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

The I-30 Bridge is a critical link in the Central Arkansas Freeway System through Little Rock, AR. As a navigable waterway extensive cargo shipping occurs along the Arkansas River, requiring robust pier protection measures to protect the bridge from boat collisions. To protect the existing bridge bents 40-ft diameter sheet pile cells were constructed upstream and downstream of each bent along the navigation channel. Currently, the northwestern most cell has failed and needs to be replaced.

Existing information consisting of as-built plans for the I-30 project (1968) are included in Attachment A. A boring log from a 2018 geotechnical exploration report (Boring B-68; drill date of 2015) is included in Attachment B. A recent ArDOT 2019 topographic river survey is included in Attachment C. Geotechnical calculations which include bearing capacity, eccentricity, and sliding calculations are included in Attachment D.

2. Existing Conditions

The original protection cell is a circular sheetpile structure founded on shale and filled with quarry stone. The failed cell is mostly submerged based on recent photographs. Further information on the failure mechanism is not known; however, it is possible that interior stone was lost out of the top of the cell during high water events, at the base of the cell, or after vessel collisions and this loss of stone may have caused the structure to “buckle” or “tip”.

The Arkansas River in the vicinity of the I-30 bridge has experienced scouring around the pier protection cells based on recent 2015 borings and recent survey. The river bed is comprised of silty non-cohesive material (“muck”) which is erodible. At the time of construction, the height of overburden above the shale was approximately 33 ft while the 2015 boring log B-68 illustrates only 3 ft of overburden. Below the silty material, a shale layer is encountered at approximate elevation 190 ft in boring B-68. The shale is part of the Jackfork Group. The shale is gray, slightly fractured, moderately weathered, with moderately fractured quartz seams. The shale encountered at boring B-68 is interbedded with sandstone from approximate elevation 179 ft to 169 ft and then the shale continues to the termination depth of the boring at elevation 72 ft (boring depth of 161.5 ft).

3. Geotechnical Analysis

3.1 Design Conditions

Design criteria for this project is AASHTO LRFD Bridge Design Specifications, 7th Edition, with 2016 Interim Revisions. All design criteria and assumptions can be found in the Pier Protection Cell Rehabilitation Design Criteria document (revision date of December 9, 2019). Design life is ten years. Hydraulic calculations are provided in a separate hydraulic memorandum (January 2020). Design assumptions included two cases:
1. Case 1: Normal water event with normal operation design force
2. Case 2: High water event with normal operation design force.

Design Loads:
- Normal Operation Design Force: 2,800 kips
- Drifting Empty Barge Design Force: 1,440 kips
- Normal Operation Design Speed: 5.9 ft/s
- Drifting Empty Barge Speed: 2.9 ft/s
- Normal Operation Design Water Surface: 231.0 ft
- Drifting Empty Barge Design Water Surface: 247.2 ft (10-yr event).

3.2 Analysis

Bearing capacity resistance, sliding resistance, and eccentricity were calculated according to AASHTO LRFD. The design assumes a unit weight of 150 pcf for the cell rockfill material. The factored resistances for both Case 1 and Case 2 exceeded the factored loads. Additionally, the eccentricity is within 9/10 of the cell base as required by AASHTO LRFD. Results are provided in Appendix D.

4. Construction Considerations

Sheetpiling is to be driven to refusal in shale with care taken not to damage the piles. Based on the minimal amount of overburden above the shale and depending on the ability to embed the sheetpile into the shale layer, it may be required to use additional bracing methods to support the sheetpile in a vertical position while the cell is constructed.

