	15 Lt	411	33
S37	EB I-30	2248+05	10 Rt	411	43
S38B	EB I-30	2248+90	60 Rt	418	40
S40	EB I-30	2249+80	30 Rt	418	30
W28	Ramp 1	122+05	25 Rt	416	20
W29	EB I-30	2249+55	CL	418	24
W30	Ramp 1	124+60	25 Rt	419	13
R25	Ramp 2	242+20	CL	410	10
R26	Ramp 1	112+85	5 Lt	409	10
R27	Ramp 1	119+90	15 Lt	417	10
R28	Ramp 2	220+55	30 Rt	425	10
R29	Ramp 2	206+95	20 Rt	451	10
R30	Ramp 2	198+10	25 Rt	452	10
R31	Ramp 3	304+50	30 Lt	446	10
R32	Ramp 3	312+55	25 Lt	446	10
R33	Ramp 4	421+65	15 Lt	444	10
R34	Ramp 4	410+90	20 Lt	441	10
R35	Ramp 4	404+10	25 Lt	446	10
R36	EB I-30	2229+50	15 Rt	448	10
R37	EB I-30	2237+35	5 Lt	444	10

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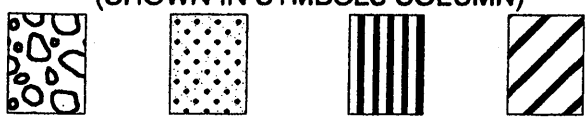
SYMBOLS AND TERMS USED ON BORING LOGS

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 3-4-03

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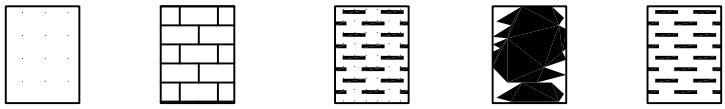
BORING LOG TERMS – ROCK

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

ATTACHMENT 2

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

LOG OF BORING NO. S34

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx WB I-30 - Sta 3245+20, 35 ft Lt

SURF. EL: 443±

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 %
			Firm reddish brown, gray and dark gray silty clay w/shale and quartz fragments and occasional concrete debris (fill)	9			
				8			
5			- with a little medium to coarse sand below 4 ft - stiff at 4 to 6 ft - soft below 6 ft	12			29
				6			
10			Firm to stiff gray and yellowish tan clay w/some sandstone and quartz fragments	10			
15			- firm at 13 to 23 ft	8			
20			- with calcareous nodules below 18 ft	7			63
25			- stiff at 23 to 28 ft	12			
30			- soft below 28 ft	4			
35			Firm grayish brown clay, sandy w/occasional rootlets	7			73
				7			

COMPLETION DEPTH: 60.0 ft
DATE: 3-2-18

DEPTH TO WATER IN BORING: 6 ft

DATE: 3/2/2018

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

LOG OF BORING NO. S34

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx WB I-30 - Sta 3245+20, 35 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 %
			Dense to very dense yellowish tan and brown clayey fine to coarse gravel w/some fine to coarse sand	50/3"			
45							
			Moderately hard to hard dark gray shale	25/0"			
50							
				25/0"			
55							
				25/0"			
60							
65							
70							
75							

COMPLETION DEPTH: 60.0 ft
DATE: 3-2-18

DEPTH TO WATER IN BORING: 6 ft

DATE: 3/2/2018

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

LOG OF BORING NO. S35

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger to 25 ft /Wash

LOCATION: Approx EB I-30 - Sta 2245+75, CL

SURF. EL: 439±

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
			Firm brown and reddish tan clay, sandy (fill)	7			63		
5			Firm to stiff gray, olive gray and tan clay w/silt pockets, ferrous and calcareous nodules	10					
				11					
10			- stiff at 6 - 33 ft	13			78		
15				17					
20				15					
25				16					
30				11			67		
35			- firm, bluish gray below 33 ft	7					
40			Dense to very dense tan sandy fine to coarse gravel	25/0"					
45			Moderately hard to hard dark gray shale, apparent dip 10°	25/0"					
			- with quartz veins at 47.2 - 48 ft					25	20
50			- with quartz veins at 52.3 to 52.5 ft					82	47
55			- with quartz inclusions at 52.7 ft - carbonaceous shale zones at 53.1, 54.1 and 55 ft						

COMPLETION DEPTH: 55.0 ft
DATE: 3-27-18

DEPTH TO WATER
IN BORING: Dry to 25 ft

DATE: 3/27/2018

RECRQDN200-2 15-019_CA0601 US 70 INTERCHANGE.GPJ 4-11-18

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

LOG OF BORING NO. S36

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger to 18 ft /Wash

LOCATION: Approx WD I-30 - Sta 3246+65, 15 ft Lt

SURF. EL: 411±

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
			Stiff to very stiff tan silty clay w/numerous sandstone and quartz fragments and concrete debris (fill)	40			22		
			- firm below 2 ft	8					
5			Stiff tan, gray and brown silty clay w/a little fine gravel	20					
			- firm below 6 ft	7					
10			Moderately hard brown, tan and dark gray highly weathered shale	50/9"					
15			Moderately hard to hard dark gray slightly weathered shale w/quartz veins and inclusions and ferrous stains in bedding planes	25/0"					
20				25/0"					
25			Moderately hard to hard dark gray shale w/quartz veins, seams and inclusions, apparent dip 15°					19	7
30			- frequent mechanical breaks in core runs					36	11
35									

COMPLETION DEPTH: 33.0 ft
DATE: 2-27-18

DEPTH TO WATER IN BORING: 11.5 ft

DATE: 2/27/2018

RECRQDN200-2 15-019_CA0601 US 70 INTERCHANGE.GPJ 4-11-18

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

LOG OF BORING NO. S37

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx EB I-30 - Sta 2248+05, 10 ft Rt

SURF. EL: 411±

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
			Stiff brown and tan silty clay w/some fine to coarse gravel, organics, quartz fragments and occasional rootlets (fill)	13					
				49			37		
5			Dense yellowish tan and gray clayey fine sand w/ferrous stains and nodules - medium dense below 4 ft	24			25		
				35					
10			Low hardness light gray and tan highly weathered shale w/silty clay seams and layers and ferrous stains - moderately hard below 8 ft - quartz vein at 9.5 ft	60					
15			Moderately hard to hard dark gray slightly weathered shale, apparent dip 30° w/ferrous stains in fractures	25/0"					
20			Moderately hard to hard dark gray shale, w/very close quartz veins and inclusions and close carbonaceous shale seams and layers, apparent dip 30° - high angle shear at 19.8 ft					48	10
25								76	28
30			- medium close carbonaceous shale zones below 30 ft - with close folds and quartz inclusions below 30.6 ft - with frequent mechanical breaks at 33 - 38 ft in run					75	35
35			- fold with quartz inclusions at 35 ft					33	28
40			- healed vertical fracture with quartz infill at 38.5 ft					35	28
45									

COMPLETION DEPTH: 43.0 ft
DATE: 3-5-18

DEPTH TO WATER
IN BORING: Dry to 15 ft

DATE: 3/5/2018

RECRQDN200-2 15-019_CA0601 US 70 INTERCHANGE.GPJ 4-11-18

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

LOG OF BORING NO. S38B

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger to 19 ft /Wash

LOCATION: Approx EB I-30 - Sta 2248+90, 60 Rt

SURF. EL: 418±

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 red, gray, brown and tan clayey fine sand w/some fine gravel (fill)	16					
			Firm to stiff brown, gray and tan silty clay w/a little coarse sand and shale fragments (fill)	10					
5			- stiff at 4 - 6 ft	14			52		
			- firm below 6 ft	8					
			Stiff gray silty clay w/occasional quartz fragments	18			43		
10									
			Moderately hard to hard gray slightly weathered shale	25/0"					
15									
				25/0"					
20			Hard dark gray shale, siliceous, thickly bedded, apparent dip 10°			q_u = 3810 psi, TUW = 168 pcf		53	76
			- healed high angle fracture with quartz infill at 20.2 ft			q_u = 3890 psi, TUW = 170 pcf			
			- healed very close low angle fracture with quartz infill at 20.5 - 20.7 ft						
25			- vertical fracture with ferrous stains at 25 - 25.2 ft			q_u = 3780 psi, TUW = 167 pcf		27	70
			- carbonaceous shale seam at 27.7 ft						
30			- carbonaceous shale zone at 28.5 ft						
			- carbonaceous seam at 31.2 ft					72	37
			- carbonaceous zone at 33 - 35 ft						

COMPLETION DEPTH: 45.0 ft
DATE: 3-9-18

DEPTH TO WATER IN BORING: Dry to 19 ft

DATE: 3/9/2018

RECRQDN200-2 15-019_CA0601 US 70 INTERCHANGE.GPJ 4-11-18

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

LOG OF BORING NO. S38B

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger to 19 ft /Wash

LOCATION: Approx EB I-30 - Sta 2248+90, 60 Rt

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
								92	62
40			- close carbonaceous seams at 38.8 - 41 ft - vertical fracture at 38.9 - 39.4 ft - close quartz partings at 40.2 and 40.8 ft Hard gray fine-grained sandstone - with quartz inclusions at 41.1 ft - with close quartz veins below 43 ft			q_u = 3790 psi, TUW = 161 pcf q_u = 4550 psi, TUW = 168 pcf		80	72
45									
50									
55									
60									
65									

COMPLETION DEPTH: 45.0 ft
DATE: 3-9-18

DEPTH TO WATER
IN BORING: Dry to 19 ft

DATE: 3/9/2018

RECRQDN200-2 15-019_CA0601 US 70 INTERCHANGE.GPJ 4-11-18

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

LOG OF BORING NO. S40

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger to 13.5 ft /Wash

LOCATION: Approx EB I-30 - Sta 2249+80, 30 ft Rt

SURF. EL: 418±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %	% Recovery	% RQD
	Loose brown silt w/some crushed stone (fill)	10				
	Loose to medium dense red clayey fine sand w/some crushed stone (fill)	8		79		
	Firm tan, gray and reddish brown fine sandy clay					
5	Low hardness gray and tan highly weathered shale	32				
	- with hard fine-grained sandstone seams at 6.5 - 7 ft	50/5"				
10		34				
	Moderately hard gray weathered fine-grained sandstone w/silty clay filled fractures	25/0"				
15	Moderately hard to hard dark gray shale, apparent dip ~ 35°				15	5
20	- very close quartz seams and partings at 20 - 20.2 ft - vertical fractures at 20.7 ft - close quartz seams, partings and inclusions at 21 - 25 ft				76	61
25	- close quartz partings at 27 - 27.8 ft and 28.9 - 29.4 ft				90	82
30						

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

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

COMPLETION DEPTH: 30.0 ft
DATE: 3-20-18

DEPTH TO WATER
IN BORING: Dry to 13.5 ft

DATE: 3/20/2018

RECRQDN200-2 15-019_CA0601 US 70 INTERCHANGE.GPJ 4-11-18

ATTACHMENT 3

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

LOG OF BORING NO. W28

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Ramp 1 - Sta 122+05, 25 ft Rt

SURF. EL: 416±

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 %
			Medium dense brown and reddish tan clayey fine gravel, sandy	12			
			Stiff gray and tan silty clay w/shale seams and layers	13			47
5			Low hardness gray and tan highly weathered shale w/ferrous stains in fractures	34			
			- moderately hard below 6 ft	50/11"			
10				50/11"			
			Moderately hard dark gray and light gray weathered shale w/ferrous stains	50/3"			
15							
			Moderately hard to hard dark gray shale	25/0"			
20							
			NOTE: Water at 9.5 ft at 10 minutes.				
25							

COMPLETION DEPTH: 20.0 ft
DATE: 3-20-18

DEPTH TO WATER IN BORING: 19 ft

DATE: 3/20/2018

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

LOG OF BORING NO. W29

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx EB I-30 - Sta 2249+55, CL

SURF. EL: 418±

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
			6 inches: Concrete						
			Loose tan and reddish tan fine to coarse sand, slightly clayey w/some concrete fragments (fill)	8			9		
			Stiff tan, brown and gray silty clay w/shale seams and layers	11			37		
5			Low hardness gray and dark gray highly weathered shale w/silty clay seams and layers	34					
			- moderately hard at 6 - 8 ft	50/11"					
			- low hardness below 8 ft	50					
10									
			Moderately hard to hard dark gray weathered shale w/occasional ferrous stains in fractures	25/0"					
15			- quartz veins at 15.4, 15.6 and 15.9 ft - healed low angle fracture at 16.4 ft - quartz inclusions at 17.5, 18, 21.3 and 21.5 ft					59	40
20			- carbonaceous shale zone below 22 ft					44	21
25									

COMPLETION DEPTH: 24.0 ft
DATE: 3-21-18

DEPTH TO WATER IN BORING: Dry

DATE: 3/21/2018

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

LOG OF BORING NO. W30

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Ramp 1 - Sta 124+60, 25 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 419±	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 %
			Medium dense tan and brown clayey fine to coarse gravel, sandy (fill)	13			13
			Low hardness tan and light gray highly weathered shale w/ferrous stains in fractures	50			
			- moderately hard at 4 - 6 ft	50/6"			
5			- low hardness below 6 ft	50			
			Moderately hard dark gray and tan weathered shale	50/11"			
10							
			Moderately hard to hard dark gray fine-grained sandstone - auger refusal in weathered fine sandstone at 13.5 ft	50/2"			
15							
20							
25							

COMPLETION DEPTH: 13.5 ft
DATE: 3-21-18

DEPTH TO WATER IN BORING: Dry

DATE: 3/21/2018

LGBNEW 15-019_W LOGS.GPJ 4-11-18

ATTACHMENT 4

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

LOG OF BORING NO. R25

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Ramp 2 - Sta 242+20, CL

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 410±	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 %
			3 inches: Crushed Stone Base				
			Loose to medium dense red clayey fine sand w/crushed stone and shale fragments (fill)	10			23
			Stiff gray and tan silty clay w/some shale fragments and ferrous stains (fill)				
				17			26
			- firm to stiff at 4 - 6 ft				
5				10			
			- stiff below 6 ft				
				11			
			Stiff gray silty clay w/occasional quartz fragments				
				14			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 2-26-18

DEPTH TO WATER IN BORING: Dry

DATE: 2/26/2018

LGBNEW 15-019_CA0601 US 70 INTERCHANGE.GPJ 4-11-18

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

LOG OF BORING NO. R26

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Ramp 1 - Sta 112+85, 5 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 409±	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 %
			Loose brown sandy silt w/sandstone fragments (fill)				
			Loose red silty fine sand (fill)	7		-NON-PLASTIC-	22
			Soft tan and light gray clay w/shale fragments (fill)				
				5			32
			- firm to stiff at 4 - 6 ft				
5				10			
			- stiff below 6 ft				
				13			
				15			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 3-21-18

DEPTH TO WATER IN BORING: Dry

DATE: 3/21/2018

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

LOG OF BORING NO. R27

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Ramp 1 - Sta 119+90, 15 ft Lt

SURF. EL: 417±

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 %
			Loose red silty fine to medium sand (fill)	6		-NON-PLASTIC-	14
			Medium dense gray and tan clayey fine gravel (fill)	15			36
5			Stiff gray and tan silty clay w/weathered shale seams and layers	19			
			Low hardness tan and gray highly weathered shale	50			
			- moderately hard below 8 ft	50/10"			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 2-26-18

DEPTH TO WATER IN BORING: Dry

DATE: 2/26/2018

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

LOG OF BORING NO. R28

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Ramp 2 - Sta 220+55, 30 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 425±	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 %
			5 inches: Crushed Stone Base				
			Loose to medium dense brown, gray and red silty fine sand, slightly clayey w/crushed stone fragments (fill)	10			39
			- medium dense below 2 ft	13			
5				13			
			Stiff gray silty clay	11			
10				11			
15							

COMPLETION DEPTH: 10.0 ft
DATE: 2-26-18

DEPTH TO WATER IN BORING: Dry

DATE: 2/26/2018

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

LOG OF BORING NO. R29

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Ramp 2 - Sta 206+95, 20 ft Rt

