**ARKANSAS DEPARTMENT OF TRANSPORTATION**

# SUBSURFACE INVESTIGATION

**STATE JOB NO.** 061190

**FEDERAL AID PROJECT NO.** HPP2-3745(1)

**I-40 INTERCHANGE (MAUMELLE) (S)**

**STATE HIGHWAY** I-40 **SECTION** 33

**IN** PULASKI **COUNTY**

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**GEOTECHNICAL INVESTIGATION**
**ARDOT JOB No. 061190**
**I-40 INTERCHANGE (MAUMELLE) (F)**
**PULASKI COUNTY, ARKANSAS**

## INTRODUCTION

Submitted herein are the final results of the geotechnical investigation performed for ARDOT Job 061190, the proposed Interstate 40 (I-40) Interchange at Counts Massie Road in Pulaski County, Arkansas. This geotechnical investigation was authorized on behalf of Michael Baker International by Mr. Scott Thornberry on February 7, 2017. This study has been performed in general accordance with our proposal of June 14, 2016 (GHBW Proposal No. 16-091). The scope of work was later expanded to include widening the I-40 Bridge over Newton Creek and a supplemental agreement was established in March 2017. Preliminary results were provided on March 2, 2017. Interim recommendations for seismic conditions and Interchange bridge foundations were provided on June 9, 2017. Interim recommendations for foundation design for the Newton Creek Bridge widening were provided on July 8, 2017. Interim recommendations regarding cut slopes for the Interchange Northbound Ramp 3 cut slope configurations were provided on July 26, 2017.

We understand the new interchange will include an overpass where the extended Counts Massie Road crosses over I-40. The interchange will include ramps for the northbound and southbound I-40 lanes. The new bridge will be a two-span, pre-engineered structure with a total length of approximately 325 feet. We also understand that a foundation system consisting of steel piles at the bridge ends (Bents 1 and 3) and drilled shafts or footings is planned at the interior

bent (Bent 2). Foundation loads of the new bridge are anticipated to be moderate. Mechanically stabilized earth (MSE) retaining walls are planned at the bridge abutments. Based on the preliminary bridge layout wall heights of about 20 ft and 27 ft are anticipated at the east and west abutments, respectively.

The project will include the addition of a 10-ft wide lane to both the northbound and southbound lanes at the Interstate 40 crossing at Newton Creek. The existing Newton Creek Bridge has a total length of approximately 90 ft with three (3) 30-ft reinforced concrete deck girder spans. Simple slopes will be utilized at the bridge ends.

The purposes of this study were to explore subsurface conditions at the interchange and Newton Creek bridge widening locations and to develop recommendations to guide design and construction of foundations. These purposes have been achieved by a multi-phased study that included the following.

- Exploring subsurface conditions by drilling sample borings and excavating test pits at planned bridge, ramp, retaining wall and bridge widening locations to evaluate subsurface conditions and to obtain samples of the subgrade and foundation soil and rock for laboratory testing.
- Performing laboratory tests to evaluate pertinent engineering properties of the foundation and subgrade strata.
- Analyzing field and laboratory data to develop recommendations for seismic site class, seismic performance zone/seismic design category, foundation and MSE wall design, cut slope stability, pavement subgrade support parameters, and construction considerations.

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

## SUBSURFACE EXPLORATION

Subsurface conditions at the proposed interchange location were investigated by drilling 24 sample and/or core borings to depths of 1 to 36 ft and excavating three (3) test pits to 3.5- to 5.5-ft depth. Subsurface conditions at the Newton Creek widening location were explored by drilling eight (8) sample and/or core borings to 25- to 50-ft depth.

The site vicinity is shown on Plate 1 of Attachment 1. The approximate boring and test pit locations at the new interchange and Newton Creek locations are shown on Plates 2a and 2b for the interchange and Plates 3a and 3b for Newton Creek. The subsurface exploration program is

summarized on Plate 4 of Attachment 1. Keys to the terms and symbols used on the boring logs are presented as Plates 5 and 6 of Attachment 1.

The boring and test pit logs for the interchange, including the overpass structure, walls, and ramps, are presented in Attachment 2. A generalized subsurface profile in the interchange bridge alignment is provided on Plate 28 of Attachment 2. Photographs of rock cores recovered from the interchange borings are provided in Attachment 3. The boring logs from the Newton Creek bridge widening are provided in Attachment 4. Photographs of rock cores recovered from the Newton Creek borings are provided in Attachment 5. The centerline station and offset of the boring locations and the inferred ground surface elevation are noted on the logs. The approximate boring surface elevation was inferred from the topographic information provided by the Engineer (Michael Baker International). It must be recognized that the elevations shown are approximate and actual elevations may vary. The generalized subsurface profile shown on Plate 28 is provided to aid in visualizing subsurface conditions. It should be recognized that the stratigraphy illustrated by the profile has been inferred between discrete boring locations. In view of the natural variations in stratigraphy and conditions, variations from the stratigraphy illustrated by the profiles should be anticipated. Additionally, the natural transition between strata is generally gradual, and the stratigraphy shown on the profile and described elsewhere in this report may vary.

The borings were drilled with truck-mounted SIMCO 2800 and Mobile B-53 rotary-drilling rigs. Samples were typically obtained at 2-ft intervals to 10-ft depth and at 5-ft intervals thereafter. Samples were recovered using a 2-in.-diameter split-barrel sampler driven into the strata by blows of a 140-lb hammer with 30-in. drop in accordance with Standard Penetration Test (SPT) procedures. An automatic hammer was used with the SIMCO 2800 and the Mobile B-53 utilized a safety hammer. 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 recovery with the split-spoon, cuttings were recovered for use in visual classification.

Representative samples of the shale bedrock were obtained using a 5-ft-long $NQ_{WL}$-size double-tube core barrel with a diamond bit. For each core run, the percent recovery was determined as the ratio of recovery to total length of core run. Rock Quality Designation (RQD) was also

determined for the core run as the sum of intact, sound rock core greater than 4-in. length divided by the total length of the run and expressed in percent. Both these values are presented in the right hand columns of the log forms, opposite the corresponding core run. Where rock was not cored cuttings were collected for visual examination. Photographs of the recovered rock cores are provided in Attachments 3 and 5.

All samples were extruded or otherwise removed from samplers in the field. Samples were visually classified and placed in appropriate containers to prevent moisture loss and/or disturbance during transfer to our laboratory for further examination and testing.

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

## LABORATORY TESTING

To evaluate pertinent soil and rock properties, laboratory tests consisting of classification and natural water content determinations were performed. Soil shear strength was estimated in the field using hand penetrometer and SPT results.

A total of 101 natural water content determinations were performed to develop a soil water content profile for each boring. Water content results are plotted on the boring log forms in accordance with the scale and symbols shown in the legend located in the upper-right corner of the logs.

To verify field classification and to evaluate soil plasticity, 24 liquid and plastic limit (Atterberg limits) determinations and 22 sieve analyses were performed on selected representative samples. The Atterberg limits are plotted on the log as pluses inter-connected with a dashed line using the water content scale. The percentage of soil passing through the No. 200 Sieve is noted in the "- No. 200 %" column on the appropriate log forms. Classification test results, along with soil classification by the Unified Soil Classification System and AASHTO designations, are summarized in Attachment 6.

Selected rock core samples were tested for unit weight and compressive strength. The test results are indicated on the boring logs, in lbs per sq in., at the appropriate depth. The total unit weight (TUW) is also noted on the logs.

One (1) laboratory Proctor test was performed on a representative bulk soil sample obtained in the ramp alignment to evaluate the moisture-density relationship of on-site subgrade soils. The Proctor test and bulk sample classification test results are provided in Attachment 7. Pavement support properties of the potential subgrade soils were evaluated by performing one (1) California Bearing Ratio (CBR) test on the collected bulk sample. The CBR results are also provided in Attachment 7.

## GENERAL SITE and SUBSURFACE CONDITIONS

### Site Conditions

The I-40 Interchange at Counts Massie Road is planned at Interstate I-40 Sta 8135+75 to Sta 8189+99 in Pulaski County, Arkansas. Counts Massie roadway is planned to extend east from the south end of the existing Short Marche Road and will span the I-40 Interstate with an approximate 325-ft length bridge. The west side of the planned Interchange extends through an abandoned rest area with localized areas of roadway pavements surround by wooded areas. The east side of the Interchange is undeveloped and thickly wooded. The terrain in this area is an apparent ridge which the I-40 alignment apparently cut through. The surrounding terrain falls north and south from this ridge. Generally, the terrain in the Interchange area is moderately to steeply sloping with existing surface grades ranging from El 280 near the interstate highway swale grade to El 400 along the planned Counts Massie Road alignment.

The existing I-40 over Newton Creek twin bridges are south of the interchange location, near Sta 8181+00. The Newton Creek channel is well formed at the bridge location, apparently the result of prior site grading. The side slopes are protected with dumped riprap. The embankment appears to be stable with no indications of past or on-going sliding. The surrounding terrain is low-lying flood plain and drainage is poor.

### Site Geology

The mapped surface geology of the project area is primarily the Jackfork Sandstone Formation. The Pennsylvanian Period Jackfork Sandstone Formation primarily consists of dark gray shale with light gray sandstone as a subordinate unit. The shale is typically inclined and folded with numerous fractures and jointing planes, which subsequently subjects the shale to some weathering along the bedding planes. The subordinate sandstone units encountered in the Jackfork are locally discontinuous. Due to the folded and faulted nature of the formation, prominent cleavage

and minor folding and faulting are found locally within the shale and sandstone units. The Jackfork is conformable on the Stanley Shale and is reported to have a thickness varying from 3500 to 6000 feet.

Seismic Conditions – Counts Massie Interchange Bridge

In light of the results of the borings and the surface geology at the Interchange bridge location, a Seismic Site Class B (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 0.14. For a Site Class B, the Site Coefficient for the PGA, $F_{PGA}$ is determined to be 1.0. Consequently, a design PGA ($A_s$) value of 0.14 is considered appropriate for the Interchange location.

Based on the bridge location, the 1.0-sec period spectral acceleration coefficient on Class B rock ($S_1$) is 0.09. The site coefficient for 1.0-sec period spectral acceleration ($F_v$) for Site Class B is 1.0. Accordingly, the calculated design 1.0-sec period spectral acceleration coefficient ($SD_1$) value is 0.09. Table 3.10.6-1 indicates that a Seismic Performance Zone 1 is fitting for the Interchange bridge site.

Seismic Conditions – Newton Creek Crossing

Based on the results of the borings and the surface geology at the Newton Creek Bridge widening, a Seismic Site Class C (very dense soil and soft rock profile) is appropriate for this location. For a Site Class C, the Site Coefficient for the PGA, $F_{PGA}$ is determined to be 1.2. Consequently, a design PGA ($A_s$) value of 0.17 is considered appropriate for the Newton Creek Crossing site.

Based on the crossing location, the 1.0-sec period spectral acceleration coefficient on Class B rock ($S_1$) is 0.09. The site coefficient for 1.0-sec period spectral acceleration ($F_v$) for Site Class C is 1.7. Accordingly, the calculated design 1.0-sec period spectral acceleration coefficient ($SD_1$) value is 0.153. Table 3.10.6-1 indicates that a Seismic Performance Zone 2 is appropriate for the Newton Creek Crossing site.

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

Subsurface Conditions

Based on the results of the borings, the subsurface stratigraphy may be generalized into several primary strata as follows.

Stratum I: The on-site embankment fill is comprised of soft to very stiff gray, tan, brown and grayish brown silty clay with silt pockets, shale fragments, and varying amounts of quartz and sandstone fragments. At the interchange location, the fill extends to depths from 0.5 to 3.5 ft at the bridge and to depths of 0.5 to 6.5 ft where encountered at the ramp boring locations. The silty clay fill exhibits low plasticity and variable fair to good compaction. These soils typically classify as A-2-4, A-4, A-6 and A-7-6 by the AASHTO classification system (AASHTO M 145), which correlates with poor to good subgrade support for pavement structures.

At Newton Creek, the on-site fill is firm to stiff gray and brown silty clay with shale fragments extending to 2- to 11-ft depths. This fill exhibits fair to good compaction.

Stratum II: The natural surface and near-surface overburden soils are firm to very stiff tan, reddish brown, light reddish brown, gray, light gray and light grayish brown silty clay with varying amounts of shale, sandstone, and quartz fragments. Localized and discontinuous highly-plastic clay units are also present (see Boring R8). Where present, the natural silty clay and clay extends to depths of 3.5 ft to in excess of 10 feet. The silty clay has low plasticity; the clay units have high plasticity. The natural overburden soils exhibit low to moderate shear strength, and moderate to low compressibility.

At Newton Creek, natural soft to very stiff tan, reddish tan and gray silty clay with varying amounts of sand, sandstone fragments and ferrous nodules is below the embankment fill and extends to 8- to 23-ft depths. The silty clay has low plasticity, low to moderate shear strength, and moderate to low compressibility.

Localized units of loose to medium dense brown and dark brown silt and fine sandy silt and firm red clayey silt with varying amounts of sandstone fragments are locally present in the ramp alignments at depths of 1.5 to 11 ft (see Borings R7, R8, R9 and R10). Localized units of soft to stiff tan and reddish brown fine sandy clay with sandstone and quartz fragments are also present at 0.5- to 2-ft depths (see Borings R8 and R9) and at Newton Creek (see Boring 9) at 3.5- to 8-ft depth.

At Newton Creek medium dense to very dense tan, brownish gray, reddish brown, reddish tan and red clayey fine to coarse gravel units are locally present at depths of 8 to 23.5 ft (see Borings 9, 10 and 12). These granular soil units have medium to high relative density and low compressibility.

The natural overburden soils also typically classify as A-2-4, A-4, A-6 and A-7-6 by the AASHTO classification system (AASHTO M 145), correlating with poor to good subgrade support for pavement structures.

Stratum III: Low hardness to moderately hard weathered reddish brown, tan, light gray, gray, red, dark red and dark gray shale with occasional sandstone, quartz or pyrite inclusions is below the embankment fill and natural overburden soils. Discontinuous units of low hardness weathered clayey shale are also locally present. The weathered shale exhibits differential weathering, ranging from highly weathered to slightly weathered. The weathered shale has a shallow dip and exhibits poor rock quality but high shear strength.

Stratum IV: The weathered shale is typically underlain at variable depths by moderately hard to hard gray to dark gray shale. The predominant shale includes varying amounts of fine sandstone and quartz seams and inclusions. The shale is thickly bedded with a shallow to flat dip. The basal shale exhibits poor to fair rock quality but high shear strength and low compressibility.

Groundwater Conditions

Groundwater was locally encountered at 6- to 13.5-ft depth at the interchange location (see Borings 5 and 6) in February and March 2017 and at 8- to 18.5-ft depth at Newton Creek in June 2017. 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. Perched water could also occur locally at shallow depths within the fill-soil-rock interface. Groundwater levels will vary, depending upon seasonal precipitation, surface runoff and infiltration, and water levels in Newton Creek and other surface water features.

Significant Conditions

The significant site and subsurface conditions considered pertinent to the design and construction of the Interchange bridge and ramps and the Newton Creek bridge widening are summarized below.

a) The interchange location in an area of high terrain, where the interstate alignment was apparently constructed in a cut and shale is exposed on both side slopes.

b) The locally steep terrain in the ramp alignment areas which will dictate some significant cuts.

c) The limited existing embankment fill at the interchange location but deeper fills at the Newton Creek bridge location, exhibiting poor to good compaction.

d) The limited thickness of natural overburden soils.

e) The shallow depth to weathered shale and shale at the interchange location, with deeper overburden soils at the Newton Creek location.

f) The low hardness to moderately hard weathered shale below the variable depth of overburden soils with very poor to poor rock quality, high shear strength and low compressibility.

g) The basal moderately hard to hard shale typically exhibiting thick bedding and shallow dip, with poor to fair rock quality, high shear strength and low compressibility.

h) Groundwater at 6- to 26-ft depth in February and March 2017 at the interchange and at 8- to 18.5-ft depth in June 2017 at the Newton Creek bridge location, with the potential for seasonal seeps and springs and variations in groundwater levels and amounts.

The relationship of these factors to design and construction of the project has been considered in developing the conclusions and recommendations discussed in subsequent sections of this report.

## ANALYSES and RECOMMENDATIONS

### Foundation Design for Bridges

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

In light of the results of the borings performed for this study, the anticipated moderate bridge foundation loads, and our understanding of the project, we recommend that foundation loads be supported on steel piling at the bridge ends (Interchange Bents 1 and 3 and Newton Creek Bents 1/1A and 4/4A), on footings or drilled shafts at the interchange interior bent (Bent 2), and on drilled shafts at the Newton Creek interior bents (Newton Creek Bents 2A/2B and 3A/3B). Recommendations for foundations are discussed in the following report sections.

### Interchange and Newton Creek Bridge Ends: Pile Foundations

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. Piles should extend through the MSE wall reinforced fill zone and all overburden soils and low hardness weathered shale to bear in the moderately hard to hard slightly weathered gray and dark gray shale or dark gray shale. 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 ($\sigma_{all}$) of 0.25 $f_y$. An effective resistance factor ($\varphi_b$) 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. At the interchange location, it is expected that steel piles will be isolated from the abutment MSE wall reinforced backfill by casing. The preliminary drawings indicate that piles could extend through up to about 16 ft of new embankment fill at Interchange Bent 1 and 21 ft of new embankment fill at Interchange Bent 3 behind the reinforced zone. Consequently, some downdrag loads could develop on uncased piles due to embankment fill settlement. Downdrag loads on un-cased piles due to the embankment fill could be eliminated by preboring through the new fill.

For the Newton Creek bridge widening, post-construction settlement of piles driven to refusal is anticipated to be negligible. It is expected that steel piles will be driven through existing embankment fill and minor amounts of new embankment fill. Consequently, downdrag loads are expected to be negligible.

We recommend a minimum pile penetration of 10 ft below natural grade unless practical refusal is encountered in the moderately hard to hard shale at shallower depth. We recommend a minimum pile length of 10 feet. Preboring at the interchange to 10 ft below existing grades could be required to develop the recommended minimum pile embedment. The prebore diameter should be large enough to prevent pile damage during driving. We also recommend that the prebore annulus around the piles be backfilled with grout, lean concrete, or an approved alternate.

At Newton Creek, developing the recommended minimum pile penetration of 10 ft below natural grade and a minimum pile length of 10 ft could warrant preboring to advance piles through the dense to very dense gravel units found to ±El 250, 13-ft depth more or less, at Bent 4A (see Boring 12) and to El 243, 20-ft depth more or less, at Bent 4B (see Boring 10). If caving

in the gravel units becomes a problem, temporary casing could be required to maintain stability of the prebore excavation. As previously recommended, the prebore diameter should be large enough to prevent pile damage during drilling. Where there are significant lateral loads, consideration may be given to preboring to achieve a minimum penetration of three (3) pile widths into the rock bearing stratum. We have recommended that the prebore annulus around the piles be backfilled with grout, lean concrete, or an approved alternate.

Estimated pile tip elevations for steel pipes at bridge ends are summarized in the tables below.

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

| Bent No. | Estimated Pile Tip Elevation, ft | Estimated Downdrag load, tons |
|---|---|---|
| Interchange 1 (West Abutment) | 286 | 17 tons for HP12x53<br>20 tons for HP14x73 |
| Interchange 3 (East Abutment) | 285 | 22 tons for HP12x53<br>26 tons for HP14x73 |

**Table 2: Estimated Tip Elevations of Steel Piles Driven to Refusal – Newton Creek**

| Bent No. | Estimated Pile Tip Elevation, ft | Comments |
|---|---|---|
| 1A (North bridge end) | 242 | |
| 1B (North bridge end) | 242 | |
| 4A (North bridge end) | 249 | Estimated prebore to El 250± |
| 4B (South bridge end) | 242 | Estimated prebore to El 243± |

It should be noted that tip elevations shown in the tables above are an estimate 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.

Footings – Interchange Bent 2

The foundation loads of the interior bent, Bent 2, may be supported on a footing or footings bearing in the competent moderately hard to hard dark gray shale. Footings should extend a minimum of 1 ft into the moderately hard to hard dark gray shale. A minimum footing depth of 5 ft below lowest adjacent grade with a minimum embedment of 12 in. into the moderately hard to hard dark gray shale is recommended.

Footings founded at Interchange Bent 2 as recommended can be designed with respect to a maximum nominal bearing pressure of 16 kips per sq foot. A resistance factor for bearing

capacity (φ) of 0.50 is recommended. Post-construction settlement of footings supported as recommended should be less than 0.5 inch.

Uplift loads from the bridge structure will be resisted by the mass of the foundation. Depending on the magnitude of uplift loads, deeper embedment or increased footing dimension may be required. If needed, additional uplift resistance can be developed by rock anchors or micropiles. Recommendations for rock anchors and or micropiles can be provided upon request.

Resistance to sliding can be evaluated using an ultimate friction factor (tan δ) value of 0.70 between the foundation concrete and the competent and sound dark gray shale bearing stratum. The passive resistance of the upper 2 ft of weathered shale should be neglected. Below 2-ft depth, a nominal unit passive resistance of 4000 lbs per sq ft of foundation area in hard contact with the competent shale can be utilized. A resistance factor (φ) of 0.50 should be applied to passive resistance. Where footings in rock are formed, the lateral resistance must be re-evaluated based on the properties of the backfill.

Individual footings should have a minimum dimension of 48 inches. A minimum footing depth of 5 ft with at least 12 in. of embedment into the competent shale bearing stratum is recommended. Some overbreak of foundation excavations in competent shale may occur. All overbreaks should be backfilled with concrete.

Any silty clay or highly weathered shale seams or layers exposed in footing bottoms should be completely excavated and backfilled with concrete. The use of dental concrete is acceptable. Footing bottoms should be essentially flat. Stepped footings are acceptable. Any overexcavation of footings should be backfilled with concrete. All footing excavations and any undercuts should be observed by the Geotechnical Engineer to verify suitable bearing and adequate undercut.

Drilled Shaft Foundations – Interchange Bent 2

Drilled straight-shafts are suitable for support of foundation loads at Interchange Bent 2, the interior bent. Drilled shafts should be founded with a minimum embedment of 10 ft or three (3) shaft diameters into the moderately hard to hard dark gray shale, whichever is greater. Drilled shafts founded as recommended may be sized using a maximum nominal end-bearing pressure ($R_n$) of 130 kips per sq foot. This bearing capacity for compression is based on end bearing resistance only. 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

shale as described is expected to be negligible. We also recommend that drilled shafts be sized for axial compression loads based on end bearing alone.

Resistance to uplift 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 8.5 kips per sq ft may be used for shaft penetration into the competent moderately hard weathered shale and moderately hard to hard shale. For the calculation of uplift capacity, the penetration within the overburden soil and the top 3 ft of weathered shale should be neglected. A resistance factor ($\varphi$) of 0.40 is recommended for evaluation of drilled shaft uplift capacity.

A minimum embedment length of either 10 ft or three (3) shaft diameters into moderately hard to 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.

Drilled Shaft Foundations – Newton Creek Bents 2A/2B and 3A/3B

Drilled straight shafts are recommended for support of foundation loads at Newton Creek Bents 2A/2B and 3A/3B, the interior bents. Drilled shafts should be founded with a minimum embedment of 10 ft or three (3) shaft diameters into the moderately hard to hard dark gray with tan slightly weathered shale or the dark gray shale. Cumulative penetration into the competent, moderately hard to hard slightly weathered to weathered shale units is suitable to achieve the recommended bearing. Drilled shafts founded as recommended may be sized using a maximum nominal end-bearing pressure ($R_n$) of 130 kips per sq foot. This bearing capacity for compression is based on end bearing resistance only. A resistance factor ($\varphi$) of 0.50 is recommended for drilled shaft end bearing. Total and differential settlement of properly installed drilled shafts founded in the competent shale/siltstone/mudstone units as recommended is expected to be negligible. We also recommend that drilled shafts be sized for axial compression loads based on end bearing alone.

Resistance to uplift will be developed by the weight of the foundations and circumferential shaft friction. For calculation of uplift capacity, a maximum nominal skin resistance ($R_n$) value of 8.5 kips per sq ft may be used for shaft penetration into the

recommended bearing strata. A resistance factor ($\varphi$) of 0.40 is recommended for evaluation of drilled shaft uplift capacity.

We understand that preliminary plans are to set permanent shaft casing to the top of rock. Estimated permanent casing bottom and minimum shaft bottom elevations are summarized in Table 3 below.

Table 3: Estimated Minimum Casing and Shaft Bottom Elevations

| Bent No. | Estimated Permanent Casing Bottom Elevation, ft | Estimated Minimum Shaft Bottom Elevation, ft |
|---|---|---|
| Newton Creek 2A | 244 | 233 |
| Newton Creek 2B | 243 | 231 |
| Newton Creek 3A | 246 | 235 |
| Newton Creek 3B | 243 | 231 |

It must be recognized that the elevations above are estimates only. Suitable depth of casing and shaft penetration must be field verified by the Engineer. A minimum shaft diameter of 30 in. is recommended for drilled shafts at Newton Creek. Drilled shaft excavations should be observed by the Engineer 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.

Interchange MSE Abutment Walls – Wall Nos. 1 and 2

MSE walls will be utilized for abutments at the Interchange bridge ends. It is understood that MSE walls will be specifically designed by Others on behalf of the Contractor. MSE Wall No. 1, located at Interchange Bent 1 (west bridge end) has a plan subgrade/leveling pad at approximately El 295 with the top of wall planned at about El 314. The bridge end slope intercept is at approximately El 324. For the purposes of bearing capacity and global stability analyses, an average wall height of 27 ft has been utilized. Interchange MSE Wall No. 2 (east bridge end) has a plan subgrade/leveling pad grade at approximately El 292. The top of wall is planned at approximately El 318. For the purposes of bearing capacity and global stability analyses, an average wall height of 32 ft has been utilized for MSE Wall No. 2.

Bearing. With the anticipated MSE Wall No. 1 bearing at about El 295 and MSE Wall No. 2 subgrade/leveling pad planned at El 292, the foundation stratum is expected to consist of moderately hard to hard light to dark gray and tan weathered shale (Stratum III). For the MSE walls supported in the moderately hard to hard weathered shale (Stratum III), a nominal unit

bearing resistance of 20 kips per sq ft is recommended. A resistance factor (φ) of 0.65 is recommended for wall bearing. Consequently, a factored unit bearing resistance (qR) of 13 kips per sq ft is considered suitable. A minimum embedment depth of 3 ft below lowest adjacent grade is recommended for the MSE wall.

