

▶ **NCDOT Geo3T2, Cary, North Carolina,
April 9, 2019**

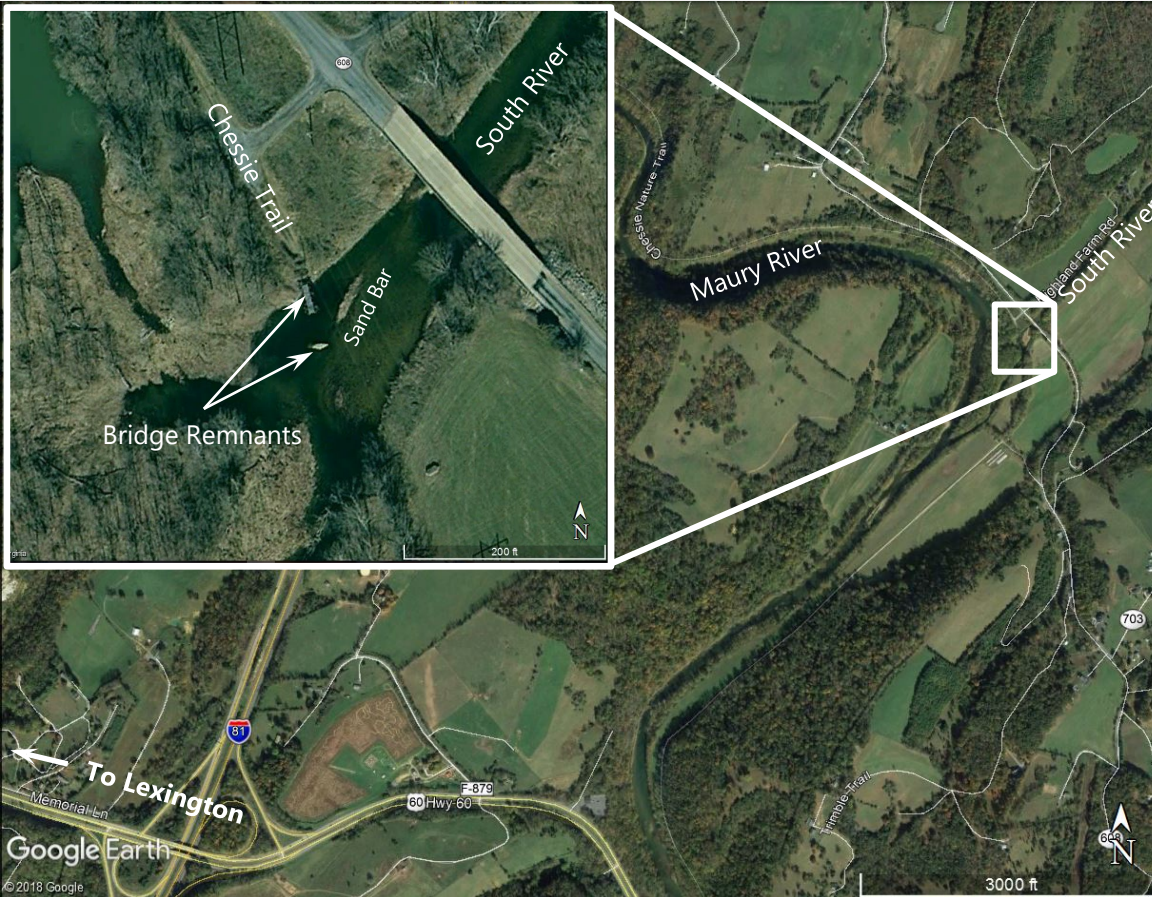
Geotechnical Evaluation of a Pedestrian Bridge Using Aquatic Resistivity Imaging to Supplement Drilling Data

**Presented by: John Z. Ding, P.E.
Warren T. "Ted" Dean, P.G.**



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Project Overview

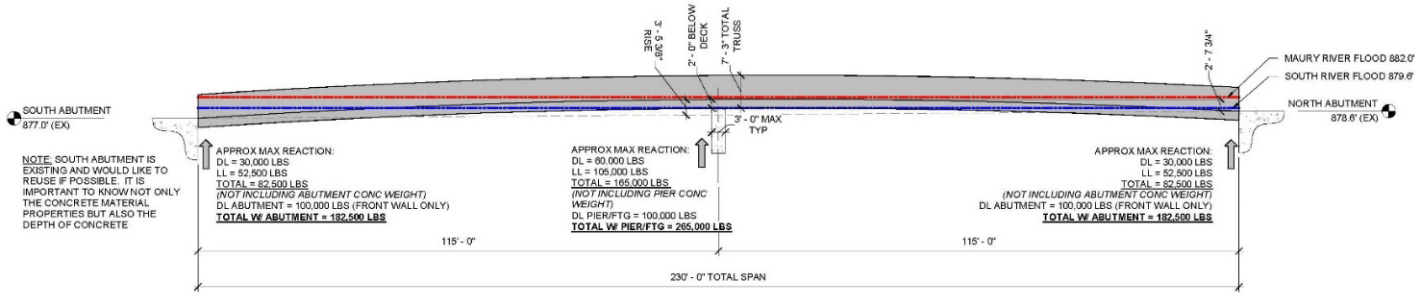


- ❖ Pedestrian bridge over the South River destroyed by flooding in 2003.
- ❖ A Virginia Military Institute (VMI) project with USDOT grant to re-build.

