Washington County
MARYLAND
DIVISION OF ENGINEERING

EXEMPT
CJ Andrzejewski
Digitally signed by CJ Andrzejewski
Date: 2022.07.22 08:37:27 -04'00'

ADDENDUM NO. 3

TO: Interested Parties

FROM: Blair Reynolds,
Chief Project Manager, Division of Engineering

DATE:
Friday, July 22, 2022

RE:
Professional Boulevard – Phase II
Contract No. RD-PB-270-10
State Contract No. WA071ZM1
FAP No. APL-3(779)E

Acknowledge receipt of this **Addendum No. 3** by signing in the space provided below and returning with your Bid.

Failure to sign and return with your Bid may subject the Bidder to disqualification. This Addendum No. 3 forms a part of the Bid Documents, it supplements and modifies them as outlined herein.

This **Addendum No. 3** consists of **164** pages, including this page and attachments.

I hereby acknowledge receipt of Addendum No. 3:

By: _____ Date_____
Signed Name

_____
Typed Name

_____
Title

For: _____
Firm

ADDENDUM NO. 3

Professional Boulevard – Phase II
Contract No. RD-PB-270-10; State Contract No. WA071ZM1; FAP No. APL-3(779)E

Date Issued: July 22, 2022

Bids Due: July 27, 2022
3:00 p.m.

The following addendum material is hereby made a part of the Bid Documents. Please note the following changes, information, and/or instructions in connection with the proposed work and submit proposals accordingly.

for Tim Mobley
Blair Reynolds
Chief Project Manager
Division of Engineering

By Authority of:
Board of County Commissioners
Washington County, Maryland

Scott Hobbs
Scott Hobbs, P.E.
Director
Division of Engineering

To: All prime Contractors and all others to whom specifications have been issued.

Item 1.01 **Special Provisions, Page SP-48R**
DELETE in its entirety
REPLACE with Revised SP-48R

Item 1.02 **Bid Forms, Page 2.24**
DELETE in its entirety
REPLACE with Revised BF-2.24R

Bid Forms, Page 2.34
DELETE in its entirety
REPLACE with Revised BF-2.34R

Item 1.03 **QUESTIONS THAT WERE SUBMITTED BY THURSDAY, JULY 14, 2022** (4:00PM)

Question #1– Valentine Electric
Please verify Item 8004A quantity of 6,100 LF of No. 6 AWG Stranded Bare Copper Ground Wire.

Response: The item is to be used within both conduits shown on the lighting pages as well as for the signal work.

Question #2– Valentine Electric
Please confirm locations and quantities of Items 8006A, 8007A, and 8008A as drawing sheets 86 and 87 show different locations for said items.

Response: Drawing sheets 86 and 87 are shown differently because the existing roadway is not to be widened if the Add Alternate is not selected.

Question #3– Valentine Electric
Drawings sheets 8 and 9 propose new sidewalks and business entrances on both side of Professional Boulevard from station 10+75 to approximately 25+00. Can item 8006A be used in these locations with Item 8008A used at 18+50 to go across Professional Blvd?

Response: The Contractor is to bid the trenched, slotted, and bored items as provided on the Construction Drawings. During construction, if the contractor wishes to use an alternate method, it will be considered by the County.

Question #4– Valentine Electric
Will Item 8007A only be needed at the concrete entrances at station 22+80?

Response: See response to the question immediately above.

Question #5– Valentine Electric
Please confirm Items 8006A, 8007A and 8008A are paid by each L.F. of conduit and not per L.F. of trench, slotting or boring of 2 conduits.

Response: Measurement and payment will be made per linear foot of conduit.

Question #6– Valentine Electric
Drawing sheet 87 shows 12 pole locations on bridge while there are 13 bases already installed. Please verify quantities for these bid items.

Response: Drawing sheet 87R shows 13 bases for the Canto Poles (one on the end of the concrete barrier West of the bridge). The additional poles (Item 8011A) and Luminaires (Item 8009A) are to go to the Hagerstown Light Department per the Special Provisions.

Question #7– Valentine Electric
Please verify quantities of Items 8010A and 8012A.

Response: The quantities are correct.

Question #8– Valentine Electric
Please verify quantities for Item 8014A.

Response: The quantity is correct.

Question #9– Valentine Electric/Rommel Infrastructure
Drawing sheet 88R equipment list proposes quantities and Add Alternate quantities. Please explain intentions as there are no electrical bid items listed on base bid items list.

Response: This federal aid project would not allow contingent items; therefore, if the add alternate is not selected, the lighting items needed would be addressed in a change order.

Question #10– Rustler Construction
Please consider removing, on the bid forms, the requirement to provide total on each sheet.

Response: The Bid Forms will remain the same.

Question #11 – Rustler Construction
Note that on the bid forms, the quantity is normally 1 when the unit is lump sum. Please revise accordingly.

Response: Lump Sum payment is tied directly to the percentage of work completed, or as stated in the Bid Documents.

Question #12– Rustler Construction
SP-48R provided in Addendum No. 2 indicates Contingent 30 Mil Synthetic Liner. Bid forms do not describe it as a contingent item (item 3020B). Please clarify.

Response: See revised SP-48R_for clarification.

Question #13– Rustler Construction
Is there any water relocation in this project? Please clarify and provide bid items.

Response: There is no anticipated water relocation.

Question #14– Rustler Construction
Is all rebar to be used in this project to be epoxy coated?

Response: Yes, per MDOT SHA Standard Specification 917.02.

Question #15– Rustler Construction
What is the MD SHA Concrete Mix number to be used in bid item 3003B?

Response: Item 3003B – Nonstandard Endwall shall use Concrete Mix # 2.

Question #16– Rustler Construction
Is there any rebar to be placed in the driveway? If affirmative, please provide sizes, details, epoxy coated, etc.

Response: No, use MDOT SHA Standard Detail 630.01 as shown on Construction Drawing Sheet 6.

Question #17– Rustler Construction
How is the County going to pay for the 12" GAB shown on detail-Eastern Boulevard on Sheet 7?

Response: We have added Item 5016A Graded Aggregate Base – 12 Inch Depth. The Item and quantity have been added to the Bid Forms Schedule of Prices page 2.24R.

Question #18– Rustler Construction
Under what items are the excavations for Curb & Gutters/Sidewalks/Driveways going to be paid?

Response: Use Items 2001B and 2001A – Class 1 and 2 Excavation.

Question #19– Rustler Construction
Provide quantities of existing Curb & Gutters/Sidewalks/Driveways to be removed and replaced. How much is new vs how much needs to be replaced in each line item?

Response: All of the existing curbs, gutters, sidewalks, and driveway entrances will be removed in the Add Alternate using Item 2001A and replaced with the corresponding items (6001A, 6002A, 6004A, 5008A).

Question #20– Rustler Construction
Please provide Geotechnical report (text) for this project.

Response: The Geotechnical report for Professional Boulevard Phases 1 and 2 combined is included in this Addendum.

Question #21– Rustler Construction
Does the County anticipate awarding any adjacent work during the construction period of this project?

Response: No.

Question #22– Rustler Construction
There is a requirement for builder's risk insurance – this is not typical on a roadway project. What is the County wanting covered as we will need a cost replacement value for said items.

Response: Coverage should include construction equipment and materials awaiting installation onsite or for damage while in transit. See GC-67.

Question #23– Rustler Construction
Please provide additional time for questions. The county will benefit from more accurate and competitive bids.

Response: Two weeks additional time was given from the original question deadline.

Question #24– C. William Hetzer, Inc.
Page SP-19 of the Specification states "The total of the Base Bid plus the Add Alternate if selected will be used as the basis for evaluation of quotations and award of the Contract". Can we be assured that if awarded, the Project will include both Base and Add Alternate Items?

Response: See Page ITB-10 of the Bid Document Section ITB 1.14 AWARD. "The total base bid plus any add alternates selected will be used as a basis for evaluation of the bids and award of the Contract. If the add alternate is not selected, the base bid alone will be used as the basis for evaluation."

Question #25– C. William Hetzer, Inc.
Based on utility information shown on Plan Sheets 8, 8A, and 9, there are numerous gas line conflicts encountered in the storm drain installation. Note 6 on page 8 states, "Gas main may require relocation if impacted by proposed storm drain." Please confirm that the Owner will pay for all costs and delays associated with utility relocation(s).

Response: Please refer to the Utility Statement beginning on SP-122 of the Bid Document. The owner will pay the utility company directly for all costs associated with its relocation.

Question #26– C. William Hetzer, Inc.
Note 3 on Sheet 8 states, "Existing inlets, water valves, and manholes shall be adjusted to proposed grades". Items 8050A and 8051A of the Bid Form provides for adjustments to the sanitary manholes and cleanouts only. Please provide additional bid items for adjusting storm drain inlets and waterline valve boxes.

Response: We have added Item 8052A Adjust Existing Stormdrain Manhole and Item 8053A Adjust Existing Water Valves. The Items and quantities have been added to the Bid Forms Schedule of Prices page 2.34R.

Attachments:

Special Provisions, Page SP-48R (1 Page)
Bid Forms, Page BF-2.24R (1 Page)
Bid Forms, Page BF-2.34R (1 Page)
Geotechnical Report (154 Pages)

END ADDENDUM No. 2

CATEGORY 300
DRAINAGE

30 MIL SYNTHETIC LINER

DESCRIPTION. This work is to install a synthetic liner in the proposed bioswales when rock is encountered during excavation and the Engineer determines the subgrade poses an increased possibility of sinkhole development.

MATERIALS. 30 mil U/V Resistant Polyethylene D4397

30 mil U/V Resistant PCV per Construction Dwg SW-09

CONSTRUCTION. When rock is encountered, contact the Geotech and the Engineer to make the determination. Install per the details on the Construction Drawings.

MEASURMENT AND PAYMENT. 30 Mil Synthetic Liner will be measured at the Contract Unit Price per Square Yard accepted in place. The payment will be full compensation for all excavation, material, labor, backfill, and for all overlap. All liner overlap shall be incidental to the cost of the liner installation.

ITEM	CODE	QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE		ITEM TOTAL	
5009A	-	830	L.F.	5 INCH WHITE THERMOPLASTIC PAVEMENT MARKING LINES	_____	__	_____	__
5010A	-	625	L.F.	5 INCH YELLOW THERMOPLASTIC PAVEMENT MARKING LINES	_____	__	_____	__
5011A	-	400	L.F.	12 INCH WHITE THERMOPLASTIC PAVEMENT MARKING LINES	_____	__	_____	__
5012A	-	120	L.F.	24 INCH WHITE PREFORMED THERMOPLASTIC PAVEMENT MARKING LINES	_____	__	_____	__
5013A	-	134	S.F.	WHITE PREFORMED THERMOPLASTIC PAVEMENT MARKING LEGENDS AND SYMBOLS	_____	__	_____	__
5014A	-	670	L.F.	REMOVAL OF EXISTING PAVEMENT MARKING LINES, ANY WIDTH	_____	__	_____	__
5015A	-	31	S.F.	REMOVAL OF EXISTING PAVEMENT LETTERS, SYMBOLS, ARROWS, AND NUMBERS	_____	__	_____	__
5016A	-	**490**	**S.Y.**	**GRADED AGGREGATE BASE - 12 INCH DEPTH**	_____	__	_____	__
						Total This Sheet	_____	__

End Category 5000-"A" Items
Contract No. RD-PB-270-10

"A" Is For Add Alternate Bid

ITEM	CODE	QUANTITY	UNIT	ITEM DESCRIPTION	UNIT PRICE		ITEM TOTAL	
8047A	-	2	EA.	10 FT BREAKAWAY PEDESTAL POLE (POWDER COATED HADCO GREEN)	_____	__	_____	__
8048A	-	1	EA.	27 FT STEEL POLE WITH A SINGLE 50 FT MAST ARM (POWDER COATED HADCO GREEN)	_____	__	_____	__
8049A	-	LUMP SUM	L.S.	REMOVE AND DISPOSE OF EXISTING SIGNAL EQUIPMENT	_____	__	_____	__
8050A	-	2	EA.	ADJUST EXISTING SEWER MANHOLE	_____	__	_____	__
8051A	-	3	EA.	ADJUST EXISTING SEWER CLEAN OUT	_____	__	_____	__
8052A	-	**3**	**EA.**	**ADJUST EXISTING STORMDRAIN MANHOLE**	_____	__	_____	__
8053A	-	**8**	**EA.**	**ADJUST EXISTING WATER VALVES**	_____	__	_____	__
					Total This Sheet		_____	__

End Category 8000-"A" Items
Contract No. RD-PB-270-10

"A" Is For Add Alternate Bid

SUBSURFACE EXPLORATION & GEOTECHNICAL EVALUATION

Professional Boulevard Bridge and Extension

Washington County, Maryland

Prepared for:
Washington County Division of Engineering and Construction Management

RK&K Commission No. 14187-03.4
December 5, 2016

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Senior Manager, Geotechnical Engineering Department

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1 INTRODUCTION

In accordance with our proposal dated September 12, 2014, Rummel, Klepper & Kahl, LLP (RK&K) has completed the Subsurface Exploration and Geotechnical Engineering Evaluation for the Professional Boulevard Bridge and Extension project in Washington County, Maryland.

The purpose of this study was to determine general subsurface conditions at the project site and to evaluate those conditions with respect to geotechnical engineering considerations for the proposed construction. The specific scope of our services on this project consisted of exploring the subsurface conditions using geophysics, soil borings, and laboratory testing, evaluating the conditions encountered, developing geotechnical recommendations, and submitting our findings in a report. Based on this geotechnical study, recommendations are provided for bridge foundations, mechanically stabilized earth walls, earthwork, pavement sections, stormwater management and other geotechnical concerns.

Also included in this report are descriptions of the field and laboratory testing on which this report is based. The results of this work are contained in the appendix of this report.

2 SITE AND PROJECT DESCRIPTION

2.1 SITE DESCRIPTION

The project site is located at the existing Professional Court near Antietam Creek in Washington County, Maryland as shown in Figure A-1 and will continue to intersect with the extended Yale Drive.

Professional Court is an unstriped local road on the east side of Eastern Boulevard with entrances to commercial and retail businesses. Professional Court is approximately 1,200-ft long from its intersection at Eastern Boulevard, 35-ft wide and terminates at a cul-de-sac. It is a closed end section and there are sidewalks on both sides of Professional Court. East of the cul-de-sac is Antietam Creek that flows north to south. East of the creek, the project site is about one mile of rolling hills with forest and farmland. Table 2.1 summarizes existing ground surface elevations and grades along the project alignment.

Table 2.1 – Summary of Existing Ground Surface Elevations

Location	Station	Elevation
Professional Court and Eastern Boulevard	10+50	497
Professional Court	14+75	495
Professional Court	20+00	511
Professional Court Eastern Terminus	22+75	507
Antietam Creek West Bank	26+50	468
Antietam Creek Stream Elevation	27+25	460
Antietam Creek East Bank	27+50	469
Proposed Professional Boulevard (Rock Outcropping)	31+50	511
Proposed Professional Boulevard	36+50	488
Proposed Professional Boulevard	40+40	508
Proposed Professional Boulevard	42+50	495
Proposed Professional Boulevard	45+40	528
Proposed Professional Boulevard	46+60	517
Proposed Professional Boulevard: End Project Limits	52+50	530

Table 2.2 summarizes the water levels in Antietam Creek.

Table 2.2 – Antietam Creek Water Levels	
Location	**Elevation (ft)**
Normal	465.19
10 Year Storm	477.04
100 Year Storm	484.20

The area west of Antietam Creek contains several existing underground utilities including water, sewer, gas, electric and communications. Approximate locations of known utilities are shown on Figures A-2a through A-2h in Appendix A.

2.2 PROJECT DESCRIPTION

The proposed construction will include the widening of the existing Professional Court and extending the roadway eastward over and beyond Antietam Creek where it will intersect the proposed limits of another roadway project, Yale Drive. Professional Court will be renamed Professional Boulevard.

2.2.1 Roadway

The proposed Professional Boulevard will be approximately 4,200-ft in length including the existing Professional Court, bridge and roadway extension. The existing Professional Court will be widened and the cul-de-sac will be removed. The proposed roadway will consist of two lanes in each direction. The roadway will be 48-ft wide undivided west of STA 30+60, and it will be 68-ft wide divided including a 12-ft grass median east of STA 30+60. Table 2.3 summarizes the earthwork involved in meeting the proposed grade elevations.

Table 2.3 – Summary of Proposed Earthwork Cut and Fill			
Start Station	End Station	Cut / Fill	Depth (ft)
10+50	21+75	Match Existing Professional Court	
21+75	25+60	Fill	0 - 20
25+60	28+60	Bridge Over Antietam Creek	
28+60	29+20	Fill	1-3
29+20	35+10	Cut	1-10
35+10	40+25	Fill	1-5
40+25	41+00	Cut	0-2
41+00	44+20	Fill	1-12
44+20	46+20	Cut	1-15
46+50	50+00	Fill	1-3

It is anticipated that the existing asphalt concrete pavement of Professional Court will be milled and overlaid. The extension of Professional Boulevard will consist of a new flexible pavement section. Table 2.4 summarizes the pavement design parameters that were developed for this project. The subgrade elevations of the new pavement will need to match the existing subgrade elevations. This road will be a minor arterial.

Table 2.4 – Summary of Pavement Design Parameters

Parameter	Value
Average Daily Traffic	See Section 5.5
Percent Truck Traffic	4.7 (Class 4 or greater)
Truck ESAL Factor	Based on MDSHA Truck Class
Performance Period	25 - years
Annual Growth	2.0 - percent
Total Equivalent Single Axles Loads (ESAL)	See Section 5.5
Reliability	85 - percent
Overall Standard Deviation	0.49
Initial Serviceability	4.2
Terminal Serviceability	2.8
Soil Resilient Modulus, Mr*	4,500 - psi
Rock Resilient Modulus, Mr*	10,500 - psi
Mr = 1,500 x California Bearing Ratio (CBR)	

2.2.2 Bridge

The bridge over Antietam Creek will be a 3-span semi-integral, continuous, steel girder bridge. The bridge will be 300-ft long, with span lengths of 90-ft, 120-ft, and 90-ft. The elevations of the proposed foundation elements and the scour elevations at each foundation are summarized in Table 2.5 and Table 2.6, respectively.

Table 2.5 – Bridge Proposed Foundation Elevations

Structural Element	Station	Bottom of Footing EL (ft)
Abutment A (West)	25+59.00	491.10
Pier 1	26+49.00	465.50
Pier 2	27+69.00	465.50
Abutment B (East)	28+59.00	483.95

Table 2.6 - Scour Elevations					
Location	**100-Year Storm**	**500-Year Storm**	**Contraction Scour 100-Yr**	**Contraction Scour 500-Yr**	**Top of Bedrock**
Pier No.1	461.1*	458.3*	465.9	465.22	463
Pier No. 2	459.0*	461.6	468.64	468.14	461
Abutment A	462.8*	466.8*	476	475.3	472

*The Erodibility Index Method and conservative values indicate that the rock is resistant to scour. Therefore, the scour elevations used in design should be no lower than the top of bedrock.

Table 2.7 summarizes the design loads for each foundation element.

Table 2.7 – Summary of Drilled Shaft Loads				
	Abutment A		**Piers**	
Load	**Strength**	**Service**	**Strength**	**Service**
Longitudinal – Fz (kips)	218	150	155	140
Transverse - Fx (kips)	0	0	20	15
Axial - Fy (kips)	1,756	1,357	3,510	2,475
Moment – Mx (kip-ft)	365	247	4,030	3,645
Moment – Mz (kip-ft)	N/A	N/A	19,990	15,275
* Loads are for the whole foundation				

2.2.3 Mechanically Stabilized Earth Walls

Mechanically stabilized earth wall construction within the limits of the proposed Professional Boulevard extension will consist of the following structures.

2.2.3.1 Retaining Wall 1: Right Offset

Retaining Wall 1 will be approximately 70-ft 6-in in length and will be located along the south side of the west approach to the bridge. The wall will extend from approximately STA 24+93.50 to STA 25+64.00. The existing ground surface in this area ranges from approximately EL 499.03 to EL 480.4.

Table 2.8 summarizes the dimensions of the proposed Retaining Wall 1. The design wall height is measured from the bottom of the leveling pad to the top elevation of the proposed wall. The anticipated front slope is also included in Table 2.8.

Table 2.8 – Dimensions of Retaining Wall 1			
STA	**Design Wall Height (ft)**	**Bottom of Leveling Pad EL.**	**Top of Wall EL.**
24+93.50	9.66	492.50	502.16
25+04.00	11.60	490.50	502.10
25+14.00	13.40	488.50	501.90
25+24.00	16.20	485.50	501.70
25+34.00	20.00	481.50	501.50
25+44.00	24.80	476.50	501.30

As indicated above, the maximum wall height of Retaining Wall 1 is near 24.8-ft.

2.2.3.2 Retaining Wall 2: Abutment Face

Retaining Wall 2 will be approximately 65.8-ft in length and will be located in front of the western bridge abutment, between the abutment and the river. The wall will be located at approximately STA 25+64. The existing ground surface in this area ranges from approximately EL 478 to EL 480.4. Above the wall will be the Professional Boulevard Bridge and below the wall will be Antietam Creek.

Table 2.9 summarizes the dimensions of the proposed Retaining Wall 2. The design wall height is measured from the bottom of the leveling pad to the top elevation of the proposed wall.

Table 2.9 – Dimensions of Retaining Wall 2			
STA	**Design Wall Height (ft)**	**Bottom of Leveling Pad EL.**	**Top of Wall EL.**
25+64.00	18.45	476.50	494.95
25+64.00	19.45	475.50	494.95
25+64.00	20.45	474.50	494.95

As indicated above, the maximum wall height of Retaining Wall 2 is near 20.45-ft.

2.2.3.3 Retaining Wall 3: Left Offset

Retaining Wall 3 will be approximately 238-ft in length and will be located on the north side of the proposed western approach, opposite RW 1. The wall will extend from approximately STA 23+74.00 to STA 25+64.00. The existing ground surface in this area ranges from approximately EL 478.8 to EL 500.2.

Table 2.10 summarizes the dimensions of the proposed Retaining Wall 3. The design wall height is measured from the bottom of the leveling pad to the top elevation of the proposed wall.

Table 2.10 – Dimensions of Retaining Wall 3

STA	Design Wall Height (ft)	Bottom of Leveling Pad EL.	Top of Wall EL.
23+74.00	8.58	495.50	504.08
24+00.00	10.16	493.50	503.66
24+25.00	12.76	490.50	503.26
24+50.00	14.86	488.00	502.86
24+75.00	16.45	486.00	502.45
25+00.00	18.55	483.50	502.05
25+25.00	21.15	480.50	501.65
25+50.00	23.75	477.50	501.25
25+64.00	20.45	474.50	494.95

As indicated above, the maximum wall height of Retaining Wall 3 is near 23.75-ft.

2.2.3.4 Retaining Wall 4

Retaining Wall 4 is proposed from STA 41+62.81 to STA 44+20.20 to avoid impacting a recently constructed pond that was built for an adjacent project. The wall will be approximately 273-ft long. The existing ground surface in this area ranges from approximately EL 494 to EL 507.

Table 2.11 summarizes the dimensions of the proposed Retaining Wall 4. The design wall height is measured from the bottom of the leveling pad to the top elevation of the proposed wall. The ground surface in front of RW4 ranges from horizontal to sloping at approximately 10(H):1(V).

Table 2.11 – Dimensions of Retaining Wall 4			
STA	**Design Wall Height (ft)**	**Bottom of Leveling Pad EL.**	**Top of Wall EL.**
41+62.81	7.05	500.50	507.55
41+75.00	8.92	498.50	507.42
42+00.00	11.26	496.00	507.26
42+25.00	13.22	494.00	507.22
42+50.00	15.31	492.00	507.31
43+50.00	14.93	494.00	508.93
43+75.00	13.65	496.00	509.65
44+00.00	8.00	499.00	510.50
44+10.14	8.89	502.00	510.89
44+20.28	6.28	505.00	511.28

As indicated above, the maximum wall height of Retaining Wall 4 is near 15.31-ft.

2.2.4 Stormwater Management

The proposed construction includes bioswales for stormwater management on both the north and south sides of Professional Boulevard. The bioswales will run from the cul-de-sac at STA 22+00 to the east end of the project limits and will have invert elevations consistently 1.5-ft below the proposed roadway surface. Sideslopes will be cut to 3(H):1(V). Infiltration will not be used to manage storm runoff because of the existence of karst features in the area.

2.3 UTILITIES

The approximate locations of many of the currently known utilities are shown in Figure A-2 in Appendix A. There is an existing underground gas utility in the area of the proposed Retaining Wall 3. Test pits are proposed to be excavated to locate the gas utility underlying Retaining Wall 3. Once the test pits are complete, the utility owner should evaluate whether reinforcing or relocating the utility will be required based on recommendations provided in Section 5.8.

Several storm drain pipes are proposed to extend through or under RW4. The details of these storm drain pipes were not available at the time of the writing of this report.

3 FIELD AND LABORATORY WORK

3.1 FIELD EXPLORATION

The subsurface exploration consisted of drilling forty-seven Standard Penetration Test (SPT) borings from April 25 through May 17, 2016. The test borings were drilled by AB Consultants, Inc. of Lanham, Maryland, under contract to Rummel, Klepper & Kahl, LLP. The borings were drilled using a Mobile B57 ATV-mounted drill rig equipped with an automatic hammer. Ground surface elevations of the borings were estimated from the plans. Table 3.1 summarizes the locations and depths of the borings. Boring locations are shown in Figures A-2a through A-2h in Appendix A of this report.

Table 3.1 – Summary of Borings

Boring No.	Primary Purpose	Station / Offset	G.S. Elevation	Depth (ft)
RB-01	Roadway	15+50 30 RT	497	10.0
RB-02	Roadway	20+35 25 LT	510	10.0
SWM-26	Bioswale	22+10 45 RT	506	11.0
SWM-27	Bioswale	22+20 95 RT	501	5.0
SWM-28	Bioswale	23+10 70 RT	503	10.0
SWM-29	Bioswale	23+75 30 LT	501	9.0
AR-01	Bridge Approach	24+60 0	493	13.0
SWM-30	Bioswale	25+00 30 LT	496	7.0
AB-01	Bridge West Abutment	25+60 24 LT	481	26.0
AB-02	Bridge West Abutment	25+60 22 RT	481	29.5
P-01	Bridge Pier 1	26+50 20 LT	470	17.5
P-01A*	Bridge Pier 1	26+50 15 LT	470	27.5
P-02	Bridge Pier 2	27+65 17 RT	470	29.0
AB-03	Bridge East Abutment	28+60 22 LT	492	23.0
AB-04	Bridge East Abutment	28+60 22 RT	490	23.0
SWM-01	Bioswale	29+50 37 LT	500	18.0
SWM-13	Bioswale	29+50 40 RT	503	11.0
SWM-18	Bioswale	29+50 40 LT	503	12.0
RB-03	Roadway	31+80 0	510	10.0
SWM-02	Bioswale	32+00 41 LT	507	17.2
SWM-14	Bioswale	32+00 41 RT	509	5.5
SWM-14A*	Bioswale	32+05 41 RT	509	7.5
SWM-03	Bioswale	34+50 41 LT	502	18.0
SWM-05	Bioswale	34+50 41 RT	502	11.0
SWM-15	Bioswale	34+50 41 RT	501	16.0

Table 3.1 – Summary of Borings				
Boring No.	Primary Purpose	Station / Offset	G.S. Elevation	Depth (ft)
RB-04	Roadway	35+60 0	493	10.0
SWM-04	Bioswale	36+00 41 LT	490	10.0
SWM-16	Bioswale	36+00 41 RT	491	10.0
RB-05	Roadway	40+00 0	504	12.0
SWM-06	Bioswale	41+00 41 LT	502	8.1
SWM-19	Bioswale	29+50 37 LT	502	14.0
RB-06	Roadway	29+50 40 RT	502	10.0
SWM-07	Bioswale	43+00 41 LT	495	7.5
SWM-20	Bioswale	43+00 41 RT	497	9.0
SWM-08	Bioswale	44+50 41 LT	518	1.0
SWM-21	Bioswale	44+50 41 RT	498	1.0
RB-08	Roadway	45+00 0	512	20.0
SWM-09	Bioswale	46+00 41 LT	525	6.0
SWM-22	Bioswale	46+00 41 RT	514	2.5
RB-07	Roadway	47+50 16 LT	518	9.9
SWM-10	Bioswale	48+00 41 LT	520	15.0
SWM-23	Bioswale	48+00 41 LT	518	13.0
SWM-11	Bioswale	50+00 41 LT	522	12.0
SWM-24	Bioswale	50+00 41 RT	520	7.0
SWM-12	Bioswale	52+00 37 LT	525	10.0
SWM-17	Bioswale	52+00 37 RT	525	4.0
SWM-25	Bioswale	52+00 41 RT	529	14.0
* Offset borings. See Test Boring Logs in Appendix B for details				

3.2 SOIL SAMPLING

Soil samples for the roadway and bridge borings were obtained at 2.5-ft intervals. Soil samples for the stormwater management borings were obtained continuously. In general, the SPT consists of advancing a 2-inch outside diameter sampling spoon 18-inches by driving it with a 140-pound hammer falling 30-inches (ASTM D 1586). Soil samples for all SWM borings were obtained by advancing the sampling spoon 24-inches. The values reported on the boring logs are the blows required to advance the sampling spoon each 6-inch increments. The first 6-inch increment is considered as seating. The sum of the number of blows for the second and third increments is the "N" value.

Bulk samples were obtained from the auger cuttings of Borings RB-01 to RB-08.

The soils were classified in general accordance with the Unified Soil Classification System (USCS) (ASTM D 2487) and the American Association of State Highway and Transportation Officials (AASHTO) Method 145. The USCS designations are shown on the Summary of Boring Data, Figure A-3. An RK&K field engineer recorded the classifications, observations, water and cave in depths and field sampling information on the Test Boring Logs contained in Appendix B.

Depth to groundwater was noted during the drilling operations. Groundwater levels were measured at the completion of drilling and, when possible, 24 hours or longer after the completion of drilling. The depth to the bottom of each borehole was also measured after the removal of the drilling augers to determine the susceptibility of the borehole to collapse or cave. This information is summarized in Section 4.3 Table 4.4.

3.3 ROCK SAMPLING

Bedrock was sampled using an NQ diamond bit with a double tube, swivel type barrel, which provides a 1.875-inch diameter core. The core description, core recovery, the Rock Quality Designation (RQD), and other pertinent information were recorded on the Test Boring Logs and on the Summary of Boring Data. The RQD value reflects the quality and fracture spacing of the rock and is defined as the sum of the length of rock pieces greater than 4-inches divided by the total core run length. The percentage of core recovery and RQD values provide an understanding of the physical and engineering properties of the rock.

3.4 LABORATORY TESTING

The laboratory testing consisted of determining the natural moisture content, grain-size distribution, Atterberg limits, modified Proctor moisture-density relationship, and California Bearing Ratio (CBR) for selected soil samples. The unconfined compressive strength was determined for selected rock core samples using the Point Load Test (PLT) method. Results of the soil and rock testing are included in Appendix C.

3.5 GEOPHYSICAL INVESTIGATION

To supplement the test borings, electrical resistivity tomography was performed by Enviroscan, Inc. on March 3, 2016. Please see Appendix D for the full Geophysical Investigation Report. Please see Appendix A-5 for an approximate interpretation of the bedrock profile.

4 SUBSURFACE CONDITIONS

4.1 GEOLOGY

4.1.1 Available Mapping

According to the Geologic Map of Maryland (1968) the project site is located in the South Mountain Anticlinorium and Frederick Valley section of the Eastern Piedmont Physiographic Province. Natural soils in this region are residual soils which have formed in place by the weathering of the parent bedrock. The project site appears to be located where the parent materials are mapped as the Frederick Formation consisting of limestone deposited during the Cambrian Period.

In situ decomposition of the parent carbonate rock typically produces a surficial layer of residual soil of variable thickness. Localized concentrations of bedding planes, fractures and other discontinuities often result in decomposition extending to deeper levels. Occasionally, solution activity develops below the rock surface, and these are generally filled with very soft reworked residual material. Sometimes the soils will arch over the cavity until the cavity becomes too large and then the soil collapses forming a sink hole. The more resistant less fractured rock will often form pinnacles of unweathered rock often extending to the ground surface. This combines with the solution cavities to form a very irregular rock surface.

More specifically, the site is located in the Cambrian Region, containing limestone, dolomite, shale, and sandstone. Conococheague Limestone described as dark blue, laminated, oolitic, argillaceous and siliceous limestone, algal limestone, and flat-pebble conglomerate; siliceous shale partings; some sandstone and dolomite. The Stonehenge Formation is part of a syncline/anticline trending N-NE, with the syncline running along Antietam Creek and the anticline to the east.

According to the Geologic and Karst Features Map of the Hagerstown Quadrangle, Washington County, Maryland (2013), the site spans across the following formations. The location of each is shown in Figure A-4 in Appendix A.

Stonehenge Formation Middle Member (Osm): The lower part of the middle member is composed of massive, medium gray, algal lime boundstone. Grades upsection into interbedded medium to dark algal thrombolites and medium gray, thinly bedded to ribbony, locally fossiliferous, lime wackestone to lime packstone. Several thin, tan dolomite beds occur near the middle of the unit.

Stonehenge Formation-Stoufferstown Member(Oss): Dark gray, argillaceous, thinly bedded to ribbony, lime mudstone with thin beds of flat-pebble lime grainstone conglomerate and hummocky, discontinuous, thin beds of laminated limestone. A single, 10-ft interval of massive, dark gray, thrombolytic, algal boundstone occurs approximately 30-ft above the base of the member. The member weathers into thin, brown and orange chips, which litter overlaying soil. Forms a low, discontinuous ridge. There are two known sinkholes mapped near the proposed alignment and several sinkholes near MD-64 found within this unit.

Stonehenge Formation-Upper Member(Osu): Medium to medium dark gray, medium-bedded, ribbony and oolitic, lime mudstone to packstone. Near the base of the member ribbony lime mudstone predominates. Upsection, medium gray, ribbony lime mudstone becomes interbedded with intervals of flat-pebble lime grainstone, and hummocky, thickly laminated lime packstone and oolitic lime packstone to grainstone. Locally, thin, algal thrombolites are present. This member commonly forms a persistent and mappable ridge and is frequently well-exposed. There is a high angle reverse fault mapped between the Stonehenge Formation Middle Member and the Stonehenge Formation-Upper member.

Rockdale Run Formation (Orr): Interbedded and cyclic limestone and dolomite, cherty in the lower 400-ft. Limestone intervals consist of medium to light gray, ribbony and thrombolytic to stromatolitic, lime mudstone to boundstone. Locally, limestone layers are light gray oolitic packstone to oolitic grainstone. Lies near the axis of a syncline, beneath Antietam Creek and the overlying alluvium deposits. Generally, strikes N-NE and dips 24-deg to 32-deg to the east.

Conococheague Formation Upper Member (Єcu): Interbedded medium to light gray, ribbony, lime mudstone that weathers to flaggy to platy beds, and arenaceous grainstone exhibiting edgewise and flat-pebble conglomerates. Locally, thin, pastel blue and pink marble strata are developed. Black or gray chert fragments and brown-weathering quartz sandstone cobbles are frequently abundant in overlaying soil. Generally strikes N-NE and has vertical bedding.

Conococheague Formation Middle Member (Єcm): Predominantly cyclically bedded, medium to dark gray, limestone and gray, laminated limestone and tan, laminated dolomite. Generally strikes N-NE and dips 35-deg to 60-deg.

Terrace Deposits (Qt): Reddish brown, sandy and clayey mixture of rounded pebbles to cobbles of sandstone, vein quartz, and quartzite. Present along elevated areas above Antietam Creek. Thickness ranges from a thin veneer to more than 10-ft. This unit is mapped as a cap in the area of the existing Professional Court. Although mapped in this area, borings did not encounter this material.

Alluvium: Poorly sorted, unconsolidated, tan, reddish brown, to dark gray mud, silt, sand and pebbles. Deposited within the channels of streams and on the flood plain adjacent to the streams. Mostly occurs along Antietam Creek.

4.1.2 Results of Geophysical Survey

The geophysical survey by Enviroscan, Inc. revealed a number of potential pinnacles and slots in the karsted bedrock. Potential pinnacles were located near STA 29+00, STA 30+00, STA 31+20, STA 40+50, STA 42+20, and STA 50+50. Potential slots were located near STA 22+20, STA 23+50, STA 30+50, STA 31+50, STA 32+50, STA 40+00, STA 42+00 and STA 43+90.

4.2 SUBSURFACE CONDITIONS

The Summary of Boring Data and the Test Boring Logs in Appendices A and B provide details related to the subsurface conditions encountered in the various borings. The stratification lines shown on the Summary of Boring Data and Test Boring Logs represent approximate transitions between material types. In situ, strata changes could occur gradually or at slightly different levels. Also, the borings depict conditions at particular locations and at the particular times indicated. Some conditions, particularly groundwater conditions between borings, could vary from the conditions encountered at the particular boring locations.

Topsoil: Topsoil was typically encountered at the surface of the borings and extends to depths ranging from 2-inches to 12-inches as shown in Table 4.1.

Table 4.1 – Topsoil Thickness Encountered in Test Borings	
Boring No.	Topsoil Thickness (inches)
AB-01	6
AB-02	6
AB-03	6
AB-04	6
AR-01	6
P-01	6
P-02	12
RB-03	6
RB-04	10
RB-05	2
RB-06	6
RB-07	6
RB-08	<1
SWM-01	3
SWM-02	6
SWM-03	8
SWM-04	6
SWM-05	6
SWM-06	2
SWM-07	3
SWM-08	12
SWM-09	12
SWM-10	6
SWM-11	6
SWM-12	6
SWM-13	6
SWM-14	6
SWM-15	10
SWM-16	10
SWM-17	3
SWM-18	2
SWM-19	6
SWM-20	6
SWM-21	12
SWM-22	6

Table 4.1 – Topsoil Thickness Encountered in Test Borings	
Boring No.	Topsoil Thickness (inches)
SWM-23	6
SWM-24	6
SWM-25	6
SWM-26	3
SWM-27	3
SWM-28	3
SWM-29	6
SWM-30	6

Existing Pavement: Borings RB-01 and RB-02 were drilled through the existing Professional Court roadway. Table 4.2 summarizes the pavement types and thicknesses observed.

Table 4.2 – Pavement Thickness Encountered in Test Borings		
Boring No.	Bituminous Concrete (inches)	Aggregate Base (inches)
RB-01	5	4
RB-02	5	5

The borings encountered the following three strata:

Stratum I – Alluvial Material: Stratum I was encountered in borings AB-01, AB-02, AB-03, P-1, and P-2 underneath surficial material and extended to depths ranging from 3-ft to 9.5-ft beneath the existing ground surface. Stratum I typically consists of brown to brownish gray, soft to stiff, medium to high plasticity CLAY with varying percentages of Silt and Sand and trace to no Gravel (CL, CH) [A-6, A-7-6]. SPT-N values ranged from 2 blows per foot (bpf) to 13 blows per foot (bpf). The natural moisture content ranges from 20.4-percent to 33-percent and averages 27.7-percent. The liquid limit ranges from 29 to 64, and the plastic limit ranges from 15 to 24.

Stratum II – Residual Soils: Stratum II was encountered in all borings except for AB-04 and RB-08, where rock was encountered immediately below the ground surface, underneath surficial material (topsoil) and extended to depths ranging from 2-ft to 13-ft beneath the existing ground surface. Stratum II typically consists of brown to brownish gray, soft to very stiff, medium to high plasticity CLAY with varying percentages of Silt, trace Sand, and trace to no Gravel (CL, CH) [A-6, A-7-6]. SPT-N values ranged from 4 blows per foot (bpf) to 50/5-inches blows per foot (bpf). The natural moisture content ranges from 14.0-percent to 37.6-percent and averages 30.6-percent. The liquid limit ranges from 43 to 77, and the plastic limit ranges from 15 to 28.

Auger refusal was encountered at depths ranging from 0.0-ft to 12.0-ft below the existing ground surface as shown in Table 4.3. Auger refusal may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Rock coring techniques are required to determine the character and continuity of the refusal materials.

Table 4.3 – Summary of Auger and Spoon Refusal

Boring No.	Auger Refusal		Spoon Refusal	
	Depth (ft)	Elevation	Depth (ft)	Elevation
AB-01	6.0	475.0	6.0	475.0
AB-02	9.5	471.5	8.5	472.5
AB-03	3.0	489.0	--	--
AB-04	3.0	487.0	1.0	489.0
AR-01*	10.0	483.0	--	--
P-01	7.5	462.5	6.0	464.0
P-01A	7.5	462.5	--	--
P-02	9.0	461.0	8.0	462.0
RB-05	12.0	491.5	12.0	491.5
RB-07	--	--	9.5	508.0
RB-08	0.0	511.7	--	--
SWM-02	--	--	17.0	490.2
SWM-06	8.0	494.1	8.0	494.1
SWM-07	--	--	7.5	488.0
SWM-08	1.0	516.9	--	--
SWM-09	6.0	518.7	--	--
SWM-13	11.0	491.5	10.0	492.5

Table 4.3 – Summary of Auger and Spoon Refusal				
Boring No.	Auger Refusal		Spoon Refusal	
	Depth (ft)	Elevation	Depth (ft)	Elevation
SWM-14	5.5	503.5	4.0	505.0
SWM-14A	7.5	501.5	7.5	501.5
SWM-17	4.0	521.1	4.0	521.1
SWM-18	12.0	490.5	--	--
SWM-21	1.0	496.6	--	--
SWM-22	2.5	511.7	2.0	512.2
SWM-24	7.0	512.9	7.0	512.9
* Auger refusal at 10-ft, but spoon broke through.				