Resistance to wall sliding can be evaluated using an ultimate friction factor (tan δ) value of 0.7 between the MSE wall reinforced zone base and bearing stratum. A resistance factor (φ) of 1.0 is recommended for evaluation of sliding resistance. Long-term post-construction settlement of the wall foundation bearing stratum is expected to be negligible.

Global Stability. Stability analyses were performed to verify the global stability of MSE Wall Nos. 1 and 2. Analyses were performed using the computer program Slope/W 2007 and a Morganstern-Price (force and moment equilibrium) analysis of the end of construction, long term, and seismic conditions. For the purposes of the stability analyses, a 375 lbs per sq ft uniform surcharge was included to accommodate vehicle traffic load surcharges. A reinforced zone extending roughly 0.7 times the wall height was also assumed. For the seismic condition analyses, a horizontal acceleration coefficient ($k_h$) of 0.07 was used for the reinforced embankment/wall, taken as one-half of the design peak ground acceleration coefficient ($0.5A_s$) per Kramer[2].

The stability analysis results are summarized in Tables 4 and 5 for MSE Wall No. 1 and Wall No. 2, respectively. Graphical results of the stability analyses, along with a summary of the soil parameters used in the analyses, are provided in Attachment 8.

**Table 4: Global Stability Analysis Results – Wall 1 Sta 181+29 (H = 27 ft)**

| Design Load Condition | Calculated Minimum Factor of Safety |
|---|---|
| End of Construction | 2.0 |
| Long Term | 1.5 |
| Seismic ($k_h = A_s/2 = 0.07$) | 1.4 |

**Table 5: Global Stability Analysis Results – MSE 2 Sta 184+55 (H = 32 ft)**

| Design Load Condition | Calculated Minimum Factor of Safety |
|---|---|
| End of Construction | 2.2 |
| Long Term | 1.5 |

[2] Geotechnical Earthquake Engineering; Prentice-Hall, Upper Saddle River, New Jersey; Steven L. Kramer; Page 436-437

| Design Load Condition | Calculated Minimum Factor of Safety |
|---|---|
| Seismic ($k_h = A_s/2 = 0.07$) | 1.4 |

The stability analyses results summarized above confirm that global stability of the plan wall configurations are within an acceptable range for all cases analyzed and for both MSE Wall No. 1 and Wall No. 2.

Cut Slopes – Interchange Ramps

It is understood that site grading in the northbound interchange ramp alignments will include cuts of up to about 40 ft in the vicinity of Ramp 3 Sta 8167+00. The cut slopes will tentatively have 3-horizontal to 1-vertical (3H:1V) slopes in soil and 1.5:1V slopes in weathered shale and shale. Horizontal benches with 10-ft width will be incorporated into the cut slopes at vertical intervals of 20 feet.

To evaluate stability of the plan slope configurations, slope stability analyses were performed for the maximum cut planned at Ramp 3 Sta 8167+00. This compound cut will have an upper slope anticipated to be overburden soils overlying shale and a lower slope expected to be advanced into weathered shale/shale. The total cut height will be approximately 45 feet.

Stability analyses were performed using the computer program Slope/W 2007 and a Morganstern-Price (force and moment equilibrium) analysis. For the cut slope, three (3) general loading conditions were evaluated, i.e., end of construction, long term, and seismic conditions. A horizontal acceleration coefficient ($k_h$) value of 0.07 was utilized in evaluation of the seismic stability of the cut slope. The sections used for the analyses are shown in the graphical results provided in Attachment 9. Soil parameters used for the analyses are also shown in Attachment 9. The results of the stability analyses of the mass slope (i.e., global stability), the upper slope, and the lower rock slope are summarized in Tables 6, 7, and 8 below.

Table 6: Global Stability Analysis Results – Ramp 3 Sta 8167+00 H = 39 ft

| Design Load Condition | Calculated Minimum Factor of Safety |
|---|---|
| End of Construction | 3.0 |
| Long Term | 1.6 |
| Seismic ($k_h = A_s/2 = 0.07$) | 1.4 |

Table 7: Stability Analysis Results – Ramp 3 Upper Slope, Sta 8167+00 H = 19 ft

| Design Load Condition | Calculated Minimum Factor of Safety |
|---|---|
| End of Construction | 8.1 |
| Long Term | 2.4 |
| Seismic ($k_h = A_s/2 = 0.07$) | 2.2 |

Table 8: Stability Analysis Results – Ramp 3 Lower Slope Sta 8167+00 H = 20 ft

| Design Load Condition | Calculated Minimum Factor of Safety |
|---|---|
| End of Construction | 7.5 |
| Long Term | 2.3 |
| Seismic ($k_h = A_s/2 = 0.07$) | 2.2 |

The results of the stability analyses indicate that stability of the plan cut slope configurations is acceptable with respect to all loading conditions evaluated. Consequently, it is our conclusion that the plan cut slope configurations are suitable with respect to slope stability.

Newton Creek Widened Embankment Slopes

With the lane additions to the Newton Creek Bridge, it is expected that the embankment slopes will be extended. To evaluate stability of the anticipated widened end and side slopes, stability analyses were performed utilizing the computer program Slope/W 2007 and a Morganstern-Price analysis. End of construction, long term, and seismic conditions were evaluated. An end slope configuration of 1.4H:1V and side slope configuration of 2.5H:1V were analyzed, approximately matching the existing configurations. A horizontal acceleration coefficient ($k_h$) value of 0.085 was utilized in evaluation of the seismic stability for the Newton Creek Crossing. The results of these analyses are summarized in Table 9 below and provided graphically in Attachment 10. Soil parameters used for the analyses are also shown in Attachment 10.

Table 9: Stability Analysis Results – Widened Newton Creek Slopes

| Design Load Condition | Calculated Minimum Factor of Safety |
|---|---|
| 2.5H:1V Side Slope End of Construction | 4.6 |
| 2.5H:1V Side Slope Long Term | 2.5 |
| 2.5H:1V Side Slope Seismic ($k_h = A_s/2 = 0.085$) | 1.9 |
| 1.4H:1V End Slope End of Construction | 2.9 |
| 1.4H:1V End Slope Long Term | 1.4 |
| 1.4H:1V End Slope Seismic ($k_h = A_s/2 = 0.085$) | 1.2 |

The results of these stability analyses indicate that stability of the extended embankment at the plan configurations is acceptable with respect to the loading conditions evaluated.

Subgrade Support – Interchange Ramps

The new interchange ramps will include significant cuts and some fill. The results of the borings and test pits indicates that the subgrade will vary from silty clay and clay which classifies as AASHTO A-6 and A-7-6 to weathered shale. Based on the results of the borings and test pits and laboratory tests on the anticipated subgrade materials, fair subgrade support is anticipated.

We recommend that any soils classifying as A-7-6 and soils with a plasticity index (PI) in excess of 18, if encountered during the work, be excluded from use as pavement 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. We also recommend that were weathered shale, shale or sandstone are encountered at the plan subgrade elevation, these rock materials be scarified to at least 8-in. depth, processed, and recompacted or undercut to a minimum 8-in. depth and replaced with suitable fill. All pavement subgrade should be proof-rolled to verify stability immediately prior to pavement construction. Areas of unstable or otherwise unsuitable subgrade should be improved by undercut and replacement or treatment with additives approved by the Engineer.

For pavement design, we recommend the following subgrade parameters for use in design of pavements.

- Design CBR: 5
- Resilient Modulus ($M_R$): 3800 lbs per sq inch
- R value: 11
- Subgrade modulus (k): 125 lbs per sq in. per inch

Site Grading and Subgrade Preparation

Site grading/site preparation in the interchange and Newton Creek areas should include necessary clearing and grubbing of trees and underbrush and stripping the organic-containing surface soils in work areas. Where fill depths in excess of 3 ft are planned, stumps may be left after close cutting trees to grade, as per ARDOT criteria. Otherwise, tree stumps must be completely excavated and stumpholes properly backfilled.

The depth of stripping will be variable, with deeper stripping depths in wooded areas, and less stripping required in the areas of higher terrain. In general, the stripping depth is estimated to be about 6 to 9 inches in cleared areas, but may be 18 to 24 in. or more in the localized wooded areas and areas with thick underbrush. The zone of organic surface soils should be completely stripped in the embankment footprint areas and at least 5 ft beyond the projected embankment toe.

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

Following required pavement demolition, clearing and grubbing, and stripping, and prior to fill placement or otherwise continuing with subgrade preparation, the extent of weak and unsuitable soils should be determined. Thorough proof-rolling should be performed to verify subgrade stability. Proof-rolling should be performed with a loaded tandem-wheel dump truck or similar equipment. Unstable soils exhibiting a tendency to rut and/or pump should be undercut and replaced with suitable fill. Care should be taken that undercuts, stump holes, and other excavations or low areas resulting from subgrade preparation are properly backfilled with compacted fill. Based on the results of the borings, localized undercutting could be required to develop subgrade stability. Potential undercut depths are estimated to range from 1 to 4 ft, more or less.

In lieu of undercutting and replacing unsuitable soils in roadway areas, consideration may be given to using additives to improve soil workability and to stabilize weak areas. Hydrated lime,

quick lime, Portland cement, fly ash, or suitable alternate materials may be used as verified by appropriate testing and approved by the Engineer. Additives can be effective where the depth of unstable soils is relatively shallow. Treatment will be less effective in areas where the zone of unstable soils is deep. The optimum application rate of stabilization additive must be determined by specific laboratory tests performed on the alignment subgrade soils. We recommend a minimum treatment depth of 8 inches.

In areas of deep fills, the potential exists for use of thick initial lifts ("bridging"), as per ARDOT 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 or gravel. Where fill amounts are limited to less than about 3 ft, bridging will be less effective and the potential for undercut or stabilization will increase. Use of bridging techniques and fill lift thickness must be specifically approved by the Engineer or Department.

Subgrade preparation and mass undercuts should extend at least 10 ft beyond the embankment toes to the extent possible. Subgrade preparation in roadway areas should extend at least 3 ft outside pavement shoulder edges to the extent possible. The existing drainage features should be completely mucked out and all loose and/or organic soils removed prior to fill placement.

Fill and backfill may consist of unclassified borrow free of organics and other deleterious materials as per AHTD Standard Specifications Subsection 210.06. Granular soils must be protected from erosion with a minimum 18-in.-thick armor of clayey soil. The on-site silty clay and sandy clay are typically suitable for this use.

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

should be tested to verify compliance with the specified density and water content prior to placement of subsequent lifts.

## CONSTRUCTION CONSIDERATIONS

### Groundwater and Seepage Control

Positive surface drainage should be established at the start of the work, be maintained during construction and following completion of the work to prevent surface water ponding and subsequent saturation of subgrade soils. Density and water content of all earthwork should be maintained until the retaining wall, embankments, and bridge work is completed.

Subgrade soils or foundation strata that become saturated by ponding water or runoff should be excavated to undisturbed soil or rock. The embankment subgrade and the retaining wall foundations should be evaluated by the Engineer during subgrade preparation.

Shallow perched groundwater may be encountered in the near-surface soils and shallow rock. The volume of groundwater produced can be highly variable depending on the condition of the soils in the immediate vicinity of the excavation. In addition, seasonal surface seeps or springs could develop.

Seepage into excavations and cuts can typically be controlled by ditching or sump-and-pump methods. If seepage into excavations becomes a problem, backfill should consist of select granular backfill (AASHTO M43 No. 57), stone backfill (AHTD Standard Specifications Section 207), or clean aggregate (AHTD Standard Specifications Subsections 403.01 and 403.02 Class 3 mineral aggregate) up to an elevation above the inflow of seepage. In areas of seepage infiltration, the granular fill should be 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.

### Piling

Piles should be installed in compliance with AHTD Standard Specifications Section 805. Pre-boring to achieve the minimum pile length is anticipated. Based on local experience, we recommend a hammer system capable of delivering at least 22,000 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 production piles should be determined by AHTD Standard Specifications Section 805.09, Method A. Driving records should be available for review by the Engineer during pile installation. Piles should be carefully examined prior to driving and piles with structural defects should be rejected. Any splices in steel piles should develop the full cross-sectional capacity of un-spliced piles. Pile installation should be monitored by qualified personnel to maintain specific and complete driving records and to observe pile installation procedures. 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.

Drilled Shafts

Groundwater could be encountered in drilled shaft excavations. Limited seepage into drilled shaft excavations can probably be controlled by close coordination of drilling, cleanup and concrete placement. We recommend that casing be on site in the event it is needed to control seepage and/or caving into shaft excavations. Drilled shaft excavations should essentially be dry at the time of concrete placement. Where more than about 3 in. of water is present in shaft excavations, the excavation should be dewatered prior to concrete placement. Where shaft excavations cannot be dewatered, underwater concrete placement should be performed with a concrete pump fitted with a rigid end extension. A muck bucket or similar tools should be utilized to clean the shaft excavation bottom prior to underwater concrete placement.

Some hard drilling could be experienced when advancing drilled shafts into the more resistant units of the moderately hard weathered shale and moderately hard to hard shale. In addition, localized and discontinuous sandstone seams, layers, inclusions, and floating sandstone boulders can be present. Heavy-duty drilling equipment and rock drilling tools will be required to advance shaft excavations to the recommended minimum penetration in these more resistant units. Coring or other rock excavation methods could be required to achieve the recommended penetration into the shale bearing stratum. All drilled shaft excavations should be observed by the Engineer to verify suitable bearing and adequate penetration.

Rock Excavation

Moderately hard to hard weathered shale and shale was encountered at shallow depths in several borings. Localized sandstone beds, seams, layers or strata could also be present at

variable depths. Rock excavation methods could be required for some site grading cuts and/or in foundation excavations. Some overbreak of excavations advanced into the weathered shale and shale or localized sandstone should be anticipated.

## CLOSURE

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

The following illustrations are attached and complete this submittal.

| | |
|---|---|
| Attachment 1 | Site Vicinity Map, Plans of Borings, Summary of Subsurface Exploration, Keys to Terms and Symbols |
| Attachment 2 | Maumelle Interchange Boring Logs |
| Attachment 3 | Maumelle Interchange Rock Core Photographs |
| Attachment 4 | Newton Creek Boring Logs |
| Attachment 5 | Newton Creek Rock Core Photographs |
| Attachment 6 | Classification Test Results |
| Attachment 7 | Subgrade Test Results |
| Attachment 8 | MSE Wall Global Stability Analyses Results |
| Attachment 9 | Interchange Ramp Cut Slope Stability |
| Attachment 10 | Newton Creek Crossing Stability Analyses Results |

* * * * *

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

Sincerely,

GRUBBS, HOSKYN,
BARTON &WYATT, INC.

Blaine M. Orth, P.E.
Sr. Project Engineer

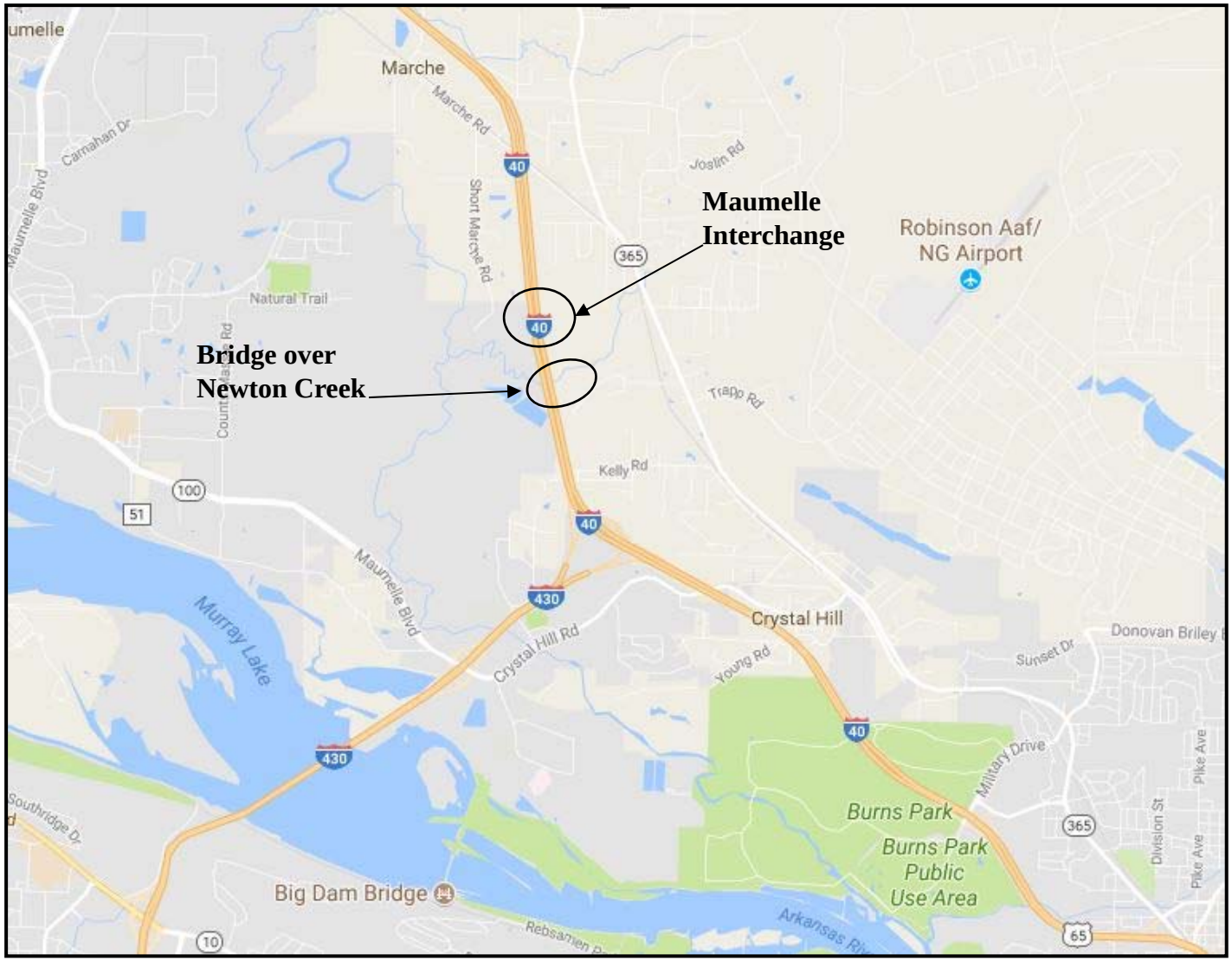
Mark E. Wyatt, P.E.
President

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

BMO/MEW:jw

Copies Submitted: Michael Baker International
Attn: Mr. Scott P. Thornsberry, P.E. (2+email)
Attn: Mr. Fred Harper, P.E. (1-email)

**ATTACHMENT 1**

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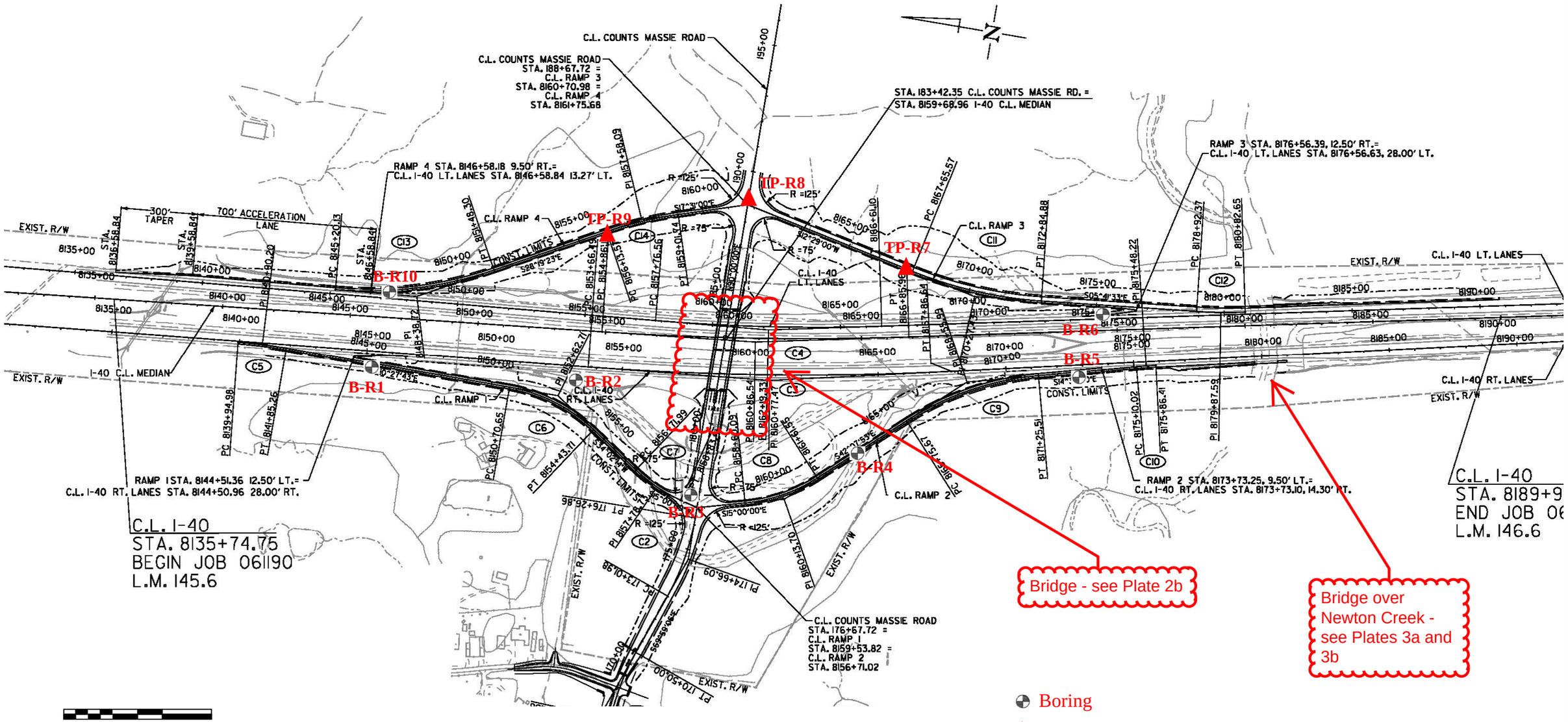
**Site Vicinity Map**
**061190 I-40 Interchange and Newton Creek Bridge**
**Pulaski County, Arkansas**

**Job No. 17-028**

**Plate 1**

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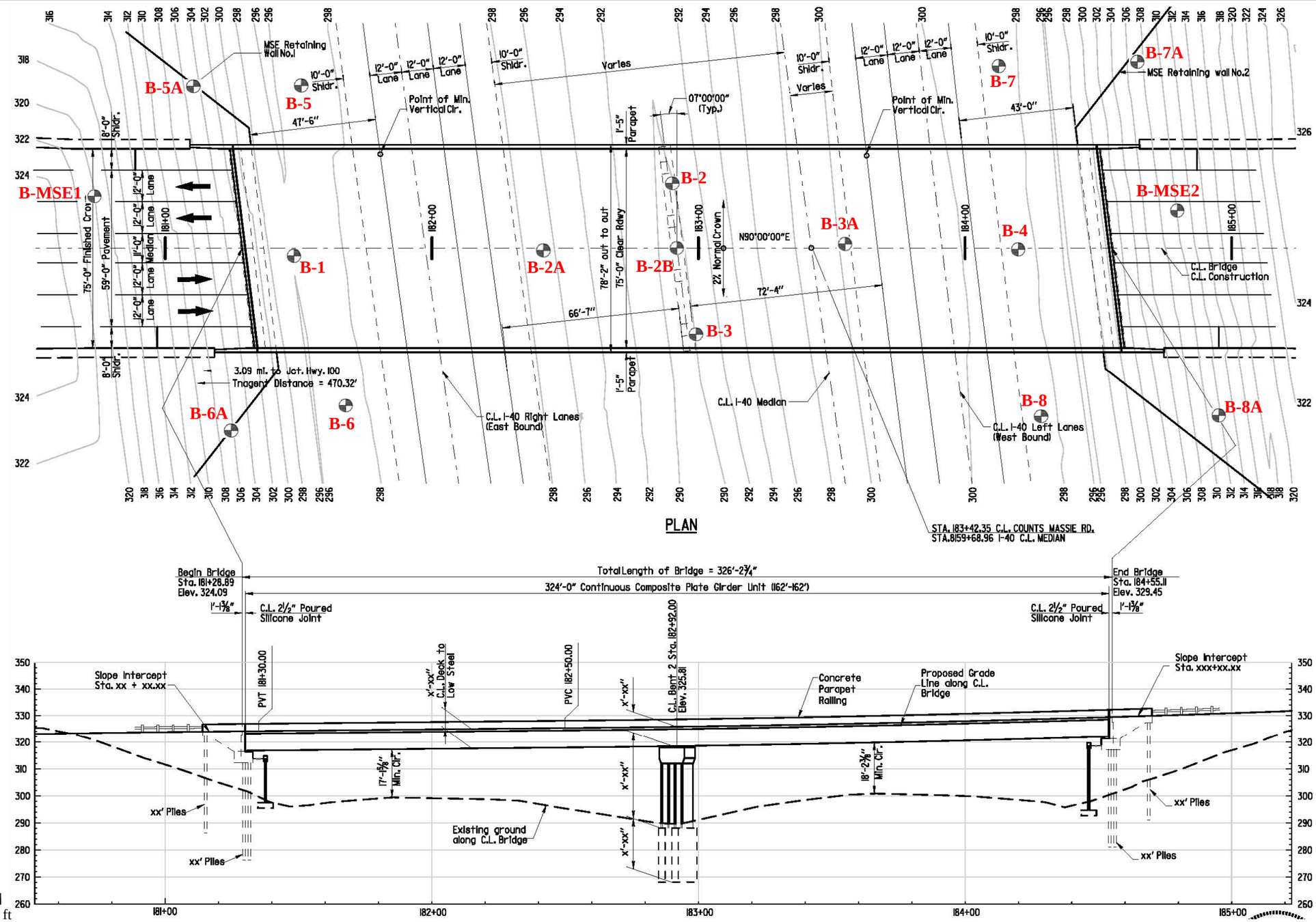
|---|---|---|---|---|
| Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS | **PLAN OF BORINGS**<br>**061190 I-40 Interchange (Maumelle) (F)**<br>**Pulaski County, Arkansas** | **Scale: As Shown**<br>**Date: March 2017** | **Job No. 17-028** | **PLATE 2a** |