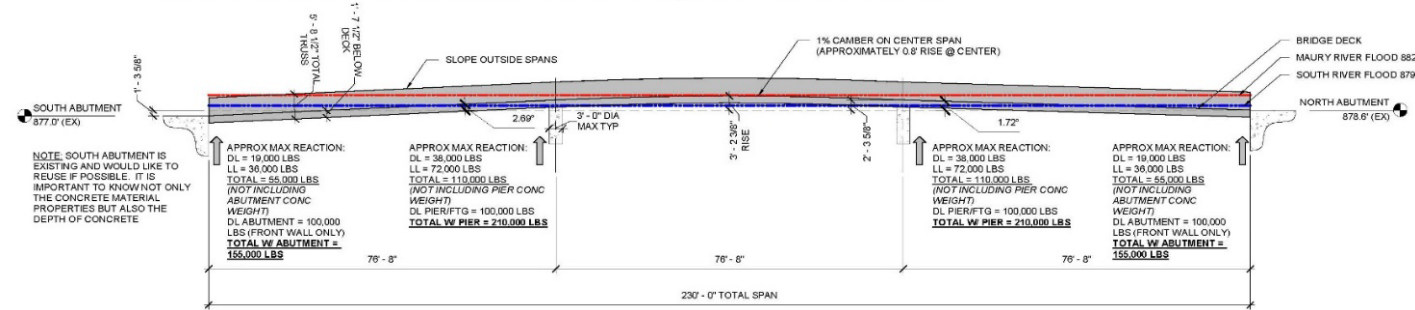


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Project Overview



2 SPAN - OPTION 1 - EX ABUTMENT HEIGHTS REMAIN AND CAMBER ENTIRE SPAN @ 1.5% TO HAVE 3.5 FEET RISE AT CENTER



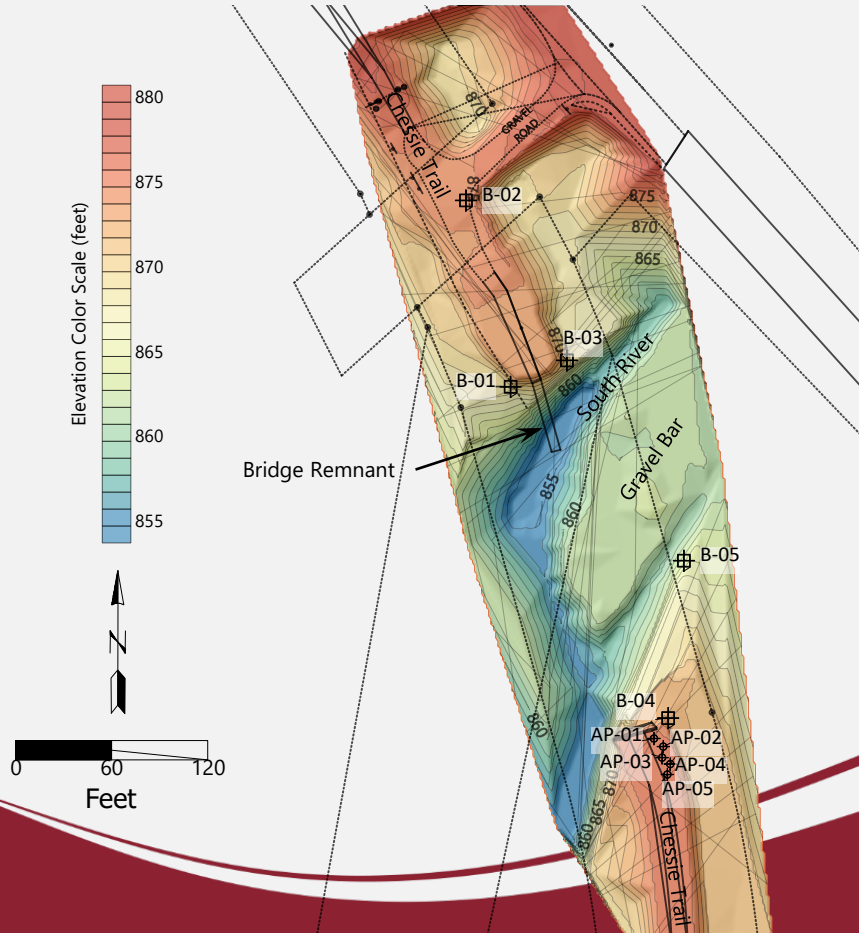
3 SPAN - OPTION 2 - CAMBER CENTER SPAN AND SLOPE SPAN TO EITHER SIDE

❖ 2-Span Option

❖ 3-Span Option



Geotechnical Exploration



- ❖ Four (4) exploratory soil borings, with Standard Penetration Testing (SPT).
- ❖ Five (5) auger probes.
- ❖ Alluvial sediments, highly variable AR likely due to cobbles.



