REPORT ON
PERIODIC SAFETY FACTOR ASSESSMENT
POND 003
NEW MADRID POWER PLANT
MARSTON, MISSOURI

by
Haley & Aldrich, Inc.
Cleveland, Ohio

for
Associated Electric Cooperative, Inc.
Springfield, Missouri

File No. 129342-046
October 2021

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15 October 2021
File No. 129342-046

Associated Electric Cooperative, Inc.
2814 South Golden Avenue
P.O. Box 754
Springfield, MO 65801-0754

Attention: Dennis Cox
Senior Engineer

Subject: Periodic Safety Factor Assessment
Pond 003
New Madrid Power Plant
Marston, Missouri

Dear Mr. Cox:

We are pleased to submit herewith our report entitled "Report on Periodic Safety Factor Assessment, Pond 003, New Madrid Power Plant, Marston, Missouri". This report includes background information regarding the project and the results of our periodic safety factor assessment.

This work was performed by Haley & Aldrich, Inc. (Haley & Aldrich) on behalf of Associated Electric Cooperative, Inc. (AECI) in accordance with the United States Environmental Protection Agency's (EPA's) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals (CCR) from Electric Utilities, 40 CFR Part 257, specifically §257.73(e).

Background

Pond 003 is located approximately a half mile southeast of the plan power block and between the United States Army Corps of Engineers (USACE) Mississippi River Levee and the Mississippi River. The dike consists of an earthen embankment with a crest length of approximately 9,300 feet around the entire impoundment. The northern portion of the impoundment is incised, and the western portion is comprised of the USACE Mississippi River Levee. Therefore, the constructed portion of the dike to create Pond 003 is considered to be the approximately 5,000 ft of the east side of the unit, 3,200 feet of the south side of the unit, and portions of the north side. The dike embankment is approximately 10 to 20 feet in height and according to records and survey information; the embankment is constructed of locally sourced silty clays. The impoundment has a surface area of approximately 110 acres. Pond 003 was constructed for the purpose of storing and managing CCR, coal pile runoff, and plant process water.

Haley & Aldrich conducted an initial safety factor assessment for Pond 003 in October 2016 (see **Appendix B**). The results of that assessment indicated that the calculated factors of safety met the requirements of Section §257.73(e) of the CCR Rule. In accordance with Section §257.73(f)(3) of the CCR Rule, periodic safety factor assessments are required every five years. This report presents the results of our 2021 periodic safety factor assessment for Pond 003.

To achieve the objective discussed above, the scope of work undertaken for this assessment included the tasks listed below.

- Reviewing existing information and prior analyses to determine appropriate updates to the 2016 safety factor assessment.

- Performing engineering evaluations related to slope stability and liquefaction.

- Preparing and submitting this report presenting the results of our periodic safety factor assessment.

Safety Factor Assessment

REVIEW OF EXISTING INFORMATION AND METHODOLOGY

Since an initial assessment was conducted by Haley & Aldrich in 2016, the focus of this periodic assessment was to determine what updates to the analyses performed in 2016 were appropriate. This evaluation involved reviewing the following:

- changes to operating conditions;
- surface topography and impoundment geometry;
- subsurface soil and water conditions;
- seismic conditions (PGA, liquefaction, etc.);
- observed distress; and
- analysis methodology.

The 2016 Initial Safety Factor Assessment identified two critical cross (DD and EE) sections at Pond 003. These two cross sections were selected for evaluation based on the following conditions:

a. the geometry of the upstream and downstream slopes;
b. phreatic surface levels within and below the cross sections;
c. subsurface soil conditions
d. presence or lack of surcharges behind the crest of the dikes; and
e. presence or lack of reinforcing measures in front of the dikes.

After a review of the impoundment in its current state, it was determined that cross sections DD and EE were still the appropriate locations for this periodic safety factor assessment evaluation. Based on our review of the items mentioned above, we identified several updates to the stability analyses that were appropriate as summarized below. The updates were applied to both cross sections at Pond 003 unless stated otherwise.

1. Static-Drained-Maximum Storage Analysis:
    a. Analyses were performed using an updated version of slope stability software by Rocscience (Slide2).
    b. Search limits, which are used in slope stability analyses to identify the limits where failure surfaces initiate and terminate, were updated to better capture all potential failure surfaces.
    c. Material strength and unit weight properties were updated based on a review of additional sitewide subsurface explorations and laboratory testing that were performed after 2016. The recent sitewide data, including test borings, CPTs, and laboratory results, was compared to the 2016 soil properties. As a result of that review, minor updates were made to material strengths and unit weight properties to take site variability into account. See **Appendix A** for a comparison of properties used in the 2016 analyses and the updated 2021 analyses. See **Appendix D** for a compilation of the supplemental subsurface information. Supplemental Subsurface explorations are shown on **Figure 1**.
    d. Slope stability models were updated to remove cohesion below the water table, which is consistent with Haley & Aldrich's current methodology for analyzing slope stability. The removal of cohesion below water is a conservative, but warranted approach since soil strength due to cohesion can be lower in saturated conditions than non-saturated conditions.
    e. To evaluate active operations and material management operations, the surface geometry of the impounded material at cross section DD was modified to represent temporary CCR stacking conditions as they currently exist on the east side of Pond 003. It is our understanding that temporarily stacked CCR is being kept a minimum flat offset distance of 150 ft west of the inside crest of the east embankment and is being stacked no higher than El. 325.

2. Static-Drained-Maximum Surcharge Analysis:
    a. Analyses were performed using an updated version of slope stability software by Rocscience (Slide2).
    b. Search limits, which are used in slope stability analyses to identify the limits where failure surfaces initiate and terminate, were updated to better capture all potential failure surfaces.
    c. In 2016, the maximum surcharge analyses were performed using undrained (total) strengths for cohesive soils, which is consistent with the approaches used by Federal Energy Regulatory Commission (FERC) and the U.S. Bureau of Reclamation (USBR). Haley & Aldrich's methodology has been subsequently updated to use drained (effective) strengths for cohesive soils for the maximum surcharge analyses, which is consistent with current guidance by the U.S. Army Corps of Engineers Manual EM 1110-2-1902 . Accordingly, the strength of all cohesive soils (Levee Fill, Embankment Fill, Impounded CCR, and Alluvial Clay) was updated to incorporate drained (effective) strengths .

   d. Material strength and unit weight properties were updated based on a review of additional sitewide subsurface explorations and laboratory testing that were performed after 2016. The recent sitewide data, including test borings, CPTs, and laboratory results, was compared to the 2016 soil properties. As a result of that review, minor updates were made to material strengths and unit weight properties to take site variability into account. See **Appendix A** for a comparison of properties used in the 2016 analyses and the updated 2021 analyses. See **Appendix D** for a compilation of the supplemental subsurface information. Supplemental Subsurface explorations are shown on **Figure 1**.
   e. Slope stability models were updated to remove cohesion below the water table, which is consistent with Haley & Aldrich's current methodology for analyzing slope stability. The removal of cohesion below water is a conservative, but warranted approach since soil strength due to cohesion can be lower in saturated conditions than non-saturated conditions.
   f. To evaluate active operations and material management operations, the surface geometry of the impounded material at cross section DD was modified to represent temporary CCR stacking conditions as they currently exist on the east side of Pond 003. It is our understanding that temporarily stacked CCR is being kept a minimum flat offset distance of 150 ft west of the inside crest of the east embankment and is being stacked no higher than El. 325.

3. <u>Pseudo-static-Undrained-Maximum Surcharge Analysis:</u>
   a. Analyses were performed using an updated version of slope stability software by Rocscience (Slide2).
   b. Search limits, which are used in slope stability analyses to identify the limits where failure surfaces initiate and terminate, were updated at cross section EE to better capture all potential failure surfaces.
   c. Material strength and unit weight properties were updated based on a review of additional sitewide subsurface explorations and laboratory testing that were performed after 2016. The recent sitewide data, including test borings, CPTs, and laboratory results, was compared to the 2016 soil properties. As a result of that review, minor updates were made to material strengths and unit weight properties to take site variability into account. See **Appendix A** for a comparison of properties used in the 2016 analyses and the updated 2021 analyses. See **Appendix D** for a compilation of the supplemental subsurface information. Supplemental Subsurface explorations are shown on **Figure 1**.
   d. In 2016, our analysis was performed by reducing all material strengths by 20%. Subsequent to 2016, Haley & Aldrich's methodology was updated such that the 20% reduction in soil strength is only applied to saturated cohesive soils. This change is based on a better understanding of modeling the threshold between large and small strains induced by cyclic loading (Duncan, 2014).
   e. In our 2016 Safety Factor Assessment Report, the most recent published USGS data was from 2008. The currently published USGS data is from 2014. Accordingly, an updated site-specific seismic response analyses was performed by Childs Engineering in April

2020 that considered more recently published 2014 USGS earthquake hazard data. In addition, the analysis was updated to incorporate the use of the unform hazard spectrum rather than the condition mean spectrum that was used in the 2016 analysis. The Childs Engineering report is included in **Appendix C**. Using the results of the updated site-specific seismic response analysis, the pseudo-static coefficient was updated from 0.28g to 0.21g. The yield acceleration plot for this analysis is included in **Appendix A**. *Note that te 2020 Childs Engineering report supersedes the discussion of the site specific response analysis on pages 10 through 16 of the 2016 Report on Safety Factor Assessment.*

f. To evaluate active operations and material management operations, the surface geometry of the impounded material at cross section DD was modified to represent temporary CCR stacking conditions as they currently exist on the east side of Pond 003. It is our understanding that temporarily stacked CCR is being kept a minimum flat offset distance of 150 ft west of the inside crest of the east embankment and is being stacked no higher than El. 325.

STABILITY ANALYSES

With the exception of the items mentioned above, the design surcharge and storage pool levels, critical cross section location (see **Figure 1**), liquefaction evaluation, and methodology for stability analyses used to perform the initial safety factor assessment in 2016 were determined to remain valid and still applicable for this periodic assessment.

As shown in **Table I**, the static safety factors are above the minimum required values for the same critical cross sections evaluated in 2016. Similarly, the pseudo-static analysis for the analyzed section indicates acceptable seismic safety factors. The results of the analyses that include these identified updates are included in **Appendix A**.

TABLE I
SUMMARY OF STATIC AND SEISMIC STABILITY EVALUATIONS

Pond	Cross Section	Condition	Earthquake Event	Soil Strength[1]	Water Level	Required Safety Factor[2]	2016 SFA Calculated Safety Factor	2021 Calculated Safety Factor
Pond 003	D-D’	Static	-	Drained	Maximum Storage	1.50	2.32	2.31
				Drained	Maximum Surcharge	1.40	4.96	2.31
		Seismic	2,500-year	Undrained[3]	Maximum Storage	1.00	1.18	1.29
Pond 003	E-E’	Static	-	Drained	Maximum Storage	1.50	3.05	2.91
				Drained	Maximum Surcharge	1.40	4.06	2.91
		Seismic	2,500-year	Undrained	Maximum Storage	1.00	1.06	1.31

1. Refer to **Appendix A** for material properties.
2. The calculated safety factor must equal or exceed the required safety factor.
3. The strength of saturated cohesive soil has been reduced by 20 percent for seismic analyses to account for the approximate threshold between large and small strains induced by cyclic loading.

Conclusions

The analyses associated with this periodic safety factor assessment have been performed in accordance with the requirement of Section §257.73(e) of the CCR Rule. A summary of our conclusions as they relate to the rule requirements are provided below.

- §257.73(e)(1)(i) - *The calculated static factor of safety under the long-term, maximum storage pool loading conditions must equal or exceed 1.50.*

  As shown in **Table I**, the static safety factors for the long-term (drained) maximum storage pool condition are above the minimum required value for the critical section analyzed. Accordingly, this requirement has been met.

- §257.73(e)(1)(ii) - *The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.*

  As shown in **Table I**, the static safety factors for the maximum surcharge pool loading condition (drained) are above the minimum required value for the critical section analyzed. Accordingly, this requirement has been met.

- §257.73(e)(1)(iii) - *The calculated seismic factor of safety must equal or exceed 1.00.*

  As shown in **Table I**, the calculated seismic safety factor is above the minimum required value for the critical section analyzed. Accordingly, this requirement has been met.

- §257.73(e)(1)(iv) - *For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.*

  The results of previous subsurface investigations indicate that the dikes at the Pond 003 are primarily constructed of clay soils that are not susceptible to liquefaction. Accordingly, this requirement has been met.

We appreciate the opportunity to provide engineering services on this project. Please do not hesitate to call if you have any questions or comments.

Sincerely yours,
HALEY & ALDRICH, INC.

Derrick A. Shelton
Geotechnical Program Manager | Senior Associate

Steven F. Putrich, P.E,
Principal

Enclosures:
Figure 1 – Subsurface Exploration Location Plan
Figure 2 – Sitewide Subsurface Exploration Location Plan
Appendix A – 2021 Updated Analyses
Appendix B – 2016 Report on Safety Factor Assessment
Appendix C – 2020 Site Specific Seismic Response Analysis
Appendix D – Supplemental Subsurface Information

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Certification

Based on our review of the information provided to us by AECI and the results of our analyses, it is our opinion that the calculated factors of safety for the critical cross section of the impoundment embankment meet the minimum factors of safety specified in §257.73(e)(1)(i) through (iv) of the EPA's CCR Rule.

Certification Statement

I certify that the Periodic Safety Factor Assessment for Pond 003 at the New Madrid Power Plant meets the requirements of §257.73(e) of the EPA's CCR Rule.