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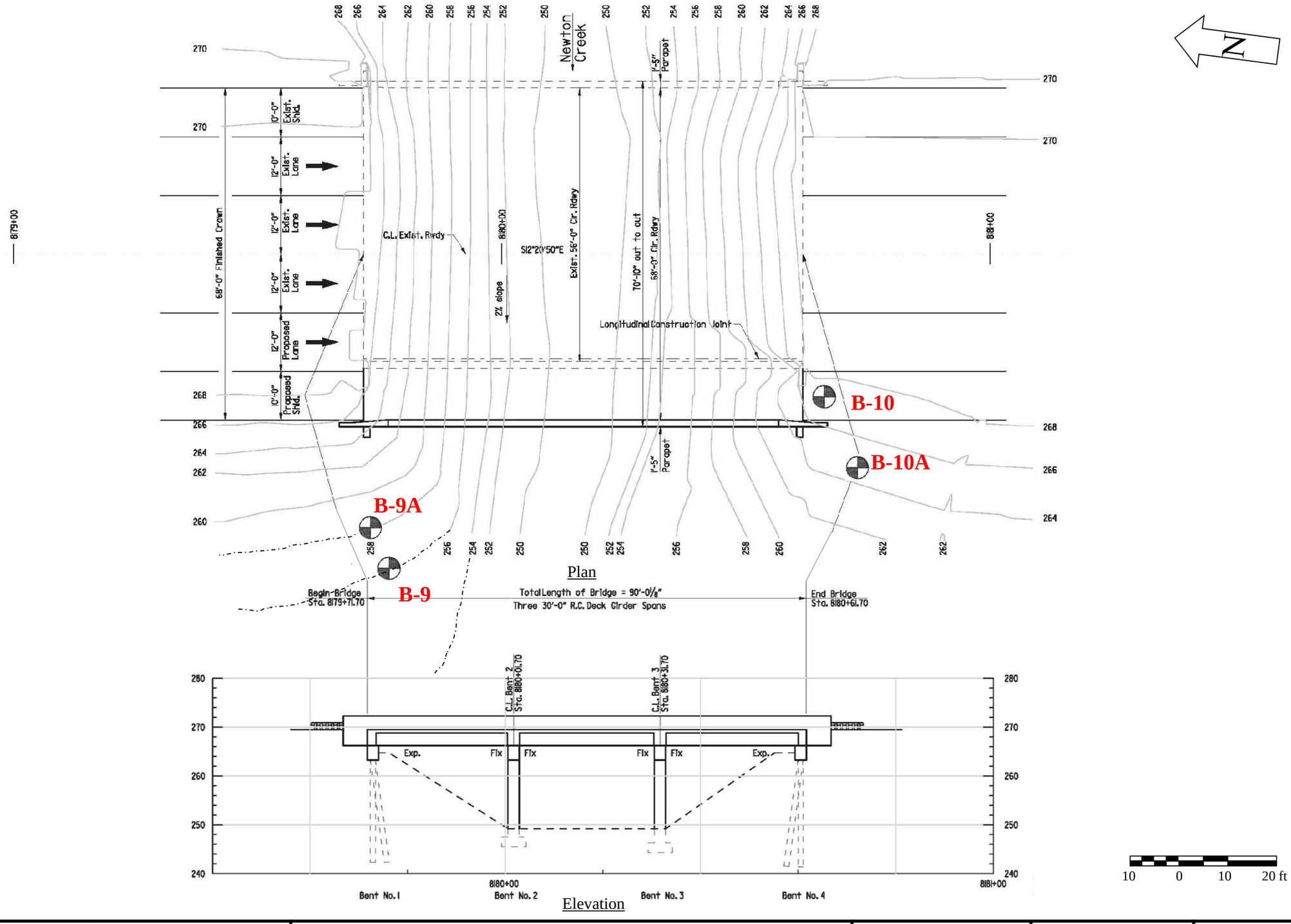
| Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS | **PLAN OF BORINGS**<br>**061190 I-40 Interchange (Maumelle) (F)**<br>**Pulaski County, Arkansas** | **Scale: As Shown**<br>**Date: March 2017** | **Job No. 17-028** | **PLATE 2b** |

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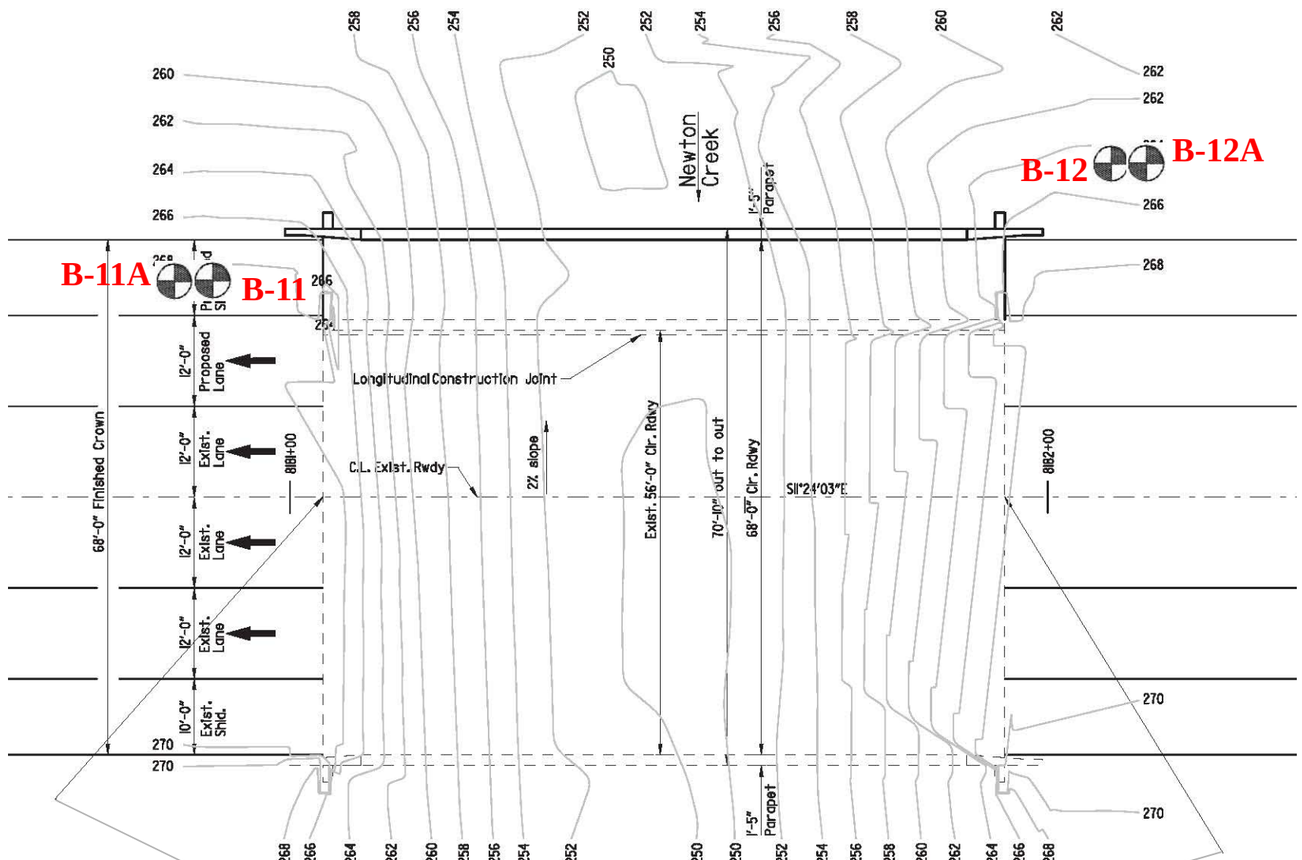
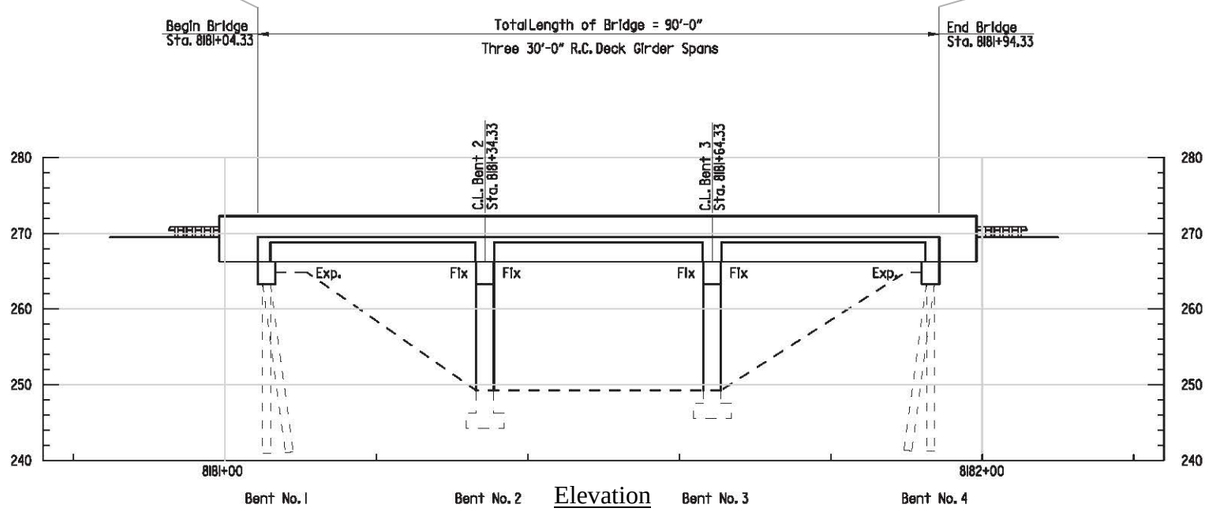
**PLAN OF BORINGS**
**061190 I-40 OVER NEWTON CREEK**
**PULASKI COUNTY, ARKANSAS**

**Scale: As shown**

**Job No. 17-028**

**PLATE 3a**




10 0 10 20 ft

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**PLAN OF BORINGS**
**061190 I-40 OVER NEWTON CREEK**
**PULASKI COUNTY, ARKANSAS**

**Scale: As shown**

**Job No. 17-028**

**PLATE 3b**

# SUMMARY of SUBSURFACE EXPLORATION

PROJECT: ARDOT JOB NO. 061190 I-40 Interchange (Maumelle) (F)
LOCATION: Pulaski County, Arkansas
GHBW JOB No.: 17-028

| Boring No. | Project Feature | Approx. Station | Offset, ft | | Approx Surface El, ft | Boring Depth, ft | Comments |
|---|---|---|---|---|---|---|---|
| **Maumelle Interchange** | | | | | | | |
| 1 | Interchange Bridge | 181+53 | 0 | CL | 296 | 31 | west bridge end |
| 2 | Interchange Bridge | 182+90 | 15 | LT | 290 | 3 | offset for interior bent |
| 2A | Interchange Bridge | 182+35 | 0 | CL | 295 | 30 | offset for interior bent |
| 2B | Interchange Bridge | 182+89 | 0 | CL | 290 | 36 | drilled at interior bent location |
| 3 | Interchange Bridge | 183+00 | 35 | RT | 290 | 1.8 | offset for interior bent |
| 3A | Interchange Bridge | 183+55 | 0 | CL | 300 | 30 | offset for interior bent |
| 4 | Interchange Bridge | 184+19 | 0 | CL | 299 | 33.5 | east bridge end |
| 5 | Bridge End Wall | 181+50 | 60 | LT | 297 | 13.5 | hand auger boring at wall location |
| 5A | Bridge End Wall | 181+10 | 62 | LT | 306 | 0.8 | offset wall boring |
| 6 | Bridge End Wall | 181+69 | 60 | RT | 297 | 13.5 | hand auger boring at wall location |
| 6A | Bridge End Wall | 181+25 | 68 | RT | 307 | 1 | offset wall boring |
| 7 | Bridge End Wall | 184+12 | 70 | LT | 299 | 13.5 | hand auger boring at wall location |
| 7A | Bridge End Wall | 184+67 | 76 | LT | 307 | 1 | offset wall boring |
| 8 | Bridge End Wall | 184+28 | 65 | RT | 299 | 13.5 | hand auger boring at wall location |
| 8A | Bridge End Wall | 184+95 | 60 | RT | 312 | 1 | offset wall boring |
| MSE1 | Bridge End MSE Wall | 180+72 | 22 | LT | 320 | 1 | west bridge end abutment wall |
| MSE2 | Bridge End MSE Wall | 184+83 | 15 | LT | 310 | 1 | east bridge end abutment wall |
| R1 | Interchange ramp | 8145+00 | 0 | CL | 277 | 10 | SB ramp |
| R2 | Interchange ramp | 8152+90 | 100 | LT | 287 | 10 | SB ramp |
| R3 | Interchange ramp | 8159+30 | 80 | RT | 310 | 9 | SB ramp |
| R4 | Interchange ramp | 8162+90 | 0 | CL | 272 | 8.5 | SB ramp |
| R5 | Interchange ramp | 8173+30 | 0 | CL | 268 | 10 | SB ramp |
| R6 | Interchange ramp | 8175+00 | 30 | RT | 266 | 10 | NB ramp |
| R7 | Interchange ramp | 8166+20 | 0 | CL | 327 | 3.5 | NB ramp, Test Pit |
| R8 | Interchange ramp | 8160+80 | 0 | CL | 348 | 5.5 | NB ramp, Test Pit |
| R9 | Interchange ramp | 8155+00 | 0 | CL | 308 | 4 | NB ramp, Test Pit |
| R10 | Interchange ramp | 8146+90 | 0 | CL | 278 | 10 | NB ramp |
| | | | | | | | |
| **Newton Creek Bridge Widening** | | | | | | | |
| 9 | Bridge Widening | 8179+73 | 84 | RT | 256 | 25 | North end, SB lane |
| 9A | Bridge Widening | 8179+70 | 55 | RT | 258 | 41 | North end, SB lane |
| 10 | Bridge Widening | 8180+65 | 30 | RT | 267 | 50 | South end, SB lane |
| 10A | Bridge Widening | 8180+72 | 42 | RT | 265 | 43.5 | South end, SB lane |
| 11 | Bridge Widening | 8180+90 | 29 | LT | 268 | 45 | North end, NB lane |
| 11A | Bridge Widening | 8180+82 | 29 | LT | 268 | 50 | North end, NB lane |
| 12 | Bridge Widening | 8182+08 | 57 | LT | 266 | 50 | South end, NB lane |
| 12A | Bridge Widening | 8182+10 | 55 | LT | 266 | 50 | South end, NB lane |

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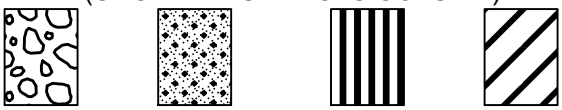
# SYMBOLS AND TERMS USED ON BORING LOGS

## 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 5-25-12

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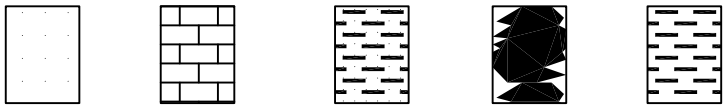
# BORING LOG TERMS – ROCK

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**

17-028

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

# LOG OF BORING NO. 1

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger to 10 ft /Wash

LOCATION: Bridge - Approx Sta 181+53, CL

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % | % Recovery | % RQD |
|---|---|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 296± | | | | | | |
| | | | Stiff gray silty clay w/shale fragments (fill) | 31 | | | | | |
| | | | Moderately hard to hard dark gray shale, ±10° dip, thickly bedded, w/numerous pyrite crystals | 50/2" | | | | | |
| | | | | 50/1" | | | | | |
| 5 | | | | 50/3" | | | | | |
| | | | | 50/3" | | | | | |
| 10 | | | | | | | | | |
| | | | | | | $q_u$ = 990 psi, TUW = 161 pcf | | 98 | 91 |
| 15 | | | - high angle to vertical fracture at 15.7 - 16.2 ft | | | $q_u$ = 560 psi | | 100 | 78 |
| 20 | | | - quartz inclusion at 20 ft<br>- sandstone seam with quartz veins at 20.3 ft<br>- pyrite inclusions at 21.5 to 21.7 ft<br>- with occasional pyrite inclusions below 22 ft | | | $q_u$ = 900 psi, TUW = 169 pcf | | 100 | 100 |
| 25 | | | | | | $q_u$ = 1290 psi, TUW = 166 pcf | | 100 | 92 |
| | | | - with occasional sandstone inclusions below 28 ft | | | | | | |
| 30 | | | - healed fracture at 30.7 ft | | | | | | |
| 35 | | | | | | | | | |

COMPLETION DEPTH: 31.0 ft
DATE: 2-23-17

DEPTH TO WATER IN BORING: Dry to 10 ft
DATE: 2/23/2017

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PLATE 1

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

# LOG OF BORING NO. 2

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Hand

LOCATION: Bridge - Approx Sta 182+90, 15 ft Lt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 290± | | | | |
| 0 | | | Soft brown, tan and gray silty clay and silt w/shale fragments and trace organics (fill) | | | ⊗ | |
| 1 | | | | | | ⊗ | |
| 2 | | | | | | ⊗ | |
| 3 | | | Moderately hard gray slightly weathered shale | | | ⊗→ | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |

COMPLETION DEPTH: 3.0 ft
DATE: 3-24-17

DEPTH TO WATER IN BORING: Dry

DATE: 3/24/2017

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

# LOG OF BORING NO. 2A

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger

LOCATION: Bridge - Approx Sta 182+35, CL

| 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 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 295± | | | | |
| | | | Very stiff brown and tan silty clay w/shale fragments (fill) | 50/7" | | | |
| | | | Moderately hard dark gray and brown slightly weathered shale | 50/1" | | | |
| | | | Moderately hard to hard dark gray shale, flat bedded | 50/0" | | | |
| 5 | | | | 50/0" | | | |
| | | | | 50/0" | | | |
| 10 | | | | | | | |
| | | | - water at 12 ft | 50/0" | | | |
| 15 | | | | | | | |
| | | | | 50/0" | | | |
| 20 | | | | | | | |
| | | | | 50/0" | | | |
| 25 | | | | | | | |
| | | | | 50/0" | | | |
| 30 | | | | | | | |

COMPLETION DEPTH: 30.0 ft
DATE: 6-9-17

DEPTH TO WATER IN BORING: 13 ft

DATE: 6/9/2017

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17-028

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

# LOG OF BORING NO. 2B

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger to 6 ft /Wash

LOCATION: Bridge - Approx Sta 182+89, CL

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % | % Recovery | % RQD |
|---|---|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 290± | | | | | | |
| | | | Soft to firm brown and gray silty clay w/shale fragments (fill) | 10<br>6 | | | | | |
| 5 | | | Moderately hard to hard dark and dark gray shale, carbonaceous, slightly micaceous, apparent 10° dip | 50/2"<br>50/1" | | | | 100 | 73 |
| 10 | | | - soft zone at 11.2 - 11.6 ft | | | | | 100 | 52 |
| 15 | | | - soft seam at 17.2 ft | | | | | 100 | 82 |
| 20 | | | - clayey shale seam at 20.1 ft<br>- sandstone inclusion at 21.3 ft<br>- harder below 21.5 ft<br>- with very close sandstone partings at 21.5 - 22 ft | | | | | 100 | 88 |
| 25 | | | - very close sandstone partings and inclusions at 24.5 - 25 ft | | | | | 93 | 77 |
| 30 | | | | | | | | 65 | 47 |
| 35 | | | | | | | | | |
| 40 | | | | | | | | | |

COMPLETION DEPTH: 36.0 ft
DATE: 9-7-17

DEPTH TO WATER
IN BORING: Dry to 6 ft

DATE: 9/7/2017

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PLATE 4

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

# LOG OF BORING NO. 3

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Hand

LOCATION: Bridge - Approx Sta 183+00, 35 ft Rt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 290± | | | | |
| | | | Firm to stiff grayish brown and tan silty clay w/sandstone, shale and occasional quartz fragments (fill) | | | | |
| 1 | | | - more gray with shale fragments below 1 ft | | | | |
| | | | Moderately hard dark gray slightly weathered shale | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |

COMPLETION DEPTH: 1.8 ft
DATE: 3-29-17

DEPTH TO WATER IN BORING: Dry

DATE: 3/29/2017

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

# LOG OF BORING NO. 3A

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger

LOCATION: Bridge - Approx Sta 183+55, CL

| 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 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 300± | | | | |
| | | | Very stiff tan silty clay w/shale fragments (fill) | 44 | | | |
| | | | Low hardness gray, dark gray and brown weathered shale<br>- moderately hard below 2 ft | 50/5" | | | |
| 5 | | | | 50/4" | | | |
| | | | | 50/3" | | | |
| | | | Moderately hard to hard dark gray shale | 50/0" | | | |
| 10 | | | | | | | |
| | | | | 50/0" | | | |
| 15 | | | | | | | |
| | | | | 50/0" | | | |
| 20 | | | | | | | |
| | | | | 50/0" | | | |
| 25 | | | | | | | |
| | | | | 50/0" | | | |
| 30 | | | NOTE: Water at 15 ft in 10 minutes. | | | | |

COMPLETION DEPTH: 30.0 ft
DATE: 6-9-17

DEPTH TO WATER IN BORING: 26 ft

DATE: 6/9/2017

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

# LOG OF BORING NO. 4

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger to 9 ft /Wash

LOCATION: Bridge - Approx Sta 184+19, CL

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % | % Recovery | % RQD |
|---|---|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 299± | | | | | | |
| | | | Stiff tan, brown and gray silty clay w/shale fragments (fill) | 15 | | | 31 | | |
| | | | Moderately hard to hard dark gray shale, ±10° dip, thickly bedded w/numerous pyrite crystals | 50/4" | | | | | |
| 5 | | | | 50/1" | | | | | |
| | | | | 50/2" | | | | | |
| | | | | 50/4" | | | | | |
| 10 | | | | | | | | | |
| 15 | | | | 50/0" | | $q_u$ = 970 psi, TUW = 165 pcf | | 100 | 93 |
| | | | - 45° fracture at 18.3 ft<br>- healed high angle fracture at 18.5 ft<br>- quartz seam at 18.7 ft | | | $q_u$ = 1250 psi, TUW = 169 pcf | | 92 | 87 |
| 20 | | | | | | | | | |
| 25 | | | - with close fractures below 24 ft | | | $q_u$ = 820 psi, TUW = 168 pcf | | 83 | 42 |
| 30 | | | - slightly carbonaceous zones at 29.5 - 29.7 ft and 30.5 - 30.8 ft | | | $q_u$ = 1370 psi, TUW = 167 pcf | | 92 | 68 |
| 35 | | | | | | | | | |

COMPLETION DEPTH: 33.5 ft
DATE: 2-27-17

DEPTH TO WATER IN BORING: Dry to 9 ft

DATE: 2/27/2017

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

# LOG OF BORING NO. 5

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger

LOCATION: MSE Wall - Approx Sta 181+50, 60 ft Lt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 297± | | | | |
| | | | Stiff gray and tan silty clay w/shale fragments (fill) | 27 | | | |
| | | | Moderately hard to hard gray shale | 50/1" | | | |
| | | | - dark gray below 3 ft | 50/1" | | | |
| 5 | | | | 50/1" | | | |
| | | | | 50/0" | | | |
| 10 | | | | | | | |
| | | | | 50/0" | | | |
| 15 | | | | | | | |
| 20 | | | | | | | |
| 25 | | | | | | | |

COMPLETION DEPTH: 13.5 ft
DATE: 2-24-17

DEPTH TO WATER IN BORING: 13.5 ft

DATE: 2/24/2017

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

# LOG OF BORING NO. 5A

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Hand

LOCATION: Bridge - Approx Sta 181+10, 62 ft Lt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 306± | | | | |
| | | | 2 inches: Stiff brown, tan and gray silty clay w/shale fragments (fill) | | | | |
| | | | Moderately hard gray and tan moderately weathered shale | | | | |

COMPLETION DEPTH: 0.8 ft
DATE: 3-29-17

DEPTH TO WATER IN BORING: Dry

DATE: 3/29/2017

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

# LOG OF BORING NO. 6

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger

LOCATION: MSE Wall - Approx Sta 181+69, 60 ft Rt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 297± | | | | |
| | | | Stiff tan and gray silty clay w/shale fragments (fill) | 16 | | | 44 |
| | | | Moderately hard to hard gray shale - dark gray below 2.5 ft | 50/3" | | | |
| 5 | | | | 50/0" | | | |
| | | | | 50/1" | | | |
| | | | | 50/0" | | | |
| 10 | | | | | | | |
| | | | | 50/0" | | | |
| 15 | | | | | | | |
| 20 | | | | | | | |
| 25 | | | | | | | |

COMPLETION DEPTH: 13.5 ft
DATE: 2-24-17

DEPTH TO WATER IN BORING: 6 ft

DATE: 2/24/2017

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

# LOG OF BORING NO. 6A

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Hand

LOCATION: Bridge - Approx Sta 181+25, 68 ft Rt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 307± | | | | |
| | | | Very stiff brown silty clay w/sandstone and shale fragments (fill) | | | ⊗ | |
| | | | Moderately hard light gray and tan moderately weathered shale | | | ⊗→ | |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |

COMPLETION DEPTH: 1.0 ft
DATE: 3-29-17

DEPTH TO WATER IN BORING: Dry

DATE: 3/29/2017

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

# LOG OF BORING NO. 7

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger

LOCATION: MSE Wall - Approx Sta 184+12, 70 ft Lt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 299± | | | | |
| | | | Firm tan, gray and red silty clay w/shale fragments (fill) | 9 | | | |
| | | | Moderately hard to hard gray slightly weathered shale w/ferrous stains in bedding planes | 50/2" | | | |
| | | | - dark gray, fresh below 4 ft | 50/0" | | | |
| 5 | | | | 50/0" | | | |
| | | | | 50/0" | | | |
| 10 | | | | | | | |
| | | | | 50/0" | | | |
| 15 | | | | | | | |
| 20 | | | | | | | |
| 25 | | | | | | | |

COMPLETION DEPTH: 13.5 ft
DATE: 2-24-17

DEPTH TO WATER IN BORING: 13.5 ft

DATE: 2/24/2017

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

# LOG OF BORING NO. 7A

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Hand

LOCATION: Bridge - Approx Sta 184+67, 76 ft Lt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 307± | | | | |
| | | | Soft brown silty clay w/shale fragments and rootlets (fill) | | | ⊗ | |
| | | | Moderately hard dark gray, dark red and tan weathered shale | | | ⊗→ | |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |

COMPLETION DEPTH: 1.0 ft
DATE: 3-29-17

DEPTH TO WATER IN BORING: Dry

DATE: 3/29/2017

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

# LOG OF BORING NO. 8

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger

LOCATION: MSE Wall - Approx Sta 184+28, 65 ft Rt

SURF. EL: 299±

| 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 tan and gray silt and shale fragments (fill) | 18 | | -NON-PLASTIC- | 19 |
| | | | | 17 | | | |
| | | | Moderately hard light gray, dark red and tan weathered shale | 50/6" | | | |
| 5 | | | Moderately hard to hard dark gray slightly weathered shale w/ferrous stains in bedding planes | 50/0" | | | |
| | | | - dark gray, fresh below 8 ft | 50/0" | | | |
| 10 | | | | | | | |
| | | | | 50/0" | | | |
| 15 | | | | | | | |
| 20 | | | | | | | |
| 25 | | | | | | | |

