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GTS, Inc.
Geotechnical & Testing Services

www.gtsconsulting.net

June 28, 2017

Washington County Road Department
2615 South Brink Drive
Fayetteville, Arkansas 72701

Attention: Mr. Jeff Crowder

RE: Geotechnical Engineering Report
Planned Blue Springs Road Culvert Replacement
Washington County, Arkansas
GTS Project No. 17-15105A

Mr. Crowder:

This report provides the results of the subsurface exploration, laboratory testing and Geotechnical engineering analysis performed for a new, single-span bridge or culvert structure that will replace the existing Blue Springs Road culvert over Mill Hollow Valley in Washington County, Arkansas.

We appreciate the opportunity to be of assistance to you on this project. We encourage retaining GTS, Inc. to be involved in pre-bid and pre-construction meetings to allow GTS, Inc. to discuss the following findings and recommendations with the project team and potential bidders. Please contact us if the assumptions stated in this report are incorrect and/or if further explanation is required for portions of the report.

Sincerely,

No. 14853
XUHUI CHANG

Xuhui Chang, P.E.
Arkansas No. 14853

6/28/2017

Andrew T. McClarrinon, P.E.
Principal Engineer

XC:ATM

Copies: *Addressee* *(email)*

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EXECUTIVE SUMMARY

Based on the soil types, rock types and in-place shear strengths encountered at the two sample borings performed by GTS, Inc. for this project site, and based on our understanding of planned site grading, summary geotechnical considerations for support of a planned replacement bridge or culvert are provided below. More comprehensive recommendations are provided in the body of this report.

Narrative

Soil and Rock Conditions

Borings were performed on each side of Mill Hollow Valley in existing paved areas of Blue Springs Road. The borings encountered sandy gravel, clayey gravel, sandy lean clay, fat clay and silty clay soils immediately below the surface asphalt and underlying crushed gravel at both boring locations. Those soils extended to auger refusal depths of about 31 to 34 feet below existing grades.

Hard chert/limestone was encountered at both boring locations beginning at depths of 31 to 34 feet below existing grades. Voids of varying sizes were encountered in the chert/limestone stratum at one of the two borings. The chert/limestone extended to the terminal depths of the borings.

Geotechnical Design Information

The planned bridge abutments/culvert are recommended to be supported either on a shallow footing foundation system or on a deep foundation system. The planned replacement structure should only be supported on one foundation type. The choice between the two options can be made on client preference and economic considerations.

For shallow foundations, a net allowable bearing capacity of 2,500 pounds per square foot (psf) may be used for foundations bearing on relatively undisturbed, medium dense to dense gravel or stiff to very still clay material (Stratum I soils). Shallow foundation should bear at a minimum depth of at least 5 feet below the lowest adjoining grades.

Deep foundations should consist of straight-shaft drilled piers bearing a minimum of two feet into hard chert/limestone. Bearing depths of 33 to 36 feet below the existing ground surface are anticipated. The piers may be sized using a net allowable bearing pressure of 30,000 pounds per square foot (psf). Other design parameters and construction considerations are included in the body of this report.

PROJECT DESCRIPTION and INFORMATION

Project Site

The culvert to be replaced is located on Blue Springs Road over Mill Hollow Valley in Washington County, Arkansas. The approximate location of the culvert to be replaced is shown on the satellite image below.

Figure 1- Approximate Location of Project Site, image courtesy of Google Earth

Planned Development

Planned construction will consist of replacing the Blue Springs Road culvert over Mill Hollow Valley. The planned structure will be a single span bridge or a culvert.

Planned Site Grading

Future grades at the planned bridge abutments/culvert were not provided to GTS, Inc. at the time this report was produced. The recommendations provided in this report anticipate that finished grades at the new bridge abutments/culvert will approximately match the existing grades at the time our sample borings were performed.

SUMMARY of SUBSURFACE FINDINGS

Surface

The two sample borings were performed in the existing roadway on either side of the culvert to be replaced. The existing asphalt pavement was approximately 6 to 7 inches in thickness at the boring locations. The asphalt was underlain by approximately 1 to 3 inches of crushed gravel.

Water Measurements

Water observations were made by the drill crew during drilling and at completion of drilling. The observations are shown at the bottom of each boring log and are also summarized in the following table.

