

ARKANSAS DEPARTMENT OF TRANSPORTATION



SUBSURFACE INVESTIGATION

STATE JOB NO. 020785

FEDERAL AID PROJECT NO. 9990

DISTRICT 2 R.E. OFFICE 23 (PINE BLUFF) (S)

STATE HIGHWAY 65 SECTION ---

IN JEFFERSON COUNTY

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.



ARKANSAS DEPARTMENT OF TRANSPORTATION

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MATERIALS DIVISION

11301 West Baseline Road | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2185 | Fax: 501.569.2368

April 28, 2021

TO: Mr. Deric Wyatt, District Engineer – District 2
SUBJECT: Foundation Recommendations
RE 23 Replacement Building
Job No. F02274
Jefferson County

Submitted herein are the foundation recommendations developed for the proposed Resident Engineer (RE) No. 23 replacement building. We understand the existing RE 23 building will be demolished and the replacement building will be constructed at the same location.

Foundation loads and floor loads are not provided but these loads are anticipated to be light to very light. Site grading information is not available at this time. However, it is expected site grading will be minor with existing grade to be utilized to the extent possible.

Field Investigation. A subsurface investigation was requested by ARDOT District 2 personnel on April 16, 2019 and four (4) borings were performed in August 2019. At that time, the new RE 23 building was planned at an offset location, south of the existing RE 23 building area. Consequently, these borings were drilled in the then planned building footprint. The approximate locations of the borings are presented in the Plan of Borings included in Attachment A. The existing RE 23 building location is also indicated on the Plan of Borings.

The borings were advanced to a depth of approximately 26 to 26.5 feet with a CME 75 rotary drill rig using hollow-stem auger method. The boring logs, showing the subsurface conditions encountered in the borings and field and laboratory test results, are also included in Attachment A, immediately following the Plan of Borings. Standard Penetration Tests (SPT) were conducted in accordance with ASTM D1586 for field testing and soil sampling. The correction factor for the hammer is indicated on the boring logs. Liners were not used inside the standard split-barrel samplers.

The number of blows required to drive the standard split-barrel sampler for each 6-inch penetration of the total 18-inch drive were counted and shown on the logs. SPT N-values are defined as the number of blows required to advance the split barrel the final 12 inches. The SPT N-values indicated on the logs are raw blow count measured in field.

Groundwater was also observed during the drilling process. Groundwater was encountered in the borings at variable depths of 9.5 to 23 feet below ground level.

Laboratory Testing. All samples were brought to the Materials laboratory for further evaluation and testing. Soil samples were tested to evaluate index and engineering properties and to verify soil type and classification. Lab tests were performed on representative soil samples to determine moisture content, Atterberg limits, and gradation. Tested soils are classified by experienced professionals in accordance with both the USCS and AASHTO soil classification systems.

The laboratory test results are presented in Attachment B. The laboratory test and their corresponding ASTM and / or and AASHTO test methods are listed in Table 1.



Table 1: Summary of Laboratory Tests and Methods

Laboratory Test	ASTM	AASHTO
Moisture Content	D2216	T 265
Grain Size Analysis by Sieving	D6913	T 88
Atterberg Limits	D4318	T 89 and T 90

Seismic Conditions. Based on the results of the borings and the surface geology of the area, a Seismic Site Class D (Stiff Soil Profile) is considered suitable for the site in accordance with the criteria of the 2012 International Building Code. The liquefaction potential of the predominantly clayey soils encountered within the exploration depths of the borings is considered low.

Subsurface Conditions. The borings indicate the surface soils to approximately 2.5- to 5-foot depth are medium stiff fine sandy clay to loose brown clayey fine sand. These surface soils contain some organics and exhibit moderate plasticity, low shear strength / relative density, and moderate to high compressibility.

Below approximately 2.5- to 5-foot depth and extending in excess of the 26- to 26.5-foot exploration depth are typically soft to stiff brown, gray, to reddish brown clay with minor amount of fine sand. Locally, loose reddish brown silt and soft to medium stiff clayey silt to silty clay are also interbedded in the predominantly clay stratum. The subsurface soils typically exhibit low shear strength / relative density and moderate to high compressibility. In addition, the clay has moderate plasticity and is volumetrically unstable and expansive with increase in water content.

In summary, the subsurface soils encountered in the borings are generally weak and compressible with some heave potential.

Shallow Footings. A shallow footing foundation system is suitable to support the light to very light structural loads of the RE 23 Building. As described above, the existing foundation soils exhibit low strength, moderate to high compressibility, and some heave potential. Consequently, these on-site soils are not suitable to support building footings.