COMPLETION DEPTH: 13.5 ft
DATE: 2-24-17

DEPTH TO WATER IN BORING: Dry

DATE: 2/24/2017

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

# LOG OF BORING NO. 8A

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Hand

LOCATION: Bridge - Approx Sta 184+95, 60 ft Rt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 312± | | | | |
| | | | 8 inches: Soft brown silty clay w/shale fragments and rootlets | | | ⊗ | |
| 1 | | | Moderately hard tan and light gray moderately weathered shale | | | ⊗ | |

COMPLETION DEPTH: 1.0 ft
DATE: 3-29-17

DEPTH TO WATER IN BORING: Dry

DATE: 3/29/2017

LGBNEW 17-028_LOGS.GPJ 12-12-17

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

# LOG OF BORING NO. MSE1

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Hand

LOCATION: Bridge - Approx Sta 180+72, 22 ft Lt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 320± | | | | |
| | | | 3 inches: Topsoil (fill) | | | | |
| | | | Stiff brown, tan and gray silty clay w/silt and shale fragments (fill) | | | ⊗ | |
| | | | Low hardness gray and tan weathered shale | | | ⊗→ | |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |

COMPLETION DEPTH: 1.0 ft
DATE: 3-24-17

DEPTH TO WATER IN BORING: Dry

DATE: 3/24/2017

LGBNEW 17-028_LOGS.GPJ 12-12-17

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

# LOG OF BORING NO. MSE2

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Hand

LOCATION: Bridge - Approx Sta 184+83, 15 ft Lt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 310± | | | | |
| | | | 3 inches: Topsoil (fill) | | | | |
| | | | Stiff brown, tan and gray silty clay w/silt and shale fragments, dry (fill) | | | ⊗ | |
| | | | Low hardness gray and tan weathered shale | | | ⊗→ | |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |

COMPLETION DEPTH: 1.0 ft
DATE: 3-24-17

DEPTH TO WATER
IN BORING: Dry

DATE: 3/24/2017

LGBNEW 17-028_LOGS.GPJ 12-12-17

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

# LOG OF BORING NO. R1

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger

LOCATION: Ramp 1 - Sta 8145+00, CL

| 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 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 277± | | | | |
| | | | Stiff dark brown silty clay, silt and sandstone and shale fragments (fill) | 14 | | | |
| | | | Stiff tan clay w/rootlets | 16 | | | |
| | | | - firm at 4 to 6 ft | 8 | | | 96 |
| 5 | | | - stiff tan and reddish brown with trace organics and stains below 6 ft | 17 | | | |
| | | | Stiff tan, reddish brown and gray silty clay w/numerous fine sandy silt seams | | | | |
| | | | - firm to stiff below 8.5 ft | 10 | | | |
| 10 | | | | | | | |
| 15 | | | | | | | |

COMPLETION DEPTH: 10.0 ft
DATE: 3-23-17

DEPTH TO WATER IN BORING: Dry

DATE: 3/23/2017

LGBNEW 17-028_RAMP LOGS.GPJ 12-20-17

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

# LOG OF BORING NO. R2

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger LOCATION: Ramp 1 - Sta 8152+90, 100 ft Lt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 287± | | | | |
| | | | Stiff brown silty clay, silt and sandstone fragments w/trace asphalt concrete debris and organics (fill) | 16 | | | |
| | | | Stiff light grayish brown silty clay | 14 | | | 95 |
| 5 | | | - tan and reddish tan below 4 ft | 12 | | | |
| | | | Stiff tan and gray silty clay w/trace roots | 13 | | | |
| | | | | 20 | | | 93 |
| 10 | | | | | | | |
| 15 | | | | | | | |

COMPLETION DEPTH: 10.0 ft
DATE: 3-17-17

DEPTH TO WATER IN BORING: Dry

DATE: 3/17/2017

LGBNEW 17-028_RAMP LOGS.GPJ 12-20-17

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

# LOG OF BORING NO. R3

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger

LOCATION: Ramp 1 - Sta 8159+30, 80 ft Rt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 310± | | | | |
| | | | 3.5 inches: Asphalt Concrete | | | | |
| | | | 2.5 inches: Crushed Stone Base w/trace silt | | | | |
| | | | Stiff to very stiff tan and brown silty clay w/trace shale fragments and occasional organics (fill) | 50 | | WC | 90 |
| | | | - with sandstone fragments below 2 ft | 50/6" | | WC | |
| 5 | | | Very stiff tan silty clay w/shale fragments | 33 | | PL WC LL | 34 |
| | | | Moderately hard tan weathered shale | 50/3" | | | |
| | | | Moderately hard gray shale | 50/3" | | | |
| 10 | | | | | | | |
| 15 | | | | | | | |

COMPLETION DEPTH: 9.0 ft
DATE: 3-17-17

DEPTH TO WATER IN BORING: Dry

DATE: 3/17/2017

LGBNEW 17-028_RAMP LOGS.GPJ 12-20-17

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

# LOG OF BORING NO. R4

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger

LOCATION: Ramp 2 - Sta 8162+90, CL

| 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 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 272± | | | | |
| | | | Loose dark brown silt w/some crushed stone (fill) | | | | |
| | | | Stiff silty clay, silt and crushed stone w/trace organics (fill) | 24 | | | |
| | | | Stiff tan silty clay, w/trace roots | 12 | | | 86 |
| 5 | | | | 21 | | | |
| | | | Low hardness to moderately hard tan highly weathered shale w/silty clay seams | 50/6" | | | |
| | | | - moderately hard below 7 ft | 50/1" | | | |
| 10 | | | | | | | |
| 15 | | | | | | | |

COMPLETION DEPTH: 8.5 ft
DATE: 3-17-17

DEPTH TO WATER IN BORING: Dry

DATE: 3/17/2017

LGBNEW 17-028_RAMP LOGS.GPJ 12-20-17

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

# LOG OF BORING NO. R5

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger LOCATION: Ramp 2 - Sta 8173+30, CL

| 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 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 268± | | | | |
| | | | Stiff dark brown silty clay and silt w/sandstone and shale fragments (fill) | 13 | | | |
| | | | - tan and gray below 2 ft | 15 | | | |
| | | | | 11 | | | |
| 5 | | | Stiff light reddish brown clay w/trace shale fragments | 13 | | | 84 |
| | | | - reddish brown below 8 ft | 18 | | | |
| 10 | | | | | | | |
| 15 | | | | | | | |

COMPLETION DEPTH: 10.0 ft
DATE: 3-23-17

DEPTH TO WATER IN BORING: Dry

DATE: 3/23/2017

LGBNEW 17-028_RAMP LOGS.GPJ 12-20-17

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

# LOG OF BORING NO. R6

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger

LOCATION: Ramp 3 - Sta 8175+00, 30 ft Rt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 266± | | | | |
| | | | Stiff to very stiff dark brown silty clay and silt w/crushed stone and sandstone fragments (fill) | 25 | | | |
| | | | - stiff, tan and gray with shale fragments below 2.5 ft | 16 | | | 47 |
| 5 | | | | 15 | | | |
| | | | Stiff light reddish brown and gray silty clay<br>- light gray below 7 ft | 16 | | | |
| | | | - reddish brown and gray with trace shale fragments below 8 ft | 14 | | | |
| 10 | | | | | | | |
| 15 | | | | | | | |

COMPLETION DEPTH: 10.0 ft
DATE: 3-23-17

DEPTH TO WATER IN BORING: Dry

DATE: 3/23/2017

LGBNEW 17-028_RAMP LOGS.GPJ 12-20-17

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

# LOG OF TEST PIT NO. R7

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Mini Excavator

LOCATION: Ramp 3 - Sta 8166+20, CL

| 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 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 327± | | | | |
| | | | Loose to medium dense brown fine sandy silt w/occasional sandstone cobbles and numerous rootlets, dry | | | | |
| 1 | | | Very stiff light reddish brown silty clay, slightly sandy w/numerous quartz and sandstone fragments and trace cobbles | | | | 25 |
| 2 | | | | | | | |
| 3 | | | - with occasional highly weathered shale seams and laminations below 2.5 ft | | | | |
| | | | Low hardness reddish brown, tan and light gray highly weathered shale w/silty clay laminations and seams, apparent 5° dip | | | | |
| 4 | | | - practical backhoe refusal in weathered shale at 3.5 ft | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |

COMPLETION DEPTH: 3.5 ft
DATE: 3-23-17

DEPTH TO WATER IN TEST PIT: Dry

DATE: 3/23/2017

LTPNEW 17-028_RAMP LOGS.GPJ 12-18-17

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

# LOG OF TEST PIT NO. R8

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Mini Excavator

LOCATION: Ramp 3 - Sta 8160+80, CL

| 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 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 348± | | | | |
| | | | Loose brown silt, slightly sandy w/trace organics | | | | |
| 1 | | | Stiff reddish brown fine sandy clay w/numerous quartz and sandstone fragments and cobbles | | | | 41 |
| | | | - with ferrous concretions below 1.5 ft | | | | |
| 2 | | | Very stiff reddish brown silty clay, slightly sandy w/sandstone cobbles, shale fragments and ferrous nodules | | | | |
| 3 | | | | | | | |
| | | | - gray, red and tan with weathered shale seams below 3.5 ft | | | | |
| 4 | | | | | | | |
| 5 | | | Low hardness tan, red, gray and light gray highly weathered shale w/silty clay laminations and seams | | | | |
| | | | - practical refusal in weathered shale at 5.5 ft | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |

COMPLETION DEPTH: 5.5 ft
DATE: 3-23-17

DEPTH TO WATER IN TEST PIT: Dry

DATE: 3/23/2017

LTPNEW 17-028_RAMP LOGS.GPJ 12-18-17

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

# LOG OF TEST PIT NO. R9

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Mini Excavator

LOCATION: Ramp 4 - Sta 8155+00, CL

| 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 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 308± | | | | |
| | | | Loose brown silt, slightly sandy w/trace organics | | | | |
| 1 | | | Stiff tan fine sandy clay w/quartz sandstone fragments and cobbles and trace roots<br>- light reddish brown below 1 ft | | | | 67 |
| 2 | | | - very stiff below 1.5 ft | | | | |
| 3 | | | Very stiff gray, tan and red silty clay, slightly sandy w/trace quartz and sandstone fragments and cobbles | | | | |
| 4 | | | Low hardness dark red, tan and gray highly weathered shale w/silty clay laminations and seams<br>- practical refusal in weathered shale at 4 ft | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |

COMPLETION DEPTH: 4.0 ft
DATE: 3-23-17

DEPTH TO WATER IN TEST PIT: Dry

DATE: 3/23/2017

LTPNEW 17-028_RAMP LOGS.GPJ 12-18-17

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

# LOG OF BORING NO. R10

061190 I-40 Interchange (Maumelle) (F)
Pulaski County, Arkansas

TYPE: Auger LOCATION: Ramp 4 - Sta 8146+90, CL

| 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 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 278± | | | | |
| | | | Loose dark brown silt | | | | |
| | | | Firm red clayey silt w/trace sandstone fragments and fine sand pockets | 8 | | | |
| | | | Firm tan and gray clay | | | | |
| | | | - stiff below 2 ft | 12 | | | 94 |
| | | | - with roots at 4.5 ft | 16 | | | |
| 5 | | | Stiff tan, light gray and gray clay w/occasional clayey silt seams | 15 | | | 99 |
| | | | | 14 | | | |
| 10 | | | - tan and reddish brown with trace shale fragments and quartz fragments below 9.5 ft | | | | |
| 15 | | | | | | | |

COMPLETION DEPTH: 10.0 ft
DATE: 3-23-17

DEPTH TO WATER IN BORING: Dry

DATE: 3/23/2017

LGBNEW 17-028_RAMP LOGS.GPJ 12-20-17

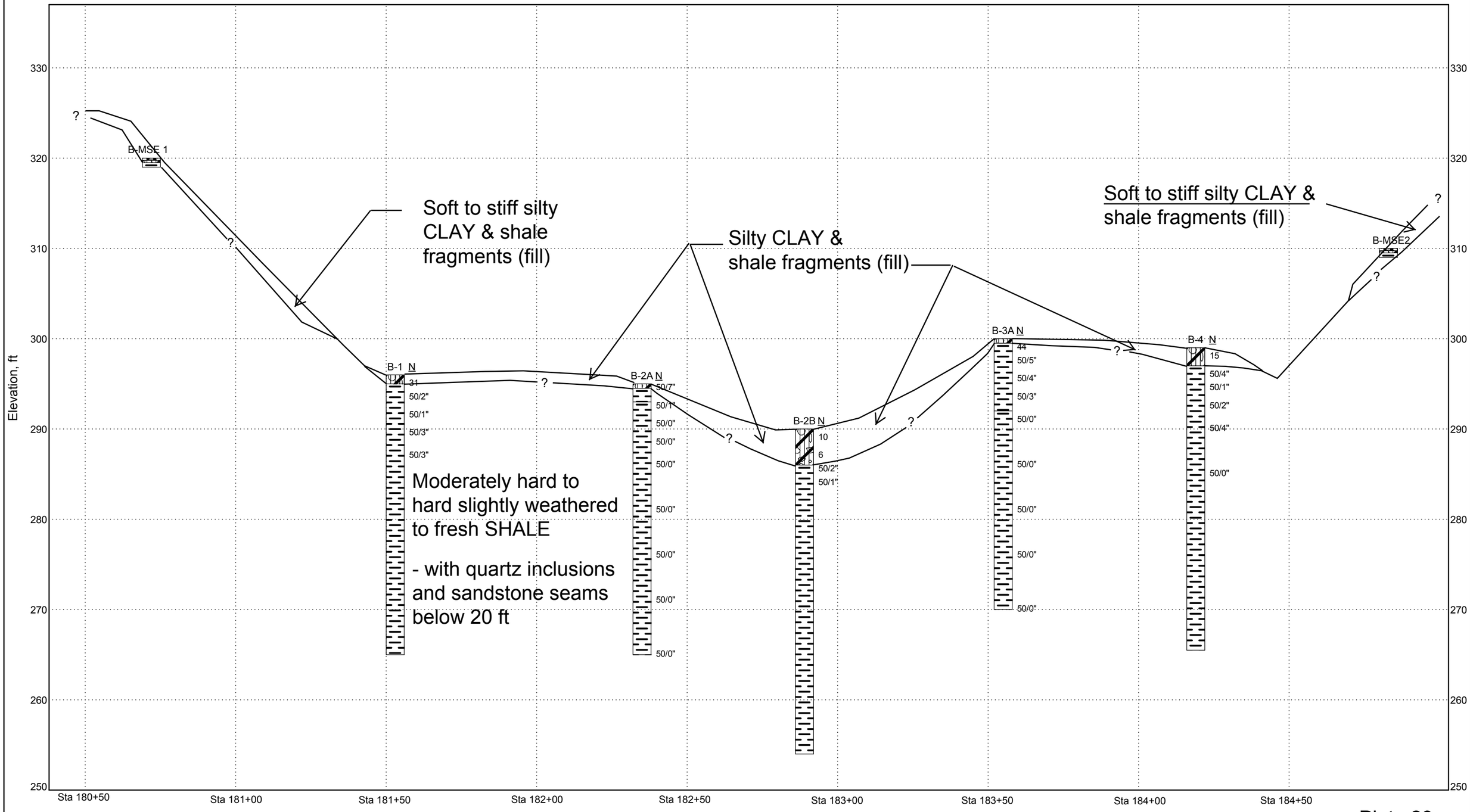



Plate 28

Grubbs, Hoskyn, Barton & Wyatt, Inc.

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

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

# Generalized Subsurface Profile
# 061190 I-40 Interchange (Maumelle) (F)
# Pulaski County, Arkansas

Project Number: 17-028

**ATTACHMENT 3**

# Boring 1

Core Run 1:
11-16 ft


Core Run 2:
16-21 ft

| | | |
|---|---|---|
| Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS | **Rock Core Pictures**<br>**061190 I-40 INTERCHANGE (MAUMELLE)(F)**<br>**PULASKI COUNTY, ARKANSAS** | **Job No. 17-028**<br>**Plate 1** |

# Boring 1

Core Run 3:
21-26 ft


Core Run 4:
26-31 ft

| | | |
|---|---|---|
| Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS | **Rock Core Pictures**<br>**061190 I-40 INTERCHANGE (MAUMELLE)(F)**<br>**PULASKI COUNTY, ARKANSAS** | **Job No. 17-028**<br>**Plate 2** |

# Boring 2B

Core Run 1:
6-11 ft


Core Run 2:
11-16 ft

| | | |
|---|---|---|
| Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS | **Rock Core Pictures**<br>**061190 I-40 INTERCHANGE (MAUMELLE)(F)**<br>**PULASKI COUNTY, ARKANSAS** | **Job No. 17-028**<br>**Plate 2** |

# Boring 2B

Core Run 3:
16-21 ft


Core Run 4:
21-26 ft

| | | |
|---|---|---|
| Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS | **Rock Core Pictures**<br>**061190 I-40 INTERCHANGE (MAUMELLE)(F)**<br>**PULASKI COUNTY, ARKANSAS** | **Job No. 17-028**<br>**Plate 2** |

# Boring 2B

Core Run 5:
26-31 ft


Core Run 6:
31-36 ft

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

**Rock Core Pictures**
**061190 I-40 INTERCHANGE (MAUMELLE)(F)**
**PULASKI COUNTY, ARKANSAS**

**Job No. 17-028**

**Plate 2**

# Boring 4

Core Run 1:
13.5-18.5 ft


Core Run 2:
18.5-23.5 ft

| | | |
|---|---|---|
| Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS | **Rock Core Pictures**<br>**061190 I-40 INTERCHANGE (MAUMELLE)(F)**<br>**PULASKI COUNTY, ARKANSAS** | **Job No. 17-028**<br>**Plate 2** |

# Boring 4

Core Run 3:
23.5-28.5 ft


Core Run 4:
28.5-33.5 ft

| | | |
|---|---|---|
| Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS | **Rock Core Pictures**<br>**061190 I-40 INTERCHANGE (MAUMELLE)(F)**<br>**PULASKI COUNTY, ARKANSAS** | **Job No. 17-028**<br>**Plate 2** |

**ATTACHMENT 4**

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

# LOG OF BORING NO. 9

061190 I-40 over Newton Creek
Pulaski County, Arkansas

TYPE: Auger to 10 ft /Wash

LOCATION: Approx Sta 8179+73, 84 ft Rt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % |
|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 256± | | | | |
| | | | Stiff tan with gray silty clay w/numerous shale fragments (fill) | 13 | | | 34 |
| | | | - firm below 2 ft | 7 | | | |
| 5 | | | Soft tan and gray fine sandy clay, silty, wet | 4 | | | |
| | | | - firm below 6 ft | 7 | | | 55 |
| 10 | | | Medium dense brownish gray and tan clayey fine to coarse gravel, sandy | 22 | | | |
| 15 | | | Moderately hard to hard dark gray with a little tan slightly weathered shale | 50/0" | | | |
| 20 | | | Moderately hard to hard dark gray shale | 50/0" | | | |
| 25 | | | | 30/0" | | | |

COMPLETION DEPTH: 25.0 ft
DATE: 6-22-17

DEPTH TO WATER IN BORING: 8 ft

DATE: 6/22/2017

LGBNEW 17-028_NEWTON CREEK.GPJ 12-12-17

PLATE 1

17-028

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

# LOG OF BORING NO. 9A

061190 I-40 over Newton Creek
Pulaski County, Arkansas

TYPE: Auger to 13 ft /Wash

LOCATION: Approx Sta 8179+70, 55 ft Rt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % | % Recovery | % RQD |
|---|---|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 258± | | | | | | |
| | | | Soft brown silty clay w/some crushed concrete debris (fill) | | | | | | |
| | | | Firm brown silty clay | 7 | | | | | |
| 5 | | | | | | | | | |
| | | | Soft brown and tan fine sandy clay | 6 | | | | | |
| 10 | | | - with some fine gravel at 11 - 13 ft | | | | | | |
| | | | Low hardness to moderately hard dark gray and tan weathered shale w/occasional sandstone seams | 25/0" | | | | | |
| 15 | | | | | | | | | |
| | | | Moderately hard dark gray with brown weathered shale w/ferrous stains and close fractures | | | | | 100 | 0 |
| 20 | | | - arenaceous zone from 17.2 - 17.6 ft | | | | | | |
| | | | - arenaceous shale below 19.7 ft | | | | | 60 | 17 |
| 25 | | | Hard dark gray fine-grained greywake sandstone, fractured w/pyrite inclusions | | | | | | |
| | | | - with gray sandstone inclusions at 22.8 ft | | | | | 74 | 42 |
| 30 | | | Hard dark gray arenaceous shale, slightly micaceous | | | | | | |
| | | | - highly weathered shale from 24 - 26 ft; no recovery | | | | | 0 | 0 |
| | | | Moderately hard dark gray highly weathered clayey shale | | | | | 55 | 0 |
| 35 | | | - 30 - 31 ft no recovery | | | | | | |
| | | | Moderately hard dark gray shale | | | | | | |
| | | | - with very close very thin sandstone partings below 32 ft | | | | | 89 | 42 |
| 40 | | | - arenaceous shale seam at 32.5 ft | | | | | | |
| | | | Moderately hard to hard dark gray shale, dip = 35° | | | | | | |
| 45 | | | | | | | | | |

COMPLETION DEPTH: 41.0 ft
DATE: 9-8-17

DEPTH TO WATER IN BORING: 9.5 ft

DATE: 9/8/2017

RECRQDN200-2 17-028_NEWTON CREEK.GPJ 12-12-17

PLATE 2

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

# LOG OF BORING NO. 10

061190 I-40 over Newton Creek
Pulaski County, Arkansas

TYPE: Auger to 18.5 ft /Wash

LOCATION: Approx Sta 8180+65, 30 ft Rt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % | % Recovery | % RQD |
|---|---|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 267± | | | | | | |
| | | | Stiff tan, brown and gray silty clay w/shale fragments (fill) | 18<br>14 | | | 34 | | |
| 5 | | | Stiff tan silty clay, sandy w/some sandstone fragments<br>- reddish tan and gray below 6 ft | 13<br>24 | | | | | |
| 10 | | | - with ferrous stains below 9 ft | 20 | | | | | |
| 15 | | | Dense to very dense reddish brown and brown clayey fine to coarse gravel, sandy<br>- with cobbles below 16.5 ft | 50/6" | | | | | |
| 20 | | | | 50/0" | | | | | |
| 25 | | | Moderately hard to hard dark gray shale, carbonaceous, ±10° dip<br>- very close healed fractures at 26.2 - 26.5 ft<br>- low angle shear at 26.4 ft<br>- harder, slightly arenaceous at 27 - 27.5 ft | 50/0" | | $q_u$ = 530 psi, TUW = 156 pcf | | 60 | 43 |
| 30 | | | | | | | | 10 | 10 |
| 35 | | | | | | | | | |
| 40 | | | | 25/0" | | | | | |
| 45 | | | NOTE: Barrel plugged at 50.5 ft, numerous mechanical fractures in limited recovery. | | | | | | |
| 50 | | | | 25/0" | | | | | |
| 55 | | | | | | | | | |

COMPLETION DEPTH: 50.0 ft
DATE: 6-27-17

DEPTH TO WATER IN BORING: 18.5 ft

DATE: 6/27/2017

RECRQDN200-2 17-028_NEWTON CREEK.GPJ 12-12-17

17-028

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

# LOG OF BORING NO. 10A

061190 I-40 over Newton Creek
Pulaski County, Arkansas

TYPE: Auger to 16 ft /Wash

LOCATION: Approx Sta 8180+72, 42 ft Rt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % | % Recovery | % RQD |
|---|---|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 265± | | | | | | |
| | | | Brown clayey silt w/sandstone fragments (fill) | | | | | | |
| | | | Firm tan silty clay, sandy | | | | | | |
| 5 | | | - with ferrous concrections below 4.5 ft | 7 | | | | | |
| | | | Stiff tan and gray silty clay w/ferrous stains | 23 | | | | | |
| 10 | | | | | | | | | |
| | | | | 24 | | | | | |
| 15 | | | Dense to very dense reddish tan sandy fine to coarse gravel - auger refusal at 16 ft | 50/9" | | | | | |
| 20 | | | | | | | | | |
| | | | Moderately hard dark gray slightly weathered shale | | | | | 100 | 30 |
| 25 | | | | | | | | | |
| | | | Moderately hard to hard dark gray shale - high angle shear at 29 ft | | | | | 38 | 30 |
| 30 | | | | | | | | | |
| | | | - 2 in sandstone layer at 33.5 ft - with close sandstone partings and seam below 34 ft | | | | | 75 | 15 |
| 35 | | | | | | | | | |
| | | | - core barrel plugged at 38.5 ft, no recovery at 38.5 - 43.5 ft | | | | | 0 | 0 |
| 40 | | | | | | | | | |
| 45 | | | | | | | | | |

COMPLETION DEPTH: 43.5 ft
DATE: 9-13-17

DEPTH TO WATER IN BORING: Dry to 16 ft

DATE: 9/13/2017

RECRQDN200-2 17-028_NEWTON CREEK.GPJ 12-12-17

PLATE 4

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

# LOG OF BORING NO. 11

061190 I-40 over Newton Creek
Pulaski County, Arkansas

TYPE: Auger to 28.5 ft /Wash

LOCATION: Approx Sta 8180+90, 29 ft Lt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % | % Recovery | % RQD |
|---|---|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 268± | | | | | | |
| | | | Stiff brown silty clay and crushed sandstone fragments (fill) | 14 | | | | | |
| | | | Stiff brown and tan silty clay and shale fragments (fill) | 17 | | | 21 | | |
| 5 | | | - reddish tan, brown and tan with sandstone fragments below 4 ft | 10 | | | | | |
| | | | - firm below 6 ft | 7 | | | | | |
| 10 | | | | 10 | | | | | |
| | | | Firm tan silty clay, w/soft pockets, wet | 10 | | | 64 | | |
| 15 | | | | | | | | | |
| 20 | | | Stiff tan and gray silty clay w/ferrous nodules and stains | 16 | | | | | |
| 25 | | | Moderately hard brownish gray and dark gray weathered shale w/ferrous stains | 50/4" | | | | | |
| | | | Moderately hard dark gray shale | 50/0" | | | | | |
| 30 | | | - with sandstone partings at 30.5 ft | | | | | 27 | 0 |
| 35 | | | Moderately hard dark gray shale, thicklt bedded w/very close fine-grained sandstone seams, flat bedded | | | | | 20 | 0 |
| | | | - with shale inclusions and healed fractures at 35 - 35.2 ft | | | | | | |
| 40 | | | - with quartz inclusions below 35 ft | | | | | | |
| | | | - high angle shear with healed fractures at 40.9 ft | | | | | 65 | 10 |
| 45 | | | Moderately hard dark gray siltstone w/fine-grained sandstone inclusions | | | | | | |
| | | | NOTE: Numerous mechanical fractures in all core runs. | | | | | | |