Table 1: Groundwater Measurements

Boring	Depth to Groundwater from Existing Grades (feet)	
	During Drilling	Immediately After Boring Completion
B-1A	13 ½	12
B-2A	8	8

The boring cave-in depths noted on the boring logs represent a loss of soil shear strength in the sides of the borings. This may be associated with the presence of groundwater and the cave-in depths may correlate to the surface of the groundwater. Cave-ins were observed at both boring locations at depths ranging from 16 to 26 feet below the existing ground surface.

The depths to water are intended as isolated measurements of groundwater levels at the time of drilling. The installation and periodic measurement of monitoring wells would be required to establish seasonal piezometric surfaces below this project site.

Subsurface Conditions

Stratum I – Clays and Gravels

A combination of clayey gravel, sandy gravel, and fat clays, lean clays and silty clay with varying amounts of sand was encountered below the existing asphalt pavement and underlying crushed gravel at both boring locations. These soils extended to auger refusal depths of 31 to 34 feet below existing grades.

The Stratum I soils had moderate shear strengths during drilling and sampling. Standard Penetration Resistance values (N-values) of 6 to 32 blows per foot were generally recorded for the Stratum I soils.

Stratum II – Chert/Limestone

The basal stratum at the project site consisted of hard, light gray to gray chert/limestone with limey shale inclusions. The chert/limestone was encountered starting at auger refusal depths of approximately 31 to 34 feet below existing grades. The Stratum II chert/limestone was cored using an NX size double-tube barrel sampler. Rock core recovery ranged from 55 to 100 percent and Rock Quality Designation (RQD) was measured to range from 22 to 90 percent. A void with an approximate dimension of 1-foot, measured vertically, was encountered starting at a depth of about 37 feet in Boring B-1A. Several smaller voids were also observed between depths of approximately 39 ½ and 40 ½ feet in Boring B-1A.

Auger Refusal Depths/Description

Auger refusal was encountered on limestone at depths of about 34 and 31 feet at Borings B-1A and B-2A, respectively.

FOUNDATION RECOMMENDATIONS and DESIGN PARAMETERS

Foundation Types

The planned bridge abutments/culvert may be supported on a shallow foundation system or a deep foundation system. The recommendations for both foundation types are provided below.

Shallow Spread Footing Foundations

Shallow Foundation Design Recommendations

The shallow foundations should be supported directly on relatively undisturbed, medium dense to dense gravel, or stiff to very stiff clay material (Stratum I soils) at a depth of 5 feet or more below adjoining grades. A net allowable bearing capacity of 2,500 pounds per square foot (psf) may be used to size foundations. A coefficient of base sliding of 0.35 may be used for lateral capacity analysis.

Total long-term and differential settlement of shallow foundations, designed and constructed as recommended in this report and per the Site Grading Recommendations section of this report, will be on the order of 1 inch and ¾ inch, respectively.

Shallow Foundation Construction Recommendations

Continuous formed and isolated column foundations should have minimum widths of 18 inches and 30 inches, respectively. The foundation bearing soils should be protected from erosion/scour, or foundations should bear below possible maximum erosion depth. Maximum erosion/scour depths should be evaluated by others.

Foundation excavations should be cleaned of loose soils, debris, and water. The bottom of all foundation trenches should be evaluated by the Geotechnical Engineer of Record, or their representative, to evaluate soils exposed on the bottom of foundation excavations.

Deep Foundations

We recommend that the deep foundation system be designed as a cast-in-place, straight shaft drilled pier foundation system.

Drilled Pier Foundation Design Recommendations

The drilled piers should be designed to bear a minimum of two feet into the hard chert/limestone using the Geotechnical parameters shown in Table 2 and Table 3 on the following pages. The design parameters shown in the tables were calculated using a factor of safety of about 3.0 for allowable end bearing pressures and about 2.0 for allowable skin friction values.

The drilled piers are recommended to be founded at a depth to satisfy a minimum length to diameter ratio of at least 3 (length):1 (diameter) for the constructed pier or to satisfy the design loading conditions, whichever depth is greater.

Soils within the top 5 feet of the project soils are recommended to be neglected for the design of the drilled piers due to the potential for these soils to be disturbed during the lifetime of the new structure.