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Geotechnical Challenges

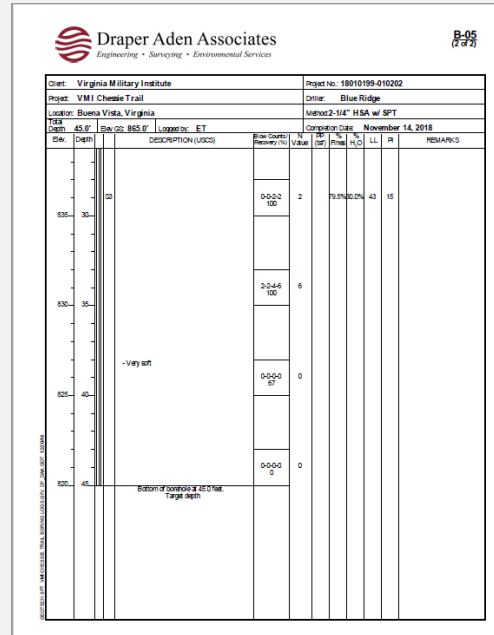
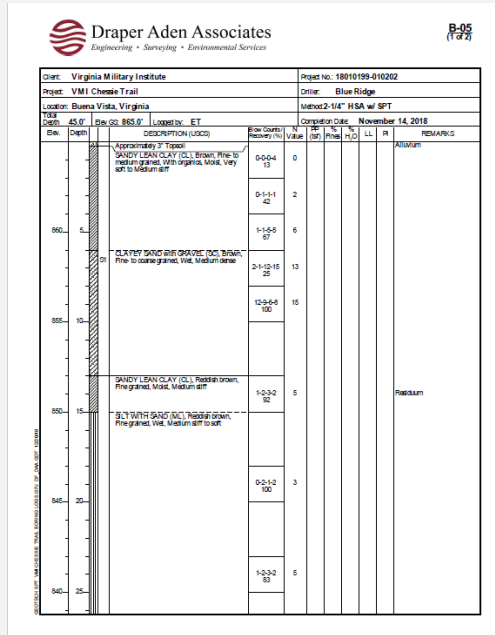


- ❖ One planned boring in the river can't be performed
 - ❖ Barge Drilling is not applicable
 - ❖ ATV/Truck mounted drill rig is not able to access



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Observed Strata



Stratum S1: Fill Material:

Lean CLAY (CL) and Fat CLAY (CH)

Stratum S2:

Alluvial Deposits @6' below surface- Lean CLAY (CL)/SILT (ML)/Silty SAND (SM) /Silty Gravel (GM), SPT >50

Stratum S3:

Alluvial Deposit - Fat CLAY (CH), Extended to boring termination at 45 feet below grade in B-5

Refusal:

From 4 to 18.5 feet below existing grade.



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Data Gaps

- ❖ Unknown nature of the soil in the riverbed
- ❖ Local experiences indicated that the soil stratum could change significantly over a short distance



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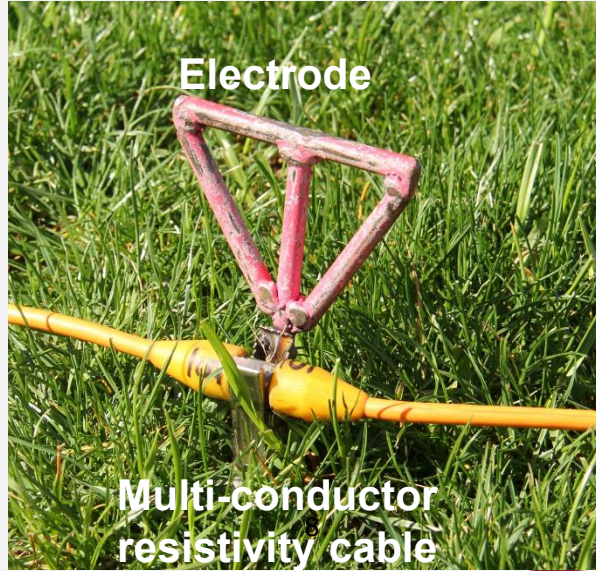
Resistivity Imaging