COMPLETION DEPTH: 45.0 ft
DATE: 6-26-17

DEPTH TO WATER IN BORING: 16.8 ft

DATE: 6/26/2017

RECRQDN200-2 17-028_NEWTON CREEK.GPJ 12-12-17

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

# LOG OF BORING NO. 11A

061190 I-40 over Newton Creek
Pulaski County, Arkansas

TYPE: Auger to 20 ft /Wash

LOCATION: Approx Sta 8180+82, 29 ft Lt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % | % Recovery | % RQD |
|---|---|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 268± | | | | | | |
| | | | Stiff brown silty clay and crushed sandstone fragments (fill) | 30 | | | | | |
| 5 | | | Stiff brown and tan silty clay and shale fragments (fill) - reddish tan, brown and tan with sandstone fragments below 4 ft | 21 | | | | | |
| 10 | | | | 18 | | | | | |
| | | | Stiff tan silty clay, w/soft pockets, wet | | | | | | |
| 15 | | | | 14 | | | | | |
| 20 | | | Stiff to very stiff tan and gray silty clay w/ferrous nodules and stains | 42 | | | | | |
| 25 | | | Moderately hard brownish gray and dark gray weathered shale w/ferrous stains | 50/5" | | | | | |
| | | | Moderately hard dark gray shale, apparent dip ~ 30° | | | | | | |
| 30 | | | - slightly arenaceous below 31.5 ft | | | | | 93 | 33 |
| 35 | | | - low hardness layer at 33.8 - 35 ft | | | | | 98 | 59 |
| 40 | | | Moderately hard to hard dark gray shale, slightly arenaceous - with close sandstone partings and inclusions below 40.5 ft | | | | | 100 | 85 |
| 45 | | | | | | | | 100 | 75 |
| 50 | | | | | | | | | |
| 55 | | | | | | | | | |

COMPLETION DEPTH: 50.0 ft
DATE: 9-21-17

DEPTH TO WATER IN BORING: Dry to 20 ft
DATE: 9/20/2017

RECRQDN200-2 17-028_NEWTON CREEK.GPJ 12-12-17

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

# LOG OF BORING NO. 12

061190 I-40 over Newton Creek
Pulaski County, Arkansas

TYPE: Auger to 23 ft /Wash

LOCATION: Approx Sta 8182+8, 57 ft Lt

SURF. EL: 266±

| 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 |
|---|---|---|---|---|---|---|---|---|---|
| | | | Fill For Access | | | | | | |
| | | | Very stiff tan silty clay | 42 | | | | | |
| 5 | | | | 32 | | | 80 | | |
| | | | - with some gray below 6 ft | 33 | | | | | |
| | | | Dense to very dense reddish tan and red sandy fine to coarse gravel | 50/6" | | | | | |
| 10 | | | - with cobbles below 12 ft | | | | | | |
| 15 | | | | | | | | | |
| | | | Moderately hard to hard dark gray shale, slightly arenaceous, ±10° dip | 50/1" | | | | | |
| 20 | | | | | | | | | |
| 25 | | | - with quartz inclusions below 24 ft<br>- with sandstone inclusions below 25.2 ft | | | $q_u$ = 470 psi, TUW = 153 pcf<br>$q_u$ = 790 psi | | 87 | 42 |
| 30 | | | NOTE: Core barrel plugged at 28.5 ft, numerous mechanical fractures and limited recovery. | | | | | 10 | 0 |
| 35 | | | | | | | | | |
| | | | | 50/0" | | | | | |
| 40 | | | | | | | | | |
| | | | | 50/0" | | | | | |
| 45 | | | | | | | | | |
| 50 | | | | 50/0" | | | | | |
| 55 | | | | | | | | | |

COMPLETION DEPTH: 50.0 ft
DATE: 6-29-17

DEPTH TO WATER IN BORING: 9 ft
DATE: 6/29/2017

RECRQDN200-2 17-028_NEWTON CREEK.GPJ 12-12-17

17-028

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

# LOG OF BORING NO. 12A

061190 I-40 over Newton Creek
Pulaski County, Arkansas

TYPE: Auger to 13 ft /Wash

LOCATION: Approx Sta 8182+10, 55 ft Lt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70) | - No. 200 % | % Recovery | % RQD |
|---|---|---|---|---|---|---|---|---|---|
| | | | SURF. EL: 266± | | | | | | |
| | | | Firm brown clayey silt w/sandstone fragments (fill) | | | | | | |
| 5 | | | Stiff tan silty clay w/construction debris and crushed rock fragments (fill) | 20 | | | | | |
| 10 | | | Dense to very dense tan and reddish tan sandy fine to coarse gravel<br>- with cobbles below 10.5 ft | 50/6" | | | | | |
| 15 | | | | | | | | | |
| 20 | | | Moderately hard dark gray slightly weathered shale | | | | | 35 | 7 |
| 25 | | | - with very close sandstone inclusions and seams below 25 ft<br>- low angle shear at 25.5 ft | | | | | 87 | 40 |
| 30 | | | - with quartz inclusions below 26 ft | | | | | 72 | 40 |
| 35 | | | - carbonaceous shale internal at 37.2 - 37.8 ft | | | | | 92 | 23 |
| 40 | | | - high angle shear at 39.5 - 40 ft | | | | | | |
| | | | Hard dark gray shale, thickly bedded, apparent dip ~ 35° | | | | | 58 | 18 |
| 45 | | | | | | | | 77 | 77 |
| 50 | | | | | | | | | |
| 55 | | | | | | | | | |

COMPLETION DEPTH: 50.0 ft
DATE: 9-18-17

DEPTH TO WATER
IN BORING: Dry to 13 ft

DATE: 9/14/2017

RECRQDN200-2 17-028_NEWTON CREEK.GPJ 12-12-17

PLATE 8

**ATTACHMENT 5**

# Boring 9B

Core Run 1:
16-21 ft


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

**Rock Core Pictures**
**061190 I-40 OVER NEWTON CREEK**
**PULASKI COUNTY, ARKANSAS**

**Job No. 17-028**

**Plate 1**

# Boring 9B

Core Run 2:
21-26 ft


Core Run 2:
26-31 ft

| | | |
|---|---|---|
| Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS | **Rock Core Pictures**<br>**061190 I-40 OVER NEWTON CREEK**<br>**PULASKI COUNTY, ARKANSAS** | **Job No. 17-028**<br>**Plate 2** |

# Boring 9B

Core Run 4:
31-36 ft


Core Run 5:
36-41 ft

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

**Rock Core Pictures**
**061190 I-40 OVER NEWTON CREEK**
**PULASKI COUNTY, ARKANSAS**

**Job No. 17-028**

**Plate 2**

# Boring 10

Core Run 1:
25-30 ft


Core Run 2:
30-35 ft

# Boring 10A

Core Run 1:
23.5-28.5 ft


Core Run 2:
28.5-33.5 ft

| | | |
|---|---|---|
| Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS | **Rock Core Pictures**<br>**061190 I-40 OVER NEWTON CREEK**<br>**PULASKI COUNTY, ARKANSAS** | **Job No. 17-028**<br>**Plate 2** |

# Boring 10A

Core Run 3:
33.5-38.5 ft


| | | |
|---|---|---|
| Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS | **Rock Core Pictures**<br>**061190 I-40 OVER NEWTON CREEK**<br>**PULASKI COUNTY, ARKANSAS** | **Job No. 17-028**<br>**Plate 2** |

# Boring 11

Core Run 1:
30-35 ft


Core Run 2:
35-40 ft

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

**Rock Core Pictures**
**061190 I-40 OVER NEWTON CREEK**
**PULASKI COUNTY, ARKANSAS**

**Job No. 17-028**

**Plate 2**

# Boring 11

Core Run
40-45 ft


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

**Rock Core Pictures**
**061190 I-40 OVER NEWTON CREEK**
**PULASKI COUNTY, ARKANSAS**

**Job No. 17-028**

**Plate 2**

# Boring 11A

Core Run 1:
30-35 ft


Core Run 2:
35-40 ft

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

**Rock Core Pictures**
**061190 I-40 OVER NEWTON CREEK**
**PULASKI COUNTY, ARKANSAS**

**Job No. 17-028**

**Plate 2**

# Boring 11A

Core Run 3:
40-45 ft


Core Run 4:
45-50 ft

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

**Rock Core Pictures**
**061190 I-40 OVER NEWTON CREEK**
**PULASKI COUNTY, ARKANSAS**

**Job No. 17-028**

**Plate 2**

# Boring 12

Core Run 1:
23-28 ft


Core Run 2:
28-33 ft

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

**Rock Core Pictures**
**061190 I-40 OVER NEWTON CREEK**
**PULASKI COUNTY, ARKANSAS**

**Job No. 17-028**

**Plate 2**

# Boring 12A

Core Run 1:
20-25 ft


Core Run 2:
25-30 ft

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

**Rock Core Pictures**
**061190 I-40 OVER NEWTON CREEK**
**PULASKI COUNTY, ARKANSAS**

**Job No. 17-028**

**Plate 2**

# Boring 12A

Core Run 3:
30-35 ft


Core Run 4:
35-40 ft

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

**Rock Core Pictures**
**061190 I-40 OVER NEWTON CREEK**
**PULASKI COUNTY, ARKANSAS**

**Job No. 17-028**

**Plate 2**

# Boring 12A

Core Run 5:
40-45 ft


Core Run 6:
45-50 ft

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

**Rock Core Pictures**
**061190 I-40 OVER NEWTON CREEK**
**PULASKI COUNTY, ARKANSAS**

**Job No. 17-028**

**Plate 2**

**ATTACHMENT 6**

# SUMMARY OF CLASSIFICATION TEST RESULTS

PROJECT: 061190 I-40 Interchange (Maumelle) (F)
LOCATION: Pulaski County, Arkansas
JOB NUMBER: 17-028

| BORING No. | SAMPLE DEPTH (ft) | WATER CONTENT (%) | ATTERBERG LIMITS | | | PERCENT PASSING #200 | UNIFIED CLASS. | AASHTO CLASS. |
|---|---|---|---|---|---|---|---|---|
| | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | | | |
| 4 | 0.5-1.5 | 13 | 25 | 16 | 9 | 31 | GC | A-2-4 |
| | | | | | | | | |
| 6 | 0.5-1.5 | 9 | 29 | 19 | 10 | 44 | GC | A-4 |
| | | | | | | | | |
| 8 | 0.5-1.5 | 6 | -NON-PLASTIC- | | | 19 | GM | A-2-4 |
| 8 | 4-4.5 | 8 | 35 | 19 | 16 | ---- | SHALE | |
| | | | | | | | | |
| R1 | 4.5-5.5 | 24 | 64 | 19 | 45 | 96 | CH | A-7-6 |
| | | | | | | | | |
| R2 | 2.5-3.5 | 23 | 41 | 16 | 25 | 95 | CL | A-7-6 |
| R2 | 9-10 | 22 | 48 | 22 | 26 | 93 | CL | A-7-6 |
| | | | | | | | | |
| R3 | 1-2 | 28 | 43 | 18 | 25 | 90 | CL | A-7-6 |
| R3 | 4.5-5.5 | 10 | 38 | 20 | 18 | 34 | GC | A-2-6 |
| | | | | | | | | |
| R4 | 2.5-3.5 | 18 | 31 | 14 | 17 | 86 | CL | A-6 |
| R4 | 6.5-7 | 11 | 29 | 17 | 12 | ---- | SHALE | |
| | | | | | | | | |
| R5 | 6.5-7.5 | 26 | 75 | 29 | 46 | 84 | CH | A-7-6 |
| | | | | | | | | |
| R6 | 2.5-3.5 | 9 | 31 | 18 | 13 | 47 | GC | A-6 |
| | | | | | | | | |
| R7 | 1-2 | 9 | 28 | 18 | 10 | 25 | GC | A-2-4 |
| | | | | | | | | |
| R8 | 0.5-1.5 | 14 | 32 | 19 | 13 | 41 | GC | A-6 |
| | | | | | | | | |
| R9 | 1-2 | 24 | 76 | 32 | 44 | 67 | CH | A-7-5 |
| | | | | | | | | |
| R10 | 2.5-3.5 | 23 | 58 | 21 | 37 | 94 | CH | A-7-6 |
| R10 | 6.5-7.5 | 29 | 59 | 21 | 38 | 99 | CH | A-7-6 |

# SUMMARY OF CLASSIFICATION TEST RESULTS

PROJECT: 061190 I-40 over Newton Creek (Maumelle) (F)
LOCATION: Pulaski County, Arkansas
JOB NUMBER: 17-028

| BORING No. | SAMPLE DEPTH (ft) | WATER CONTENT (%) | ATTERBERG LIMITS | | | PERCENT PASSING #200 | UNIFIED CLASS. | AASHTO CLASS. |
|---|---|---|---|---|---|---|---|---|
| | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | | | |
| 9 | 0.5-1.5 | 10 | 36 | 20 | 16 | 34 | GC | A-2-6 |
| 9 | 6.5-7.5 | 21 | 22 | 17 | 5 | 55 | CL-ML | A-4 |
| | | | | | | | | |
| 10 | 2.5-3.5 | 7 | 31 | 18 | 13 | 34 | GC | A-2-6 |
| | | | | | | | | |
| 11 | 2.5-3.5 | 8 | 29 | 18 | 11 | 21 | GC | A-2-6 |
| 11 | 14-15 | 19 | 21 | 16 | 5 | 64 | CL-ML | A-4 |
| | | | | | | | | |
| 12 | 4.5-5.5 | 18 | 39 | 21 | 18 | 80 | CL | A-6 |

**ATTACHMENT 7**

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)

Project: 061190 I-40 Interchange (Maumelle) (F), Pulaski County, Arkansas  Job No: 17-028

Material Description: Brownish yellow and brown silty CLAY with silt and sandstone fragments

Location Sampled/Source: Boring R2

Sample Depth, ft: 1-2

Date Sampled: 3/8/2017

Date Tested: 3/15/2017

Tested By: KF/BT

Report Date: 3/29/2017

| LAB COMPACTION PROCEDURE: AASHTO T-99 Method: A | |
|---|---|
| **Maximum Unit Dry Wt. (pcf):** | 111.8 |
| **Optimum Water Content (%):** | 15.8 |

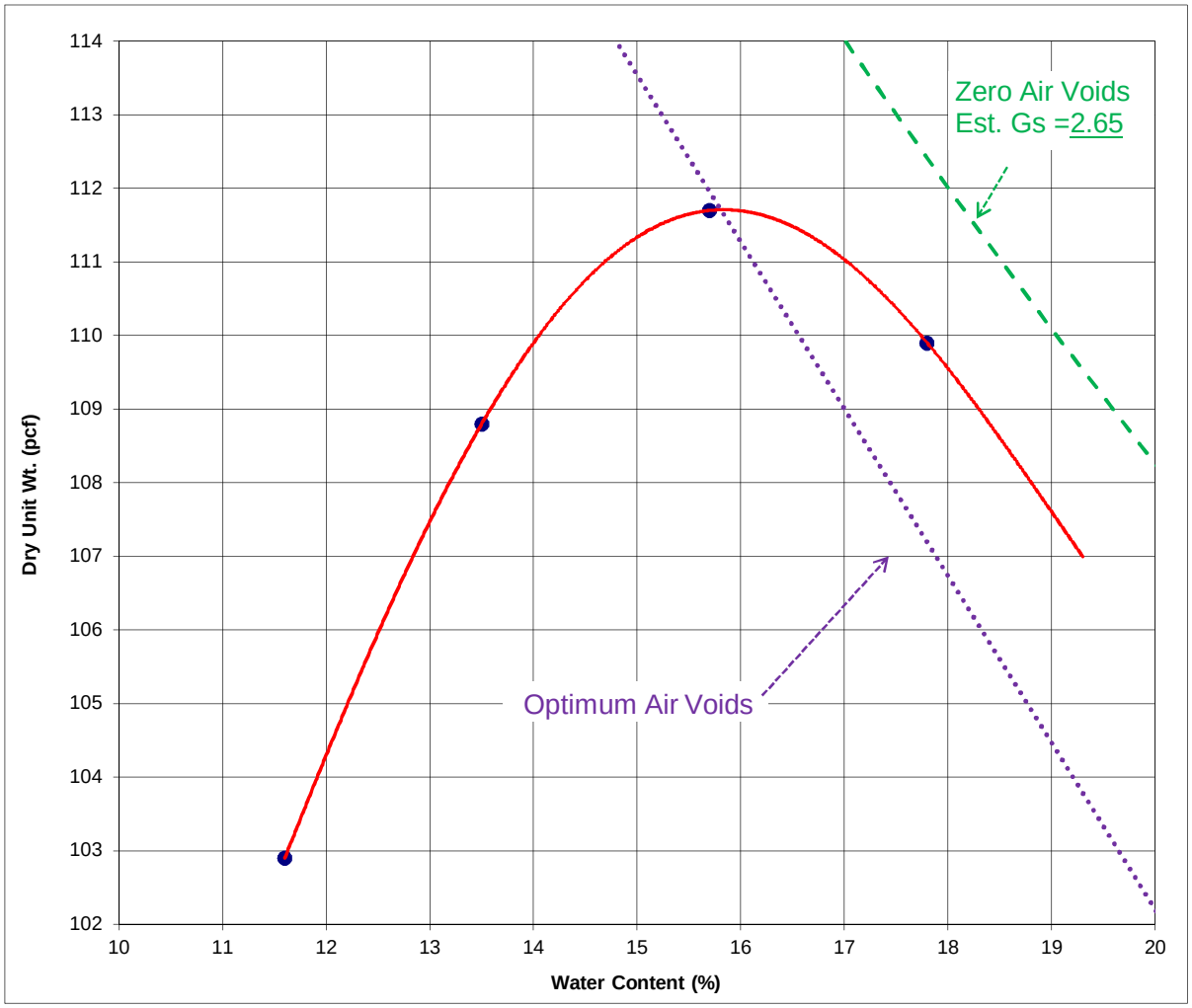
As Recieved Water Content: 15.6 %

| ATTERBERG LIMITS AASHTO T-89 & T-90 |
|---|
| Liquid Limit: 33 |
| Plastic Limit: 19 |
| Plasticity Index: 14 |

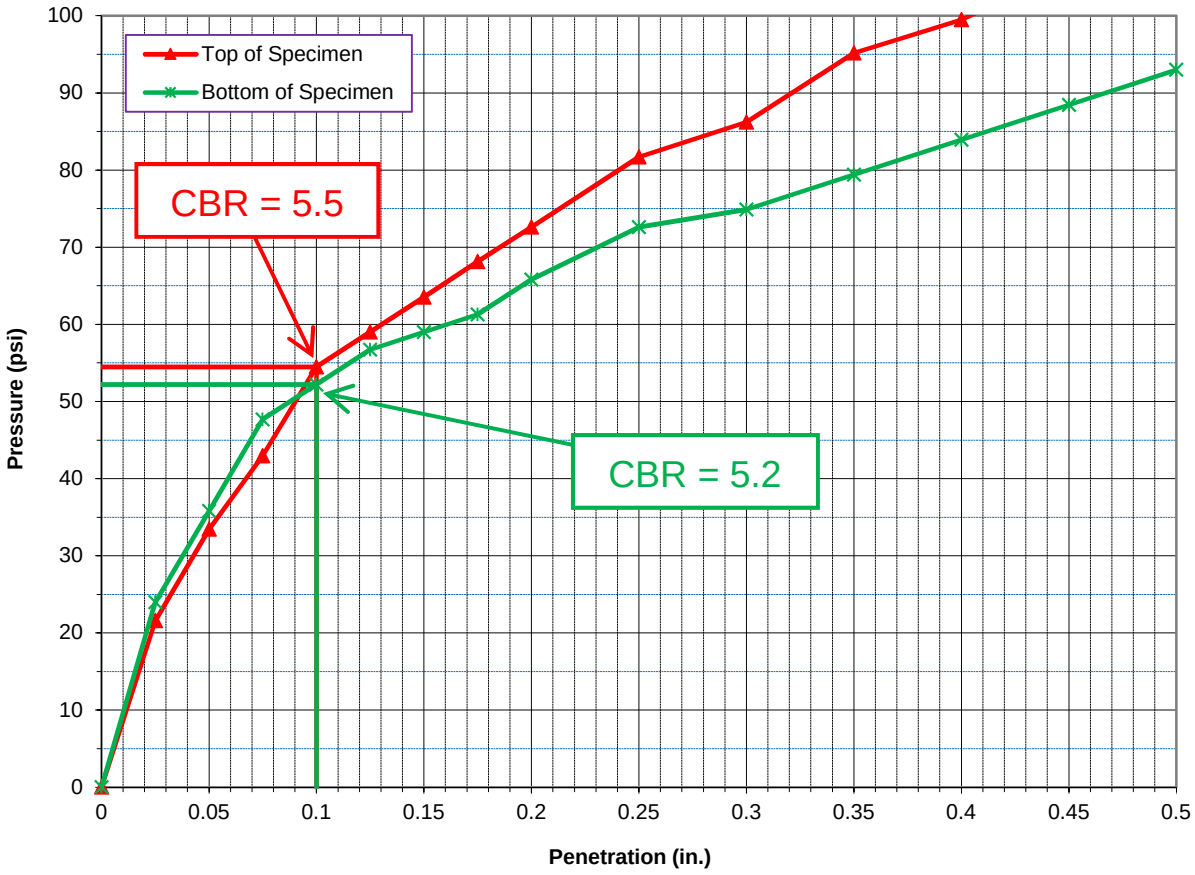
| AASHTO Classification: |
|---|
| A-6 |

| USCS Classification: |
|---|
| CL |

| GRADATION AASHTO T-88 | |
|---|---|
| Sieve Number | Percent Passing |
| 3 in. | 100 |
| 2 in. | 100 |
| 3/4 in. | 99 |
| 3/8 in. | 99 |
| #4 | 98 |
| #10 | 94 |
| #40 | 88 |
| #200 | 79 |



# Laboratory CBR Test Report
# (AASHTO T-193)




| Test Pit/Depth, ft | Classification | | Natural Moisture Content, % | Assumed Specific Gravity | Liquid Limit, % | Plastic Limit, % | % Retained No.4 | % Passing No.200 |
|---|---|---|---|---|---|---|---|---|
| | USCS | AASHTO | | | | | | |
| B-R2 @ 1-2 ft | CL | A-6 | 15.6 | 2.65 | 33 | 19 | 14 | 79 |
| **PROCTOR TEST RESULTS (AASHTO T-99)** | | | | **MATERIAL DESCRIPTION** | | | | |
| Optimum Moisture Content = 15.8%<br>Maximum Dry Density = 111.8 pcf | | | | Brownish yellow and brown silty CLAY with silt and sandstone fragments | | | | |

Remarks:

As molded: Dry Unit Weight, $\gamma_d$ = 102.4 pcf; Moisture Content, w = 15.4%

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| |
|---|
| Project: 061190 I-40 Interchange (Maumelle) (F), |
| GHBW Project No.: 17-028 |
| Location: Pulaski County, Arkansas |
| Sample Date: 3/8/17 |
| Test Date: 3/24/17 |

**ATTACHMENT 8**

**Summary of Stability Analysis Results**
**MSE-1 (West) – STA 181+29 Bridge over I-40**
**0611190 – I-40 Interchange (Maumelle) (F)**

| Location | Design Loading Condition | Calculated Minimum Factor of Safety |
|---|---|---|
| MSE Wall 1 – West STA 181+29 | End of Construction | 2.0 |
| | Long Term | 1.5 |
| | Seismic ($k_h = 0.5A_S = 0.07$) | 1.4 |

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**Barton & Wyatt, Inc.**
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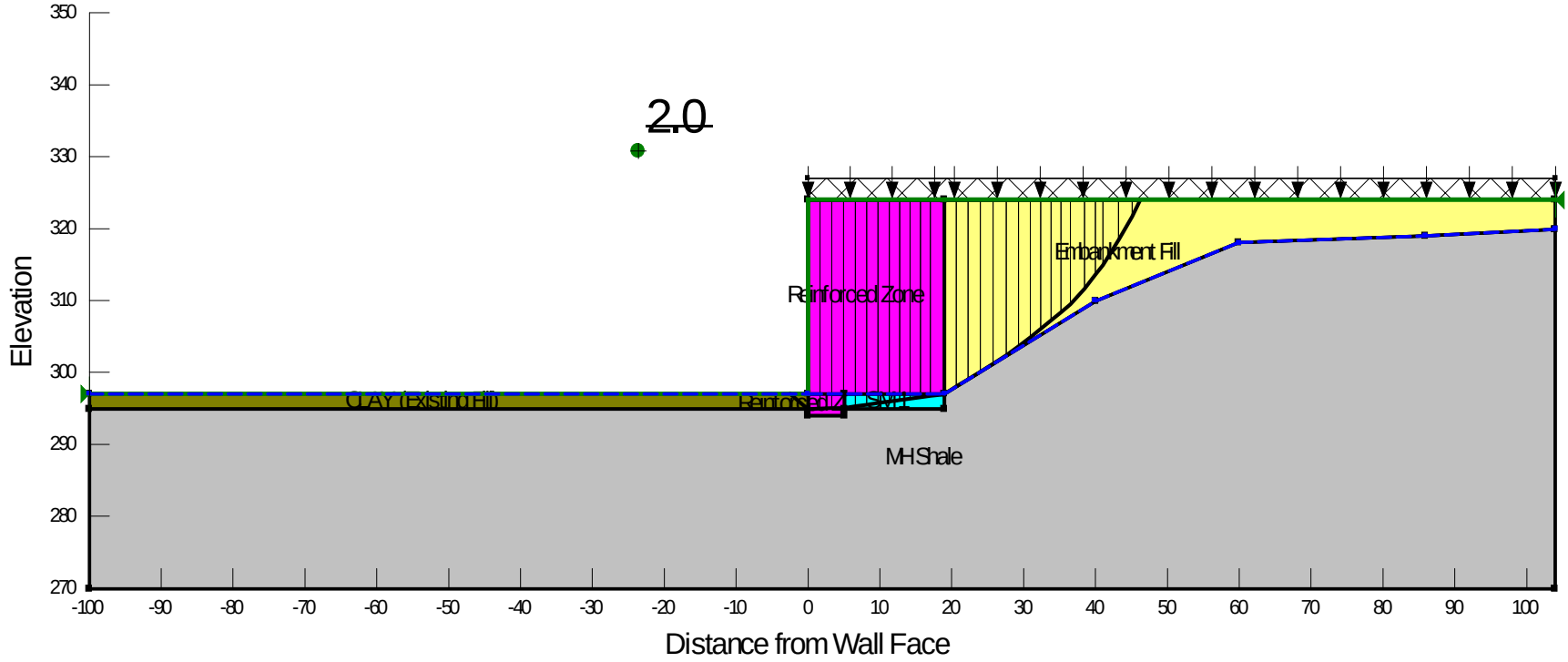
**Summary of Soil Strength Parameters**

| Soil Description | Total Unit Weight ($\gamma$), pcf | Undrained Shear Strength ($s_u$), psf | Effective Cohesion (c'), psf | Effective Friction Angle ($\varphi$'), deg |
|---|---|---|---|---|
| New Embankment Fill | 125 | 750 | 250 | 20 |
| Existing Clay/Shale Fill | 120 | 1750 | 250 | 20 |
| Select Fill (SM-1) | 125 | --- | --- | 32 |
| Moderately hard weathered Shale bedrock | 135 | 4000 | 1000 | 20 |