Table 2: Drilled Pier Foundation Design Parameters – Boring B-1A

Depth	Soil/Rock Description	Effective Unit Weight: γ'	Friction Angle: φ	Cohesion: c	Allowable Skin Friction	Horizontal Modulus of Soil Reaction: K_f	Strain at 50% of Ultimate Compression: $\varepsilon 50$	Net Allowable End Bearing Pressure
(feet)		(pounds per cubic foot)		(pounds per square foot)	(pounds per square foot)	(pounds per square inch, per inch)		(pounds per square foot)
0 to 5	Clayey Gravel	Neglect						
5 to 17	Clayey Gravel	55	32	0	38 @5 feet, increase 7.5 psf per foot of depth	100	-	-
17 to 33	Fat Clay and Silty Clay	55	0	1,500	425	500	0.008	-
33 to 34	Sandy Gravel	55	32	0	250 @ 33 feet, increase 7.5 psf per foot of depth	100	-	-
34 +	Chert/ Limestone	75	0	7,200	3,000	1,000	0.0005	30,000 [A]

[A] The drilled piers should be constructed with a minimum length to diameter ratio of 3:1. A minimum penetration of two feet into light gray to gray chert/limestone is recommended.

Table 3: Drilled Pier Foundation Design Parameters – Boring B-2A

Depth	Soil/Rock Description	Effective Unit Weight: γ'	Friction Angle: φ	Cohesion: c	Allowable Skin Friction	Horizontal Modulus of Soil Reaction: K_f	Strain at 50% of Ultimate Compression: ε50	Net Allowable End Bearing Pressure
(feet)		(pounds per cubic foot)		(pounds per square foot)	(pounds per square foot)	(pounds per square inch, per inch)		(pounds per square foot)
0 to 5	Clays and Gravel	Neglect						
5 to 12	Clayey Gravel	55	32	0	38 @5 feet, increase 7.5 psf per foot of depth	100	-	-
12 to 28	Fat Clay and Lean Clay	55	0	1,000	350	400	0.01	-
28 to 31	Sandy Gravel	55	32	0	210 @ 28 feet, increase 7.5 psf per foot of depth	100	-	-
31 +	Chert/ Limestone	75	0	7,200	3,000	1,000	0.0005	30,000 [A]

[A] The drilled piers should be constructed with a minimum length to diameter ratio of 3:1. A minimum penetration of two feet into light gray to gray chert/limestone is recommended.

Total long-term and differential settlement of the drilled pier foundations, using the design parameters shown in this report, will be less than ½ inch.

Drilled Pier Foundation Construction Recommendations

We recommend that the drilled piers have a minimum diameter of 18 inches. All drilled pier excavations should be evaluated for suitable bearing material by the Geotechnical Engineer of Record or their representative prior to placement of reinforcing bar and concrete. Additionally, the drilled pier excavations should be cleaned of loose soil/rock, debris, and water prior to reinforcing bar and concrete placement.

Since one of the two borings indicates there are up to 1-foot voids in the chert/limestone bearing stratum, we recommend a 1-inch diameter probe hole be drilled in the base of all piers to at least 5 feet below the base of the pier or two times the design pier diameter, whichever is greater. If the probe holes indicate voids are present below the base of the drilled pier excavation, it may be necessary to deepen the drilled pier to develop adequate bearing.

Concrete should be placed in the shafts as soon as possible after excavation to reduce the risk of groundwater seepage, deterioration of the foundation bearing surface, and possible cave in of the sides. The pier excavation should not be allowed to remain open for more than 8 hours.

The concrete used in the drilled piers should be placed at a slump of between 5 and 7 inches. The higher than typical slump is recommended to reduce the likelihood of honeycombing within the drilled pier and to provide a positive pressure against the earth formed sides of the pier excavation. Therefore, the concrete mix design used in the drilled piers should have a demonstrated history of meeting the specified strength when placed within the specified slump range. Concrete should be placed directly down the center of the drilled pier reinforcing.

Based on the strength of the soils encountered at the boring location, sloughing of the gravel soils is likely to occur, especially below groundwater level, during the drilled pier excavation. Therefore, temporary casing is anticipated to be required to allow construction of the drilled piers.

A heavy-duty drill rig equipped with rock coring capability will be needed to penetrate hard, light gray to gray chert/limestone encountered beginning at depths of 31 to 34 feet below the ground surface.