Resistivity
Meter



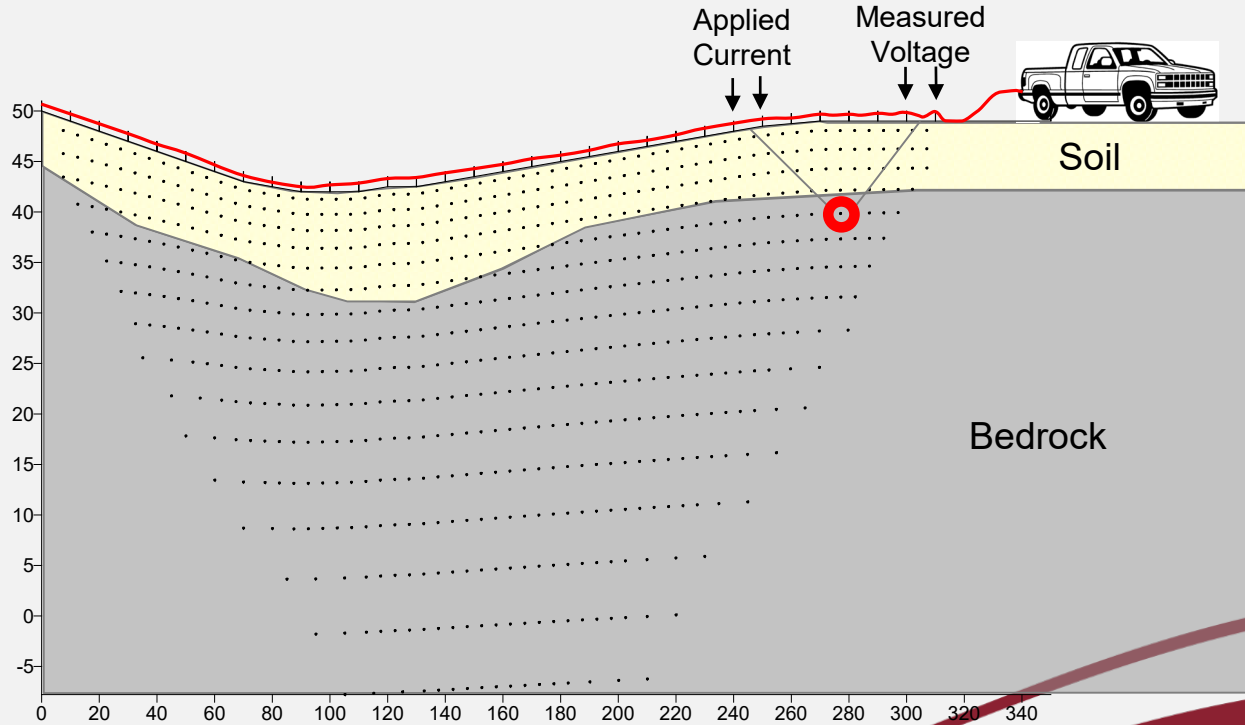
Electrode

Multi-conductor
resistivity cable

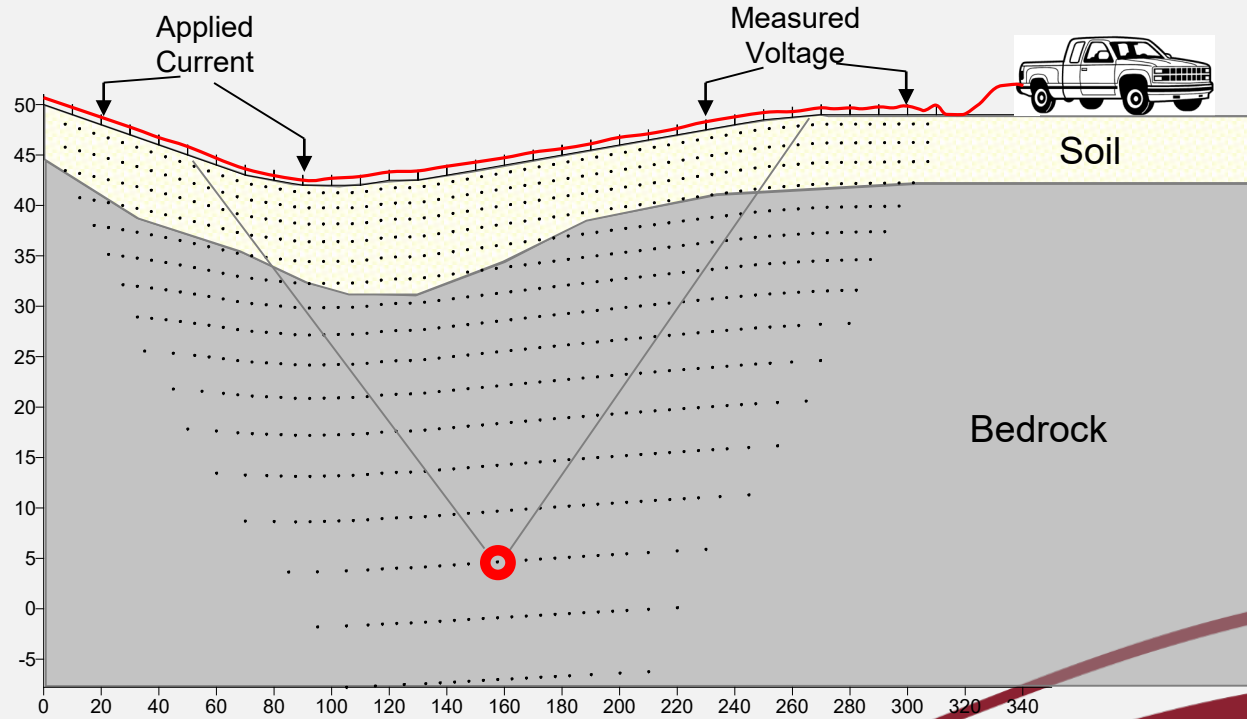


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Shallow Data Acquisition