Preliminary hydraulic calculations for the rock fill gradation for the cell structure determined a d50 of 8 inches or unit weight of 26 lbf and a gradation with 100% passing 20 inches or less than 300 lb stone. The high turbulence set of rock size curves were used for an average velocity equal to 7 ft/s and a rock specific weight equal to 155 lbf/cf. See hydraulic memorandum for additional information.
ATTACHMENT A
AS-BUILT PLAN
### INDEX TO SHEETS

<table>
<thead>
<tr>
<th>SHEET NO.</th>
<th>TITLE</th>
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<tbody>
<tr>
<td>1</td>
<td>Title Sheet</td>
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<tr>
<td>2</td>
<td>Index To Sheets, Special Provisions and Quantities</td>
<td>16007</td>
</tr>
<tr>
<td>3</td>
<td>Triangulation Control and Soil Information</td>
<td>16007</td>
</tr>
<tr>
<td>4</td>
<td>Profile and Elevations</td>
<td>16010</td>
</tr>
<tr>
<td>5</td>
<td>Structural Details</td>
<td>16011</td>
</tr>
<tr>
<td>6</td>
<td>Navigation Lighting System Details</td>
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### SUMMARY OF QUANTITIES

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<thead>
<tr>
<th>ITEM NO.</th>
<th>STEEL SHEET PILING (FEET)</th>
<th>QUARRY RUN STONE</th>
<th>STRUCTURAL STEEL PER PROTECTION CELL (FT)</th>
<th>CLEARANCE GAGE</th>
<th>DEMOLIC COATING</th>
<th>WET EXCAVATION</th>
<th>TURFING FIELD OFFICE</th>
<th>NAVIGATION LIGHTING SYSTEM</th>
<th>BITUMEN COATING</th>
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<tr>
<td>JOB</td>
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<td>0.000</td>
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<td>4-1</td>
<td>Plant Sites and Equipment Storage 4-100</td>
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<td>4-2</td>
<td>Work Areas</td>
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<td>2-3</td>
<td>Sources of Materials</td>
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<td>5-5</td>
<td>Firefighting Materials from Dike, Fill or Dewatering</td>
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<td>7-7</td>
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<td>6-7</td>
<td>Containment Damming or Dam or Reservoirs</td>
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<td>Expansion Strip</td>
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<tr>
<td>16003</td>
<td>Permanent Navigation Lights</td>
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</table>
The navigation pool elevation of 291.0 shown on this drawing is normal low flow elevation. Actual elevations will depend on river discharges. Information on water surface elevations for various discharges is available at the office of the U.S. Army Corps of Engineers, Little Rock, Arkansas.
ATTACHMENT B

2015 BORING LOG B-68
NOTE: DIAGRAM IS FOR GENERAL LOCATION ONLY AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES.

LEGEND:

SPT BORING (BORING DEPTH)
**WATER LEVEL OBSERVATIONS**

<table>
<thead>
<tr>
<th>ELEVATION (Ft.)</th>
<th>TOTAL ROCK UNIT WEIGHT (pcf)</th>
<th>COMPRESSIVE STRENGTH (tsf)</th>
<th>UNDRAINED SHEAR STRENGTH (tsf)</th>
<th>ATTERBERG LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.5' from water surface to mudline</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ADVANCEMENT METHOD:**
0 to 45.5 Feet: Wash Rotary with 3-7/8" Tricone Roller Bit
45.5 to 161.5 Feet: NQ Core Barrel

**ABANDONMENT METHOD:**
25 ft casing past mudline and began rock coring.

**FIELD TEST RESULTS**

<table>
<thead>
<tr>
<th>DEPTH (Ft.)</th>
<th>SURFACE ELEV.: 233.3 (Ft.)</th>
<th>LATITUDE: 34.74983°</th>
<th>LONGITUDE: -92.262528°</th>
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<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
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<td></td>
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<td>15</td>
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<td></td>
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<tr>
<td>25</td>
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**HORIZONTAL DATUM:** NAD 83 (Y.X Localized)
**VERTICAL DATUM:** NAVD 88
**STATE PLANE ZONE:** 0302 Arkansas South

**BORING LOG NO. B-068**

**PROJECT:** AHTD Job No. CA0602 - 30 Crossing

**SITE:** Little Rock Area
Pulaski County, Arkansas

**LOCATION:** See Exhibit A-12
Latitude: 34.74983° Longitude: -92.262528°
Northing: 2070540.42 Easting: 1233497.18
Surface Elev.: 233.3 (Ft.)