Signed: ______________________________________
Consulting Engineer

Print Name: Steven F. Putrich
Missouri License No.: 2014035813
Title: Principal
Company: Haley & Aldrich, Inc.

Professional Engineer's Seal:

STEVEN F.
PUTRICH
NUMBER
PE-2014035813

10/15/2021

Steven F. Putrich
Digitally signed by Steven F. Putrich
Date: 2021.10.15 14:04:09 -04'00'

References

1. Childs Engineering (April 2020). "New Madrid Power Plant Seismic Response and Newmark Analysis".

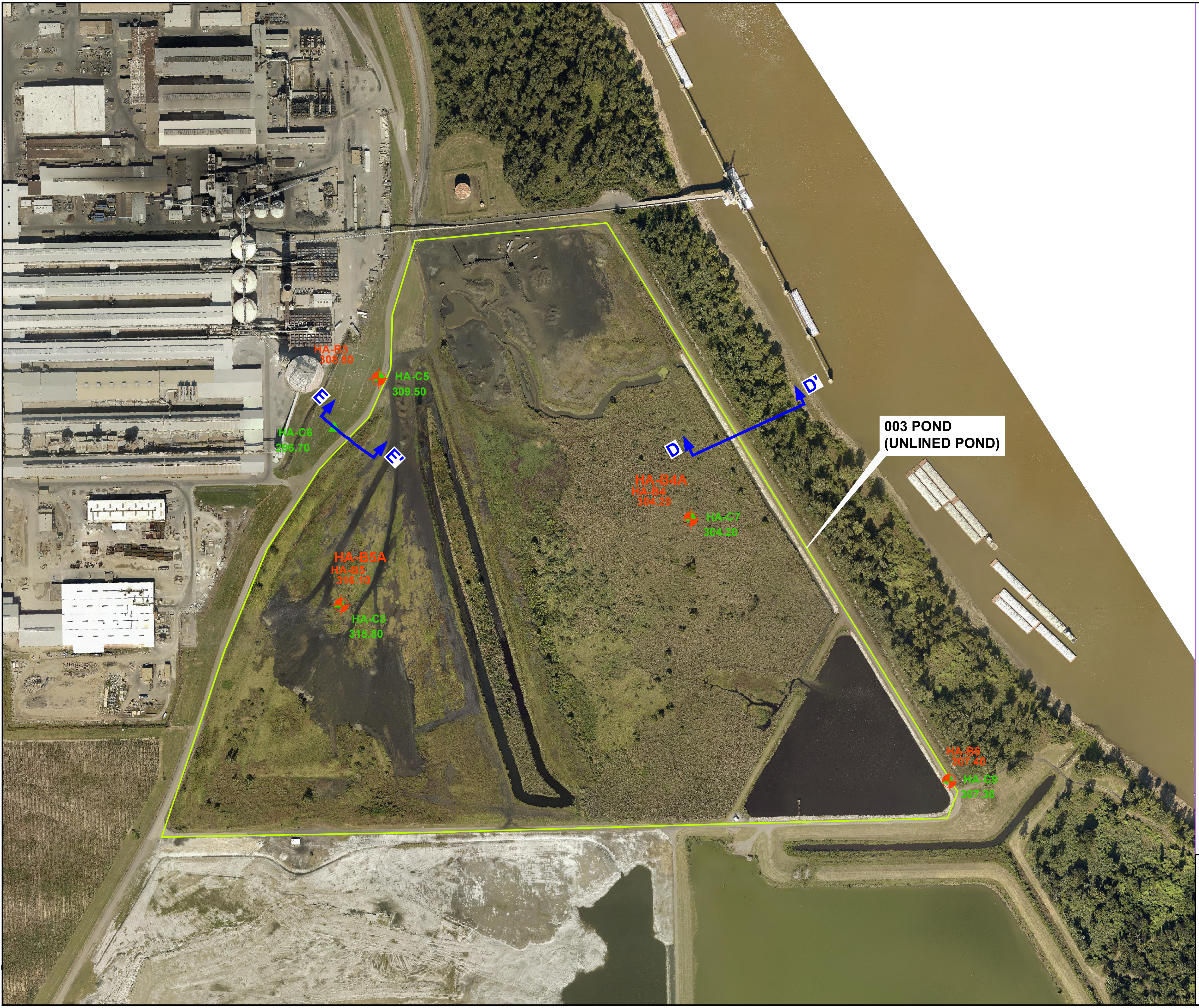
2. Environmental Protection Agency, (2015). Code of Federal Regulations, "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule, "Title 40, Chapter I, Parts 257 and 261, April 17.

3. Haley & Aldrich, Inc. (April 2018). "Report on Initial Safety Factor Assessment, Inactive Lined Pond, New Madrid Power Plant, New Madrid, Missouri".

4. Haley & Aldrich, Inc. (October 2016). "Report on Safety Factor Assessment Pond 003 and Pond 004, New Madrid Power Plant, Marston, Missouri".

FIGURES

KRAKORA, MATTHEW Printed: 9/17/2021 10:40 AM Layout: XS LOC
G:\40616_AECI-CCR ELG MANAGEMENT SUPPORT\CAD-NMPONDS\FIGURES\EXPLORATION\40616-300_FIG-2_EXPLORATION LOCATION PLAN V2.DWG



LEGEND

HA-B3 308.8	DESIGNATION, LOCATION AND GROUND SURFACE ELEVATION OF TEST BORINGS PERFORMED BY BULLDOG DRILLING, INC. OF DUPO, ILLINOIS DURING THE PERIOD 14 SEPTEMBER 2015 TO 22 SEPTEMBER 2015. DESIGNATIONS THAT INCLUDE AN "A" CORRESPOND TO OFFSET BORINGS PERFORMED IMMEDIATELY ADJACENT TO THE ORIGINAL BORING.
A ▲ HA-C6 296.7	DESIGNATION, LOCATION AND GROUND SURFACE ELEVATION OF CONE PENETROMETER SOUNDINGS PERFORMED BY CONETEC, INC. OF WEST BERLIN, NEW JERSEY DURING THE PERIOD 15 SEPTEMBER 2015 TO 17 SEPTEMBER 2015.
A A'	LOCATION OF SLOPE STABILITY CROSS SECTION
—	APPROXIMATE POND EXTENT

NOTES

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM AN AERIAL IMAGE PROVIDED BY AECI THAT WAS CONDUCTED BY PICTOMETRY INTERNATIONAL CORP BETWEEN OCTOBER 4-8, 2014.
2. ELEVATIONS INDICATED ON THIS DRAWING ARE IN FEET AND REFER TO NAVD 1988 DATUM. HORIZONTAL CONTROL IS BASED ON MISSOURI STATE PLANE COORDINATE SYSTEM - EAST ZONE.
3. TECHNICAL MONITORING OF TEST BORINGS AND CONE PENETROMETER SOUNDINGS COMPLETED DURING THE PERIOD 14 SEPTEMBER 2015 TO 22 SEPTEMBER 2015 WAS PERFORMED BY HALEY & ALDRICH, INC.
4. AS DRILLED LOCATIONS AND GROUND SURFACE ELEVATIONS OF TEST BORINGS AND CONE PENETROMETER SOUNDINGS WERE DETERMINED IN THE FIELD BY SMITH & COMPANY ENGINEERS OF POPLAR BLUFF, MISSOURI BY OPTICAL SURVEY.

N

0 400 800
SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
POND 003
MARSTON, MO

SUBSURFACE EXPLORATION LOCATION PLAN

SCALE: AS SHOWN
SEPTEMBER 2021

FIGURE 1

LEGEND

🟩	APPROXIMATE LIMIT OF CCR UNIT
HA-B10 ●	DESIGNATION AND LOCATION OF TEST BORING
HA-C12 ●	DESIGNATION AND LOCATION OF CONE PENETROMETER SOUNDING

NOTES:

1. BACKGROUND IMAGE IS DATED 2 AUGUST 2014 FROM ESRI GIS.

N

0 800 1600
SCALE IN FEET

HALEY ALDRICH

AECI, NEW MADRID POWER PLANT
MARSTON, MISSOURI

SITEWIDE SUBSURFACE EXPLORATION LOCATION PLAN

SCALE: AS SHOWN
SEPTEMBER 2021

FIGURE 2

KRAKORA, MATTHEW Printed: 9/22/2021 4:47 PM Layout: FIG 2
G:\129342_AECI-NMPP\CAD\LINED POND\FIGURES\129342_FIG 2_LINED POND.DWG