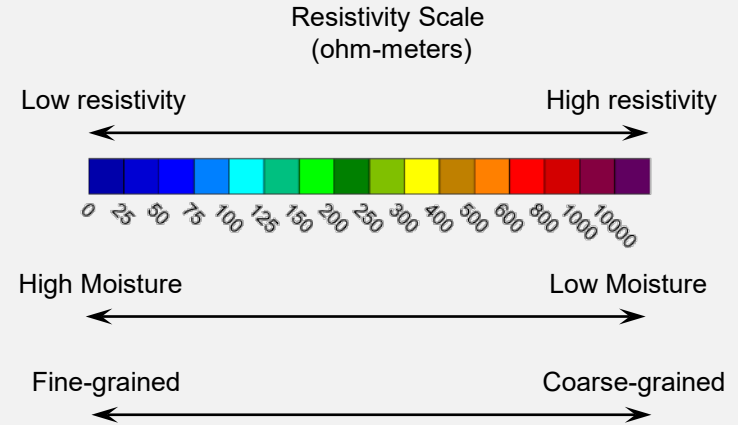
Deep Data Acquisition



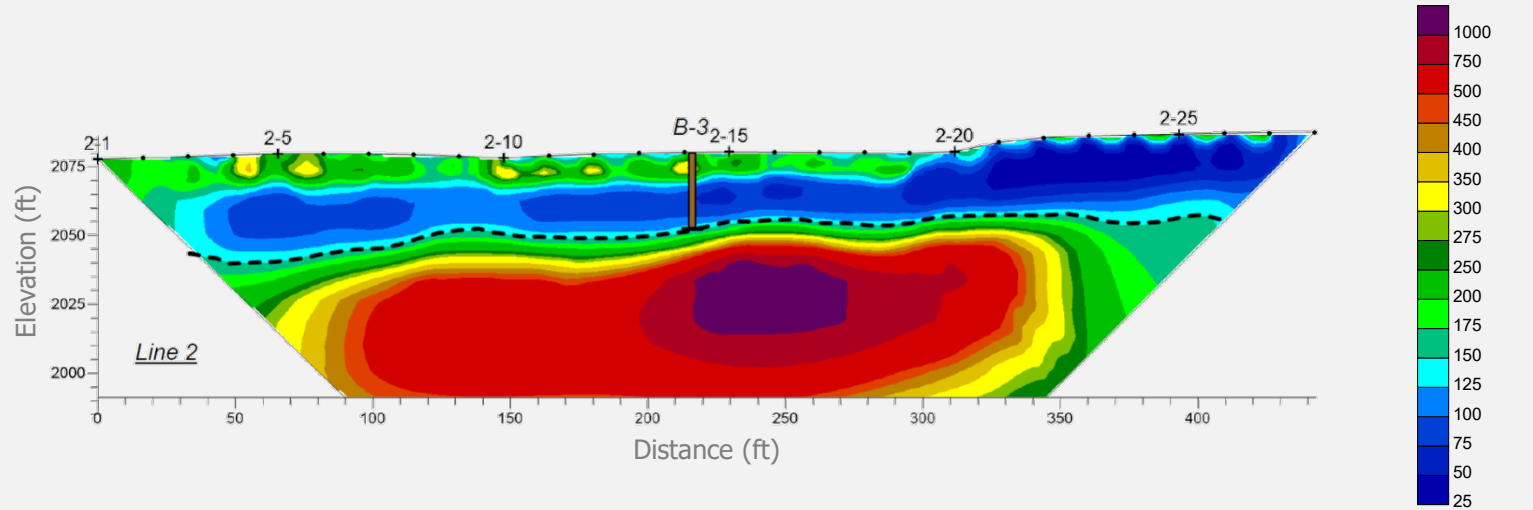
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Factors that Affect Resistivity