SURF. EL: 451±

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 %
			Medium dense red clayey fine sand w/some crushed stone and quartz fragments (fill)	16			14
				17			
5				13			
				22			
			Stiff grayish brown silty clay	14			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 2-7-18

DEPTH TO WATER IN BORING: Dry

DATE: 2/7/2018

LGBNEW 15-019_CA0601 US 70 INTERCHANGE.GPJ 4-11-18

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

LOG OF BORING NO. R30

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Ramp 2 - Sta 198+00, 25 ft Rt

SURF. EL: 437±

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 %
			6 Inches: Crushed Stone Base				
			Medium dense red and gray clayey fine to coarse sand w/some shale fragments and coarse gravel (fill)	17			22
			Stiff red and gray clay w/some shale and crushed stone fragments (fill)	13			52
5				16			
			Very stiff gray, tan and red silty clay w/a little shale fragments	36			
			Moderately hard tan and gray highly weathered shale	50/11"			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 2-7-18

DEPTH TO WATER IN BORING: Dry

DATE: 2/7/2018

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

LOG OF BORING NO. R31

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Ramp 3 - Sta 304+50, 30 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 447±	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 %
			Crushed Stone Base	7			
			Soft olive gray and gray silty clay w/shale fragments and crushed stone (fill)	6			44
			- firm below 4 ft	8			
5				7			
				8			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 2-7-18

DEPTH TO WATER IN BORING: Dry

DATE: 2/7/2018

LGBNEW 15-019_CA0601 US 70 INTERCHANGE.GPJ 7-2-18

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

LOG OF BORING NO. R32

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Ramp 3 - Sta 312+55, 25 ft Lt

SURF. EL: 437±

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 %
			6 Inches: Crushed Stone Base				
			Medium dense reddish tan and tan silty fine to medium sand w/some quartz and novaculite fragments (fill)	22			26
			Very stiff red silty clay w/some quartz fragments	32			
5				28			
				27			
			Low hardness tan and gray highly weathered shale w/silty clay seams and layers	29			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 2-7-18

DEPTH TO WATER IN BORING: Dry

DATE: 2/7/2018

LGBNEW 15-019_CA0601 US 70 INTERCHANGE.GPJ 7-2-18

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

LOG OF BORING NO. R33

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Ramp 4 - Sta 421+65, 15 ft Lt

SURF. EL: 445±

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 %
			Medium dense light tan fine to coarse sand, slightly silty w/some quartz fragments (fill)	19		-NON-PLASTIC-	10
			Stiff gray silty clay (fill)	12			
5			Stiff red and tan silty clay w/some quartz fragments	16			
			- soft at 6 to 8 ft	5			
			- firm below 8 ft	9			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 2-7-18

DEPTH TO WATER IN BORING: Dry

DATE: 2/7/2018

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

LOG OF BORING NO. R34

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Ramp 4 - Sta 410+95, 15 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 447±	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 %
			9 Inches: Crushed Stone Base				
			Stiff brown, gray and tan clay w/some crushed stone and quartz fragments (fill)	19			12
			- firm with less quartz and crushed stone fragments below 2 ft	8			
			Stiff brown and gray silty clay				
5				11			
			- with silty fine sand seams and partings at 6 to 8 ft	11			
				12			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 2-7-18

DEPTH TO WATER IN BORING: Dry

DATE: 2/7/2018

LGBNEW 15-019_CA0601 US 70 INTERCHANGE.GPJ 7-2-18

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

LOG OF BORING NO. R35

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Ramp 4 - Sta 404+10, 25 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 446±	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 %
			6 Inches: Crushed Stone Base				
			Stiff to very stiff tan and gray silty clay w/crushed quartz fragments (fill)	34			16
			- stiff below 2 ft	12			
			Stiff brown and reddish tan silty clay w/ferrous stains and nodules	19			69
5				13			
			- with numerous quartz fragments below 8 ft	17			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 2-7-18

DEPTH TO WATER IN BORING: Dry

DATE: 2/7/2018

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

LOG OF BORING NO. R36

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx EB I-30 - Sta 2229+50, 15 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 448±	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 %
			8 inches: Crushed Stone Base				
			Medium dense red clayey fine to medium sand w/quartz and crushed stone fragments (fill)	16			16
			- loose to medium dense below 2 ft	10			
			Soft gray clay, sandy w/ferrous nodules	4			55
5				5			
			Stiff dark gray silty clay	18			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 2-26-18

DEPTH TO WATER IN BORING: Dry

DATE: 2/26/2018

LGBNEW 15-019_CA0601 US 70 INTERCHANGE.GPJ 4-11-18

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

LOG OF BORING NO. R37

CA0601 US 70 Interchange
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx EB I-30 - Sta 2237+35, 5 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 443±	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 %
			8 inches: Crushed Stone Base				
			Stiff red silty clay w/crushed stone fragments (fill)	13			27
			- very stiff at 2 - 4 ft	35			
			- stiff at 4 - 6 ft	19			
5			- very stiff below 6 ft	50			
			Stiff to very stiff red fine sandy clay	24			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 2-26-18

DEPTH TO WATER IN BORING: Dry

DATE: 2/26/2018

ATTACHMENT 5

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

LOG OF BORING NO. R20

CA0601: I-30 - Roadway Widening
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 253+05, 475 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 410±	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 %
			Crushed Stone Base				
			Medium dense reddish tan silty fine to medium sand, slightly clayey w/numerous quartz and sandstone fragments	27			11
			Low hardness gray, tan, reddish brown and reddish tan highly weathered shale w/silty clay seams and layers and some ferrous partings	31			
			- with occasional clay seams and ferrous stains and nodules below 4 ft	28			
5							
			- tan and reddish tan with more silty clay seams below 6 ft	20			
				13			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 8-10-15

DEPTH TO WATER IN BORING: Dry

DATE: 8/10/2015

LGBNEW 15-019.GPJ 11-6-15

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

LOG OF BORING NO. R21

CA0601: I-30 - Roadway Widening
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 256+15, 350 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 400±	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 %
			Dense light reddish tan silty fine sand w/numerous quartz fragments and some crushed stone (fill)	50			
			Stiff tan, reddish tan and gray clay, slightly sandy w/trace fine gravel and some shale fragments	11			54
5			Firm to stiff tan, reddish tan and gray silty clay w/shale fragments and occasional clay seams and trace fine sand partings	10			
			- firm, less silt with occasional highly weathered shale seams below 6 ft	8			
			- stiff, slightly silty with some ferrous stains and nodules and a little fine to coarse gravel below 8 ft	21			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 8-7-15

DEPTH TO WATER IN BORING: Dry

DATE: 8/7/2015

LGBNEW 15-019.GPJ 11-6-15

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

LOG OF BORING NO. R22

CA0601: I-30 - Roadway Widening
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 256+50, 100 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 411±	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 %
			Crushed Stone Base				
			Low hardness light gray, tan and reddish tan highly weathered shale w/occasional silty clay partings	28			
			- with some clay seams, silt partings and ferrous stains and nodules below 2 ft	50/11"			
			- less clay seams below 4 ft				
5				47			
			- with some silty clay seams and layers below 6 ft	48			
				43			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 8-10-15

DEPTH TO WATER IN BORING: Dry

DATE: 8/10/2015

LGBNEW 15-019.GPJ 11-6-15

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

LOG OF BORING NO. R23

CA0601: I-30 - Roadway Widening
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 250+55, 290 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 436±	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 %
			Dense reddish tan fine sand w/some fine to coarse gravel (fill)	50/10"			
			Stiff gray, reddish tan and tan silty clay w/shale and sandstone fragments and occasional clay partings	17			56
5			Low hardness gray and tan highly weathered shale w/occasional silty clay partings and seams	17			
				38			
			- low hardness to moderately hard with medium spaced sandstone partings and occasional fine sand partings below 8 ft	50			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 8-13-15

DEPTH TO WATER IN BORING: Dry

DATE: 8/13/2015

LGBNEW 15-019.GPJ 11-6-15

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

LOG OF BORING NO. R24

CA0601: I-30 - Roadway Widening
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 254+90, 95 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 425±	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 %
			Crushed Stone Base (fill)	50/8"			
			Dense reddish brown silty fine sand, slightly clayey w/occasional shale fragments and quartz fragments (fill)	35			26
5			Firm reddish tan, tan and gray silty clay w/shale fragments and quartz fragments	7			64
			Stiff brown and gray clay, slightly silty w/some shale fragments and occasional silty clay pockets	19			
			- with shale and quartz fragments below 8 ft	17			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 8-13-15

DEPTH TO WATER IN BORING: Dry

DATE: 8/13/2015

LGBNEW 15-019.GPJ 11-6-15

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

LOG OF BORING NO. 1

CA0601: I-30 (Widening)(S)
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 250+00, 55 ft Rt

SURF. EL: 446±

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 %
			Medium dense dark gray and brown fine to medium sand, slightly clayey w/fine to coarse gravel and some organics (fill)	16			19
			Firm to stiff gray, brown and tan silty clay w/some shale fragments and some silt pockets (fill)	10			
			- stiff below 4 ft	14			
5			Stiff tan and dark gray silty clay w/some fine to coarse gravel	22			
			Medium dense reddish tan clayey fine to coarse sand w/some fine to coarse gravel	30			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 6-9-15

DEPTH TO WATER IN BORING: Dry

DATE: 9/9/2015

LGBNEW 15-019.GPJ 10-20-15

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

LOG OF BORING NO. 2

CA0601: I-30 (Widening)(S)
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 255+00, 60 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 423±	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 %
			Dense Crushed Stone Base (fill)	50			
				28			
5			Medium dense gray, tan and reddish tan fine sandy gravel, slightly clayey w/some coarse gravel (fill)	23		● -NON-PLASTIC-	10
			Stiff light gray, tan and reddish tan clay, slightly silty w/shale fragments and trace fine quartz gravel (fill)	11		●	
			- very stiff with some silty clay pockets below 8 ft			●	
10			Very stiff dark olive gray silty clay w/some fine to coarse gravel	26			
15							

COMPLETION DEPTH: 10.0 ft
DATE: 6-23-15

DEPTH TO WATER IN BORING: Dry

DATE: 6/23/2015

LGBNEW 15-019.GPJ 10-20-15

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

LOG OF BORING NO. 3

CA0601: I-30 (Widening)(S)
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 260+00, 40 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 409±	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 %
			Medium dense reddish brown, reddish tan and gray clayey fine sand w/trace fine gravel (fill)	12			16
			- with some fine to coarse gravel below 2 ft	12			
5			Stiff tan and gray silty clay w/shale fragments (fill)	14			
				10			
			Firm olive gray and brown silty clay w/trace organics and fine gravel	8			
10							
15							

COMPLETION DEPTH: 10.0 ft
DATE: 6-9-15

DEPTH TO WATER IN BORING: Dry

DATE: 6/9/2015

LGBNEW 15-019.GPJ 10-20-15

ATTACHMENT 6

15.019
B-534
S-13
49-50
Ball
SureTight™

5-13
45'-7'
15-019
B-535
45'-50'
50-55'
Grubbs, Hoskyn,
Barton & Wyatt INC
CONSULTING ENGINEERS

16-184
B-536
23'-28'
28'-33'
23'

15-019
B-537
18'-23'
23-28'
18'

15-019
B-537
28'-33'
33'-38'
28'

15-019
B-537
38'-43'

19'
15-019
B-538B
19'-24'
25-30'

30'
15-019
B-538B
30'-35'
35'-40'

40'
15-019
B-538B
40'-45'

B-540
S-7 15-20'
S-8 20
15-019
B-540
15'-20'
20'-25'
Grubbs, Hoskyn, Barton & Wyatt INC
CONSULTING ENGINEERS
TOP
15 →
20'

5 - 25 - 30'

15-019
B-540
25'-30'

Grubbs, Hoskyn, Barton & Wyatt INC
CONSULTING ENGINEERS

TOP
25'

15'
15-019
BW29
15-20'
20-24'
Grubbs, Hoskyn,
Barton & Wyatt INC
CONSULTING ENGINEERS

ATTACHMENT 7

SUMMARY of CLASSIFICATION TEST RESULTS

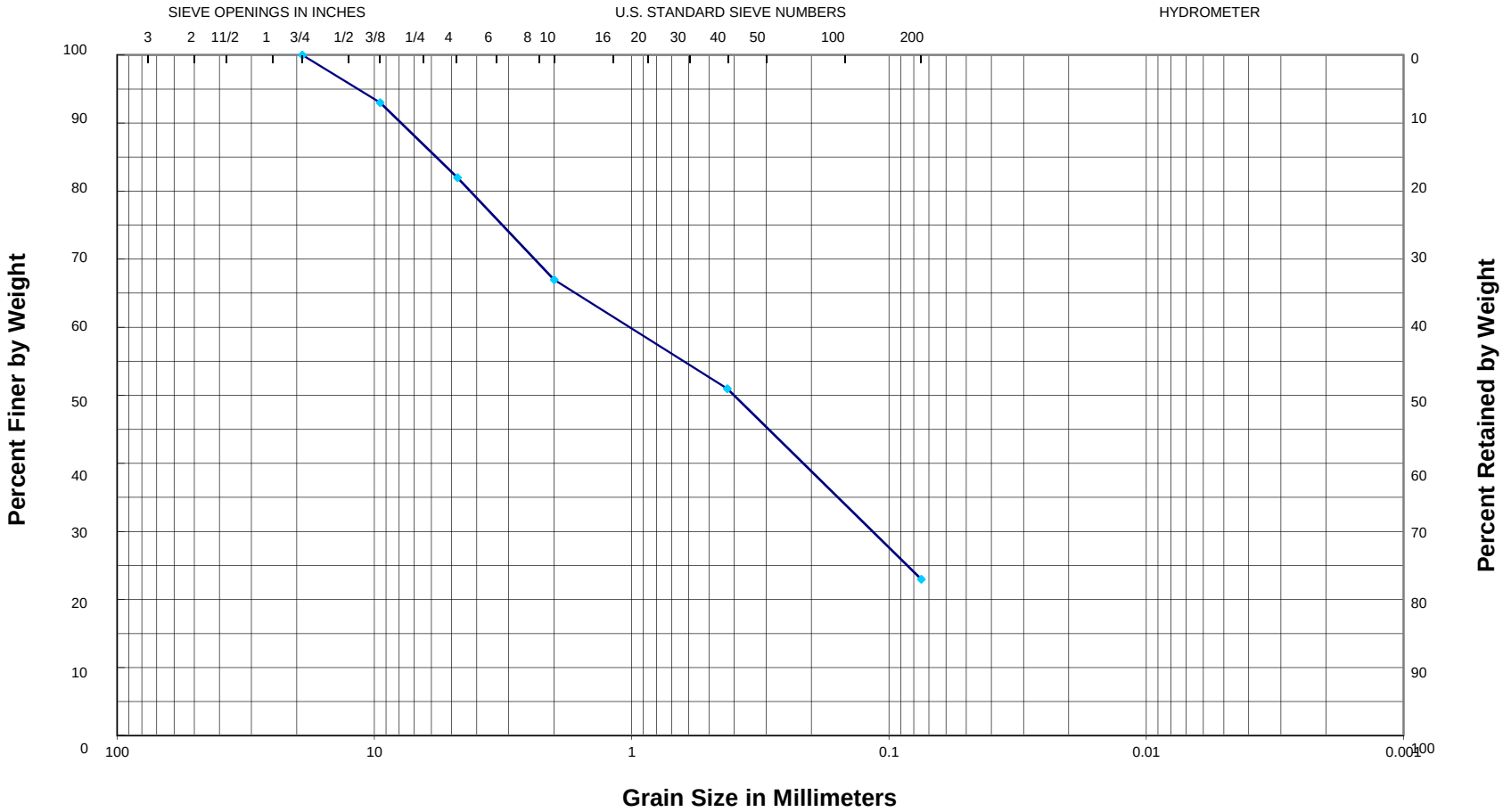
PROJECT: CA0601: Hwy 70 - I-30 Interchange
LOCATION: Saline County, Arkansas
JOB NUMBER: 15-019