APPENDIX A

2021 Updated Analyses

Design Soil Properties

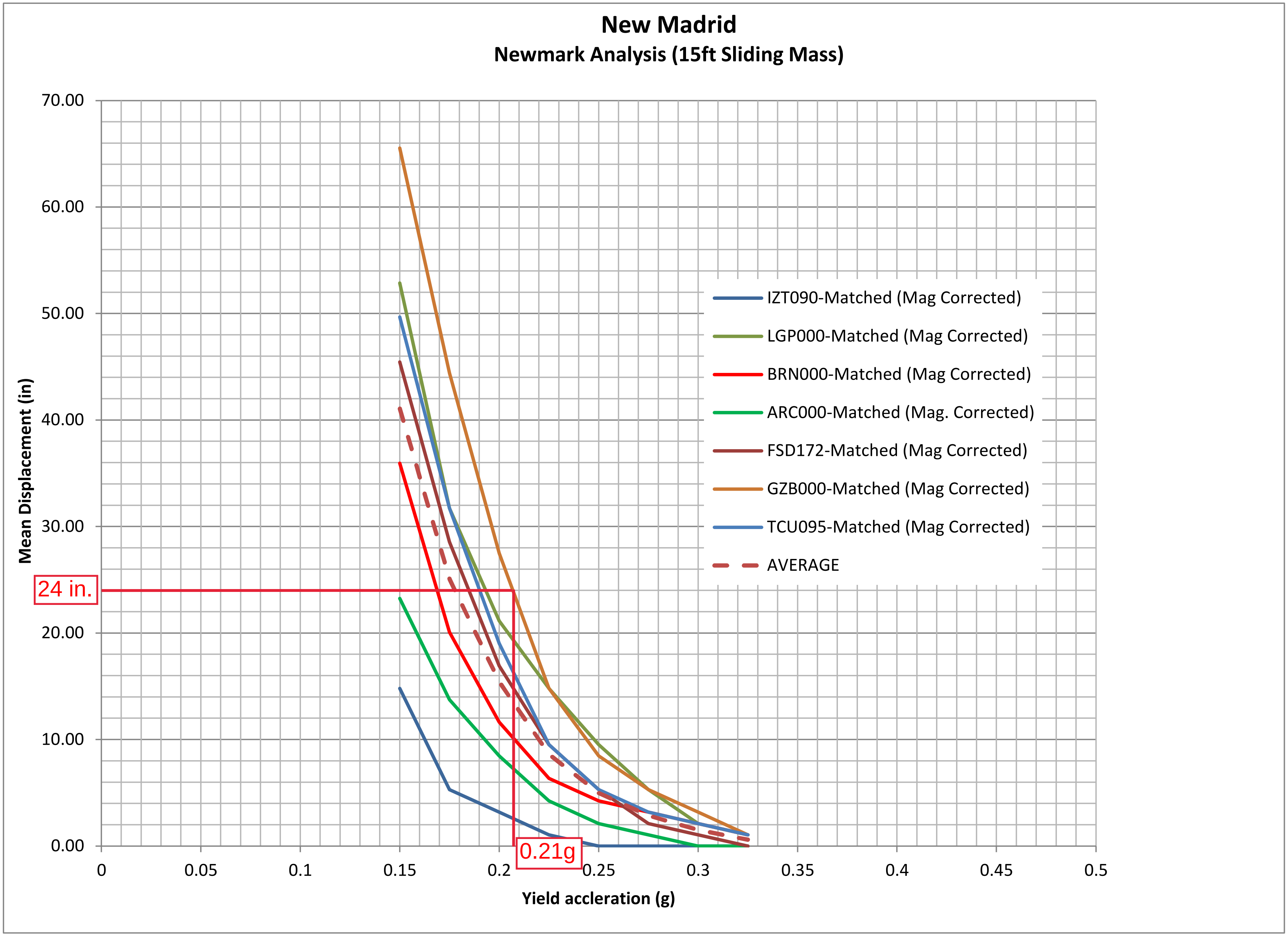
SOIL PROPERTY CHARACTERIZATION - AECI NMPP POND 003

Material	Location	Total Unit Weight, γ_T				Undrained Shear Strength								Drained Shear Strength										
		CPT	Laboratory[2]	H&A 2016 Stability Evaluation	Current Design	SPT		CPT[3]		UU Triaxial[2]	CU Triaxial[2]	H&A 2016 Stability Evaluation	Current Design	SPT		CPT[4,5]			Laboratory CIU Trx or Direct Shear[2]		H&A 2016 Stability Evaluation		Current Design	
		avg	Test Avg.			avg	avg - 1σ	avg	avg - 1σ	avg				avg	avg - 1σ	avg	avg - 1σ	c' avg	avg					
		γ_T	γ_T	γ_T	γ_T	S_u	S_u	S_u	S_u	S_u		S_u	S_u	ϕ'	ϕ'	ϕ'	ϕ'		c'	ϕ'	c'	ϕ'	c'	ϕ'
Impounded CCR	Pond 003 Only	101 pcf	107 pcf	90 to 110 pcf	**100 pcf**	--	--	1,173 psf	326 psf	600 psf	N/A	500 to 800 psf	**S_u/p' = 0.30 min = 500 psf**	30°	28°	27°	23°		--	--	0 psf	28 to 30°	**0 psf**	**28°**
	Sitewide[1]	112 pcf	N/A			--	--	1,199 psf	344 psf	N/A	S_u/p' = 0.30			32°	29°	29°	24°		90 (remolded)	40 (remolded)				
Cohesive Embankment Fill (Levee)	Pond 003 Only	115 pcf	--	115 pcf	**115 pcf**	1,169 psf	436 psf	1,160 psf	679 psf	--	N/A	800 psf	**800 psf**	--	--	21°	15°	122 psf	--	--	50 psf	30°	**120 psf**	**21°**
	Sitewide[1]	117 pcf	117 pcf			1,301 psf	714 psf	2,840 psf	1,160 psf	--	S_u/p' = 0.27			--	--	25°	20°	326 psf	380 psf	14°				
Cohesive Embankment Fill (Non-Levee)	Pond 003 Only	117 pcf	--	115 pcf	**125 pcf**	2,155 psf	1,601 psf	4,728 psf	3,725 psf	--	N/A	800 psf	**S_u/p' = 0.39 min = 1,000 psf**	--	--	33°	28°	104 psf	0 psf	36°	50 psf	30°	**50 psf**	**30°**
	Sitewide[1]	116 pcf	129 pcf			1,552 psf	937 psf	3,612 psf	763 psf	--	S_u/p' = 0.39			--	--	30°	24°	465 psf	343 psf	30°				
General Fill	Pond 003 Only	116 pcf	--	115 pcf	**115 pcf**	1,197 psf	1,197 psf	864 psf	603 psf	--	--	800 psf	**800 psf**	--	--	23°	19°	234 psf	--	--	50 psf	30°	**50 psf**	**30°**
	Sitewide[1]	N/A	--			N/A	N/A	N/A	N/A	--	--			--	--	N/A	N/A	N/A	--	--				
Alluvial Deposits (cohesive)	Pond 003 Only	114 pcf	--	110 pcf	**120 pcf**	1,466 psf	219 psf	2,217 psf	720 psf	N/A	N/A	1,300 psf	**S_u/p' = 0.50 min = 1,000 psf**	--	--	27°	22°	384 psf	--	--	50 psf	28°	**50 psf**	**28°**
	Sitewide[1]	115 pcf	120 pcf			1,043 psf	229 psf	3,472 psf	880 psf	2,400 psf	S_u/p' = 0.50			--	--	27°	22°	564 psf	120 psf	33°				
Alluvial Deposits (granular)	Pond 003 Only	122 pcf	--	108 pcf	**120 pcf**	--	--	--	--	--	--	0 psf	**N/A**	33°	32°	40°	38°	--	--	--	0 psf	36°	**0 psf**	**36°**
	Sitewide[1]	121 pcf	--			--	--	--	--	--	--			35°	33°	37°	35°	--	--	--				
Fluvial Deposits	Pond 003 Only	125 pcf	--	120 pcf	**125 pcf**	--	--	--	--	--	--	0 psf	**N/A**	35°	34°	41°	40°	--	--	--	0 psf	38°	**0 psf**	**38°**
	Sitewide[1]	124 pcf	--			--	--	--	--	--	--			36°	34°	41°	39°	--	--	--				

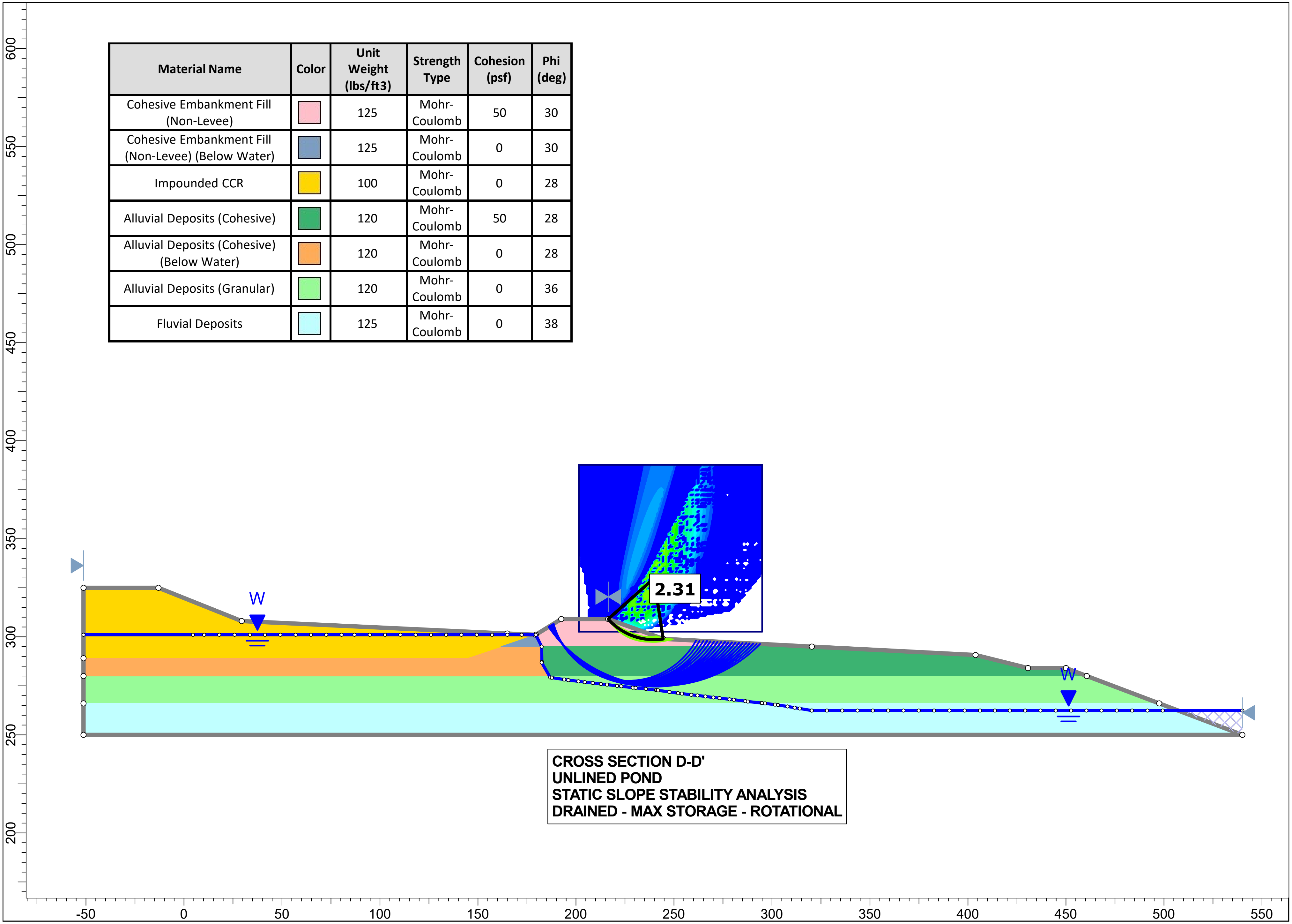
Notes:

1. Sitewide properties take into consideration subsurface investigations performed in 2009, 2015, 2017, and 2021.
2. Laboratory values shown represent Haley & Aldrich's interpretation of the laboratory test results and may differ from the results reported by the laboratory.
3. Undrained shear strength correlations from CPT data are based on a N_{kt} factor of 15.
4. CPT effective friction angle for cohesive materials is based on the NTNU method (Mayne and Campanella, 2005). CPT effecitve friction angle for granular materials is based on Kulhawy and Mayne (2014).
5. CPT effective cohesion based on Mayne and Stuart (1988), c'/σ_p' = 0.045.

Newmark Displacement Curve

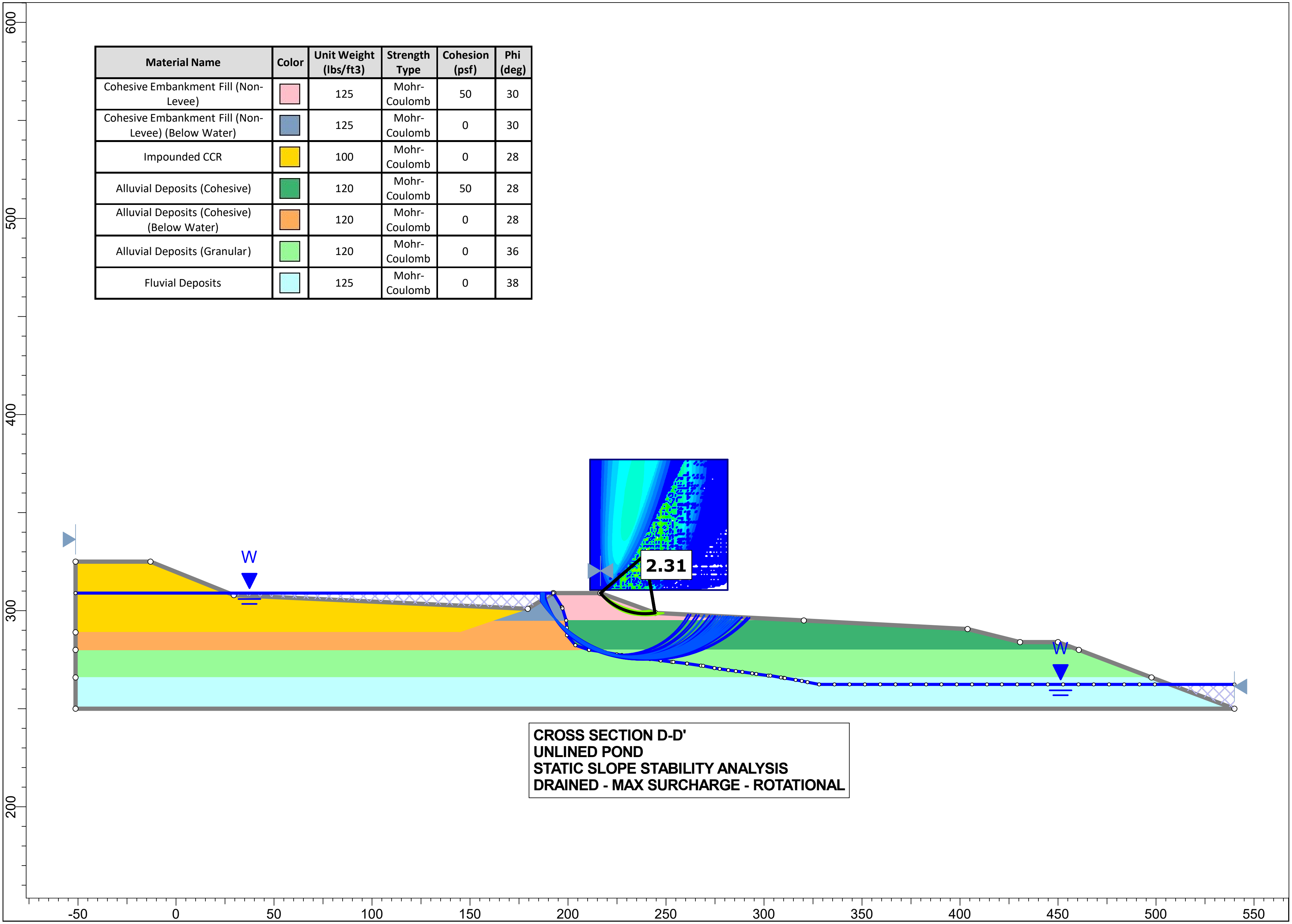

New Madrid
Newmark Analysis (15ft Sliding Mass)
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Mean Displacement (in)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Yield accleration (g)
IZT090-Matched (Mag Corrected)
LGP000-Matched (Mag Corrected)
BRN000-Matched (Mag Corrected)
ARC000-Matched (Mag. Corrected)
FSD172-Matched (Mag Corrected)
GZB000-Matched (Mag Corrected)
TCU095-Matched (Mag Corrected)
AVERAGE
24 in.
0.21g