Stratum III – Bedrock: Bedrock was encountered beneath surficial material, Stratum I, or Stratum II. Stratum III consisted of light gray, medium strong to strong LIMESTONE. Recovery ranged from 31 to 100-percent and averaged 90-percent. The Rock Quality Designation (RQD) ranged from 0 to 100-percent and averaged of 83.7-percent. Unconfined compressive strength ranged from 648-ksf to 2,399-ksf with an average of 1,643-ksf. Electrical resistivity surveys suggest that this stratum is pinnacled and contains some soft areas extending to depth as well as other anomalies.

4.3 GROUNDWATER

Groundwater was not encountered in the borings during drilling. It is generally desirable to allow test borings to remain open for at least 24 hours after the completion of drilling and the removal of the drill tools and casing from the borehole. The purpose of this procedure is to allow the groundwater level in each borehole to recover from the effects of the test drilling. In clay soils, the length of time may extend several days before the groundwater level recovers to the pre-drilling elevation. It was necessary to backfill certain borings immediately after the completion of drilling due to traffic, safety and/or logistical concerns. Groundwater data is summarized in Table 4.4.

A more accurate determination of the hydrostatic water table would require the installation of perforated pipes or piezometers which could be monitored over an extended period of time. The actual level of the hydrostatic water table and the amount and level of perched water should be anticipated to fluctuate throughout the year, depending upon variations in precipitation, surface runoff, infiltration, site topography, and drainage.

In addition to groundwater levels, the depth to the bottom of each borehole was measured to determine the susceptibility of the borehole to collapse or cave. This information provides the contractor with information regarding the "stand-up" time of the soil, or the ability of the sides of an excavation to remain vertical or near vertical during trench excavation. This information is summarized in Table 4.4.

Table 4.4 – Summary of Borehole Groundwater and Cave Data

Boring No.	Ground Surface Elevation	Groundwater Elevation		24-Hour Cave Depth (ft)
		Initial	24-Hour	
AB-01	481.0	NE	NE	4
AB-02	481.0	NE	NE	7
AB-03	492.0	NE	NE	7
AB-04	490.0	NE	NE	10
AR-01	493.0	NE	NE	8.3
P-01A	470.0	NE	467.0	7
P-02	470.0	NE	466.0	8
RB-01	497.0	NE	NE	3
RB-02	510.0	NE	NE	5
RB-03	510.0	NE	NE	7.5
RB-04	493.0	NE	NE	5
RB-05	503.5	NE	NE	7.9
RB-06	502.0	NE	NE	4.5
RB-07	517.5	NE	NE	5.3
RB-08	511.7	NE	500.7	20
SWM-1	500.0	NE	NE	--
SWM-2	507.2	NE	NE	3.5
SWM-3	502.3	NE	NE	15
SWM-4	490.0	NE	NE	5.5
SWM-5	502.3	NE	NE	4
SWM-6	502.1	NE	NE	--
SWM-7	495.0	NE	NE	4
SWM-8	517.9	NE	NE	--
SWM-9	524.7	NE	NE	--
SWM-10	520.2	NE	NE	7
SWM-11	522.4	NE	NE	6.2
SWM-12	525.1	NE	NE	4
SWM-13	502.5	NE	NE	7.5

Table 4.4 – Summary of Borehole Groundwater and Cave Data

Boring No.	Ground Surface Elevation	Groundwater Elevation		24-Hour Cave Depth (ft)
		Initial	24-Hour	
SWM-14	509.0	NE	NE	--
SWM-15	500.9	NE	NE	6.5
SWM-16	491.0	NE	NE	6.5
SWM-17	525.1	NE	NE	4.7
SWM-18	502.5	NE	NE	7.4
SWM-19	502.1	NE	NE	5.5
SWM-20	496.8	NE	NE	4.6
SWM-21	497.6	NE	NE	--
SWM-22	514.2	NE	NE	--
SWM-23	518.4	NE	NE	7
SWM-24	519.9	NE	NE	4.5
SWM-25	529.4	NE	NE	5.5
SWM-26	506.3	NE	NE	6
SWM-27	500.5	NE	NE	--
SWM-28	503.0	NE	NE	3.5
SWM-29	500.6	NE	NE	4
SWM-30	495.7	NE	NE	2

"--" Borehole backfilled upon completion

"NE" Groundwater not encountered

5 EVALUATIONS AND RECOMMENDATIONS

The following recommendations have been developed on the basis of the previously described project characteristics and subsurface conditions. If there are any significant changes to the project characteristics or if significantly different subsurface conditions are encountered during construction, RK&K should be consulted so that the recommendations of this report can be reviewed.

5.1 GENERAL EARTHWORK

Topsoil, other organic materials, frozen, wet, soft or loose soils, and other deleterious materials should be removed and wasted before placement of fill. These stripping operations should be performed in a manner consistent with good erosion and sediment control practices. Stripping, clearing and grubbing should be performed in accordance with Section 101 of the Maryland Department of Transportation State Highway Administration *Standard Specifications for Constructions and Materials*, 2008.

5.2 DEWATERING AND DRAINAGE

The proposed construction is anticipated to encounter surface water and groundwater. The site drainage should be such that the runoff onto adjacent properties, into the creek, streams, and storm drains is controlled properly.

It is likely that groundwater will be encountered in some of the undercutting for the MSE walls and possibly in the bridge abutment foundations. Appropriate dewatering should be carried out so that construction will be performed in a relatively dry condition. Dewatering inside excavations should be able to be handled with conventional ditching, sumps, and pumps. The actual dewatering plan is the responsibility of the Contractor.

Sediment laden water should not be allowed to flow into any watercourse, adjacent drainageway, or over land without first filtering it through an approved desilting device.

5.3 FILL SELECTION, PLACEMENT AND COMPACTION

In general, existing on-site soils free from environmental contamination, building debris, frozen, organic or wet materials, are anticipated to meet the requirements for common borrow as per Maryland Department of Transportation State Highway Administration *Standard Specifications for Constructions and Materials* Section 916.01. If imported materials are required, the material

should be in accordance with Section 916.01.01. Embankments and areas supporting pavements should be prepared in accordance with Maryland Department of Transportation State Highway Administration *Standard Specifications for Constructions and Materials* Section 204. Fill in structural areas should be placed and compacted in accordance with Section 402.03. Smaller lift thicknesses may be required near structures or retaining walls to avoid overstressing the retaining walls or other structures.

5.4 ROCK SLOPE

In some areas, cuts will be required to reach the proposed subgrade elevation of the proposed Professional Boulevard. Some of these cuts will require rock excavation. The cut required to reach the roadway grade from approximately STA 44+25 to 46+60 will be as deep as 15-ft and will likely require rock excavation.

Because of the high quality of rock (RQD > 90%), predictable and moderate joint angle (~45-deg), rough joints (Jr = 3), and the maximum slope height of approximately 15-ft, there is minimal concern for global stability or failure on the face but rock falls could be an issue which is hard to predict. Once blasting is complete, the exposed rock surface should be observed to locate any loose rock. It may be necessary to scale the rock face to remove loose rocks and thereby reduce the risk of rock fall in the future.

A “Ritchie Ditch” should be constructed between the rock cut and the roadway for rock fall protection purposes. The ditch width and depth depend on the slope angle and height. A summary of the ditch dimensions based on different slope angles of the rock cut is shown in Table 5.1 below.

Table 5.1 – Summary of Ditch Dimensions and Rock Fall Protection

	2H:1V (~27-deg)	1H:1V (45-deg)	0.5H:1V (~63-deg)	0.1H:1V (~84-deg)
Rock Motion	Rolling	Rolling	Bounce	Free Fall
Ditch Depth	3.5-ft	3.5-ft	4-ft	3-ft
Ditch Width	12-ft	12-ft	10-ft	10-ft
Fall Protection	Vertical Barrier	Vertical Barrier	Vertical Barrier	None

We recommend a 0.1H:1V angle for the rock cut and a 3-ft deep, 10-ft wide ditch between the rock cut and the roadway. A 0.1H:1V slope will minimize rock excavation, has minimal risk of global stability or rock slide failures, has minimized ditch dimensions, and does not require barriers since the rocks will free fall and land in the ditch.

5.5 PAVEMENT

Pavement design was performed in accordance with AASHTO Guide for Design of Pavement Structures, 2015. Two traffic models were used to evaluate pavement design options; one developed by Sabra, Wang & Associates using NCHRP, and the second using a HEMPMO model.

5.5.1 Pavement Design for New Roadway Sections

Table 5.2 summarizes the estimated service life of the three proposed pavement sections depending on the traffic conditions. The Yale Drive pavement section in Table 5.2c is designed to match that of the existing pavement section at Yale Drive. The ESAL values for Yale Drive and the mill and overlay pavement sections were back-calculated based on the structural number of the existing pavement and a 25-year design life.

If the pavement is designed assuming NCHRP traffic loads (ADT = 4,075), the required pavement Structural Number (SN) is 4.15 for a 25-year design life. However, if the HEMPMO model (ADT = 6,943) is actually more accurate, then the service life will be only 16 years. If the pavement is designed using the HEMPMO model, the required SN is 4.76 for a 25-year design life, but if the actual traffic is closer to the NCHRP model, then the service life will be approximately 45 years. If the Yale Drive section (SN = 4.72) is used and the HEMPMO model is accurate the service life will be 24 years, but if the NCHRP model is more accurate, the service life will be about 34 years.

All of these estimates assume that regular maintenance, such as crack sealing, slurry seals, or mill and overlay are performed on a regular basis. Table 5.2a, 5.2b, and 5.2c summarize the three proposed sections in detail.

If the NCHRP traffic model is chosen, we recommend using the pavement section in Table 5.2a. If the HEMPMO traffic model is chosen, we recommend using the pavement section in Table 5.2b. All these sections assumed the subgrade CBR is 3.0. The in situ CBR value should be determined prior to placing pavement to verify the design CBR. The in situ CBR can be verified using the Clegg Impact Hammer, light weight deflectometer, drop hammer penetrometer or the field CBR procedure.

Table 5.2 – Summary of New Pavement Section Service Life

Traffic Model (ADT)	SN Required (25-Years)	Estimated Service Life (Years)		
		NCHRP Design (SN = 4.18)	HEMPMO Design (SN = 4.9)	Yale Dr. Section (SN = 4.72)
NCHRP (4,075)	4.15	25	45	39
HEMPMO (6,943)	4.76	16	25	24

Table 5.2a – Pavement Section (NCHRP)

NCHRP (ADT = 4,075) ESAL = 835,300 Minor Arterial	1.5-inches Superpave Asphalt Mix, 9.5 mm, PG 64S-22, Level 2
	7.0-inches Superpave Asphalt Mix, 19.0 mm, PG 64S-22, Level 2
	6.0-inches Dense Graded Aggregate Base
	GSSA

Table 5.2b – Pavement Section (HEMPMO)	
HEMPMO (ADT = 6,943) ESAL = 2,250,900 Minor Arterial	1.5-inches Superpave Asphalt Mix, 9.5 mm, PG 64S-22, Level 2
	7.0-inches Superpave Asphalt Mix, 19.0 mm, PG 64S-22, Level 2
	12.0-inches Dense Graded Aggregate Base
	GSSA

Table 5.2c – Pavement Section (Yale Dr.)	
(Back Calculated) ESAL = 1,764,400 Minor Arterial	4.0-inches Superpave Asphalt Mix, 9.5 mm, PG 64S-22, Level 2
	5.0-inches Superpave Asphalt Mix, 19.0 mm, PG 64S-22, Level 2
	8.0-inches Dense Graded Aggregate Base
	GSSA

5.5.2 Pavement Design for Existing Professional Court

A portion of the existing pavement section of the existing Professional Court will be reused in constructing the new roadway. Table 5.3 summarizes pavement section options considering removal of all of the existing bituminous concrete.

Table 5.3 – Existing Professional Court

Traffic	Design	SN Required	SN Calculated	GAB (in)	# Lifts	Base (in)	# Lifts	Surface (in)	# Lifts	Service Life (yrs)
Sabra & Wang	4.5" 19.0mm	4.15	3	4.5	N/A	4.5	2	1.5	1	6
Sabra & Wang	5.5" 19.0mm	4.15	3.4	4.5	N/A	5.5	2	1.5	1	11
Sabra & Wang	6.5" 19.0mm	4.15	3.8	4.5	N/A	6.5	2	1.5	1	18
Sabra & Wang	7.5" 19.0mm	4.15	4.2	4.5	N/A	7.5	2	1.5	1	28
HEMPMO	4.5" 19.0mm	4.76	3	4.5	N/A	4.5	2	1.5	1	3
HEMPMO	5.5" 19.0mm	4.76	3.4	4.5	N/A	5.5	2	1.5	1	6
HEMPMO	6.5" 19.0mm	4.76	3.8	4.5	N/A	6.5	2	1.5	1	10
HEMPMO	7.5" 19.0mm	4.76	4.2	4.5	N/A	7.5	2	1.5	1	15
HEMPMO	9.0" 19.0mm	4.76	4.8	4.5	N/A	9	3	1.5	1	25

Based on our analysis, to construct a new bituminous concrete pavement section for the existing Professional Court, if the NCHRP traffic model is chosen, we recommend using 7.5-inches of Superpave Asphalt Mix 19.0mm PG-64S-22, Level 2. If the HEMPMO model is chosen, we recommend using 9.0-inches of Superpave Asphalt Mix 19.0mm PG-64S-22, Level 2. In all sections the surface course should be Superpave Asphalt Mix 9.5mm PG 64S-22, Level 2, the base course should be Superpave Asphalt Mix 19.0mm PG-64S-22, Level 2, and the subbase should be graded aggregate base (GAB).

We also evaluated reusing some of the existing bituminous concrete pavement section on the existing Professional Court. We propose to mill the top 2-inches, then construct the new pavement section over the remaining existing bituminous concrete. Table 5.4 summarizes the required pavement sections for this option.

Table 5.4 - Existing Professional Court (2-inch Mill)

Traffic	Design	SN Required	SN Calculated	Existing GAB (in)	# Lifts	Existing Base (in)	# Lifts	New Base (in)	# Lifts	New Surface (in)	# Lifts	Design Life (yrs)
Sabra & Wang	4.5" Base	4.15	2.88	4.5	N/A	3	N/A	1.5	1	1.5	1	4
Sabra & Wang	5.5" Base	4.15	3.28	4.5	N/A	3	N/A	2.5	1	1.5	1	9
Sabra & Wang	6.5" Base	4.15	3.68	4.5	N/A	3	N/A	3.5	1	1.5	1	15
Sabra & Wang	8.0" Base	4.15	4.28	4.5	N/A	3	N/A	5	2	1.5	1	30
HEMPMO	4.5" Base	4.76	2.88	4.5	N/A	3	N/A	1.5	1	1.5	1	2
HEMPMO	5.5" Base	4.76	3.28	4.5	N/A	3	N/A	2.5	1	1.5	1	5
HEMPMO	6.5" Base	4.76	3.68	4.5	N/A	3	N/A	3.5	1	1.5	1	9
HEMPMO	7.5" Base	4.76	4.08	4.5	N/A	3	N/A	4.5	2	1.5	1	14
HEMPMO	9.5" Base	4.76	4.88	4.5	N/A	3	N/A	6.5	2	1.5	1	28

Based on our analysis, for the 2-inch mill option, if the NCHRP traffic model is chosen we recommend using 5-inches of Superpave Asphalt Mix 19.0mm PG-64S-22, Level 2. If the HEMPMO model is chosen, we recommend using 9.0inches of Superpave Asphalt Mix 19.0mm PG-64S-22, Level 2.

In all sections, the surface course should be Superpave Asphalt Mix 9.5mm PG 64S-22, Level 2, the base course should be Superpave Asphalt Mix 19.0mm PG-64S-22, Level 2, and the subbase should be graded aggregate base (GAB).

We recommend the 2-inch mill and overlay option for existing Professional Court. It will facilitate and simplify maintenance of traffic during construction. It will also provide time and cost savings for the project.

After the top 2-inches is removed, all visible cracks in the remaining pavement should be sealed in accordance with Maryland State Highway Administration *Standard Specifications for Construction and Materials*, Section 510. If any alligator cracking or otherwise highly distressed pavement is observed, the area should be saw cut and a full depth patch in accordance with Maryland State Highway Administration *Standard Specifications for Construction and Materials*, Section 505 will be required.

5.5.3 Construction Recommendations

All pavement construction procedures should be in accordance with Maryland Department of Transportation State Highway Administration Standards. Pavement subgrades should be kept dry and should be sloped to prevent ponding of precipitation and run-off.

Prior to the placement of pavements, all subgrades should be proof-rolled with a heavily-loaded dump truck or other pneumatic-tired vehicle of similar size and weight. The purpose of the proof-rolling is to provide surficial densification and to locate any isolated areas of soft or loose soils.

Unsuitable subgrade materials should be undercut a minimum of 24-inches. A Class ST Geotextile should be placed in accordance with Maryland State Highway Administration *Standard Specifications for Construction and Materials*, Section 921.09 on the prepared subgrade, and then backfilled with compacted select fill. Based on the subsurface exploration, unsuitable areas that will require undercutting are anticipated between STA 20+35 to 44+00 and STA 46+50 to 52+50.

As an alternative to a 2-ft undercut, soft materials may be removed and replaced with Geosynthetic Stabilized Subgrade using Graded Aggregate Base (GSSA) in accordance with Maryland State Highway Administration *Standard Specifications for Construction and Materials*, Section 211. This consists of placing a stabilization geotextile on the prepared bottom of undercutting and placing and compacting 12-inches of Graded Aggregate Base (GAB).

5.6 STORMWATER MANAGEMENT

Based on the subsurface exploration, the proposed stormwater management facilities inverts will be in a karst area at or near bedrock. For this reason, infiltration practices are not recommended at this site. Ponds or swales should be lined to prevent infiltration into bedrock that could expand karst features.

5.7 BRIDGE FOUNDATION RECOMMENDATIONS

5.7.1 Shallow Foundations

Bearing resistance for shallow foundations was evaluated using AASHTO LRFD methods. It is recommended that the conventional spread footing for Abutment B be proportioned for a factored bearing resistance of 30-ksf, provided that sliding and eccentricity requirements are satisfied. The spread footing should be founded on competent, sound bedrock. Settlements are anticipated to be negligible.

Uneven rock surface and karst features discovered during excavation should be grouted to provide a stable bearing surface for the spread footing foundation. Over excavated areas should be backfilled using Mix No. 1 subfoundation concrete according to *MD SHA Standard Specifications for Construction and Materials* Section 402.02.

5.7.2 Drilled Shaft Foundations

Based on the foundation loads described in Section 2.2.2 of this report, the results of the subsurface exploration and our experience in the area, we recommend that the west abutment and the two piers of the Professional Boulevard Bridge be supported on drilled shaft foundations. The shaft diameter and socket length were governed by lateral loads for the West Abutment, and axial loads for the piers. Recommendations for the drilled shafts are summarized in Table 5.5.

Table 5.5 – Summary of Drilled Shaft Recommendations					
Structure	Shaft Diameter in Soil (in)	Rock Socket Diameter (in)	Approximate Total Shaft Length (ft)	Rock Socket Length (ft)	Estimated Lateral Deflection (in)
West Abutment	42	36	22	3	0.22
Pier 1	42	36	13	10	0.02
Pier 2	42	36	15	10	0.04

The drilled shaft foundations have been evaluated based on the results of the subsurface exploration and the foundation loads for each structure. The lateral deflections have been estimated for the service limit state lateral loads. The software Allpile7 was used to estimate lateral deflections. The axial resistance was checked manually using procedures in the AASHTO LRFD code. The drilled shaft design parameters used in the software were estimated using subsurface information from the test borings including SPT N-value correlations, PLT and UCC tests results, and our experience in this area.

For the design of the drilled shafts, it should be noted that the scour elevation is located below the bottom of footing elevation, therefore the drilled shafts have been designed for an unsupported length from the bottom of footing to the scour depth.

The shafts should extend a minimum of 3-ft into sound bedrock at the West Abutment foundation location and 10-ft into sound bedrock at both Pier 1 and Pier 2. It is recommended that prior to the installation of the drilled shafts, the Contractor conduct probe holes using either air track drilling or other testing methods at each of the drilled shaft locations to verify the depth of sound bedrock. These probes should extend to a depth of at least 10-ft below the design tip elevation.

The length of the drilled shaft extending through rock is the rock socket. The length of the rock socket is defined as the length of excavation through rock that cannot be drilled with conventional earth or rock augers and/or underreaming tools and requires the use of special rock core barrels, air tools, and/or other methods of hand excavation. Auger refusal is defined as drilling advancement of less than 2-inches per minute for a 42-inch diameter rock auger with carbide

teeth powered by a drilling machine exerting a rotary output of 80,000-ft-lbs of torque and 20,000-lb of crowd.

5.7.3 Construction and Monitoring Recommendations

We recommend that the installation of the drilled shafts be monitored by a Geotechnical Engineer or Engineering Geologist and supervised by a Geotechnical Engineer licensed in the State of Maryland. During the installation of the drilled shafts, the depth of embedment, the diameter of the shafts and sockets, plumbness, and appropriateness of the bearing materials should be verified. A Geotechnical Engineer should document the occurrence or absence of differing site conditions and verify that the construction is performed in accordance with the specifications.

At the West Abutment, permanent casing will be required extending through the proposed MSE wall at each drilled shaft location to isolate the foundation from the MSE wall. Temporary casing will be required to support the shaft excavation. Bentonite slurry should not be used. Water or polymer slurry may be used if necessary to balance any hydrostatic pressures.

Before concrete placement commences, the bottom of the shaft excavation should be cleaned out using procedures such as airlifts and video monitoring to verify the removal of loose material.

Given the small diameter of the shaft and socket, we recommend the use of a hopper, tremie, or other suitable device to control concrete placement. The placement of concrete in the shaft should proceed until the concrete level is above the external fluid level and should be maintained above this level throughout casing removal. If water or slurry is present in the drilled shaft at the time of concrete placement, a tremie tube should be used to place the concrete below the level of water or slurry. Concrete should be discharged with the tremie pipe within 6-inches off of the bottom of excavation. A concrete head of at least 5-ft above the discharge should be maintained at all times.

5.8 MSE WALL RECOMMENDATIONS

Retaining wall recommendations are provided below for each structure. These recommendations are based on the TS&L structural drawings and the available subsurface information at the time of this report. The MSE walls were evaluated using the software MSEW 3.0 by ADAMA Engineering.

The construction of the bridge will require three MSE walls at the western abutment, Abutment A. It is recommended that the MSE walls for the West Bridge abutments be constructed with No. 57 stone in the reinforced zone. The minimum reinforcement length, L, for the walls will need to be extended beyond the minimum length specified in AASHTO. This is detailed in the following sections.

Global stability analyses were also performed using the Morgenstern-Price method with the software application Slope/W 2012 and indicate a satisfactory factor of safety of at least 1.5.

5.8.1 Retaining Walls RW1

At the west abutment, due to scour elevations, RW1 will need to bear on bedrock. Alternatively, soil within the 100-year and 500-year floodplains may be undercut to bedrock and backfilled to the proposed leveling pad elevation with non-erodible Mix No. 1 subfoundation concrete according to *MD SHA Standard Specifications for Construction and Materials* Section 402.02.

Table 5.6 summarizes the soil parameters to be used by the Contractor during design of the MSE wall for this structure.

Table 5.6 – Retaining Wall RW1 Soil Parameters

Soil	Design Unit Weight – γ (pcf)	Drained Angle of Friction – ϕ (deg)	Undrained Shear - S_u (psf)
Reinforced Soil (#57 Stone)	105	34	-
Retained Soil (Common Borrow)	125	28	-
Foundation Soil (Clay)	120	24	1,550

It is recommended that the wall be constructed with No. 57 stone in the reinforced zone, and common borrow fill in the retained zone. The minimum reinforcement length for the wall is L = 1.1H, which was increased from the AASHTO minimum to satisfy minimum requirements for bearing resistance. The suitability of the wall subgrade and bearing resistance as shown on the approved shop drawings should be verified prior to wall construction.

It is anticipated that the maximum settlement for the wall will be about 7.4-inches. The differential settlement along the wall face satisfies the AASHTO minimum requirements of less than 1/100, so the wall can be constructed in one stage. Based on our evaluation, the settlement should occur within four to 17 months after fill placement to final grade. Settlements should be monitored with settlement plates and surface monitoring points to verify movement has substantially ceased or less than 1-inch of remaining settlement is predicted prior construction of parapets and pavements.

The topographical conditions at Retaining Wall 1 minimize the probability of global instability of Retaining Wall 1.

5.8.2 Retaining Wall RW2

Due to scour elevations, the base elevation of the MSE wall should be lowered to bedrock. Alternatively, soil in the scour zone may be undercut to bedrock and backfilled to the proposed leveling pad elevation with non-erodible lean concrete in according to MD SHA Standard Specification Section 402.02.

Table 5.7 summarizes the soil parameters to be used by the Contractor during design of the MSE wall for this structure.

Table 5.7 – Retaining Wall RW2 Soil Parameters

Soil	Design Unit Weight – γ (pcf)	Drained Angle of Friction – ϕ (deg)	Undrained Shear - S_u (psf)
Reinforced Soil (No. 57 Stone)	105	34	-
Retained Soil (Common Borrow)	125	28	-
Foundation Soil (Bedrock)	150	34	-

It is recommended that the wall be constructed with No. 57 Stone in the reinforced zone and common borrow fill in the retained zone.

The minimum reinforcement length for the walls is L = 0.8 H. The suitability of the wall subgrade and bearing resistance as shown on the approved shop drawings should be verified prior to wall construction.

Due to the wall bearing on bedrock, total and differential settlement will not be significant and global stability will be acceptable.

5.8.3 Retaining Wall RW3

At the abutment, due to scour elevations, the base of RW3 will need to be lowered to bedrock within the 100-year and 500-year floodplains. Alternatively, soil in the floodplains may be undercut to bedrock and backfilled to the proposed leveling pad elevation with non-erodible lean concrete in according to *MD SHA Standard Specifications for Construction and Materials* Section 402.02.

Table 5.8 summarizes the soil parameters to be used by the Contractor during design of the MSE wall for this structure.

Table 5.8 – Retaining Wall RW3 Soil Parameters

Soil	Design Unit Weight γ (pcf)	Drained Angle of Friction, ϕ (deg)	Undrained Shear, S_u (psf)
Reinforced Soil (No. 57 Stone)	105	34	-
Retained Soil (Common Borrow)	125	28	-
Foundation Soil (Select Fill)	125	32	-

It is recommended that the wall be constructed with No. 57 Stone in the reinforced zone and common borrow in the retained zone.

The minimum reinforcement length for the wall is L = 0.8H, which was increased from the AASHTO minimum to satisfy minimum requirements for bearing resistance and global stability.

Highly plastic clay was encountered in the test borings at the proposed foundation elevation of RW3 outside of the scour zone. The wall will need to be undercut to a depth of 0.5L, or to bedrock

if encountered shallower, and backfilled with select fill or CR-6. The suitability of the wall subgrade and bearing resistance as shown on the approved shop drawings should be verified prior to wall construction.

It is anticipated that the total settlement for the wall will be negligible as a result of the foundation soil being undercut and replaced with compacted select fill or CR-6. Global stability analyses indicate the factor of safety satisfies the AASHTO requirement.

The owner of the gas utility in the area of RW3 should be notified so that the impact, if any, of the proposed construction can be evaluated.

5.8.4 Retaining Wall RW4

Table 5.9 summarizes the soil parameters to be used by the Contractor during design of the MSE wall for this structure.

Table 5.9 – Retaining Wall RW4 Soil Parameters

Soil	Design Unit Weight γ (pcf)	Drained Angle of Friction, ϕ (deg)	Undrained Shear, S_u (psf)
Reinforced Soil (No. 57 Stone)	105	34	-
Retained Soil (Common Borrow)	125	28	-
Foundation Soil (Clay)	115	25	1,530

It is recommended that the wall be constructed with No. 57 Stone in the reinforced zone and common borrow in the retained zone.

The minimum reinforcement length for the wall is L = 1.0H, which was increased from the AASHTO minimum to satisfy minimum requirements for bearing resistance and global stability. The suitability of the wall subgrade and bearing resistance as shown on the approved shop drawings should be verified prior to wall construction.

It is anticipated that the maximum total settlement will be 9.5-inches. The differential settlement along the wall face satisfies the AASHTO minimum requirements of less than 1/100. Global stability analyses indicate the factor of safety satisfies the AASHTO requirement. Based on our evaluation, the settlement should occur within approximately 13 months after fill placement to final grade. Settlements should be monitored with settlement plates and surface monitoring points to verify movement has substantially ceased prior construction of parapets and pavements.

The effects of differential settlement along the length of the proposed storm drain pipes that extend through or below the wall should be evaluated to determine appropriate pipe type, joint type, joint spacing, elevation, and other pertinent design details. If the pipes extend through the wall, details should be provided by the wall manufacturer for layout of reinforcement in the areas of the proposed pipes.

5.8.5 MSE General Foundation Recommendations

The following sections are general recommendations for construction of the MSE walls.

The detailed internal and external stability design of the MSE walls is the Contractor's responsibility and will need to be designed by a Professional Engineer licensed in the State of Maryland and reviewed by the Engineer.

Bearing Resistance: The nominal bearing resistance, Meyerhof stress, and eccentricity (e) were estimated using a software program entitled MSEW, a design and analysis software for mechanically stabilized earth walls. The factored bearing resistance was estimated using the following equation:

$$q_r = \phi_b q_n$$

Where: q_r – Factored Bearing Resistance
ϕ_b – Bearing Resistance Factor from AASHTO (Table 11.5.7.1)
q_n – Nominal Bearing Resistance

Proper construction procedures should be used to maintain the bearing qualities of the MSE excavations. Foundations and excavations should be protected from the detrimental effects of precipitation, seepage, surface runoff, and frost. The top of the leveling pad should be a minimum

of 2.5-ft below the proposed ground surface to protect against frost heave. Before placing the leveling pad or new compacted fill, the subgrade should be reviewed and tested by a technician under the guidance of a professional Geotechnical Engineer, licensed in the State of Maryland. In the field, if the material is judged unsuitable, it should be undercut to firm material. The undercut area should be backfilled with crusher run, dense graded aggregate or sub-foundation concrete for taller walls. Where the design bearing stress is relatively low, select borrow as defined in the MD SHA Standard Specification Section 916.01.01, may provide adequate support.

Lightweight walk behind compaction equipment may be required near the wall face to attain the proper degree of compaction without overstressing connections or facing panels. Extra care should be given to avoid damaging the wall due to heavier loads produced by larger construction equipment.

Prior to placing new fill, the exposed ground surface should be proof-rolled to locate any soft spots requiring additional undercutting in accordance with Section 204.03.01 of the MD SHA Standard Specifications.

Corrosion Protection: As indicated in FHWA NHI-00-044, the retaining wall backfill material should meet certain electrochemical properties. Table 5.10 provides details regarding the limits of electrochemical properties and the corresponding test method for the reinforcement backfill. We recommend that No. 57 stone be used for fill in the reinforcement zone.

Table 5.10 – Limits of Electrochemical Properties for Backfill

Property	Criteria	Test Method
Resistivity	Greater than 3,000 ohm-cm	AASHTO T-288-91
pH	5 to 10	AASHTO T-289-91
Chlorides	Less than 100 PPM	AASHTO T-291-91
Sulfates	Less than 200 PPM	AASHTO T-290-91
Organic Content	1% max	AASHTO T-267-86

Surface and Subsurface Drainage Requirements: It is possible that during excavation groundwater may be encountered. It is anticipated that minor dewatering during construction will be required using sumps and trenches. If No. 57 stone is used in the reinforcement zone, special drainage such as blanket, face, or chimney drains will not be required.

Erosion Control: Exposed slopes should be protected from erosion in accordance with local sediment and erosion control regulations and as described in the Erosion and Sediment Control Plans. Runoff onto new construction or other disturbed areas should be diverted until vegetation has been firmly established.

Reinforcement Length and Global Stability: A minimum Factor of Safety (FS) of 1.5 was used to evaluate global stability. The reinforcement length for all MSE walls should be a minimum of 0.8H to 1.1H (see Section 5.8), where H is the height of the retaining wall from the top of the leveling pad to the ground surface above the wall, unless otherwise noted. The minimum length of reinforcement regardless of the wall height should be 8-ft.

Settlement: Proposed underground utilities need to be evaluated for settlement due to the MSE walls. Utilities and inlets through the MSE reinforcement zone should be installed to avoid interferences with the reinforcement straps.

BASIS OF RECOMMENDATIONS

This report has been prepared to present the geotechnical conditions at the site and the recommended method of founding the proposed construction. Adequate recommendations have been provided to serve as a basis for design and preparation of plans and specifications. The opinions, conclusions and recommendations contained in this report are based upon our professional judgment and generally accepted principles of geotechnical engineering. Inherent to these are the assumptions that the earthwork and foundation construction should be monitored and tested by an engineering technician acting under the guidance of a geotechnical engineer licensed in the State of Maryland.

These analyses and recommendations are, of necessity, based on the information available at the time of the actual writing of the report and on the site conditions, surface and subsurface, that existed at the time the exploratory borings were drilled. Further, assumptions have been made regarding the limited exploratory borings, in relation to both the lateral extent of the site conditions and to the depth.

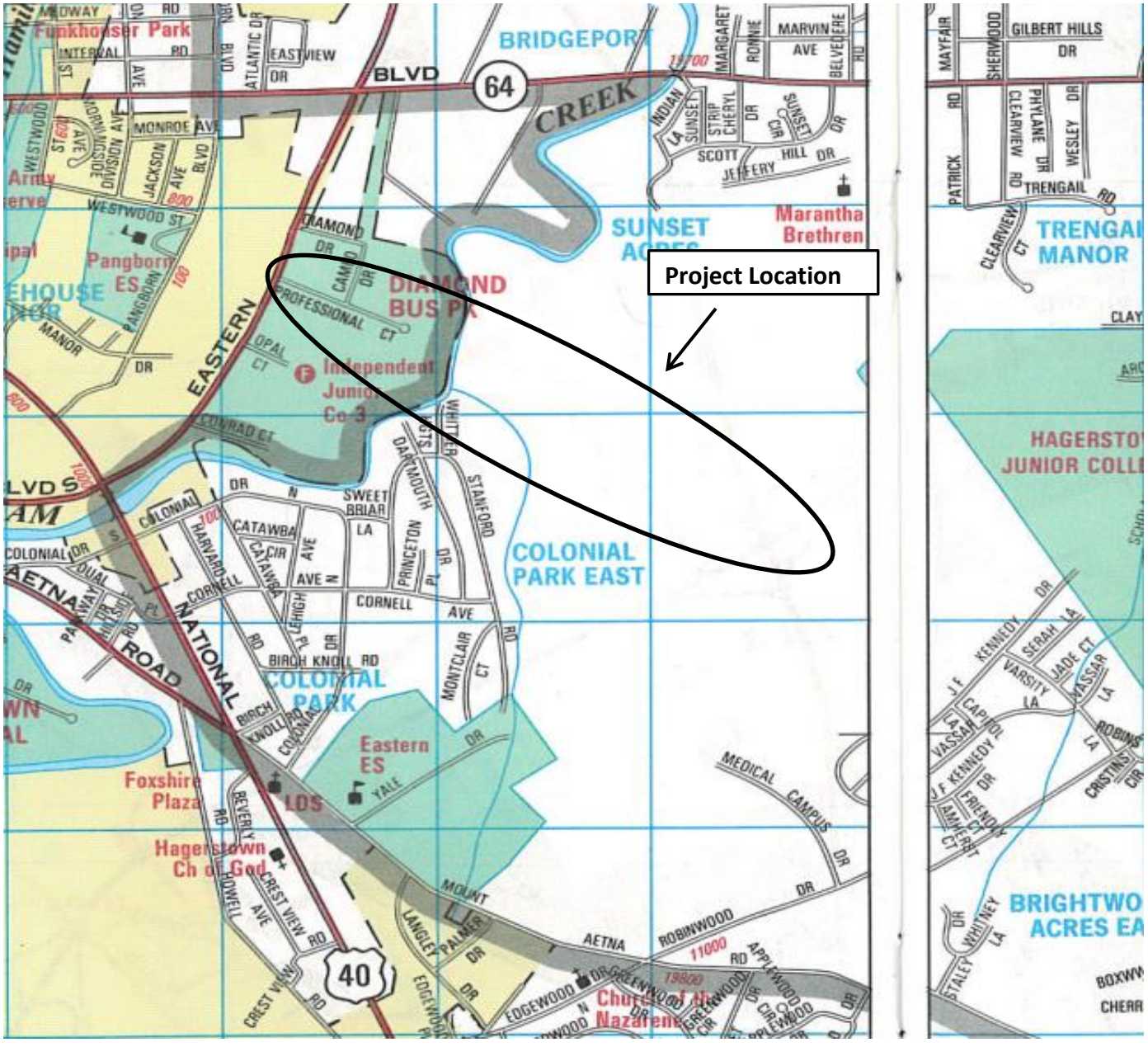
The nature and extent of variations between borings may not become evident until construction. If variations from the anticipated conditions are encountered, it may be necessary to revise the recommendations in this report.

Our professional services have been performed in accordance with generally accepted engineering principles and practices; no other warranty, expressed or implied, is made. RK&K assumes no responsibility for interpretations made by others on the work performed by RK&K.