Results of Stability Analyses – End of Construction Condition
MSE-1 (West) – STA 181+29 Bridge over I-40
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)

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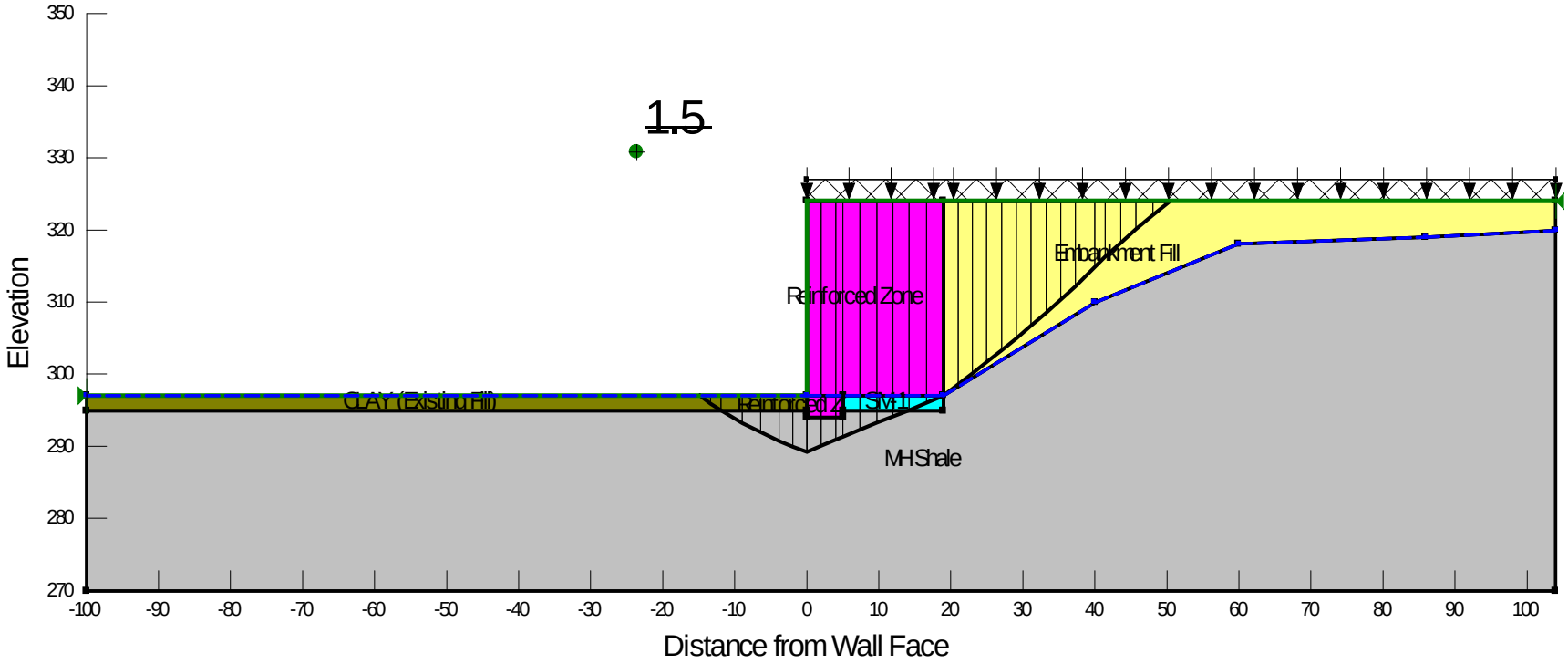


Results of Stability Analyses – Long Term Condition
MSE-1 (West) – STA 181+29 Bridge over I-40
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)

**Grubbs, Hoskyn,**
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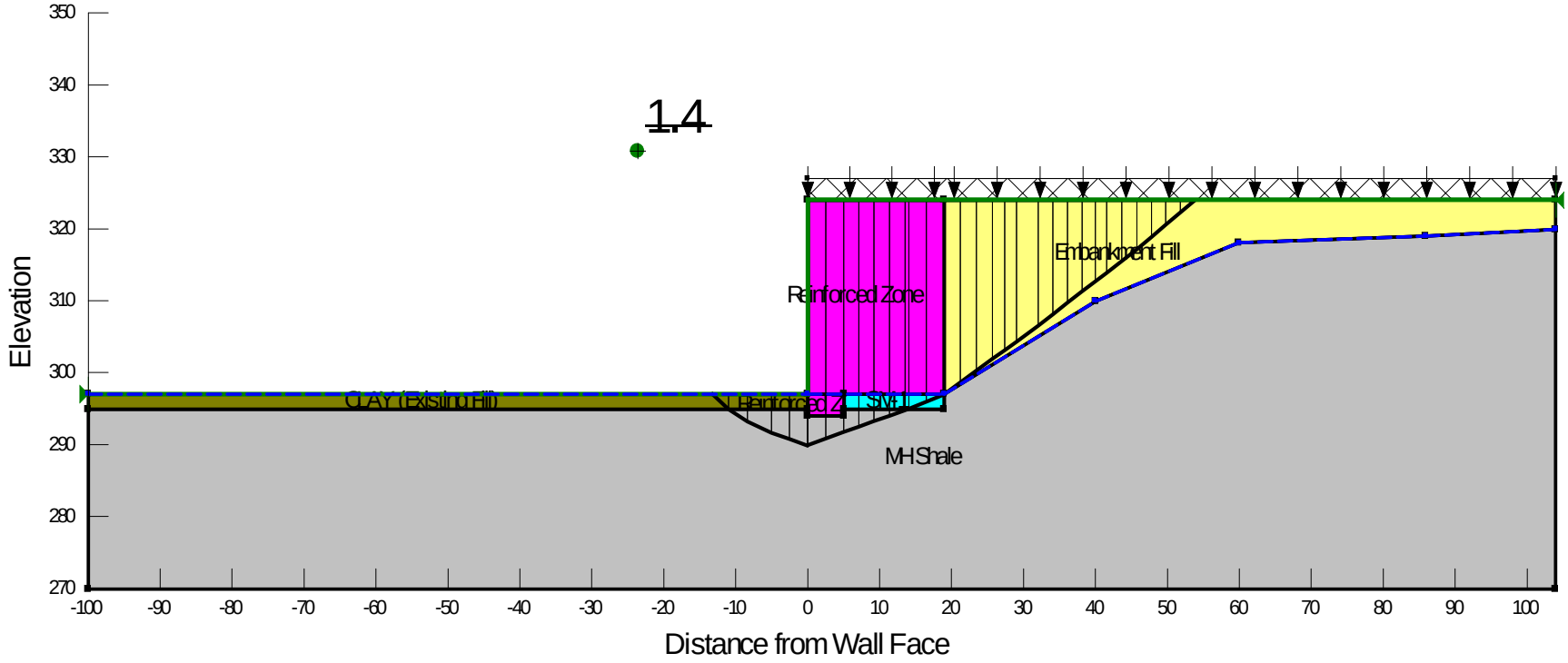


Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.08$)
MSE-1 (West) – STA 181+29 Bridge over I-40
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)

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**Summary of Stability Analysis Results**
**MSE-2 (East) – STA 184+55 Bridge over I-40**
**0611190 – I-40 Interchange (Maumelle) (F)**

| Location | Design Loading Condition | Calculated Minimum Factor of Safety |
|---|---|---|
| MSE Wall 2 – East STA 184+55 | End of Construction | 2.2 |
| | Long Term | 1.5 |
| | Seismic ($k_h = 0.5A_S = 0.07$) | 1.4 |

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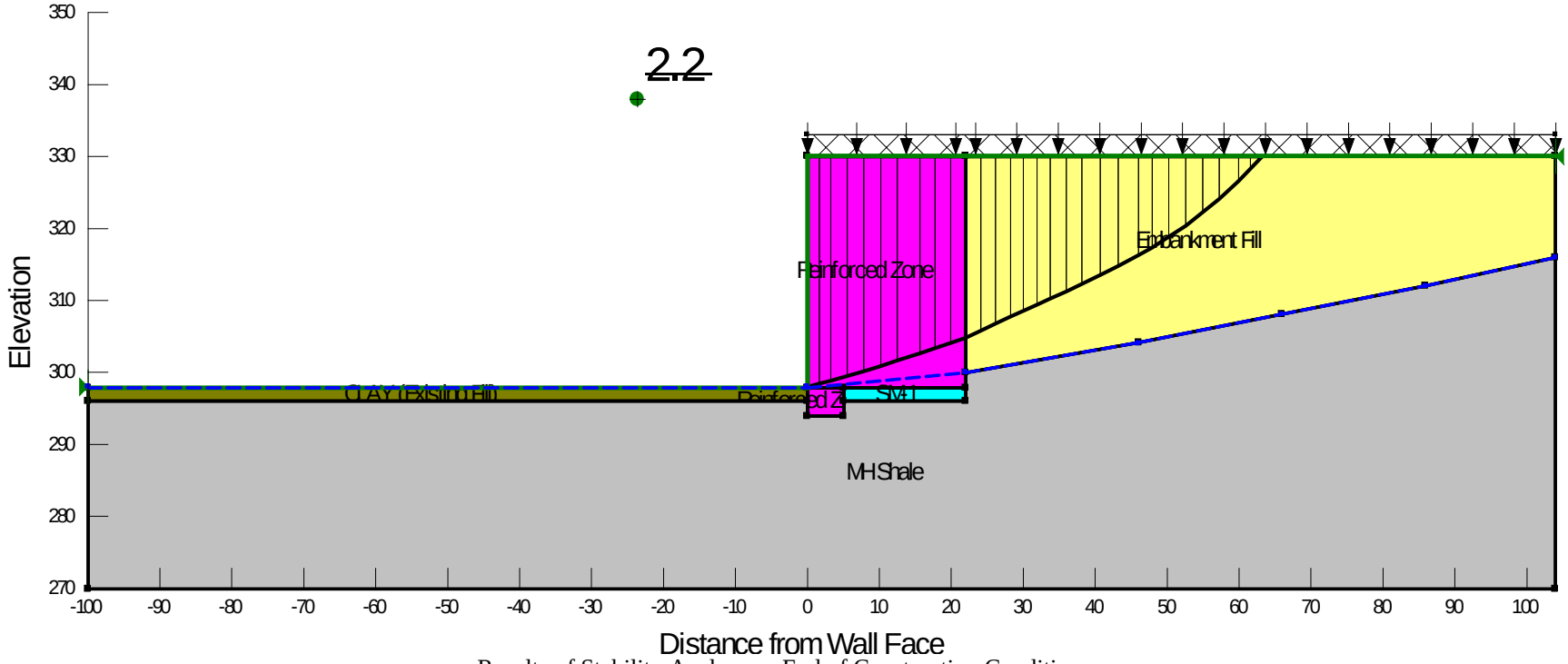
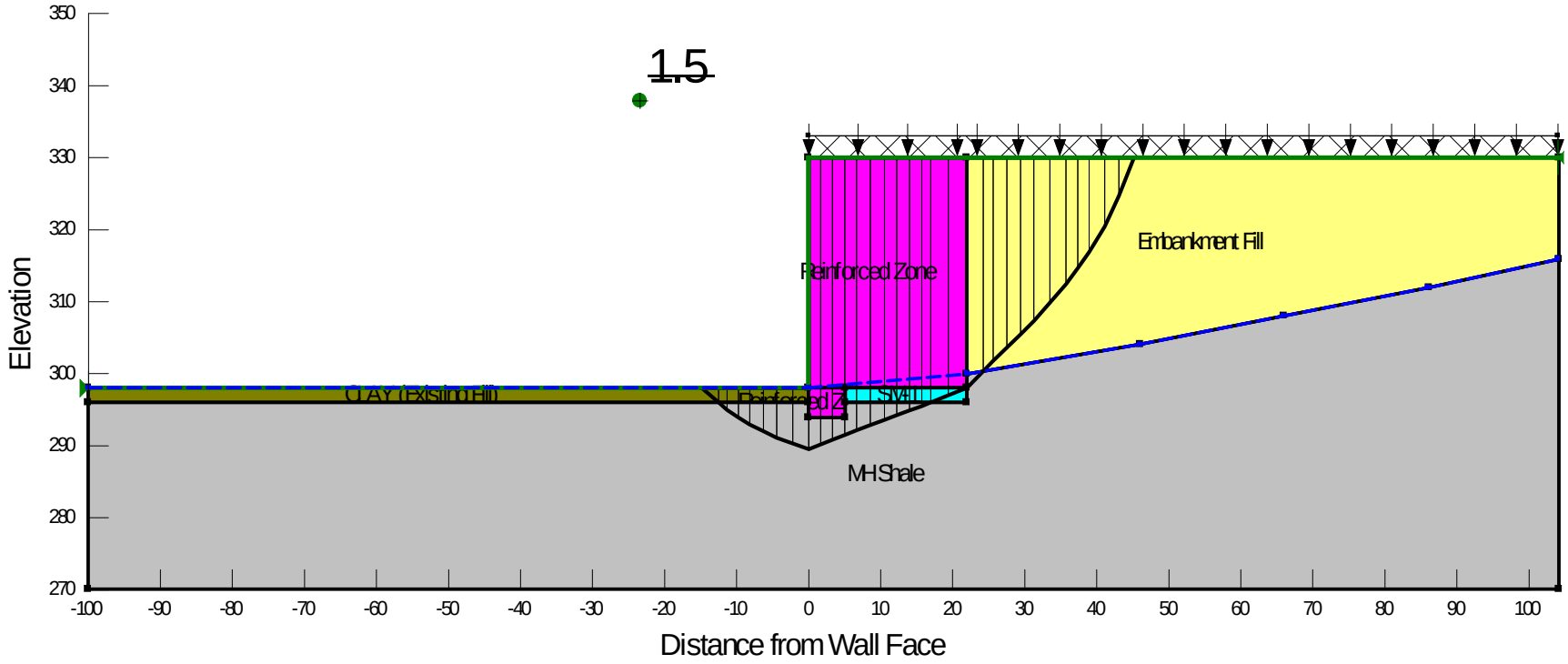
**Summary of Soil Strength Parameters**

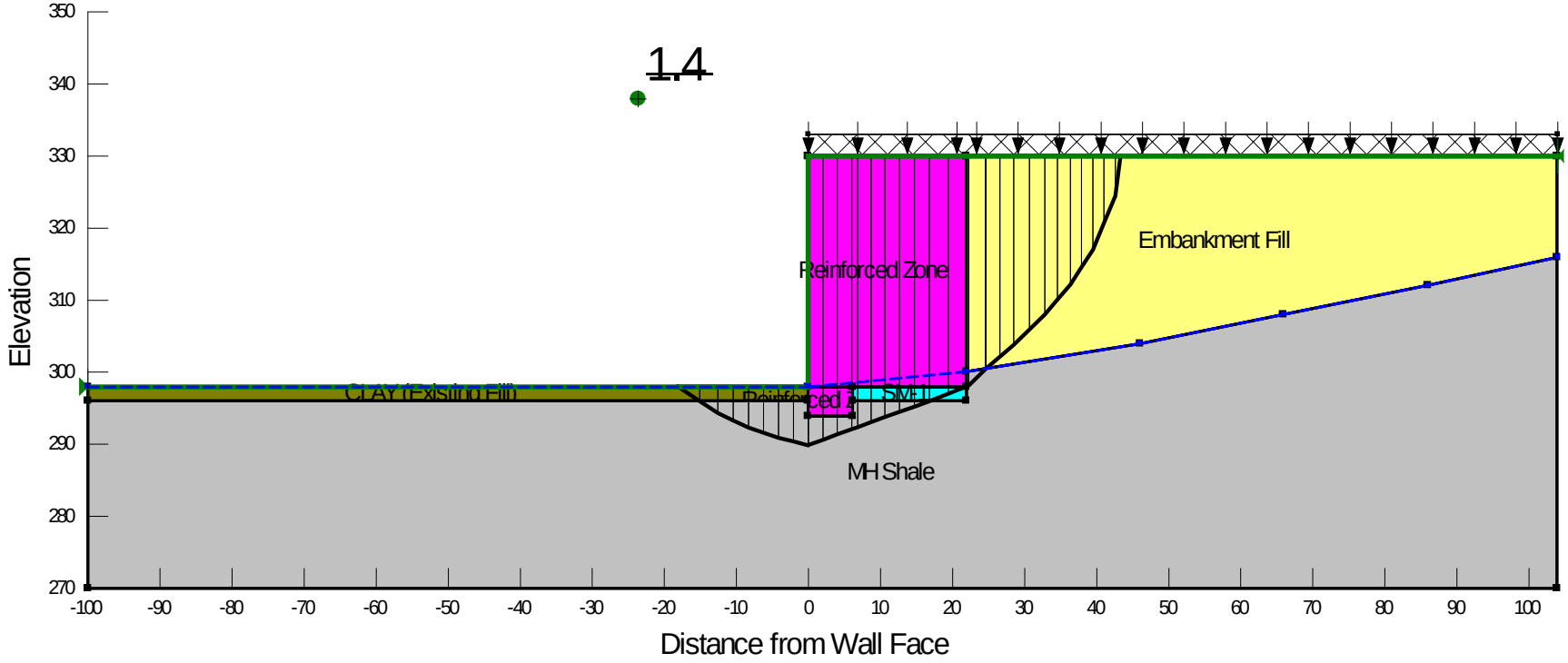
| Soil Description | Total Unit Weight ($\gamma$), pcf | Undrained Shear Strength ($s_u$), psf | Effective Cohesion (c'), psf | Effective Friction Angle ($\varphi$'), deg |
|---|---|---|---|---|
| New Embankment Fill | 125 | 750 | 250 | 20 |
| Existing Clay/Shale Fill | 120 | 1750 | 250 | 20 |
| Select Fill (SM-1) | 125 | --- | --- | 32 |
| Moderately hard weathered Shale bedrock | 135 | 4000 | 1000 | 20 |




Results of Stability Analyses – End of Construction Condition
MSE-2 (East) – STA 184+55 Bridge over I-40
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)




Results of Stability Analyses – Long Term Condition
MSE-2 (East) – STA 184+55 Bridge over I-40
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)




Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.08$)
MSE-2 (East) – STA 184+55 Bridge over I-40
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)

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**ATTACHMENT 9**

**Summary of Stability Analysis Results**
**1.5H:1V in Shale & 3H:1V in Soil Cut Slope – Ramp 3**
**0611190 – I-40 Interchange (Maumelle) (F)**

| Location | Design Loading Condition | Calculated Minimum Factor of Safety |
|---|---|---|
| Ramp 3 STA 8167+00 (Left) Overall | End of Construction | 3.0 |
| | Long Term | 1.6 |
| | Seismic ($k_h = 0.5A_S = 0.07$) | 1.4 |

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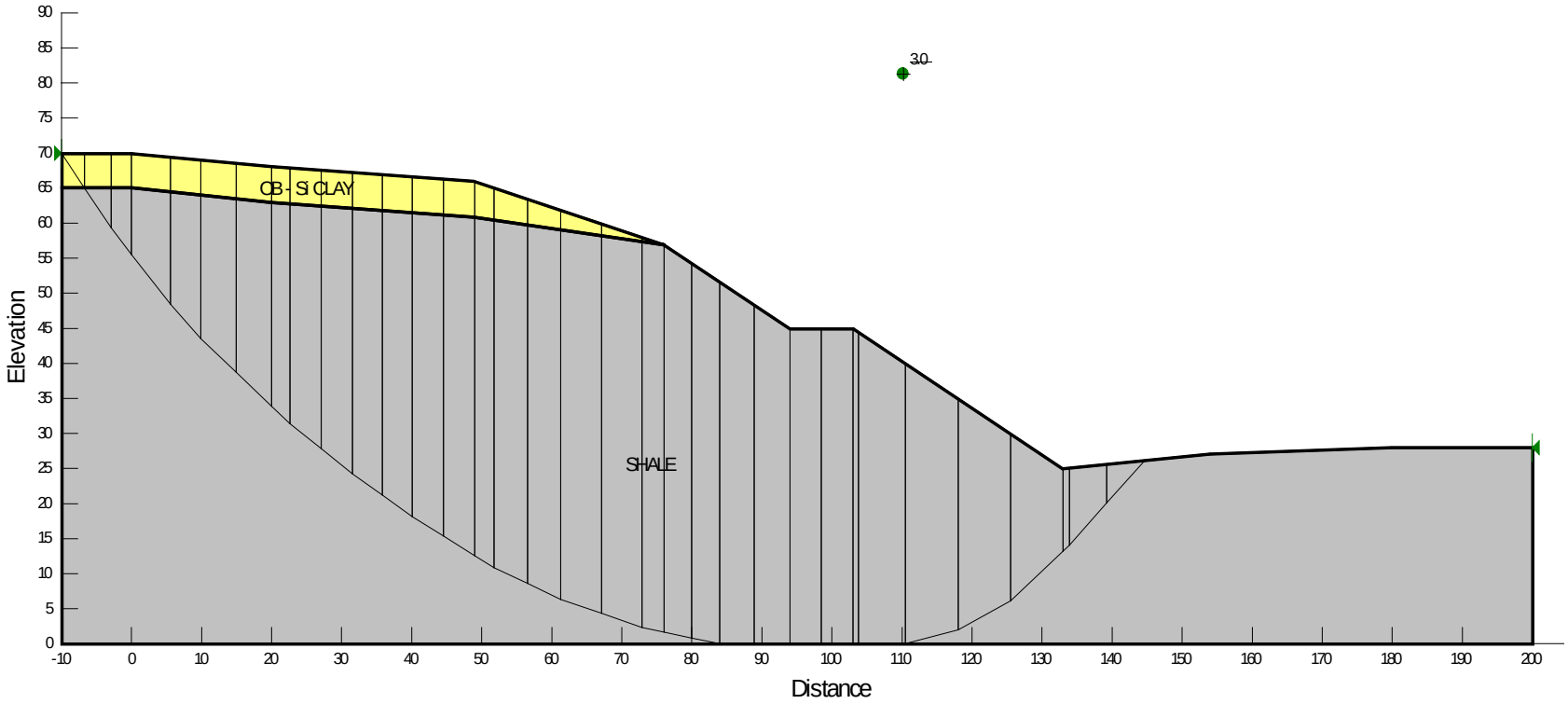
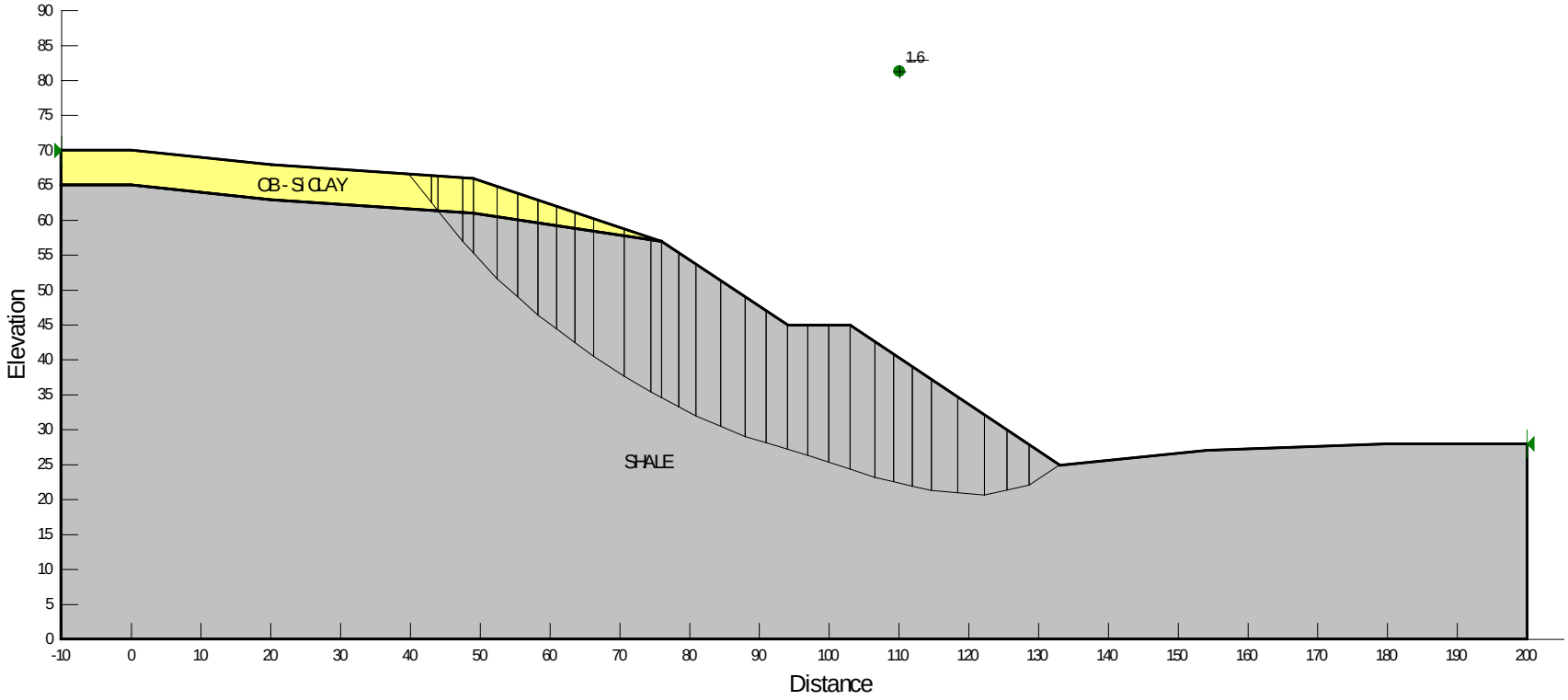
**Summary of Soil Strength Parameters**

| Soil Description | Total Unit Weight ($\gamma$), pcf | Undrained Shear Strength ($s_u$), psf | Effective Cohesion (c'), psf | Effective Friction Angle ($\varphi$'), deg |
|---|---|---|---|---|
| Overburden – Silty Clay | 125 | 1500 | 150 | 20 |
| Moderately hard weathered Shale bedrock | 140 | 3000 | 500 | 20 |