Slope Stability



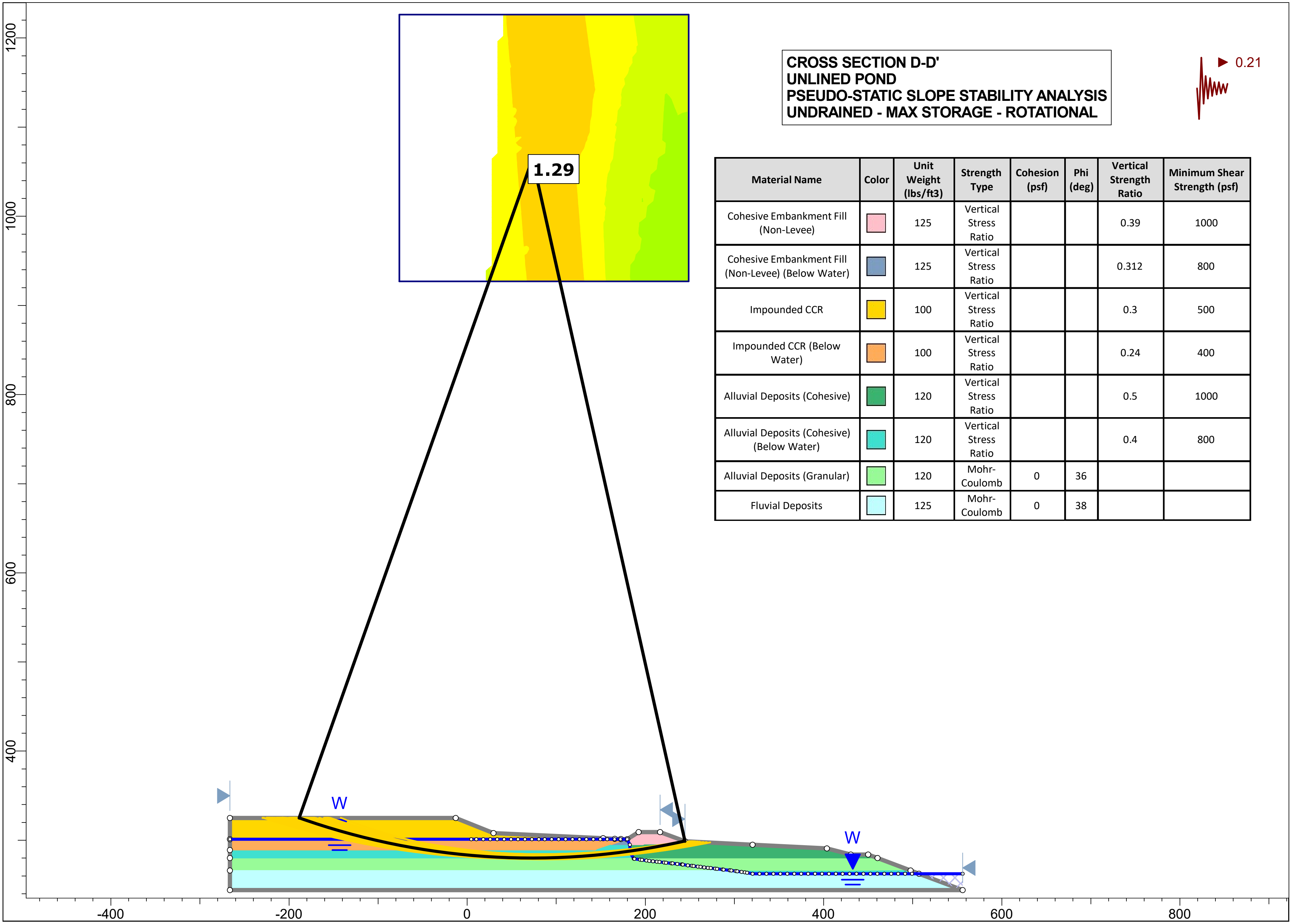
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Cohesive Embankment Fill (Non-Levee)	🟥	125	Mohr-Coulomb	50	30
Cohesive Embankment Fill (Non-Levee) (Below Water)	🟦	125	Mohr-Coulomb	0	30
Impounded CCR	🟨	100	Mohr-Coulomb	0	28
Alluvial Deposits (Cohesive)	🟩	120	Mohr-Coulomb	50	28
Alluvial Deposits (Cohesive) (Below Water)	🟧	120	Mohr-Coulomb	0	28
Alluvial Deposits (Granular)	🟩	120	Mohr-Coulomb	0	36
Fluvial Deposits	🟦	125	Mohr-Coulomb	0	38

CROSS SECTION D-D'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
DRAINED - MAX STORAGE - ROTATIONAL



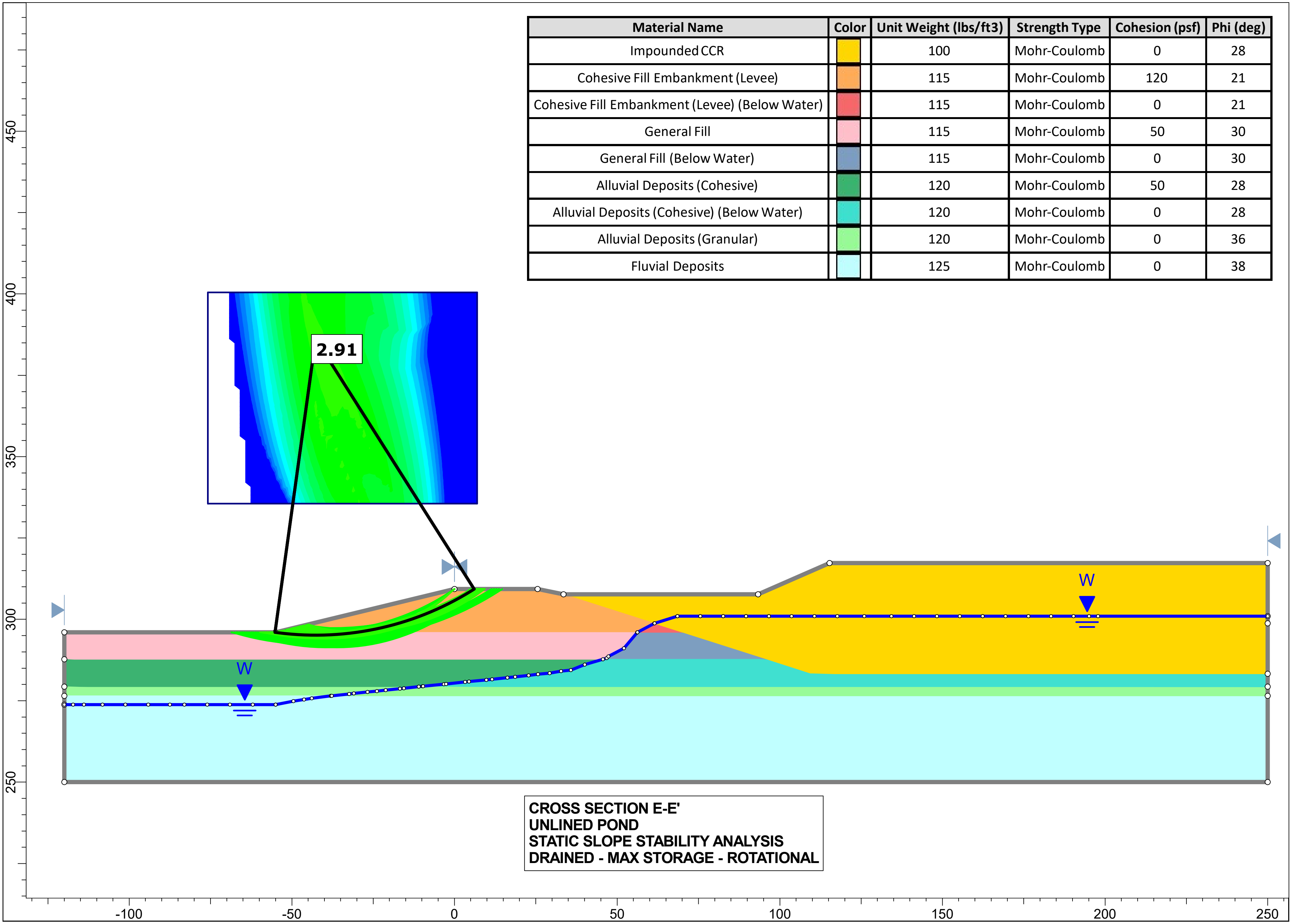
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Cohesive Embankment Fill (Non-Levee)	🟥	125	Mohr-Coulomb	50	30
Cohesive Embankment Fill (Non-Levee) (Below Water)	🟦	125	Mohr-Coulomb	0	30
Impounded CCR	🟨	100	Mohr-Coulomb	0	28
Alluvial Deposits (Cohesive)	🟩	120	Mohr-Coulomb	50	28
Alluvial Deposits (Cohesive) (Below Water)	🟧	120	Mohr-Coulomb	0	28
Alluvial Deposits (Granular)	🟩	120	Mohr-Coulomb	0	36
Fluvial Deposits	🟦	125	Mohr-Coulomb	0	38

CROSS SECTION D-D'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
DRAINED - MAX SURCHARGE - ROTATIONAL



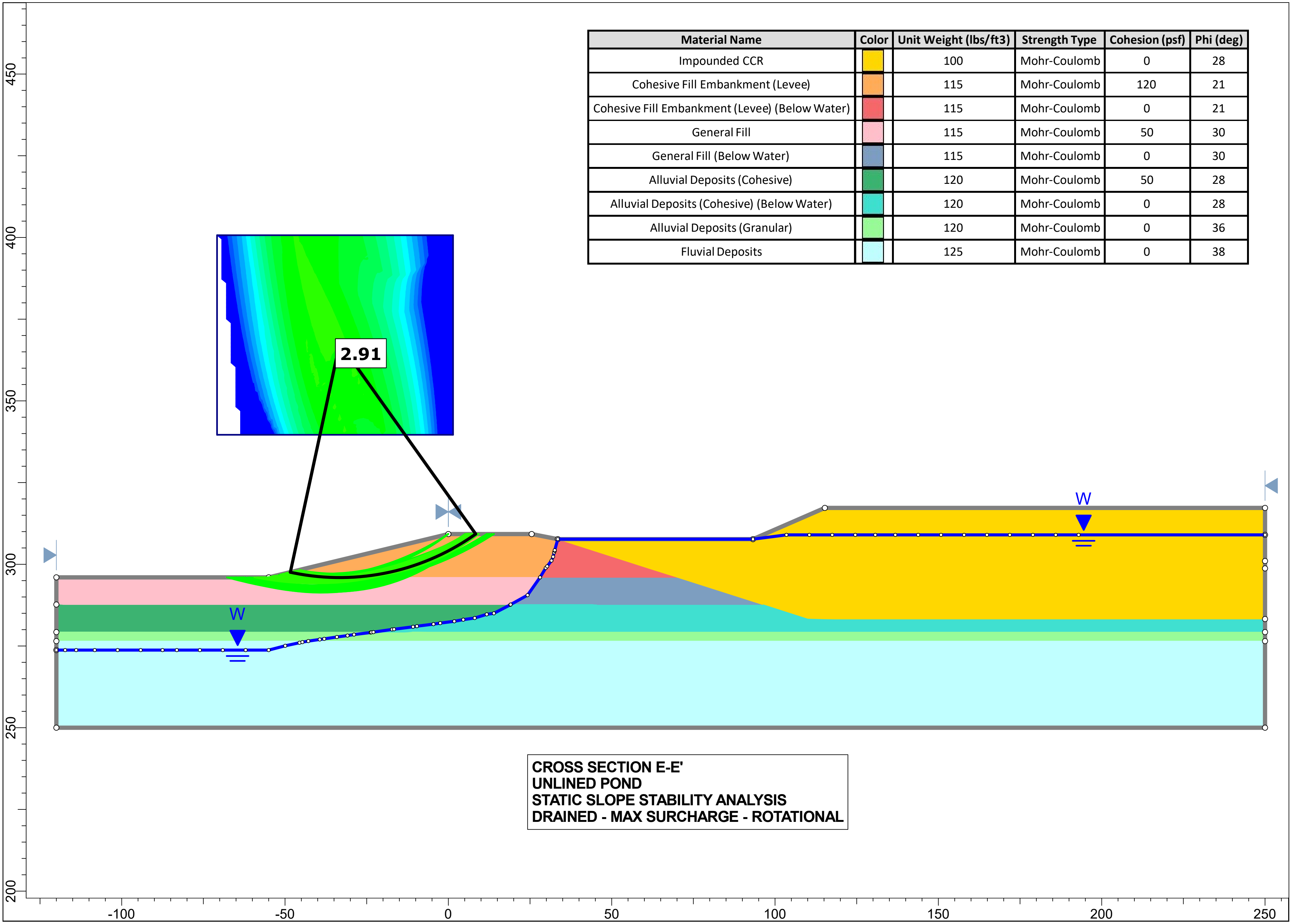
CROSS SECTION D-D'
UNLINED POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
UNDRAINED - MAX STORAGE - ROTATIONAL

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Cohesive Embankment Fill (Non-Levee)	🟥	125	Vertical Stress Ratio			0.39	1000
Cohesive Embankment Fill (Non-Levee) (Below Water)	🟦	125	Vertical Stress Ratio			0.312	800
Impounded CCR	🟨	100	Vertical Stress Ratio			0.3	500
Impounded CCR (Below Water)	🟧	100	Vertical Stress Ratio			0.24	400
Alluvial Deposits (Cohesive)	🟩	120	Vertical Stress Ratio			0.5	1000
Alluvial Deposits (Cohesive) (Below Water)	🟦	120	Vertical Stress Ratio			0.4	800
Alluvial Deposits (Granular)	🟩	120	Mohr-Coulomb	0	36		
Fluvial Deposits	⬜	125	Mohr-Coulomb	0	38		