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS PERCENT PASSING								Unified Class.	AASHTO Class.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
R25	0.5-1.5	15	24	16	8	-----	-----	100	93	82	67	51	23	SC	A-2-4
R25	2.5-3.5	12	33	20	13	-----	-----	-----	-----	60	-----	-----	26	GC	A-2-6
R26	0.5-1.5	10	NON-PLASTIC			-----	-----	100	84	77	72	68	22	SM	A-2-4
R26	2.5-3.5	17	50	27	23	-----	-----	-----	-----	57	-----	-----	32	SC	A-2-7
R27	0.5-1.5	12	NON-PLASTIC			-----	-----	100	93	87	76	58	14	SM	A-2-4
R27	2.5-3.5	14	45	26	19	-----	-----	-----	-----	65	-----	-----	36	GC	A-7-6
R28	0.5-1.5	16	19	17	2	-----	-----	-----	-----	90	-----	-----	39	SM	A-4
R29	0.5-1.5	7				100	89	85	75	67	57	45	14	SC	A-2-6
R29	2.5-3.5	9	34	16	18	-----	100	94	76	67	54	37	17	SC	A-2-6
R30	0.5-1.5	10	-----	-----	-----	-----	100	88	80	65	54	41	22	SC	A-7-6
R30	2.5-3.5	21	50	28	22	-----	-----	-----	-----	82	-----	-----	52	CH	A-7-6
R31	2.5-3.5	20	47	25	22	-----	-----	-----	-----	77	-----	-----	45	SC	A-7-6
R32	0.5-1.5	9	-----	-----	-----	-----	-----	100	96	82	61	42	26	SC	A-2-4
R33	0.5-1.5	5	NON-PLASTIC			-----	-----	100	84	65	45	26	11	SW-SM	A-3
R34	0.5-1.5	7	-----	-----	-----	-----	100	97	78	61	43	26	12	SW-SM	A-3
R34	2.5-3.5	-----	50	18	32	-----	-----	-----	-----	-----	-----	-----	-----	CH	A-7-6
R35	0.5-1.5	13	54	23	31	-----	100	96	79	61	45	28	17	SC	A-7-6
R35	4.5-5.5	30	-----	-----	-----	-----	-----	-----	-----	100	-----	-----	69	CH	A-7-6

15-019

GRAIN SIZE CURVE

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



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring R25, 0.5-1.5 ft; LL = 24, PL = 16, PI = 8
Description: Red clayey fine sand with crushed stone and shale fragments

USCS = SC AASHTO = A-2-4

15-019

GRAIN SIZE CURVE

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

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

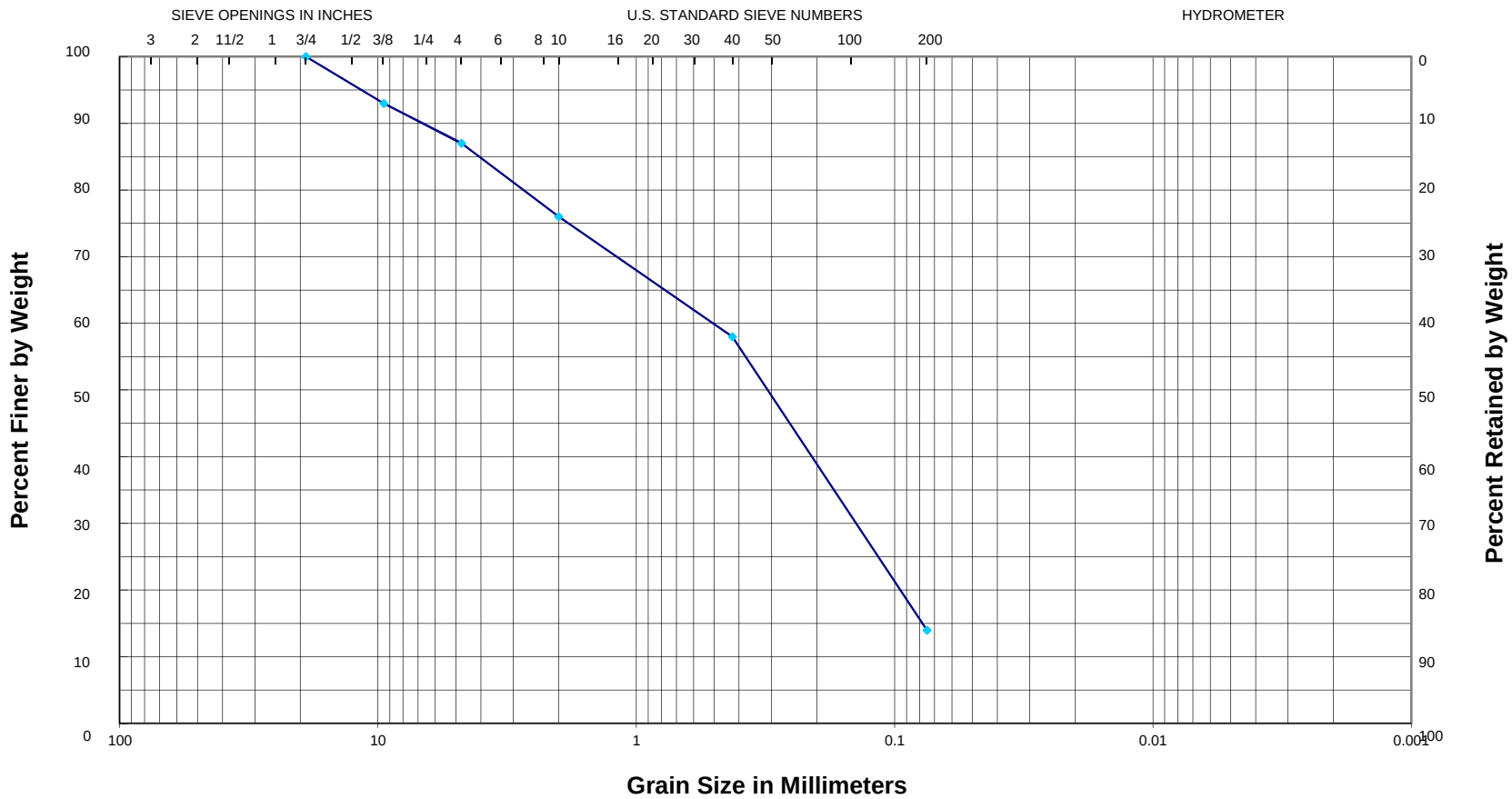
Sample: Boring R26, 0.5-1.5 ft; Non-plastic
Description: Red silty fine sand with crushed stone fragments

USCS = SC AASHTO = A-2-4

15-019

GRAIN SIZE CURVE

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



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring R27, 0.5-1.5 ft; Nonplastic
Description: Red clayey fine to medium sand

USCS = SM AASHTO = A-2-4

15-019

GRAIN SIZE CURVE

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

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

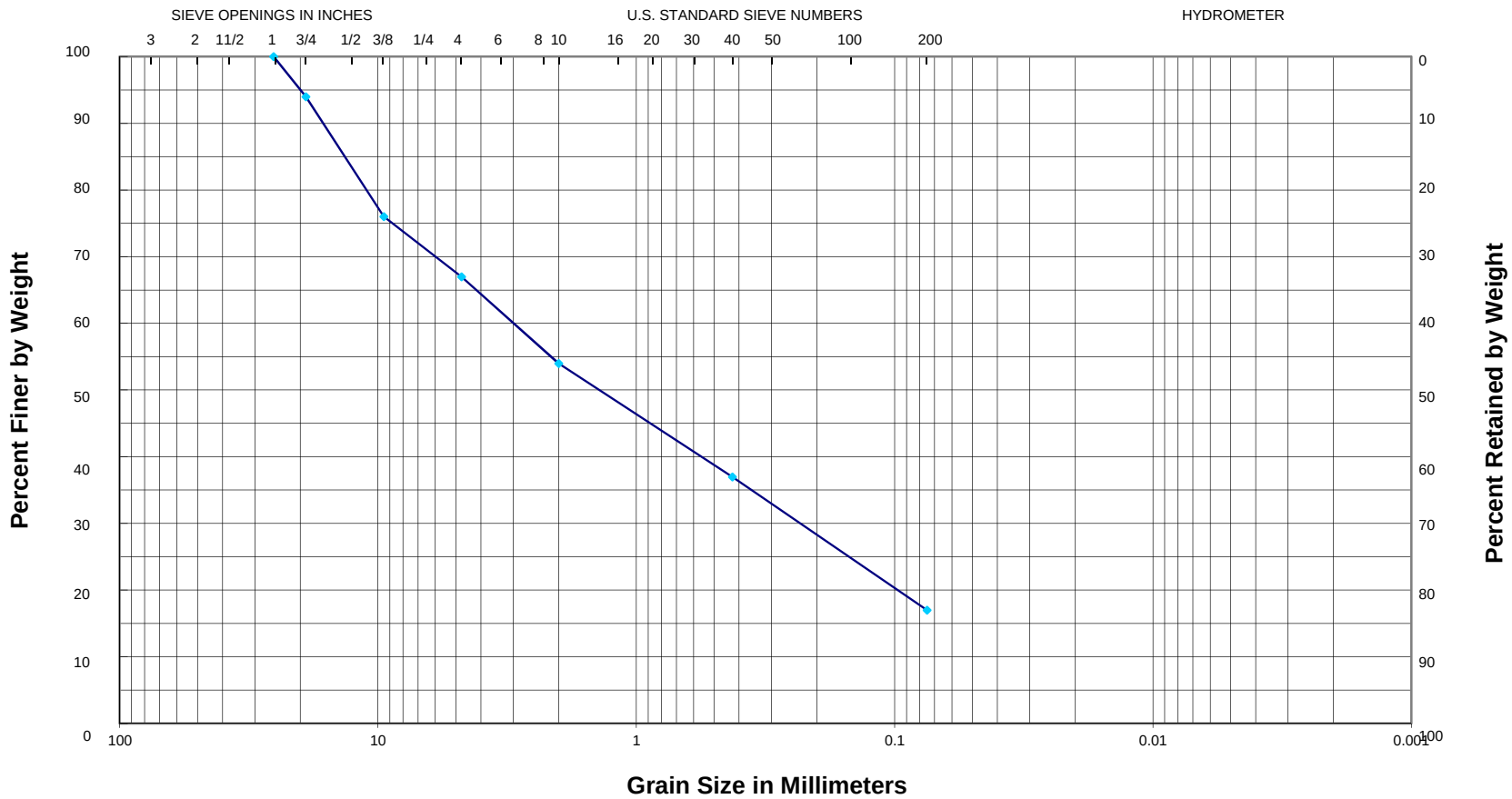
Sample: Boring R29, 0.5-1.5 ft;
Description: Red clayey fine sand with some crushed stone and quartz fragments

USCS = SC AASHTO = A-2-6

15-019

GRAIN SIZE CURVE

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



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring R29, 2.5-3.5 ft; LL = 34, PL = 16, PI = 18
Description: Red clayey fine sand with some crushed stone and quartz fragments

USCS = SC AASHTO = A-2-6

15-019

GRAIN SIZE CURVE

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

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

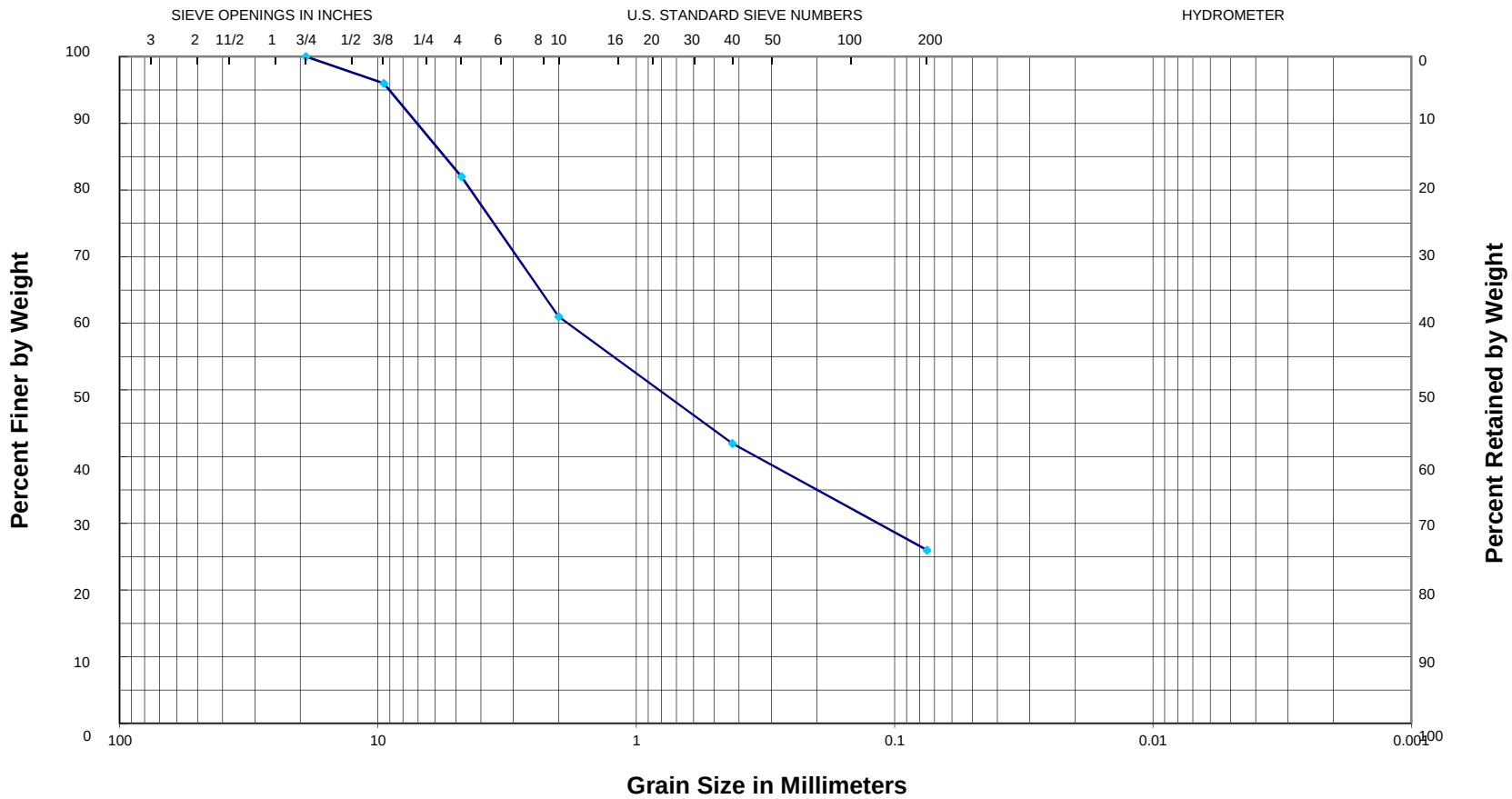
Sample: Boring R30, 0.5-1.5 ft;
Description: Red and gray clayey fine to coarse sand with some shale fragments and coarse gravel