**DEPTH**

<table>
<thead>
<tr>
<th>DEPTH (Ft.)</th>
<th>ELEVATION (Ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
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<tr>
<td>10</td>
<td></td>
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<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
</tr>
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</table>

**FLOOR TEST RESULTS**

<table>
<thead>
<tr>
<th>DEPTH (Ft.)</th>
<th>TOTAL ROCK UNIT WEIGHT (pcf)</th>
<th>COMPRESSIVE STRENGTH (tsf)</th>
<th>UNDRAINED SHEAR STRENGTH (tsf)</th>
<th>ATTERBERG LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.5' from water surface to mudline</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ENERGY TRANSFER RATIO (ETR):**
76.3%

**ATTERBERG LIMITS**

**Notes:**
40.5 feet from water surface to mudline.
Advanced 4-inch casing 5 feet past mudline and began rock coring.

**Boring Started:** 12-07-2015
**Boring Completed:** 12-08-2015

**Drill Rig:** 977, ATV, CME-850
**Driller:** S. Zeien
**Checked by:** P. McCroidl
**Logged by:** D. Tennison

**Project No.:** 35159097
**Exhibit:** B-29
**BORING LOG NO. B-068**

**PROJECT:** AHTD Job No. CA0602 - 30 Crossing

**SITE:** Little Rock Area
Pulaski County, Arkansas

**CLIENT:** Arkansas State Highway and Transportation Dept.

---

**LOCATION**
See Exhibit A-12

Latitude: 34.74983°  Longitude: -92.262528°

Northing: 2070540.42  Easting: 1233497.18
Surface Elev.: 233.3 (Ft.)

---

**GRAPHIC LOG**

<table>
<thead>
<tr>
<th>DEPTH (Ft.)</th>
<th>WATER LEVEL OBSERVATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>40.5' from water surface to mudline</td>
</tr>
<tr>
<td>35</td>
<td>43.5' from water surface to mudline</td>
</tr>
<tr>
<td>40</td>
<td>46.5' from water surface to mudline</td>
</tr>
<tr>
<td>45</td>
<td>49.5' from water surface to mudline</td>
</tr>
<tr>
<td>50</td>
<td>52.5' from water surface to mudline</td>
</tr>
<tr>
<td>55</td>
<td>55.5' from water surface to mudline</td>
</tr>
</tbody>
</table>

---

**MUDLINE**
Apparent shale at 3'.

---

**JACKFORK GROUP, PI - SHALE**

- Gray, slightly fractured, moderately weathered, with quartz seams, moderately fractured

---

**SHALE WITH INTERBEDDED SANDSTONE**

---

**TOTAL DEPTH**
Total depth of hole: 161.5 Feet

---

**HORIZONTAL DATUM:** NAD 83 (Y.X Localized)
**VERTICAL DATUM:** NAVD 88
State Plane Zone: 0302 Arkansas South
Surveyed by NTB Associates

---

**WATER LEVEL OBSERVATIONS**

---

**PROJECT NO.:** 35159097

---

**ADVANCEMENT METHOD:**
0 to 45.5 Feet: Wash Rotary with 3-7/8" Tricone Roller Bit
45.5 to 161.5 Feet: NQ Core Barrel

---

**ABANDONMENT METHOD:**

---

**BORING LOGGED:**
D. Tennison

---

**BORING MACHINERY:**
Drill Rig: 977, ATV, CME-850

---

**CHECKED:**
P. McCloud

---

**LOGGED:**
D. Tennison

---

**BORING STARTED:** 12-07-2015
**BORING COMPLETED:** 12-08-2015

---

**NOTES:**

---

**TERRACON2015.GDT**

---

**2/16/18**
**SHALE WITH INTERBEDDED SANDSTONE** (continued)

<table>
<thead>
<tr>
<th>Depth (Ft.)</th>
<th>Sample Type</th>
<th>Sample ID</th>
<th>Recovery (%)</th>
<th>% Weathered</th>
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</thead>
<tbody>
<tr>
<td>60</td>
<td>RUN 2</td>
<td></td>
<td>REC = 96%</td>
<td>RQD = 85%</td>
</tr>
<tr>
<td>64.5</td>
<td>RUN 3</td>
<td></td>
<td>REC = 97%</td>
<td>RQD = 91%</td>
</tr>
<tr>
<td></td>
<td>RUN 4</td>
<td></td>
<td>REC = 94%</td>
<td>RQD = 93%</td>
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</table>