Drilled Pier Observation Recommendations

The construction of the piers should be observed to confirm compliance with design assumptions. Observed items should include:

- the bearing stratum;
- pier reinforcement bar size, spacing and installation;
- the removal loose material from the base of the pier prior to placement of concrete;
- the correct handling of groundwater seepage, if encountered; and
- plumbness of the drilled shafts

Seismic Design Parameters

The subsurface conditions at this project are consistent with a Site Class C per the International Building Code (IBC), 2012 Edition.

MASS GRADING INFORMATION

Fill Placement

Site grading plans were not available to GTS, Inc. at the time this report was prepared. If applicable to this project, lifts of fill material required to reach plan finish subgrade elevations should be composed of Geotechnical Engineer approved select fill material and placed per the specifications shown in this report. The requirements to meet for a select fill material are provided in the Geotechnical Report Requirements and Specifications section of this report.

Fill should be placed in near horizontal lifts beginning in areas requiring the deepest amount of fill. The fill should be benched into the native soils each lift. Fill should not be placed on frozen, saturated or unstable soils without the approval of a Geotechnical Engineer.

Re-Use of On-Site Soils as Fill

The on-site asphalt may be reused as fill material provided that all asphalt fragments are mechanically broken such that all fragments measure less than 3 inches in all dimensions prior to reuse.

On-site gravel and lean clay (Stratum I soils) are anticipated to be suitable for reuse as select fill material. On-site fat clay and silty clay should not be re-used as fill. Larger, bulk samples of the on-site soil proposed for use as fill should be obtained in the field by GTS, Inc. during mass grading to confirm the apparent classification of these soils, prior to reuse. Additionally, all rock will need to be crushed into pieces no greater than 3 inches in any dimension prior to reuse or after compaction breakdown.

Rock Excavation Potential

The use of rock excavation techniques is anticipated to be required to penetrate hard chert/limestone. Hard chert/limestone was encountered beginning at depths of 31 to 34 feet below existing grades.

LATERAL LOADING CONDITIONS

Planned abutment walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to those defined in the below diagram and indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement/rotation at the top of the wall. The "at-rest" condition assumes the wall is structurally restrained from movement at the top. The recommended design lateral earth pressures do not include a factor of safety and are based on a drained soil condition behind the wall.