We recommend that this report be made available in its entirety to contractors for informational purposes only. The boring logs and laboratory test data contained in this report represent an integral part of this report and incorrect interpretation of the data may occur if the attachments are separated from the text. The project plans or specifications should include the following note:

> *A geotechnical report has been prepared for this project by Rummel, Klepper & Kahl, LLP. This report is for informational purposes only and shall not be considered as part of the contract documents. The opinions and conclusions of RK&K represent our interpretation of the subsurface conditions and the planned construction at the time of the report preparation. The data in this report may not be adequate for contractors estimating purposes.*

Appendix A



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Professional Boulevard Road Extension

Vicinity Map

Figure No: A-1

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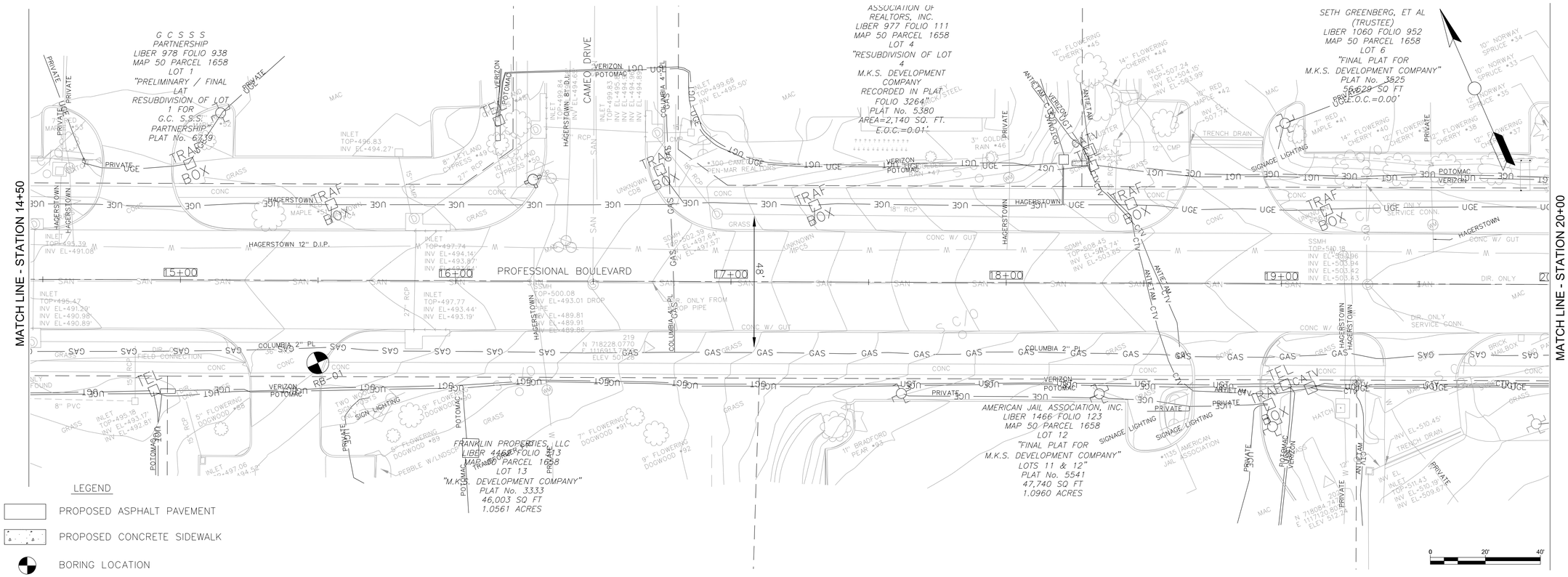
JAR	EMK	NTS	November 2016	14187-03.4



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PROFESSIONAL BOULEVARD BRIDGE & EXTENSION BORING LOCATION PLAN

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TR	EMK	AS SHOWN	06/2016

FIGURE NO. A-2a

COMMISSION. NO. 14187.03-04

SHEET NO. 01 OF 08

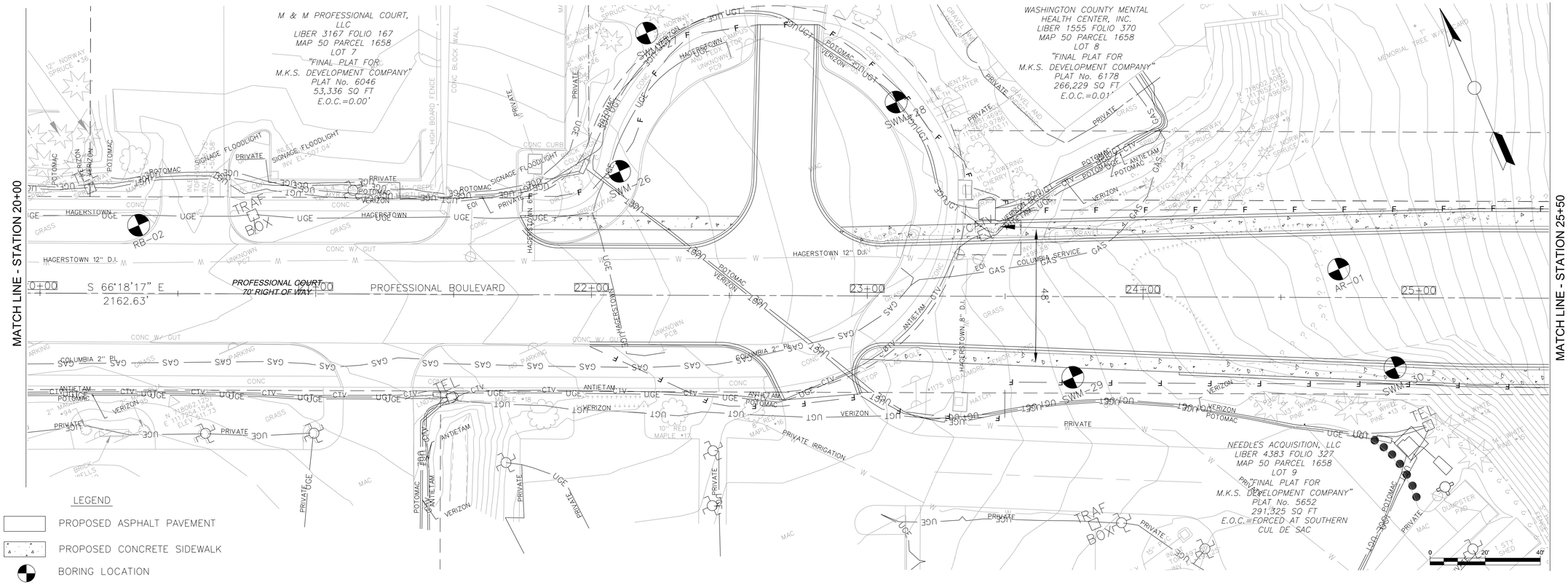

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FIGURE NO.	COMMISSION. NO.
A-2b	14187.03-04

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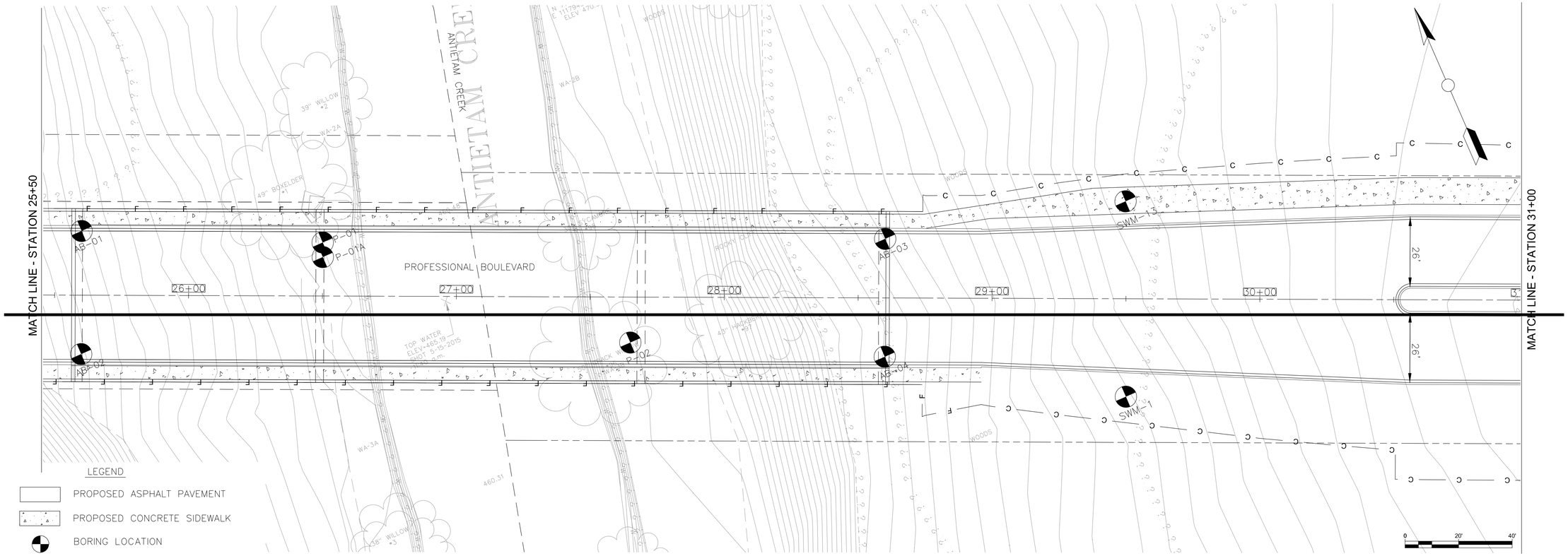

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TR	EMK	AS SHOWN	06/2016

FIGURE NO. A-2c

COMMISSION NO. 1418.03-04

SHEET NO. 03 OF 08

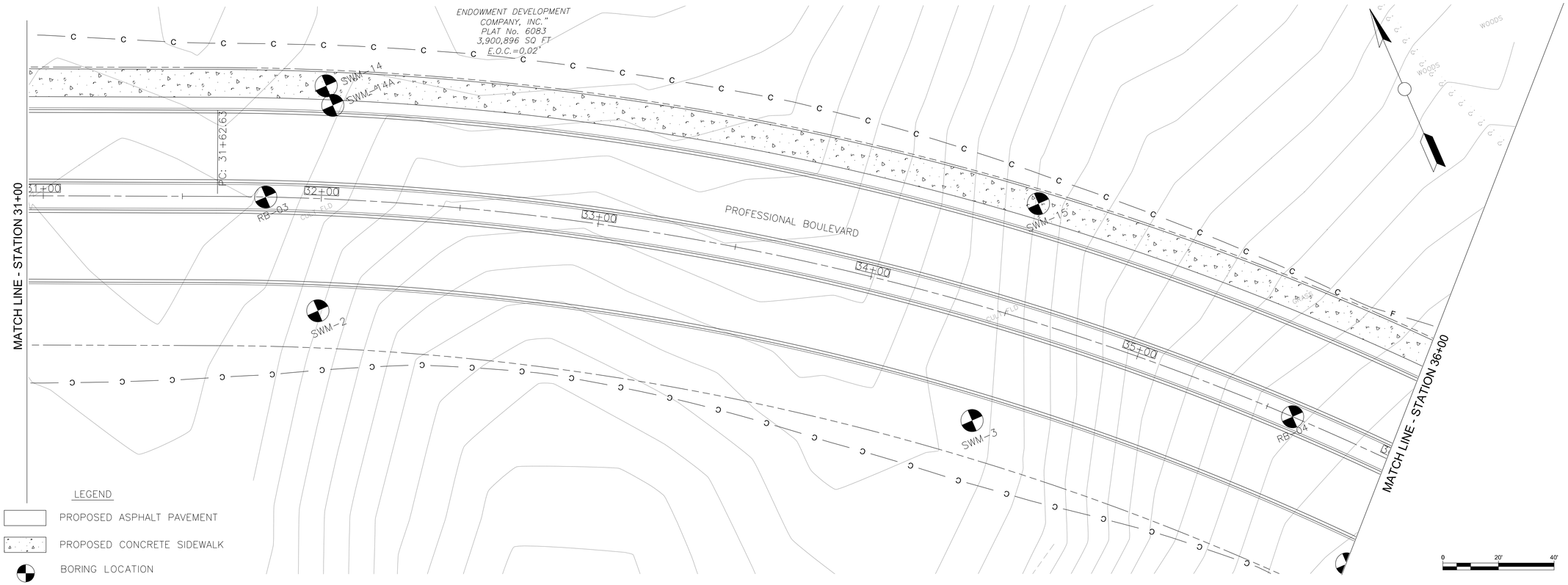

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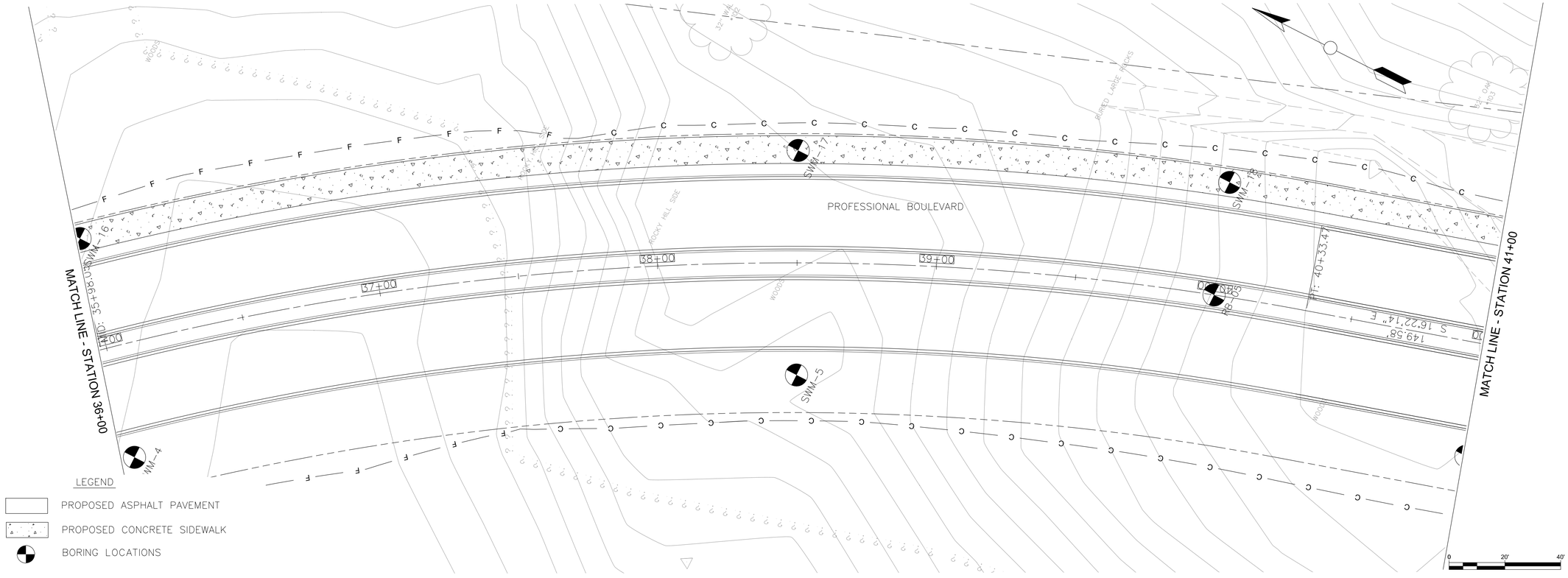
FIGURE NO. A-2d

COMMISSION. NO. 1418.03-04

SHEET NO. 04 OF 08



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A-2e	14187.06-04

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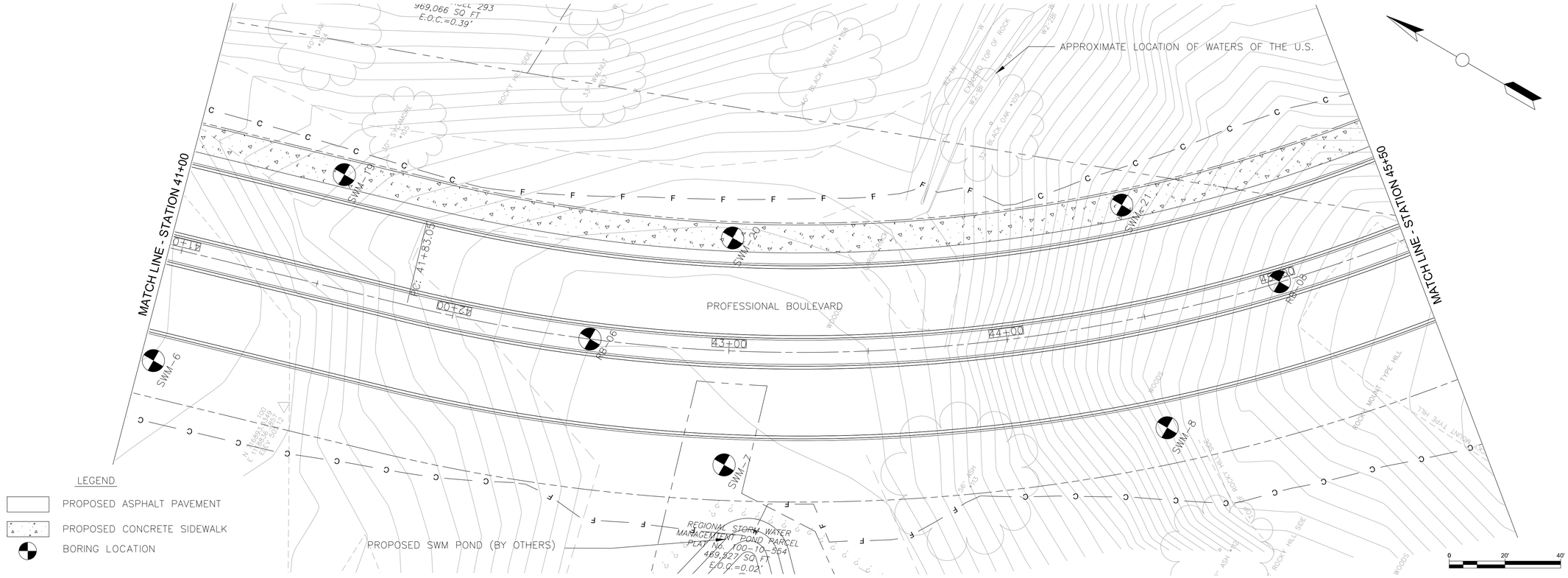

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A-2f	14187.06-04

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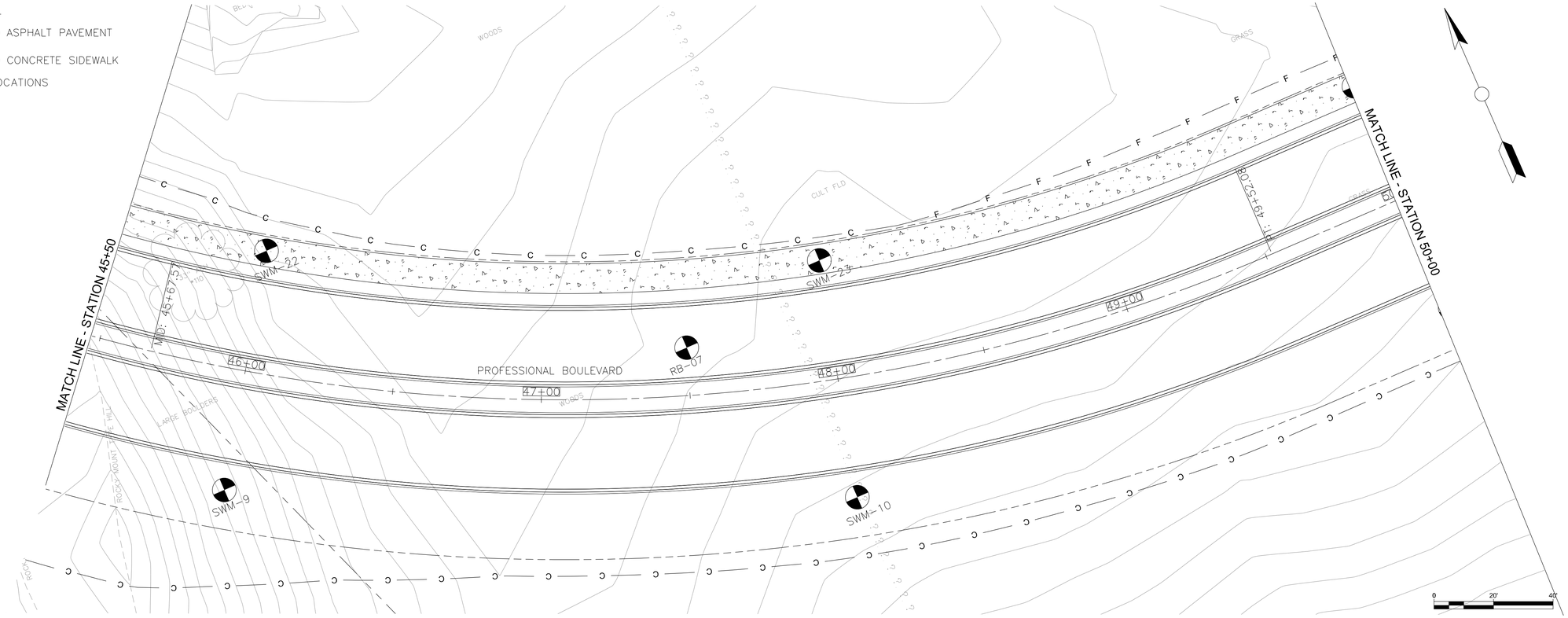
TR	EMK	AS SHOWN	06/2016	06 OF 08

LEGEND

PROPOSED ASPHALT PAVEMENT

PROPOSED CONCRETE SIDEWALK

BORING LOCATIONS



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PROFESSIONAL BOULEVARD BRIDGE & EXTENSION BORING LOCATION PLAN

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TR	EMK	AS SHOWN	06/2016

FIGURE NO. A-2g

COMMISSION. NO. 14187.06-04

SHEET NO. 07 OF 08

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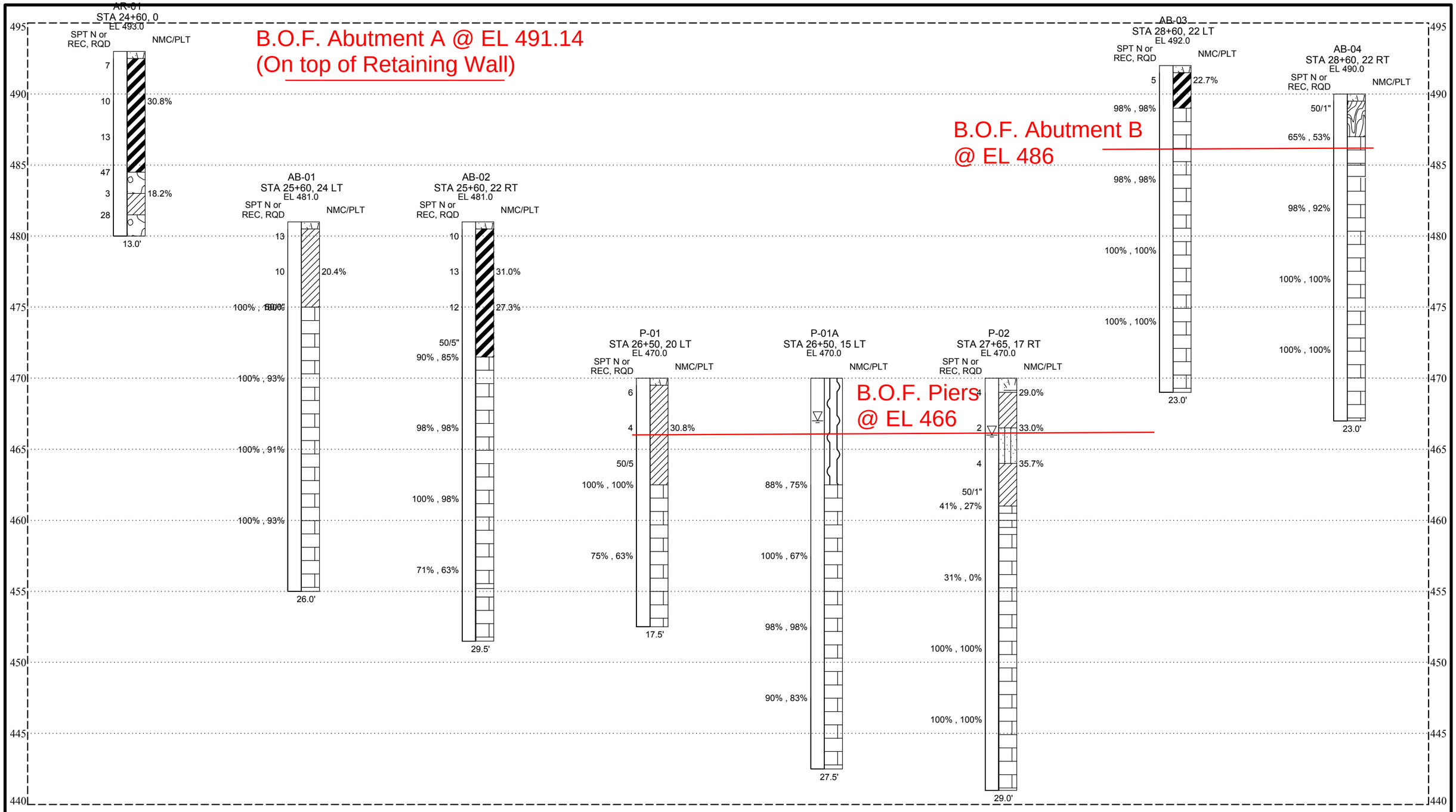
PROFESSIONAL BOULEVARD BRIDGE & EXTENSION BORING LOCATION PLAN

DRAWN BY	APPROVED BY	SCALE	DATE
TR	EMK	AS SHOWN	06/2016

FIGURE NO. A-2h

COMMISSION. NO. 14187.06-04

SHEET NO. 08 OF 08



USCS SOIL KEY

GW	SW	ML	OL				
GP	SP	MH	OH				
GM	SM	CL	FILL				
GC	SC	CH	Decomposed Rock				

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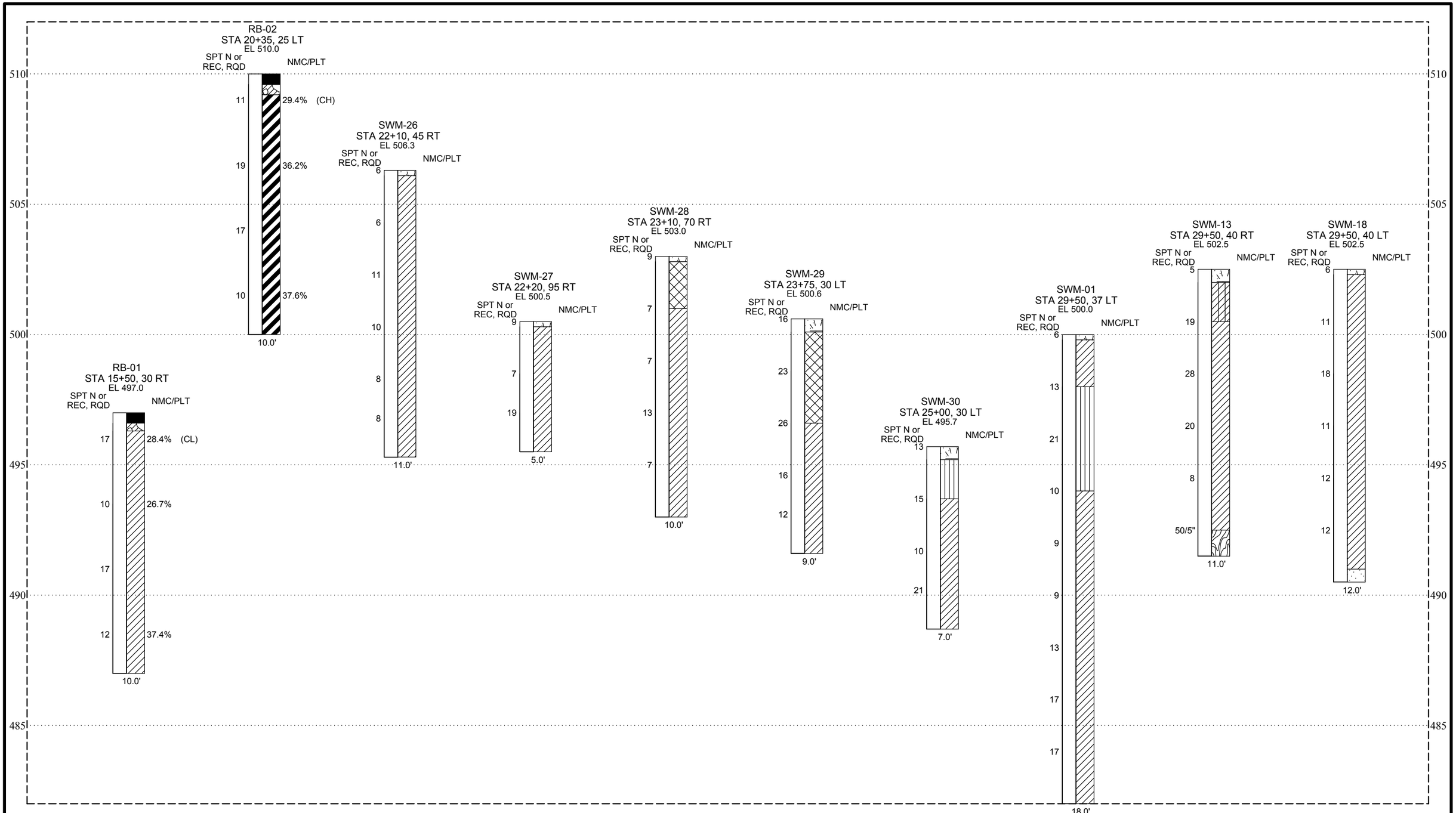
Title: Summary of Boring Data

Bridge Borings

Figure No. A-3-A

Drawn: JAR | Approved: JLT | Date: 7/1/16 | Comm. No. 14187-03.4



USCS SOIL KEY

GW	SW	ML	OL				
GP	SP	MH	OH				
GM	SM	CL	FILL				
GC	SC	CH	Decomposed Rock				

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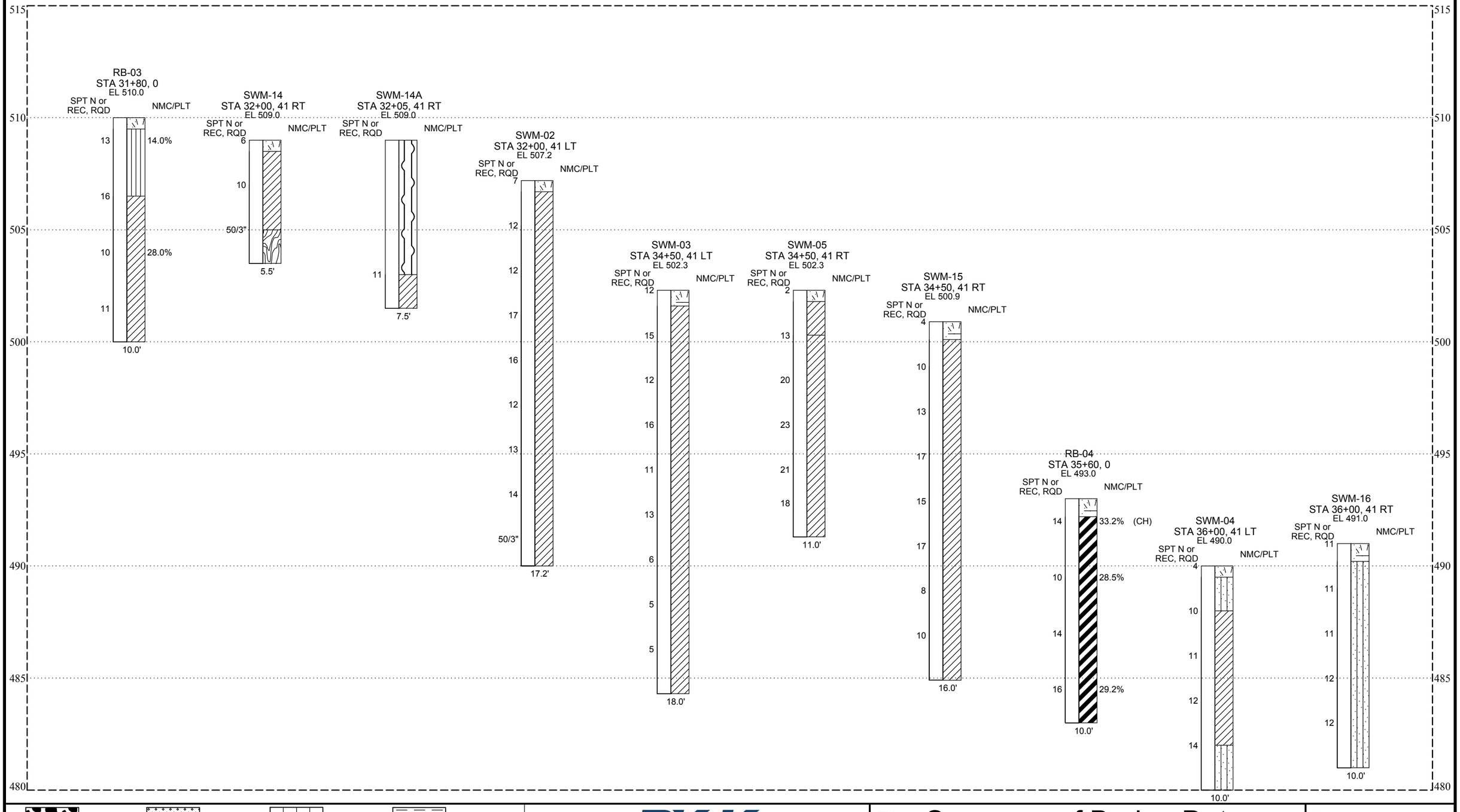
Title: Summary of Boring Data

Roadway Borings

Figure No. A-3-B

Drawn: JR | Approved: JLT | Date: 6/30/16 | Comm. No. 14187-03.4

RKK FENCE - USCS WITH STATION/OFFSET PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16



USCS SOIL KEY

GW	SW	ML	OL				
GP	SP	MH	OH				
GM	SM	CL	FILL				
GC	SC	CH	Decomposed Rock				

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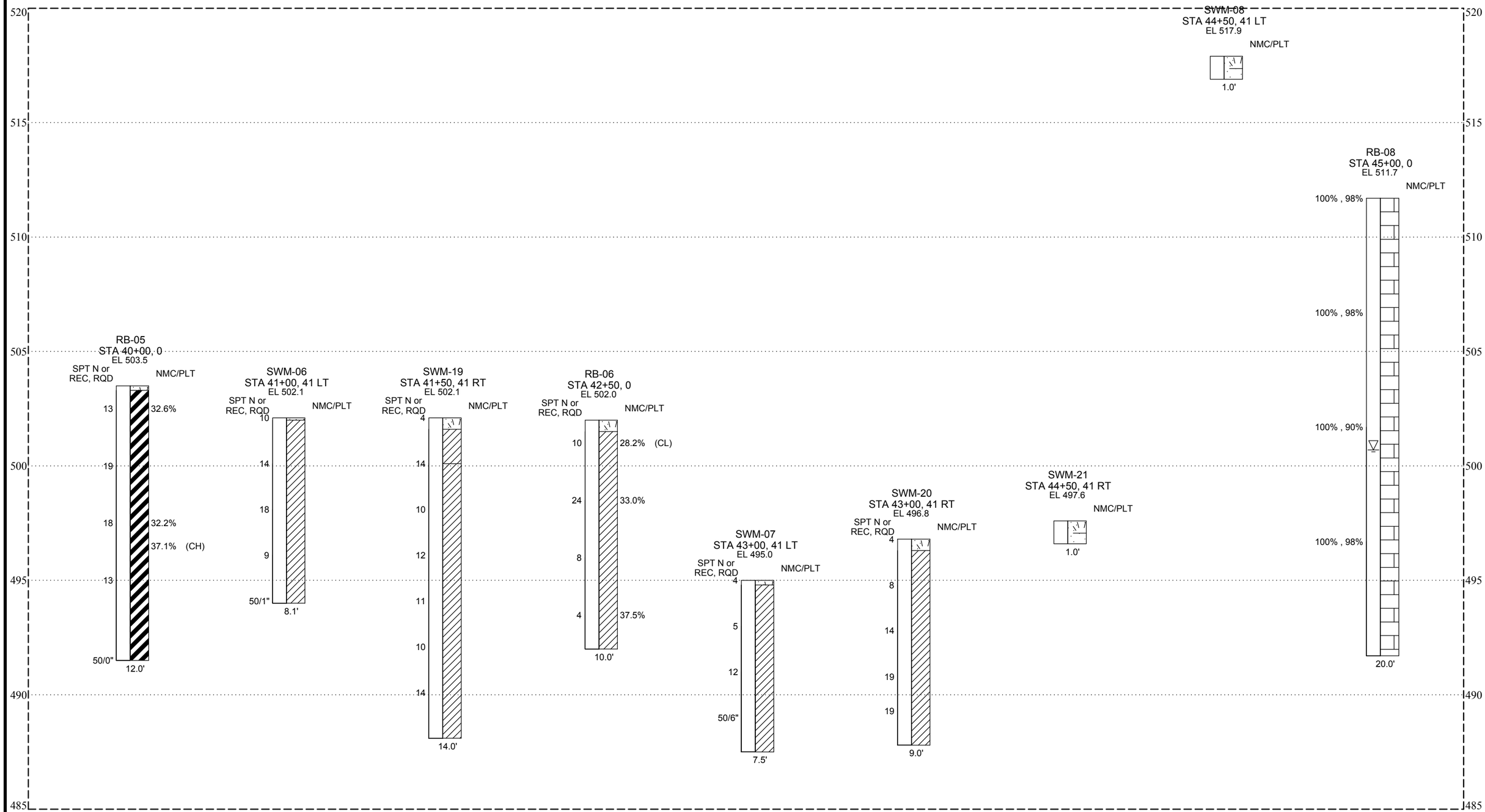
Title: Summary of Boring Data

Roadway Borings

Figure No. A-3-C

Drawn: JR | Approved: JLT | Date: 6/30/16 | Comm. No. 14187-03.4

RKK FENCE - USCS WITH STATION/OFFSET PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16



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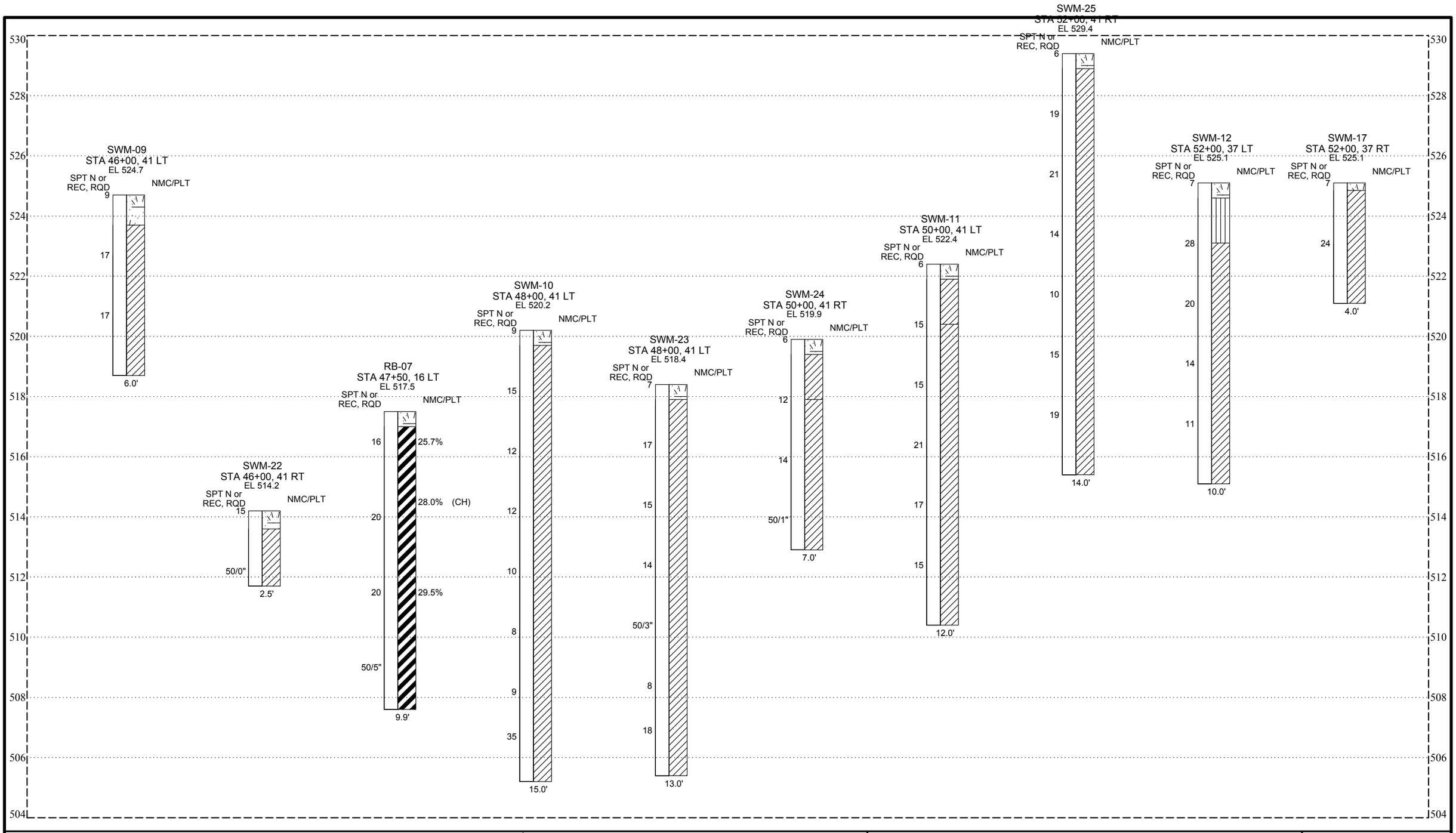
Title: Summary of Boring Data

Roadway Borings

Figure No. A-3-D

Drawn: JR | Approved: JLT | Date: 6/30/16 | Comm. No. 14187-03.4

RKK FENCE - USCS WITH STATION/OFFSET PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16



USCS SOIL KEY

GW	SW	ML	OL
GP	SP	MH	OH
GM	SM	CL	FILL
GC	SC	CH	Decomposed Rock

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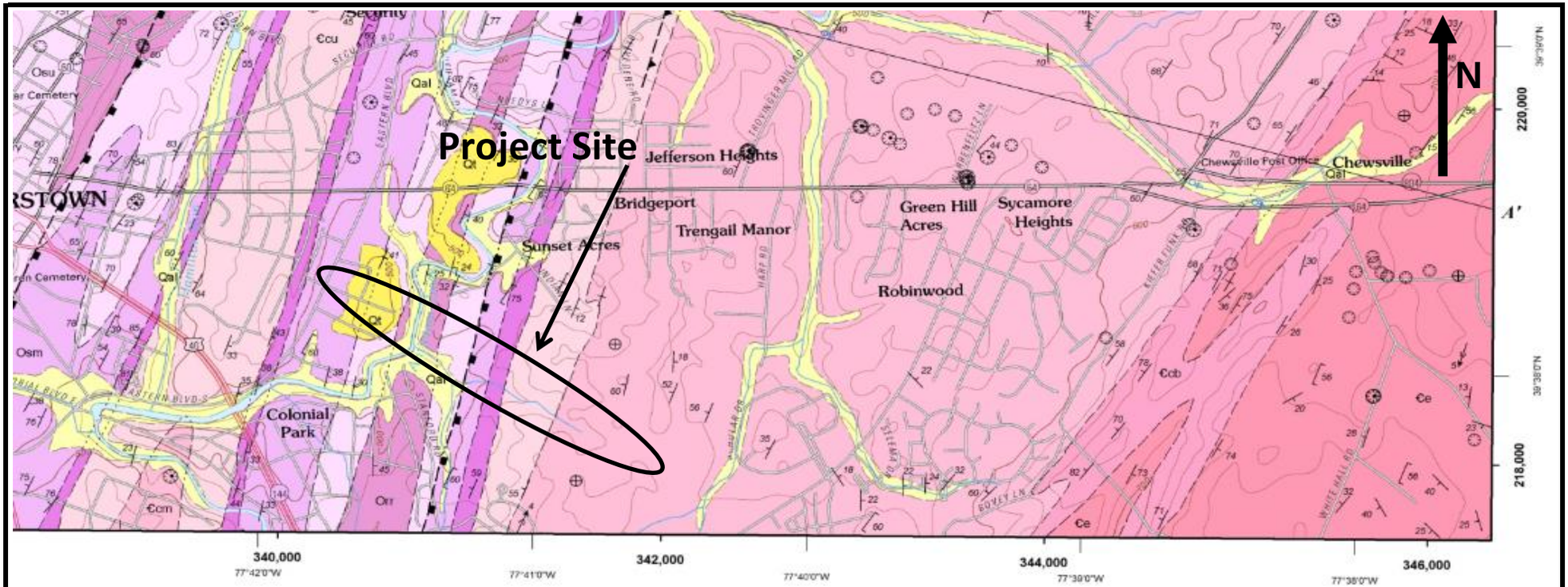
Title: **Summary of Boring Data**

Roadway Borings

Figure No. A-3-E

Drawn: JR | Approved: JLT | Date: 6/30/16 | Comm. No. 14187-03.4

RKK FENCE - USCS WITH STATION/OFFSET PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16



Qal — Alluvium	Orr — Rockdale Run Formation	Oss — Stonehenge Fm. Stoufferstown Member
Qt — Terrace Deposits	Osu — Stonehenge Fm. Upper Member	Ccu — Conococheague Fm. Upper Member
	Osm — Stonehenge Fm. Middle Member	Ccm — Conococheague Fm. Middle Member

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Geologic and Karst Features Map of the Hagerstown Quadrangle