**SHALE**

<table>
<thead>
<tr>
<th>Depth (Ft.)</th>
<th>Sample Type</th>
<th>Sample ID</th>
<th>Recovery (%)</th>
<th>% Weathered</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>RUN 2</td>
<td></td>
<td>REC = 96%</td>
<td>RQD = 85%</td>
</tr>
<tr>
<td>64.5</td>
<td>RUN 3</td>
<td></td>
<td>REC = 97%</td>
<td>RQD = 91%</td>
</tr>
<tr>
<td></td>
<td>RUN 4</td>
<td></td>
<td>REC = 94%</td>
<td>RQD = 93%</td>
</tr>
</tbody>
</table>

- Hammer Type: Automatic, 140-lb hammer with a 30-inch drop, Energy Transfer Ratio (ETR) = 76.3%
- Advancement Method: 0 to 45.5 Feet: Wash Rotary with 3-7/8” Tricone Roller Bit
  45.5 to 161.5 Feet: NQ Core Barrel
- Abandonment Method: 25809 I 30
- Notes:
  2. Boring Completed: 12-08-2015
  3. Drill Rig: 977, ATV, CME-850
  4. Driller: S. Zeien
  5. Checked by: P. McCloud
  6. Logged by: D. Tennison
  7. Project No.: 35159097
  8. Exhibit: B-29

**WATER LEVEL OBSERVATIONS**

- 40.5' from water surface to mudline
**SHALE (continued)**

gray, slightly fractured, unweathered

<table>
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<tr>
<th>DEPTH (Ft.)</th>
<th>90</th>
<th>95</th>
<th>100</th>
<th>105</th>
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<tr>
<td>SAMPLE ID</td>
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<td>RUN 6</td>
<td>RUN 7</td>
<td>174</td>
<td>171</td>
<td>171</td>
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<tr>
<td>SAMPLE TYPE</td>
<td>REC = 93% PL</td>
<td>REC = 100%</td>
<td>REC = 88% PL</td>
<td>93.5</td>
<td>78</td>
<td>83.4</td>
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<tr>
<td>RECOVERED (%)</td>
<td>RQD = 93%</td>
<td>RQD = 99%</td>
<td>RQD = 85%</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**WATER LEVEL OBSERVATIONS**

40.5' from water surface to mudline

**LOCATION**
See Exhibit A-12

**GRAPHIC LOG**

- Latitude: 34.74983°
- Longitude: -92.262528°
- Northing: 2070540.42
- Easting: 1233497.18
- Surface Elev.: 233.3 (Ft.)

**SOIL DRY UNIT WEIGHT (pcf)**

Hammer Type: Automatic, 140-lb hammer with a 30-inch drop,
Energy Transfer Ratio (ETR) = 76.3%

---

**Notes:**
- Advancement Method: 0 to 45.5 Feet: Wash Rotary with 3-7/8" Tricone Roller Bit
  45.5 to 161.5 Feet: NQ Core Barrel
- Abandonment Method: 25809 I 30 Bryant, AR
- State Plane Zone: 0302 Arkansas South
- Surveyed by NTB Associates
- Boring Started: 12-07-2015
- Boring Completed: 12-08-2015
- Drill Rig: 977, ATV, CME-850
- Driller: S. Zeien
- Checked by: P. McCloud
- Logged by: D. Tennison
- Project No.: 35159097
- Exhibit: B-29
### WATER LEVEL OBSERVATIONS

```
40.5' from water surface to mudline
```

### SHALE (continued)

- **Gray, slightly fractured, unweathered, angled fractures**
- **Gray, wide fracture spacing, unweathered, angled fractures**
- **Gray, wide fracture spacing, unweathered, angled fractures**