Results of Stability Analyses – End of Construction Condition
1.5H:1V in Shale & 3H:1V in Soil Cut Slope – Ramp 3
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)




Results of Stability Analyses – Long Term Condition
1.5H:1V in Shale & 3H:1V in Soil Cut Slope – Ramp 3
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)

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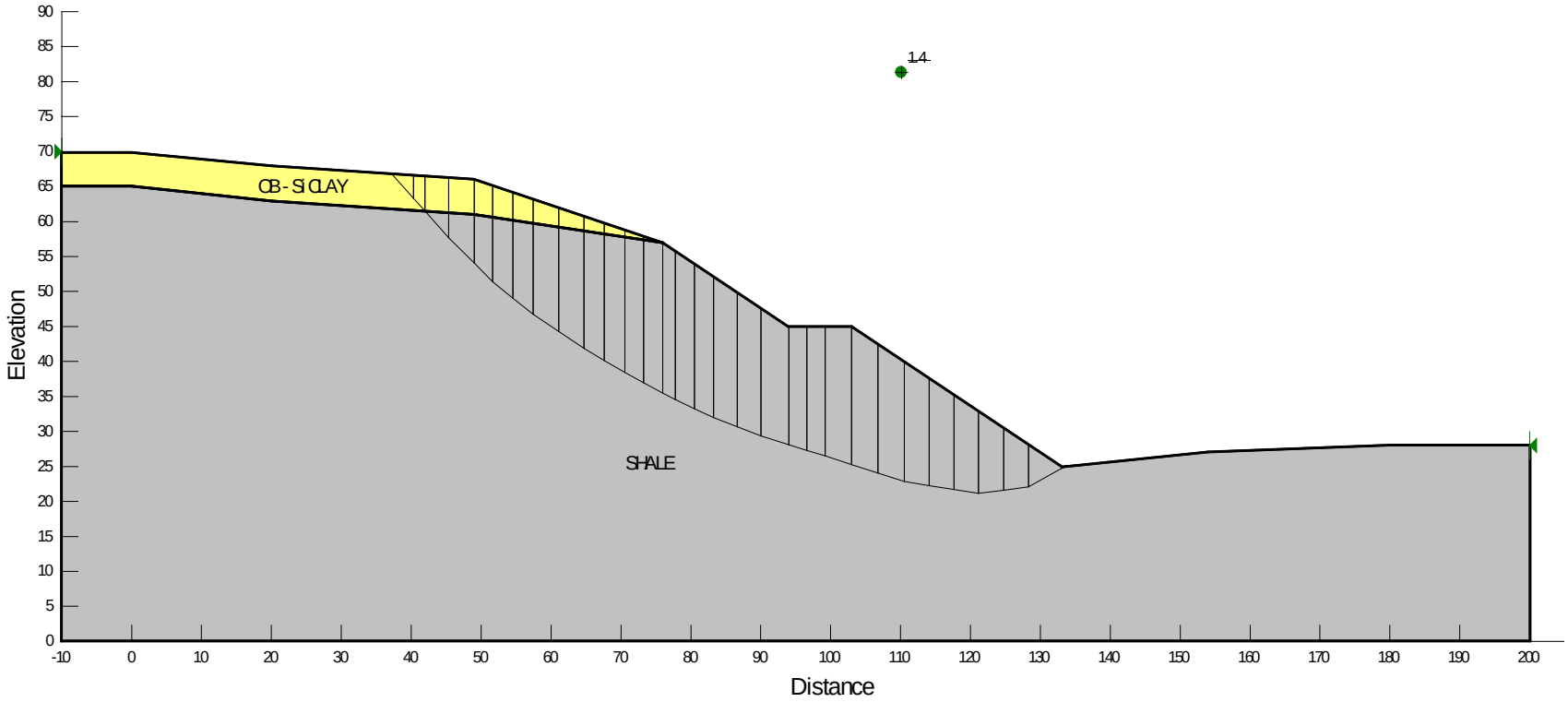


Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.07$)
1.5H:1V in Shale & 3H:1V in Soil Cut Slope – Ramp 3
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)

**Summary of Stability Analysis Results**
**1.5H:1V in Shale & 3H:1V in Soil Cut Slope – Upper Slope Ramp 3**
**AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)**

| Embankment Side | Design Loading Condition | Calculated Minimum Factor of Safety |
|---|---|---|
| Ramp 3 STA 8167+00 (Left) Soil – Rock Slope | End of Construction | 8.1 |
| | Long Term | 2.4 |
| | Seismic ($k_h = 0.5A_S = 0.07$) | 2.2 |

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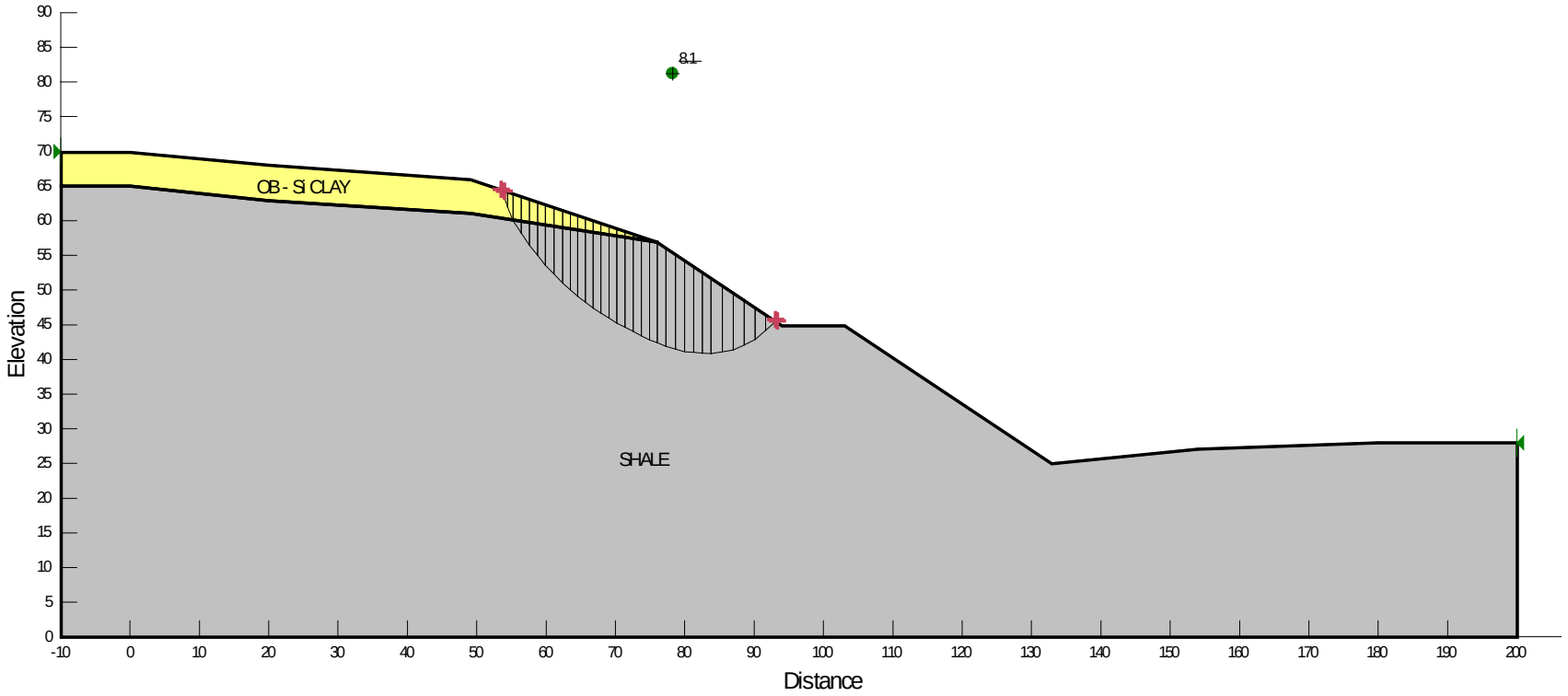
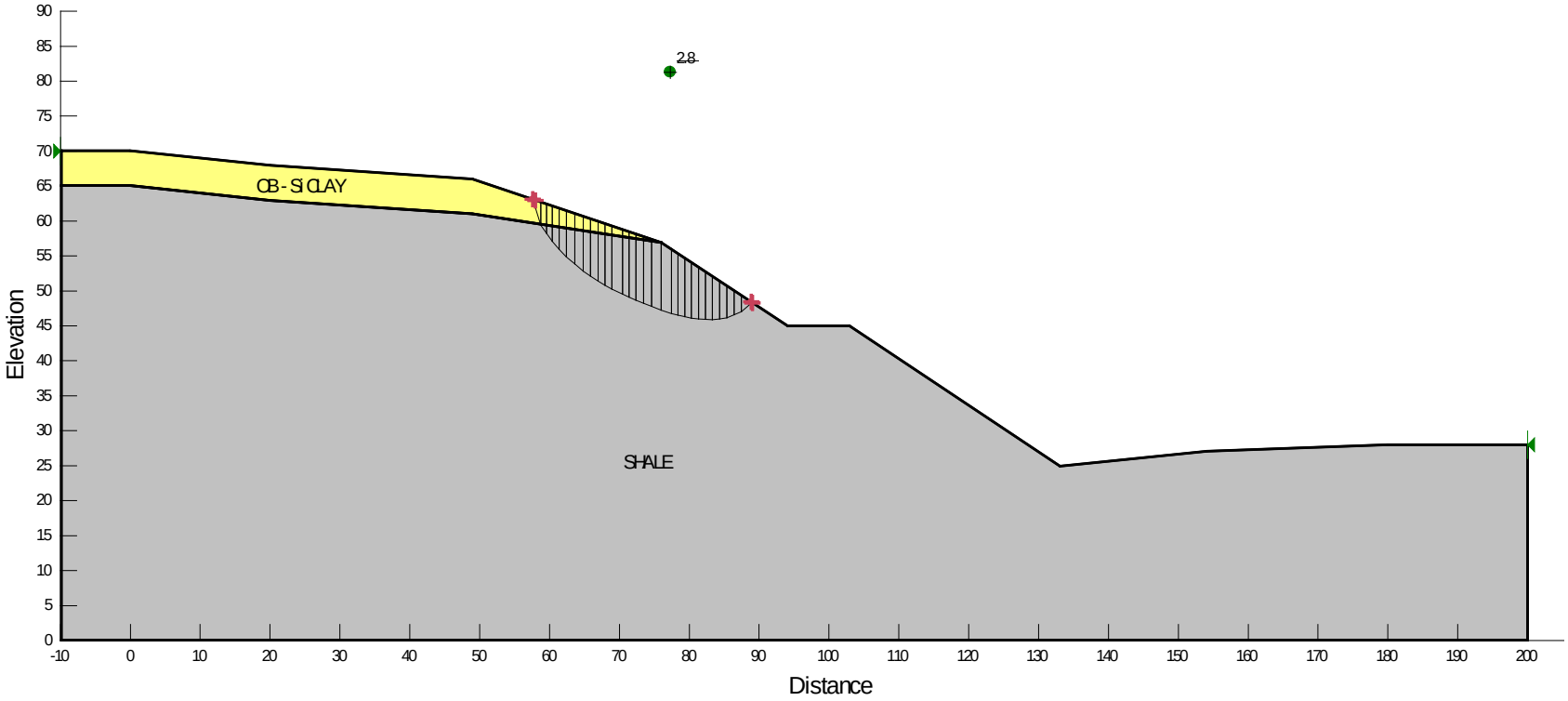
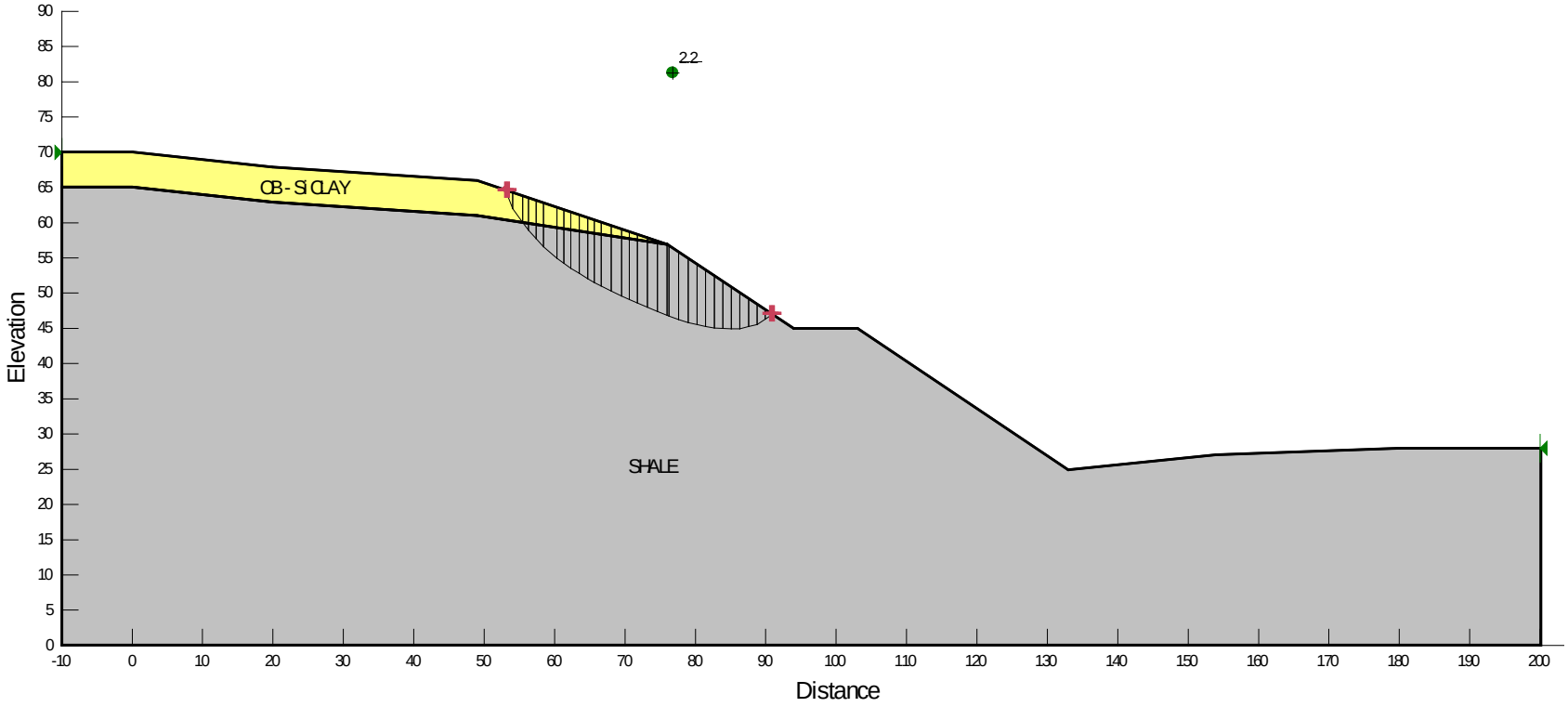



Results of Stability Analyses – End of Construction Condition
1.5H:1V in Shale & 3H:1V in Soil Cut Slope – Upper Slope Ramp 3
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)




Results of Stability Analyses – Long Term Condition
1.5H:1V in Shale & 3H:1V in Soil Cut Slope – Upper Slope Ramp 3
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)




Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.07$)
1.5H:1V in Shale & 3H:1V in Soil Cut Slope – Upper Slope Ramp 3
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)

**Summary of Stability Analysis Results**
**1.5H:1V in Shale & 3H:1V in Soil Cut Slope – Lower Slope Ramp 3**
**0611190 – I-40 Interchange (Maumelle) (F)**

| Bridge End | Design Loading Condition | Calculated Minimum Factor of Safety |
|---|---|---|
| Ramp 3 STA 8167+00 (Left) Rock Slope | End of Construction | 7.5 |
| | Long Term | 2.3 |
| | Seismic ($k_h = 0.5A_S = 0.07$) | 2.2 |

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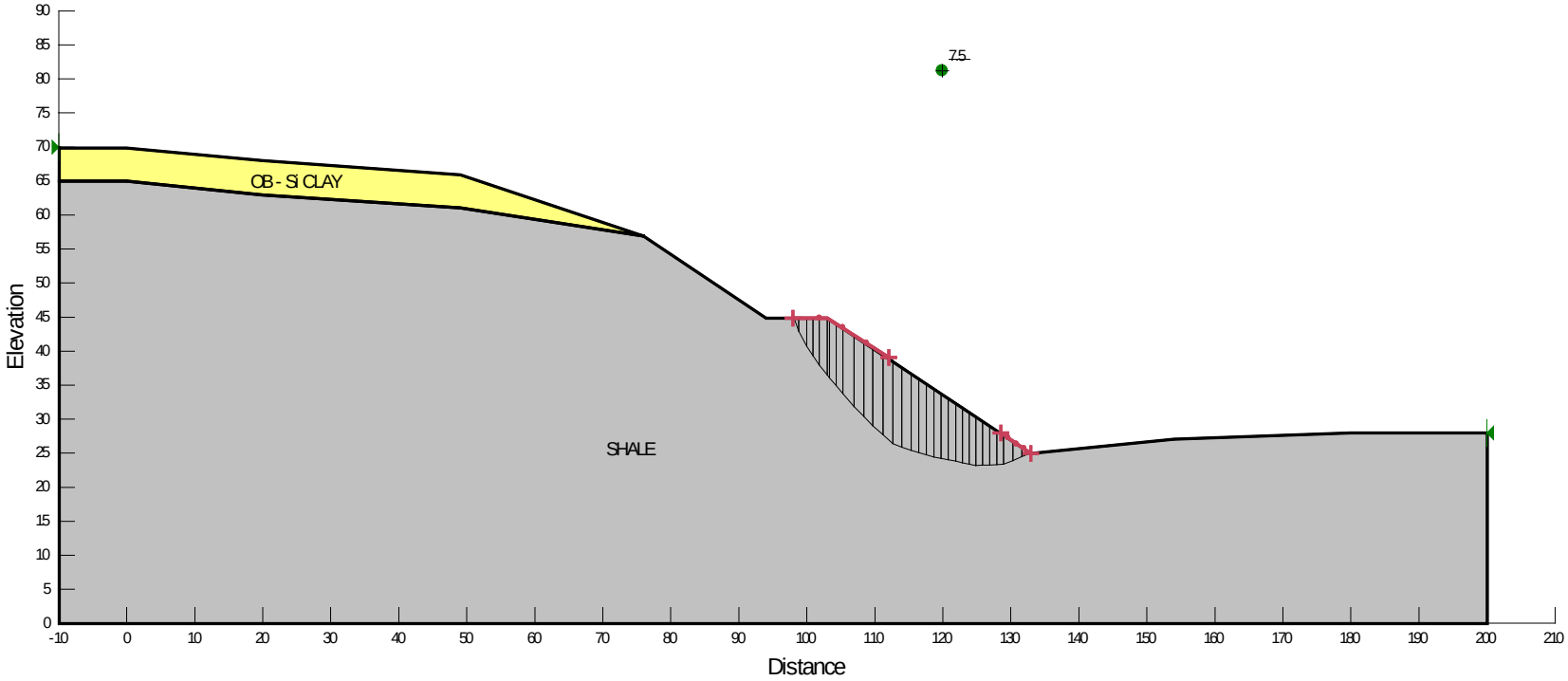


Results of Stability Analyses – End of Construction Condition
1.5H:1V in Shale & 3H:1V in Soil Cut Slope – Lower Slope Ramp 3
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)

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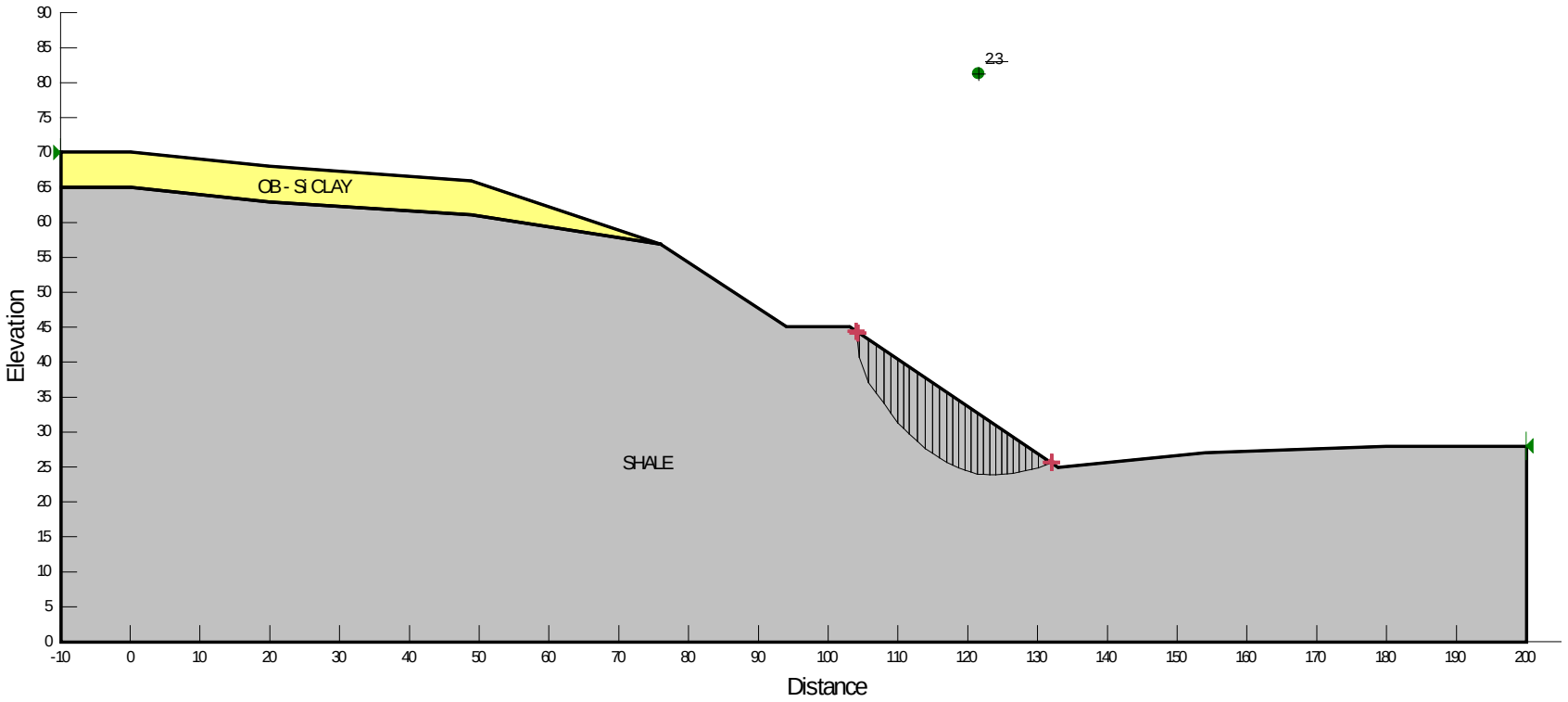
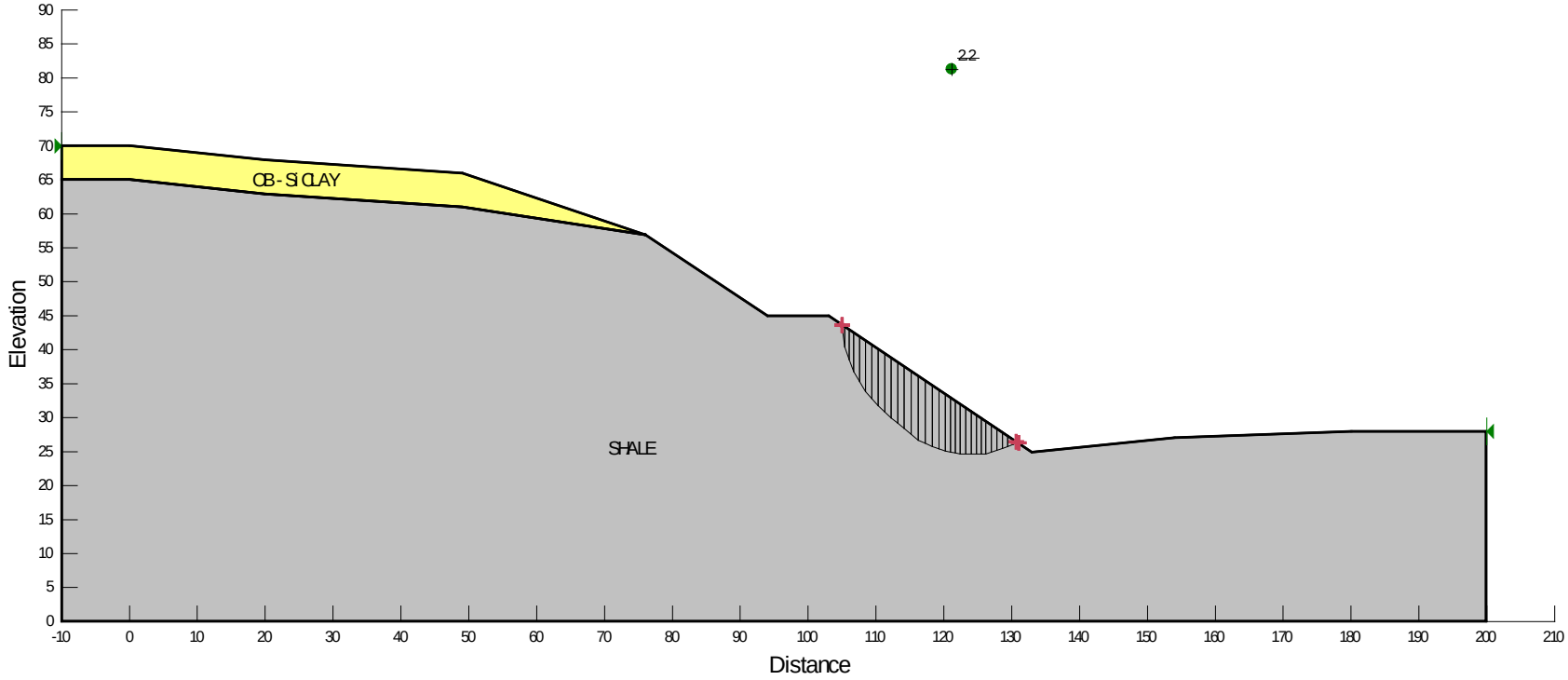