USCS = SC AASHTO = A-7-6

15-019

GRAIN SIZE CURVE

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



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

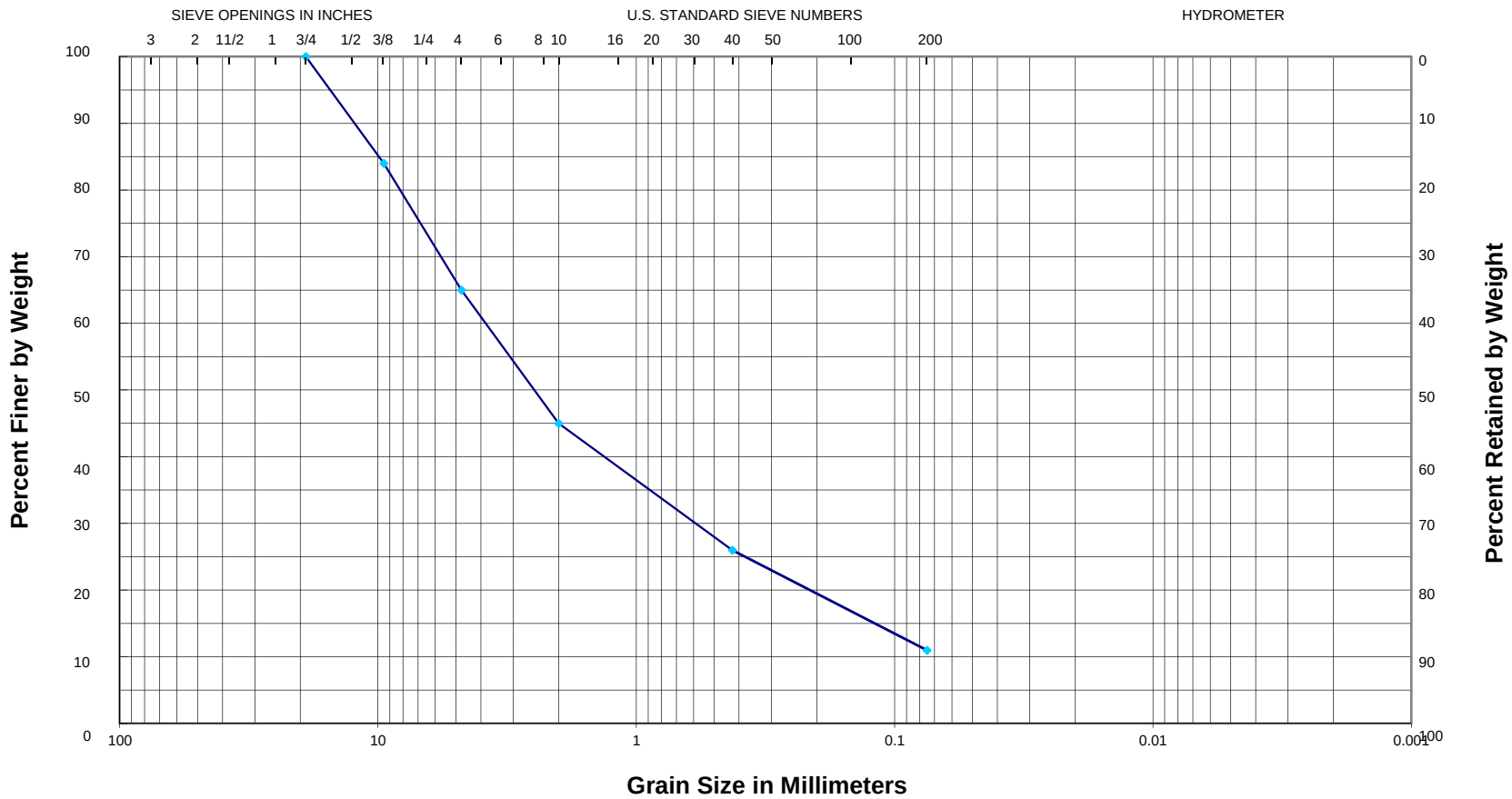
Sample: Boring R32, 0.5-1.5 ft;
Description: Reddish tan and tan silty fine to medium sand with some quartz and novaculite fragments

USCS = SC AASHTO = A-2-4

15-019

GRAIN SIZE CURVE

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



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring R33, 0.5-1.5 ft; Nonplastic
Description: Light tan fine to coarse sand, slightly silty with some quartz fragments

USCS = SW-SM AASHTO = A-3

15-019

GRAIN SIZE CURVE

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

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring R34, 0.5-1.5 ft;
Description: Brown, gray and tan clay with some crushed stone and quartz fragments

USCS = SW-SM AASHTO = A-3

15-019

GRAIN SIZE CURVE

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

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

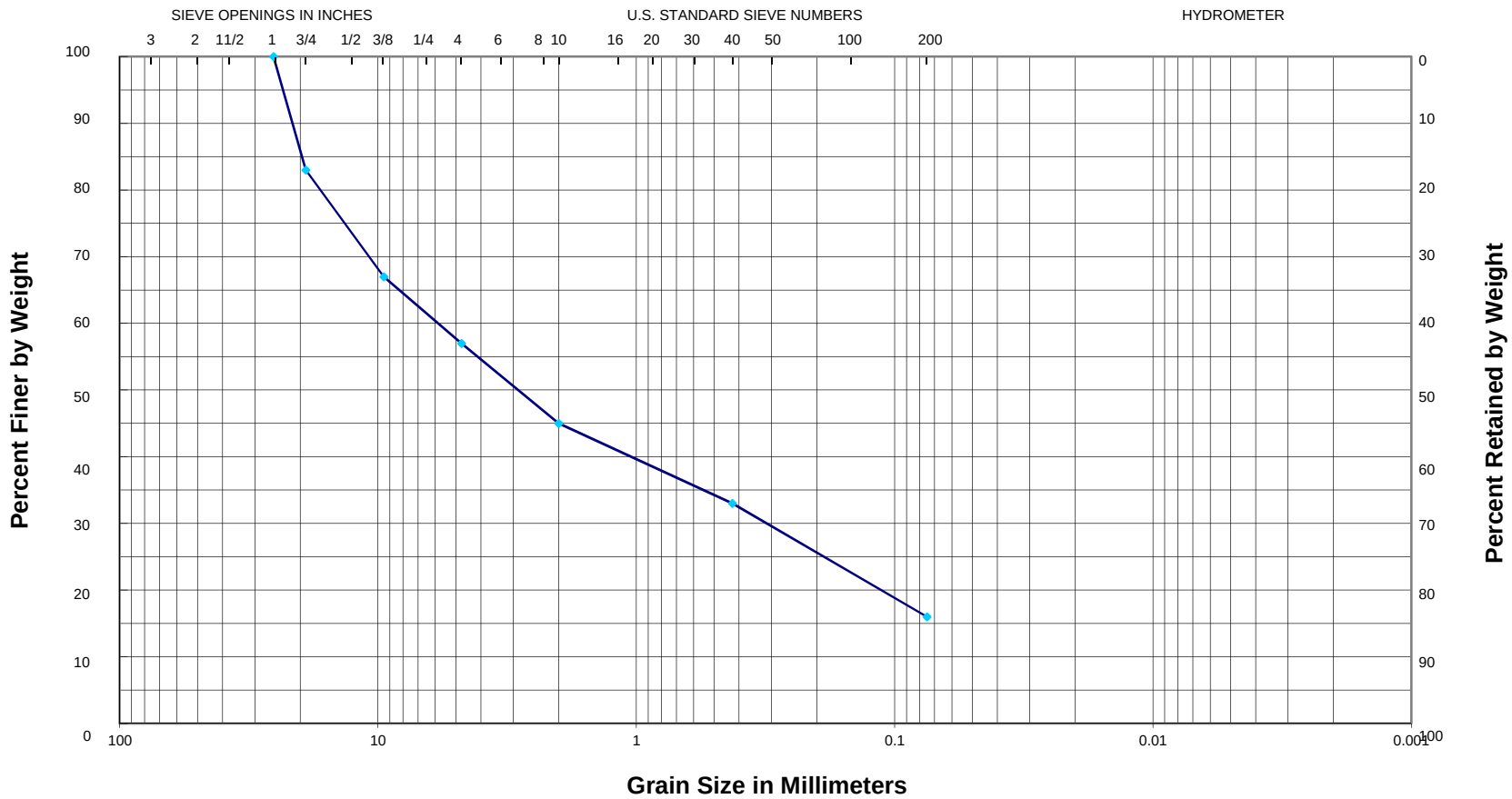
Sample: Boring R35, 0.5-1.5 ft; LL = 54, PL = 23, PI = 31
Description: Tan and gray silty clay with crushed quartz fragments

USCS = SC AASHTO = A-7-6

15-019

GRAIN SIZE CURVE

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



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

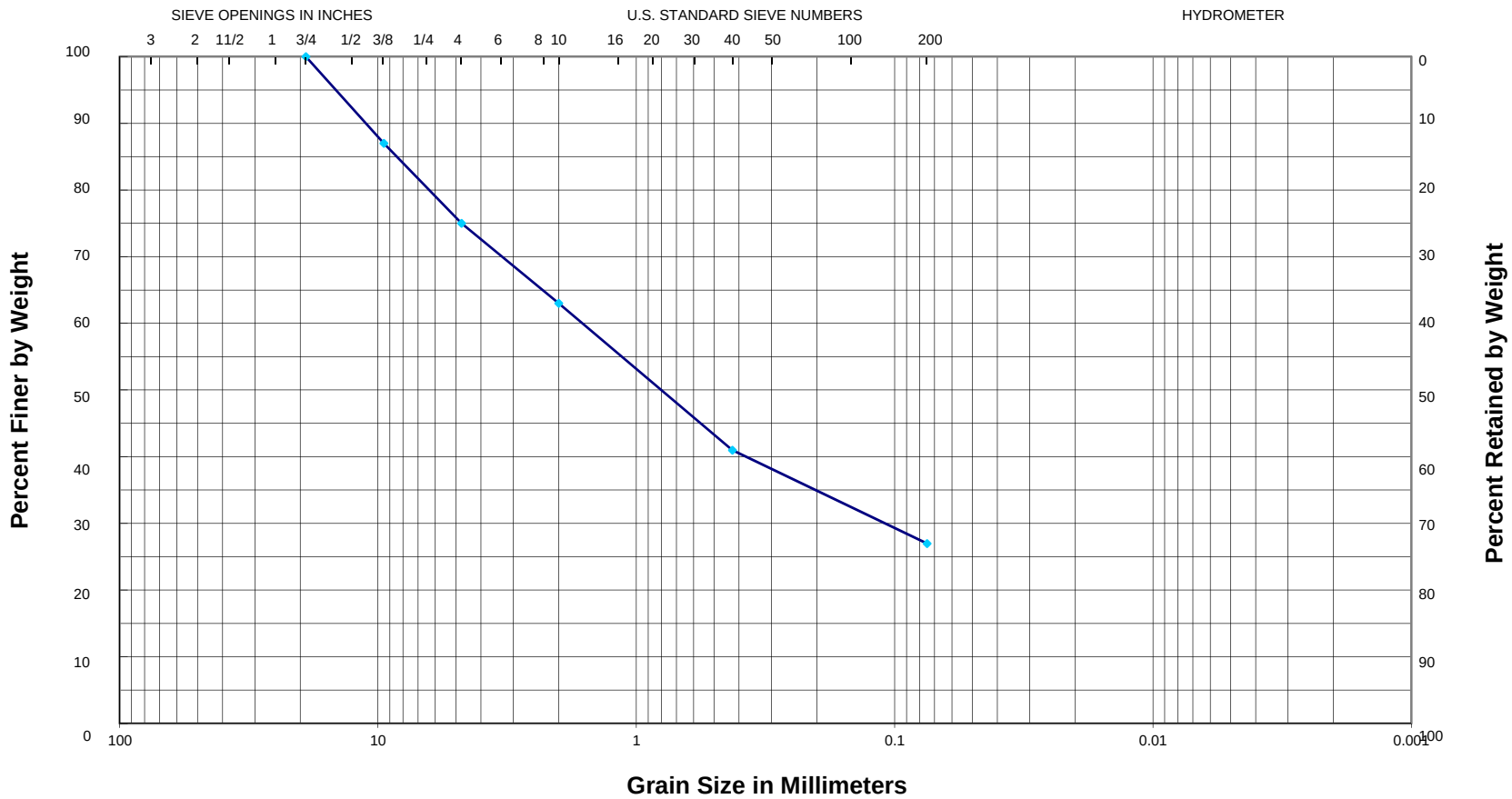
Sample: Boring R36, 0.5-1.5 ft; LL = 28, PL = 17, PI = 11
Description: Red clayey fine to medium sand with quartz and crushed stone fragments

USCS = GC AASHTO = A-2-6

15-019

GRAIN SIZE CURVE

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



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

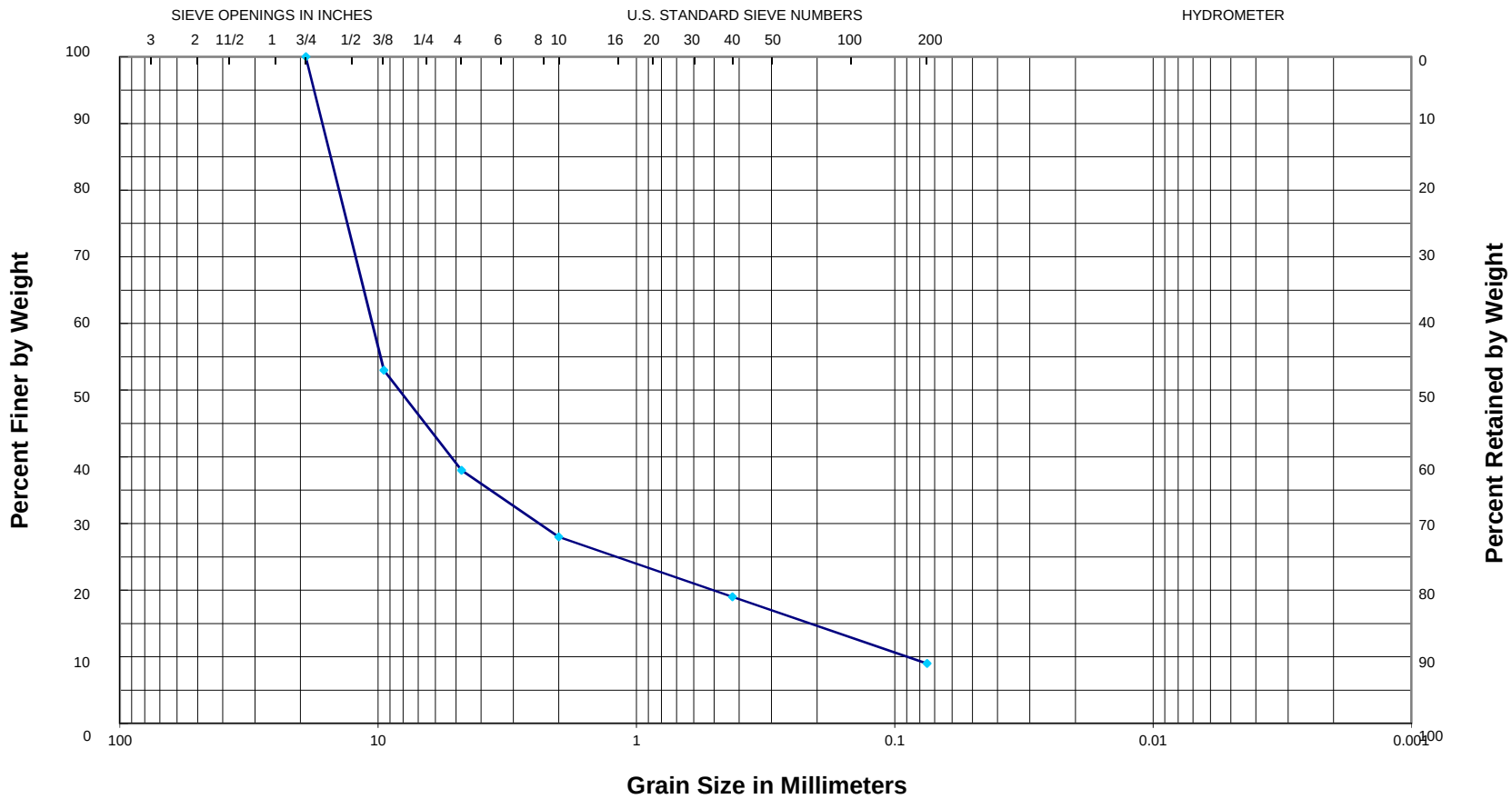
Sample: Boring R37, 0.5-1.5 ft; LL = 40, PL = 20, PI = 20
Description: Red silty clay with crushed stone fragments