- ▶ Moisture content
- ▶ Material grain size





Resistivity Model



B-2 = boring ID

 = soil

 = auger refusal

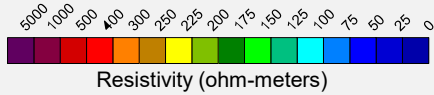
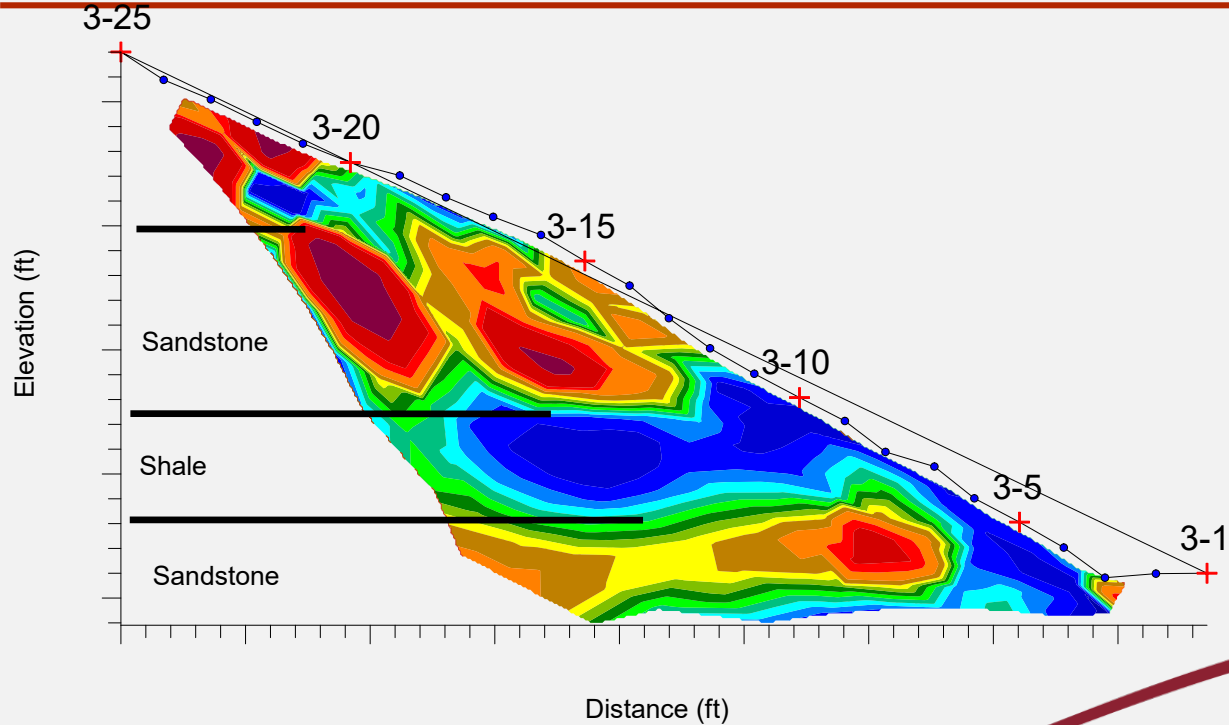
 = estimated top of bedrock