Results of Stability Analyses – Long Term Condition
1.5H:1V in Shale & 3H:1V in Soil Cut Slope – Lower Slope Ramp 3
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)




Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.07$)
1.5H:1V in Shale & 3H:1V in Soil Cut Slope – Lower Slope Ramp 3
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)

**ATTACHMENT 10**

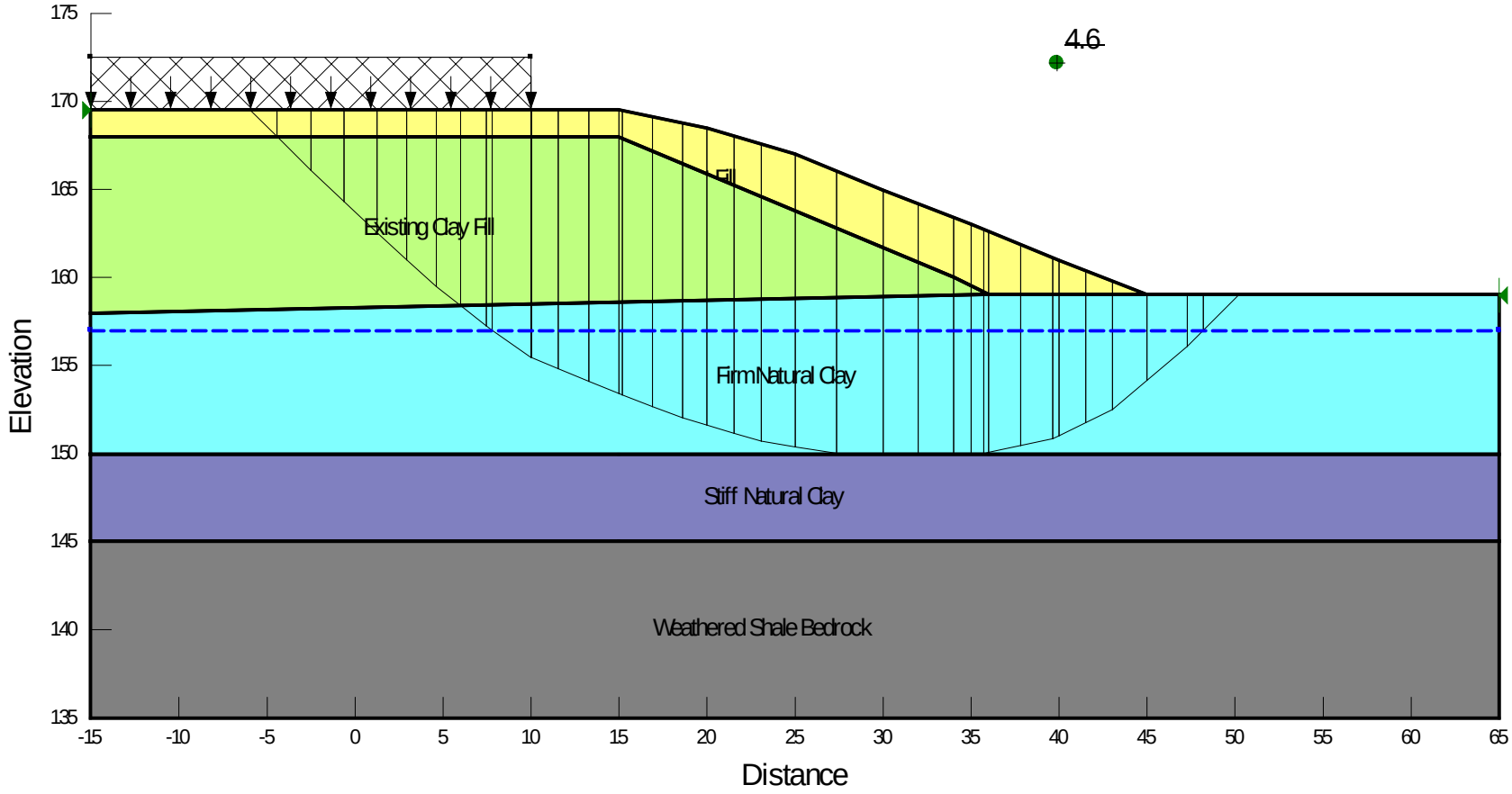
**Summary of Stability Analysis Results**
**Bridge over Newton Creek – STA 8181+00 Side Slope**
**AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)**

| Location | Design Loading Condition | Calculated Minimum Factor of Safety |
|---|---|---|
| Embankment Side Slope – STA 8181+00 | End of Construction | 4.6 |
| | Long Term | 2.5 |
| | Seismic ($k_h = 0.5A_S = 0.085$) | 1.9 |

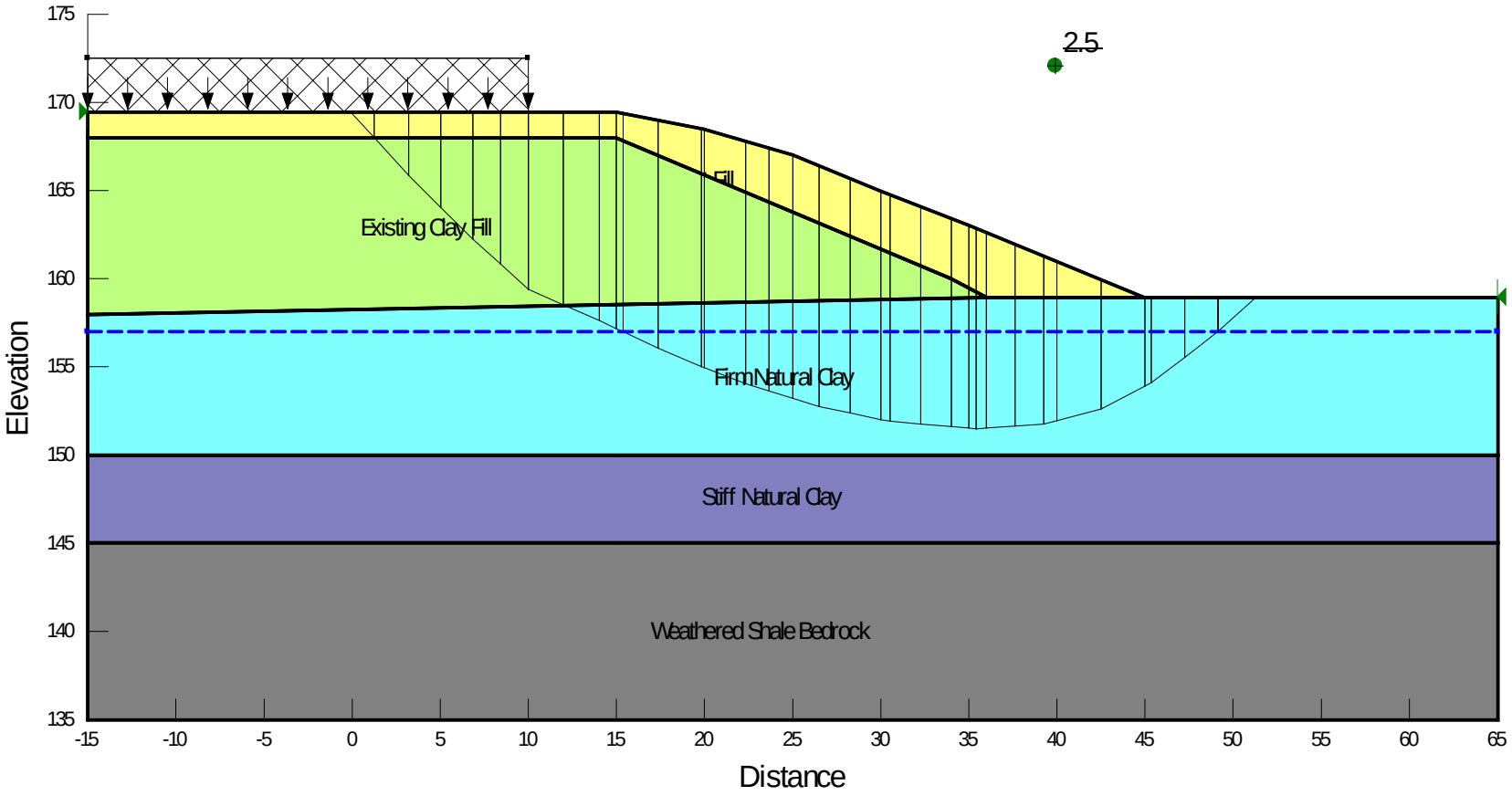
**Grubbs, Hoskyn,**
**Barton & Wyatt, Inc.**
CONSULTING ENGINEERS

**Summary of Soil Strength Parameters**

| Soil Description | Total Unit Weight ($\gamma$), pcf | Undrained Shear Strength ($s_u$), psf | Effective Cohesion (c'), psf | Effective Friction Angle ($\varphi$'), deg |
|---|---|---|---|---|
| New Embankment Fill | 125 | 750 | 250 | 20 |
| Existing Clay/Shale Fill | 120 | 1200 | 250 | 20 |
| Natural Firm Clay | 120 | 1250 | 250 | 20 |
| Natural Stiff Clay | 120 | 2000 | 400 | 20 |
| Moderately hard weathered shale | 135 | 5000 | 1000 | 20 |




Results of Stability Analyses – End of Construction Condition
Embankment Side Slope – STA 8181+00 Bridge over Newton Creek
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)




Results of Stability Analyses – Long Term Condition
Embankment Side Slope – STA 8181+00 Bridge over Newton Creek
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)

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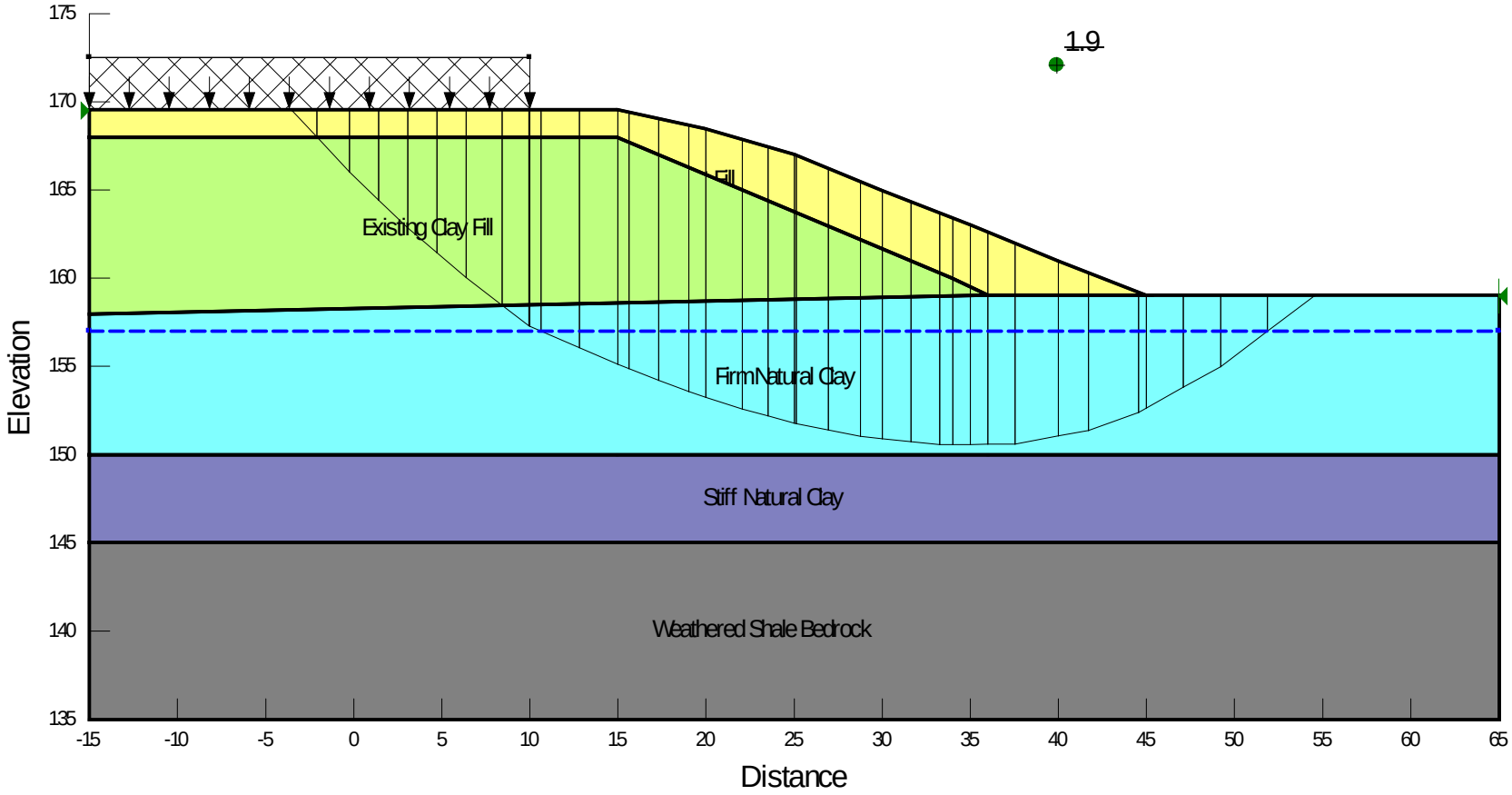


Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.085$)
Embankment Side Slope – STA 8181+00 Bridge over Newton Creek
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)

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**Summary of Stability Analysis Results**
**Bridge over Newton Creek – STA 8181+00 End Slope**
**AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)**

| Location | Design Loading Condition | Calculated Minimum Factor of Safety |
|---|---|---|
| Embankment End Slope – STA 8181+00 | End of Construction | 2.9 |
| | Long Term | 1.4 |
| | Seismic ($k_h = 0.5A_S = 0.085$) | 1.2 |

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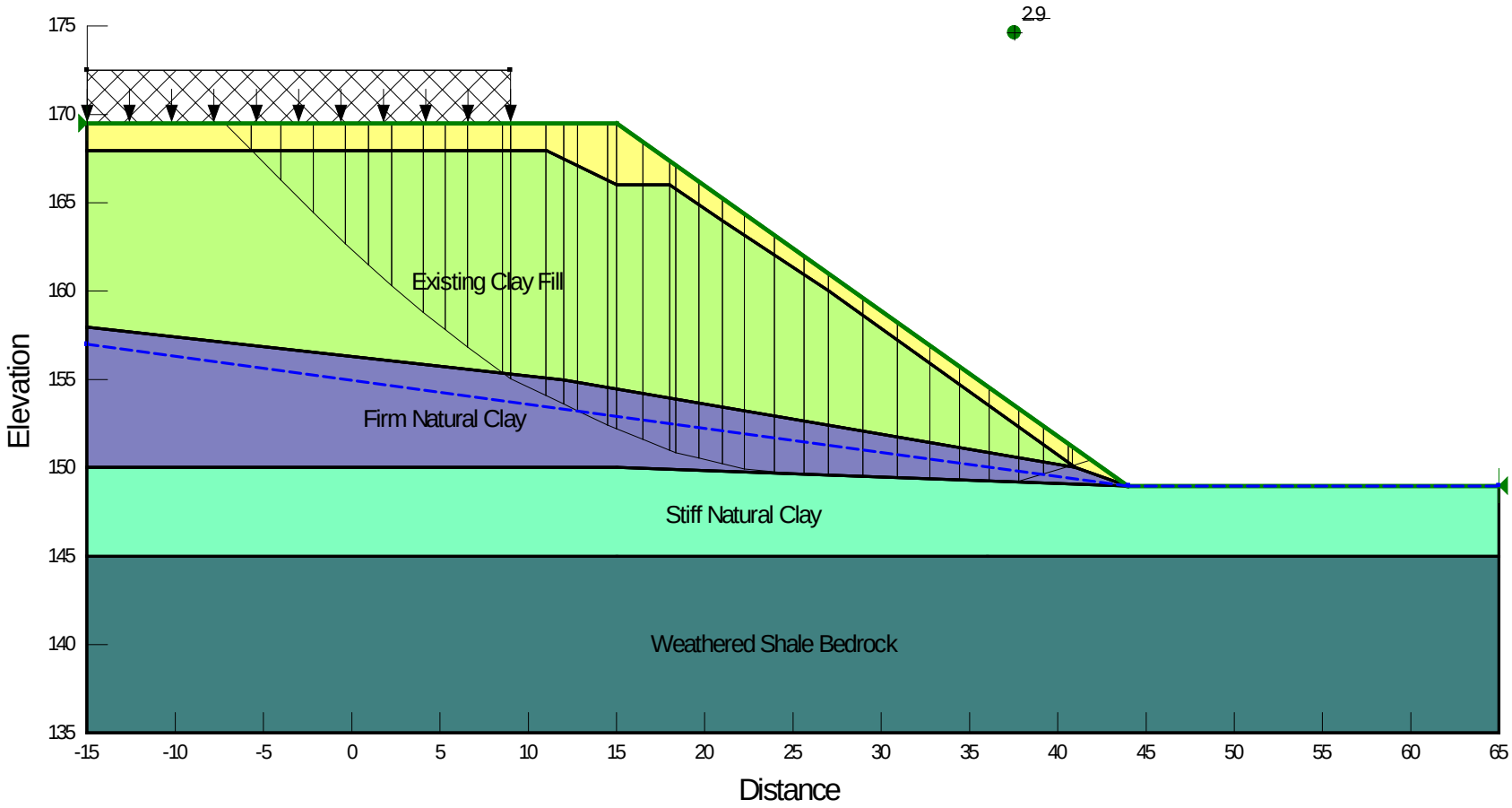
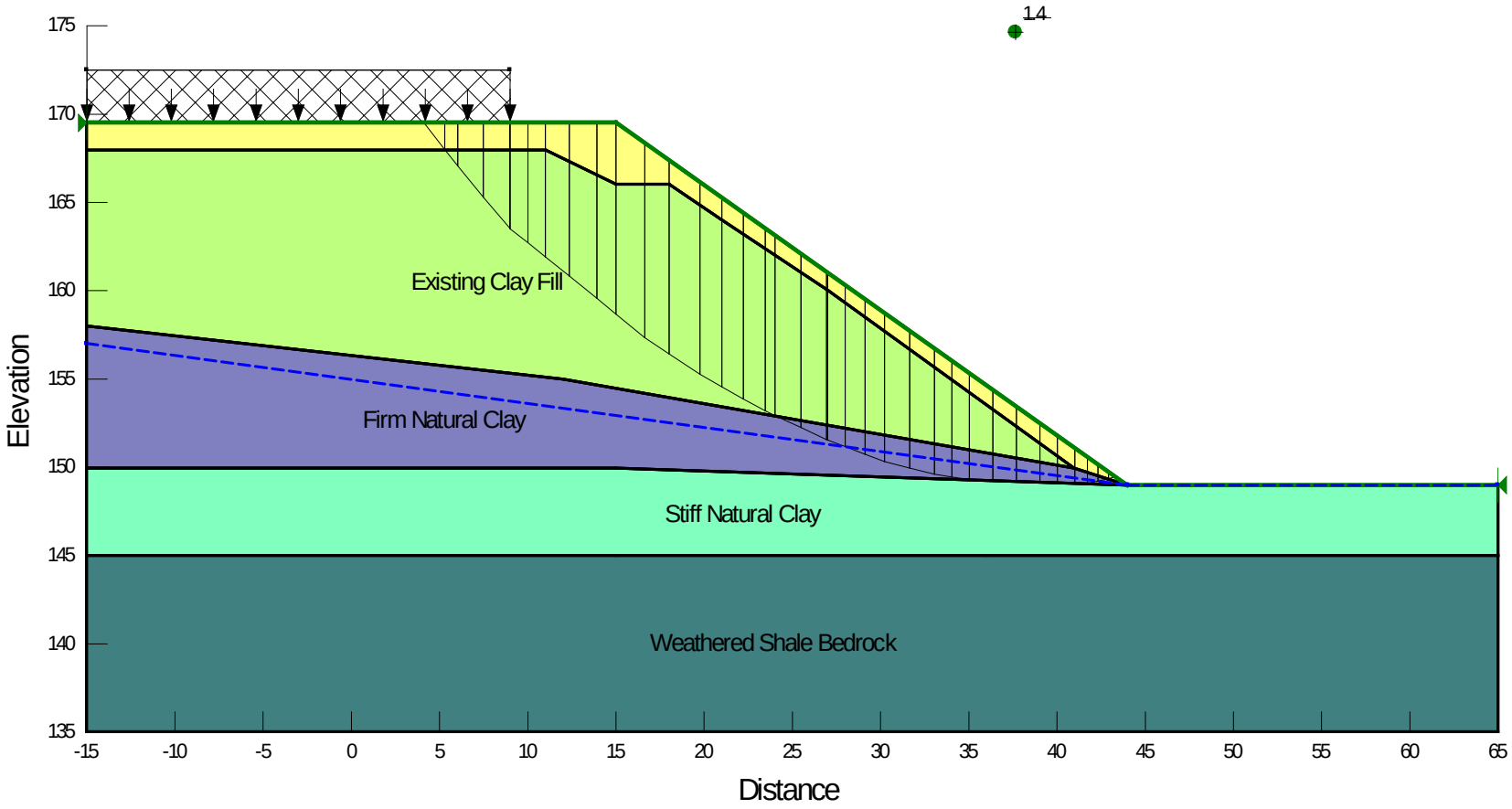
**Summary of Soil Strength Parameters**

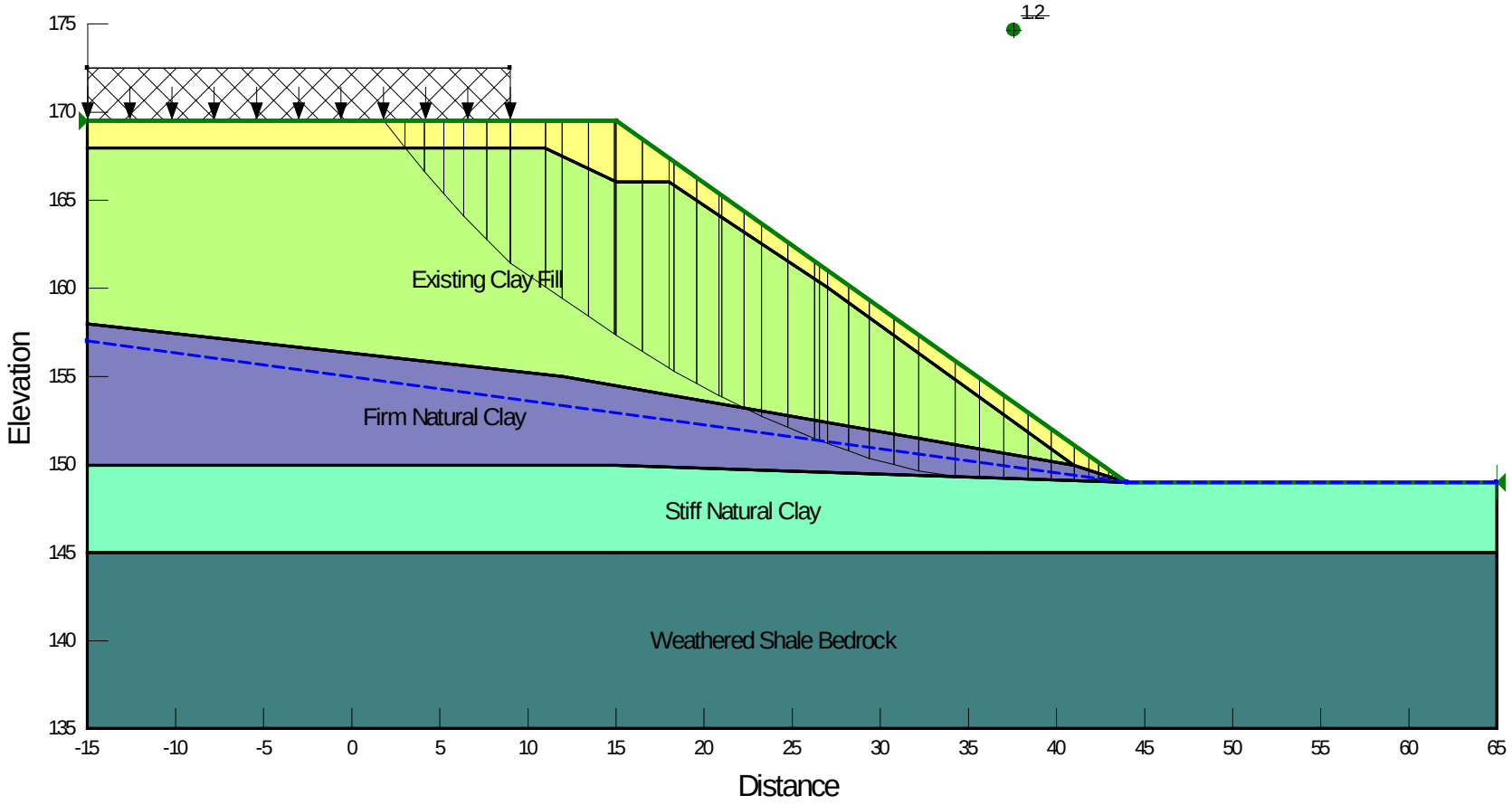
| Soil Description | Total Unit Weight ($\gamma$), pcf | Undrained Shear Strength ($s_u$), psf | Effective Cohesion (c'), psf | Effective Friction Angle ($\varphi$'), deg |
|---|---|---|---|---|
| New Embankment Fill | 125 | 750 | 250 | 20 |
| Existing Clay/Shale Fill | 120 | 1200 | 250 | 20 |
| Natural Firm Clay | 120 | 1250 | 250 | 20 |
| Natural Stiff Clay | 120 | 2000 | 400 | 20 |
| Moderately hard weathered shale | 135 | 5000 | 1000 | 20 |




Results of Stability Analyses – End of Construction Condition
Embankment End Slope – STA 8181+00 Bridge over Newton Creek
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)




Results of Stability Analyses – Long Term Condition
Embankment End Slope – STA 8181+00 Bridge over Newton Creek
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)




Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.085$)
Embankment End Slope – STA 8181+00 Bridge over Newton Creek
AHTD Job No. 0611190 – I-40 Interchange (Maumelle) (F)