Karst Features Map

Figure No: A-4

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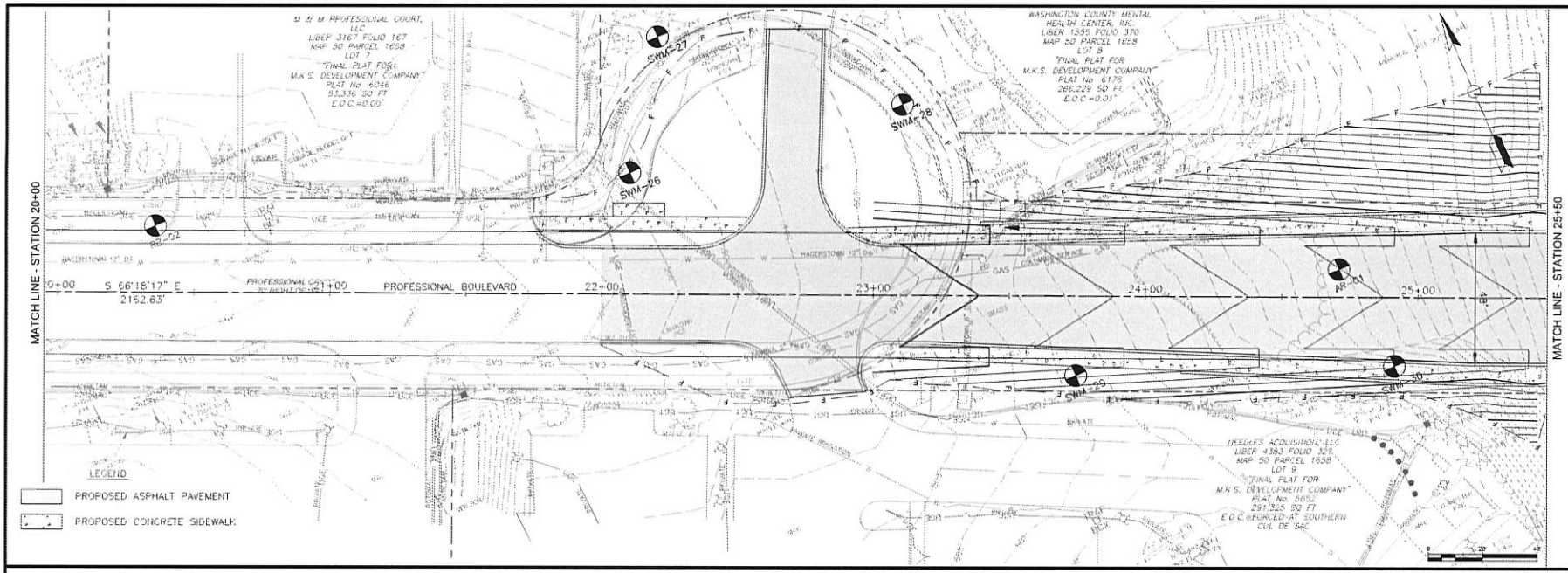
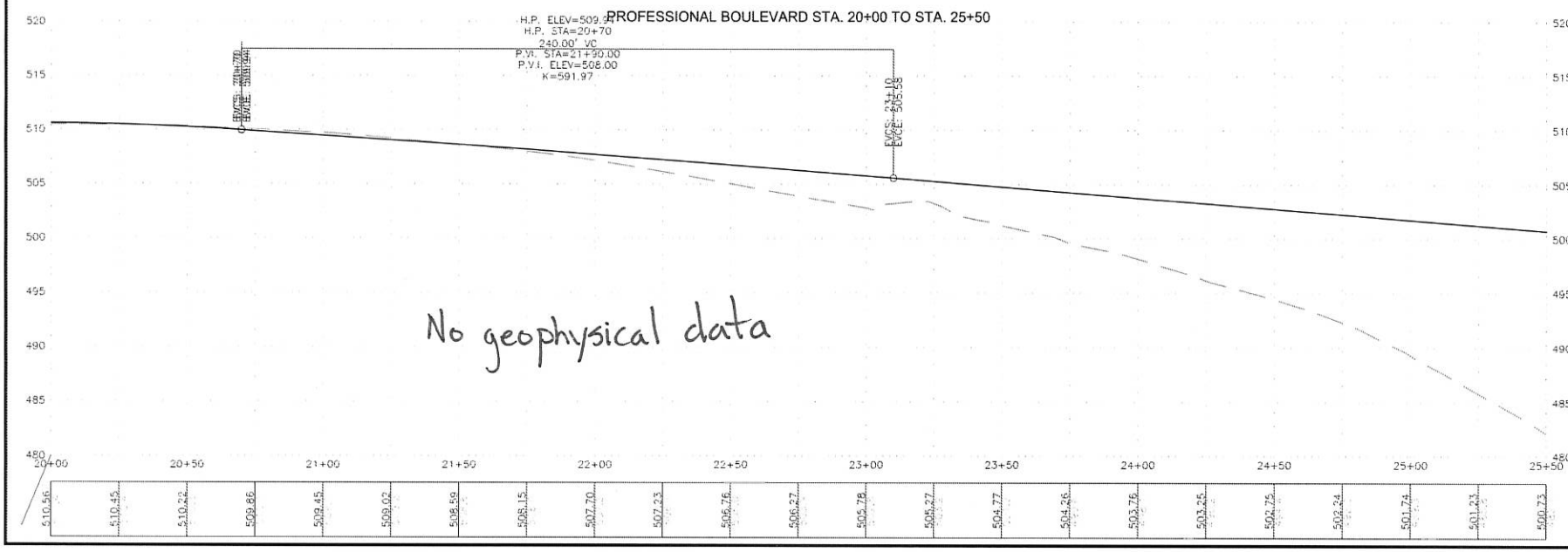
JAR	EMK	NTS	June 2016		14187-03.4

JR
11/28/16





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DRAWN BY: TMB
CHECKED BY: TMB
DATE: 12-11-15

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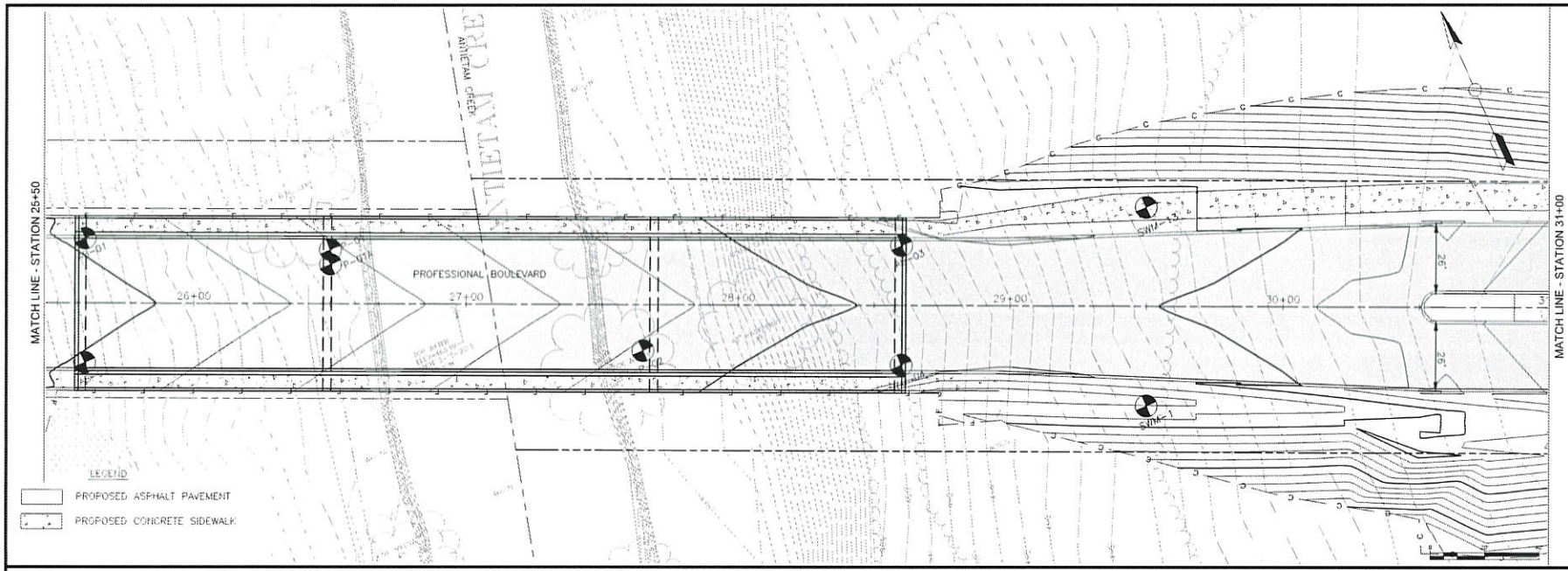
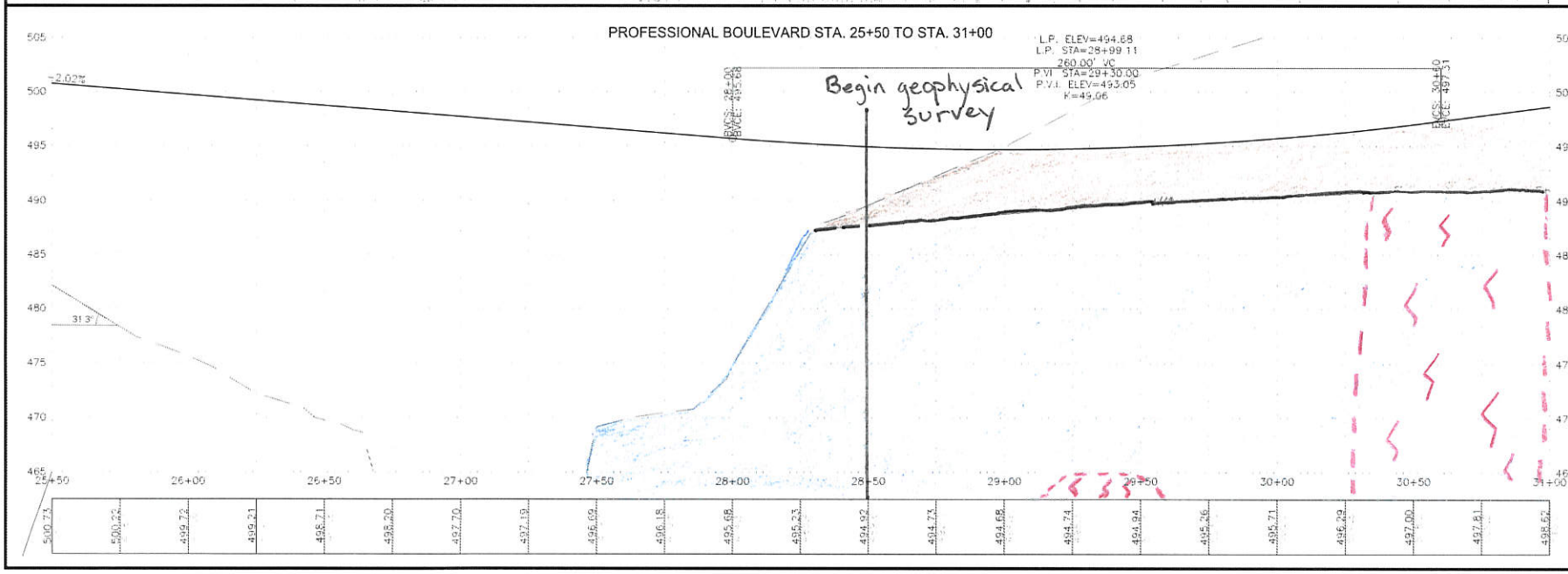
PROFESSIONAL BOULEVARD
BRIDGE & EXTENSION

ROADWAY PLAN & PROFILE

SCALE: 1"=20'
SHEET NO: 7 OF 17
PROJECT NO: 10-244





Soil

Limestone

Fractured Rock

Contact

Inferred Contact

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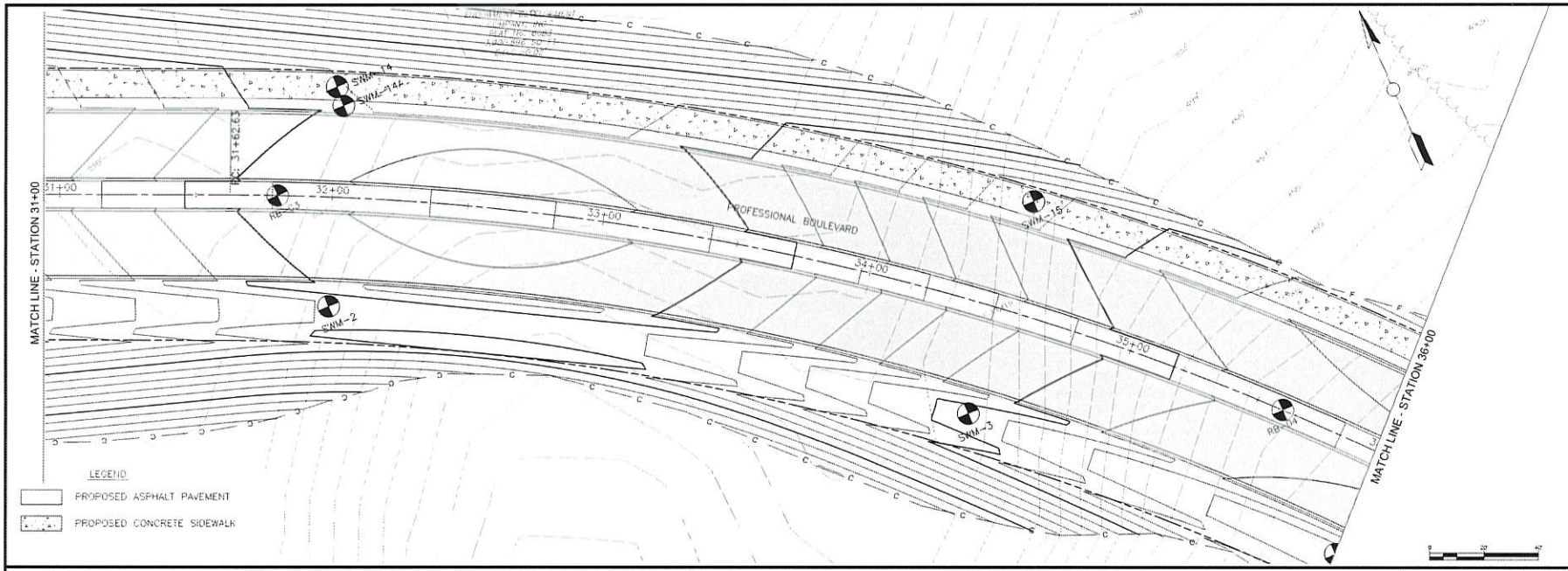
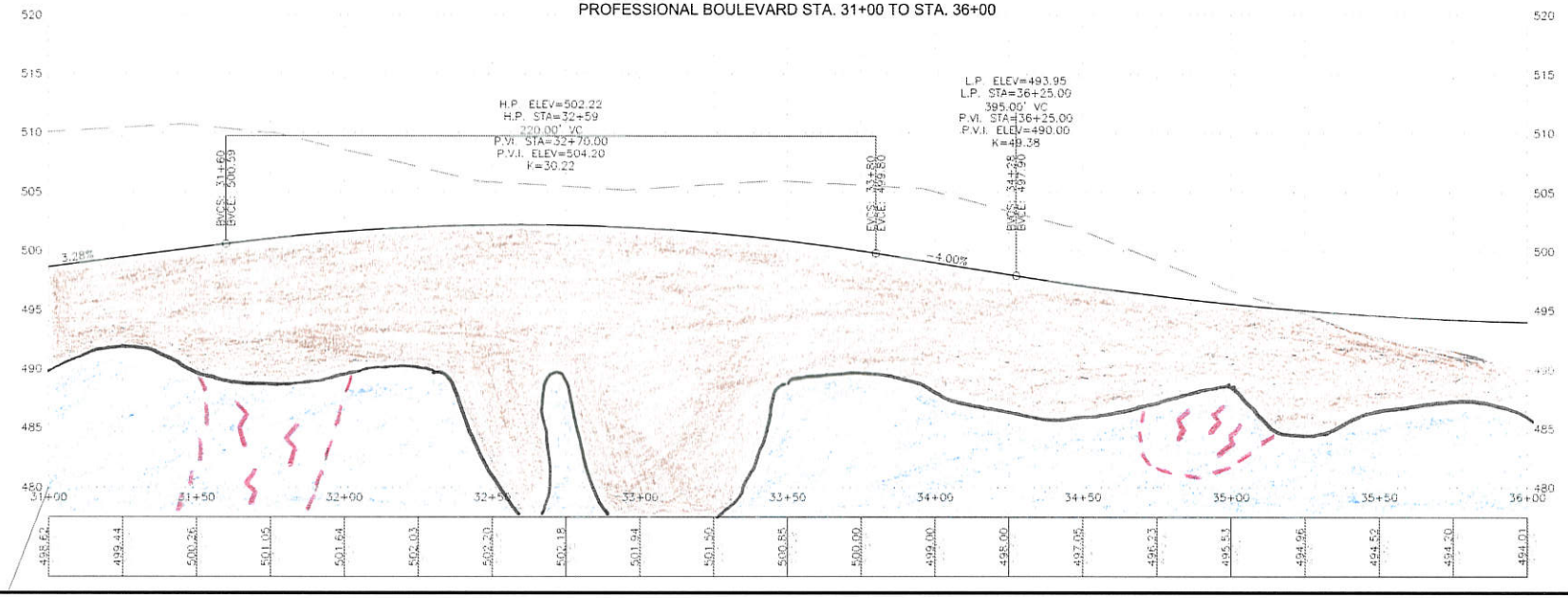
ROADWAY PLAN & PROFILE

SCALE
1"=20'

SHEET NO.
8 OF 17

PROJECT NO.
10-244





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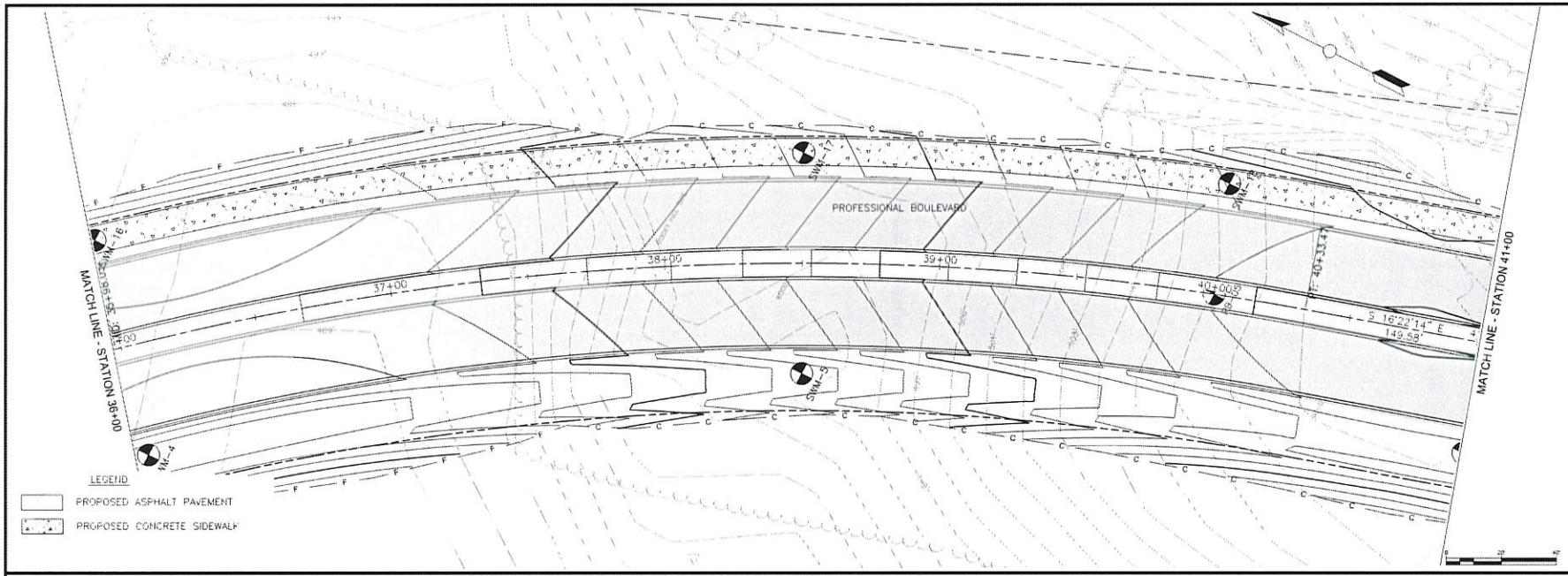
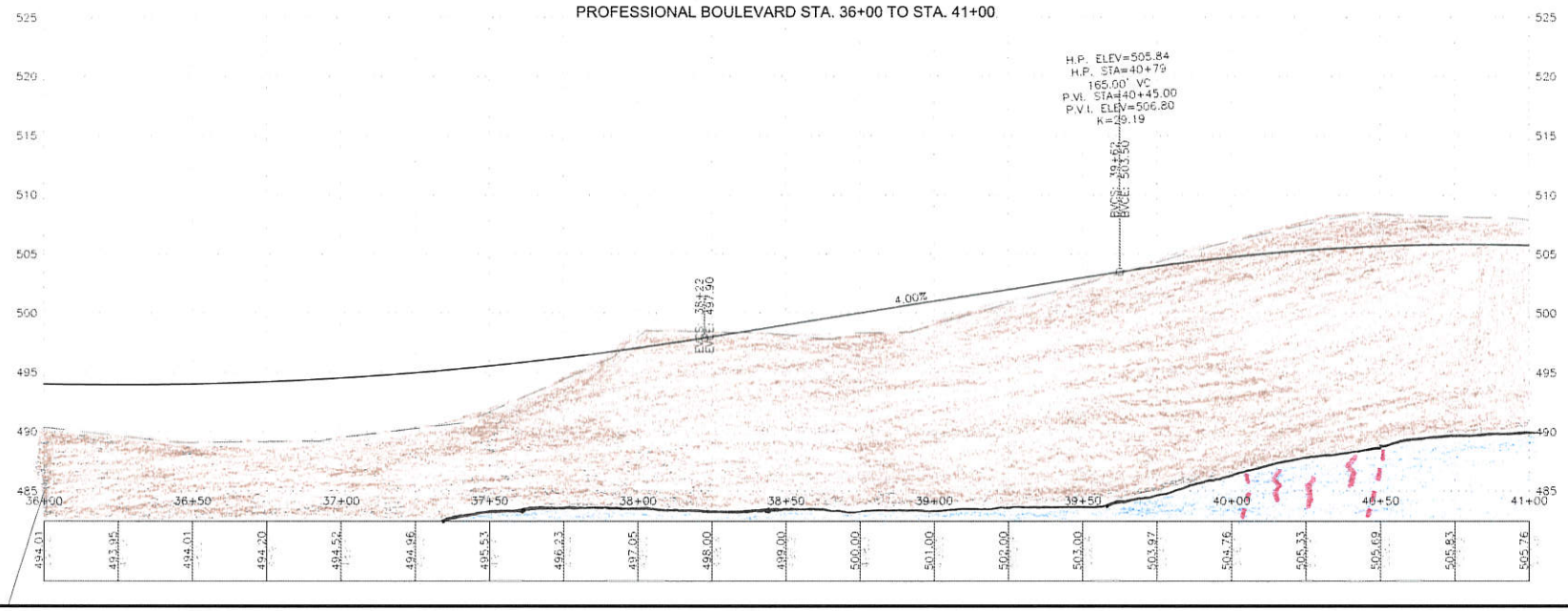
ROADWAY PLAN & PROFILE

SCALE
1"=20'

SHEET NO.
9 OF 17

PROJECT NO.
10-244





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PROFESSIONAL BOULEVARD
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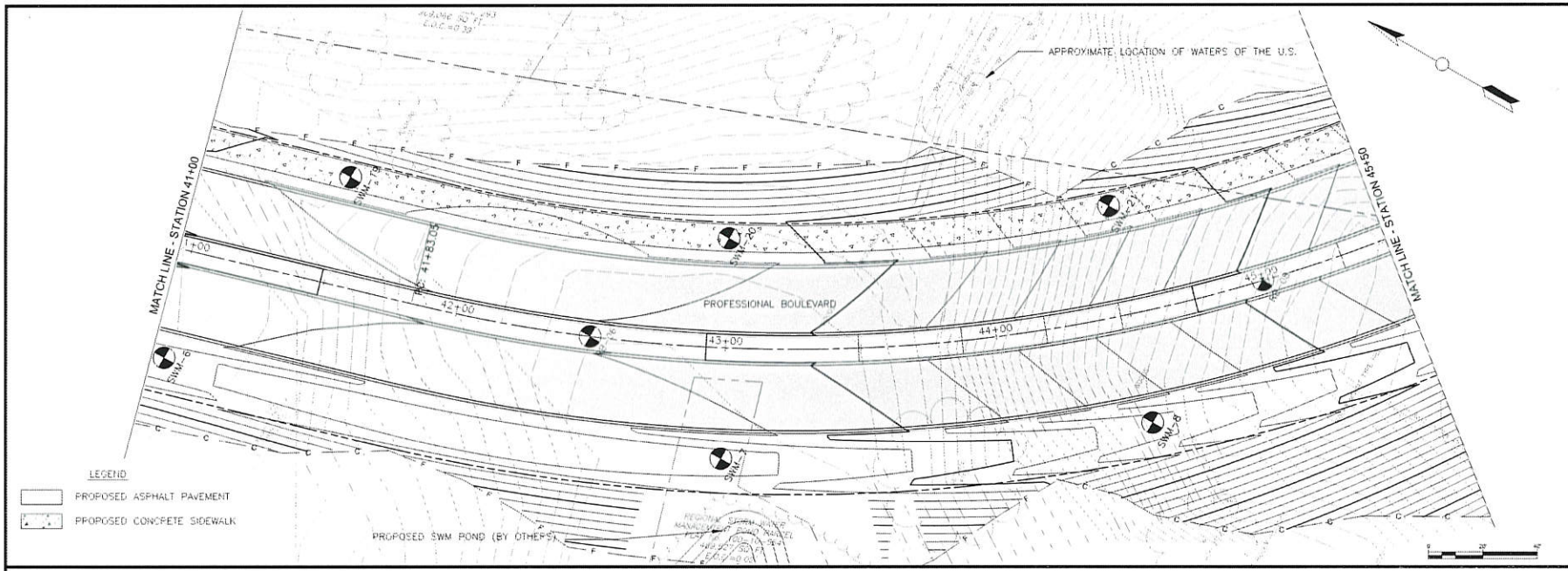
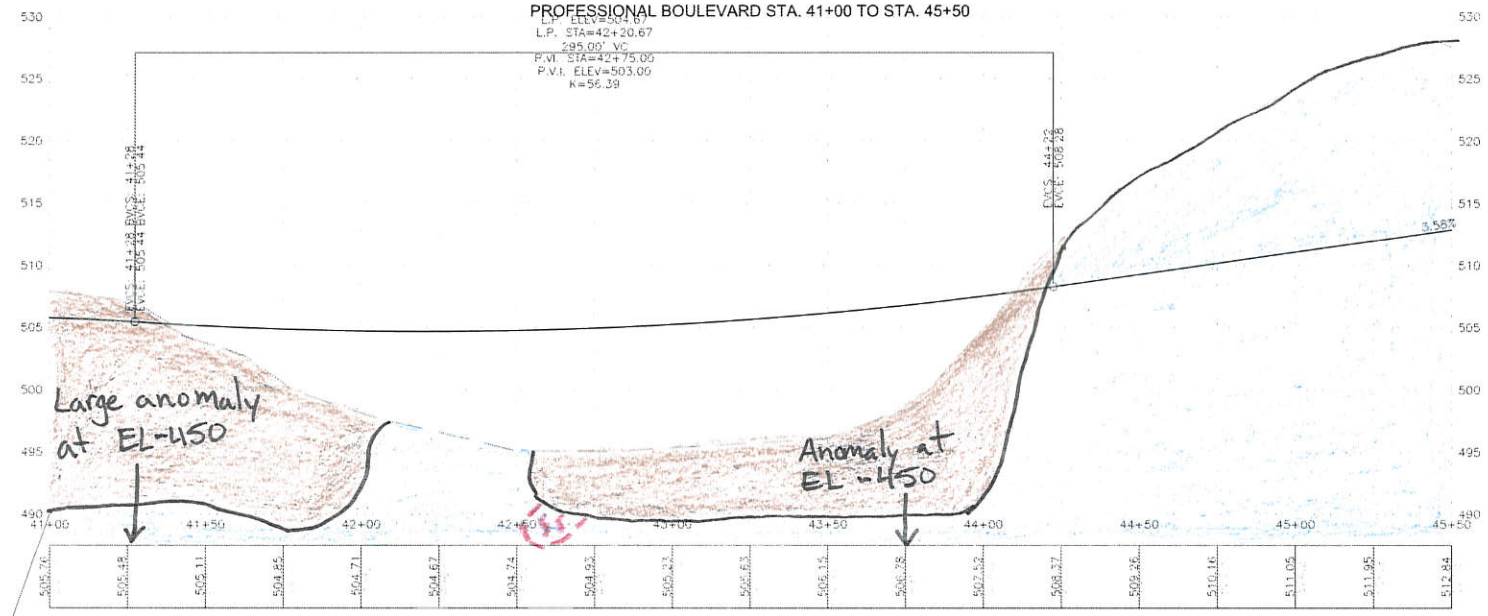
ROADWAY PLAN & PROFILE

SCALE
1"=20'

SHEET NO
10 OF 17

PROJECT NO
10-244





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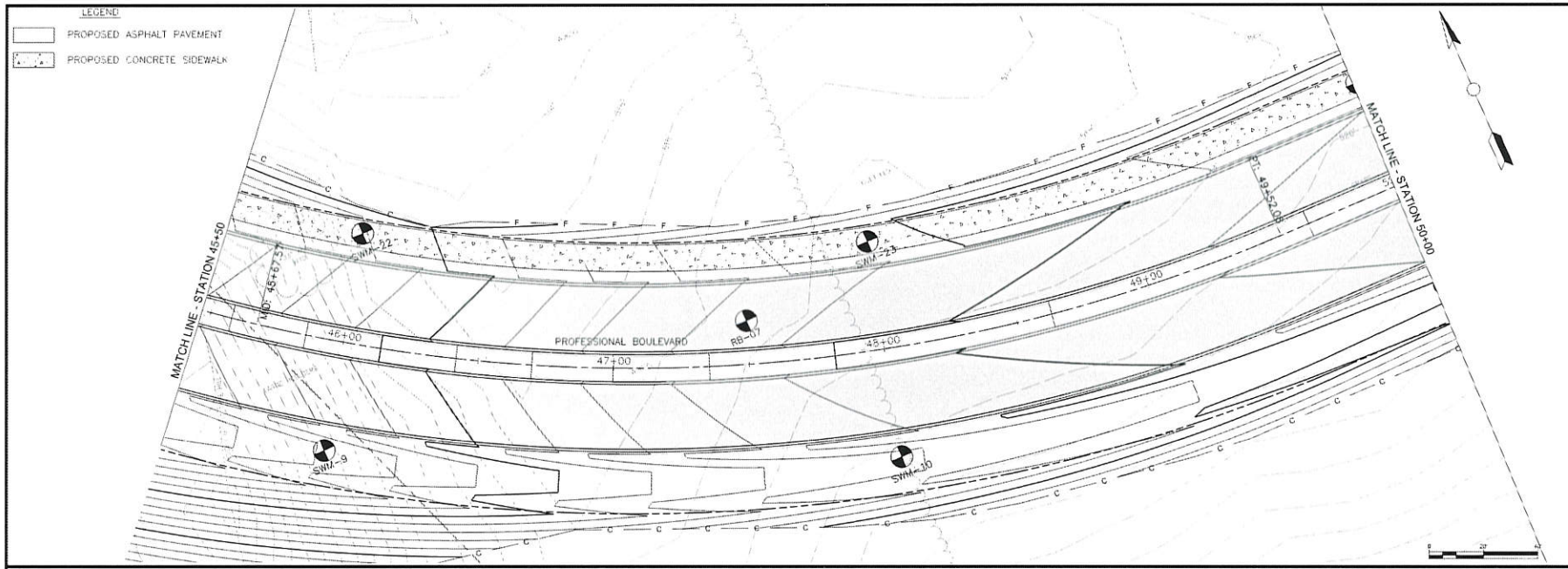
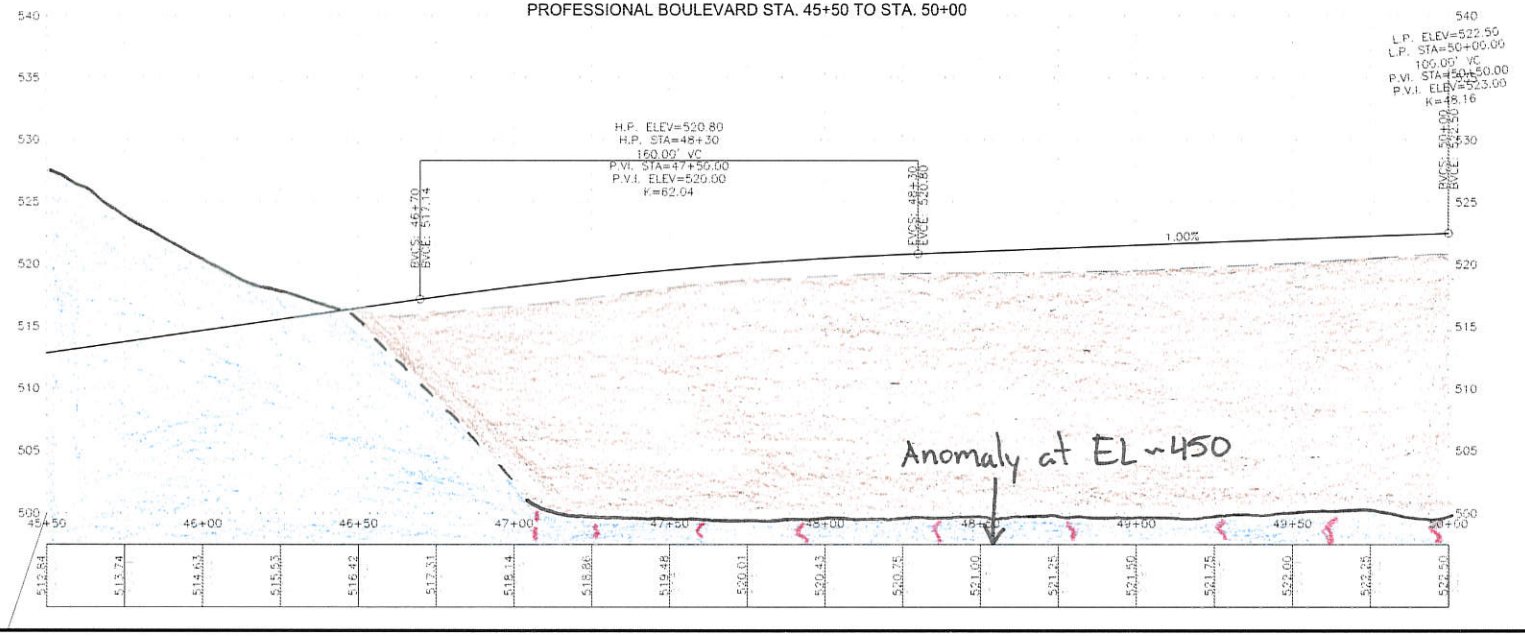
SCALE
1"=20'

SHEET NO
11 OF 17

PROJECT NO
10-244



PROFESSIONAL BOULEVARD STA. 45+50 TO STA. 50+00



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SCALE
1"=20'

SHEET NO
12 OF 17

PROJECT NO
10-244

Appendix B

FIELD CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

COHESIONLESS SOILS
(Silt, Sand, Gravel, and Combinations)

Density

Very Loose	4 blows/ft or less
Loose	5 to 10 blows/ft
Medium Dense	11 to 30 blows/ft
Dense	31 to 50 blows/ft
Very Dense	51 blows/ft or more

Relative Proportions

Descriptive Term	Percent
Trace	1 to 10
Little	11 to 20
Some	21 to 35
And	35 to 50

Particle Size Identification

Boulders	12 inches diameter or more
Cobbles	3 to 12 inch diameter
Gravel	Coarse: 3/4 to 3 inch diameter
	Fine: 1/4 to 3/4 inch diameter
Sand	Coarse: 2 mm to 1/4 inch (diameter of pencil lead)
	Medium: 0.425 to 2 mm (diameter of broom straw)
	Fine: 0.075 to 0.425 mm (diameter of human hair)
Silt	0.005 to 0.075 mm (Cannot see particles)

COHESIVE SOILS
(Clay, Silt, and Combinations)

Consistency

Very Soft	2 blows/ft or less
Soft	3 to 4 blows/ft
Medium Stiff	5 to 8 blows/ft
Stiff	9 to 15 blows/ft
Very Stiff	16 to 30 blows/ft
Hard	31 blows/ft or more

Plasticity

Degree of Plasticity	Plasticity Index
No to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	over 22

Soil Classifications on Test Boring Logs are made by visual-manual inspection of samples. Soil classification symbols using lower case letters are based on a visual-manual classification. Soil classification symbols using upper case letters are based on laboratory testing.

Standard Penetration Test - Driving a 2.0-inch OD, 1 3/8-inch ID sampler a distance of 1.0-foot into undisturbed soil with a 140-lb hammer free falling a distance of 30.0-inches. It is required to drive the spoon 6.0-inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating and making the test are recorded each 6.0-inches of penetration on the Test boring Log (Example 6-8-9, 8+9=17 blows/ft). (ASTM D-1586)

Strata Changes - In the column "Soil Descriptions" on the Test Boring Logs, the horizontal lines represent strata changes. A solid line represents an actually observed change, a dashed line represents an estimated change.

Ground Water - Observations were made at the time indicated. Porosity of soil strata, weather conditions, site topography, etc. may cause changes in the water levels indicated on the Test Boring Log.

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Title:			Figure No:
FIELD CLASSIFICATION SYSTEM FOR SOIL EXPLORATION			B-1
Drawn: JLT	Approved: EMK	Date: April 2004	Comm No: General

FIELD CLASSIFICATION SYSTEM FOR ROCK EXPLORATION

Rock Penetrated by Split Spoon Sampler: A transitional material between soil and rock retains the relic structure of the parent rock and exhibits penetration resistance between 60 blows/ft and 100 blows/ 2-inches of penetration

RQD: Rock Quality Designation: Ratio of the core lengths greater than 4-inches to the total length of the run. Applies only to sound, fresh, unweathered rock.

Recovery	Description	RQD	Description of Rock Quality	Approximate General Tunneler's Description
< 40%	Incompetent	0 - 25	Very Poor	Crushed
40-70	Competent	25 - 50	Poor	Shattered, very blocky and seamy
70-90	Fairly Continuous	50 - 75	Fair	Blocky and seamy
90-100	Continuous	75 - 90	Good	Massive, moderately jointed
		90 - 100	Excellent	Intact Rock

FIELD HARDNESS

(A measure of resistance to scratching or abrasion.)

Very Hard

Cannot be scratched with knife or geologist's pick. Breaking of hand specimens requires hard blows of geologist's pick. Typical UCC > 28- ksi

Hard

Can be scratched with knife or geologist's pick only with difficulty. Hard blow of a hammer required to detach hand specimen. Typical UCC: 14 to 28- ksi

Medium Hard

Can be scratched with knife or geologist's pick. Gouges or grooves of 1/4-inch deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow. Typical UCC: 10.5 to 14- ksi

Medium

Can be grooved or gouged 1/16-inch deep by firm pressure on knife or geologist's pick point. Can be excavated in small chips to pieces about 1-inch maximum size by hard blows of the point of a geologist's pick. Typical UCC: 7 to 10.5- ksi

Soft

Can be gouged or grooved readily with knife or pick point. Can be excavated in chips and pieces several inches in size by moderate blows of a geologist's pick point. Small thin pieces can be broken by finger pressure. Typical UCC: 3.5 to 7- ksi

Very Soft

Can be carved with knife. Can be excavated with point of pick. Pieces 1-inch or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail. Typical UCC: 140 to 3,500- psi

ROCK FRACTURE FREQUENCY

Description	Spacing Between Fractures
Extremely Fractured	< 1-in
Moderately Fractured	1 to 4-in
Slightly Fractured	4 to 8-in
Sound	> 8-in

NOTE: Fracture frequency terms are generalized to describe the average condition of the rock obtained from the core run. Portions of the rock within the run described may vary from the generalized descriptions. Where a core break appears to be due to drilling and not to natural causes, it has not been considered as a break for accessing fracture frequency. Frequency shown on the Test Boring Logs represents conditions of core as removed from the core barrel.

WEATHERING

(The action of the elements in altering the color, texture, and composition of the

Very Slightly

Rock generally fresh, joints stained, some joints may contain thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.

Slightly

Rock generally fresh, joints stained, and discoloration extends into rock up to 1-inch. Joints may contain clay. In granitoid rocks, some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.

Moderately

Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some may be decomposed to clay. Rock has dull sound under hammer and has a significant loss of strength compared with fresh rock.

Severely

All rock except quartz discolored or stained. Rock "fabric" clear and evident but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.

Very Severely

All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.

Completely

All rock completely altered to soil-like material.

JOINTS, BEDDING AND FOLIATION

Joints	Bedding and Foliation	Spacing
	Fissile	< 0.25-in
Very Close	Very Thin	< 2-in
Close	Thin	2-in to 1-ft
Moderately Close	Medium	1 to 3-ft
Wide	Thick	3 to 10-ft
Very Wide	Very Thick	> 10-ft

NOTE: Refers to perpendicular distance between discontinuities.