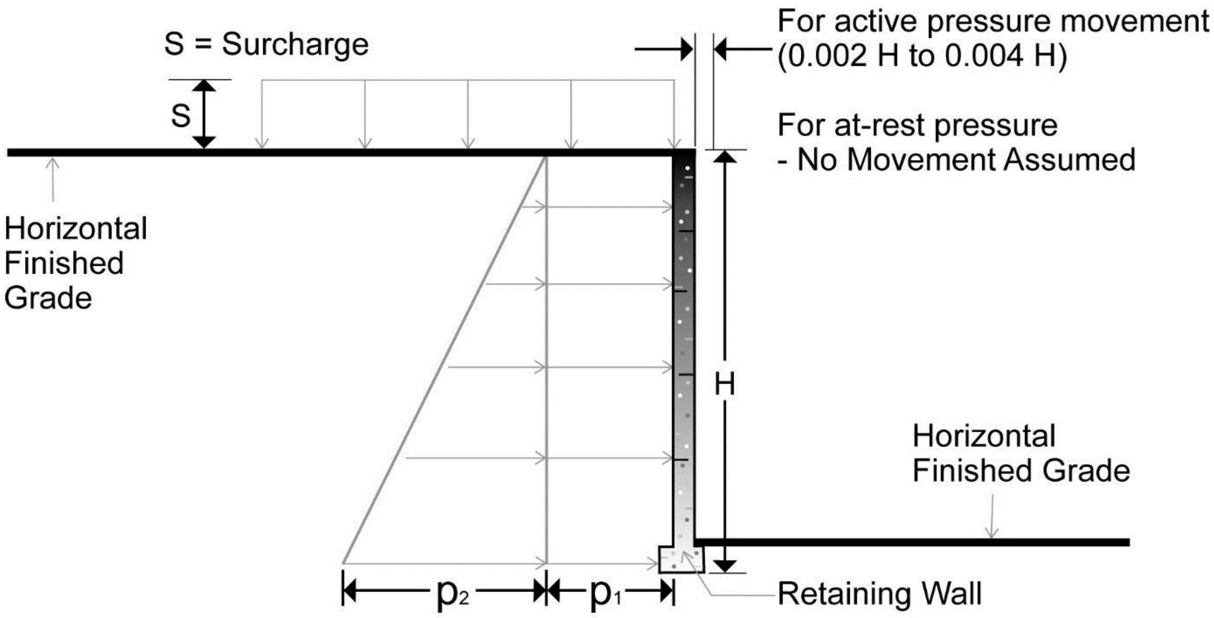

Figure 2 – General Diagram of Lateral Earth Pressures acting on Retaining Walls

Table 4: Earth Pressure Coefficients

Earth Pressure Conditions	Coefficient for Backfill Type	Equivalent Fluid Density (pcf)	Surcharge Pressure, p_1 (psf)	Earth Pressure, p_2 (psf)
Active (Ka)	Granular - 0.33 Clay - 0.42	40 50	(0.33)S (0.42)S	(40)H (50)H
At-Rest (Ko)	Granular - 0.46 Clay - 0.58	55 70	(0.46)S (0.58)S	(55)H (70)H
Passive (Kp)	Granular - 3.0 Clay - 2.4	360 288	--- ---	--- ---

The values shown in the table on the previous page require the following:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 H to 0.004 H, where H is wall height
- For passive earth pressure to develop, wall must move horizontally to mobilize resistance.
- Uniform surcharge, where S is surcharge pressure
- In-situ soil or placed and compacted soil backfill with a maximum moist unit weight of 120 pcf
- Backfill placed near horizontal, compacted to a minimum of 95 percent of standard Proctor maximum dry density
- Loading associated with backfill operations and construction not included in the recommended design values
- A drained soil condition
- No dynamic loading acting above the wall
- No safety factor included in soil parameters
- Ignore passive pressure in frost zone

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively. To calculate the resistance to sliding, a value of 0.35 should be used as the ultimate coefficient of friction between the retaining wall foundation and the underlying soil.

To reduce hydrostatic pressure behind the wall (i.e. a “drained” soil condition) we recommend that a minimum 12-inch-wide chimney drain be installed continuously on the back side of the retaining structure, with a collection pipe installed at the top of the foundation. The collection pipe should be rigid, perforated pipe and should be designed to gravity discharge at a location away from the wall and any other planned structures. The values shown in the table on the previous page assume a drained soil condition.

If constructing drainage behind the wall is not feasible (i.e. an “undrained” soil condition), or in-service walls will be below the water table, then the wall should be design using a combined hydrostatic and lateral earth pressure of 90 and 100 pcf for active and at-rest conditions, respectively. For granular backfill, an equivalent fluid pressures of 85 and 90 pcf should be used for active and at-rest, respectively. These pressures do not include the influence of surcharge, equipment or floor loading which should be added. Heavy equipment should not operate within a distance closer than the exposed height of retaining walls to prevent lateral pressures more than those provided.

GEOTECHNICAL REPORT REQUIREMENTS and SPECIFICATIONS

Unless otherwise stated in this report, the recommendations contained in this report are based on the compaction specifications and material types noted in Table 5, Table 6 and the following paragraphs.

Table 5: Compaction Criteria

Type of Material	Moisture-Density Specification	Minimum Dry Density (percentage of proctor)	Range from Optimum Moisture Content (%)
Fill material	ASTM D-698 (Standard Proctor)	95	-3 to +3
Class 7 Base Course	ASTM D-1557 (Modified Proctor)	95	n/a

Table 6: Soil Fill Material Requirements

Type of Soil Fill	Location/Use	Maximum LL	Maximum PI	USCS Classifications
Select	All Areas	40[A]	18[A]	GM, GC, GP, SP, SC, CL, Chert

[A] Plasticity requirements may be waived provided that the fill has a minimum of 65% retained on the No. 200 sieve.

Except for Geotechnical Engineer approved bridging lifts, fill needed for site grading should be placed in loose lifts not exceeding 9 inches in thickness (compacted lift thickness of approximately 6 to 7 inches). We recommend the fill be tested for density every lift during site grading, with a minimum of one test every 2,500 square feet of placed fill.