We understand it is District’s plan to undercut the on-site soils and backfill with rubblized concrete. The top of the rubblized concrete will be choked with crushed concrete complying with ARDOT Standard Specifications Section 303 for Class 7 Base Course. District’s plan is considered suitable. We recommend the foundation soils be undercut a minimum of 5 feet below the current slab elevation. The top of the undercut backfill should be comprised of at least 2.5 feet of crushed concrete satisfying the gradation requirements for Class 7 Base Course.

The crushed concrete should be compacted to a minimum of 98 percent of the laboratory-determined maximum dry density near optimum moisture content in accordance with AASHTO T 180, Method D. Fill and backfill should be placed in horizontal, nominal 6- to 8-inch-thick loose lifts. Density and moisture of each lift of backfill and fill should be tested (minimum one test per lift) and approved prior to placing subsequent lifts.

The foundation loads of the RE building will be supported on continuous or individual footings founded in compacted, crushed concrete. Footings founded as recommended may be designed based on maximum net allowable bearing pressures of 1500 and 2000 psf for



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continuous and individual footings, respectively. These recommended allowable bearing pressures include a minimum factor of safety of 2.5. Total settlement of footings founded as recommended should be less than 1 inch. Differential settlement may be estimated as about one-half of the total settlement value.


Uplift of footings will be resisted by the weight of the structure and the foundation units. Resistance to lateral forces will be mobilized by sliding resistance at the footing bottom. Resistance to sliding may be evaluated using an ultimate friction ($\tan\delta$) value of 0.35 for concrete footings on compacted fill bearing stratum.

Continuous footings should have a minimum width of 18 inches. Individual footings should have a minimum dimension of 24 inches. A minimum footing depth of 18 inches below lowest adjacent grade is recommended for frost protection.

Floor Slab. Slab-on-grade construction will be suitable for the building floor slab. Subgrade preparation must include thorough proof-rolling of the subgrade. We recommend the floor slab be supported on a 6-inch-thick clean crushed stone or gravel layer placed on a properly prepared subgrade. Suitable materials for this use include Mineral Aggregate (Class 3) complying with 2014 ARDOT Standard Specifications Sub-Section 403.01 or Coarse Aggregate complying with Sub-Section 802.02(c) for Class S concrete. The granular layer should be densified with vibrating equipment prior to floor slab construction. Impervious sheeting should be placed between the slab and granular layer to act as a moisture barrier.

Shrink/Swell Potential. As noted, the moderately plastic clay is predominant across the site and will become volumetrically unstable with change in soil water content. To reduce seasonal changes in soil water content and therefore reduce the potential for accompanying movement, we recommend the following:

- Site grading should consider to design the ground surface to slope away from building perimeter to prevent water ponding around the building.
- Surface and roof runoff should be directed away from the building.
- Deep-rooted shrubs or trees that can have an impact on soil water content should not be planted adjacent to the building.