Attitude	Angle (Degrees)
Vertical	0 to 5
Steep or High Angle	5 to 35
Moderately Dipping	35 to 55
Shallow to Low Angle	55 to 85
Horizontal	85 to 90

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Title:	Figure No:
FIELD CLASSIFICATION SYSTEM FOR ROCK EXPLORATION	B-2

Drawn:	Approved:	Date:	Comm No:
JJV	EMK	August, 2015	General

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

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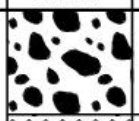
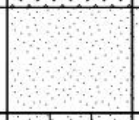
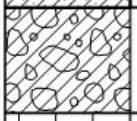
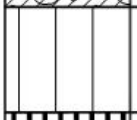
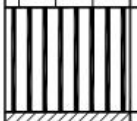
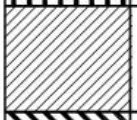
Title:	Figure No:
UNIFIED SOIL CLASSIFICATION SYSTEM	B-3

Drawn:	Approved:	Date:	Comm No:
JJV	EMK	August, 2015	General

AASHTO SOIL CLASSIFICATION CHART

GENERAL CLASSIFICATION	SOIL TYPE	SYMBOLS: GRAPH	SYMBOLS: LETTER	GRADING REQUIREMENTS	PHYSICAL CHARACTERISTICS
GRANULAR MATERIALS (35 percent or less of total sample passing No. 200)	GRAVEL & SAND		A-1-a	Sieve analysis % passing No. 10 = 50 max No. 40 = 30 max No. 200 = 15 max	P.I. = 6 max
			A-1-b	Sieve analysis % passing No. 40 = 50 max No. 200 = 25 max	P.I. = 6 max
	FINE SAND		A-3	Sieve analysis % passing No. 40 = 51 max No. 200 = 10 max	Non-plastic
	SILTY OR CLAYEY GRAVEL & SAND		A-2-4	Sieve analysis % passing No. 200 = 35 max	L.L. = 40 max P.I. = 10 max
			A-2-5	Sieve analysis % passing No. 200 = 35 max	L.L = 41 min P.I. = 10 max
			A-2-6	Sieve analysis % passing No. 200 = 35 max	L.L. = 40 max P.I. = 11 min
			A-2-7	Sieve analysis % passing No. 200 = 35 max	L.L. = 41 min P.I. = 11 min
SILT-CLAY MATERIALS (More than 35 oercent of total sample passing No. 200)	SILTY SOILS		A-4	Sieve analysis % passing No. 200 = 36 min	L.L. = 40 max P.I. = 10 max
			A-5	Sieve analysis % passing No. 200 = 36 min	L.L. = 41 min P.I. = 10 max
			A-6	Sieve analysis % passing No. 200 = 36 min	L.L. = 40 max P.I. = 11 min
	CLAYEY SOILS		A-7-5	Sieve analysis % passing No. 200 = 36 min	L.L. = 41 min P.I. = 11 min
			A-7-6	Sieve analysis % passing No. 200 = 36 min	L.L. = 41 min P.I. = 11 min
	PEAT OR MUCK		A-8	Based on Visual Classification	

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

RK&K
81 Mosher Street
Baltimore, Maryland 21217
(410) 728-2900

Title:	Figure No:
AASHTO SOIL CLASSIFICATION SYSTEM	**B-4**

Drawn:	Approved:	Date:	Comm No:
JJV	EMK	August, 2015	General

TEST BORING LOG

RK&K

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717914
EAST: 1117748
ELEVATION: 481 - ft
START DATE: 4/25/2016
END DATE: 4/25/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	NQ2
4/27/2016	9:00:00 AM	Dry		4	SIZE, ID (in)	3.25	1.375	2
4/27/2016	12:20:00 PM	Dry		4	HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 480.5		6-inches Topsoil	
S-1		18	4 6 7					0.5		Moist, Stiff, Brown, Medium Plasticity CLAY, Some Fine Sand (CL) [A-6]	
S-2		18	4 6 4	20.4%	29	14	5				Rough Augering at 5-ft
								EL 475.0			
S-3		0	50/0"					6.0		Light Gray, Argillaceous LIMESTONE, Slightly Weathered to Unweathered, Fine-grained, Slightly Fractured to Sound, Wide Fracture Spacing, Medium Strong RMR=72	
R-1		60	100%								Water Loss From 6 to 26-ft
R-2		60	93%				10			Run R-2: Moderately Fractured to Sound gray Limestone and Dolomite, Very Close to Wide Fracture Spacing, Thin bands of quartz RMR=72	
R-3		60	91%				15			Run R-3: Moderately Fractured to Sound Limestone, Very Close to Wide Fracture Spacing RMR=59	Laboratory UCC=16,660-psi at 16-ft
R-4		60	93%				20			Run R-4: Brown Silt on Joint Faces RMR=53	
							25	EL 455.0			
								26.0		Bottom of Boring @ 26.0 ft	Grouted on 4/27/16
							30				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717872
EAST: 1117730
ELEVATION: 481 - ft
START DATE: 4/25/2016
END DATE: 4/26/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
4/27/2016	12:15:00 PM	Dry		7.0

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	NQ2
SIZE, ID (in)	3.25	1.375	2
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 480.5		6-inches Topsoil	
S-1		12	4 4 6					0.5		Moist, Stiff, Grayish Brown, High Plasticity CLAY, Little Coarse to Fine Sand (CH) [A-7-6] Sample S-1: Trace Gravel	
S-2		12	4 6 7	31%	59	35	5			Sample S-2: Brown, Trace Fine Sand	
S-3		12	4 4 8	27.3%						Sample S-3: Brown, Trace Fine Sand	
S-4		8	14 50/5"					EL 471.5		Sample S-4: Hard, Brown, Gray	Auger Refusal at 9.5-ft
R-1		54	85%				10	9.5		Gray, LIMESTONE, Slightly Weathered to Unweathered, Fine-Grained, Slightly Fractured to Sound, Close to Wide Fracture Spacing, Medium Strong, Brown Silt on Joint Faces RMR=56	Laboratory UCC=13,540-psi at 9.5-ft
R-2		59	98%				15			Run R-2: Unweathered, Sound, Wide Fracture Spacing (No Joints) RMR=74	
R-3		60	98%				20			Run R-3: Unweathered, Sound, Wide Fracture Spacing (No Joints) RMR=72	
R-4		43	63%				25			Run R-4: Unweathered Sound, Wide Fracture Spacing	
								EL 455.2		25.5-ft to 25.8-ft: Completely Weathered Rock	
								25.8		RMR=52	
								EL 454.6		25.8-ft to 26.4-ft: Void (Based on Core Barrel Drop)	
								26.4		Gray, LIMESTONE, Unweathered, Sound, Fine-Grained, Wide Fracture Spacing, Medium Strong	
								EL 451.5			
							30	29.5		Bottom of Boring @ 29.5 ft	Grouted on 4/27/16

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717792
EAST: 1118022
ELEVATION: 492 - ft
START DATE: 5/9/2016
END DATE: 5/9/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/18/2016		Dry		7

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	NQ2
SIZE, ID (in)	3.25	1.375	2
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 491.5		6-inches Topsoil	
S-1		12	2 3 2	22.7%	64	44		0.5		Moist, Medium Stiff, Reddish Brown, High Plasticity CLAY, Trace Fine Sand (CH) [A-7-6]	
								EL 489.0			Auger Refusal at 3.0-ft
R-1		59	98%					3.0		Light Gray, LIMESTONE, Unweathered, Fine Grained, Sound, Wide Fracture Spacing, Medium Strong RMR=59	Laboratory UCC=9,580-psi at 3-ft
							5				
R-2		59	98%							Run R-2: RMR=67	
							10				
R-3		60	100%							Run R-3: Moderately Fractured to Sound, Close to Wide Fracture Spacing, Oxidized Joint Faces RMR=61	Water Loss From 13 to 23-ft
							15				
R-4		60	100%							Run R-4: RMR=59	
							20				
								EL 469.0			
								23.0		Bottom of Boring @ 23.0 ft	Grouted on 5/18/16
							25				
							30				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717752
EAST: 1118004
ELEVATION: 490 - ft
START DATE: 5/10/2016
END DATE: 5/10/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/18/2016		Dry		10

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	NQ2
SIZE, ID (in)	3.25	1.375	2
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 489.5		6-inches Topsoil	
S-1		1	50/1"					0.5		COMPLETELY WEATHERED ROCK Sampled As: Moist, Very Dense, Gray, Coarse Subangular Gravel-sized ROCK FRAGMENT (gp) [a-1-a]	
								EL 487.0			Auger Refusal at 3.0-ft
R-1		39	53%					3.0		Light Gray, LIMESTONE, Slightly Weathered to Unweathered, Fine Grained, Slightly Fractured to Sound, Close to Wide Fracture Spacing, Medium Strong	Laboratory UCC=12,080-psi at 3-ft
								EL 485.0			
							5	5.0		RMR=40	
								EL 484.2		Note: Void Encountered from 5.0-ft to 5.8-ft	
								5.8		Light Gray, LIMESTONE, Slightly Weathered to Unweathered, Fine Grained, Slightly Fractured to Sound, Close to Wide Fracture Spacing, Medium Strong	
R-2		58	92%							Run R-2: Unweathered, Sound, Moderate Fracture Spacing RMR=53	
							10				
R-3		60	100%							Run R-3: Unweathered, Sound, Wide Fracture Spacing RMR=53	
							15				
R-4		60	100%							Run R-4: Unweathered, Sound, Wide Fracture Spacing RMR=69	
							20				
								EL 467.0			
								23.0		Bottom of Boring @ 23.0 ft	Grouted on 5/18/16
							25				
							30				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717932
EAST: 1117647
ELEVATION: 493 - ft
START DATE: 4/25/2016
END DATE: 4/25/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
4/25/2016	10:50:00 AM	Dry		8.3
4/27/2016	12:30:00 PM	Dry		8.3

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	
SIZE, ID (in)	3.25	1.375	
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 492.5		6-inches Topsoil	
								0.5		Moist, Medium Stiff, Brown, High Plasticity CLAY, Trace Fine Sand (CH) [A-7-6]	
S-1		18	2 3 4								
S-2		18	2 4 6	30.8%	67	41				Sample S-2: Stiff	
							5				
S-3		18	4 6 7							Sample S-3: Stiff	
								EL 484.5			
S-4		8	28 27 20					8.5		Moist, Dense, Light Gray, Coarse to Fine Angular Gravel-Sized ROCK FRAGMENTS, Trace Coarse to Fine Sand [gp] [a-1-a]	
								EL 483.0			
S-5		6	1 1 2	18.2%	47	28	10	10.0		Moist, Soft, Brown, High Plasticity CLAY, Some Coarse to Fine Sand, Trace Gravel (CL) [A-7-6]	Initial Auger Refusal at 10-ft, But Spoon Broke Through
								EL 481.5			
S-6		4	20 16 12					11.5		Moist, Medium Dense, Light Gray, Coarse to Fine Subangular Gravel-Sized ROCK FRAGMENTS, Trace Sand (gp) [a-1-a]	
								EL 480.0			
								13.0		Bottom of Boring @ 13.0 ft	Grouted on 4/27/16
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717874
EAST: 1117829
ELEVATION: 470 - ft
START DATE: 4/26/2016
END DATE: 4/26/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	NQ2
					SIZE, ID (in)	3.25	1.375	2
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 469.5 0.5		6-inches Topsoil	
S-1		12	3 3 3							Moist, Medium Stiff, Brownish Gray, Medium Plasticity CLAY, Little Coarse to Fine Sand (CL) [A-6] Sample S-1: Trace Roots	
S-2		8	2 2 2	30.8%	34	13	5			Sample S-2: Soft	
S-3		6	2 50/5					EL 462.5 7.5		Sample S-3: Hard, Dark Gray, Some Medium to Fine Sand, Trace Silt	Water on Spoon at 6.0-ft
R-1		60	100%				10			Gray, LIMESTONE, Unweathered, Fine-grained, Slightly Fractured to Sound, Close Fracture Spacing, Medium Strong RMR=45	
R-2		45	63%				15			Run R-2: Extremely Fractured to Sound, Very Close to Close Fracture Spacing RMR=44	Laboratory UCC=16,400-psi at 12.5-ft
								EL 452.5 17.5		Bottom of Boring @ 17.5 ft	Sampler Jammed with Rock Fragments. Offset performed 5-ft South. See Log for P-01A. Grouted upon completion
							20				
							25				
							30				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717869
EAST: 1117829
ELEVATION: 470 - ft
START DATE: 4/27/2016
END DATE: 4/27/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/18/2016		3		7

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	NQ2
SIZE, ID (in)	3.25	1.375	2
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
										Blank Auger to 7.5-ft	
							5				
								EL 462.5			
R-1		53	75%					7.5		Gray, LIMESTONE, Slightly Weathered to Unweathered, Fine-grained, Sound, Moderate to Wide Fracture Spacing, Medium Strong, Quartz Layers Sparsely Present Throughout RMR=31	Laboratory UCC=4,500-psi at 7.5-ft
							10				
R-2		60	67%							Run R-2: Moderately Fractured to Sound, Very Close to Wide Fracture Spacing, Quartz Layers Throughout, Brown Rust on Joint Faces RMR=23	
							15				
R-3		59	98%							Run R-3: Unweathered, Sound, Wide Fracture Spacing, Brown Rust on Joint Face RMR=51	
							20				
R-4		54	83%							Run R-4: Unweathered, Wide Fracture Spacing, No Quartz RMR=58	
							25				
								EL 442.5			
								27.5		Bottom of Boring @ 27.5 ft	Grouted on 5/18/16
							30				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717794
EAST: 1117919
ELEVATION: 470 - ft
START DATE: 5/9/2016
END DATE: 5/9/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/18/2016		4		8

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	NQ2
SIZE, ID (in)	3.25	1.375	2
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 469.0		12-inches Topsoil	
S-1		11	2 2 2	29%	31	12		1.0		Moist, Soft, Gray, Medium Plasticity CLAY, Little Fine Sand (CL) [A-6]	
								EL 466.5			
S-2		18	1 1 1	33%	30	10		3.5		Moist, Very Loose, Dark Gray, Fine to Medium SAND And Medium Plasticity Silt (SM) [A-4]	
							5				
								EL 464.0			
S-3		12	1 2 2	35.7%				6.0		Moist. Soft, Dark Gray, CLAY, Some Fine Sand (cl) [a-6]	
S-4		1	50/1"							Sample S-4: Hard, Trace Gravel-sized Rock Fragments	Auger Refusal at 9-ft
								EL 461.0			
R-1		25	27%					9.0		Light Gray, LIMESTONE, Slightly Weathered to Completely Weathered, Fine-grained, Extremely Fractured to Sound, Extremely Close to Moderate Fracture Spacing, Medium Strong	Laboratory UCC=7,130-psi at 9-ft
								EL 460.5			
								9.5			
							10	EL 460.0			
								10.0		RMR=33	
								EL 459.5			
								10.5		Voids Encountered from 9.5-ft to 10.0-ft	
								EL 459.0			
								11.0		Light Gray, LIMESTONE, Slightly Weathered to Completely Weathered, Fine-grained, Extremely Fractured to Sound, Extremely Close to Moderate Fracture Spacing, Medium Strong	
										Voids Encountered from 10.5-ft to 11.0-ft	
										Light Gray, LIMESTONE, Slightly Weathered to Completely Weathered, Fine-grained, Extremely Fractured to Sound, Extremely Close to Moderate Fracture Spacing, Medium Strong	
R-2		19	0%							Run R-2: Extremely Fractured to Moderately Fractured, Extremely Close to Close Fr RMR=25	

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LABORATORY TEST RESULTS: LIQUID LIMIT	LABORATORY TEST RESULTS: PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
										Light Gray, LIMESTONE, Slightly Weathered to Completely Weathered, Fine-grained, Extremely Fractured to Sound, Extremely Close to Moderate Fracture Spacing, Medium Strong	
R-3		60	100%				20			Run R-3: Slightly Weathered, Sound, Wide Fracture Spacing RMR=57	
R-4		60	100%				25			Run R-4: Slightly Weathered, Sound, Wide Fracture Spacing RMR=59	
								EL 441.0			
								29.0		Bottom of Boring @ 29.0 ft	Grouted on 5/18/16
							30				

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 718271
EAST: 1116802
ELEVATION: 497 - ft
START DATE: 5/2/2016
END DATE: 5/2/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/2/2016	10:10:00 AM	Dry		3

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	
SIZE, ID (in)	3.25	1.375	
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 496.6		5-inches Bituminous Concrete	
								0.4		4-inches Graded Aggregate Base (Crushed Stone)	
S-1		6	7 7 10	28.4%	47	32		EL 496.3 0.7		Moist, Very Stiff, Brown, High Plasticity CLAY, Little Coarse to Fine Sand, Trace Coarse to Fine Gravel (CL) [A-7-6]	MDD = 116.1-pcf OMC = 15.9% CBR =9.7
S-2		6	4 4 6	26.7%			5			Sample S-2: Stiff	
S-3		16	6 6 11							Sample S-3: Reddish Brown, Trace Fine Sand	Bulk Sample Taken From Auger Cuttings 1.0 to 6.0-ft
S-4		18	5 6 6	37.4%			10	EL 487.0 10.0		Sample S-4: Stiff, Reddish Brown Bottom of Boring @ 10.0 ft	Backfilled with auger cuttings and patched upon completion
							15				
							20				
							25				
							30				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 718126
EAST: 1117268
ELEVATION: 510 - ft
START DATE: 5/2/2016
END DATE: 5/2/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/2/2016	10:50:00 AM	Dry		5.0	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 509.6		5-inches Bituminous Concrete	
								0.4		5-inches Cemented Sand	
S-1		12	2 4 7	29.4%	65	44		EL 509.2 0.8		Moist, Stiff, Brown, High Plasticity CLAY, Trace Fine Sand (CH) [A-7-6]	MDD = 113.5-pcf OMC = 14.9% CBR =1.7
S-2		13	6 9 10	36.2%			5			Sample S-2: Very Stiff	
S-3		18	6 7 10							Sample S-3: Reddish Brown, Very Stiff	Bulk Sample Taken From Auger Cuttings 1.0 to 6.0-ft
S-4		18	4 4 6	37.6%						Sample S-4: Reddish Brown	
							10	EL 500.0 10.0		Bottom of Boring @ 10.0 ft	Backfilled with auger cuttings and patched upon completion
							15				
							20				
							25				
							30				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717643
EAST: 1118306
ELEVATION: 510 - ft
START DATE: 5/3/2016
END DATE: 5/3/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/3/2016		Dry		7.5	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 509.5		6-inches Topsoil	
S-1	X	6	8 7 6	14%				0.5		Moist, Stiff, Gray, Brown, SILT, And Fine SAND (ml) [a-4]	Bulk Sample Taken From Auger Cuttings 0.0 to 6.0-ft
								EL 506.5			
S-2	X	18	4 6 10				5	3.5		Moist, Very Stiff, Yellowish Brown, CLAY, And Fine Sand (cl) [a-6]	
S-3	X	18	4 4 6	28%						Sample S-3: Stiff	
S-4	X	18	4 5 6				10			Sample S-4: Stiff	
								EL 500.0			
								10.0		Bottom of Boring @ 10.0 ft	Backfilled with auger cuttings upon completion
							15				
							20				
							25				
							30				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717423
EAST: 1118613
ELEVATION: 493 - ft
START DATE: 5/2/2016
END DATE: 5/2/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/2/2016	1:55:00 PM	Dry		5.0	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 492.2		10-inches Topsoil	
S-1	X	9	5 7 7	33.2%	58	37		0.8		Moist, Stiff, Brown, High Plasticity CLAY, Trace Fine to Coarse Sand (CH) [A-7-6]	MDD = 115.4-pcf OMC = 14.5% CBR =2
S-2	X	12	2 4 6	28.5%			5				
S-3	X	18	3 6 8								Bulk Sample Taken From Auger Cuttings 0.0 to 7.0-ft
S-4	X	18	4 7 9	29.2%						Sample S-4: Very Stiff, Some Coarse to Fine Sand, Trace Fine Angular Gravel	
							10	EL 483.0 10.0		Bottom of Boring @ 10.0 ft	Backfilled with auger cuttings upon completion
							15				
							20				
							25				
							30				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717049
EAST: 1118838
ELEVATION: 503.5 - ft
START DATE: 5/10/2016
END DATE: 5/10/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/10/2016	12:50:00 PM	Dry		7.9	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 503.3 0.2		2-inches Topsoil	
S-1		12	3 5 8	32.6%						Moist, Stiff, Reddish Brown, High Plasticity CLAY, Trace Fine Sand (CH) [A-7-6]	
S-2		16	3 8 11				5			Sample S-2: Very Stiff, Little Sand	Bulk Sample Taken From Auger Cuttings 7.0 to 12.0-ft
S-3		16	3 8 10	32.2% 37.1%	77	49				Sample S-3: Very Stiff	MDD = 105.3-pcf OMC = 18.9% CBR =1.4
S-4		18	6 6 7				10				
								EL 491.5 12.0			
S-5		0	50/0"							Sample S-5: No Recovery Bottom of Boring @ 12.0 ft	Auger Refusal at 12.0-ft Backfilled with auger cuttings upon completion
							15				
							20				
							25				
							30				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716810
EAST: 1118912
ELEVATION: 502 - ft
START DATE: 5/11/2016
END DATE: 5/11/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/11/2016	9:15:00 AM	Dry		4.5

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	
SIZE, ID (in)	3.25	1.375	
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LABORATORY TEST RESULTS: LIQUID LIMIT	LABORATORY TEST RESULTS: PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 501.5		6-inches Topsoil	
S-1	X	18	2 5 5	28.2%	43	24		0.5		Moist, Stiff, Reddish Brown, High Plasticity CLAY, Some Coarse to Fine Sand, Trace Fine Gravel (CL) [A-7-6]	MDD = 115.8-pcf OMC = 14.8% CBR =3.3
S-2	X	18	3 4 20	33%			5			Sample S-2: Very Stiff, Brown, Gray, Little Coarse to Fine Sand, Little Gravel-sized Rock Fragments at the Tip of Spoon	Bulk Sample Taken From Auger Cuttings 0.0 to 10.0-ft
S-3	X	16	4 4 4							Sample S-3: Medium Stiff, Grayish Brown, Trace Gravel-sized Rock Fragments	
S-4	X	18	3 2 2	37.5%						Sample S-4: Soft, Grayish Brown	
							10	EL 492.0 10.0		Bottom of Boring @ 10.0 ft	Backfilled with auger cuttings upon completion
							15				
							20				
							25				
							30				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716492
EAST: 1119270
ELEVATION: 517.5 - ft
START DATE: 5/12/2016
END DATE: 5/12/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/12/2016	9:00:00 AM	Dry		5.3

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	
SIZE, ID (in)	3.25	1.375	
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 517.0		6-inches Topsoil	
S-1		14	4 7 9	25.7%				0.5		Moist, Very Stiff, Reddish Brown, High Plasticity CLAY, Trace Fine to Coarse Sand (CH) [A-7-6]	
S-2		18	6 8 12	28%	72	49	5			Sample S-2: Yellowish Brown	MDD = 110.3-pcf OMC = 18.2% CBR =2.3
S-3		18	7 9 11	29.5%						Sample S-3: Reddish to Yellowish Brown	Bulk Sample Taken From Auger Cuttings 0.0 to 6.0-ft
S-4		16	6 6 50/5"				10			Sample S-4: Hard, Reddish to Yellowish Brown	
								EL 507.6 9.9		Bottom of Boring @ 9.9 ft	Backfilled with auger cuttings upon completion
							15				
							20				
							25				
							30				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716606
EAST: 1119053
ELEVATION: 511.7 - ft
START DATE: 5/16/2016
END DATE: 5/16/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/18/2016	9:30:00 AM	11		20

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	NQ2
SIZE, ID (in)	3.25	1.375	2
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
R-1		60	98%							Light Gray to Gray, LIMESTONE, Unweathered, Fine-grained, Sound, Moderate Fracture Spacing, Medium Strong to Strong	Laboratory UCC=2,070-psi at 0-ft
R-2		60	98%				5				Rock outcrops observed in the vicinity of boring
R-3		60	90%				10 ▽			Run R-3: Wide Fracture Spacing	
R-4		60	98%				15			Run R-4: Very Wide Fracture Spacing	
							20	EL 491.7 / 20.0		Bottom of Boring @ 20.0 ft	Grouted on 5/18/16
							25				
							30				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717702
EAST: 1118081
ELEVATION: 500 - ft
START DATE: 5/3/2016
END DATE: 5/3/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
					SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		18	2 3 3 3					EL 499.8 0.2		3-inches Topsoil Moist, Medium Stiff, Brown, CLAY (cl) [a-7-6]	
S-2		10	6 8 5 2	9.9%	20	7		EL 498.0 2.0		Moist, Stiff, Gray, Brown, SILT, Some Fine Sand, Little Clay (ML) [A-4]	
S-3		8	20 13 8 5				5			Sample S-3: Very Stiff, Brown, And Coarse to Fine SAND	
S-4		18	4 4 6 9					EL 494.0 6.0		Moist, Stiff, Reddish Brown, CLAY (cl) [a-7-6]	
S-5		18	4 4 5 6							Sample S-5: Brown, Little Fine Angular Gravel	
S-6		24	4 4 5 8	15.9%			10			Sample S-6: Brown, Little Fine Angular Gravel	
S-7		17	4 6 7 10							Sample S-7: Brown, Little Fine Sand, Little Fine Angular Gravel	
S-8		18	6 7 10 9				15			Sample S-8: Very Stiff, Trace Fine Sand	
S-9		12	8 9 8 7							Sample S-9: Very Stiff, And Medium to Fine SAND	
								EL 482.0 18.0		Bottom of Boring @ 18.0 ft	Backfilled with auger cuttings upon completion

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 7/26/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717598
EAST: 1118307
ELEVATION: 507.2 - ft
START DATE: 5/3/2016
END DATE: 5/3/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/3/2016	11:15:00 AM	Dry		3.5	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		9	3 4 3 4					EL 506.7 0.5		6-inches Topsoil Moist, Medium Stiff, Brown, CLAY (CH) [A-7-6]	
S-2		12	3 5 7 11							Sample S-2: Stiff	
S-3		22	3 5 7 11	32.9%			5			Sample S-3: Stiff	
S-4		18	4 7 10 15							Sample S-4: Very Stiff	
S-5		24	5 7 9 10							Sample S-5: Very Stiff	
S-6		18	3 5 7 11	27.8%	61	39	10			Sample S-6: Stiff	
S-7		24	3 6 7 8							Sample S-7: Stiff	
S-8		18	3 5 9 5	37.7%			15			Sample S-8: Stiff	
S-9		15	16 8 50/3"							Sample S-9: Hard, Light Gray at Tip of Spoon	
								EL 490.0 17.2		Bottom of Boring @ 17.2 ft	Backfilled with auger cuttings upon completion

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 7/26/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717468
EAST: 1118507
ELEVATION: 502.3 - ft
START DATE: 5/2/2016
END DATE: 5/2/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/2/2016	4:15:00 PM	Dry		15	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LABORATORY TEST RESULTS: LIQUID LIMIT	LABORATORY TEST RESULTS: PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		12	4 6 6 6					EL 501.6		8-inches Topsoil	
								0.7		Moist, Stiff, Reddish Brown, CLAY (CH) [A-7-6]	
S-2		6	4 6 9 9								
S-3		12	4 5 7 9	26.7%			5				
S-4		18	5 7 9 12							Sample S-4: Very Stiff	
S-5		15	5 5 6 9								
S-6		18	4 5 8 10				10			Sample S-6: Reddish to Yellowish Brown	
S-7		18	3 3 3 5	28.4%	48	28				Sample S-7: Medium Stiff, Brown	
S-8		12	3 2 3 1				15			Sample S-8: Medium Stiff, Brown, Trace Fine Sand	
S-9		6	2 3 2 11	30.1%						Sample S-9: Medium Stiff, Light Gray to Brown, Little Medium to Fine Sand	
								EL 484.3			
								18.0		Bottom of Boring @ 18.0 ft	Backfilled with auger cuttings upon completion

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717367
EAST: 1118610
ELEVATION: 490 - ft
START DATE: 5/2/2016
END DATE: 5/2/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/2/2016	2:15:00 PM	Dry		5.5	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		18	2 2 2 2					EL 489.5 0.5		6-inches Topsoil Moist, Very Loose, Brown, Fine SAND, And Silt (sm) [a-4]	
S-2		18	4 7 3 5					EL 488.0 2.0		Moist, Stiff, Brown, CLAY, Some Coarse to Fine Sand, Little Coarse to Fine Gravel-sized Rock Fragments (cl) [a-7-6]	
S-3		18	4 4 7 10				5			Sample S-3: Little Coarse to Medium Sand in a Pocket, Little Fine Angular Gravel	
S-4		24	4 4 8 11							Sample S-4: Grayish Brown, And Fine Sand	
S-5		24	7 7 7 8					EL 482.0 8.0		Moist, Medium Dense, Light Gray, Brown, Coarse to Fine SAND, Some Silt (sm) [a-2-4]	
							10	EL 480.0 10.0		Bottom of Boring @ 10.0 ft	Backfilled with auger cuttings upon completion
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717468
EAST: 1118507
ELEVATION: 502.3 - ft
START DATE: 5/10/2016
END DATE: 5/10/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/10/2016	11:45:00 AM	Dry		4.0	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		14	1 1 1 2					EL 501.8 0.5		6-inches Topsoil Moist, Very Soft, Brown, CLAY, Trace Fine Sand (cl) [a-7-6]	
S-2		14	3 4 9 10					EL 500.3 2.0		Moist, Stiff, Reddish Brown, CLAY, Trace Fine Sand, Trace Fine Gravel (cl) [a-7-6]	
S-3		20	7 9 11 13				5			Sample S-3: Very Stiff	
S-4		24	8 10 13 15							Sample S-4: Very Stiff	
S-5		18	7 10 11							Sample S-5: Very Stiff, Trace Lignite	
S-6		18	6 8 10				10			Sample S-6: Very Stiff	Backfilled with auger cuttings upon completion
								EL 491.3 11.0		Bottom of Boring @ 11.0 ft	
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716942
EAST: 1118827
ELEVATION: 502.1 - ft
START DATE: 5/10/2016
END DATE: 5/10/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
					SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		14	4 4 6 8					EL 502.0 0.1		2-inches Topsoil Moist, Stiff, Reddish Brown, CLAY, Trace Fine Sand (cl) [a-7-6]	
S-2		14	3 5 9 11								
S-3		24	7 9 9 10				5			Sample S-3: Very Stiff	
S-4		24	4 4 5 7							Sample S-4: Light Gray to Reddish Brown, Little Coarse to Fine Sand, Little Coarse to Fine Angular Gravel-sized Rock Fragments at the Tip of Spoon	
S-5		0	50/1"					EL 494.0 8.1		Bottom of Boring @ 8.1 ft	Auger Refusal at 8.0-ft Backfilled with auger cuttings upon completion
							10				
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716746
EAST: 1118897
ELEVATION: 495 - ft
START DATE: 5/11/2016
END DATE: 5/11/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/11/2016	8:20:00 AM	Dry		4.0

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	
SIZE, ID (in)	3.25	1.375	
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		8	2 2 2 1					EL 494.8 0.2		3-inches Topsoil Moist, Soft, Gray, CLAY, Trace Fine Sand (cl) [a-7-6] Sample S-1: Trace Roots	
S-2		6	2 2 3 9							Sample S-2: Medium Stiff, Brownish Gray, And Medium to Fine SAND	
S-3		9	5 6 6 9				5			Sample S-3: Stiff, Brownish Gray, Some Medium to Fine Sand, Trace Angular Gravel	
S-4		18	6 9 50/6"							Sample S-4: Hard, Brown, Little Fine Sand	
								EL 487.5 7.5		Bottom of Boring @ 7.5 ft	Backfilled with auger cuttings upon completion
							10				
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716615
EAST: 1118988
ELEVATION: 517.9 - ft
START DATE: 5/16/2016
END DATE: 5/16/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
					SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LABORATORY TEST RESULTS: LIQUID LIMIT	LABORATORY TEST RESULTS: PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 516.9		12-inches Topsoil	Rock outcrops observed in the vicinity of boring
								1.0		Bottom of Boring @ 1.0 ft	Auger Refusal at 1-ft
											Backfilled with auger cuttings upon completion
							5				
							10				
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716510
EAST: 1119109
ELEVATION: 524.7 - ft
START DATE: 5/12/2016
END DATE: 5/12/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
					SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		20	2 4 5 5					EL 523.7 1.0		12-inches Topsoil	
										Moist, Stiff, Gray to Reddish Brown, CLAY, Trace Fine Sand (cl) [a-7-6]	
S-2		24	4 8 9 11							Sample S-2: Very Stiff, Reddish Brown	
S-3		24	4 8 9 11				5			Sample S-3: Very Stiff, Reddish Brown	
								EL 518.7 6.0		Bottom of Boring @ 6.0 ft	Auger Refusal at 6.0-ft Backfilled with auger cuttings upon completion
							10				
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716423
EAST: 1119303
ELEVATION: 520.2 - ft
START DATE: 5/12/2016
END DATE: 5/12/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/12/2016	8:30:00 AM	Dry		7.0	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		9	4 4 5 6					EL 519.7 0.5		6-inches Topsoil Moist, Stiff, Reddish Brown, CLAY, And Fine SAND (cl) [a-7-6]	
S-2		15	9 7 8 11							Sample S-2: Trace Fine Sand	
S-3		18	5 5 7 11				5			Sample S-3: Yellowish Brown, Little Fine Sand	
S-4		18	3 6 6 10							Sample S-4: Yellowish Brown	
S-5		18	4 5 5 6							Sample S-5: Brown, Trace Fine Sand	
S-6		20	3 4 4 4				10			Sample S-6: Medium Stiff, Grayish Brown, Trace Fine Sand	
S-7		18	3 4 5							Sample S-7: Trace Fine Sand	
S-8		12	6 15 20							Sample S-8: Hard, Brown, Gray, And Coarse to Fine Angular Gravel-sized Rock Fragments, Trace Fine Sand	
							15	EL 505.2 15.0		Bottom of Boring @ 15.0 ft	Backfilled with auger cuttings upon completion

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716402
EAST: 1119511
ELEVATION: 522.4 - ft
START DATE: 5/11/2016
END DATE: 5/11/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/11/2016	3:40:00 PM	Dry		6.2

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	
SIZE, ID (in)	3.25	1.375	
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		20	2 3 3 2					EL 521.9 0.5		6-inches Topsoil Moist, Medium Stiff, Gray, CLAY, Little Fine Sand (cl) [a-7-6]	
S-2		24	5 7 8 8					EL 520.4 2.0		Moist, Stiff, Reddish Brown, CLAY, Trace Fine Sand (cl) [a-7-6]	
S-3		24	5 7 8 9				5				
S-4		24	7 10 11 12							Sample S-4: Very Stiff, Brown, Little Coarse to Fine Angular Black Gravel	
S-5		24	7 8 9 9							Sample S-5: Very Stiff, Brown	
S-6		24	7 9 6 8				10			Sample S-6: Brown	
								EL 510.4 12.0		Bottom of Boring @ 12.0 ft	Backfilled with auger cuttings upon completion
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716401
EAST: 1119711
ELEVATION: 525.1 - ft
START DATE: 5/11/2016
END DATE: 5/11/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/11/2016	2:15:00 PM	Dry		4.0	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		12	3 3 4 3					EL 524.6 0.5		6-inches Topsoil Moist, Medium Stiff, Brown, SILT, Little Fine Sand (ml) [a-4]	
S-2		12	17 15 13 10					EL 523.1 2.0		Moist, Very Stiff, Reddish Brown, CLAY, And Coarse to Fine Sand (cl) [a-7-6] Sample S-2: Little Coarse to Fine Subangular Gravel	
S-3		22	7 11 9 13				5			Sample S-3: Some Medium to Fine Sand	
S-4		24	4 6 8 8							Sample S-4: Stiff, Reddish to Yellowish Brown, Little Fine Sand	
S-5		24	5 5 6 6							Sample S-5: Stiff, Yellowish Brown, Little Fine Sand	
							10	EL 515.1 10.0		Bottom of Boring @ 10.0 ft	Backfilled with auger cuttings upon completion
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717769
EAST: 1118110
ELEVATION: 502.5 - ft
START DATE: 5/3/2016
END DATE: 5/3/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/3/2016	4:05:00 PM	Dry		7.5	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		8	2 2 3 6					EL 502.0 0.5		6-inches Topsoil Moist, Medium Stiff, Grayish Brown, CLAY, And SILT, Trace Fine Sand (cl-ml) [a-4]	
								EL 500.5 2.0		Moist, Very Stiff, Reddish Brown, CLAY (CH) [A-7-6]	
S-2		12	6 8 11 14								
S-3		12	8 11 17 20	25.9%			5			Sample S-3: Little Silt	
S-4		12	7 8 12 16							Sample S-4: Brown, Little Silt	
S-5		21	4 3 5 7	29.1%	65	42				Sample S-5: Medium Stiff, Brown, Some Silt	
								EL 492.5 10.0		Completely Weathered Rock, Sampled As: Moist, Hard, Light Gray, CLAY, And SILT, Trace Coarse to Fine Sand, Trace Fine Gravel-sized Rock Fragments	
S-6		5	50/5"				10	EL 491.5 11.0		Bottom of Boring @ 11.0 ft	Auger Refusal at 11.0-ft Backfilled with auger cuttings upon completion
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 7/26/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717671
EAST: 1118342
ELEVATION: 509 - ft
START DATE: 5/3/2016
END DATE: 5/3/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
					SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		12	3 3 3 5					EL 508.5 0.5		6-inches Topsoil Moist, Medium Stiff, Brown, CLAY (cl) [a-7-6]	
S-2		8	5 5 5 7							Sample S-2: Stiff	
S-3		2	7 50/3"				5	EL 505.0 4.0 EL 503.5		COMPLETELY WEATHERED ROCK Sampled As: Moist, Hard, Light Gray, CLAY	
								5.5		Bottom of Boring @ 5.5 ft	Auger Refusal at 5.5-ft Backfilled with auger cuttings upon completion Offset performed 5-ft East. See Log for SWM-14A
							10				
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717671
EAST: 1118347
ELEVATION: 509 - ft
START DATE: 5/3/2016
END DATE: 5/3/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
					SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LABORATORY TEST RESULTS: LIQUID LIMIT	LABORATORY TEST RESULTS: PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
										Blank Auger to 6.0-ft	
							5				
								EL 503.0			
S-1		18	4 5 6 50/1"	26.5%	60	40		6.0		Moist, Stiff, Brown, CLAY (CH) [A-7-6]	
								EL 501.5			
								7.5		Bottom of Boring @ 7.5 ft	Auger Refusal at 7.5-ft Backfilled with auger cuttings upon completion
							10				
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 7/26/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717530
EAST: 1118560
ELEVATION: 500.9 - ft
START DATE: 5/2/2016
END DATE: 5/2/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/2/2016	3:25:00 PM	Dry		6.5	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		18	2 2 2 4					EL 500.1		10-inches Topsoil	
								0.8		Moist, Soft, Brownish Gray, CLAY (CH) [A-7-6]	
S-2		12	3 4 6 8	20.7%	48	30				Sample S-2: Stiff, Grayish Brown	
S-3		12	6 6 7 11				5			Sample S-3: Stiff, Reddish Brown	
S-4		24	6 6 11 14	32.1%						Sample S-4: Very Stiff, Reddish Brown	
S-5		24	4 7 8 9							Sample S-5: Stiff, Reddish Brown	
S-6		24	6 8 9 7				10			Sample S-6: Very Stiff, Reddish Brown	
S-7		24	4 4 4 6	31.8%						Sample S-7: Medium Stiff, Brown	
S-8		18	3 4 6 7				15			Sample S-8: Stiff, Brown	
								EL 484.9			
								16.0		Bottom of Boring @ 16.0 ft	Backfilled with auger cuttings upon completion

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 7/26/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717420
EAST: 1118671
ELEVATION: 491 - ft
START DATE: 5/2/2016
END DATE: 5/2/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/2/2016	2:40:00 PM	Dry		4.7	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		12	4 4 7 6					EL 490.2 0.8		10-inches Topsoil Moist, Stiff, Brown, Fine SAND, And Silt (sm) [a-4]	
S-2		18	4 5 6 9							Sample S-2: Trace Lignite	
S-3		18	4 5 6 11				5			Sample S-3: Trace Lignite	
S-4		24	5 6 6 6							Sample S-4: Grayish Brown	
S-5		12	4 6 6 9							Sample S-5: Grayish Brown	
							10	EL 481.0 10.0		Bottom of Boring @ 10.0 ft	Backfilled with auger cuttings upon completion
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716401
EAST: 1119711
ELEVATION: 525.1 - ft
START DATE: 5/10/2016
END DATE: 5/10/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
					SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		12	1 3 4 7					~~EL 524.9~~ 0.3		3-inches Topsoil Moist, Medium Stiff, Reddish Brown, CLAY, Trace Fine Sand (cl) [a-7-6]	
S-2		20	7 11 13 50/5"							Sample S-2: Very Stiff, Some Fine Gravel-sized Rock Fragments	
								EL 521.1 4.0		Bottom of Boring @ 4.0 ft	Auger Refusal at 4.0-ft Backfilled with auger cuttings upon completion
							5				
							10				
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717769
EAST: 1118110
ELEVATION: 502.5 - ft
START DATE: 5/10/2016
END DATE: 5/10/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/10/2016	1:40:00 PM	Dry		7.4	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		18	1 3 3 4					EL 502.3 / 0.2		2-inches Topsoil Moist, Medium Stiff, Reddish Brown, CLAY, Trace Fine Sand (cl) [a-7-6]	
S-2		20	5 5 6 8								
S-3		24	5 7 11 13				5			Sample S-2: Stiff, Little Sand	
S-4		24	4 4 7 7							Sample S-3: Very Stiff	
S-5		16	5 5 7 8							Sample S-4: Stiff	
S-6		10	7 9 3 2				10			Sample S-5: Stiff	
								EL 491.0 / 11.5		Sample S-6A: Stiff	
								EL 490.5 / 12.0		Moist, Medium Dense, Light Gray, Coarse to Fine SAND, And Gravel-sized Rock Fragments, Trace Silt (sp) [a-1-b]	Auger Refusal at 12.0-ft
										Bottom of Boring @ 12.0 ft	
							15				Backfilled with auger cuttings upon completion