The recommended moisture content and compaction of the fill should be maintained until fills are completed.

Design and construction plans should provide for rapid, positive drainage away from the construction area both during construction and at completion of the project.

SUBSURFACE EXPLORATION and PROCEDURES

The subsurface exploration consisted of evaluating and sampling two (2) sample boring locations. The borings were drilled to depths of about 41 to 44 feet below existing grades with a rock penetration of about 10 feet for each boring.

The boring locations were established in the field by GTS, Inc. and are shown on the attached boring location diagram. The results of the borings are attached to this report.

The borings were drilled with a truck mounted CME-75 drill rig. Disturbed samples and estimates of the in-situ shear strengths of the soil were obtained using an automatic-hammer-driven split barrel sampler in general accordance with the Standard Penetration Test at the boring locations. Rock was cored using an NX size double-tube barrel sampler.

The soil samples obtained in the field were sealed to reduce moisture loss and taken to the GTS, Inc. soil laboratory for further examination, testing, and classification. The results of laboratory tests on select samples are shown on the boring logs and are attached to this report.

Field logs were prepared during the drilling and sampling of the borings. These logs report sampling methods, sampling intervals, soil and groundwater conditions, and notes regarding soil and drilling conditions observed between sample depths. The final boring logs, included in this report, have been prepared based on the field logs and have been modified, where appropriate, based on the results of the laboratory observation.

LABORATORY TESTING and PROCEDURES

The soil samples were examined in the field by an experienced geotechnical engineer and classified based on the soil's texture and plasticity, in accordance with the Unified Soil Classification System. The estimated Unified Soil Classification System group symbols are shown on the boring logs.

The laboratory testing was performed by GTS, Inc. in general accordance with the American Society for Testing and Materials (ASTM) test designations shown in the table below:

Table 7: Laboratory Test Method Designations

Laboratory Test	Test Designation	Method (if applicable)
Visual Classification of Soil Types	ASTM D 2488	
USCS Classification	ASTM D 2487	

GEOTECHNICAL REPORT LIMITATIONS

The recommendations contained in this report are based on our interpretation of subsurface conditions encountered at the discrete boring locations. Variations between the subsurface conditions anticipated in this report and actual project site conditions may occur away from the boring locations.

If significant differences between the findings of the borings and site conditions are observed, GTS, Inc. should be contacted to assess the variation and, if necessary, reevaluate the recommendations contained in this report.

ENVIRONMENTAL EXCLUSION

A Geotechnical Engineering report assesses the engineering properties of soil and rock. No environmental assessment of a project site is performed during a geotechnical exploration. If the owner is concerned about the potential for environmental hazards at the project site, additional studies should be performed by GTS, Inc.

APPENDIX A

Boring Location Diagram

Boring Logs

Photographs of Rock Cores

Boring Location Diagram

LOG OF BORING NO.B-1A

Planned Washington County Bridge Replacements
Washington County, Arkansas

GTS, Inc.
Geotechnical & Testing Services
Fayetteville, AR

Project No.: 17-15105 Location: Shown on Boring Location Diagram

DEPTH, FT	SAMPLE No.	RECOVERY (in.)	DESCRIPTION OF MATERIAL Surface Description=Asphalt Pavement	USCS	%<#200	HAND PENETROMETER, TSF ■ LAB. COHESION, TSF ▲ 0.4 0.8 1.2 1.6 WATER CONTENT, % ● PL ├──┤ LL 20 40 60 80	BLOWS PER FT
0			ASPHALT = 6"				
			CRUSHED GRAVEL = 3"				
	1	9	CLAYEY GRAVEL, with sand medium dense, brown and red with chert fragments	GC			29
	2	9					24
	3	18					17
5	4	12					12
10	5	3					14
15	6	15					11
			- Cave-in overnight at 16 feet				
			GRAVELLY FAT CLAY very stiff, brown and gray with chert fragments, wet	CH			
20	7	18					14
25	8	18	SILTY CLAY, with gravel stiff to very stiff, brown with chert fragments, wet	CL-ML			7
30	9	12					19
	10	0	SANDY GRAVEL very dense, brown with chert fragments	GP			50/1"
35			LIMESTONE/CHERT				

COMPLETION DEPTH: 44 ft.
DATE: 6/6/2017
RIG: CME-75, Truck Mounted, Auto-Hammer Assisted