USCS = SC AASHTO = A-2-6

15-019

GRAIN SIZE CURVE

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



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

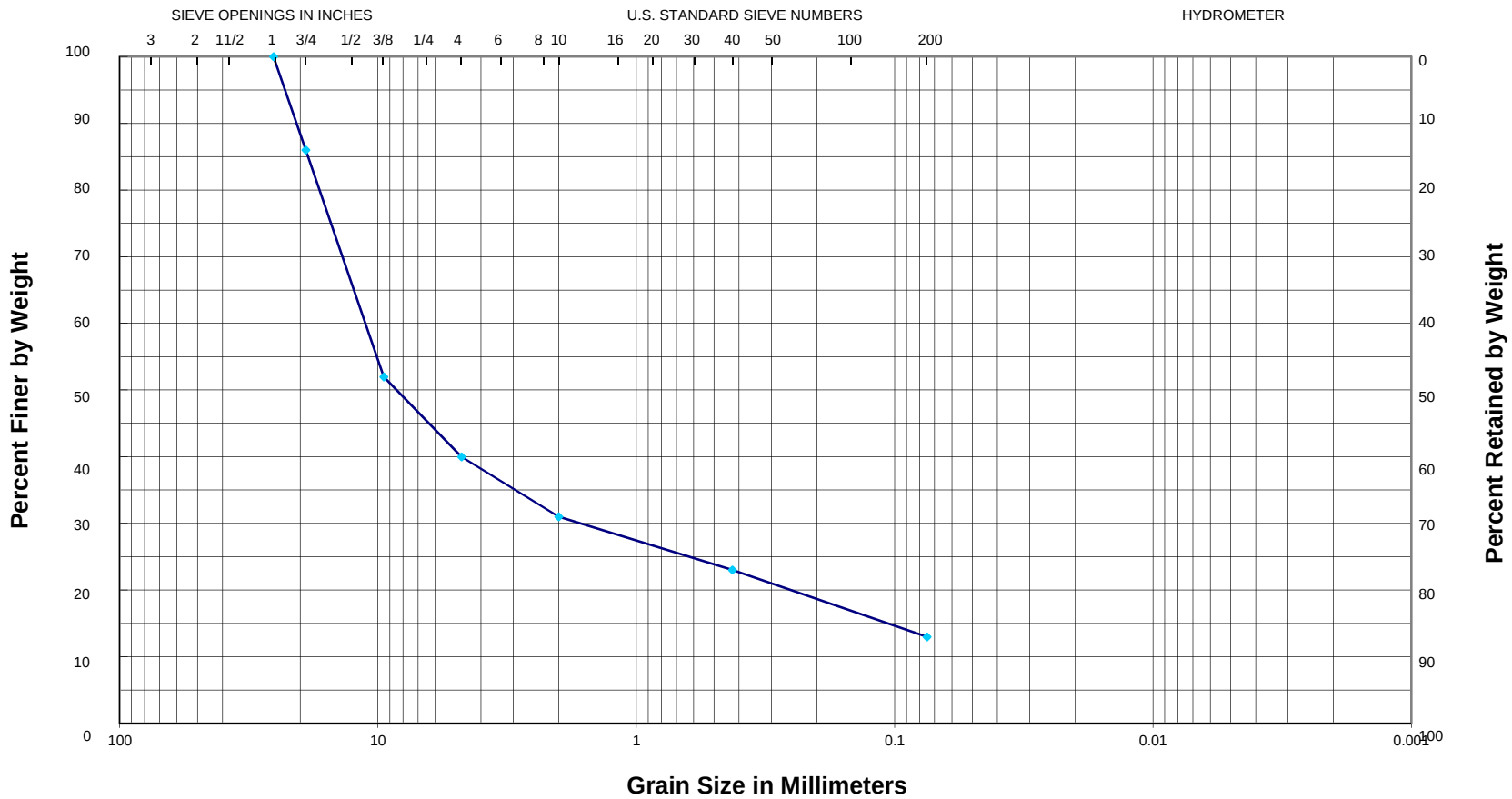
Sample: Boring W29, 0.5-1.5 ft; LL = 19, PL = 14, PI = 5
Description: Tan and reddish tan sandy fine to coarse gravel, slightly clayey

USCS = GP-GC AASHTO = A-1-a

15-019

GRAIN SIZE CURVE

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



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

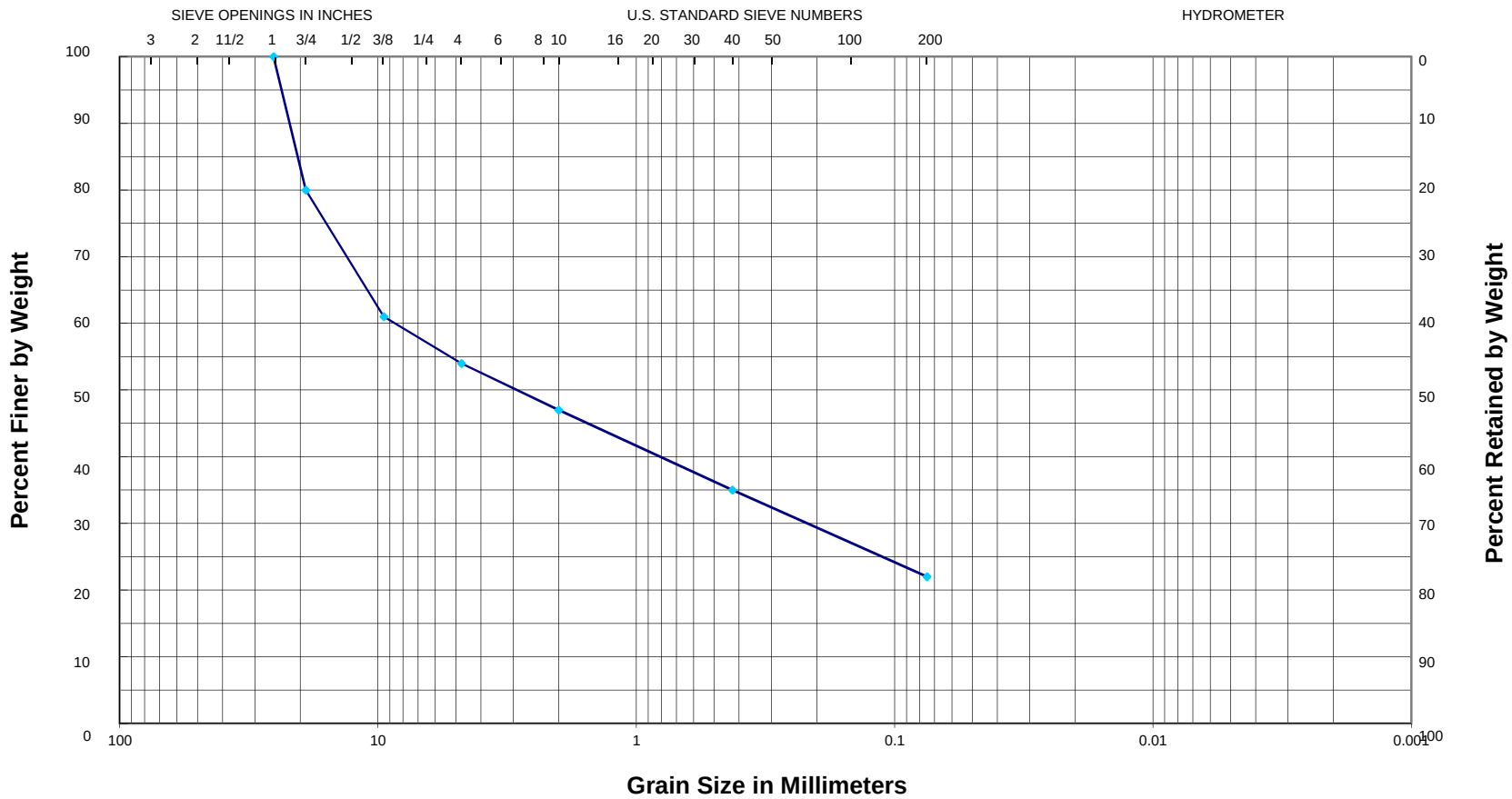
Sample: Boring W30, 0.5-1.5 ft; LL = 21, PL = 14, PI = 7
Description: Tan and brown clayey fine to coarse gravel, sandy

USCS = GC AASHTO = A-1-a

15-019

GRAIN SIZE CURVE

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



GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

Sample: Boring S36, 0.5-1.5 ft; LL = 39, PL = 22, PI = 17
Description: Tan silty clay with numerous sandstone and quartz fragments and concrete debris

USCS = GC AASHTO = A-2-6

ATTACHMENT 8

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

P.O. Box 30970
Little Rock, Arkansas 72260-0970
#1 Trigon Place 72209
(501) 455-2536
FAX (501) 455-4137

REPORT OF STANDARD PROCTOR TEST

(AASHTO T-99 Method A)

Project: CA0601 US70 Interchange Job No: 15-019

Material Description: Fine sandy CLAY with shale and sandstone fragments

Location Sampled/Source: B-R26
Sample Depth, ft.: 1.5-2
Date Sampled: 2/16/2018
Date Tested: 2/24/2018
Tested By: LLC
Report Date: 3/16/2018

LAB COMPACTION PROCEDURE: AASHTO T-99 A	
Maximum Unit Dry Wt. (pcf):	104.8
Optimum Water Content (%):	19.5

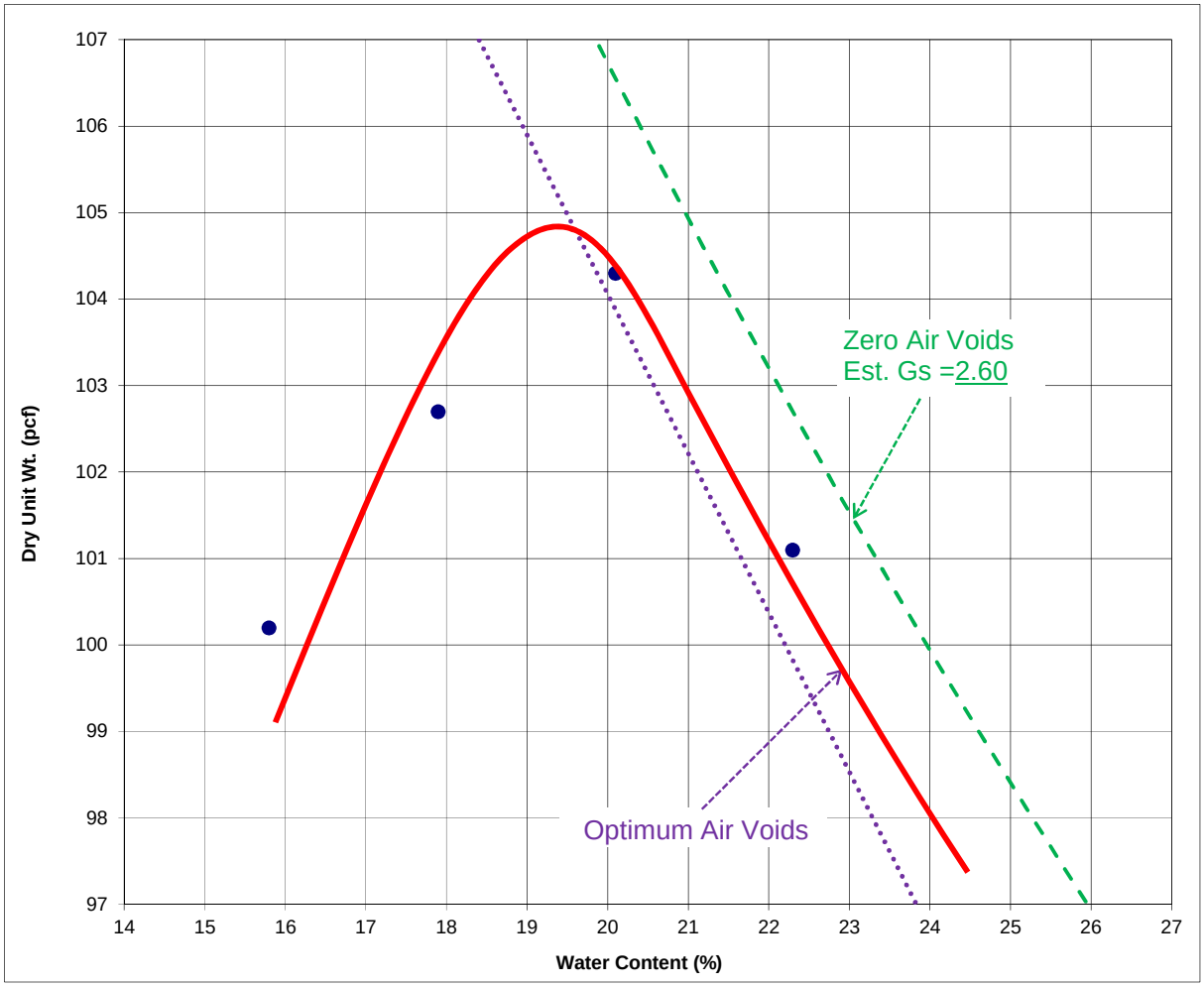
As Processed Water Content: 23.0 %

ATTERBERG LIMITS AASHTO T-89, T-90
Liquid Limit: 47
Plastic Limit: 28
Plasticity Index: 19

AASHTO Classification:
A-7-6

USCS Classification:
CL

GRADATION AASHTO T-27, T-11	
Sieve Number	Percent Passing
3 in.	100
2 in.	100
1 in.	100
3/4 in.	98
3/8 in.	95
#4	87
#10	76
#40	62
#200	51



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

P.O. Box 30970
Little Rock, Arkansas 72260-0970
#1 Trigon Place 72209
(501) 455-2536
FAX (501) 455-4137

REPORT OF STANDARD PROCTOR TEST

(AASHTO T-99 Method A)

Project: CA0601 US70 Interchange Job No: 15-019

Material Description: Olive gray and gray silty clay with shale fragments and crushed stone

Location Sampled/Source: B-R31
Sample Depth, ft.: 1.5-2
Date Sampled: 2/16/2018
Date Tested: 2/24/2018
Tested By: LLC
Report Date: 3/16/2018

LAB COMPACTION PROCEDURE: AASHTO T-99 A	
Maximum Unit Dry Wt. (pcf):	109.5
Optimum Water Content (%):	17.0