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

RK&K

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716916
EAST: 1118919
ELEVATION: 502.1 - ft
START DATE: 5/11/2016
END DATE: 5/11/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/11/2016	9:55:00 AM	Dry		5.5	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		12	2 1 3 3					EL 501.6		6-inches Topsoil	
								0.5		Moist, Soft, Grayish Brown, CLAY, Trace Fine Sand, Trace Roots (cl) [a-7-6]	
								EL 500.1			
S-2		22	3 6 8 7					2.0		Moist, Stiff, Reddish Brown, CLAY, Trace Fine Sand, Trace Lignite (cl) [a-7-6]	
S-3		24	3 4 6 7				5			Sample S-3: Reddish Brown to Yellow Brown	
S-4		24	3 5 7 9							Sample S-4: Reddish Brown to Yellow Brown	
S-5		24	3 5 6 9							Sample S-5: Reddish Brown to Yellow Brown	
S-6		24	5 5 5 6				10			Sample S-6: Reddish Brown	
S-7		22	6 6 8 7							Sample S-7: Reddish Brown	
								EL 488.1			
								14.0		Bottom of Boring @ 14.0 ft	Backfilled with auger cuttings upon completion
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716784
EAST: 1118969
ELEVATION: 496.8 - ft
START DATE: 5/11/2016
END DATE: 5/11/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/11/2016	8:45:00 AM	Dry		4.6

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	
SIZE, ID (in)	3.25	1.375	
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		8	1 2 2 3					EL 496.3 0.5		6-inches Topsoil Moist, Soft, Gray to Brown, CLAY, And Medium to Fine SAND (cl) [a-7-6]	
S-2		8	7 6 2 7							Sample S-2: Medium Stiff, Some Coarse to Fine Sand, Little Coarse to Fine Angular Gravel	
S-3		20	10 6 8 9				5			Sample S-3: Stiff, Reddish Brown, Trace Fine Sand	
S-4		18	6 9 10							Sample S-4: Very Stiff, Reddish Brown, Trace Fine Sand, Little Lignite	
S-5		18	6 9 10							Sample S-5: Very Stiff, Reddish Brown, Trace Fine Sand, Trace Lignite	
								EL 487.8 9.0		Bottom of Boring @ 9.0 ft	Backfilled with auger cuttings upon completion
							10				
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716669
EAST: 1119049
ELEVATION: 497.6 - ft
START DATE: 5/16/2016
END DATE: 5/16/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
					SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LABORATORY TEST RESULTS: LIQUID LIMIT	LABORATORY TEST RESULTS: PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
								EL 496.6		12-inches Topsoil	Rock outcrops observed in the vicinity of boring
								1.0		Bottom of Boring @ 1.0 ft	Auger Refusal at 1-ft
											Backfilled with auger cuttings upon completion
							5				
							10				
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716578
EAST: 1119154
ELEVATION: 514.2 - ft
START DATE: 5/12/2016
END DATE: 5/12/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
					SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		18	4 6 9 7					EL 513.6 0.6		6-inches Topsoil Moist, Stiff, Grayish Brown, CLAY, Little Fine Sand (cl) [a-7-6]	
S-2		0	50/0"					EL 511.7 2.5		Bottom of Boring @ 2.5 ft	Auger Refusal at 2.5-ft Backfilled with auger cuttings upon completion
							5				
							10				
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716501
EAST: 1119323
ELEVATION: 518.4 - ft
START DATE: 5/11/2016
END DATE: 5/11/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/11/2016	4:40:00 PM	Dry		7

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	
SIZE, ID (in)	3.25	1.375	
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		18	3 2 5 6					EL 517.9 0.5		6-inches Topsoil Moist, Medium Stiff, Gray, Reddish Brown, CLAY, Trace Fine Sand (cl) [a-7-6] Sample S-1: Trace Roots	
S-2		22	6 8 9 9							Sample S-2: Very Stiff	
S-3		18	6 6 9 10				5			Sample S-3: Stiff, Reddish Brown	
S-4		18	6 6 8 9							Sample S-4: Stiff	
S-5		11	3 50/3"							Sample S-5: Hard, Trace Gravel-sized Rock Fragments at the Tip of Spoon	Sample S-5: Gravel-sized Rock Fragments may have exaggerated SPT N-Value.
S-6		18	3 4 4				10			Sample S-6: Reddish Brown	
S-7		18	5 7 11							Sample S-7: Very Stiff, Reddish Brown	
								EL 505.4 13.0		Bottom of Boring @ 13.0 ft	Backfilled with auger cuttings upon completion
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716483
EAST: 1119511
ELEVATION: 519.9 - ft
START DATE: 5/11/2016
END DATE: 5/11/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/11/2016	4:00:00 PM	Dry		4.5

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	
SIZE, ID (in)	3.25	1.375	
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		12	3 3 3 4					EL 519.4 0.5		6-inches Topsoil Moist, Medium Stiff, Gray, CLAY, Little Fine Sand (cl) [a-7-6]	
								EL 517.9 2.0		Moist, Stiff, Yellowish Brown, CLAY, Trace Fine Sand (cl) [a-7-6]	
S-2		22	3 6 6 8							Sample S-2: Trace Lignite	
S-3		20	5 7 7 7				5				
S-4		13	13 16 50/1"							Sample S-4: Hard, Brown, Little Coarse to Fine Sand, Little Angular Gravel-sized Rock Fragments at the Tip of Spoon	
								EL 512.9 7.0		Bottom of Boring @ 7.0 ft	Backfilled with auger cuttings upon completion
							10				
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 716482
EAST: 1119711
ELEVATION: 529.4 - ft
START DATE: 5/11/2016
END DATE: 5/11/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
5/11/2016	3:00:00 PM	Dry		5.5	SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		18	2 2 4 6					EL 528.9 0.5		6-inches Topsoil Moist, Medium Stiff, Brown, CLAY, Trace Fine Sand (cl) [a-7-6]	
S-2		22	7 9 10 11							Sample S-2: Very Stiff, Reddish Brown	
S-3		24	6 9 12 16				5			Sample S-3: Very Stiff, Light Gray to Brown, Some Fine Sand	
S-4		24	5 6 8 9							Sample S-4: Stiff, Reddish Brown, Trace Lignite	
S-5		24	4 5 5 7							Sample S-5: Stiff, Yellowish Brown	
S-6		24	6 9 6 7				10			Sample S-6: Stiff, Reddish Brown	
S-7		24	5 9 10 10							Sample S-7: Very Stiff, Brown	
								EL 515.4 14.0		Bottom of Boring @ 14.0 ft	Backfilled with auger cuttings upon completion
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 718074
EAST: 1117436
ELEVATION: 506.3 - ft
START DATE: 5/17/2016
END DATE: 5/17/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/17/2016	11:40:00 PM	Dry		6

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	
SIZE, ID (in)	3.25	1.375	
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		14	3 3 3 4					EL 506.1 / 0.2		3-inches Topsoil/Grass Moist, Medium Stiff, Brownish Gray, CLAY, Some Fine Sand (cl) [a-7-6]	
S-2		0	3 4 2 1								
S-3		21	5 5 6 6				5			Sample S-3: Stiff, Reddish Brown, Trace Fine Sand	
S-4		18	5 5 5 5							Sample S-4: Stiff, Reddish to Yellowish Brown, Trace Fine Sand	
S-5		12	3 4 4							Sample S-5: Reddish Brown, Trace Fine Sand	
S-6		18	3 4 4				10			Sample S-6: Reddish Brown, Trace Fine Sand	
								EL 495.3 / 11.0		Bottom of Boring @ 11.0 ft	Backfilled with auger cuttings upon completion
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 718116
EAST: 1117465
ELEVATION: 500.5 - ft
START DATE: 5/17/2016
END DATE: 5/17/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)					EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Cave-In	TYPE	HSA	S	
					SIZE, ID (in)	3.25	1.375	
					HAMMER WT. (lb)		140	-
					HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		14	4 4 5 4					EL 500.3 0.2		3-inches Topsoil/Grass Moist, Stiff, Reddish Brown, CLAY (cl) [a-7-6]	
S-2		18	5 4 3							Sample S-2: Medium Stiff	
S-3		10	7 9 10							Sample S-3: Very Stiff	
							5	EL 495.5 5.0		Bottom of Boring @ 5.0 ft	Backfilled with auger cuttings upon completion
							10				
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

RK&K

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 718057
EAST: 1117538
ELEVATION: 503.0 - ft
START DATE: 5/17/2016
END DATE: 5/17/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/17/2016	10:30:00 AM	Dry		3.5

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	
SIZE, ID (in)	3.25	1.375	
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		8	6 4 5 5					EL 502.8 0.2		3-inches Topsoil/ Grass FILL, Sampled As: Moist, Stiff, Gray to Dark Brown, CLAY, Some Coarse to Fine Sand, Trace Gravel, Trace Roots	
S-2		2	4 3 4 3					EL 501.0 2.0		Moist, Medium Stiff, Yellowish to Reddish Brown, CLAY, Little Coarse to Fine Sand (cl) [a-7-6]	
S-3		12	4 3 4 2				5			Sample S-3: Reddish Brown, Trace Fine Angular Gravel in a Pocket	
S-4		18	4 6 7 10							Sample S-4: Stiff, Reddish Brown, Trace Fine Angular Gravel in a Pocket	
S-5		22	3 3 4 6							Sample S-5: Reddish Brown	
							10	EL 493.0 10.0		Bottom of Boring @ 10.0 ft	Backfilled with auger cuttings upon completion
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

RK&K

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717940
EAST: 1117557
ELEVATION: 500.6 - ft
START DATE: 5/17/2016
END DATE: 5/17/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/17/2016	9:25:00 AM	Dry		4

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	
SIZE, ID (in)	3.25	1.375	
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		8	2 10 6 7					EL 500.1 0.5		6-inches Topsoil FILL Sampled As: Moist, Very Stiff, Grayish Brown, CLAY, And Medium to Fine SAND, Trace Roots	
S-2		12	8 11 12 12							Sample S-2: Little Coarse to Fine Subangular Gravel	
								EL 496.6 4.0		Moist, Very Stiff, Reddish Brown, CLAY, Some Coarse to Fine Sand (cl) [a-7-6]	
S-3		14	13 13 13 20				5			Sample S-3: Little Coarse to Fine Subangular Gravel	
S-4		18	6 8 8							Sample S-4: Trace Fine Sand	
S-5		18	6 5 7							Sample S-5: Stiff, Reddish to Yellowish Brown, Trace Fine Sand	
								EL 491.6 9.0		Bottom of Boring @ 9.0 ft	Backfilled with auger cuttings upon completion
							10				
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

TEST BORING LOG

PROJECT: Professional Boulevard

SITE: Washington County , Maryland

DRILLING CO.: AB **RIG/HAMMER:** Mobil B57 ATV / Safety

COMMISSION NO.: 14187-03.4
NORTH: 717889
EAST: 1117672
ELEVATION: 495.7 - ft
START DATE: 5/17/2016
END DATE: 5/17/2016
DRILLER: K. Manos
LOGGED BY: ACR

GROUNDWATER DATA (ft)				
Date	Time	Water	Casing	Cave-In
5/17/2016	9:40:00 AM	Dry		2.0

EQUIPMENT	CASING	SAMPLER	CORE
TYPE	HSA	S	
SIZE, ID (in)	3.25	1.375	
HAMMER WT. (lb)		140	-
HAMMER FALL (in)		30	-

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (in)	BLOWS/6" (% RQD)	LABORATORY TEST RESULTS: NMC/ Frac. Freq.	LIQUID LIMIT	PLASTICITY INDEX	DEPTH	ELEV. / DEPTH	GRAPHIC	DESCRIPTION AND CLASSIFICATION (moisture, density, color, proportions, etc.)	NOTES:
S-1		18	2 5 8 7					EL 495.2 0.5		6-inches Topsoil Moist, Stiff, Brownish Gray, SILT, Little Fine Sand (ml) [a-4]	
S-2		20	5 7 8 8					EL 493.7 2.0		Moist, Stiff, Reddish Brown, CLAY, Trace Fine Sand (cl) [a-7-6]	
S-3		18	4 5 5				5				
S-4		14	4 10 11							Sample S-4: Very Stiff	
								EL 488.7 7.0		Bottom of Boring @ 7.0 ft	Backfilled with auger cuttings upon completion
							10				
							15				

SAMPLE IDENTIFICATION	DRILLING METHOD	BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY	SAMPLE PROPORTIONS (PERCENT)	
- S - SPLIT SPOON	HSA - HOLLOW STEM AUGERS	0-4	VERY LOOSE	0-2	VERY SOFT	TRACE	1 TO 10
- T - THIN WALL TUBE	SSA - SOLID STEM AUGERS	5-10	LOOSE	3-4	SOFT	LITTLE	11 TO 20
- SS - 3" SPLIT SPOON	DC - DRIVING CASING	11-30	MEDIUM DENSE	5-8	MEDIUM STIFF	SOME	21 TO 35
- D - DENISON	MD - MUD DRILLING	31-50	DENSE	9-15	STIFF	AND	36 TO 50
- RC - ROCK CORE	HA - HAND AUGER	OVER 50	VERY DENSE	16-30	VERY STIFF		
				OVER 30	HARD		

RKK NORTH/EAST (DEFAULT) PROFESSIONAL BOULEVARD.GPJ RKK_CURRENT.GDT 6/30/16

Appendix C

AB CONSULTANTS, INC.
9450 Annapolis Road
Lanham, Maryland 20706
Tel: 301-306-3091 Fax: 301-306-3092

AB JOB NO.: 2014117
PROJECT: Professional Bloulevard Bridge and Extension
LOCATION:
REF. NO.: 14187.03-4

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	SAMPLE NO.	SAMPLE DEPTH (FT)	WATER CONTENT (%)	ATTERBERG LIMIT			SIEVE ANALYSIS PERCENT PASSING							MODIFIED		USCS	CALIFORNIA BEARING RATIO	COMPRESSIVE STRENGTH
				LL	PL	PI	3/4"	3/8"	#4	#10	#40	#100	#200	OPT DRY UNIT WTG (lb/cu.ft)	OPT MOIST CONTENT (%)			
AR-01	S-2	3.5-5.0	30.8	67	26	41				100.0	99.2	97.8	95.4					
AR-01	S-5	10.0-11.5	18.2	47	19	28	93.0	90.8	85.7	76.6	67.4	63.4	59.4					
AB-01	S-2	3.5-5.0	20.4	29	15	14				100.0	99.4	89.4	75.1					
AB-01	R-3	16.0-21.0																16660
AB-02	S-2	3.5-5.0	31.0	59	24	35			100.0	99.7	95.5	89.6	85.2					
AB-02	S-3	6.0-7.5	27.3															
AB-02	R-1	9.5-14.5																13540
P-01	S-2	3.5-5.0	30.8	34	21	13			100.0	99.6	95.9	90.2	84.9					
P-01	R-2	12.5-17.5																16400
P-01A	R-1	7.5-12.5																4500
P-02	S-1	1.0-2.5	29.0	31	19	12			100.0	99.6	98.9	92.3	84.9					
P-02	S-2	3.5-5.0	33.0	30	20	10				100.0	99.3	74.3	47.3					
P-02	S-3	6.0-7.5	35.7															
P-02	R-1	9.0-10.5																7130
AB-03	S-1	1.0-2.5	22.7	64	20	44				100.0	99.6	98.7	96.7					
AB-03	R-1	3.0-8.0																9580
AB-04	R-1	3.0-8.0																12080
RB-01	BULK	1.0-6.0	28.4	47	15	32	100.0	97.3	94.1	91.4	87.0	83.5	81.5	116.1	15.9	CL	x	
RB-01	S-2	3.5-5.0	26.7															
RB-01	S-4	8.5-10.0	37.4															
RB-02	BULK	1.0-6.0	29.4	65	21	44	100.0	98.4	97.9	96.3	91.0	86.1	83.8	113.5	14.9	CH	1.7 @ 0.1"	

Date Printed: 6/17/2016

AB CONSULTANTS, INC.
9450 Annapolis Road
Lanham, Maryland 20706
Tel: 301-306-3091 Fax: 301-306-3092

AB JOB NO.: 2014117
PROJECT: Professional Bloulevard Bridge and Extension
LOCATION:
REF. NO.: 14187.03-4

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	SAMPLE NO.	SAMPLE DEPTH (FT)	WATER CONTENT (%)	ATTERBERG LIMIT			SIEVE ANALYSIS PERCENT PASSING							MODIFIED		USCS	CALIFORNIA BEARING RATIO	COMPRESSIVE STRENGTH
				LL	PL	PI	3/4"	3/8"	#4	#10	#40	#100	#200	OPT DRY UNIT WTG (lb/cu.ft)	OPT MOIST CONTENT (%)			
RB-02	S-2	3.5-5.0	36.2															
RB-02	S-4	8.5-10.0	37.6															
RB-03	S-1	1.0-2.5	14.0															
RB-03	S-3	6.0-7.5	28.0															
RB-04	BULK	0.0-7.0	33.2	58	21	37		100.0	99.1	98.1	95.8	93.6	90.5	115.4	14.5	CH	x	
RB-04	S-2	3.5-5.0	28.5															
RB-04	S-4	8.5-10.0	29.2															
RB-05	BULK	7.0-12.0	37.1	77	28	49			100.0	99.8	99.2	98.5	97.6	105.3	18.9	CH	1.4 @ 0.1"	
RB-05	S-1	1.0-2.5	32.6															
RB-05	S-3	6.0-7.5	32.2															
RB-06	BULK	0.0-10.0	28.2	43	19	24	100.0	97.0	94.3	90.2	83.3	80.2	77.4	115.8	14.8	CL	3.5 @ 0.2"	
RB-06	S-2	3.5-5.0	33.0															
RB-06	S-4	8.5-10.0	37.5															
RB-07	BULK	0.0-6.0	28.0	72	23	49		100.0	99.5	98.7	96.4	94.0	91.4	110.3	18.2	CH	2.6 @ 0.2"	
RB-07	S-1	1.0-2.5	25.7															
RB-07	S-3	6.0-7.5	29.5															
RB-08	R-1	0.0-5.0																2070

Date Printed: 6/17/2016

AB CONSULTANTS, INC.
9450 Annapolis Road
Lanham, Maryland 20706
Tel: 301-306-3091 Fax: 301-306-3092

AB JOB NO.: 2014117
PROJECT: Professional Bloulevard Bridge and Extension
LOCATION:
REF. NO.: 14187.03-4

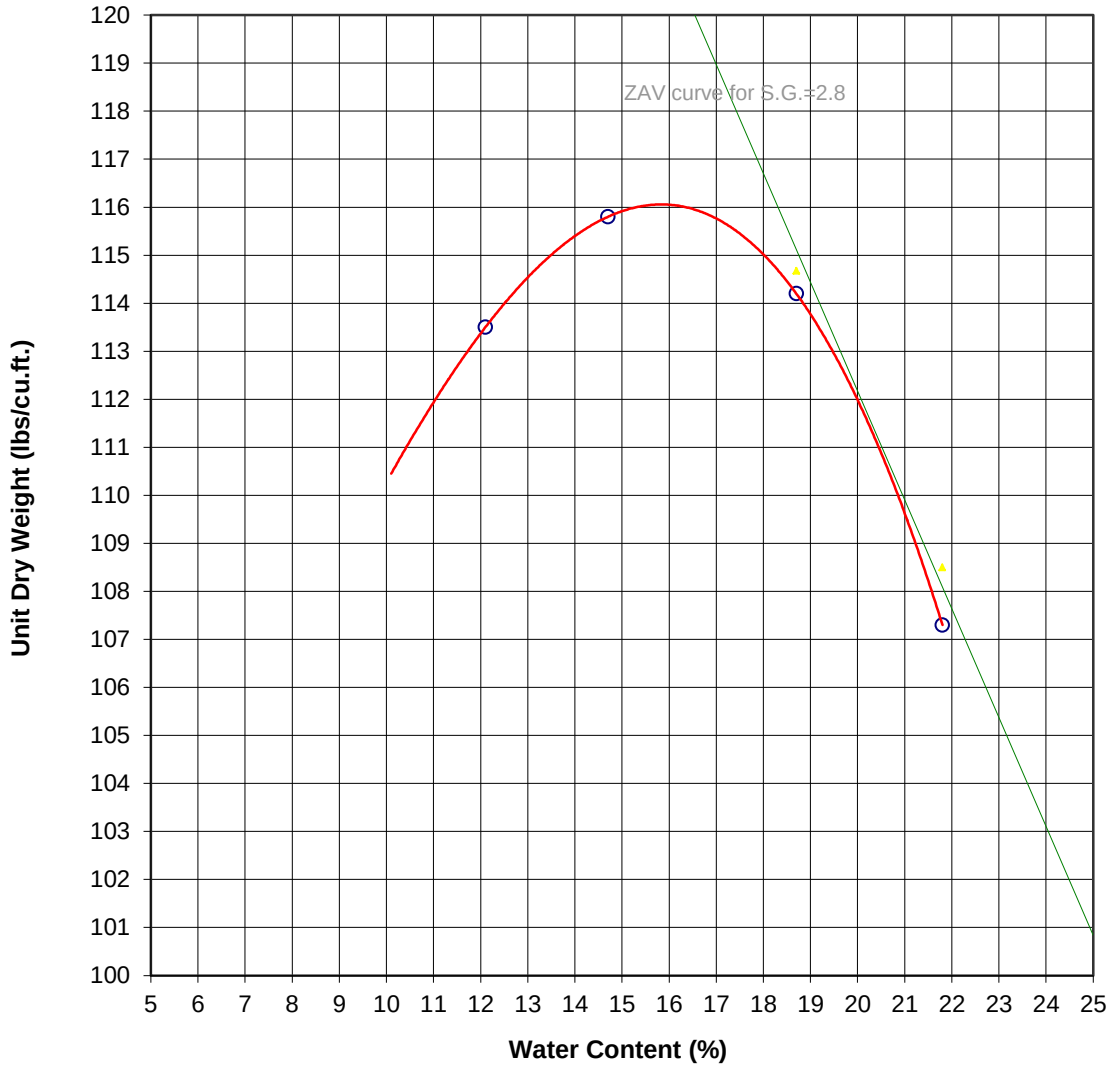
SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	SAMPLE NO.	SAMPLE DEPTH (FT)	WATER CONTENT	ATTERBERG LIMIT			SIEVE ANALYSIS PERCENT PASSING							MODIFIED		USCS	CALIFORNIA BEARING RATIO	COMPRESSIVE STRENGTH
														OPT DRY UNIT WTG	OPT MOIST CONTENT			
			(%)	LL	PL	PI	3/4"	3/8"	#4	#10	#40	#100	#200	(lb/cu.ft)	(%)			
SWM-01	S-2	2 - 3.5	9.9	20	13	7	100.0	96.9	93.6	89.9	82.4	77.8	73.6					
SWM-01	S-6	10 - 11.5	15.9															
SWM-02	S-3	4 - 5.5	32.9															
SWM-02	S-6	10 - 11.5	27.8	61	22	39				100.0	99.8	99.6	99.0					
SWM-02	S-8	14 - 15.5	37.7															
SWM-03	S-3	4 - 5.5	26.7															
SWM-03	S-7	12 - 13.5	28.4	48	20	28			100.0	98.1	96.0	94.5	92.5					
SWM-03	S-9	16 - 17.5	30.1															
SWM-13	S-3	4 - 5.5	25.9															
SWM-13	S-5	8 - 9.5	29.1	65	23	42			100.0	99.4	94.9	93.6	93.1					
SWM-14	S-1	6 - 7.5	26.5	60	20	40		100.0	98.0	96.1	93.7	92.5	91.1					
SWM-15	S-2	2 - 3.5	20.7	48	18	30			100.0	99.1	96.2	93.9	91.7					
SWM-15	S-4	6 - 7.5	32.1															
SWM-15	S-17	12 - 13.5	31.8															

Date Printed: 7/25/2016

LABORATORY COMPACTION TEST RESULT

Modified Effort (ASTM D1557 / AASHTO T180)



Sample Description:	Reddish brown fine sandy clay	
Classification:	CL / A-7-6	
Test Method:	A	
Soil Engineering Properties		
Liquid Limit:	47	
Plastic Limit:	16	
Plasticity Index:	31	
Proctor Data and Results		
Max. Unit Dry Weight	**116.1**	lbs/cu.ft.
Opt. Water Content	**15.9**	%
Corr. Max. Unit Dry Weight	**n/a**	
Corr. Opt. Water Content	**n/a**	

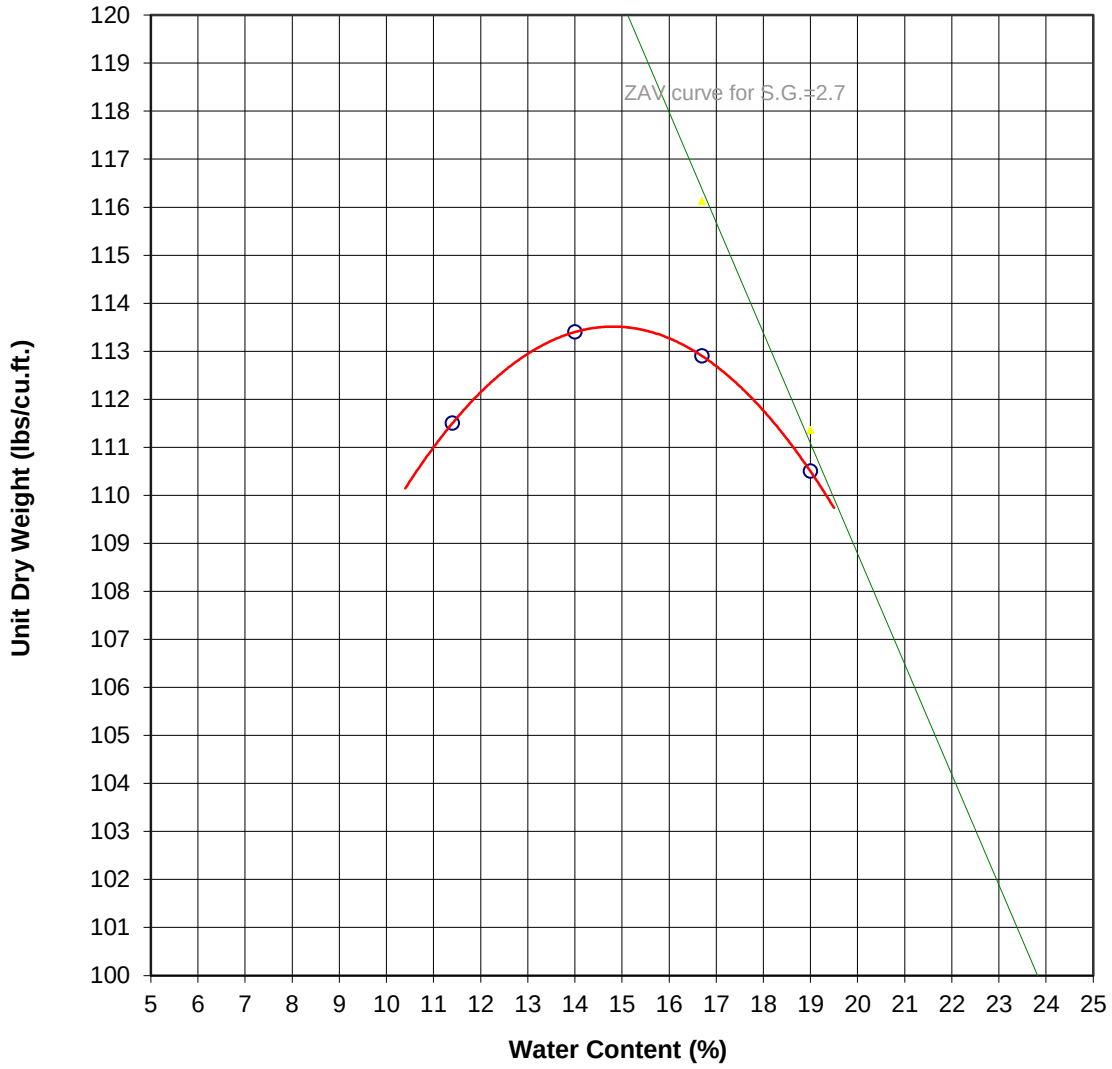
Gradation	
Sieve No.	% Passing
3"	
1 1/2"	
3/4"	100.0
3/8"	97.3
4	94.1
10	91.4
40	87.0
200	81.5

AB CONSULTANTS, INC.
9450 Annapolis Road
Lanham, Maryland 20706
Tel: 301-306-3091
Fax: 301-306-3092

Job No.:	2014117
Project:	Professional Blvd Bridge & Extension
Sample No.:	Bag
Sample Location:	RB-01
Test Date:	5/24/2016

LABORATORY COMPACTION TEST RESULT

Modified Effort (ASTM D1557 / AASHTO T180)



Sample Description:	Reddish brown fine sandy clay	
Classification:	CH / A-7-6	
Test Method:	A	
Soil Engineering Properties		
Liquid Limit:	66	
Plastic Limit:	21	
Plasticity Index:	45	
Proctor Data and Results		
Max. Unit Dry Weight	**113.5**	lbs/cu.ft.
Opt. Water Content	**14.9**	%
Corr. Max. Unit Dry Weight	**n/a**	
Corr. Opt. Water Content	**n/a**	

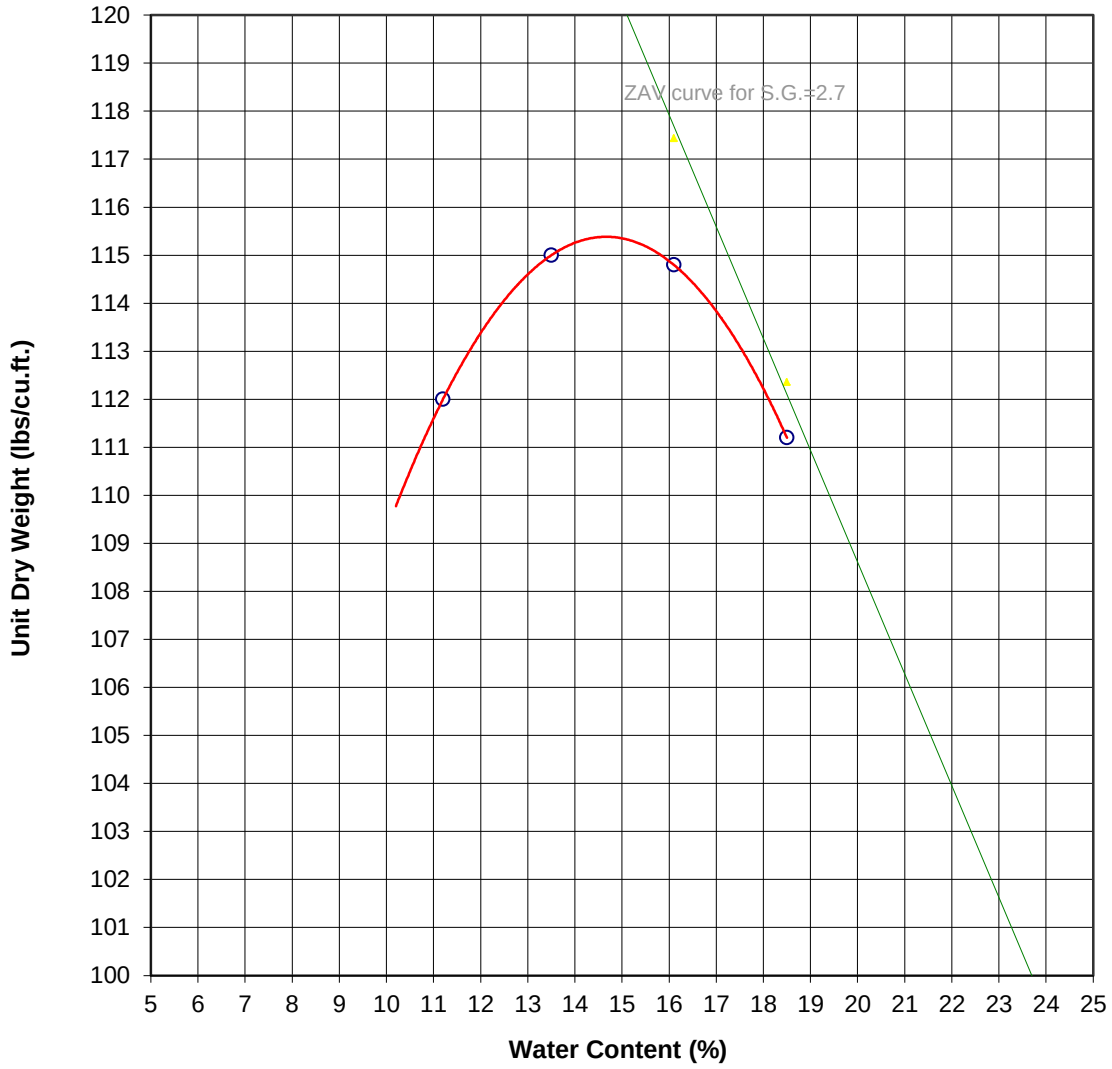
Gradation	
Sieve No.	% Passing
3"	
1 1/2"	
3/4"	100.0
3/8"	98.4
4	97.9
10	96.3
40	91.0
200	83.8

AB CONSULTANTS, INC.
9450 Annapolis Road
Lanham, Maryland 20706
Tel: 301-306-3091
Fax: 301-306-3092

Job No.:	2014117
Project:	Professional Blvd Bridge & Extension
Sample No.:	Bag
Sample Location:	RB-02
Test Date:	5/26/2016

LABORATORY COMPACTION TEST RESULT

Modified Effort (ASTM D1557 / AASHTO T180)



Sample Description:	Reddish brown fine sandy clay	
Classification:	CH / A-7-6	
Test Method:	A	
Soil Engineering Properties		
Liquid Limit:	58	
Plastic Limit:	21	
Plasticity Index:	37	
Proctor Data and Results		
Max. Unit Dry Weight	**115.4**	lbs/cu.ft.
Opt. Water Content	**14.5**	%
Corr. Max. Unit Dry Weight	**n/a**	
Corr. Opt. Water Content	**n/a**	

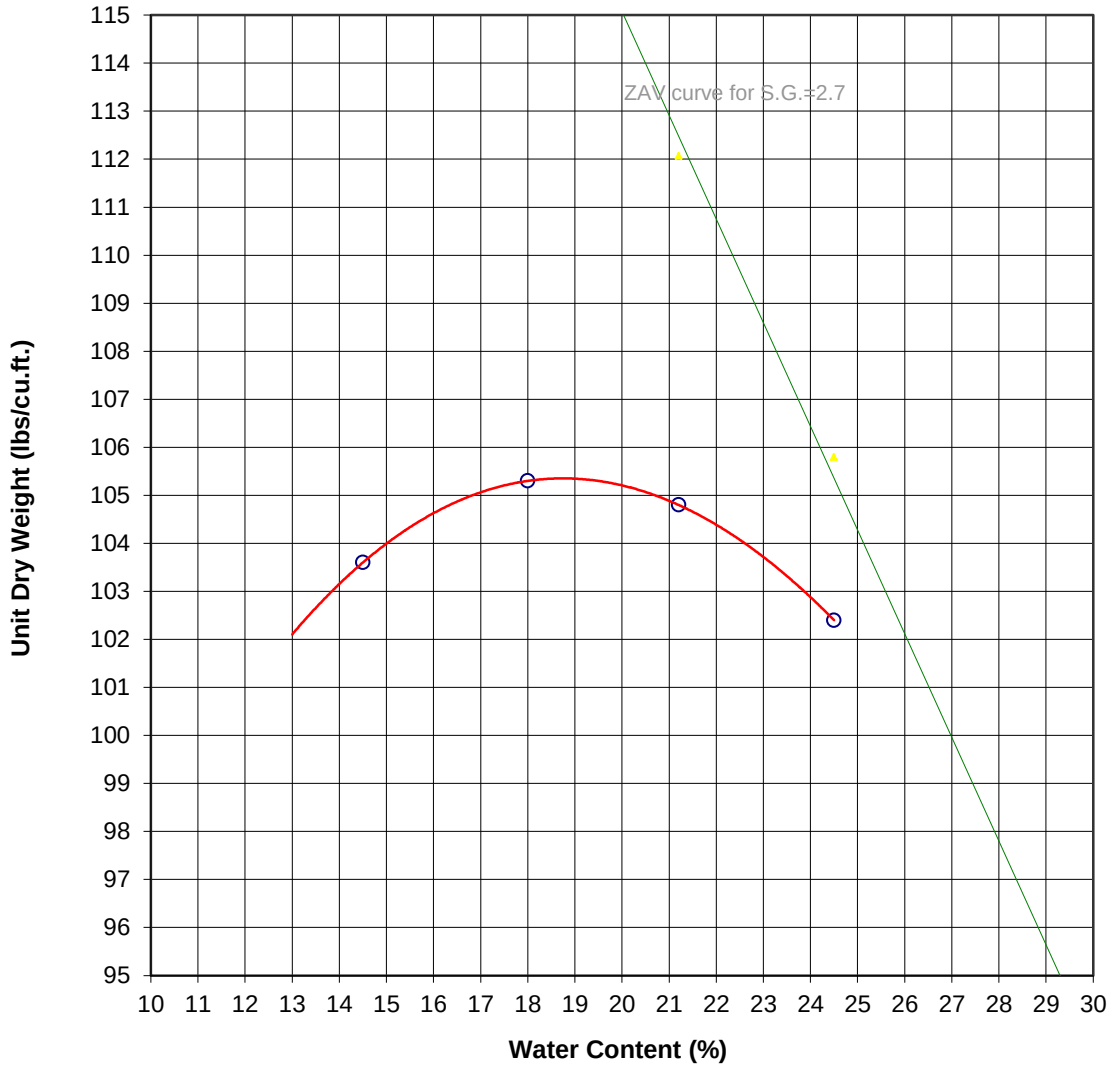
Gradation	
Sieve No.	% Passing
3"	
1 1/2"	
3/4"	
3/8"	100.0
4	99.1
10	98.1
40	95.8
200	90.5

AB CONSULTANTS, INC.
9450 Annapolis Road
Lanham, Maryland 20706
Tel: 301-306-3091
Fax: 301-306-3092

Job No.:	2014117
Project:	Professional Blvd Bridge & Extension
Sample No.:	Bag
Sample Location:	RB-04
Test Date:	5/24/2016

LABORATORY COMPACTION TEST RESULT

Modified Effort (ASTM D1557 / AASHTO T180)



Sample Description:	Reddish brown fine sandy clay	
Classification:	CH / A-7-6	
Test Method:	A	
Soil Engineering Properties		
Liquid Limit:	77	
Plastic Limit:	28	
Plasticity Index:	49	
Proctor Data and Results		
Max. Unit Dry Weight	105.3	lbs/cu.ft.
Opt. Water Content	18.9	%
Corr. Max. Unit Dry Weight	n/a	
Corr. Opt. Water Content	n/a	

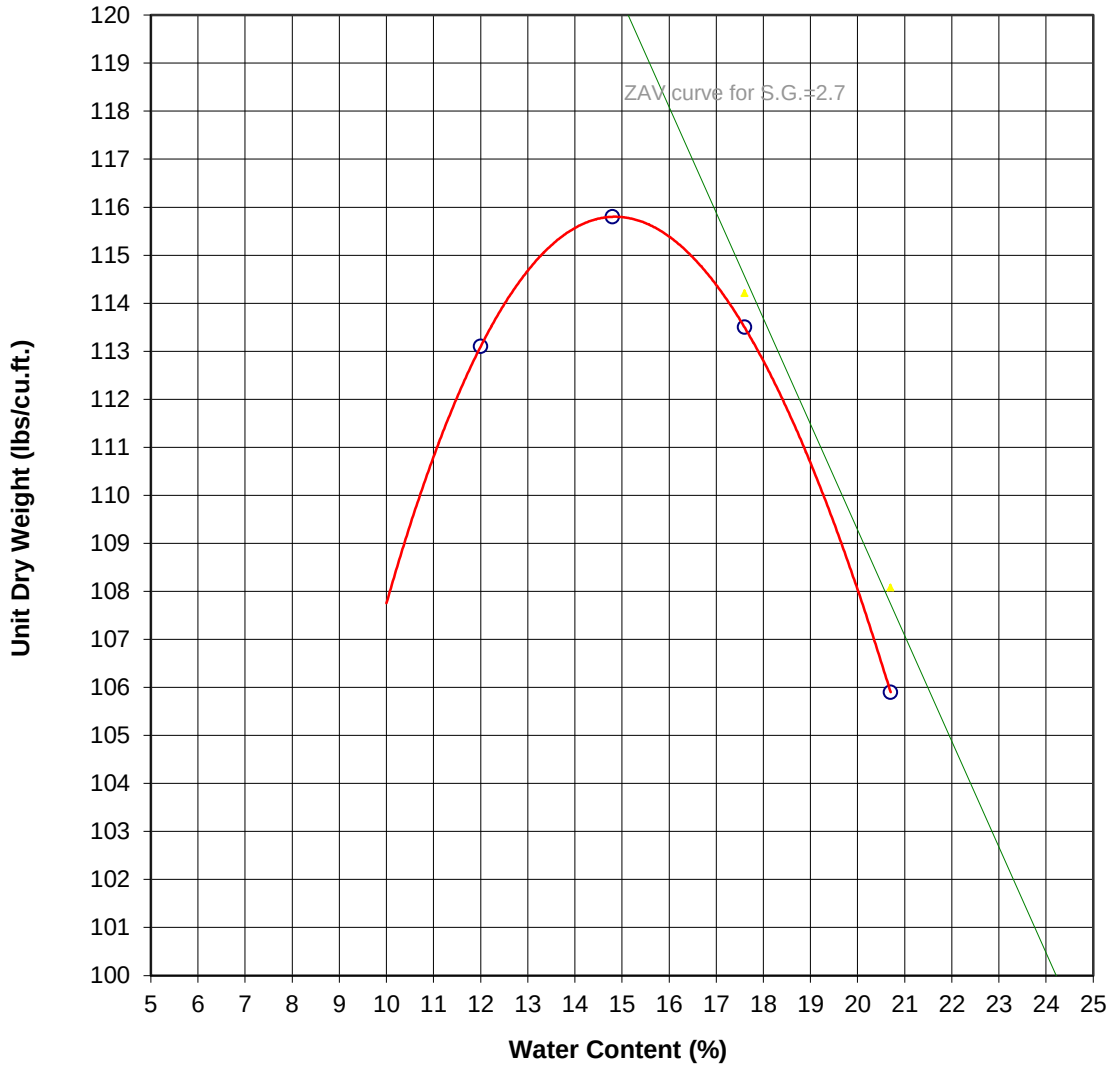
Gradation	
Sieve No.	% Passing
3"	
1 1/2"	
3/4"	
3/8"	100.0
4	99.9
10	99.8
40	99.2
200	97.6