Jonathan A. Annable
Materials Engineer

JAA:yz:mlg:pjt
Attachments

cc: Facilities Management
G. C. File

Attachment A

Plan of Borings
Job No. F02274
RE 23 Building

Existing RE23 Building

Boring 1

Boring 2

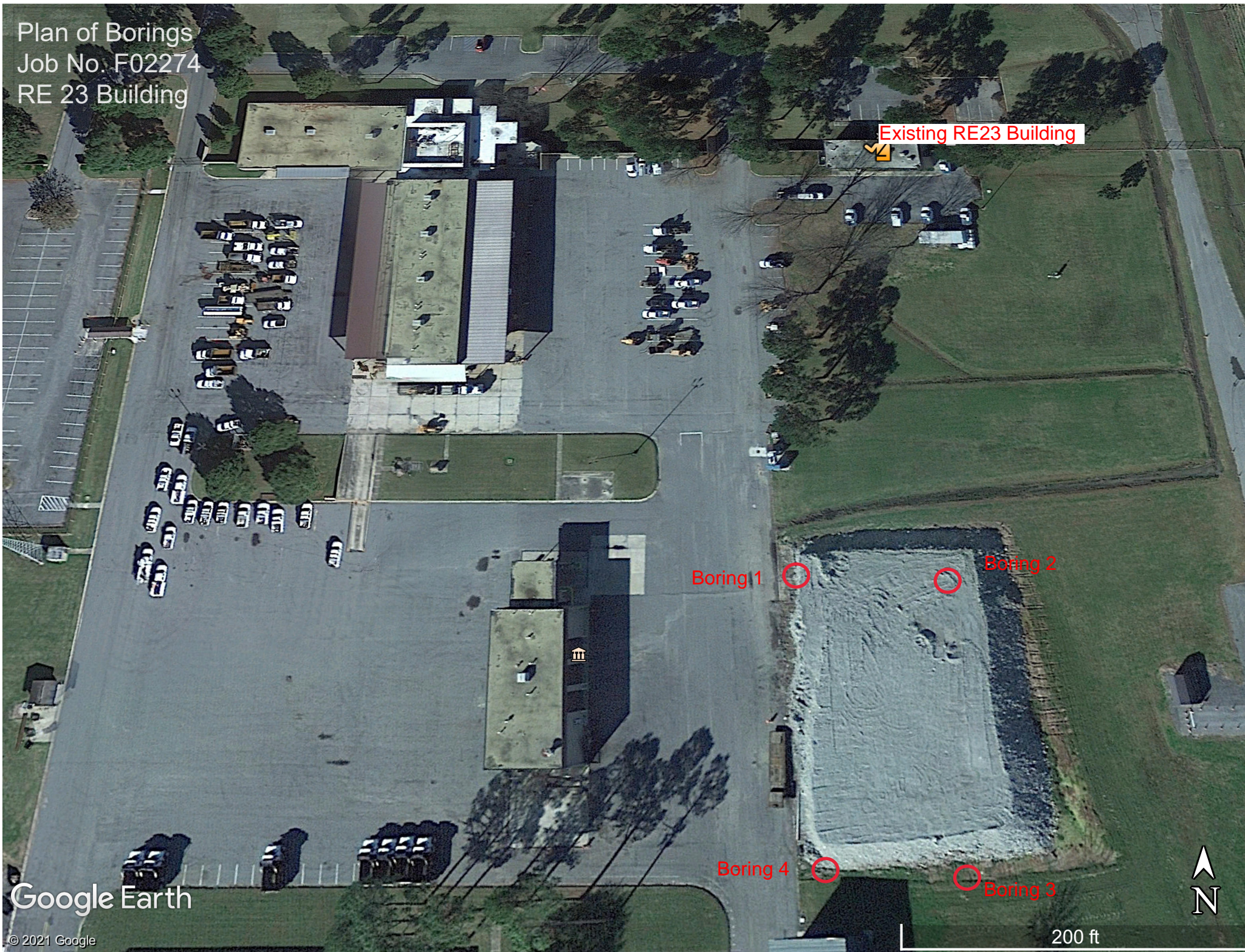
Boring 4

Boring 3

Google Earth

© 2021 Google

200 ft



**ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 1
PAGE 1 OF 1

JOB NO. F02274 Jefferson County
JOB NAME: RE 23 Building

DATE: August 26, 2019
TYPE OF DRILLING:
Hollow Stem Auger
EQUIPMENT: CME 75

STATION:
LOCATION:
LOGGED BY: Troy Frazier

HAMMER CORRECTION FACTOR: 1.37

COMPLETION DEPTH: 26.3

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SOIL GROUP	PLASTIC LIMIT	% MOISTURE	LIQUID LIMIT	Percent Passing	No. 200 Sieve	NO. OF BLOWS PER 6-IN.	% T C R	% R Q D
			SURFACE ELEVATION: 198.8									
5		X	Moist, Medium Stiff, Brown Sandy Clay with Organic Matter							1 2-3		
		X	Moist, Medium Stiff, Reddish Brown Clay							2 3-3		
10		X	Moist, Stiff, Reddish Brown Clay*							2 3-3		
		X	Wet, Soft, Reddish Brown Silty Clay							1 2-2		
15		X	Wet, Loose, Reddish Brown Silt							2 2-3		
		X	Moist, Medium Stiff, Gray Clay							1 3-3		
20		X	Wet, Soft, Dark Gray Clay with Organic Matter							2 3-3		
		X	Wet, Soft, Dark Gray Clay with Organic Matter							1 2-2		
25		X	Wet, Medium Stiff, Gray Sandy Clay							1 2-3		
			Boring Terminated									
30												
35												

REMARKS: *Water was encountered at 11.3' below ground level.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 2
PAGE 1 OF 1