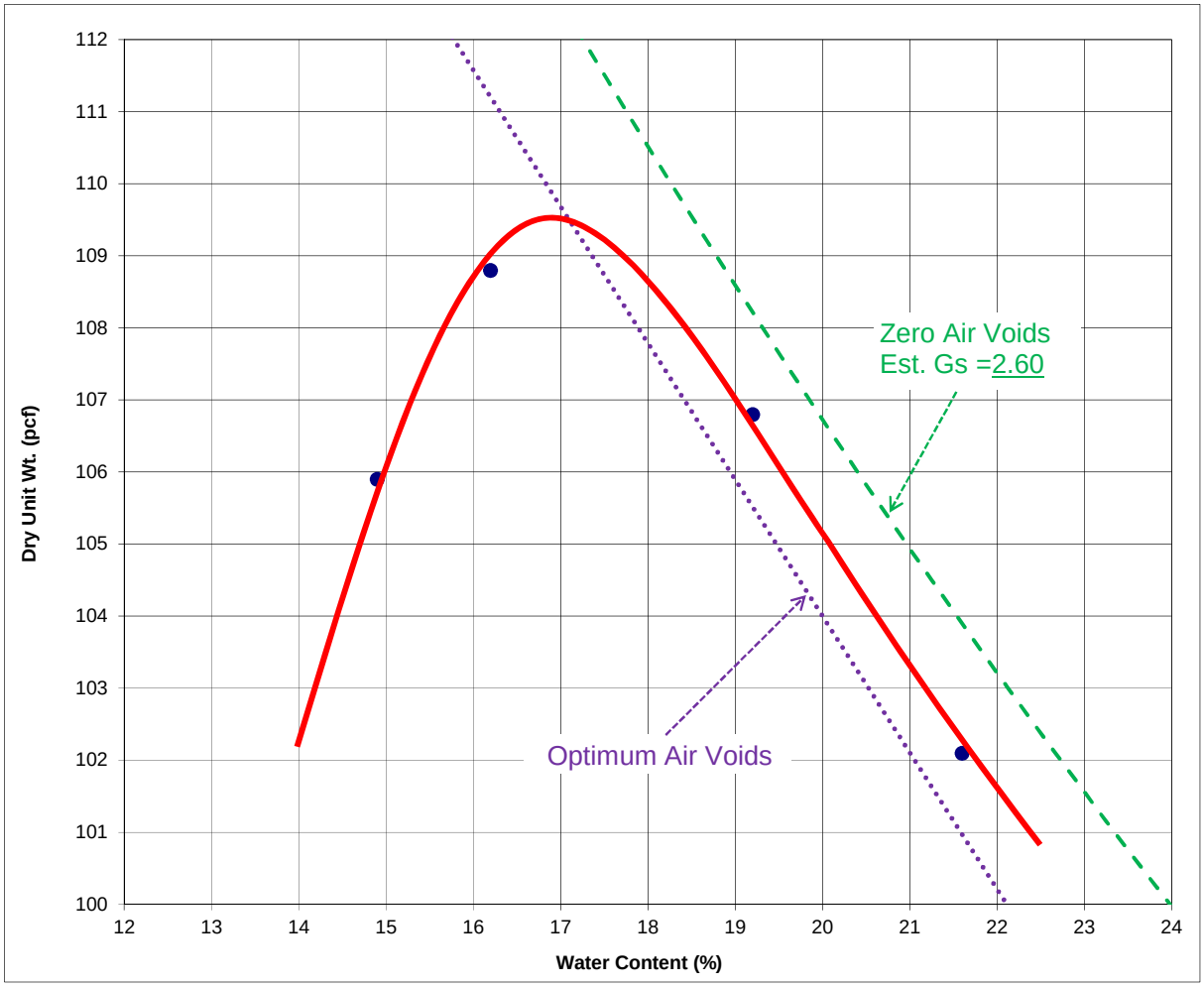
As Processed Water Content: 18.9 %

ATTERBERG LIMITS AASHTO T-89, T-90
Liquid Limit: 34
Plastic Limit: 25
Plasticity Index: 9

AASHTO Classification:
A-4

USCS Classification:
ML

GRADATION AASHTO T-27, T-11	
Sieve Number	Percent Passing
3 in.	100
2 in.	100
1 in.	100
3/4 in.	100
3/8 in.	97
#4	90
#10	80
#40	68
#200	59



ATTACHMENT 9

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED.RD. DIST.NO.	STATE	FED.AID PROJ.NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.			
				JOB NO.		CA0601	247	326

1 [Brdg#] BRIDGE LAYOUT [Dwg#]

90% SUBMITTAL

PRELIMINARY
FOR REVIEW ONLY

STEPHEN T. SMILEY, P.E., 13072

APRIL-2018

For R/W Data, See Roadway Plans

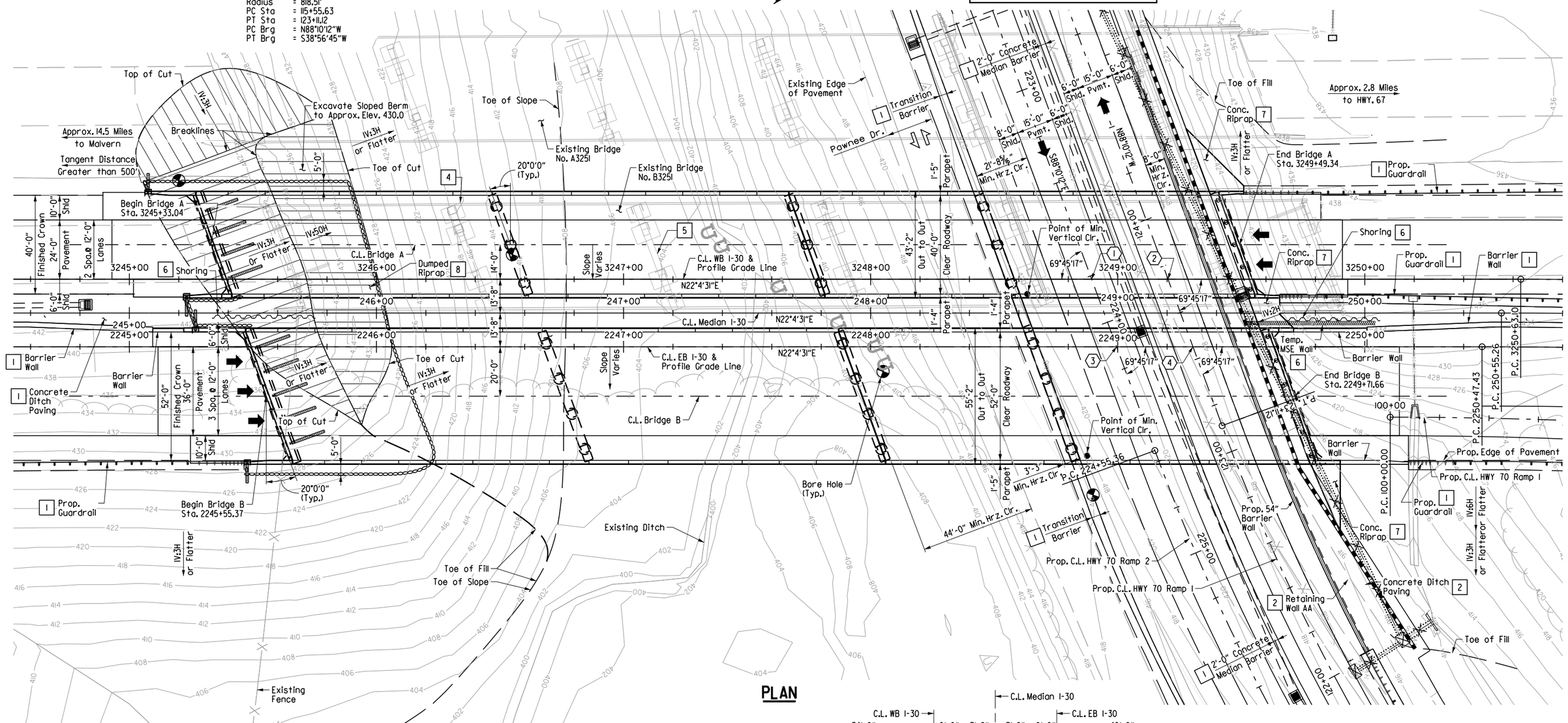
See key-plan Dwg. No. XXXX1 for location and type of approach slabs and approach gutters.

HORIZONTAL CURVE DATA

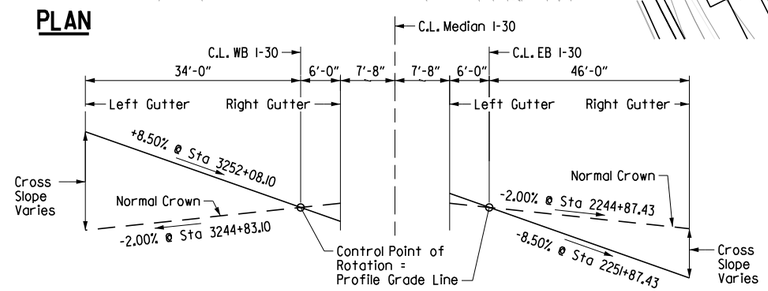
C.L. HWY 70 Ramp 1 Curve 3

PI Sta	= 119+62.69
Delta	= 52°53'03" RT
Degree	= 7°00'00"
Tangent	= 407.06'
Length	= 755.49'
Radius	= 818.51'
PC Sta	= 115+55.63
PT Sta	= 123+11.12
PC Brg	= N88°10'12"W
PT Brg	= S38°56'45"W

Notes:
1. Unless otherwise noted, All Bridge A & B longitudinal edges of deck and approaches are parallel to C.L. WB I-30 and C.L. EB I-30, respectively.
2. All Bents are parallel to each other.



PLAN



SUPERELEVATION TRANSITION DETAIL FOR BRIDGE A & B

(Looking Ahead)
No Scale

For additional information, see Std. Dwg. SE-1.

1. See Roadway Plans
2. See Retaining Wall Plans
3. Angle is measured from a line perpendicular to the C.L. Bridge to C.L. of Joint or Bent.
4. Existing foundations, Typ.
5. Existing substructures, Typ.
6. Shoring & Temp. MSE Wall is required during construction, See Project Bridge General Notes regarding Shoring & Temp. MSE Wall, on Dwg. No. XXXX2
7. Concrete Riprap - See Std. Dwg. 55002
8. Dumped Riprap - 1'-6" thick placed on filter blanket See Std. Dwg. 55001

NOTE:
The proposed bridges are positioned to avoid interference with the existing substructures. The Contractor shall verify the location of the existing substructures before constructing the new substructures. Any adjustments required to fit the proposed bridge shall be submitted to the Engineer for approval.

1. Prop. C.L. WB I-30 Sta. 3248+89.43 = Prop. C.L. Ramp 2 Sta. 223+81.45
2. Prop. C.L. WB I-30 Sta. 3249+20.34 = Prop. C.L. Ramp 1 Sta. 123+74.33
3. Prop. C.L. EB I-30 Sta. 2248+99.51 = Prop. C.L. Ramp 2 Sta. 224+10.58
4. Prop. C.L. EB I-30 Sta. 2249+30.42 = Prop. C.L. Ramp 1 Sta. 123+45.20

SHEET 1 OF 4
LAYOUT OF I-30 BRIDGES
OVER HWY. 70

HWY. 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY:	AKH	DATE:	10/08/17	FILENAME:	bca0601_11
CHECKED BY:	STS	DATE:	11/08/17	SCALE:	AS SHOWN
DESIGNED BY:	JH	DATE:	10/08/17		

BRIDGE NO. XXXXX DRAWING NO. XXXXX

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jharrell 3/28/2018 2:15:10 PM

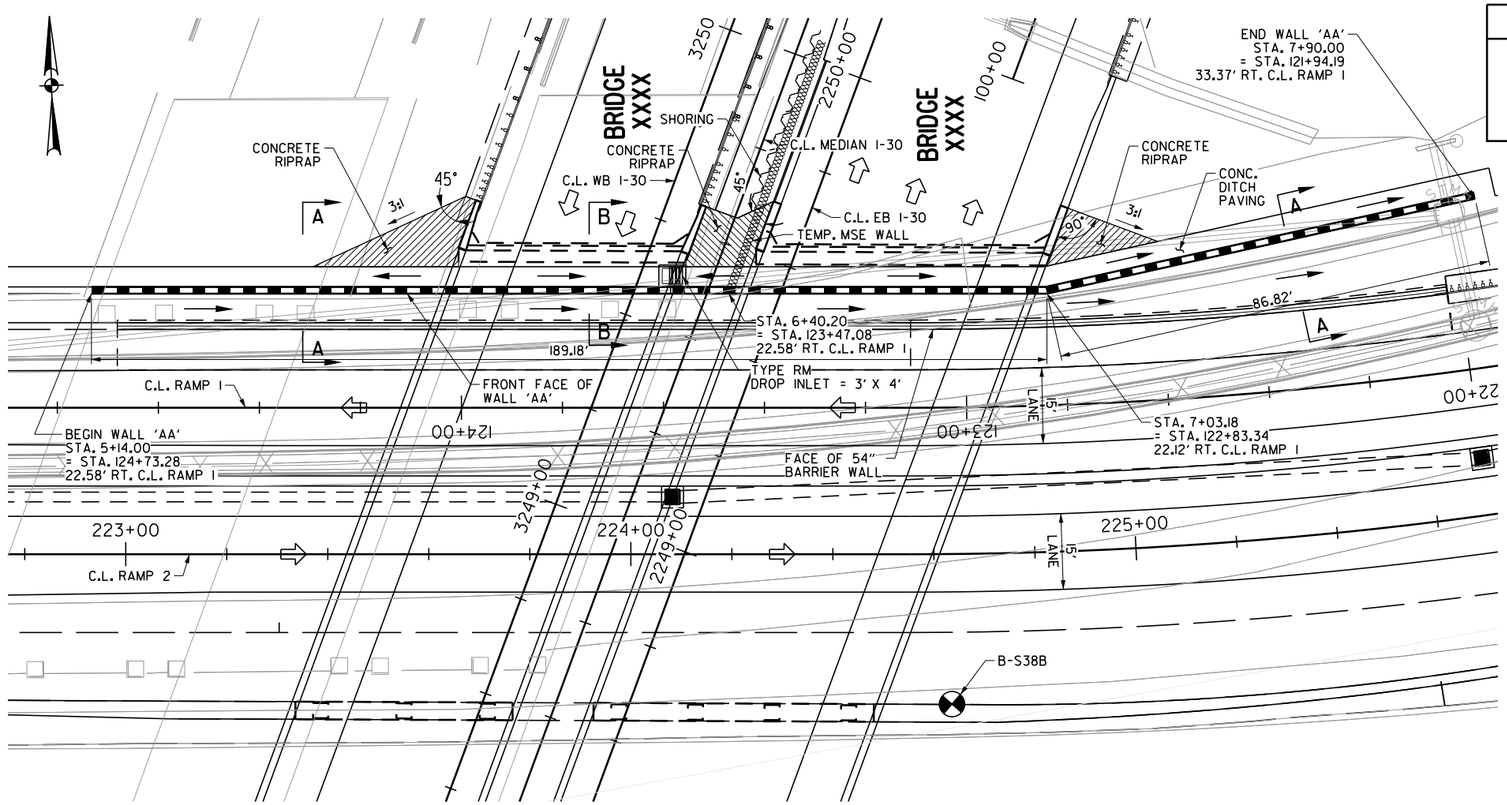
DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED.RD. DIST.NO.	STATE	FED.AID PROJ.NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.			
				JOB NO.		CA0601	251	326
						P&P RET. WALL 'AA'		XXXXX

90% SUBMITTAL

PRELIMINARY
FOR REVIEW ONLY

SHAHRIAR AZAD, P.E., 12404

APRIL-2018

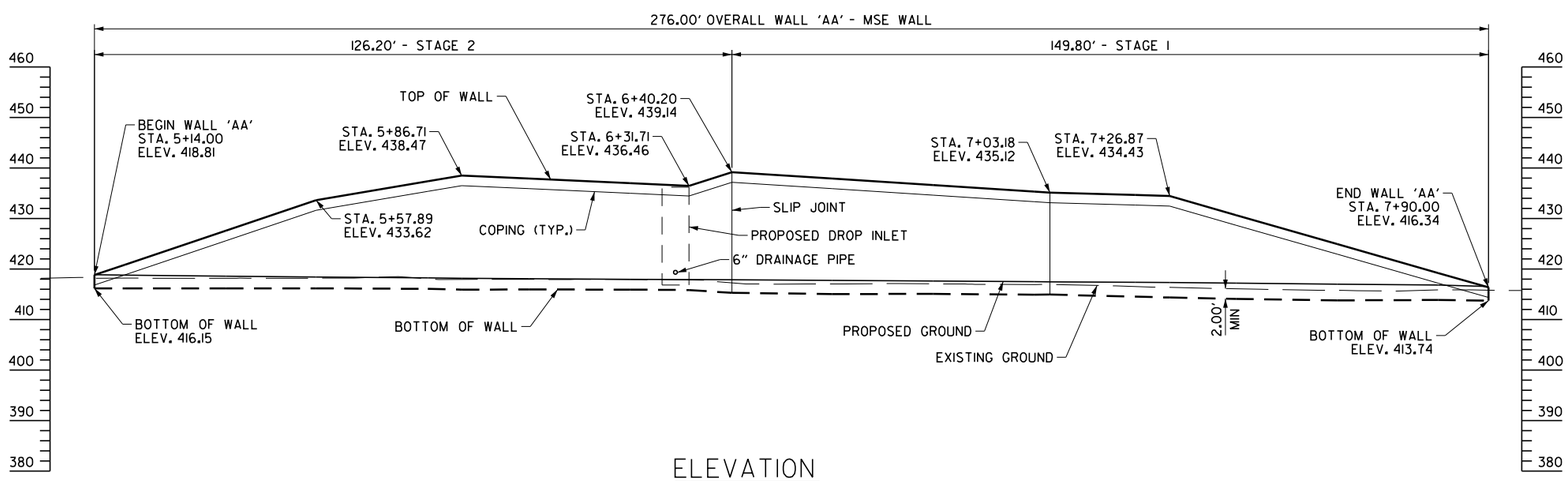


PLAN

SCALE 1"=15'

```
* BENTLEY HORIZONTAL ALIGNMENT REVIEW
*
* Alignment name: RW*AA
* Alignment description: RW*AA
* Alignment style: Default
* Input Factor: 1.00000000
*
```