AB CONSULTANTS, INC.
9450 Annapolis Road
Lanham, Maryland 20706
Tel: 301-306-3091
Fax: 301-306-3092

Job No.:	2014117
Project:	Professional Blvd Bridge & Extension
Sample No.:	Bag
Sample Location:	RB-05
Test Date:	5/24/2016

LABORATORY COMPACTION TEST RESULT

Modified Effort (ASTM D1557 / AASHTO T180)



Sample Description:	Reddish brown fine sandy clay	
Classification:	CL / A-7-6	
Test Method:	A	
Soil Engineering Properties		
Liquid Limit:	43	
Plastic Limit:	19	
Plasticity Index:	24	
Proctor Data and Results		
Max. Unit Dry Weight	**115.8**	lbs/cu.ft.
Opt. Water Content	**14.8**	%
Corr. Max. Unit Dry Weight	**n/a**	
Corr. Opt. Water Content	**n/a**	

Gradation	
Sieve No.	% Passing
3"	
1 1/2"	
3/4"	100.0
3/8"	97.0
4	94.3
10	90.2
40	83.3
200	77.4

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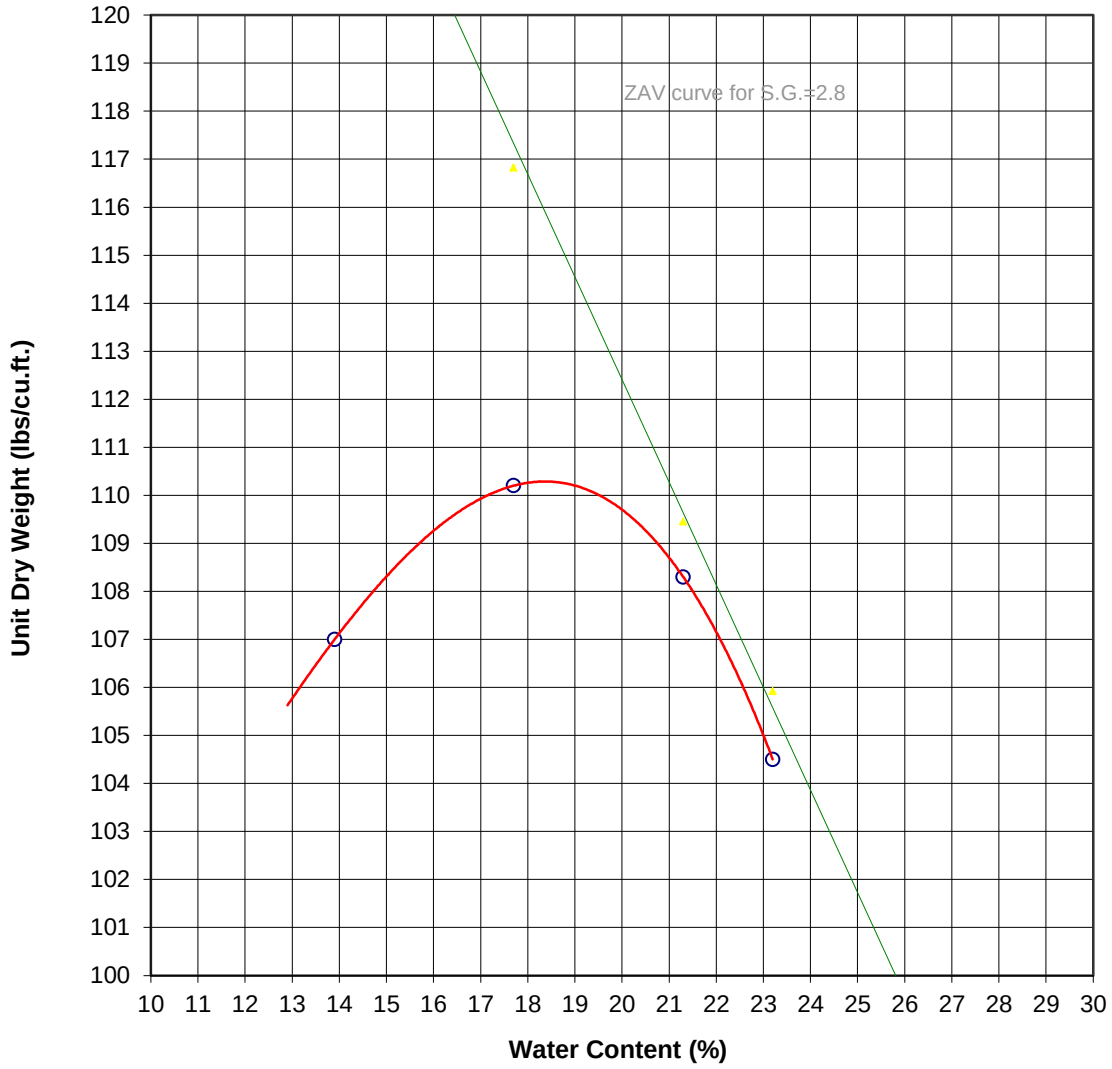
Job No.:	2014117
Project:	Professional Blvd Bridge & Extension
Sample No.:	Bag
Sample Location:	RB-06
Test Date:	5/24/2016

LABORATORY COMPACTION TEST RESULT

Modified Effort (ASTM D1557 / AASHTO T180)



Sample Description:	Reddish brown fine sandy clay	
Classification:	CH / A-7-6	
Test Method:	A	
Soil Engineering Properties		
Liquid Limit:	72	
Plastic Limit:	23	
Plasticity Index:	49	
Proctor Data and Results		
Max. Unit Dry Weight	**110.3**	lbs/cu.ft.
Opt. Water Content	**18.2**	%
Corr. Max. Unit Dry Weight	**n/a**	
Corr. Opt. Water Content	**n/a**	

Gradation	
Sieve No.	% Passing
3"	
1 1/2"	
3/4"	
3/8"	100.0
4	99.5
10	98.7
40	96.4
200	91.4

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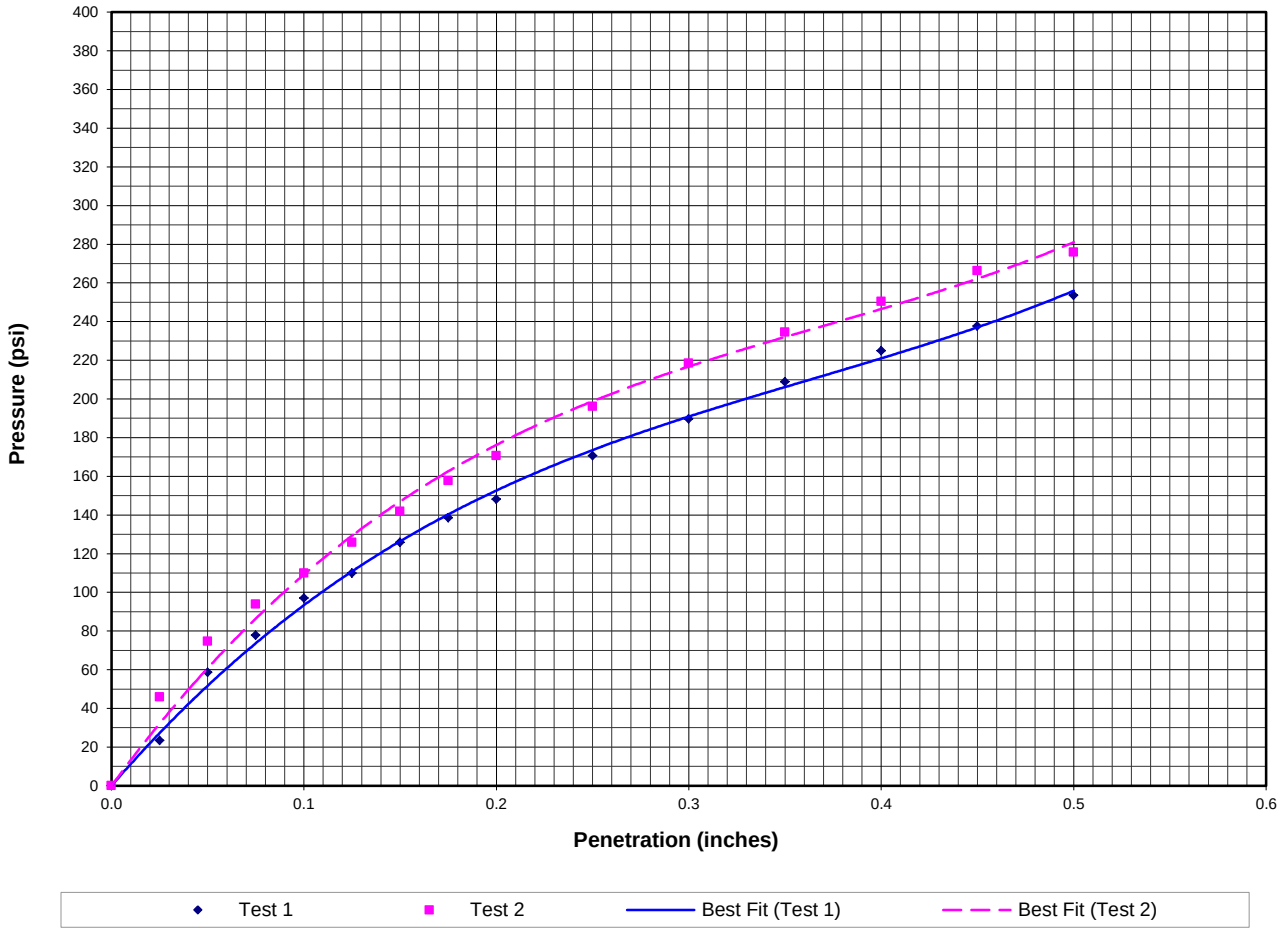
Job No.:	2014117
Project:	Professional Blvd Bridge & Extension
Sample No.:	Bag
Sample Location:	RB-07
Test Date:	5/24/2016

CALIFORNIA BEARING RATIO (CBR) TEST RESULT

(ASTM D1883 / AASHTO T193)



Sample Description: Reddish brown fine sandy clay

Classification: CL / A-7-6

Soil Engineering Properties

Specific Gravity =	2.8
Liquid Limit =	47
Plasticity Index =	31
% Passing #4 =	94.1
% Passing #200 =	81.5

Proctor Test Results

Compaction Effort =	Modified	
Max. Unit Dry Weight =	116.1	lbs/cu.ft.
Opt. Water Content =	15.9	%

CBR Results:	Test 1	Test 2
CBR @ 0.1" =	**9.7**	**11.0**
CBR @ 0.2" =	**9.9**	**11.4**

Swell/Shrink:	Test 1	Test 2
% Swell =	1.70	1.70
% Shrink =		

As Molded:	Test 1	Test 2	
Unit Dry Weight =	115.8	115.8	lbs/cu.ft
Water Content =	15.3	15.3	%

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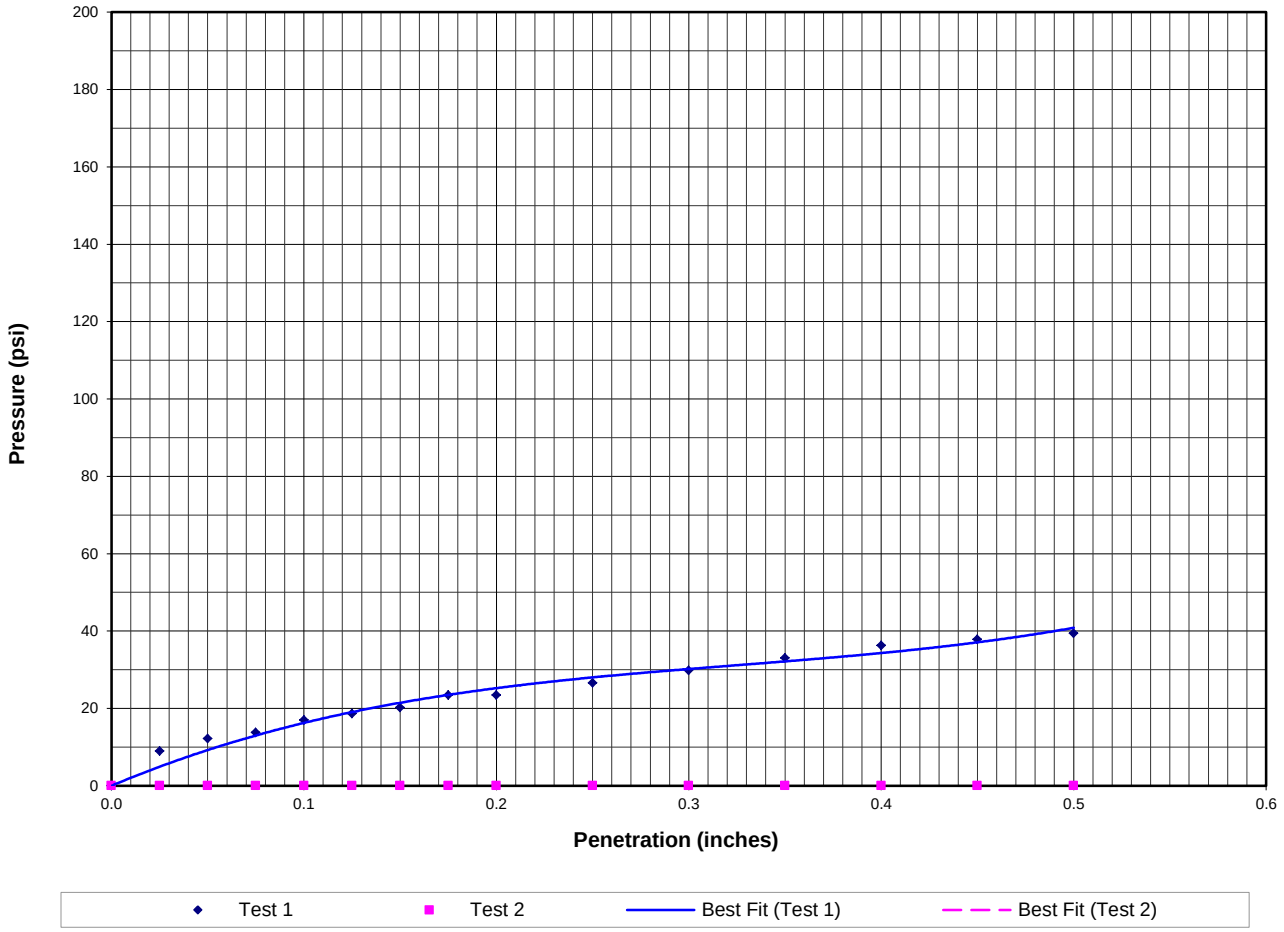
Tel: 301-306-3091
Fax: 301-306-3092

Job No.:	2014117
Project:	Professional Blvd.
Sample No.:	Bag
Sample Location:	RB-01
Test Date:	6/13/2016

CALIFORNIA BEARING RATIO (CBR) TEST RESULT

(ASTM D1883 / AASHTO T193)



Sample Description: Reddish Brown fine sandy clay

Classification: CH / A-7-6

Soil Engineering Properties

Specific Gravity =	2.7
Liquid Limit =	66
Plasticity Index =	45
% Passing #4 =	97.9
% Passing #200 =	83.8

Proctor Test Results

Compaction Effort =	Modified	
Max. Unit Dry Weight =	113.5	lbs/cu.ft.
Opt. Water Content =	14.9	%

CBR Results:	Test 1	Test 2
CBR @ 0.1" =	**1.7**	
CBR @ 0.2" =	**1.6**	

Swell/Shrink:	Test 1	Test 2
% Swell =	10.51	
% Shrink =		

As Molded:	Test 1	Test 2	
Unit Dry Weight =	110.9		lbs/cu.ft
Water Content =	12.0		%

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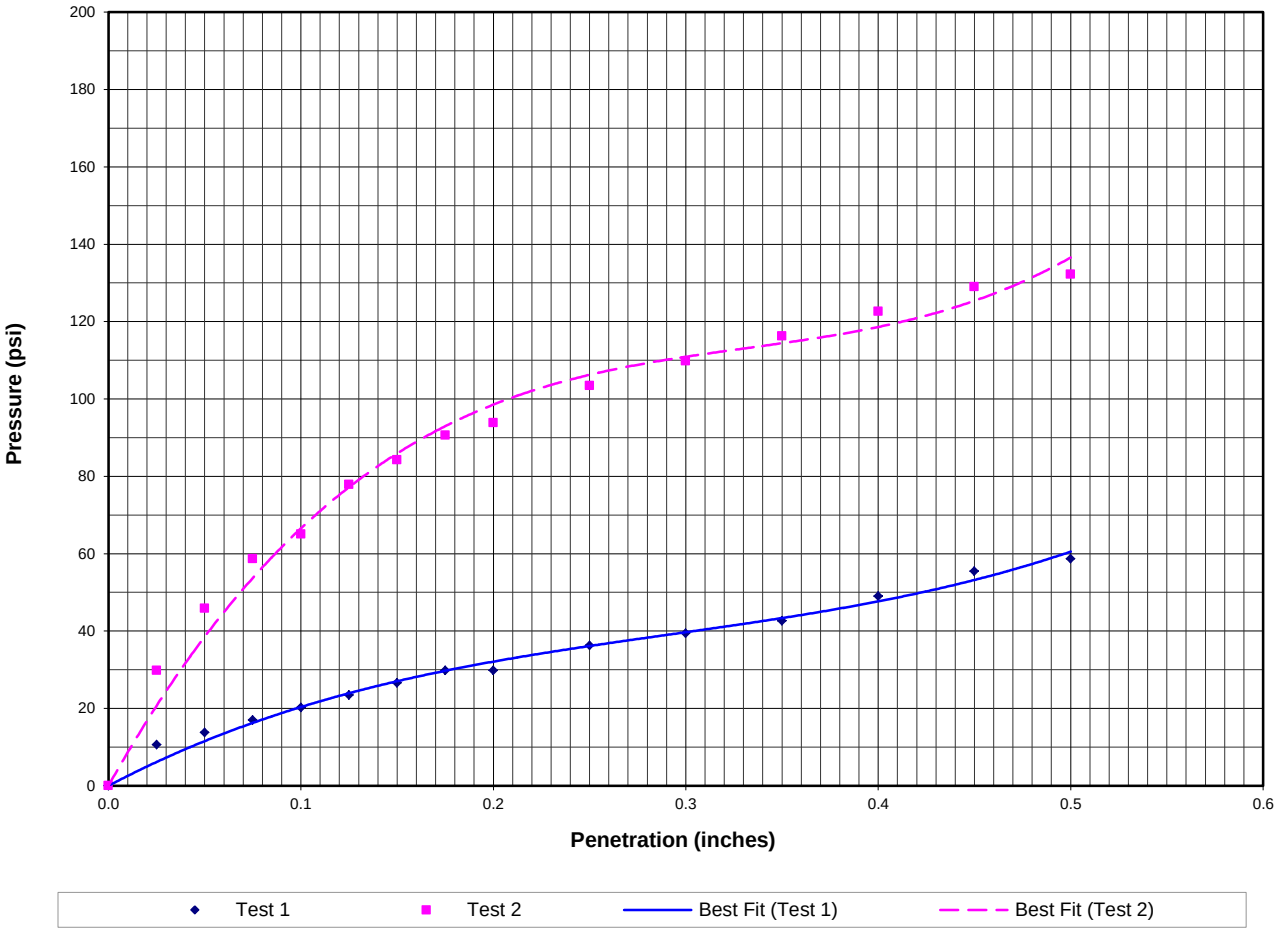
Tel: 301-306-3091
Fax: 301-306-3092

Job No.:	2014117
Project:	Professional Blvd.
Sample No.:	Bag
Sample Location:	RB-02
Test Date:	6/3/2016

CALIFORNIA BEARING RATIO (CBR) TEST RESULT

(ASTM D1883 / AASHTO T193)



Sample Description: Reddish brown fine sandy clay

Classification: CH / A-7-6

Soil Engineering Properties

Specific Gravity =	2.7
Liquid Limit =	58
Plasticity Index =	37
% Passing #4 =	99.1
% Passing #200 =	90.5

Proctor Test Results

Compaction Effort =	Modified	
Max. Unit Dry Weight =	115.4	lbs/cu.ft.
Opt. Water Content =	14.5	%

CBR Results:	Test 1	Test 2
CBR @ 0.1" =	**2.0**	**6.5**
CBR @ 0.2" =	**2.0**	**6.3**

Swell/Shrink:	Test 1	Test 2
% Swell =	6.54	6.54
% Shrink =		

As Molded:	Test 1	Test 2	
Unit Dry Weight =	108.3	108.3	lbs/cu.ft
Water Content =	14.4	14.4	%

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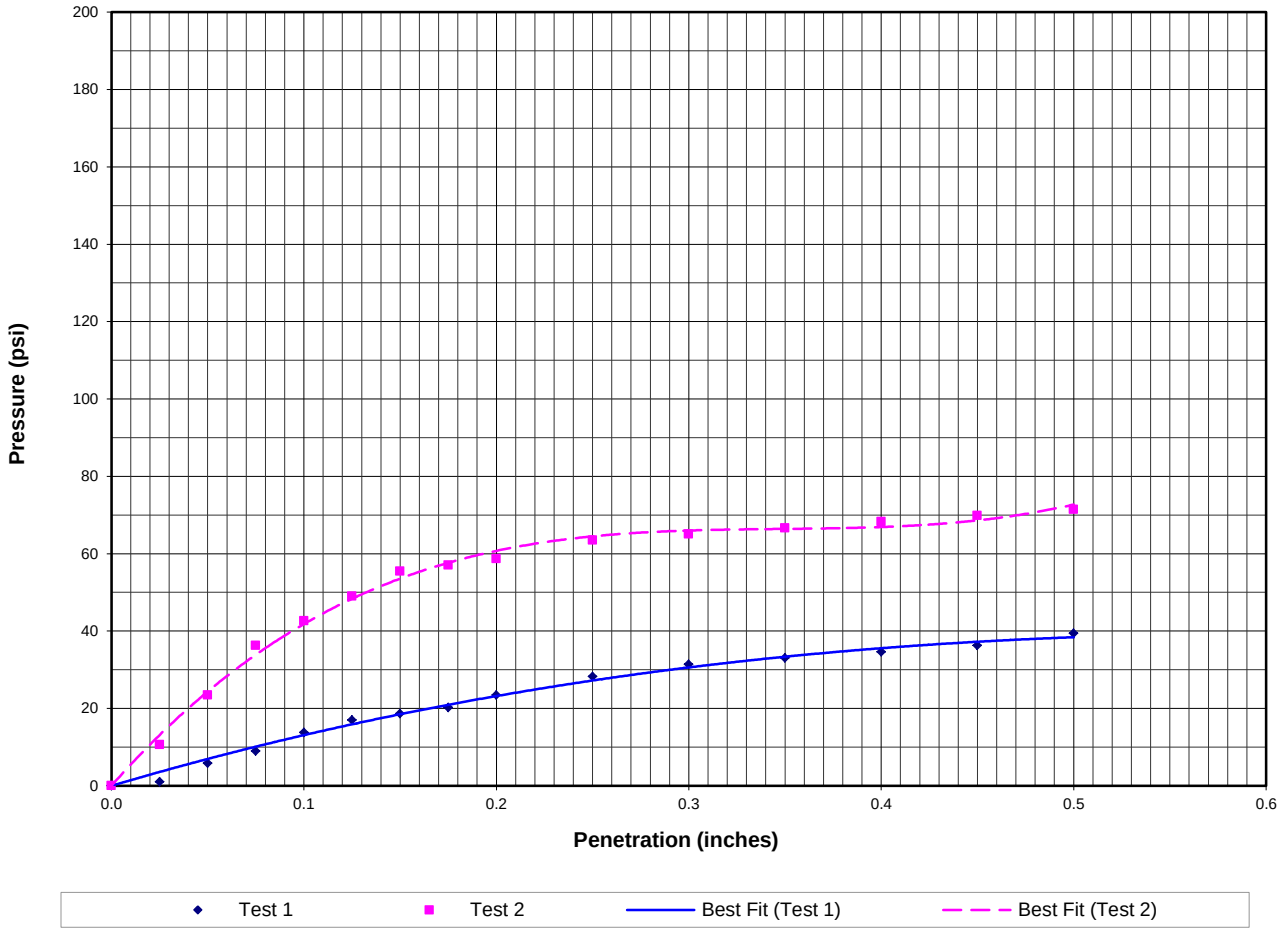
Tel: 301-306-3091
Fax: 301-306-3092

Job No.:	2014117
Project:	Professional Blvd.
Sample No.:	Bag
Sample Location:	RB-04
Test Date:	6/13/2016

CALIFORNIA BEARING RATIO (CBR) TEST RESULT

(ASTM D1883 / AASHTO T193)



Sample Description: Reddish brown fine sandy clay

Classification: CH / A-7-6

Soil Engineering Properties

Specific Gravity =	2.9
Liquid Limit =	77
Plasticity Index =	49
% Passing #4 =	99.9
% Passing #200 =	97.6

Proctor Test Results

Compaction Effort =	Modified	
Max. Unit Dry Weight =	105.3	lbs/cu.ft.
Opt. Water Content =	18.9	%

CBR Results:

	Test 1	Test 2
CBR @ 0.1" =	**1.4**	**4.3**
CBR @ 0.2" =	**1.6**	**3.9**

Swell/Shrink:

	Test 1	Test 2
% Swell =	10.86	10.86
% Shrink =		

As Molded:

	Test 1	Test 2	
Unit Dry Weight =	109.1	109.1	lbs/cu.ft
Water Content =	16.5	16.5	%

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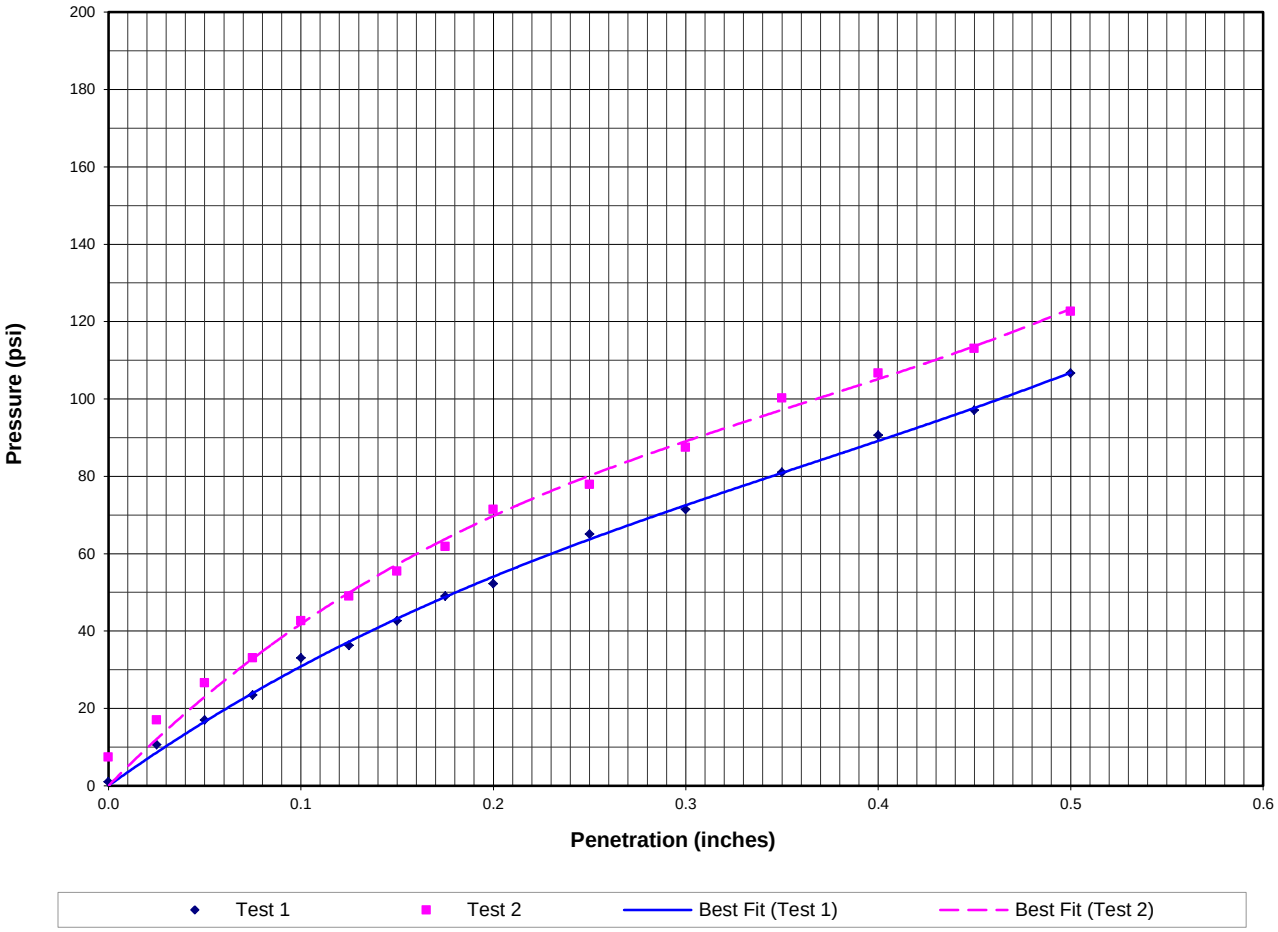
Tel: 301-306-3091
Fax: 301-306-3092

Job No.:	2014117
Project:	Professional Blvd.
Sample No.:	Bag
Sample Location:	RB-05
Test Date:	6/3/2016

CALIFORNIA BEARING RATIO (CBR) TEST RESULT

(ASTM D1883 / AASHTO T193)



Sample Description: Reddish brown fine sandy clay

Classification: CL / A-7-6

Soil Engineering Properties

Specific Gravity =	2.7
Liquid Limit =	43
Plasticity Index =	24
% Passing #4 =	94.3
% Passing #200 =	77.4

Proctor Test Results

Compaction Effort =	Modified	
Max. Unit Dry Weight =	115.8	lbs/cu.ft.
Opt. Water Content =	14.8	%

CBR Results:	Test 1	Test 2
CBR @ 0.1" =	**3.3**	**4.3**
CBR @ 0.2" =	**3.5**	**4.8**

Swell/Shrink:	Test 1	Test 2
% Swell =	6.39	6.39
% Shrink =		

As Molded:	Test 1	Test 2	
Unit Dry Weight =	116.0	116.0	lbs/cu.ft
Water Content =	12.7	12.7	%

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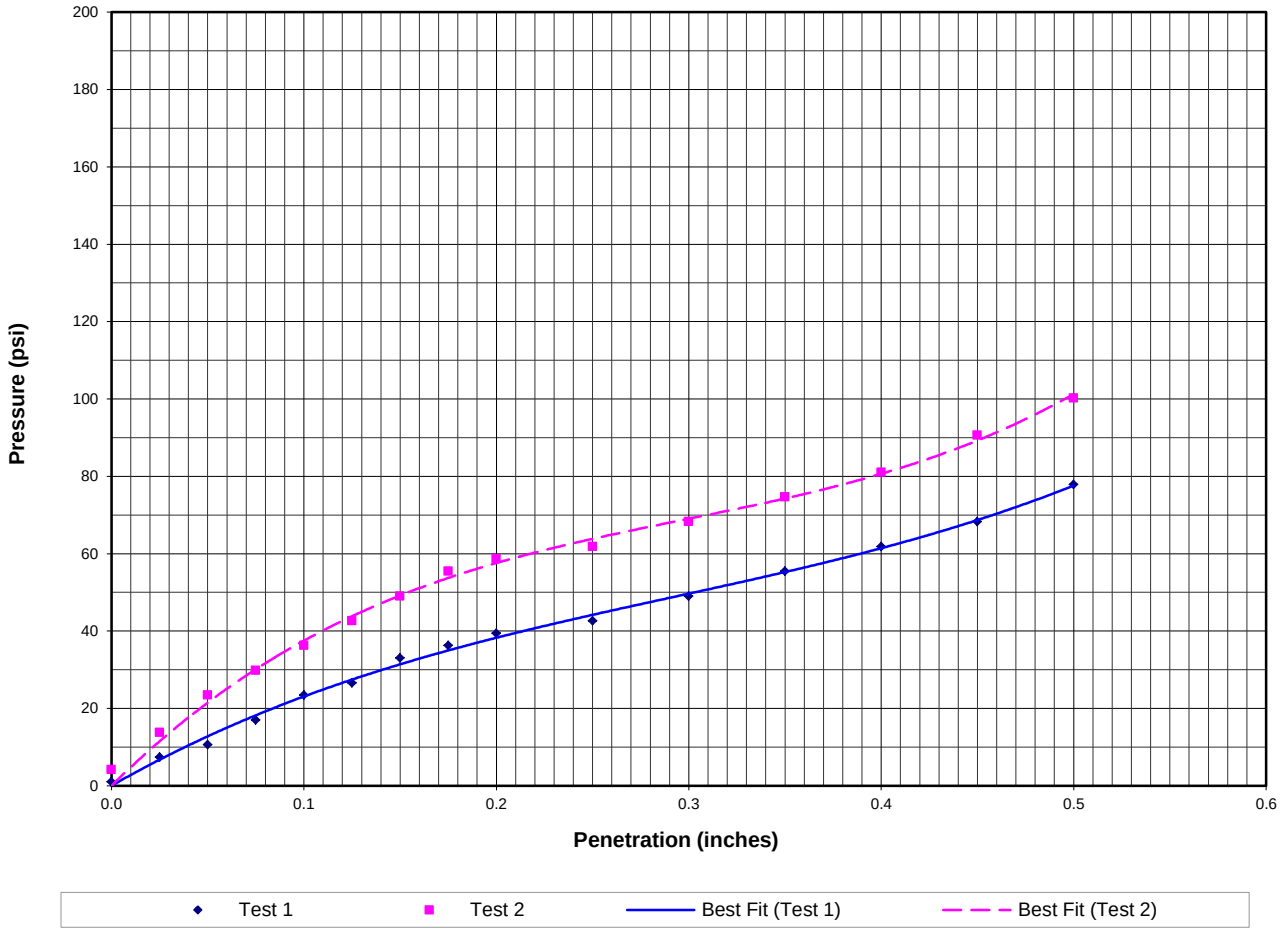
Job No.:	2014117
Project:	Professional Blvd.
Sample No.:	Bag
Sample Location:	RB-06
Test Date:	6/9/2016

CALIFORNIA BEARING RATIO (CBR) TEST RESULT

(ASTM D1883 / AASHTO T193)



Sample Description: Reddish brown fine sandy clay

Classification: CH / A-7-6

Soil Engineering Properties

Specific Gravity =	2.8
Liquid Limit =	72
Plasticity Index =	49
% Passing #4 =	99.5
% Passing #200 =	91.4

Proctor Test Results

Compaction Effort =	Modfied	
Max. Unit Dry Weight =	110.3	lbs/cu.ft.
Opt. Water Content =	18.2	%

CBR Results:

	Test 1	Test 2
CBR @ 0.1" =	**2.3**	**3.6**
CBR @ 0.2" =	**2.6**	**3.9**

Swell/Shrink:

	Test 1	Test 2
% Swell =	8.75	8.75
% Shrink =		

As Molded:

	Test 1	Test 2	
Unit Dry Weight =	108.7	108.7	lbs/cu.ft
Water Content =	16.6	16.6	%

AB CONSULTANTS, INC.
9450 Annapolis Road
Lanham, Maryland 20706
Tel: 301-306-3091
Fax: 301-306-3092

Job No.:	2014117
Project:	Professional Blvd.
Sample No.:	Bag
Sample Location:	RB-07
Test Date:	6/9/2016

Professional Boulevard Extension
Washington County, Maryland
RKK PROJECT NO. 14187-03.4

Design: JR **Date:** 6/16/16
Updated: JR **Date:** 6/24/16
Check: **Date:**

Summary of Rock Mass Rating (RMR)
Professional Boulevard

ROCK MASS RATING

BORING NUMBER	ROCK CORE RUN NUMBER	ROCK TYPE	STRENGTH OF ROCK				RQD		SPACING OF JOINTS		JOINT CONDITION RATING	GROUNDWATER		STRIKE & DIP		SUM	RMR
			(psi)	(ksf)	(MPa)	Rating	%	RATING	(mm)	RATING			RATING	FOR FOUNDATIONS	RATING		
AB-01	R-1	LIMESTONE			114	12	100	20	60 to 200	8	25	COMPLETELY DRY	15	VERY FAVOURABLE	0	80	I
AB-01	R-2	LIMESTONE			114	12	93	20	60 to 200	8	25	COMPLETELY DRY	15	VERY FAVOURABLE	0	80	I
AB-01	R-3	LIMESTONE	16660	2399	114	12	91	20	60 to 200	8	12	COMPLETELY DRY	15	VERY FAVOURABLE	0	67	II
AB-01	R-4	LIMESTONE			114	12	93	20	60 to 200	8	6	COMPLETELY DRY	15	VERY FAVOURABLE	0	61	II
AB-02	R-1	LIMESTONE	13540	1950	93	7	85	17	60 to 200	8	12	COMPLETELY DRY	15	VERY FAVOURABLE	0	59	III
AB-02	R-2	LIMESTONE			93	7	98	20	200 to 600	10	25	COMPLETELY DRY	15	VERY FAVOURABLE	0	77	II
AB-02	R-3	LIMESTONE			93	7	98	20	60 to 200	8	25	COMPLETELY DRY	15	VERY FAVOURABLE	0	75	II
AB-02	R-4	LIMESTONE			93	7	63	13	60 to 200	8	12	COMPLETELY DRY	15	VERY FAVOURABLE	0	55	III
AB-03	R-1	LIMESTONE	9580	1380	66	7	98	20	60 to 200	8	12	COMPLETELY DRY	15	VERY FAVOURABLE	0	62	II
AB-03	R-2	LIMESTONE			66	7	98	20	60 to 200	8	20	COMPLETELY DRY	15	VERY FAVOURABLE	0	70	II
AB-03	R-3	LIMESTONE			66	7	100	20	200 to 600	10	12	COMPLETELY DRY	15	VERY FAVOURABLE	0	64	II
AB-03	R-4	LIMESTONE			66	7	100	20	60 to 200	8	12	COMPLETELY DRY	15	VERY FAVOURABLE	0	62	II
AB-04	R-1	LIMESTONE	12080	1740	83	7	53	13	60 to 200	8	0	COMPLETELY DRY	15	VERY FAVOURABLE	0	43	III
AB-04	R-2	LIMESTONE			83	7	92	20	60 to 200	8	6	COMPLETELY DRY	15	VERY FAVOURABLE	0	56	III
AB-04	R-3	LIMESTONE			83	7	100	20	60 to 200	8	6	COMPLETELY DRY	15	VERY FAVOURABLE	0	56	III
AB-04	R-4	LIMESTONE			83	7	100	20	200 to 600	10	20	COMPLETELY DRY	15	VERY FAVOURABLE	0	72	II
P-01	R-1	LIMESTONE			113	12	100	20	60 to 200	8	6	WET	7	VERY FAVOURABLE	0	53	III
P-01	R-2	LIMESTONE	16400	2362	113	12	63	13	60 to 200	8	12	WET	7	VERY FAVOURABLE	0	52	III
P-01A	R-1	LIMESTONE	4500	648	31	4	75	13	60 to 200	8	6	WET	7	FAIR	-7	31	IV
P-01A	R-2	LIMESTONE			31	4	67	13	60 to 200	8	6	WET	7	UNFAVOURABLE	-15	23	IV
P-01A	R-3	LIMESTONE			31	4	98	20	60 to 200	8	12	WET	7	VERY FAVOURABLE	0	51	III
P-01A	R-4	LIMESTONE			31	4	83	17	200 to 600	10	20	WET	7	VERY FAVOURABLE	0	58	III
P-02	R-1	LIMESTONE	7130	1027	49	4	27	8	60 to 200	8	6	WET	7	VERY FAVOURABLE	0	33	IV
P-02	R-2	LIMESTONE				0	0	3	0 to 60	5	6	WET	7	VERY FAVOURABLE	0	21	IV
P-02	R-3	LIMESTONE			49	4	100	20	60 to 200	8	20	WET	7	FAVOURABLE	-2	57	III
P-02	R-4	LIMESTONE			49	4	100	20	60 to 200	8	20	WET	7	VERY FAVOURABLE	0	59	III

Appendix D

Final Report
Geophysical Survey
Pinnacles and Sinkholes beneath Proposed Roadway
4300 Lineal Feet of Proposed Roadway
Hagerstown, MD
Enviroscan Project Number 061423

Prepared For: RK & K
Prepared By: Enviroscan, Inc.
March 24, 2016

1051 Columbia Avenue ● Lancaster, PA 17603 ● 717.396.8922 ● Fax 717.396.8746 ● email@enviroscan.com ● www.enviroscan.com

March 24, 2016

Mr. Richard Adams, Jr., P.E.
RK&K
81 Mosher Street
Baltimore, MD 21217

RE: Geophysical Survey
Pinnacles and Sinkholes beneath Proposed Roadway
4300 Lineal Feet of Proposed Roadway
Hagerstown, MD
Enviroscan Project Number 061423

Dear Mr. Goins:

Pursuant to our proposal dated June 9, 2014, Enviroscan, Inc. ("Enviroscan") has completed a geophysical investigation at the above-referenced site. The purpose of the survey was to provide reconnaissance detection and delineation of incipient sinkholes and sinkhole-prone areas beneath the site. Fieldwork for the survey was completed on March 3, 2016.