JOB NO. F02274 Jefferson County
JOB NAME: RE 23 Building

DATE: August 27, 2019
TYPE OF DRILLING:
Hollow Stem Auger
EQUIPMENT: CME 75

STATION:
LOCATION:
LOGGED BY: Troy Frazier

HAMMER CORRECTION FACTOR: 1.37

COMPLETION DEPTH: 26.5

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SOIL GROUP	PLASTIC LIMIT	% MOISTURE	LIQUID LIMIT	Percent Passing	No. 200 Sieve	NO. OF BLOWS PER 6-IN.	% TCR	% RQD
		X	Moist, Medium Stiff, Brown Sandy Clay with Organic Matter							2 4-3		
5		X	Moist, Stiff, Dark Brown Clay							3 4-6		
		X	Moist, Stiff, Dark Brown Clay							3 4-5		
10		X	Moist, Medium Stiff, Reddish Brown Clay with Some Organic Matter							1 3-4		
		X	Moist, Stiff, Gray Clay with Some Organic Matter							2 4-5		
15		X	Moist, Medium Stiff, Reddish Brown Clay with Some Organic Matter							2 2-3		
		X	Moist, Medium Stiff, Reddish Brown and Gray Clay with Some Sand							1 3-3		
20		X	Moist, Medium Stiff, Reddish Brown and Gray Clay with Some Sand							2 3-4		
		X	Moist, Medium Stiff, Gray Clay							1 3-3		
25		X	Moist, Soft, Gray Clay with Some Organic Matter*							1 1-2		
		X	Moist, Soft, Gray Sandy Clay with Some Organic Matter							0 0-2		
			Boring Terminated									
30												
35												

REMARKS: *Water was encountered at 23.2' below ground level.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 3
PAGE 1 OF 1

JOB NO. F02274 Jefferson County
JOB NAME: RE 23 Building

DATE: August 27, 2019
TYPE OF DRILLING:
Hollow Stem Auger
EQUIPMENT: CME 75

STATION:
LOCATION:
LOGGED BY: Troy Frazier

HAMMER CORRECTION FACTOR: 1.37

COMPLETION DEPTH: 26.1

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SOIL GROUP	PLASTIC LIMIT	% MOISTURE	LIQUID LIMIT	Percent Passing	No. 200 Sieve	NO. OF BLOWS PER 6-IN.	% T C R	% R Q D	
			SURFACE ELEVATION: 198.1										
		X	Moist, Medium Stiff, Brown Sandy Clay with Organic Matter	NT						1 1-4			
		X	Moist, Medium Stiff, Brown Fat Clay	CH	15		53	95		1 2-5			
5		X	Moist, Stiff, Brown Fat Clay	CH	14		50	96		2 5-7			
		X	Moist, Stiff, Brown Lean Clay	CL	17		39	96		2 3-6			
10		X	Wet, Loose, Reddish Brown Silt with Sand*	ML	NP			77		2 5-5			
		X	Wet, Loose, Reddish Brown Lean Clay	CL	20		29	99		1 2-5			
15		X	Wet, Medium Stiff, Reddish Brown Silty Clay	CL-ML	22		29	98		1 2-3			
		X	Wet, Soft, Gray Lean Clay	CL	21		31	99		0 1-2			
20		X	Wet, Soft, Gray Fat Clay with Organic Matter	CH	24		72	98		0 1-2			
25		X	Wet, Soft, Gray Lean Clay	CL	15		45	99		1 1-2			
			Boring Terminated										
30													
35													

REMARKS: *Water was encountered at 9.6' below ground level.

**ARKANSAS DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 4
PAGE 1 OF 1

JOB NO. F02274 Jefferson County
JOB NAME: RE 23 Building

DATE: August 28, 2019
TYPE OF DRILLING:
Hollow Stem Auger
EQUIPMENT: CME 75

STATION:
LOCATION:
LOGGED BY: Troy Frazier

HAMMER CORRECTION FACTOR: 1.37

COMPLETION DEPTH: 26.1

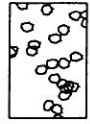
DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SOIL GROUP	PLASTIC LIMIT	% MOISTURE	LIQUID LIMIT	Percent Passing	No. 200 Sieve	NO. OF BLOWS PER 6-IN.	% T C R	% R Q D
		X	Moist, Loose, Brown Clayey Sand with Some Gravel and Some Organic Matter							2 5-4		
		X	Moist, Stiff, Brown Clay with Organic Matter*							3 5-5		
5		X	Moist, Medium Stiff, Brown Clay with Organic Matter.							2 4-3		
		X								2 3-4		
10		X	Moist, Medium Stiff, Brown Sandy Clay with Some Organic Matter							2 3-4		
		X								2 3-4		
15		X	Wet, Medium Stiff, Reddish Brown Sandy Clay with Some Organic Matter							1 3-3		
		X								1 2-3		
20		X	Wet, Medium Stiff, Brown Clay with Some Organic Matter							2 3-4		
		X								2 2-3		
25		X	Wet, Soft, Reddish Brown Sandy Clay with Some Organic Matter							2 2-2		
			Boring Terminated									
30												
35												

REMARKS: *A root blocked off the sampler preventing soil from being collected.