		STATION	NORTHING	EASTING
Element: Linear				
P.O.B.	(WAAHXX001)	5+00.00	1992658.6691	1108520.1068
P.I.	(WAAHXX002)	7+03.18	1992652.1804	1108723.1863
Tangential Direction:		S 88°10'11.8" E		
Tangential Length:		203.18		
Element: Linear				
P.I.	(WAAHXX002)	7+03.18	1992652.1804	1108723.1863
P.O.E.	(WAAHXX003)	8+07.55	1992671.4936	1108825.7478
Tangential Direction:		N 79°20'08.1" E		
Tangential Length:		104.36		



ELEVATION

SCALE 1"=15'
(VIEWED FROM FRONT FACE OF WALL)

RETAINING WALL 'AA'

STATION ALONG WALL	TOP OF WALL ELEV.	FINISHED GRADE ELEV.	BOTTOM OF WALL ELEV.
5+14.00	418.81	418.87	416.15
5+39.00	427.24	418.58	416.14
5+64.00	434.65	418.35	416.14
5+89.00	438.37	418.15	415.91
6+14.00	437.25	418.00	415.92
6+39.00	438.76	417.85	415.34
6+64.00	437.62	417.69	415.04
6+89.00	436.02	417.54	414.99
7+14.00	434.80	417.38	414.67
7+39.00	430.96	417.19	414.10
7+64.00	423.79	416.95	413.79
7+89.00	416.63	416.55	413.75
7+90.00	416.34	416.52	413.74

NOTES:

1. CONTROL POINT STATIONS AND OFFSETS ARE MEARSURED TO THE OUTSIDE TOP CORNER OF COPING.
2. SEE ROADWAY PLANS FOR ADDITIONAL ROADWAY HORIZONTAL ALIGNMENT DATA.
3. SEE DRAINAGE PLANS FOR ADDITIONAL DRAINAGE INFORMATION.
4. THE CONTRACTOR SHALL SUBMIT DETAILED WORKING DRAWINGS AND DESIGN CALCULATIONS FOR APPROVAL AS DESCRIBED IN SP JOB CA0601 "RETAINING WALLS". ANY ADDITIONAL GEOTECHNICAL INVESTIGATION TO BE PERFORMED BY CONTRACTOR'S ENGINEER SHALL BE CONSIDERED SUBSIDIARY TO PAY ITEM "RETAINING WALLS".
5. BORING LOGS MAY BE OBTAINED FROM THE CONSTRUCTION CONTRACT PROCUREMENT SECTION OF THE PROGRAM MANAGEMENT DIVISION UPON REQUEST.
6. REFER TO RETAINING WALL DETAIL SHEETS FOR ADDITIONAL INFORMATION.
7. REFER TO SP JOB CA0601 "SHORING" FOR SHORING REQUIREMENTS.
8. ALL EXPOSED WALL CONCRETE ELEMENTS SHALL HAVE TEXTURED COATING FINISH USING COLOR CHIP NUMBER 33522. REFER TO SP JOB CA0601 "TEXTURED COATING FINISH".
9. WALL FASCIA VISIBLE BEYOND COPINGS SHALL HAVE "ASHLAR STONE" FORMLINER PRODUCED FINISH PATTERN WITH 3/4" NOMINAL DEPTH OF RELIEF. REFER TO SP JOB CA0601 "ARCHITECTURAL FINISH".

LAYOUT OF RETAINING WALL 'AA'

HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22

ARKANSAS STATE HIGHWAY COMMISSION

LITTLE ROCK, ARK.

DRAWN BY:	DCD	DATE:	1/23/2018	FILENAME:	rca0601_p&p_aa_01
CHECKED BY:	SA	DATE:	1/25/2018	SCALE:	As Shown
DESIGNED BY:	DCD	DATE:	1/22/2018		

DRAWING NO. XXXXX

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Summary of Preliminary Recommendations for Retaining Walls

PROJECT: CA0601 Hwy 70 Interchange
LOCATION: Saline County, Arkansas
JOB NUMBER: 15-019

Wall	Wall Type	Wall Station	Wall Length, ft	Approx Wall Height, ft	Plan Wall Bottom El, ft	Relevant Borings	Nominal unit bearing resistance, ksf	Estimated reinforcing strap length, ft	Estimated undercut requirements, ft	Bearing Stratum	Nominal Sliding Resistance (tan δ)	Comments
Wall AA	MSE	Sta 5+14 to Sta 6+45	131	3 to 24	416	W30, W29	17.4	0.7H ≥ 8	2	Compacted crushed stone base (Cl 7)	0.45	Backfill undercut with Crushed Stone Base (Class 7)
Wall AA	MSE	Sta 6+45 to Sta 6+85	40	21 to 24	414	W30	17.4	0.7H ≥ 8	1	Compacted crushed stone base (Cl 7)	0.45	Backfill undercut with Crushed Stone Base (Class 7)
Wall AA	MSE	Sta 6+85 to Sta 7+90	105	3 to 24	414	S40, W28	17.4	0.7H ≥ 8	3	Compacted crushed stone base (Cl 7)	0.45	Backfill undercut with Crushed Stone Base (Class 7)

Notes:

1. Strap length is an estimate only. The Designer must select the length for use in final design.
2. The suitability of the wall bearing stratum must be field verified by the Engineer or Department at the time of construction.
3. Undercuts required to develop suitable bearing should be backfilled with crushed stone base (AHTD SS 303, Class 7) or an approved alternate.
4. Undercuts should extend at least 10 ft outside the reinforced zone to the extent possible.
5. Criteria above provided for information only. Final design to be developed by Others.

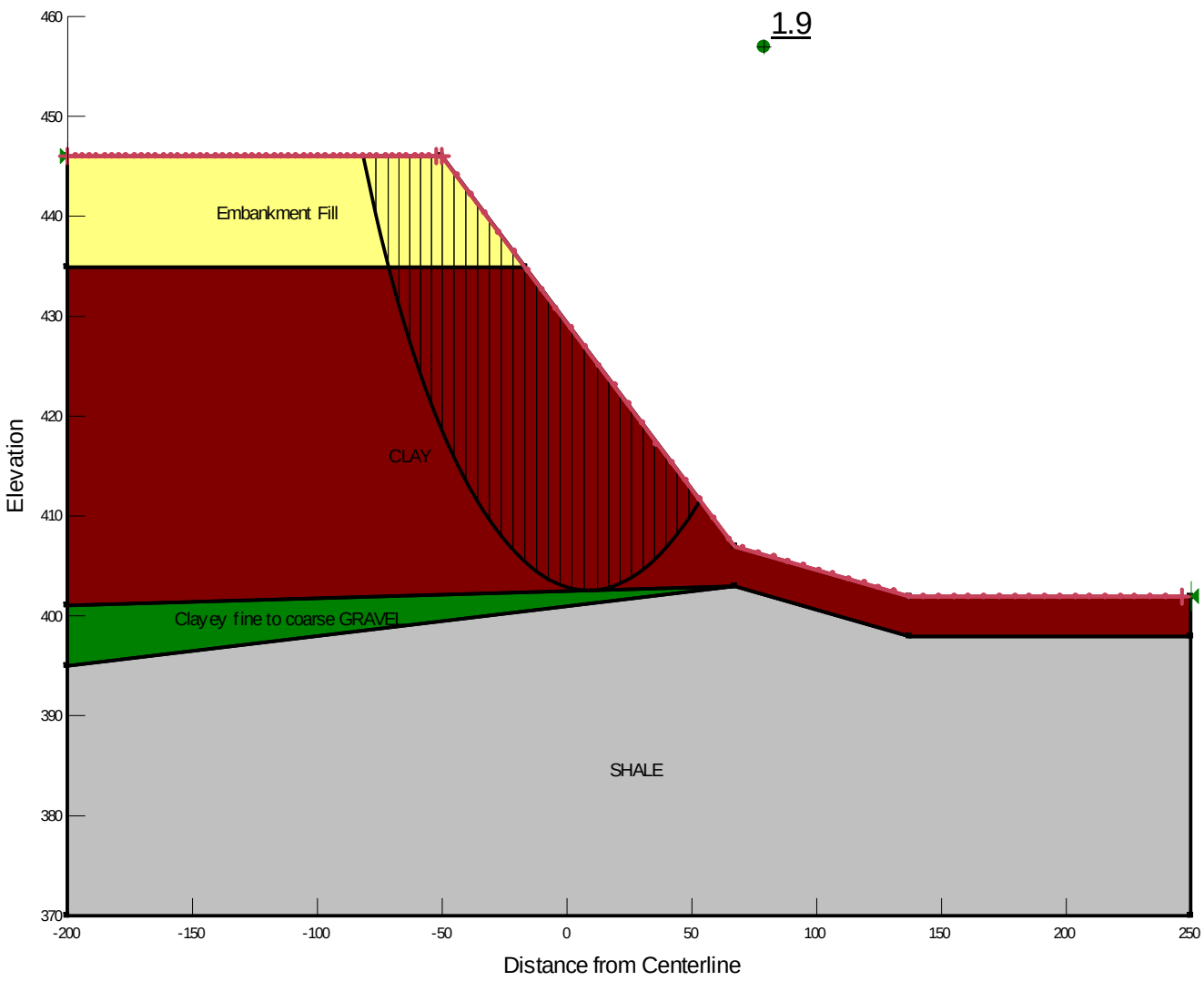
ATTACHMENT 10

Summary of Stability Analysis Results
3H:1V End Slope near WB I-30 Sta 2245+00
AHTD Job No. CA 0601 – HWY 70 Interchange

Design Loading Condition	Calculated Minimum Factor of Safety
End of Construction	1.9
Long Term	1.6
Seismic ($k_h = 0.5A_S = 0.07$)	1.4

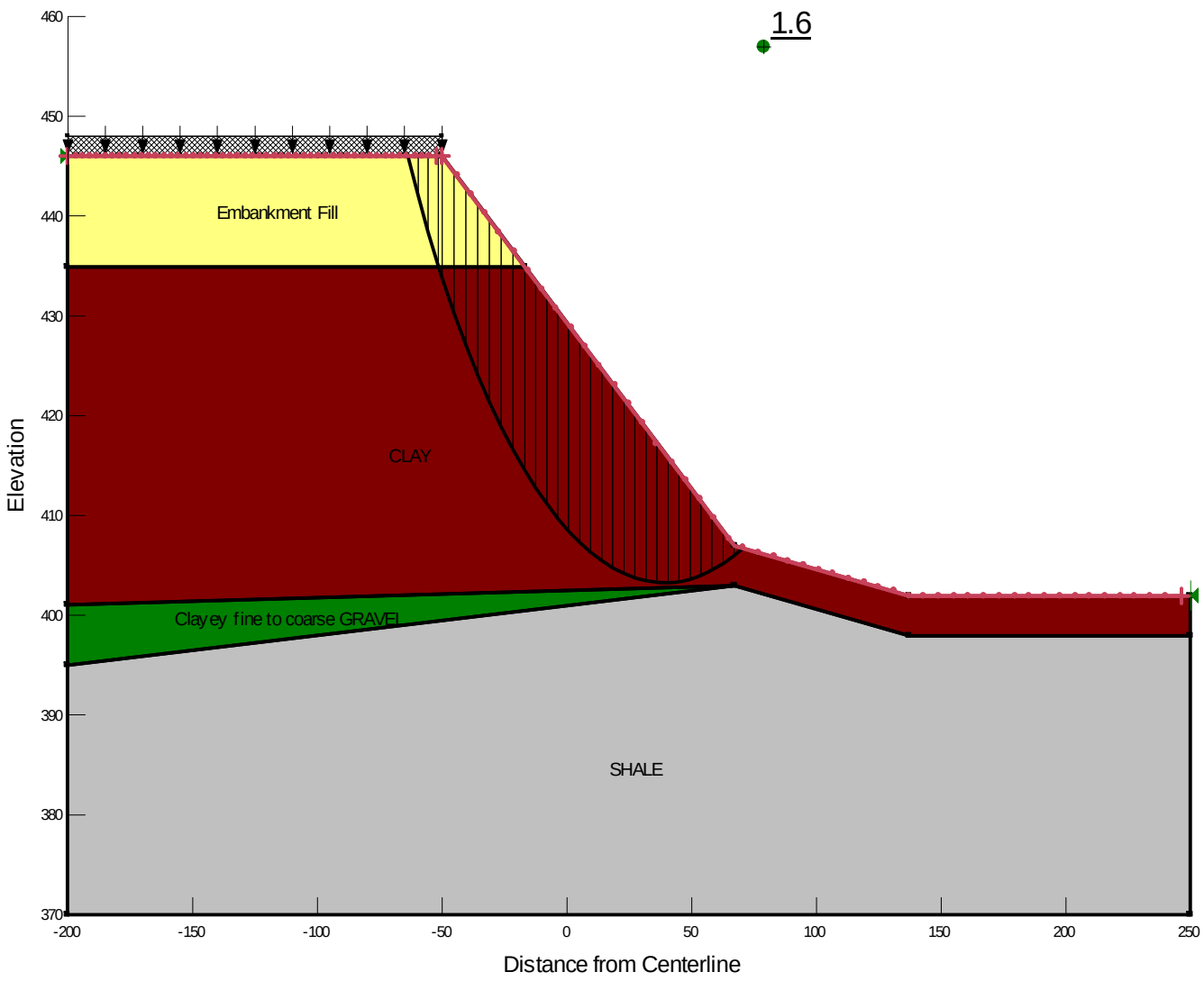
Summary of Soil Strength Parameters

Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (φ') deg
Embankment Fill	125	750	--	--
Clay	111	1000	125	20
Clayey Fine to Coarse Gravel	130	--	--	34
Shale	135	4000	1000	20