DEPTH TO WATER:
DURING DRILLING: 13.5
AT COMPLETION: 12
AT 24 HOURS: n/a

LOG OF BORING NO.B-1A

Planned Washington County Bridge Replacements
Washington County, Arkansas

GTS, Inc.
Geotechnical & Testing Services
Fayetteville, AR

Project No.: 17-15105 Location: Shown on Boring Location Diagram

DEPTH, FT	SYMBOL	SAMPLES	SAMPLE No.	RECOVERY (in.)	DESCRIPTION OF MATERIAL	USCS	%<#200	HAND PENETROMETER, TSF ■ LAB. COHESION, TSF ▲ 0.4 0.8 1.2 1.6 WATER CONTENT, % ● PL ├──┤ LL 20 40 60 80	BLOWS PER FT
					hard, gray and light gray with trace limey shale inclusions 66% RECOVERY 22% RQD				
40					- one foot void at 37 feet 55% RECOVERY 46% RQD				
					- several small voids appear between 39½ and 40½ feet 100% RECOVERY 77% RQD				
45					AUGER REFUSAL AT 34 FEET BOTTOM OF BORING AT 44 FEET				
50									
55									
60									
65									
70									

LOG OF BORING NO.B-2A

Planned Washington County Bridge Replacements
Washington County, Arkansas

GTS, Inc.
Geotechnical & Testing Services
Fayetteville, AR

Project No.: 17-15105 Location: Shown on Boring Location Diagram

Surface Description=Asphalt Pavement

DEPTH, FT	SAMPLE No.	RECOVERY (in.)	DESCRIPTION OF MATERIAL	USCS	%<#200	HAND PENETROMETER, TSF ■ LAB. COHESION, TSF ▲ 0.4 0.8 1.2 1.6 WATER CONTENT, % ● PL ├──┤ LL 20 40 60 80	BLOWS PER FT
0			ASPHALT = 7"				
	1	18	CRUSHED GRAVEL = 1"	GP			26
	2	18	SANDY GRAVEL medium dense, brown with chert fragments	CL			16
	3	10	SANDY LEAN CLAY, with gravel very stiff, brown and orange with chert fragments				14
5	4	15					12
			CLAYEY GRAVEL, with sand medium dense, brown with chert fragments	▽ GC			
10	5	16					14
			SANDY LEAN CLAY, with gravel stiff to very stiff, brown with chert fragments, wet				
15	6	14					6
				CL			
20	7	10					11
			FAT CLAY, with sand and gravel very stiff, brown with chert fragments, wet				
25	8	14		CH			6
			- Cave-in overnight at 26 feet				
			SANDY GRAVEL dense, brown with chert fragments, wet				
30	9	1		GP			32
			LIMESTONE/CHERT hard, gray and light gray with trace limey shale and limestone inclusions and seams 78% RECOVERY 65% RQD				
35							

COMPLETION DEPTH: 41 ft.
DATE: 6/5/2017
RIG: CME-75, Truck Mounted, Auto-Hammer Assisted

DEPTH TO WATER: DURING DRILLING: 8 ▽
AT COMPLETION: 8 ▼
AT 24 HOURS: n/a ▼

LOG OF BORING NO.B-2A

Planned Washington County Bridge Replacements
Washington County, Arkansas

GTS, Inc.
Geotechnical & Testing Services
Fayetteville, AR

Project No.: 17-15105 Location: Shown on Boring Location Diagram

DEPTH, FT	SYMBOL	SAMPLES	SAMPLE No.	RECOVERY (in.)	DESCRIPTION OF MATERIAL	USCS	%<#200	HAND PENETROMETER, TSF ■ LAB. COHESION, TSF ▲ 0.4 0.8 1.2 1.6 WATER CONTENT, % ● PL ├───┤ LL 20 40 60 80	BLOWS PER FT
					100% RECOVERY 90% RQD				
40					92% RECOVERY 58% RQD				
					AUGER REFUSAL AT 31 FEET BOTTOM OF BORING AT 41 FEET				
45									
50									
55									
60									
65									
70									


17-15105
B-1A
34'-44'
Todd's
35.5'
40.5
44'


17-15105
B-2A
31'-41'
Todd's
31'
31'
35'
40'