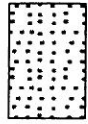
LEGEND

SOIL TYPES

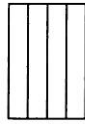
(SHOWN IN SYMBOL COLUMN)
(PREDOMINANT TYPE SHOWN HEAVY)



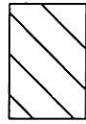
GRAVEL



SAND



SILT



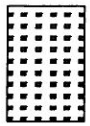
CLAY



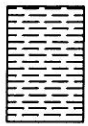
ORGANIC
MATTER

ROCK TYPES

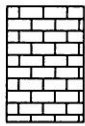
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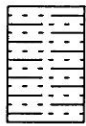
SANDSTONE



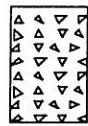
SHALE
or
SILTSTONE



LIMESTONE
or
DOLOMITE



ALTERNATING
LAYERS of
SHALE and
SANDSTONE



OTHER

SAMPLER TYPES

(SHOWN IN SAMPLE COLUMN)

SHELBY TUBE



UNDISTURBED
SAMPLE
RECOVERY

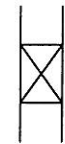


DISTURBED
SAMPLE
RECOVERY

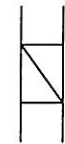


NO
RECOVERY

SPLIT SPOON

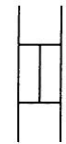


SAMPLE
RECOVERY



NO
RECOVERY

ROCK CORING



% RECOVERY
INDICATED ON LOGS

TERMS DESCRIBING CONSISTENCY OR CONDITION

GRANULAR SOIL		CLAY		CLAY-SHALE		SHALE	
*N' Value	Density	*N' Value	Consistency	*N' Value	Consistency	*N' Value	Consistency
0-4	Very Loose	0-1	Very Soft	0-1	Very Soft		
5-10	Loose	2-4	Soft	2-4	Soft	31-60	Soft
11-30	Medium Dense	5-8	Medium Stiff	5-8	Medium Stiff	Over 60	
31-50	Dense	9-15	Stiff	9-15	Stiff	More than 2'	
Over 50	Very Dense	16-30	Very Stiff	16-30	Very Stiff	Penetration	
		31-60	Hard	31-60	Hard	in 60 Blows: Medium Hard	
		Over 60	Very Hard	Over 60	Very Hard	Less than 2'	
						Penetration	
						in 60 Blows: Hard	

1. Ground water elevations indicated on boring logs represent ground water elevations at date or time shown on boring log. Absence of water surface implies that no ground water data is available but does not necessarily mean that ground water will not be encountered at locations or within the vertical reaches of these borings.
2. Borings represent subsurface conditions at their respective locations for their respective depths. Variations in conditions between or adjacent to boring locations may be encountered.
3. Terms used for describing soils according to their texture or grain size distribution are in accordance with the Unified Soil Classification System.

Standard Penetration Test – Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6.0 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and performing the test are recorded for each 6 inches of penetration on the drill log. The field "N" Value (N_f) can be obtained by

adding the bottom two numbers for example: $\frac{6}{8-9} \Rightarrow 8+9 = 17 \text{blows/ft}$. The "N" Value corrected to 60%

efficiency (N_{60}) can be obtained by multiplying N_f by the hammer correction factor published on the boring log.

Attachment B



Materials
Division

Results of Classification Tests
ARDOT Project No.: F02274
Project: RE 23 Building
County: Jefferson

Summarized by: JCS
Checked by: PWC

Sample Identification		Atterberg Limits			% Fines	Soil Classification	
Boring	Depth, ft	LL	PL	PI		USCS	AASHTO
3	2.5	53	15	38	95	CH	A-7-6(38)
3	4.6	50	14	36	96	CL	A-7-6(36)
3	7.1	39	17	22	96	CL	A-6
3	9.6	NP	NP	NP	77	ML	A-4
3	12.1	29	20	9	99	CL	A-4
3	14.6	29	22	7	98	CL-ML	A-4
3	17.1	31	21	10	99	CL	A-4
3	19.6	38	20	18	99	CL	A-6
3	22.1	72	24	48	98	CH	A-7-6(54)
3	24.6	45	15	30	99	CL	A-7-6(31)