Explanation



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Material Grain Size



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Aquatic Resistivity



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Aquatic Resistivity

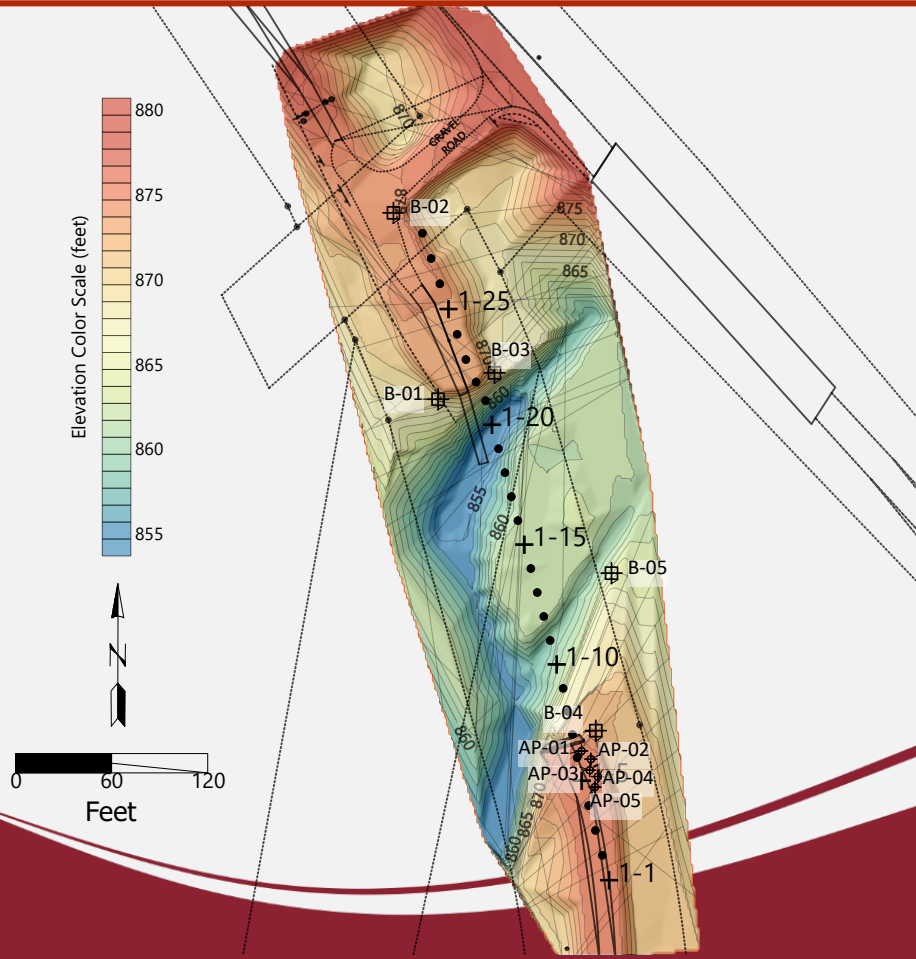


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Aquatic Resistivity

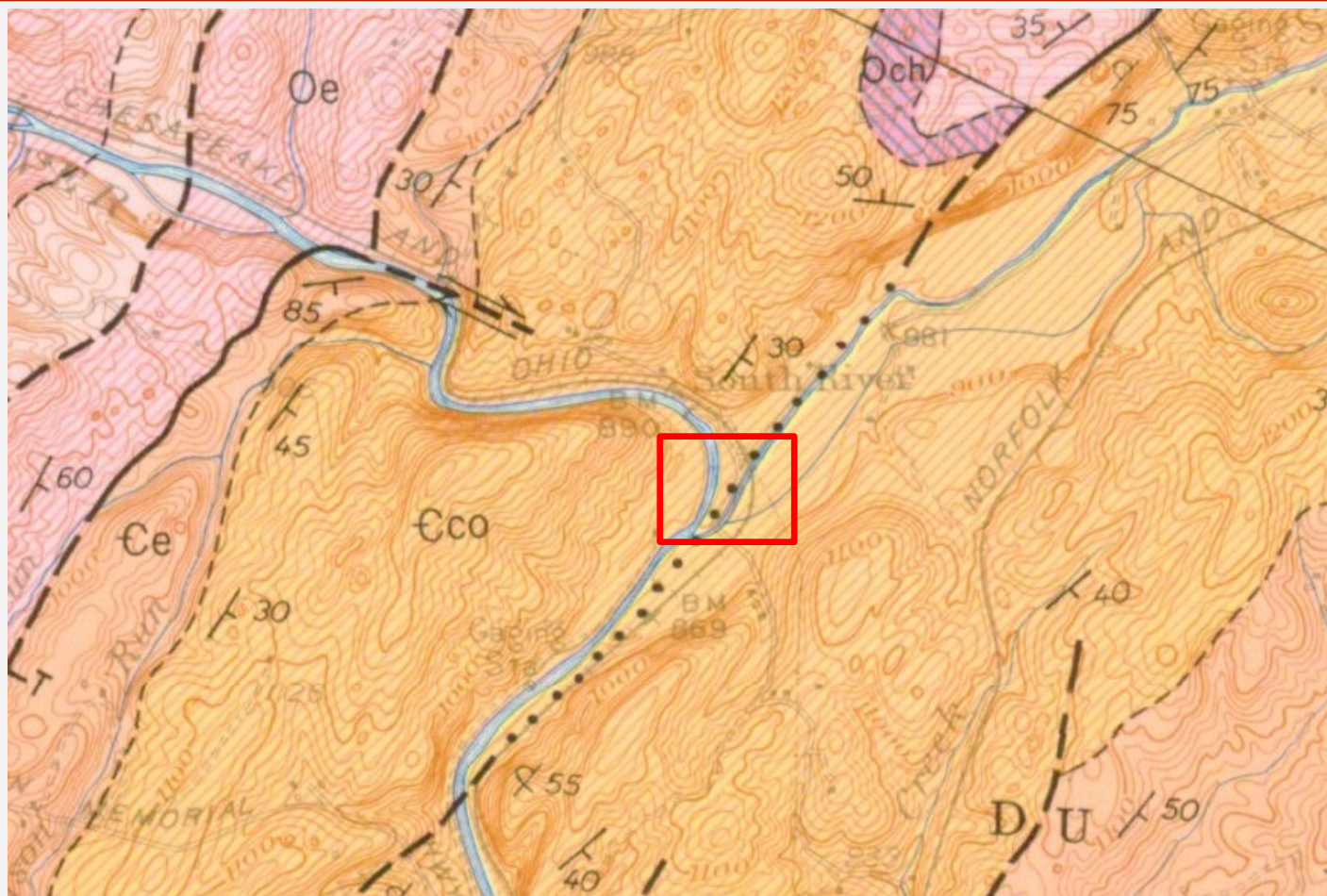


Resistivity Line Location



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Geology Map

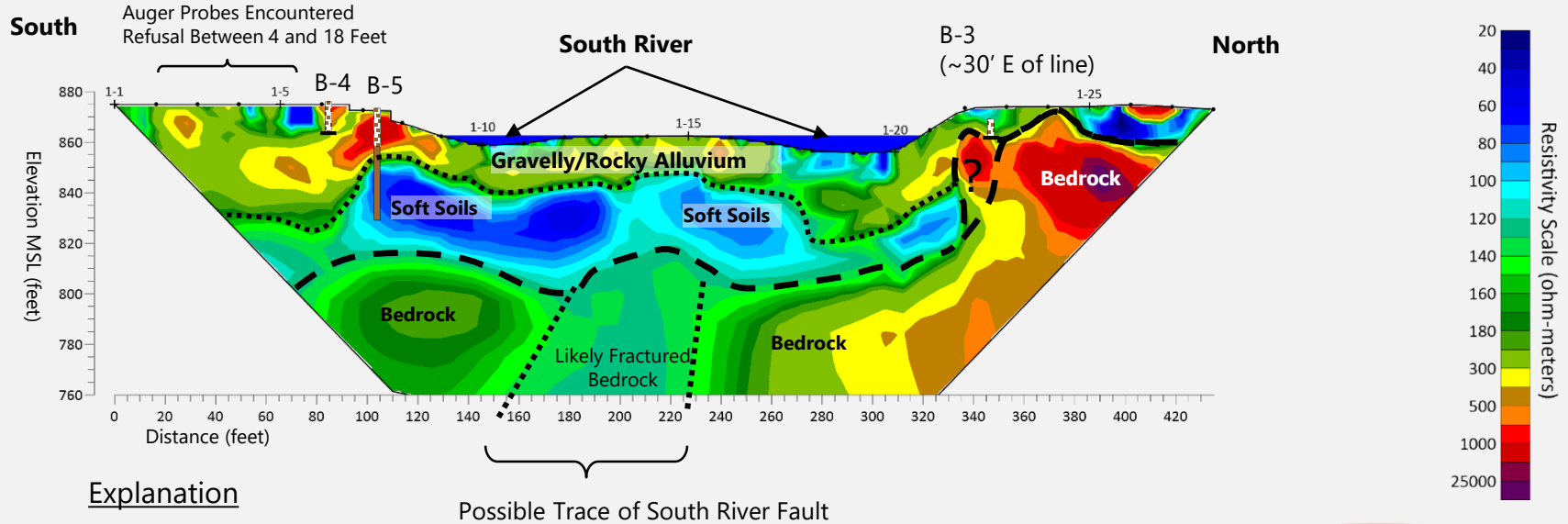


Conococheague Formation
Limestone and dolomite



From Bick, K.F., 1960

Resistivity Results and Interpretations



Explanation

B-# = Boring ID

= Alluvium with Gravels

= Soft Soils

= Auger Refusal (if encountered)

= Approximate Boundary Between Alluvium with Gravels and Soft Soils

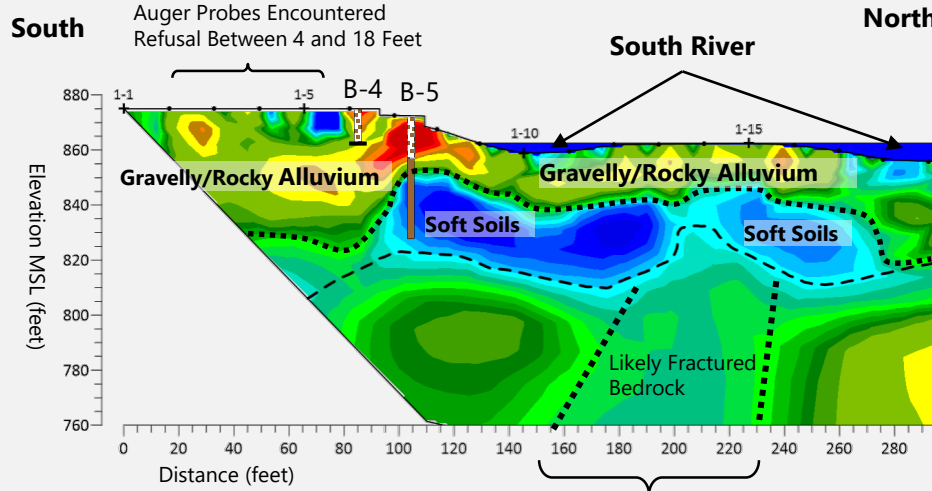
= Estimated Top of Bedrock



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Boring Correlation



Explanation

- B-# = Boring ID
- = Alluvium with Gravels
- = Soft Soils
- = Auger Refusal (if encountered)

- = Approximate Boundary Between Alluvium with Gravels and Soft Soils
- = Estimated Top of Bedrock



Client: Virginia Military Institute					Pr	
Project: VMI Chessie Trail					Dr	
Location: Buena Vista, Virginia					M	
Total Depth 45.0'					C	
Elev GS: 865.0' Logged by: ET					N	