---

<table>
<thead>
<tr>
<th>Depth (Ft.)</th>
<th>Sample ID</th>
<th>Sample Type</th>
<th>Recovery (%</th>
<th>RQD</th>
<th>REC</th>
<th>Unconfined Compressive Strength (tsf)</th>
<th>Undrained Shear Strength (tsf)</th>
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<td>95%</td>
<td>89%</td>
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<tr>
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<td>98%</td>
<td>98%</td>
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<td>39</td>
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</table>

**Total depth of hole: 161.5 Feet**

**Stratification lines are approximate. In-situ, the transition may be gradual.**

**Hammer Type:** Automatic, 140-lb hammer with a 30-inch drop, Energy Transfer Ratio (ETR) = 76.3%
**BORING LOG NO. B-068**

**PROJECT:** AHTD Job No. CA0602 - 30 Crossing  
**CLIENT:** Arkansas State Highway and Transportation Dept.

**SITE:** Little Rock Area  
Pulaski County, Arkansas

<table>
<thead>
<tr>
<th>GRAPHIC LOG</th>
<th>LOCATION</th>
<th>See Exhibit A-12</th>
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<tbody>
<tr>
<td>Latitude: 34.74983°</td>
<td>Longitude: -92.262528°</td>
<td></td>
</tr>
<tr>
<td>Northing: 2070540.42</td>
<td>Easting: 1233497.18</td>
<td></td>
</tr>
<tr>
<td>Surface Elev.: 233.3 (Ft.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEPTH</td>
<td>ELEVATION (FL.)</td>
<td></td>
</tr>
<tr>
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<tr>
<td>150</td>
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<td></td>
</tr>
<tr>
<td>155</td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td></td>
<td></td>
</tr>
<tr>
<td>161.5</td>
<td>72</td>
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</tbody>
</table>

**WATER LEVEL OBSERVATIONS**

- **SHALE (continued)**
  - gray, wide fracture spacing, unweathered, angled fractures

**Boring Terminated at 161.5 Feet**

**TOTAL DEPTH OF HOLE:** 161.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

**WATER CONTENT (%):**

- Run 11: REC = 98% RQD = 98%
- Run 12: REC = 99% RQD = 99%
- Run 13: REC = 100% RQD = 94%

**FIELD TEST RESULTS**

- Surface Elev.: 233.3 (Ft.)
- Latitude: 34.74983°    Longitude: -92.262528°

**TOTAL DEPTH OF HOLE:** 161.5 Feet

**Notes:**

- Advancement Method: 0 to 45.5 Feet: Wash Rotary with 3-7/8" Tricone Roller Bit  
45.5 to 161.5 Feet: NQ Core Barrel

- Abandonment Method: 

- Horizontal Datum: NAD 83 (Y.X Localized) 
  Vertical Datum: NAVD 88

- State Plane Zone: 0302 Arkansas South

- Surveyed by NTB Associates

**WATER LEVEL OBSERVATIONS**

- 40.5' from water surface to mudline

**Notes:**

- Boring Started: 12-07-2015  
  Boring Completed: 12-08-2015

- Drill Rig: 977, ATV, CME-850  
  Driller: S. Zeien

- Checked by: P. McClaud  
  Logged by: D. Tennison

- Project No.: 35159097  
  Exhibit: B-29
Arkansas State Highway and Transportation Department  
AHTD Job No. CA0602 – 30 Crossing  
Soil and Rock Photographs

<table>
<thead>
<tr>
<th>Site: Little Rock, Arkansas</th>
<th>County: Pulaski</th>
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<td>Boring Depth: 161.5 feet</td>
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<td>Boring Started: 12/7/2015</td>
<td>Boring Completed: 12/8/2015</td>
</tr>
</tbody>
</table>

- 45.5 ft
- 54.5 ft
- 54.5 ft
- UC Test
- 64.5 ft
Arkansas State Highway and Transportation Department  
AHTD Job No. CA0602 – 30 Crossing  
Soil and Rock Photographs