Site Description

The site is located along the proposed Professional Boulevard road extension, which is a currently open field with a semi-accessible wooded section. The survey alignment was based on drawings provided by the client prior to the field survey. Please note that portions of the alignment were inaccessible due to dense vegetation (Figure 1).

According to the Geologic Map of Maryland (Cleaves, E.T., Edwards, J., Jr., Glaser, J.D., 1968) the site is primarily underlain by the Ordovician-aged Stonehenge and Conococheague Limestones. Figure 1, lower right panel, shows the relative site location within the limestone formations. Common surface features seen in carbonate rocks are sinkholes and closed depressions. Both of these features form from the dissolution of carbonate bedrock (forming cavities and conduits) and the downward movement of surface material and groundwater into these voids. Note that the main difference between a sinkhole and a closed depression is that a sinkhole may appear suddenly as a break in the ground surface revealing a hole, whereas a closed depression typically subsides slowly with no break at the surface.

Karst Processes

Pinnacled bedrock, depressions, and sinkholes are among the geologic features characteristic of karst terranes — i.e. terranes underlain by soluble carbonate (limestone or dolomite) bedrock in wet climates. In karst terranes, infiltrating precipitation dissolves the carbonate bedrock surface, causing the top-of-rock to retreat downward leaving behind a soil mantle of the insoluble clay and/or silica particles formerly bonded in the rock (see Appendix A, panels I and II). Within the bedrock, percolating water enlarges fractures, bedding planes, etc. to produce solution openings ranging in size from minor seams to scenic caverns.

Sinkholes form where particularly enhanced infiltration into a sufficiently wide solution opening (often called a throat or chimney) washes the soil mantle down into cavities in the underlying rock — a process commonly called soil piping. In areas where the residual soil mantle is clay-rich and cohesive, incipient sinkholes may not display any surficial topographic expression, and are present only as air-, water-, or mud-filled voids which may grow or "stope" upward (see Appendix A, panel III). Eventually, the overlying soil arch collapses under its own weight or under the weight of an overlying structure or passing vehicle. The resulting collapse sink, or "sinkhole," is commonly filled with the remains of the soil arch and may display rock at its base (see Appendix A, panel IV). In some cases, surficial subsidence may keep pace with soil piping at depth such that a sinkhole forms by progressive deepening of a surficial depression (sometimes called a subsidence sink), rather than by catastrophic collapse of a stoping void.

Note that the dissolution of bedrock occurs on a time scale measured in thousands to tens of thousands of years. Therefore, the natural occurrence of new sinkholes is a rare occurrence on a human time scale (see Newton, 1987). However, concentration of storm water and excess infiltration due to man's activities can trigger man-made sinkholes virtually anywhere in a karst terrane - even on topographic highs or beneath paved streets or buildings.

Since sinkhole activity is allowed by bedrock cavities and triggered/driven by infiltrating water, hydraulically-active geologic features can act as foci for sinkhole activity. In particular, where open faults, fractures, bedding planes or contacts act as preferred pathways for groundwater infiltration or flow, the water can dissolve networks of solution openings along the fault/fracture/bedding plane/contact. The enhanced infiltration also encourages movement of soil or soil fines into the solution openings, which may cause surficial subsidence and enhanced capture and infiltration of storm water, etc. in a positive-feedback process.

Survey Methods

Electrical Imaging

Surface resistivity measurements involve driving an electrical current in the ground using two current electrodes at the ground surface. The apparent resistivity of the subsurface (essentially the mathematical inverse of terrain conductivity) is determined by measuring the potential difference or voltage between two potential electrodes with a known separation and position/orientation relative to the current electrodes. The depth and volume of the subsurface zone represented by the measured apparent resistivity is a function of the geometry of the current and potential electrodes located at the surface. The principles of electrical imaging are described in the accompanying Introduction to Electrical Imaging (Appendix B).

Using an AGI Super Sting R8/IP resistivity meter, apparent resistivity readings were collected along the four profiles (see Figure 1). Along each profile, electrodes were spaced at 10-foot intervals. To collect electrical imaging data, a dipole-dipole array was used. The locations of profile endpoints were surveyed using a Topcon GMS-110 global positioning system (GPS) receiver. The GPS positions were collected with real-time differential correction, using the corrections from the Satellite-Based Augmentation Service (SBAS). The resulting differential GPS (DGPS) positions have an accuracy of better than two feet. The measured apparent resistivities (ρ_a's) were plotted, after each line was completed, as resistivity pseudo-sections depicting the apparent resistivity versus nominal survey depth for each profile, in order to confirm data quality.

In post-field processing, the apparent resistivity pseudo-sections were mathematically inverted using EarthImager2D software by AGI, Inc., to provide color-contoured electrical images of true resistivity versus depth along each profile, as depicted in Figures 2 and 3. On these images, low-resistivity (high-conductivity) material is depicted in shades of blue to yellow, with high-resistivity (low-conductivity) material in shades of orange to red and moderately resistive/conductive materials in shades of yellow. Note that clay-rich and/or wet materials are typically represented by local resistivity lows (conductivity highs – shades of blue), while competent rock, and dry sands, gravels or other well-drained porous materials are typically represented by areas of resistivity highs (low conductivity – orange to red).

Survey Results

Figure 1 depicts the locations of Profiles 1 through 4, and the corresponding resistivity cross sections are depicted in Figure 2. The yellow- to red-shaded contours represent inferred dry soil/rock, and the green- to blue-shaded contours represent moist or conductive soil/rock. Alternating high- and low-resistivity values are a common feature in karst terrain and are evident along all four profiles.

The conductive anomalies of the type expected for water- or soil-filled fractures (low resistivity) are identified in Figures 2 and 3 with blue arrows. Please note that Profile 3 contains numerous alternating high/low anomalies indicative of highly karstified terrain. Any of these anomalies could be typical sinkhole "throats" through which water infiltrates into deeper voids or solution cavities. Figure 4 depicts the plan-view location of the significant conductive anomalies identified in Figures 2 and 3.

Enviroscan recommends that any future geotechnical investigations include direct testing of each of these anomalies to determine the extent and source of the conductive feature.

Limitations

The geophysical survey described above was completed using standard and/or routinely accepted practices of the geophysical industry and equipment representing the best available technology. Enviroscan does not accept responsibility for survey limitations due to inherent technological limitations or unforeseen site-specific conditions. However, we make every effort to identify and notify the client of such limitations or conditions.

We have enjoyed and appreciated the opportunity to work with you. If you have any questions, please do not hesitate to contact the undersigned.

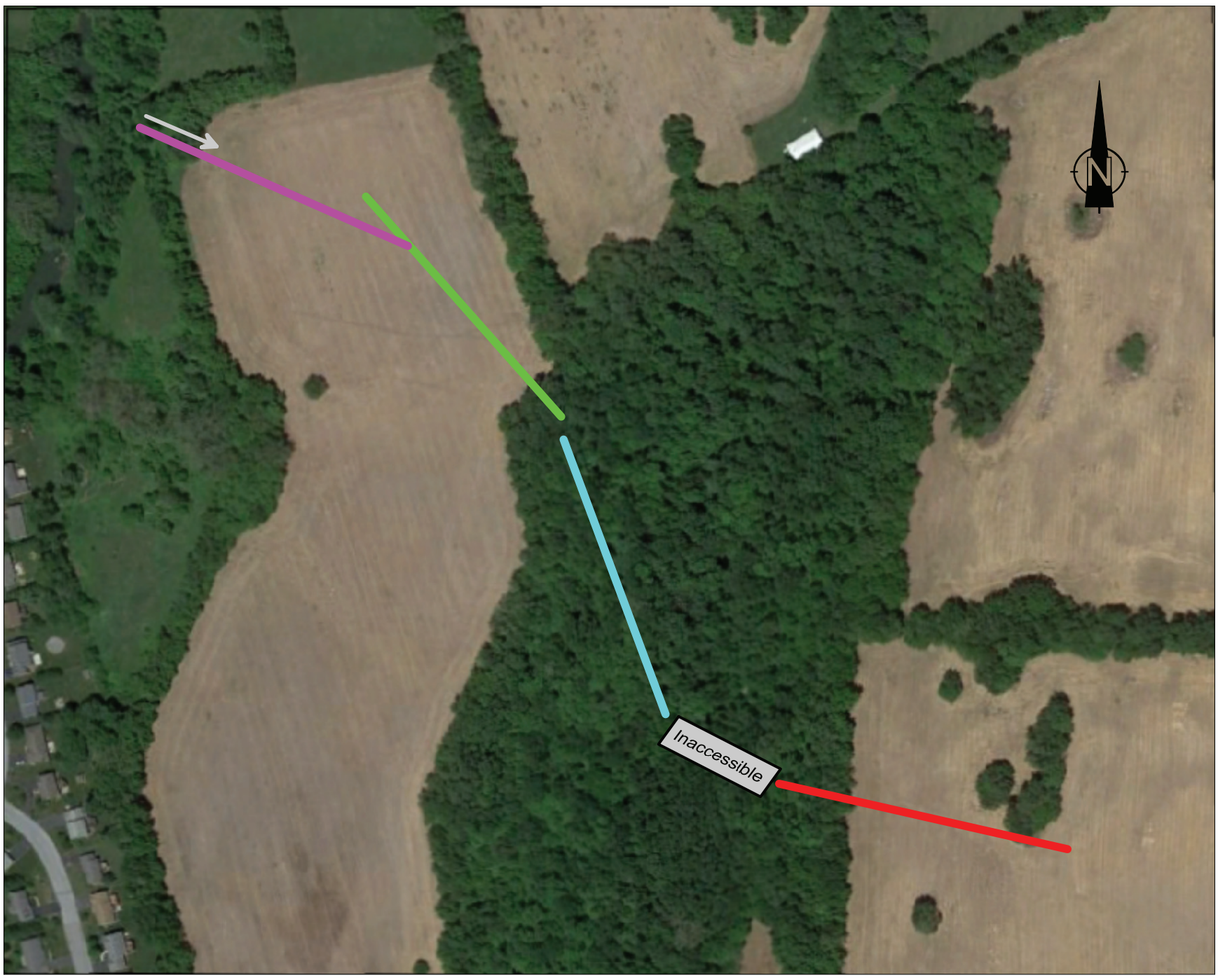
Sincerely,
Enviroscan, Inc.

Charles H. Rhine, M.Sc., P.G.
Senior Geophysics Project Manager

Technical Review By:
Enviroscan, Inc.

Felicia Kegel Bechtel, M.Sc., P.G.
President

enc.:
Figure 1: Resistivity Profile Location Map
Figure 2: Electrical Imaging Profiles 1 & 2
Figure 3: Electrical Imaging Profiles 3 & 4
Figure 4: Electrical Resistivity Survey Results
Appendix A: Schematic Karst Processes
Appendix B: Introduction to Electrical Imaging



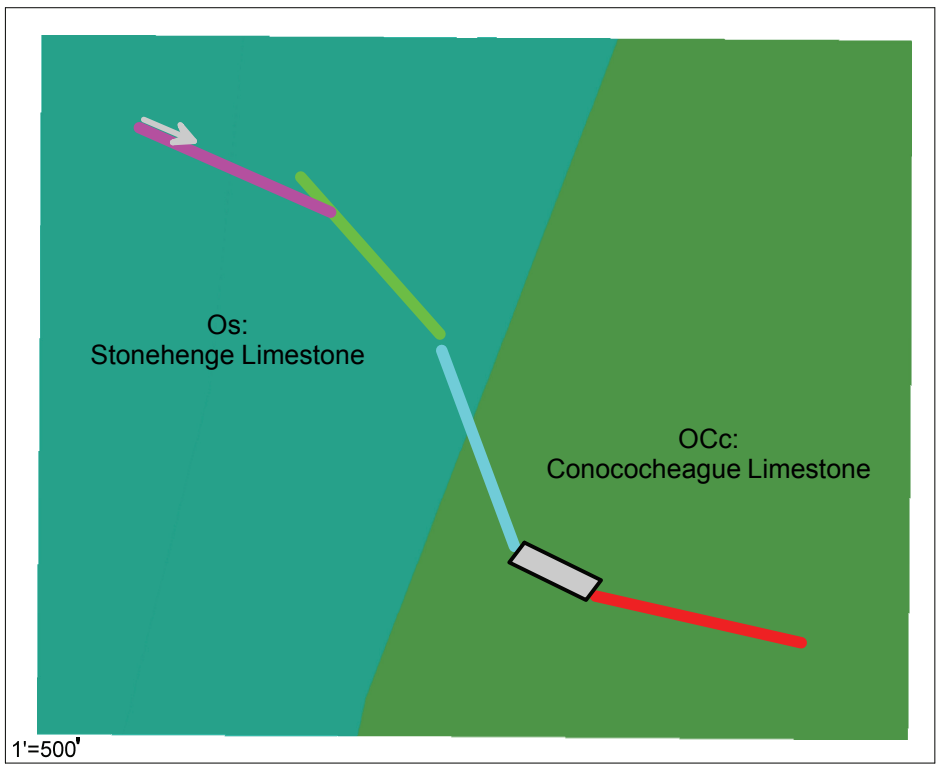
Scale (ft)

0 125 250 375 500

Geophysical Survey Legend

- Profile 1
- Profile 2
- Profile 3
- Profile 4

Geologic Setting



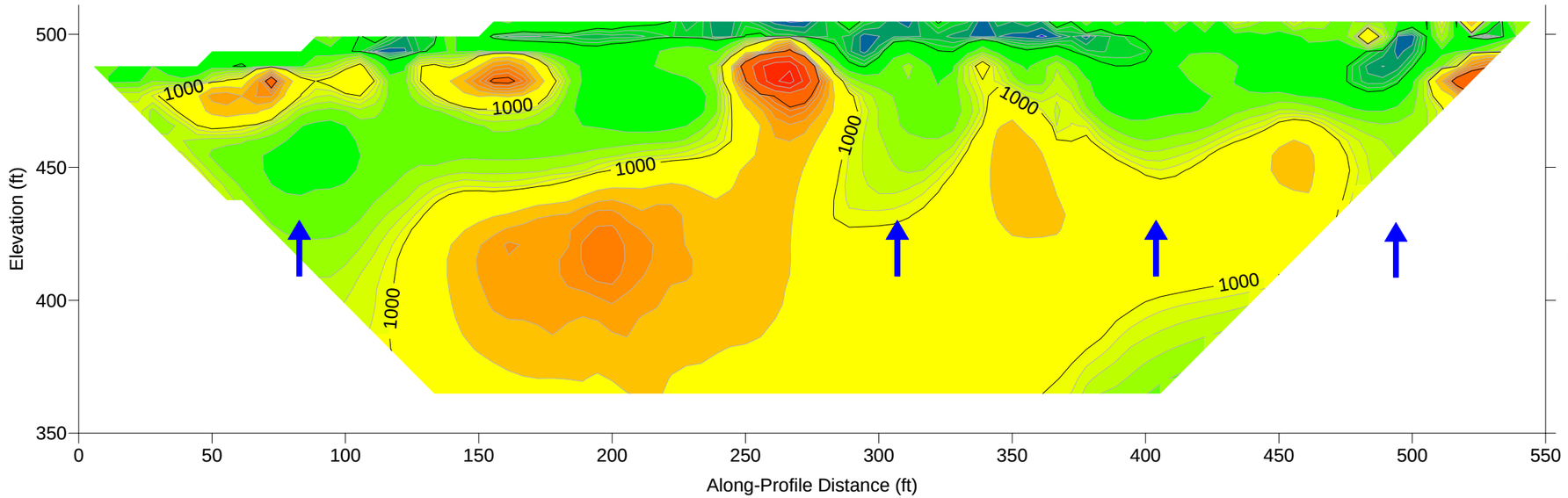
Note:
The information depicted on this drawing represents survey results on the date surveyed and can only be considered to be indicative of the general conditions existing on the survey date.

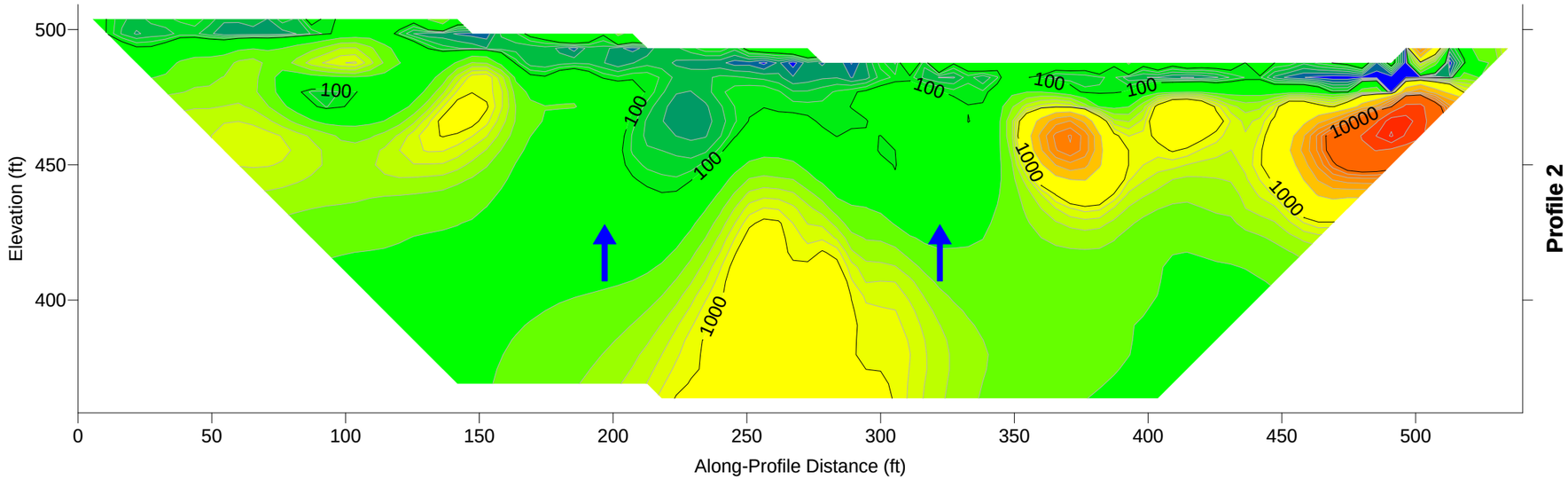
Figure composed using aerial image from Google Earth and RTK survey by Enviroscan, Inc. personnel.

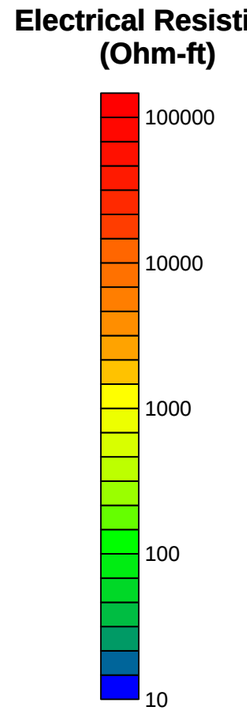
Geologic Map of Maryland (Cleaves, E.T., Edwards, J., Jr., Glaser, J.D., 1968)

Prepared by:	Title:	Project Location:	Figure
Enviroscan, Inc. 1051 Columbia Ave. Lancaster PA 17603 717-396-8922 www.enviroscan.com	**Resistivity Profile Location Map**	**Professional Boulevard Bridge and Extension Hagerstown, MD**	1

Project Number	Revision/Issue		
061423	03/24/16		
Original Scale	Survey Ending Date	Drawn by:	Approved by:
1"= 250'	03/03/2016	MEG	FKB







Geophysical Survey Legend

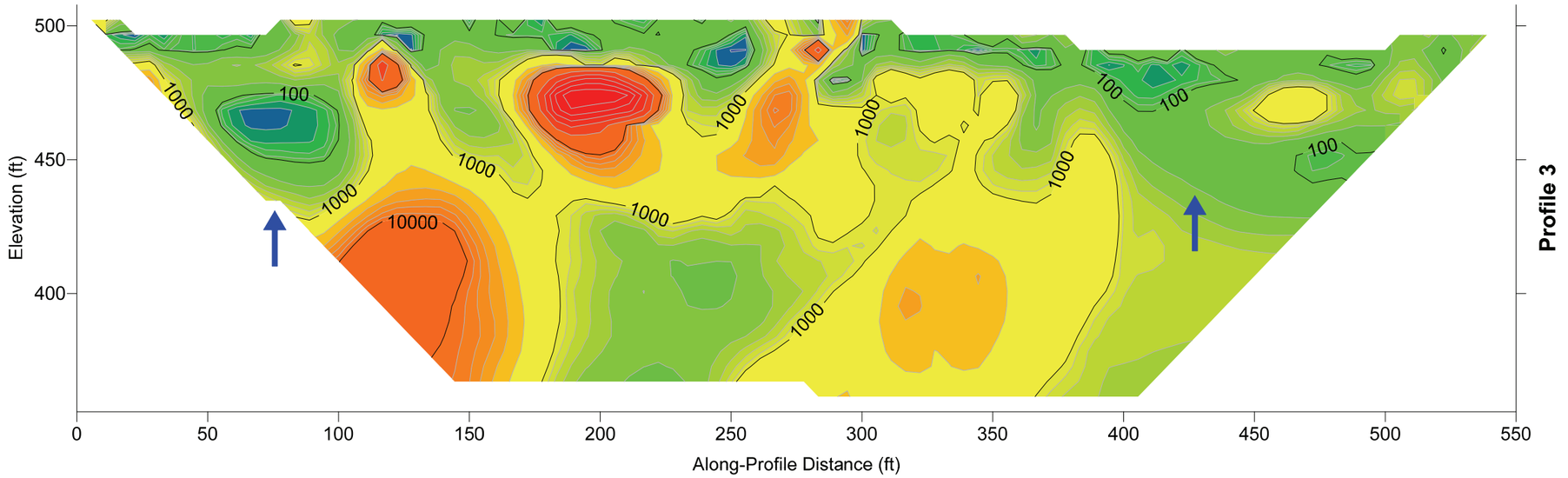
Anomalous Feature

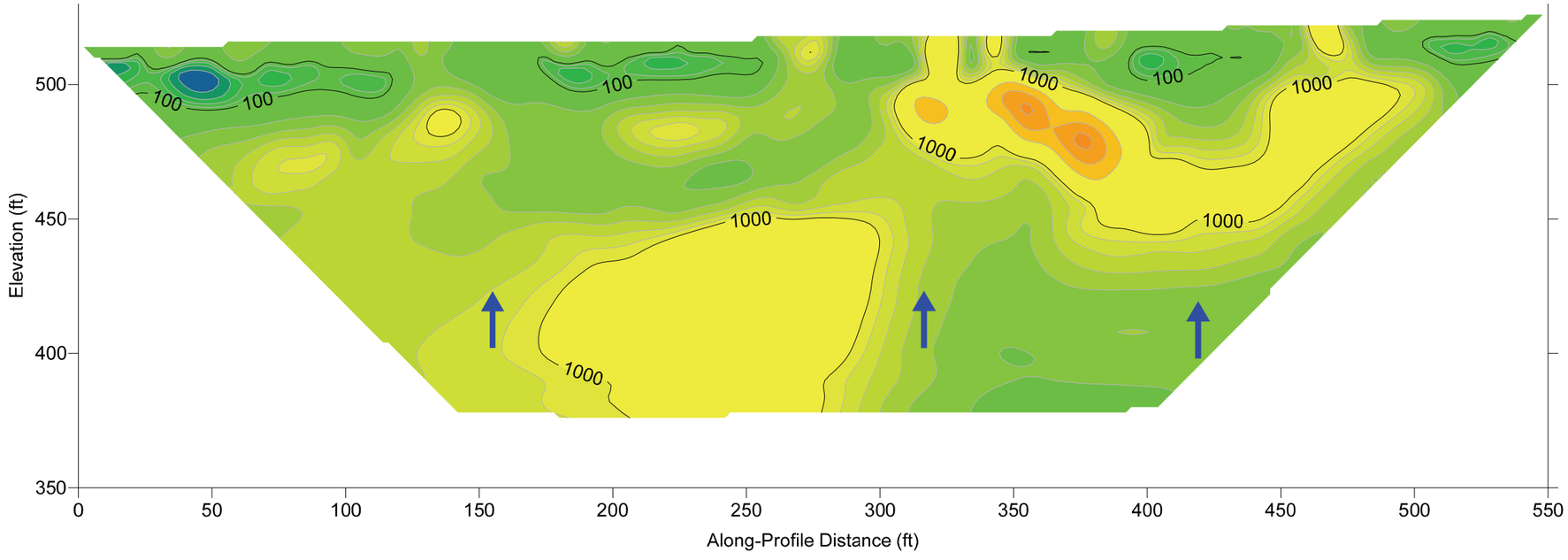
Notes:

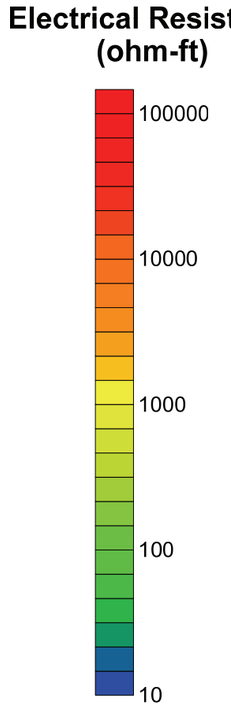
Distance in feet along-profile, elevation in feet.

EI data from AGI SuperSting R8 system, models from EarhImager 2D inversions.

Prepared by: **Enviroscan, Inc.** 1051 Columbia Ave. Lancaster PA 17603 717-396-8922 www.enviroscan.com	Title: **Electrical Imaging Profiles 1 & 2**	Project Location: **Professional Boulevard Bridge and Extension Hagerstown, MD**	Figure 2
		Project Number 061423 / Revision/Issue 03/24/2016	
		Original Scale 1"= 50' / Survey Ending Date 03/03/2016	Drawn by: MEG / Approved by: FKB







Geophysical Survey Legend

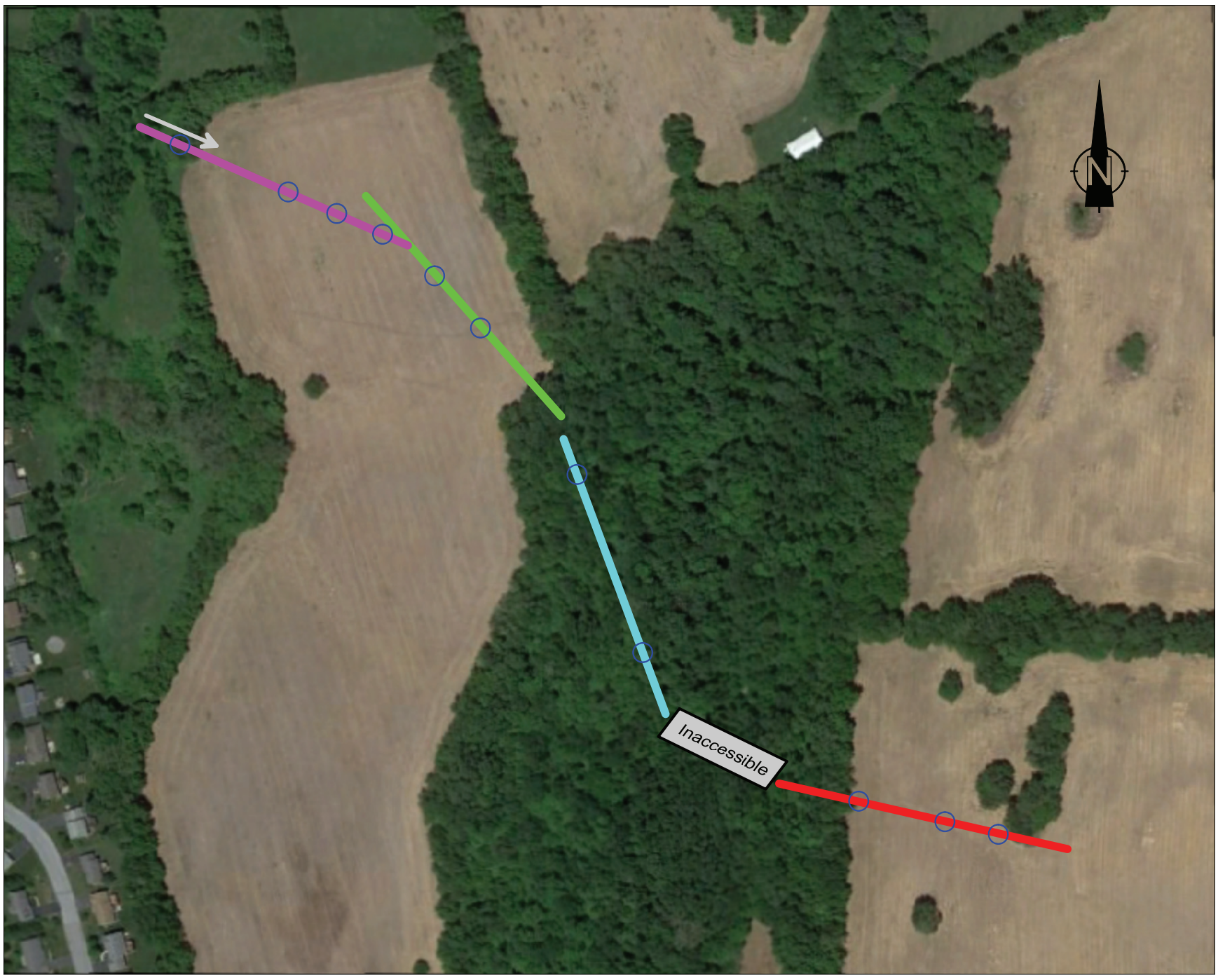
Anomalous Feature

Notes:

Distance in feet along-profile, elevation in feet.

EI data from AGI SuperSting R8 system, models from EarhImager 2D inversions.

Prepared by: **Enviroscan, Inc.** 1051 Columbia Ave. Lancaster PA 17603 717-396-8922 www.enviroscan.com	Title: **Electrical Imaging Profiles 3 & 4**	Project Location: **Professional Boulevard Bridge and Extension Hagerstown, MD**	Figure 3
		Project Number 061423 / Revision/Issue 03/24/2016	
		Original Scale 1"= 50' / Survey Ending Date 03/03/2016	Drawn by: MEG / Approved by: FKB



Scale (ft)

0 125 250 375 500

Geophysical Survey Legend

- Profile 1
- Profile 2
- Profile 3
- Profile 4
- Low Resistivity Area

Note:
The information depicted on this drawing represents survey results on the date surveyed and can only be considered to be indicative of the general conditions existing on the survey date.

Figure composed using aerial image from Google Earth and RTK survey by Enviroscan, Inc. personnel.

Geologic Map of Maryland (Cleaves, E.T., Edwards, J., Jr., Glaser, J.D., 1968)

Prepared by:	Title:	Project Location:	Figure
Enviroscan, Inc. 1051 Columbia Ave. Lancaster PA 17603 717-396-8922 www.enviroscan.com	**Electrical Resistivity Survey Results**	**Professional Boulevard Bridge and Extension Hagerstown, MD**	4

Project Number	Revision/Issue	Drawn by:	Approved by:
061423	03/24/2016	MEG	FKB

Original Scale	Survey Ending Date
1"= 250'	03/03/2016

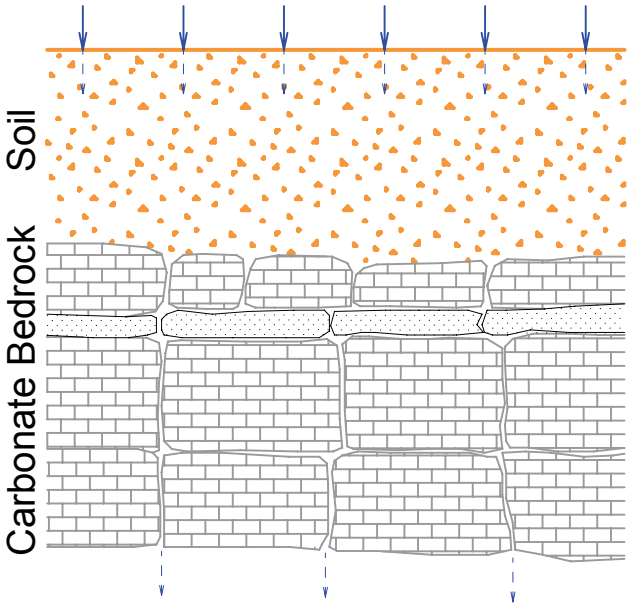
Appendix A

Schematic Karst Processes

1051 Columbia Avenue ● Lancaster, PA 17603 ● 717.396.8922 ● Fax 717.396.8746 ● email@enviroscan.com ● www.enviroscan.com

I

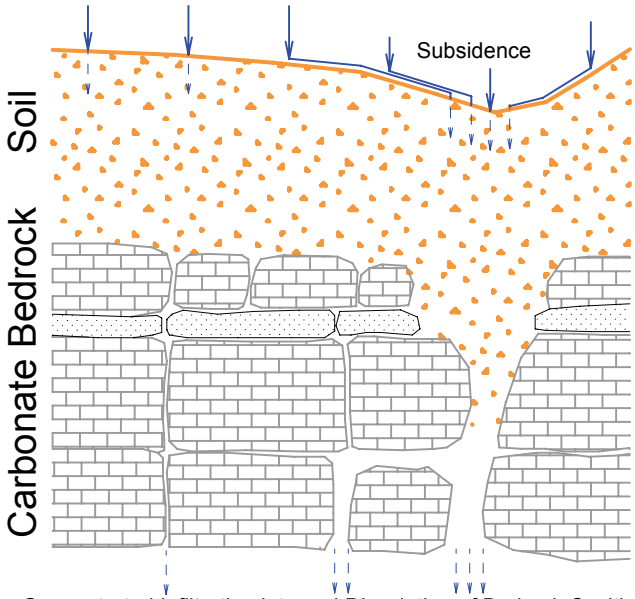
Precipitation



Infiltration

II

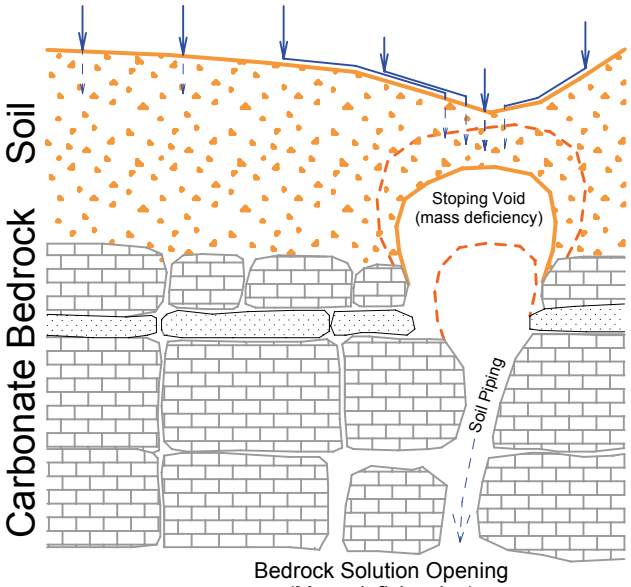
Precipitation And Run-Off



Concentrated Infiltration into and Dissolution of Bedrock Cavities
(mass deficiencies)

III

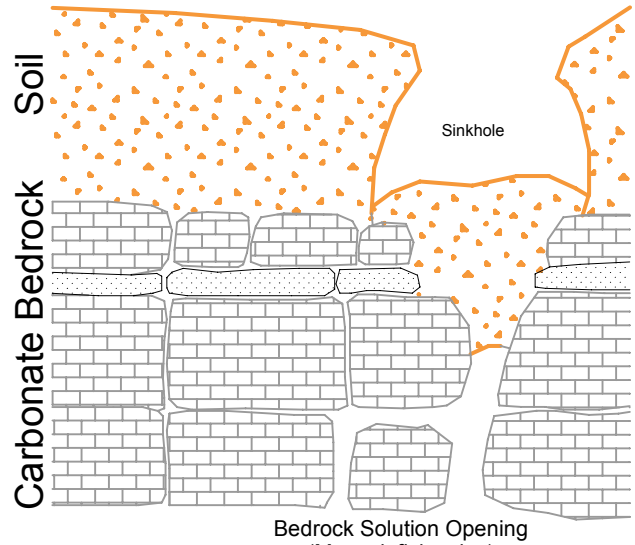
Enhanced Precipitation and Run-Off



Bedrock Solution Opening
(Mass deficiencies)

IV

Soil Arch Collapse



Bedrock Solution Opening
(Mass deficiencies)

Typical Time Scale

I → Thousands to Millions of Years

II → Indefinite
(may be stable until activated
by enhanced precipitation)

III → Hours to Months
(may be accelerated
by enhanced precipitation)

IV

Schematic Karst Processes

Rev. 01/2009

ENVIROSCAN, INC.

Appendix A

Introduction to Electrical Imaging

Introduction to Electrical Imaging

by

Timothy D. Bechtel, Ph.D., P.G.

Energy

Electrical currents injected into the subsurface between electrodes pushed into the ground surface or non-intrusive, protected capacitors.

Sensitivity

Detects changes in electrical resistivity (the inverse of conductivity).

Basic Equipment

Either (traditional "steel spike electrode" method):

Steel spike electrodes (called current electrodes) connected by wires to a current source (to inject current), and steel spike electrodes (called voltage electrodes) connected to a microvolt meter (to measure the surficial distribution of electrical potentials). Note that current and voltage electrodes differ only by that to which they are connected (i.e. current source or microvolt meter, respectively.) Modern systems use arrays of electrodes (connected to multi-channel cables and an automated electrode-switching/recording system) to take measurements from electrodes at different locations and spacings (which adjusts the survey depth and resolution). Electrodes are hand-pushed into the ground surface along desired survey profiles.

Or (innovative "capacitively-coupled electrode" method):

Straight-wire capacitors which are capable of driving subsurface electrical currents and measuring surface potentials. The wire lengths and the distance between wires can be varied to adjust the survey depth and resolution. Capacitors are encased in torpedo-like protectors between the wire lengths, and the entire array (similar to a swimming rope with flotation buoys) is hand- or vehicle-towed along desired survey profiles.

Common Applications

Electrical imaging produces color-contour cross sections (commonly called electrical images) of subsurface electrical resistivity variations. These images can depict a target that has a different electrical resistivity from its surroundings, such as: buried wastes (pits, trenches, etc.); conductive groundwater plumes; resistive hydrocarbon plumes; foundation elements; water-bearing or mineralized faults or fractures; clay seams in bedrock; soil moisture anomalies; soil voids; clay layers bounded by sand or sand lenses bounded by clay; the top of competent (non-water-bearing) rock.

Principles

Electrical imaging can be performed by driving a harmless, very low amperage (e.g. 1 milliamp) DC electrical current in the ground between two steel spike electrodes. The depth to which the current flows is dictated by the separation of the two electrodes, and by the resistivity of subsurface materials. The flow of electrical current is mapped by measuring the electrical potential at various points of the ground surface using a very high impedance microvolt meter. Data suitable for determining a cross-sectional electrical image can be collected by taking many voltage readings with differing current electrode separations (i.e. different effective measurement depths) using different current electrode positions and voltage electrode positions (i.e. different locations along a profile). A two-dimensional image or cross-section is produced by employing electrodes in a linear array. Three-dimensional images (or color-contoured blocks of data) can be calculated using multiple linear arrays or grids of electrodes. The field-measured voltages, together with associated electrode positions, are mathematically inverted to provide the statistically best-fitting model of the subsurface resistivity distribution.

Electrical imaging can also be performed using straight-wire capacitors to drive currents and measure voltages. In this case, the length of the transmitter wire and the separation between the transmitter and receiver wires dictate the effective survey depth. Two- or three-dimensional data is collected by varying the lengths and separations of the transmitter and receiver capacitor wires for a given survey profile (i.e. the same profile is traversed several times using different wire lengths and separations).

Capabilities

Electrical imaging can detect and delineate a target that has a different electrical resistivity from its surroundings. Particularly good targets for electrical imaging include: electrically conductive clay seams, and water-bearing or mineralized faults or fractures in resistive bedrock; electrically resistive hydrocarbon plumes in moist electrically conductive soils; highly conductive electrolytic groundwater plumes (e.g. leachate or saltwater intrusion); highly conductive or resistive wastes buried in "normal" soils; soil moisture anomalies (e.g. dam seepage or incipient sinkholes).

Where site conditions allow, capacitively-coupled electrode systems can collect greater quantities of data in a given time (or at a given cost) than the traditional steel spike systems. The capacitive systems can also be used on asphalt pavement (where steel spike systems would require drilling many electrode holes).

Limitations

Electrical resistivities of differing materials have wide and overlapping ranges, making it impossible to positively identify a subsurface material based on its resistivity alone. For instance, profiling of the top-of-rock can be done by electrical imaging, but it is often difficult to specify exactly what resistivity contour corresponds with the top of rock (particularly where there is a weathering or saprolite zone). Since electrical resistivity (unlike seismic velocity) does not correlate with rippability or density, it is not typically the method of choice for rock profiling.

Based largely on a single well-publicized incident, electrical imaging has been promoted (by others) as a method for detecting bedrock cavities. However, since an air-filled cavity and competent rock are both electrical resistors, many cavities are not detectable using electrical methods (in this case, gravity would be the method of choice since air and competent rock have very different densities).

Electrical imaging data is susceptible to interference from underground utilities that capture and channel the subsurface current flow. This can be minimized in two-dimensional surveys by orienting the trace of an image perpendicular to any existing utilities.

Capacitively-coupled electrode systems suffer loss of signal penetration depth in highly conductive terranes. In addition, they are difficult to use in rugged or brushy terrain.

Survey depths using steel spike electrode systems can be limited by high contact resistances between the spikes and highly resistive surficial material.