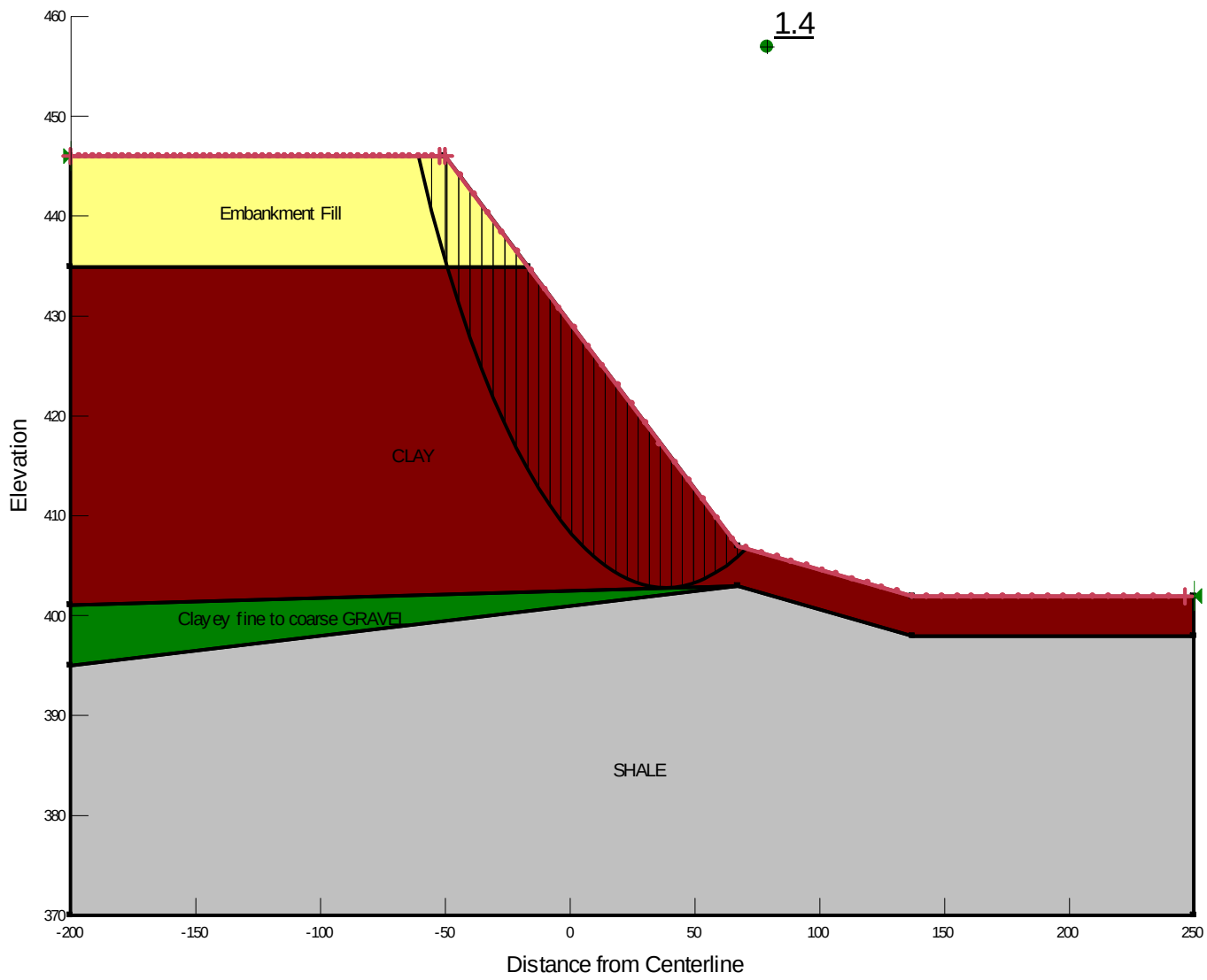
Results of Stability Analyses – End of Construction Condition
3H:1V End Slope near WB I-30 Sta 2245+00
AHTD Job No. CA0601 – HWY 70 Interchange

GRUBBS, HOSKYN, BARTON & WYATT, INC.
Consulting Engineers



Results of Stability Analyses – Long Term Condition
3H:1V End Slope near WB I-30 Sta 2245+00
AHTD Job No. CA0601 – HWY 70 Interchange

GRUBBS, HOSKYN, BARTON & WYATT, INC.
Consulting Engineers



Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.07$)
3H:1V End Slope near WB I-30 Sta 2245+00
AHTD Job No. CA0601 – HWY 70 Interchange

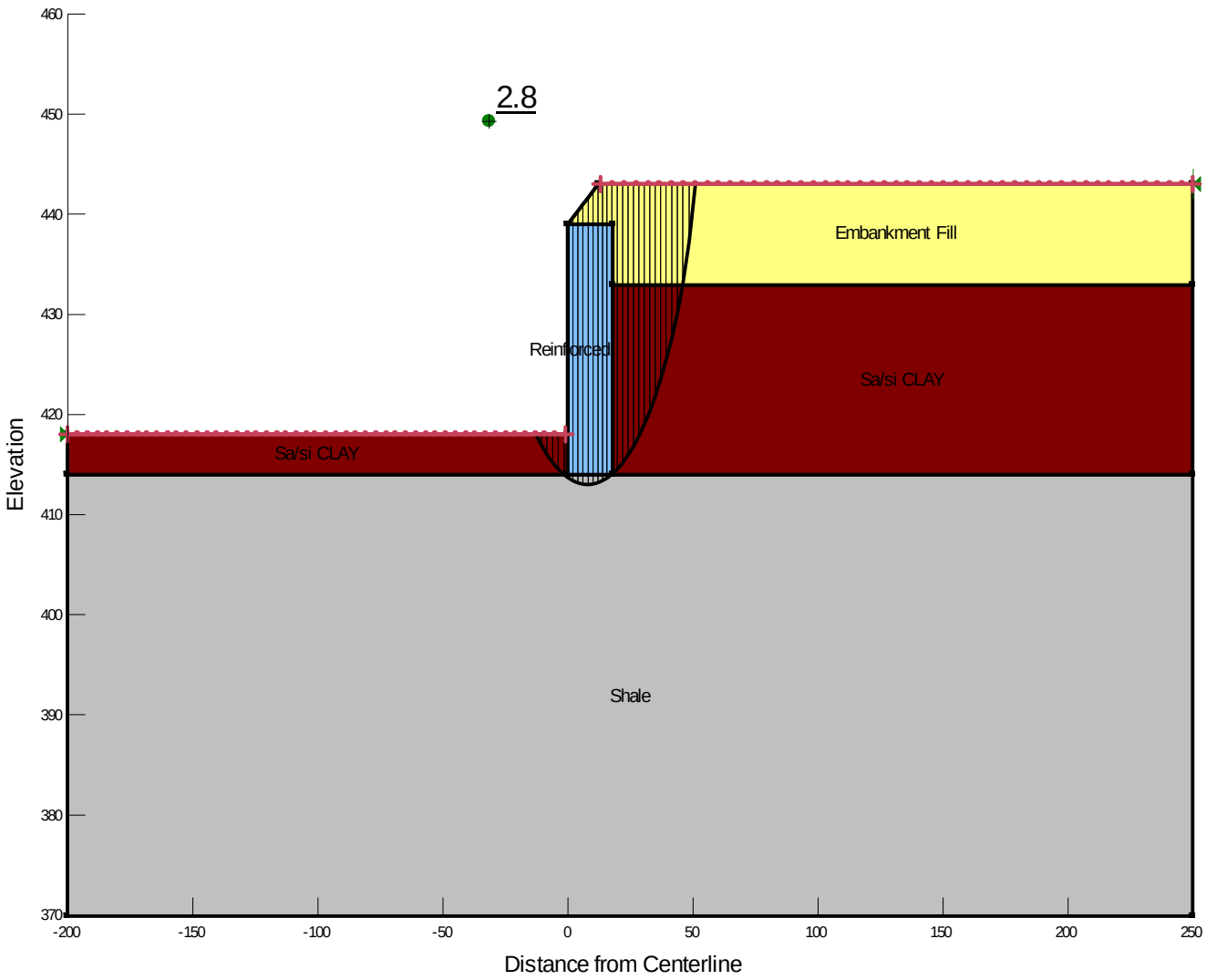
GRUBBS, HOSKYN, BARTON & WYATT, INC.
Consulting Engineers

Summary of Stability Analysis Results
Wall AA @ WB I-30 Sta 2249+60
AHTD Job No. CA 0601 – HWY 70 Interchagne

Design Loading Condition	Calculated Minimum Factor of Safety
End of Construction	2.8
Long Term	2.1
Seismic ($k_h = 0.5A_S = 0.07$)	2.0

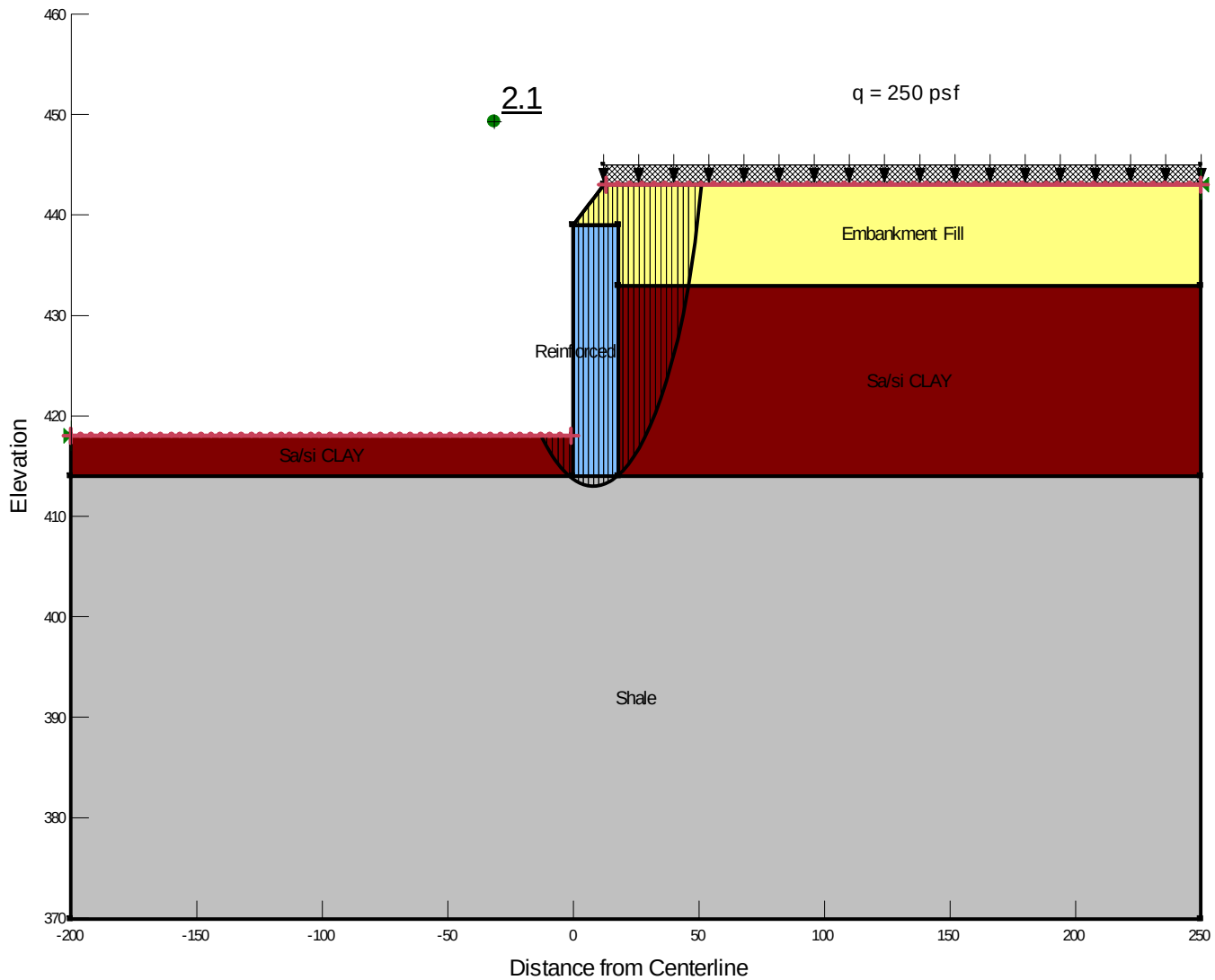
Summary of Soil Strength Parameters

Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (φ') deg
Embankment Fill	125	750	--	--
Sandy/Silty Clay	111	1125	200	20
Shale	135	4000	1000	20



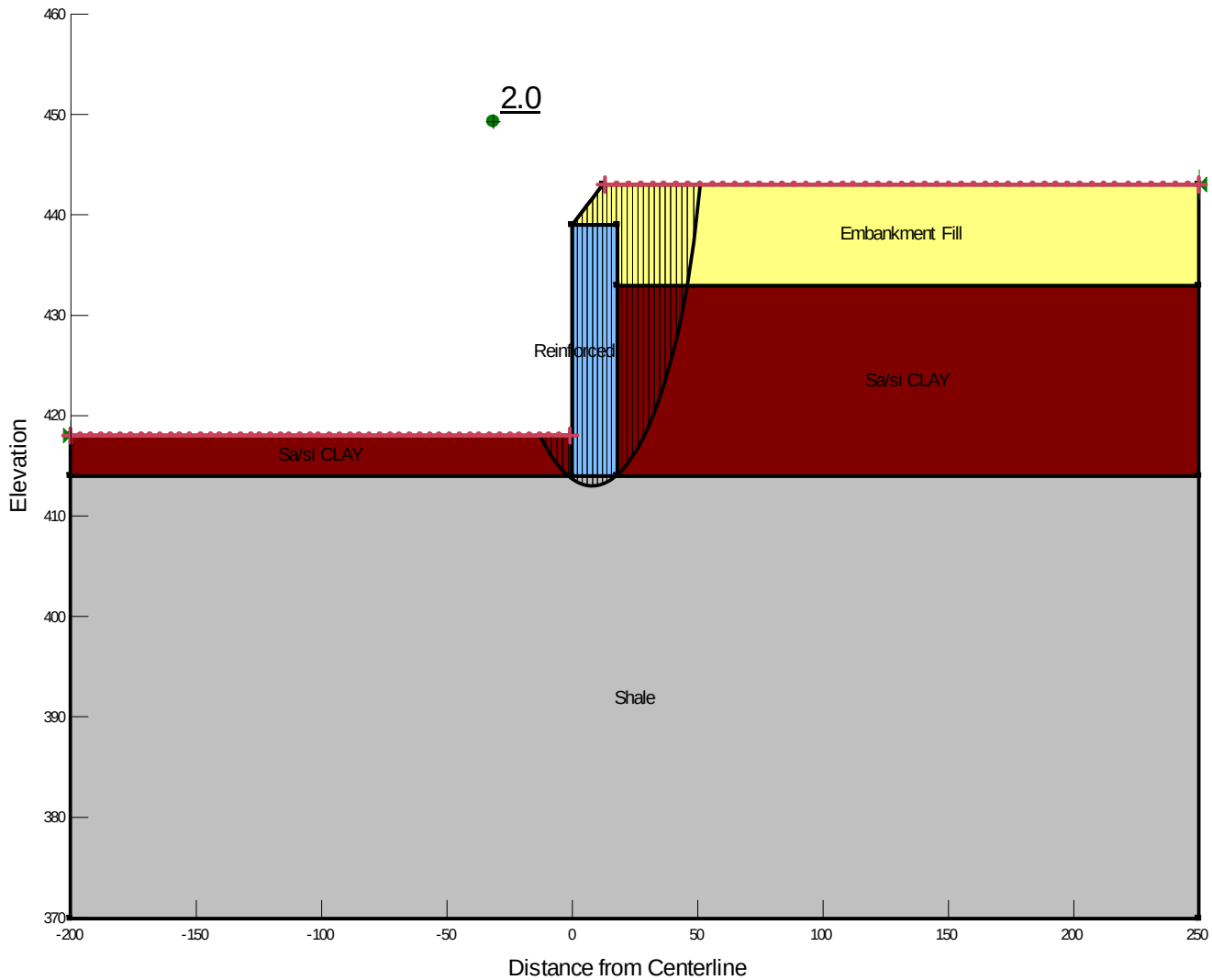
Results of Stability Analyses – End of Construction Condition
Wall AA @ WB I-30 Sta 2249+60
AHTD Job No. CA0601 – HWY 70 Interchange

GRUBBS, HOSKYN, BARTON & WYATT, INC.
Consulting Engineers



Results of Stability Analyses – Long Term Condition
Wall AA @ WB I-30 Sta 2249+60
AHTD Job No. CA0601 – HWY 70 Interchange

GRUBBS, HOSKYN, BARTON & WYATT, INC.
Consulting Engineers



Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.07$)
Wall AA @ WB I-30 Sta 2249+60
AHTD Job No. CA0601 – HWY 70 Interchange

GRUBBS, HOSKYN, BARTON & WYATT, INC.
Consulting Engineers