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```
0  0.5  1.0  1.5  2.0
```

- 84.5 ft
- 94.5 ft
- UC Test
- UC Test
- UC Test
- 104.5 ft
### Soil and Rock Photographs

**Site:** Little Rock, Arkansas  
**County:** Pulaski  
**Boring Location:** B-068

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</table>

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<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>Description</th>
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<tr>
<td>0 – 0.5</td>
<td>UC Test</td>
</tr>
<tr>
<td>1.0 – 1.5</td>
<td>UC Test</td>
</tr>
<tr>
<td>2.0</td>
<td></td>
</tr>
</tbody>
</table>

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**UC Test at 104.5 ft**

**UC Test at 110 ft**

**UC Test at 120 ft**
Arkansas State Highway and Transportation Department
AHTD Job No. CA0602 – 30 Crossing
Soil and Rock Photographs

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UC Test
Arkansas State Highway and Transportation Department
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0  0.5  1.0  1.5  2.0

feet

UC Test
Site: Little Rock, Arkansas  
County: Pulaski  
Boring Location: B-068  

Driller: S. Zeien  
Drill Rig: #972, CME-850  
Boring Depth: 161.5 feet  

Terracon Project No.: 35159097  
Boring Started: 12/7/2015  
Boring Completed: 12/8/2015  

0  0.5  1.0  1.5  2.0  
feet  

UC Test  

159 ft  

160 ft  

161.5 ft
ATTACHMENT C

SURVEY CONTOUR PLOT (ArDOT 2019)
Survey Contour Plot (ARDOT 2019)
ATTACHMENT D

GEOTECHNICAL ANALYSIS
PIER GEOMETRY AND DESIGN CONDITIONS

Top of Cell Elevation: 251.5 ft
Shale Elevation: 190 ft
Normal Water Level Surface: 231 ft
10-year event water surface: 247.2 ft
Normal Operation Design Force: 2800 kips
Drifting Empty Barge Design Force: 1440 kips
Rock Fill Unit Weight: 150 pcf
Presumptive Shale Bearing Resistance: 20 ksf
100 Year Water Force (WA): 170 kips
Cell Diameter: 40 ft
Total Cell Height: 61.5 ft
Area: 1257 ft²

CASE 1: Normal Water Event with Normal Operation Design Force

Submerged Height: 41 ft
Height above water: 20.5 ft
Submerged Weight: 4,513,338 lb
Weight above water: 3,864,159 lb
Total Weight: 8,377,497 lb

eccentricity: 15.6 ft
Allowable e = 18 ft
e = (Sum of Overturning Moments) / Total Weight

Bearing Capacity FOS at service limit: 3.0

LRFD BEARING CAPACITY AT STRENGTH LIMIT STATE
Nominal Load: 6666.6 lb/ft²
Factored Load: 8333.25 lb/ft²
Nominal Resistance: 20000 lb/ft²
Factored Resistance: 9000 lb/ft²

SLIDING AASHTO 10.6.3.4
Nominal Load: 2,970,410 lb
Factored Load: 2,970,410 lb
Nominal Resistance: 4,691,398 lb
Factored Resistance: 4,222,258 lb

CASE 2: 10 yr High Water Event with Drifting Empty Barge Design Force

Submerged Height: 57.2 ft
Height above water: 4.3 ft
Submerged Weight: 6,296,656 lb
Weight above water: 810,531 lb
Total Weight: 7,107,187 lb

eccentricity: 12.5 ft

Bearing Capacity FOS at service limit: 3.5

LRFD BEARING CAPACITY AT STRENGTH LIMIT STATE
Nominal Load: 5655.72 lb/ft²
Factored Load: 7069.65 lb/ft²
Nominal Resistance: 20000 lb/ft²
Factored Resistance: 9000 lb/ft²

SLIDING AASHTO 10.6.3.4
Nominal Load: 1,610,410 lb
Factored Load: 1,610,410 lb
Nominal Resistance: 3,080,025 lb
Factored Resistance: 3,582,022 lb

AASHTO 11.6.3.3 Eccentricity limit for foundation on rock, the location of the resultant should be within nine-tenths of the base width. Eccentricity must be less than 18 ft for a 40-ft diameter cell
Eccentricity calc is conservative as Water Force (WA) is from 100-yr velocity
Water force assumes uniform water velocity for height of river and is based on 100-yr velocity