Elev.	Depth	DESCRIPTION (USCS)	Flow Counts/Recovery (%)	N	Value	
880	0	Approximately 3" Topsoil	0-0-0-4 13	0		
875	2	SANDY LEAN CLAY (CL), Brown, Fine to medium grained, With organics, Moist, Vary soft to Medium stiff	0-1-1-1 42	2		
865	6	CLAYEY SAND WITH GRAVEL (SC), Brown, Fine to coarse grained, Wet, Medium dense	1-1-5-5 67	6		
860	13		2-1-12-15 25	13		
855	15		12-9-5-8 100	15		
850	10			10		
860	15	SANDY LEAN CLAY (CL), Reddish brown, Fine grained, Moist, Medium stiff	1-2-3-2 92	5		
860	15	SILT WITH SAND (ML), Reddish brown, Fine grained, Wet, Medium stiff to soft				
845	20		0-2-1-2 100	3		
840	25		1-2-3-2 83	5		
835	30					
830	35					
825	40					
820	45					
820	45	Bottom of borehole at 45.0 feet. Target depth				

Project Geotechnical Recommendations

1. Shallow foundations for the bridge abutments.
2. Drilled shaft supporting on bedrock for the center pier.



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Conclusions

1. Geophysical studies assist in geotechnical exploration not only in a broader geologic setting but also in discrete areas.
2. Geophysical studies in geotechnical exploration can potentially save significant project costs.



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Thanks and Questions !

Great Lake Winter, OH



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