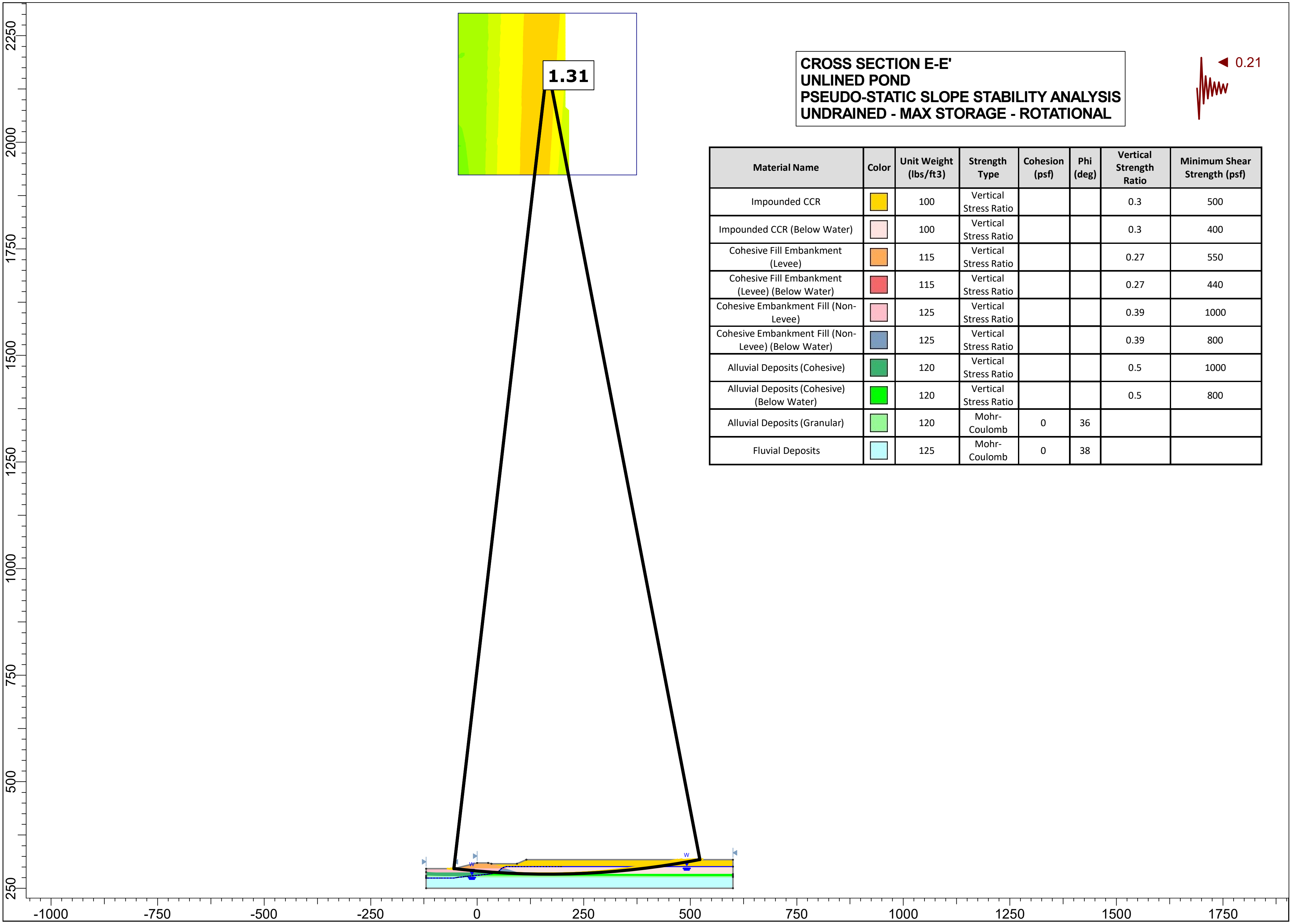
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Impounded CCR	🟨	100	Mohr-Coulomb	0	28
Cohesive Fill Embankment (Levee)	🟧	115	Mohr-Coulomb	120	21
Cohesive Fill Embankment (Levee) (Below Water)	🟥	115	Mohr-Coulomb	0	21
General Fill	▨	115	Mohr-Coulomb	50	30
General Fill (Below Water)	🟦	115	Mohr-Coulomb	0	30
Alluvial Deposits (Cohesive)	🟩	120	Mohr-Coulomb	50	28
Alluvial Deposits (Cohesive) (Below Water)	🟦	120	Mohr-Coulomb	0	28
Alluvial Deposits (Granular)	🟩	120	Mohr-Coulomb	0	36
Fluvial Deposits	🟦	125	Mohr-Coulomb	0	38

CROSS SECTION E-E'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
DRAINED - MAX STORAGE - ROTATIONAL



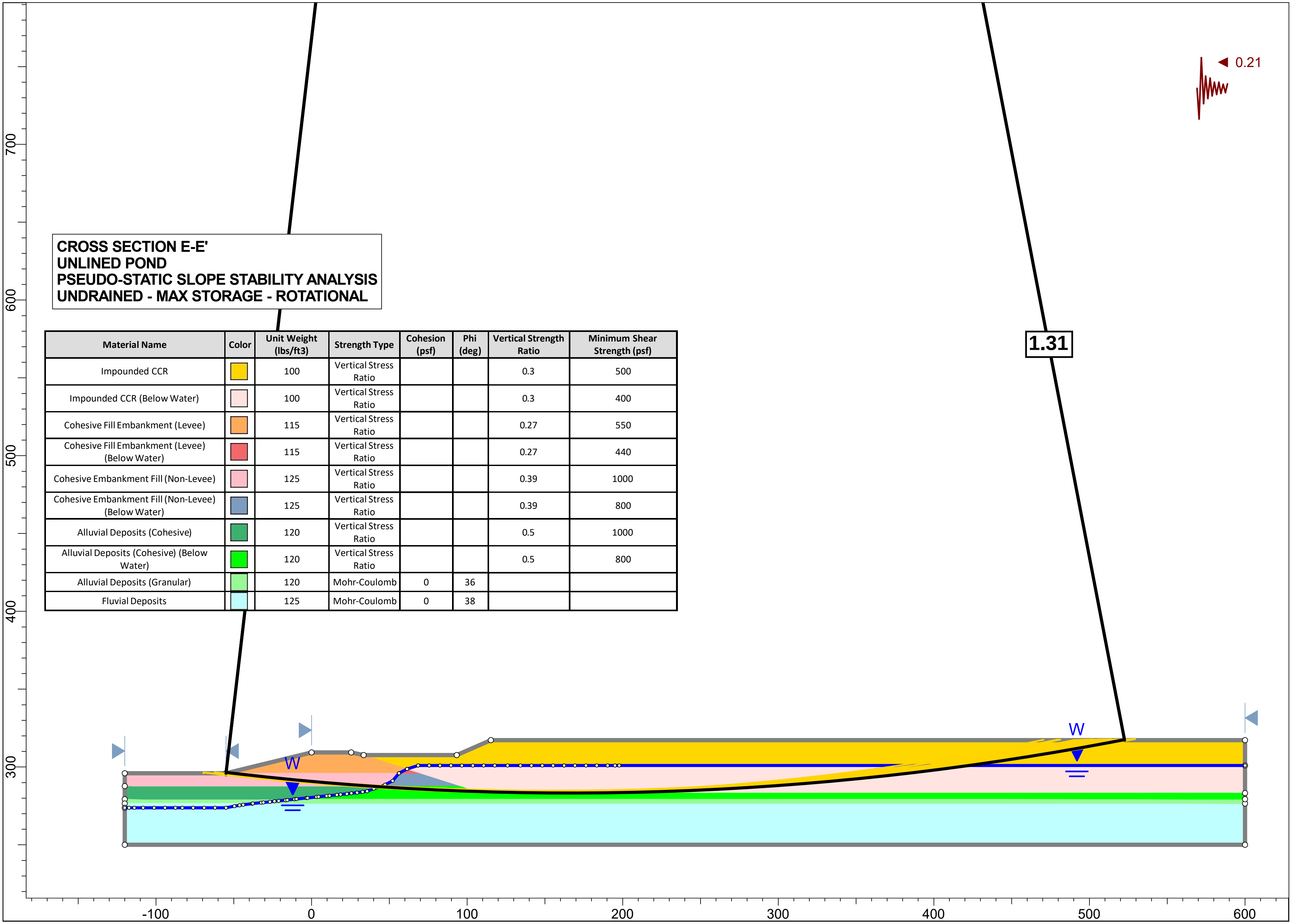
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Impounded CCR	🟨	100	Mohr-Coulomb	0	28
Cohesive Fill Embankment (Levee)	🟧	115	Mohr-Coulomb	120	21
Cohesive Fill Embankment (Levee) (Below Water)	🟥	115	Mohr-Coulomb	0	21
General Fill	🟪	115	Mohr-Coulomb	50	30
General Fill (Below Water)	🟦	115	Mohr-Coulomb	0	30
Alluvial Deposits (Cohesive)	🟩	120	Mohr-Coulomb	50	28
Alluvial Deposits (Cohesive) (Below Water)	🟦	120	Mohr-Coulomb	0	28
Alluvial Deposits (Granular)	🟩	120	Mohr-Coulomb	0	36
Fluvial Deposits	⬜	125	Mohr-Coulomb	0	38

CROSS SECTION E-E'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
DRAINED - MAX SURCHARGE - ROTATIONAL



CROSS SECTION E-E'
UNLINED POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
UNDRAINED - MAX STORAGE - ROTATIONAL

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Impounded CCR	🟨	100	Vertical Stress Ratio			0.3	500
Impounded CCR (Below Water)	⬜	100	Vertical Stress Ratio			0.3	400
Cohesive Fill Embankment (Levee)	🟧	115	Vertical Stress Ratio			0.27	550
Cohesive Fill Embankment (Levee) (Below Water)	🟥	115	Vertical Stress Ratio			0.27	440
Cohesive Embankment Fill (Non-Levee)	⬜	125	Vertical Stress Ratio			0.39	1000
Cohesive Embankment Fill (Non-Levee) (Below Water)	🟦	125	Vertical Stress Ratio			0.39	800
Alluvial Deposits (Cohesive)	🟩	120	Vertical Stress Ratio			0.5	1000
Alluvial Deposits (Cohesive) (Below Water)	🟩	120	Vertical Stress Ratio			0.5	800
Alluvial Deposits (Granular)	🟩	120	Mohr-Coulomb	0	36		
Fluvial Deposits	🟦	125	Mohr-Coulomb	0	38		



CROSS SECTION E-E'
UNLINED POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
UNDRAINED - MAX STORAGE - ROTATIONAL

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Impounded CCR	🟨	100	Vertical Stress Ratio			0.3	500
Impounded CCR (Below Water)	⬜	100	Vertical Stress Ratio			0.3	400
Cohesive Fill Embankment (Levee)	🟧	115	Vertical Stress Ratio			0.27	550
Cohesive Fill Embankment (Levee) (Below Water)	🟥	115	Vertical Stress Ratio			0.27	440
Cohesive Embankment Fill (Non-Levee)	🟪	125	Vertical Stress Ratio			0.39	1000
Cohesive Embankment Fill (Non-Levee) (Below Water)	🟦	125	Vertical Stress Ratio			0.39	800
Alluvial Deposits (Cohesive)	🟩	120	Vertical Stress Ratio			0.5	1000
Alluvial Deposits (Cohesive) (Below Water)	🟩	120	Vertical Stress Ratio			0.5	800
Alluvial Deposits (Granular)	🟩	120	Mohr-Coulomb	0	36		
Fluvial Deposits	🟦	125	Mohr-Coulomb	0	38		

APPENDIX B

2016 Report on Safety Factor Assessment

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REPORT ON
SAFETY FACTOR ASSESSMENT
POND 003 AND POND 004
NEW MADRID POWER PLANT
NEW MADRID, MISSOURI

by Haley & Aldrich, Inc.
Cleveland, Ohio

for Associated Electric Cooperative, Inc.
Springfield, Missouri

File No. 40616-300
October 2016

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

17 October 2016
File No. 40616-300

Associated Electric Cooperative, Inc.
2814 South Golden Avenue
P.O. Box 754
Springfield, Missouri 65801

Attention: Russ Weatherly
Supervisor, Land and Water Resources

Subject: Report on Safety Factor Assessment
Pond 003 and Pond 004
New Madrid Power Plant
New Madrid, Missouri

Mr. Weatherly:

We are pleased to submit herewith our report to Associated Electric Cooperative, Inc. (AECI) entitled, "Report on Safety Factor Assessment, Pond 003[1] and Pond 004[2], New Madrid Power Plant, New Madrid, Missouri." This report has been prepared in accordance with our agreed to scopes of work and your subsequent authorizations, and includes background information regarding the project, the results of our field investigation program, and the results of our safety factor assessment.

The purpose of this study was to evaluate the subsurface soil and water conditions at the coal combustion residuals (CCR) surface impoundments site and evaluate the stability of the subject impoundments in accordance with the Environmental Protection Agency (EPA) 40 CFR Parts 257 and 261, "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities" (CCR Rule). A subsurface exploration program was conducted in September 2015 at the project site to obtain subsurface information for engineering evaluations. The program consisted of drilling a total of nine (9) test borings and advancing ten (10) cone penetrometer soundings. A review of the subsurface information and laboratory test results revealed that the soils used to construct the impoundment dikes are not susceptible to liquefaction. A series of one-dimensional ground response analyses were performed to estimate the subsurface response to six (6) site-specific earthquake events at the New Madrid site. The results were used to perform Newmark displacement analyses and select the pseudostatic coefficient for use in the seismic stability analyses. The results of the stability analyses indicate that the static safety factors are above the minimum required values for all analyzed sections at each impoundment. Preliminary seismic stability analyses for the analyzed sections indicated acceptable safety factors for all sections except the section on the west side of Pond 003 where CCR had been

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[1] Pond 003 is also referred to as the 003 Unlined Pond
[2] Pond 004 is also referred to as the 004 Slag Dewatering Pond

staged directly adjacent to the dike within the impoundment footprint. AECI has since regraded that material along the west side of Pond 003 to a configuration that that has acceptable safety factors.

This report includes background information regarding the project, the results of our field investigation program, and the detailed results of our safety factor assessment.

Background

The project site is located at the New Madrid Power Plant located at 41 St. Jude Industrial Park Highway, New Madrid, Missouri as shown on **Figure 1**. The approximately 100-acre Pond 003 and 10-acre Pond 004 are located on the east side of the site, adjacent to the Mississippi River.

AECI is be required to meet the requirements of the Environmental Protection Agency (EPA) 40 CFR Parts 257 and 261, "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities" (CCR Rule) effective 19 October 2015. In particular for existing active CCR surface impoundments, AECI must demonstrate that specified slope stability safety factors are met in accordance with §257.73(e). This report satisfies that requirement.

Purpose and Scope

The purpose of this study was to investigate the subsurface soil and water conditions at the site and to perform the initial safety factor assessment in accordance with Section §257.73(e)(1) of the CCR Rule. To achieve the objective discussed above, the scope of work undertaken for this investigation included the tasks listed below.

- Planning and executing a field investigation program to obtain subsurface information for dike liquefaction and slope stability analyses. A total of nine (9) test borings were drilled to depths ranging from between approximately 25 and 100 ft below ground surface. Ten (10) cone penetrometer soundings (CPTs) were performed to depths ranging from approximately 50 to 100 ft below ground surface.

- Conducting a geotechnical laboratory testing program on soil, CCR and boiler slag samples recovered from subsurface explorations to aid in classification and for determination of engineering properties required for engineering analyses.

- Performing a site-specific seismic analysis to estimate the subsurface response to an earthquake event at the New Madrid site.

- Performing a Newmark displacement analysis to determine the amount of slope displacement for a given value of yield acceleration.

- Performing slope stability (static and seismic) and liquefaction analyses.

Field Investigation Program

SUBSURFACE EXPLORATION PROGRAM

A subsurface exploration program was conducted at the project site during the period 14 September 2015 to 22 September 2015 to obtain subsurface information for engineering evaluations. The program consisted of drilling a total of nine (9) test borings and advancing ten (10) CPTs. The borings were drilled by Bulldog Drilling, Inc. of Dupo, IL using an ATV-mounted CME 55 L6 drill rig. The CPT soundings were advanced by ConeTec, Inc. of West Berlin, New Jersey using a track-mounted rig. A Haley & Aldrich representative was present in the field to observe the subsurface explorations.

The locations of the subsurface explorations are shown on **Figure 2**. The as-drilled locations and elevations of the explorations were determined in the field by Smith & Company Engineers by optical survey. The locations and elevations of the explorations should be considered accurate only to the degree implied by the method used. A summary of the subsurface explorations is presented in **Table I**[3].

Test Borings

The test borings were drilled to depths ranging from approximately 25 ft to 100 ft below ground surface. The borings were advanced using 4-1/4-in. inside diameter (i.d.) hollow stem augers. Split-spoon samples were typically obtained continuously for the upper 15 ft at each test boring and at 5 ft intervals thereafter. In some instances, continuous split spoon sampling extended to depths up to 30 ft until natural soil was observed. The standard penetration resistance was determined at each sample level by counting the number of blows required to drive a standard split-spoon sampler (1-3/8-in. inside diameter, 2-in. outside diameter) a distance of either 18 in. or 24 in. into undisturbed soil and ash under the impact of a 140-lb hammer free-falling 30 in. The number of blows required to advance the sampler was recorded for each 6-in. interval. The standard penetration resistance N-value is determined by summing the number of blows required to advance the sampler the middle 12 in. of the 24-in. sampling range or by summing the number of blows required to advance the sampler the last 12 in. of the 18-in. sampling range.

Relatively undisturbed samples of ponded CCR were obtained from test borings HA-B4A and HA-B5A by pushing a 3-in. diameter thin-walled steel tube (Shelby tube) into the CCR at a planned sampling depth. A hydraulically operated stationary piston sampler attached to the drill rods was used to advance the tubes. The tubes were removed from the ground and sealed.

Samples recovered from the borings were taken to Shannon and Wilson, Inc. in Saint Louis, Missouri for laboratory testing. The boring logs are presented in **Appendix A**. The boring logs and related information depict subsurface conditions only at the specific locations and at the particular time designated on the logs. Subsurface conditions at other locations may differ from conditions occurring at the exploration locations. Also the passage of time may result in a change in the subsurface conditions at these exploration locations.

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3 Note: a table that does not appear near its citation can be found in a separate table at the end of the report.

Cone Penetrometer Soundings

The majority of the CPT soundings were performed immediately adjacent to SPT borings to facilitate correlating the readings from the CPT sounding with the samples obtained from the split-spoon and Shelby tube samplers. The CPT soundings were advanced to depths of approximately 50 ft and 100 ft below ground surface. The CPT soundings were performed using a piezocone penetrometer that provides measurements of pore water pressure at one or more locations on the penetrometer surface in general conformance with ASTM D5778. CPT data, including pore pressure measurements, were collected at 2-cm depth intervals.

The rod string and cone were advanced in natural ground at the standard rate of 2 cm/sec. At HA-C8, the rod string was advanced through the existing stratum of fly ash/boiler slag at a rate of approximately 0.6 cm per second and through the underlying natural soil at the standard rate of 2 cm/sec. The slower advancement rate in the fly ash/boiler slag was utilized because research has shown that the slower penetration rate better simulates the drained condition and provides a better interpretation of the CCR friction angle.

Seismic cone penetration testing was used to obtain in-situ measurements of shear wave velocity at HA-C7 and HA-C8. Measurements were taken at 1-meter (3.3-ft) intervals, which correspond to the intervals at which additional rods needed to be added to the rod string. Pore water dissipation testing was also performed at select depths in all CPTs to estimate hydraulic conductivity/pore pressure dissipation properties. The CPT sounding results are presented in **Appendix B**.

LABORATORY TESTING PROGRAM

A laboratory testing program was conducted on selected soil and CCR samples recovered from subsurface explorations to aid in classification and for determination of engineering properties required for design. The primary purpose of the testing program was to evaluate the index and strength properties of the soil, CCR, and boiler slag materials. Testing included natural moisture contents, Atterberg limits, grain size distributions, percent passing the No. 200 sieve, unconsolidated-undrained (UU) triaxial strength, consolidation, and tube density. The tests were performed in general conformance with applicable ASTM test procedures. Results of the laboratory testing program are presented in **Appendix C** and are summarized in **Table II**.

Subsurface Soil and Water Conditions

GEOLOGY

The site is located within the New Madrid Seismic Zone. The new Madrid Seismic Zone lies at the north end of the Mississippi Embayment, which is a deep, low-lying basin filled with Cretaceous to recent sediments. The stratigraphy at our site is presented on **Figure 3** and is based on the general profile develop by Van Arsdale and TenBrink (2000). The project site is immediately underlain by imported embankment fill and levee fill associated with embankment and levee construction as well as various deposits of fly ash and boiler slag associated with coal burning operations.

The existing fill is underlain by Quaternary Mississippi River alluvium, which is characterized by silty clay and sand, Pleistocene Loess, which is characterized by silt and clayey silt, and Pliocene-Pleistocene Upland Complex Gravel consisting of fine to very coarse sand and gravel. These sediments are believed to be surficial deposits of fluvial or estuarine origin.

Underlying the Quaternary Deposits is the Jackson Formation, which is characterized by fluvial/deltaic medium to very fine grained silty sand, interbedded with clayey silt. The Jackson Formation overlies the Eocene Claiborne Group that consists of the Cockfield Formation over the Cook Mountain Formation over The Memphis Sand. The Cockfield formation is characterized by fluvial/deltaic silt and clay interbedded with medium to fine grained sand. The Cook Mountain Formation consists of silt and clay containing variable amounts of lignite and sand. The Memphis Sand is predominately described as consisting of fluvial/deltaic fine to very coarse grained quartzose sand containing rock fragments, pyrite and lignite.

Below the Eocene Claiborne Group is Paleocene consisting of the Wilcox Group and Midway Group. The Wilcox Group is comprised of the Flour Island Formation overlying the Fort Pillow Sand. The Flour Island formation is characterized by silty clay and clayey silt with lenses of fine grained sand. The Fort Pillow Sand is described as consisting of fine to very coarse grained quartzose sand. The Midway Group is comprised of Old Breastworks Formation, Porters Creek Clay and The Clayton Formation. Old Breastworks Formation is described as sandy, micaceous silty clay. The Porters Creek Clay is described as a micaceous clay. The Clayton Formation consists of glauconitic, fossiliferous clay.

Underlying the Wilcox and Midway groups is Upper Cretaceous soil consisting of McNairy Sand, Demopolis Formation and Coffee Formation. McNairy Sand is characterized by fine to coarse grained sand interbedded with silty clay. The Demopolis Formation is composed of calcareous clays, marls and some chalky materials. The Coffee Formation is made up of stratified and cross-bedded clays and fine grained sand.

Below the Upper Cretaceous lies the Paleozoic strata. The Paleozoic strata is described as fine to coarse crystalline dolomite. At the AECI site, the depth to the Paleozoic strata is approximately 1,900 ft below ground surface.

The geologic descriptions discussed herein are credited to various references entitled “General Geology of the Mississippi Embayment” (Cushing, Boswell, Hosman 1964), “Deep Shear Wave Velocity Profiles of Mississippi Embayment Sediments Determined From Surface Wave Measurements” (Rosenblad, 2007) and “Late Cretaceous and Cenozoic Geology of the New Madrid Seismic Zone” (Van Arsdale and TenBrink, 2000).

SUBSURFACE CONDITIONS

Descriptions of the soil conditions encountered during the subsurface exploration program conducted at the site are provided below in order of increasing depth below ground surface. Actual soil conditions between boring locations may differ from these typical descriptions. Refer to the test boring logs for specific descriptions of soil samples obtained from the borings.

The subsurface conditions identified by the CPT soundings do not represent material classifications based on grain-size distributions, index tests, or visual observation. Rather, the CPT soundings provide an indicator of relative behavior type based on the mechanical characteristics measured during the soundings. For this reason, the descriptions of subsurface conditions discussed below are based on our visual-manual classification of samples obtained from test borings and the results of laboratory testing.

- *ROADWAY FILL* - Below the ground surface there is a stratum of fill material primarily described as SAND and GRAVEL. This stratum was encountered only in HA-B1, HA-B2, and HA-B6 and was fully penetrated where encountered. The thickness of this stratum was approximately 1 ft.

- *FLY ASH* - Below the ground surface at HA-B5, there is a stratum of fill material primarily described as brown, dark-brown, and black SILT with sand (ML). This stratum was encountered only in HA-B5 and was fully penetrated. Where encountered and fully penetrated, the thickness of this stratum was approximately 17 ft.

- *FLY ASH INTERMIXED WITH BOILER SLAG* - Below the fly ash at HA-B5, there is a stratum of fill material primarily described as brown and dark-brown SILT with sand and slag particles (ML). This stratum was encountered only in HA-B5 and was fully penetrated. Where encountered, the thickness of this stratum was approximately 15 ft.

- *BOILER SLAG* - Below the ground surface at HA-B4, there is a stratum of fill material primarily described as brown and dark-brown SILT with sand and slag particles (ML). This stratum was encountered only in HA-B4 and was fully penetrated. Where encountered, the thickness of this stratum was approximately 15 ft.

- *FILL* – Below the ground surface in HA-B3 and HA-B7 and below the ROADWAY FILL in HA-B1, HA-B2, and HA-B6 a stratum of FILL material was encountered. The FILL is primarily described as lean CLAY (CL) and fat CLAY (CH). This stratum was encountered and fully penetrated in borings HA-B1, HA-B2, HA-B3, HA-B6, and HA-B7. Where encountered and fully penetrated, the thickness of the stratum ranged from approximately 10.0 ft to 25.0 ft. The density of cohesive, fine-grained soils encountered in this stratum ranged from soft to stiff, but was generally medium stiff to stiff.

- *ALLUVIAL DEPOSITS* – Below the FILL, FLY ASH, FLY ASH INTERMIXED WITH BOILER SLAG, and BOILER SLAG there is a stratum of natural soil primarily described as silty SAND (SM), poorly graded SAND (SP), SILT (ML), lean CLAY (CL), and fat CLAY (CH). This stratum was encountered in all borings. This stratum was fully penetrated in all borings with the exception of HA-B7. Where encountered and fully penetrated, the thickness of this stratum ranged from approximately 7 ft to 26 ft. The density of coarse-grained soils encountered in this stratum ranged from very loose to medium dense. The consistency of fine-grained soils encountered in this stratum ranged from soft to stiff.

- *FLUVIAL DEPOSITS* – Below the ALLUVIAL DEPOSITS, there is a stratum of natural soil primarily described as light brown and gray poorly-graded SAND (SP), and light brown well-graded sand (SW). This stratum was encountered in all borings except HA-B7, but was not fully penetrated by any of the test borings. The density of coarse-grained soils encountered in this stratum ranged from medium dense to dense.

Water levels were typically measured in the boreholes when water was encountered during drilling and after the test borings were completed. Measured water levels are summarized in **Table I**. Where encountered, water levels measured during drilling generally ranged from a depth of 18 to 43 ft below ground surface, which corresponds to a water level ranging between approximately El. 257 and 293 for geotechnical evaluation purposes. It should be noted that the water levels measured in borings HA-B3, HA-B5, and HA-B5A were significantly higher than the water levels measured in the other borings and likely represent localized water conditions within the impoundment footprint.

Water levels were also estimated by the cone penetrometer soundings and are also summarized in **Table I**. Water levels estimated during the soundings generally ranged from 30 to 48 ft below ground surface, which corresponds to a water level ranging between approximately El. 258 and El. 274. It should be noted that measurements estimated during the soundings did not involve physical observation of water levels, but rather an estimated water level based on pore pressure measurements. The estimates of water levels at each sounding should only be considered accurate to the degree implied by the determination method.

Water level readings have been made in the subsurface explorations at times and under conditions discussed herein. However, it must be noted that fluctuations in the level of the water may occur due to variations in power plant sluicing activities, season, rainfall, temperature, dewatering activities, and other factors not evident at the time measurements were made and reported herein.

Safety Factor Assessment

As mentioned previously, the purpose of this study was to perform the initial safety factor assessment in accordance with Section §257.73(e)(1) of the CCR Rule. As required by the CCR Rule, the initial safety factor assessment is performed for each applicable CCR unit to determine calculated factors of safety (using simple static and pseudo-static analysis) relative to the minimum prescribed safety factors for the critical cross section of the embankment. Those are defined as follows:

- For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.
- The calculated static factor of safety under the long-term, maximum storage pool loading conditions must equal or exceed 1.50.
- The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.
- The calculated seismic factor of safety must equal or exceed 1.00.

The results of our evaluation of the safety factors are presented in the following sections of the report.

LIQUEFACTION EVALUATION

During strong earthquake shaking, loose, saturated cohesionless soil deposits may experience a sudden loss of strength and stiffness, sometimes resulting in loss of bearing capacity, large permanent lateral displacements, and/or seismic settlement of the ground. This phenomenon is called soil liquefaction.

In accordance with the requirements of §257.73(e)(1)(iv), liquefaction evaluation required is to assess the potential for liquefaction of the impoundment dikes at the site in question. A variety of screening techniques exist to distinguish sites that are clearly safe with respect to liquefaction from those sites that require more detailed study. One of the most commonly used screening techniques used to make this assessment is the evaluation of fines content and plasticity index. In general, soils having greater than 15 percent (by weight) finer than 0.005 mm, a liquid limit greater than 35 percent, and an in-situ water content less than 90 percent of the liquid limit generally do not liquefy (Seed and Idriss, 1982).

The results of our subsurface investigation indicate that the impoundment dikes at Pond 003 and Pond 004 are primarily constructed of clay soils and have the following characteristics:

- 90 percent (by weight) finer than 0.005
- Liquid limits > 40
- In-situ moisture contents less than 50 percent of the liquid limit

In consideration of the clay soils used to construct the dikes, it is our opinion, in accordance with generally accepted standards, that the impoundment dikes are not constructed of soils that are susceptible to liquefaction.

GLOBAL STABILITY FACTORS OF SAFETY

Stability analyses have been performed in general conformance with the principles and methodologies described in the USACE Slope Stability Manual (U.S. Army Corps of Engineers, 2003). Conventional static and seismic stability analyses of the impoundment dike structures were performed for rotational and block failures using limit equilibrium methods. Limit equilibrium methods compare forces, moments, and stresses which cause instability of the mass of the dike to those which resist that instability. The principle of the limit equilibrium method is to assume that if the slope under consideration were about to fail, or at the structural limit of failure, then one must determine the resulting shear stresses along the expected failure surface. These determined shear stresses are then compared with the shear strength of the soils along the expected failure surface to determine the safety factor. The specific details of the analyses performed for Pond 003 and Pond 004 are presented in the following sections of this report.

DESIGN WATER LEVEL

As stated earlier, subsurface water levels measured during our subsurface exploration program indicated static water levels were generally 30 to 48 ft below the existing ground surface. In Pond 003, zones of perched water within the impoundment were encountered within the fly ash and boiler slag due to sluicing operations. Accordingly, the following static water levels were used in our analyses.

Location	Elevation
Pond 003	East Side – El. 262 West Side – El. 274
Pond 004 (North Portion)	East Side - El. 261
Pond 004 (Southern Portion)	East Side – El. 258 West Side – El. 262

The water retained in each impoundment must be modeled at the maximum storage pool level for the static drained and seismic undrained analyses. The maximum surcharge pool level must be used to model the ponded water for the static undrained analyses. This approach is consistent with the requirements of the CCR Rule. The specific pool levels used in our analyses are summarized below and chosen as the conservative values associated with each impoundment and cross sections.

Location	Maximum Storage Pool Level	Maximum Surcharge Pool Level
Pond 003 (max. storage)	El. 301	El. 309
Pond 004 (max. storage)	El. 294	El. 301

Given the prescribed impoundment pool levels and the design static groundwater levels mentioned above, a seepage analysis was performed to determine the piezometric head between the edge of the impoundment and the toe of the dike, which is where the static groundwater level was encountered. The computer software program, Slide 6.029, developed by RocScience, Inc., was used to perform the seepage analyses and the resulting piezometric head was used in the stability analyses discussed herein.

MATERIAL PROPERTIES

The material properties used in our analyses have been developed using the results of the referenced test borings, CPT soundings, and laboratory testing. When evaluating the CPT results, material strengths were typically determined by averaging the measurements in a particular stratum and choosing conservative strength properties equal to the average value minus one standard deviation. A summary of the material properties is provided below in **Table III**.

TABLE III
MATERIAL PROPERTIES

Material	Material Strength	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Embankment Fill	Drained	115	50	30
	Undrained	115	800	0
Levee Fill	Drained	115	50	30
	Undrained	115	800	0
Boiler Slag (Fill)	Drained	110	0	30
	Undrained	110	500	0
Fly Ash (Fill)	Drained	90	0	28
	Undrained	90	500	0
Fly Ash / Boiler Slag (Fill)	Drained	105	0	29
	Undrained	105	800	0
Alluvial Clay	Drained	110	50	28
	Undrained	110	1300	0
Alluvial Sand	Drained	108	0	36
	Undrained	108	0	36
Fluvial Sand	Drained	120	0	38
	Undrained	120	0	38

Seismic cone penetration testing was used to obtain in-situ measurements of shear wave velocity during the subsurface exploration program. The insitu measurements were performed to a depth of 95 ft below ground surface. Below that depth, shear wave velocity measurements of the underlying soils were approximated using published data specific to the Mississippi Embayment and the New Madrid Seismic Zone (Cramer, Hashash, Romero, Rosenblad, Van Arsdale). The site specific shear wave velocity profile is shown on **Figure 4**.

SITE SPECIFIC SEISMIC RESPONSE ANALYSIS

Introduction

As mentioned previously, the New Madrid Power Plant is located within the New Madrid Seismic Zone and the Mississippi embayment. The natural embayment soils underlying the impoundments are estimated to be 1,900-ft thick. It has been demonstrated that strong ground motions are significantly de-amplified at both the short and long periods due to the nonlinear behavior of the soils in the Mississippi embayment. It has also been shown that at short periods increasing soil thickness correlates with a decreasing hazard due the nonlinear soil behavior. Similarly, at long periods, increasing soil thickness correlates with increasing hazard due to soil resonance (Cramer, 2015).

Overview of Site-Specific Seismic Analysis

A one-dimensional ground response analysis was performed to estimate the subsurface response to an earthquake event at New Madrid. Due to the complex nature of the analyses required, Dr. Professor Edward Kavazanjian, Jr. at Arizona State University and Dr. Chris Cramer at the University of Memphis were retained as part of our team to assist with the site-specific seismic analyses.

It is important that the rock motions and soil characteristics are correlated to the site conditions at the New Madrid Power Plant. Properly conditioned bedrock strong ground motions (acceleration time histories) are required to perform a site-specific seismic analysis. Strong motion records for large magnitude events are not available for Central U.S. (Romero and Rix, 2001). Therefore, alternative records were obtained from other sources that approximate the spectral response characteristics at the site.

The bedrock at the site is classified as NEHRP Site Class A, hard rock. The USGS Uniform Hazard spectral response characteristics for a hypothetical Site Class A rock, based on the 2,500 –year return period ground motions, were used to identify the spectral characteristics of the time histories (i.e., the “Target Spectrum”) used for the site-specific evaluation.

USGS Deaggregation and Deterministic Target Spectrum

There is a great deal of uncertainty with regard to predicting the location, size, and shaking intensity of future earthquakes. Probabilistic Seismic Hazard Analysis (PSHA) aims to quantify these uncertainties, and combine them to produce a description of the distribution of future shaking that may occur at a site. The 2008 NSHMP PSHA interactive deaggregation web site was used to obtain the characteristics of the most significant earthquakes (the earthquakes that contribute the most to the seismic hazard) responsible for seismic activity at the New Madrid power plant. This website produces graphical representations of the characteristics of earthquake events most likely to affect the site within a given time span. The deaggregation plot for spectral response period T=0.1s is shown on **Figure D-1 located in Appendix D**. This plot suggests that the representative design earthquake for ground motions with a return period of 2,500 years should be between magnitude 7.5 and 8.0 at a distance of approximately 11 km from the site.

The significant characteristics of the earthquake such as magnitude and distance are used to select representative ground motions. The characteristics are also used to construct the deterministic target spectrum that is used for selecting ground motions.

A special type of target spectrum, called the conditional mean spectrum (CMS), was created for the study because it focuses the spectral response of all the ground motions to a particular period along the target spectrum (Baker, 2011). The particular target period selected is related to characteristics of the structure being analyzed such as shear wave velocity and height of sliding mass in the case of the impoundments. Based on the characteristics of general failure planes determined from slope stability analysis for the impoundment, a target period of 0.1s was chosen for the deterministic CMS target spectrum for the New Madrid Power Plant. The magnitude of the CMS target spectrum was then amplified to a mean plus one standard deviation target which is conservative (i.e., the approximately 84th percentile ground motion, rather than the median, or expected, ground motion) and is generally chosen to evaluate structures that are of critical importance.

The deterministic target spectrum is based on ground motion prediction equations (GMPEs) that use magnitude and distance to predict the spectral response of the ground motion. According to the USGS PSHA, the largest event predicted to affect New Madrid Power Plant is a magnitude 8 earthquake that is 10.5km from the site. The computer software program Shake 2000, developed by GeoMotions, provided the central and eastern U.S. (CEUS) GMPEs and the CMS algorithms used to create the target spectrum. Site-specific spectral responses were generated from five CEUS attenuation relationships using Shake 2000 as shown on **Figure D-2 in Appendix D**. These attenuation relationships were based on a magnitude 8 earthquake as a distance of 10.5 km from the source. The largest spectral response in the group (i.e., Campbell, 2003) was selected to produce the target spectrum for the site.

Conditional Mean Spectrum Groundmotions Scaled To Target Period T=0.1s

The CMS spectrum according to Baker, 2011 is to be constructed with the ground motions scaled so that their spectral response at the target period, T* matches the spectral response at the CMS Target spectrum. The target period, T* is chosen to approximate the fundamental frequency of the sliding mass which can be determined from the location of the failure plane within the slope at a condition of equilibrium (i.e., safety factor equal to 1.0). The shear wave velocity V_S of the sliding mass was estimated to range between 450 ft/sec to as much as 1000 ft/sec for the impoundments at the site based on our in-situ shear wave testing. Our analyses assumed the height of the sliding mass varies from 5ft to 21ft. Based on the anticipated variance of embankment height and shear wave velocity, an average fundamental frequency of T*=0.1s was used to scale the ground motions to the target spectrum

Shake 2000 was used to provide the CMS spectrum for Campbell 2003 CEUS GMPE using a target period T* = 0.1s and amplifying the CMS to correspond to a mean plus one standard deviation spectrum. The mean plus one standard deviation spectrum shown on **Figure D-3 in Appendix D** was used as the deterministic CMS target spectrum for the New Madrid Power Plant.

Rock Motions for The CMS

Six time history records were selected to match the target response spectrum for the site. Five of these rock motions were obtained from naturally occurring events and one rock motion was synthetically generated to match a magnitude 8 earthquake associated with the ground response for the Mississippi Embayment at Memphis, TN (Atkinson 2002). A primary focus was to match the ground motion spectra to the CMS target spectrum, as suggested by NEHRP (2011) when considering magnitude, distance, and focal mechanism. Rock motion records were selected from the Pacific Earthquake Engineering Research (PEER) Center's Strong Motion Database. The motions are summarized below in **Table IV** and depicted graphically **Figure D-4 in Appendix D**. As shown on **Figure D-5 in Appendix D**, the arithmetic mean spectrum of the generated records closely matches the CMS bedrock spectrum over the period range of interest.

TABLE IV
EARTHQUAKE RECORDS

Event	Return Period	PEER File Name	Earthquake Record Used			
			Earthquake	M	Mechanism	Distance (km)
Conditional Mean Response	2,500-year	RSN497-Nahanni_S3270.AT2	Nahinni	6.76	Reverse	5.32
		RSN550_Chalfant.A_A-CPL070.AT2	Chalfant	6.19	Strike-slip	18.31
		RSN4481_L-Aquila_FA030XTE.AT2	L'Aquila	6.3	Normal	6.81
		RSN825_ CAPEMEND_CPM000.AT2	Cape Mendocino	7.1	Reverse	6.96
		RSN8158_CChurch_LPCCN10W.AT2	Christ Church	6.2	Reverse Oblique	6.12
		N/A	Synthetic (Atkinson and Beresnev)	8.0	N/A	N/A

Due to the unusually large magnitude and close proximity of the earthquake projected for the site, it is difficult to locate ground motions that effectively scale to the shorter period portion of the CMS target spectrum. Many of the selected ground motions have spectral response characteristics that are significantly lower than the target between periods ranging from 0.01s to 0.06s. According to the Federal Highway Administration, due to the low number of ground motions for central and eastern U.S., it is acceptable to spectrally match the ground motions to the lower period portions of the target spectrum (FHWA, 2011). For this reason, the ground motions were spectrally matched to the CMS target spectrum between T=0.02sec to 0.06sec as shown on **Figure D-6 in Appendix D.**

One-Dimensional Ground Response Analysis

As mentioned previously, a one-dimensional ground response analysis was performed to estimate the surface ground motion at the site. The soil column used as input into the model was constructed from the shear wave velocity profile at the site (from in-situ testing) along with other characteristics such as layer thickness, soil density and the dynamic behavior. The dynamic geotechnical properties (damping, modulus-damping curves, density, etc.) used in the ground response analysis were obtained from prior models developed by Dr. Chris Cramer and are representative of the non-linear, pressure dependent soil properties attributed to the Mississippi Embayment as described by Romero and Rix, 2005.

The computer software program Shake2000 was used to numerically simulate the propagation of rock motions applied to the base of the soil column up through the soil layers to the top of the soil column. Shake2000 uses an equivalent linear numerical technique to model the non-linear dynamic soil behavior in the soil column. **Figure D-7 included in Appendix D** shows the results of the Shake ground response analysis for the six representative rock motions. This figure compares the spectral response of the bedrock motions to the surface ground response and shows the transformation in response caused by wave propagation through the 1,900-ft thick soil column. **Table V** summarizes the surface PGA estimates at the New Madrid Power Plant.

TABLE V
PREDICTED SURFACE PGA AND NEWMARK MAGNITUDE CORRECTION FACTOR

Earthquake	Original Magnitude	CMS Scaled-Matched PGA	Shake Surface PGA	Newmark Magnitude Correction Factor[1]
Nahinni	6.76	1.60 g	0.33 g	1.41
Chalfant	6.19	1.77 g	0.33 g	1.65
L'Aquila	6.30	1.60 g	0.66 g	1.60
Cape Mendocino	7.01	1.40 g	0.41 g	1.32
Christ Church	6.25	2.00 g	0.41 g	1.65
Synthetic (Atkinson and Beresnev)	8.00	0.95 g	0.47 g	1.00

[1] Determined using the method developed by Bray and Traversarou

Newmark Displacement Analysis

The Newmark method predicts the amount of block displacement for a given value of yield acceleration. The Newmark displacement analysis is based on the shear stress time history acting along the failure plane within the slope. The yield acceleration is the minimum amount of ground acceleration necessary to initiate motion along the failure surface and is used to determine the appropriate pseudo-static coefficient for seismic stability analyses.

Shake2000 was used to perform the Newmark displacement analysis by incorporating the results of the one-dimensional ground response analysis to estimate slope displacement. Shake2000 incorporates several different variants of the Newmark block displacement method and the numerical approach known as YSLIP developed by Kavazanjian and Matasovic (1996) was chosen for our analysis. All six site-specific bedrock motions were used to evaluate relationships between the Newmark permanent displacements and the associated yield acceleration. Several impoundment cross-sections were evaluated and the most conservative location of the failure plane was determined to be 15 ft below the top of slope.

After performing the Newmark displacement analysis, it was necessary to adjust the displacement predictions to correspond to the difference between the magnitudes of the ground motions used in the analysis and the magnitude of the representative earthquake event established for the New Madrid Power Plant. Correction factors were applied to scale the displacements to the target magnitude 8 event. The correction factors were determined using the approach developed by Bray and Travasarou (2007), which relates permanent displacement from a Newmark analysis with the magnitude of the earthquake event (Bray, 2007). **Figure D-8 in Appendix D** presents the magnitude scaled permanent displacement versus yield acceleration.

DECOUPLED SEISMIC STABILITY ANALYSIS

Methodology for Analyses

The computer software program Slide 6.029 was used to evaluate the static and seismic stability of the impoundment dikes. Analyses were performed to evaluate static drained (long-term) and undrained (short-term) strength conditions for circular and block failures using Spencer's method of slices. Spencer's method of slices was selected because it fully satisfies the requirements of force and moment equilibrium (limit equilibrium method).

Seismic stability was evaluated using pseudo-static analyses and a 20 percent reduction in material strength to represent the approximate threshold between large and small strains induced by cyclic loading (Duncan, 2014). Pseudo-static analysis models the seismic shaking as a "permanent" body force that is added to the force-body diagram of a conventional static limit-equilibrium analysis; typically, only the horizontal component of earthquake shaking is modeled because the effects of vertical forces tend to average out to near zero (Jibson, 2011). This is a traditional approach for evaluating the stability of a slope during earthquake shaking and provides a simplified safety factor analysis for one earthquake pulse. A safety factor greater than or equal to one (FS ≥ 1.0) indicates a slope is stable and a safety factor below one (FS < 1.0) indicates that the slope is unstable.

Pseudo-static Coefficient

The pseudo-static coefficient, k_s, used in our seismic analyses was selected using the results of the Newmark displacement analysis discussed previously. Accordingly, to the MSHA Impoundment Design Manual, the acceptable displacement of coal refuse impoundments is 25% of the upstream freeboard (MSHA, 2009). At each impoundment based observed conditions, that equates to:

- Pond 003 – 8 ft freeboard, acceptable displacement is 24 in.
- Pond 004 – 7-ft Freeboard, acceptable displacement is 21 in.

Assuming the most conservative case of 21-in. acceptable displacement, **Figure D-8 in Appendix D** shows that the yield acceleration corresponding to the most conservative earthquake motion is 0.25g. A pseudostatic coefficient lower than 0.25 will result in more than 21 in. deformation and one higher than 0.25 will result in less than 21 in. deformation. For the seismic stability analyses performed for the impoundments, we selected a pseudostatic coefficient of 0.28. This value was selected because it is slightly above the minimum value, which is conservative, and will result in displacements at each impoundment that are below MSHA acceptable values.

Results of Stability Evaluation

The critical cross section is defined as that which is anticipated to be most susceptible amongst all cross sections. To identify the critical cross sections at our project site, we examined the following conditions at several cross section locations at each impoundment:

a. the geometry of the upstream and downstream slopes;

- b. phreatic surface levels within and below the cross sections;
- c. subsurface soil conditions;
- d. presence or lack of surcharge loads behind the crest of the dikes; and
- e. presence or lack of reinforcing measures in front of the dikes.

Examination of the conditions noted above resulted in the identification of five (5) critical cross sections. Two (2) of the cross sections were located at Pond 003 and three (3) of the cross sections were located at the Pond 004. The results of our analyses are presented below in **Table VI** and are shown on the Slide output files included in **Appendix D**. As shown below, the static safety factors are above the minimum required values for all sections. The pseudo-static analyses for the analyzed sections indicate acceptable seismic safety factors for sections A-A', B-B', C-C', and D-D'. Section E-E' was originally modeled with its configuration as of 2015 with CCR staged near the dike on the west side of the Pond 004 impoundment. The preliminary static analyses for that scenario indicated acceptable factors of safety, but the seismic analyses did not. As noted previously, AECI revised the configuration of that staged material in 2016, and the results of the revised E-E' configuration indicate acceptable seismic and static safety factors. The results of the analyses based on the revised configuration are presented in Table VI and Appendix D.

TABLE VI
SUMMARY OF STABILITY EVALUATIONS

Cross Section	Condition[1]	Earthquake Event	Soil Strength	Required Safety Factor	Safety Factor	
					Rotational Failure Surface	Block Failure Surface
A-A’ (Pond 004)	Static	-	Drained	1.5	4.3	4.9
			Undrained	1.4	4.3	4.5
	Seismic	2,500-year	Undrained[2]	1.0	1.2	1.1
B-B’ (Pond 004)	Static	-	Drained	1.5	3.8	4.3
			Undrained	1.4	7.6	6.4
	Seismic	2,500-year	Undrained[2]	1.0	1.2	1.3
C-C’ (Pond 004)	Static	-	Drained	1.5	3.6	4.3
			Undrained	1.4	3.9	4.5
	Seismic	2,500-year	Undrained[2]	1.0	1.1	1.2
D-D’ (Pond 003)	Static	-	Drained	1.5	2.3	3.7
			Undrained	1.4	5.0	6.3
	Seismic	2,500-year	Undrained[2]	1.0	1.2	1.3
E-E’ (Pond 003)	Static	-	Drained	1.5	3.1	4.1
			Undrained	1.4	4.1	4.3
	Seismic	2,500-year	Undrained[2]	1.0	1.1	1.3

1. Refer to Table III for material properties.
2. Shear strengths have been reduced by 20 percent for seismic analyses.

DISCUSSION AND RECOMMENDATIONS

The analyses associated with the safety factor assessment have been performed in accordance with the requirement of Section §257.73 of the CCR Rule. A summary of our conclusions and recommendations as they relate to the rule requirements are provided below.

- *For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.*

  The results of our subsurface investigation indicate that the impoundment dikes at the Pond 003 and Pond 004 are primarily constructed of clay soils that are not susceptible to liquefaction. Accordingly, this requirement has been met.

- *The calculated static factor of safety under the long-term, maximum storage pool loading conditions must equal or exceed 1.50.*

  As shown in **Table VI**, the static safety factors for the long-term (drained) maximum storage pool condition are above the minimum required values for all critical sections analyzed at Pond 003 and Pond 004. Accordingly, this requirement has been met.

- *The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.*

  As shown **in Table VI**, the static safety factors for the maximum surcharge pool loading condition (undrained) are above the minimum required values for all critical sections analyzed at Pond 003 and Pond 004. Accordingly, this requirement has been met.

- *The calculated seismic factor of safety must equal or exceed 1.00.*

  As shown in **Table VI**, the calculated seismic safety factors are above the minimum required value for all critical sections at Pond 003 and Pond 004. Accordingly, this requirement has been met.

CERTIFICATION

Based on our review of the information provided to us by AECI and the results of our field investigations and analyses, it is our opinion that the calculated factors of safety for the critical cross sections of the impoundment embankments for Pond 003 and Pond 004 meet the minimum factors of safety specified in §257.73(e)(1)(i) through (iv) of the EPA's CCR Rule.

Certification Statement – Pond 003

I certify that the Initial Safety Factor Assessment for AECI's Pond 003 at the New Madrid Power Plant meets the requirements of §257.73(e) of the EPA's CCR Rule.

Signed: ____________________________
Certifying Engineer

Print Name: Steven F. Putrich
Missouri License No.: 2014035813
Title: Project Principal
Company: Haley & Aldrich, Inc.

Professional Engineer's Seal:

STEVEN F. PUTRICH
NUMBER
PE-2014035813
10-17-16

Certification Statement – Pond 004

I certify that the Initial Safety Factor Assessment for AECI's Pond 004 at the New Madrid Power Plant meets the requirements of §257.73(e) of the EPA's CCR Rule.

Signed: ____________________________
Certifying Engineer

Print Name: Steven F. Putrich
Missouri License No.: 2014035813
Title: Project Principal
Company: Haley & Aldrich, Inc.

Professional Engineer's Seal:

STEVEN F. PUTRICH
NUMBER
PE-2014035813
10-17-16

CLOSING

We appreciate the opportunity to provide engineering services on this project to AECI.

Sincerely yours,
HALEY & ALDRICH, INC.

Derrick A. Shelton
Geotechnical Program Manager | Senior Associate

Steven F. Putrich, P.E.
Project Principal

Enclosures:
- References
- Table I – Summary of Subsurface Explorations
- Table II – Summary of Laboratory Test Results
- Figure 1 – Project Locus
- Figure 2 – Subsurface Exploration Location Plan
- Figure 3 – Geologic Column for the New Madrid Seismic Zone
- Figure 4 – Design Shear Wave Velocity Profile
- Appendix A – Test Boring Logs
- Appendix B – CPT Sounding Logs and Related Information
- Appendix C – Laboratory Test Results
- Appendix D - Analyses

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TABLE I

SUMMARY OF SUBSURFACE EXPLORATIONS
ASSOCIATED ELECTRIC COOPEATIVE, INC.
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

Exploration Designation[1]	Ground Surface El.[2] (ft)	Northing[2]	Easting[2]	Total Exploration Depth (ft)	Water[3]	
					Depth Below Ground Surface (ft)	Elevation (ft)
HA-B1	309.3	249123.8	1096406.3	50.0	43.0	266.3
HA-B2	300.2	249425.1	1096677.9	95.0	40.5	259.7
HA-B3	308.8	247288.9	1096492.8	75.0	43.0	265.8
HA-B4	304.2	246728.8	1097737.1	95.0	13.0[4]	291.2
HA-B4A	304.2	246728.8	1097737.1	15.0	Not Encountered	--
HA-B5	316.1	246385.4	1096344.8	50.0	43.0	273.1
HA-B5A	316.1	246385.4	1096344.8	29.0	25.0[4]	291.1
HA-B6	307.4	245683.4	1098768.8	75.0	40.0	267.4
HA-B7	302.9	249818.4	1096496.9	27.0	Not Encountered	--
HA-C1	301.1	249768.9	1096418.4	50.0	41.0	260.1
HA-C2	309.2	249121.4	1096407.6	50.0	48.1	261.1
HA-C3	299.9	249422.8	1096674.6	95.1	41.8	258.1
HA-C4	296.5	249095.4	1096352.8	50.0	35.0	261.5
HA-C5	309.5	247296.2	1096499.1	75.1	43.4	266.1
HA-C6	296.7	247092.3	1096316.1	50.0	30.1	266.6
HA-C7	304.2	246735.4	1097740.8	95.1	41.8	262.4
HA-C8	315.8	246390.2	1096337.2	50.0	42.0	273.8
HA-C9	307.3	245688.2	1098766.8	75.1	47.2	260.1
HA-C10	303.0	249815.6	1096496.5	50.5	42.0	261.0

Notes:

1) Technical monitoring of subsurface explorations completed during the period 14 September 2015 through 2 September 2015 was performed by Haley & Aldrich, Inc.

2) Elevations are in feet and reference North American Vertical Datum of 1988 (NAVD88). Ground surface elevations of subsurface explorations were determined by optical survey. Survey performed by Smith & Company, Inc.

3) Water level readings represent the highest water level observed either during drilling, after completion of the boring, or as indicated by subsurface exploration instruments. Refer to the subsurface exploration logs for additional water level data. Water level readings have been made in the subsurface explorations at times and under conditions discussed herein. However, it must be noted that fluctuations in the level of the water may occur due to variations in season, rainfall, temperature, and other factors not evident at the time measurements were made and reported.

4) Possible perched water.

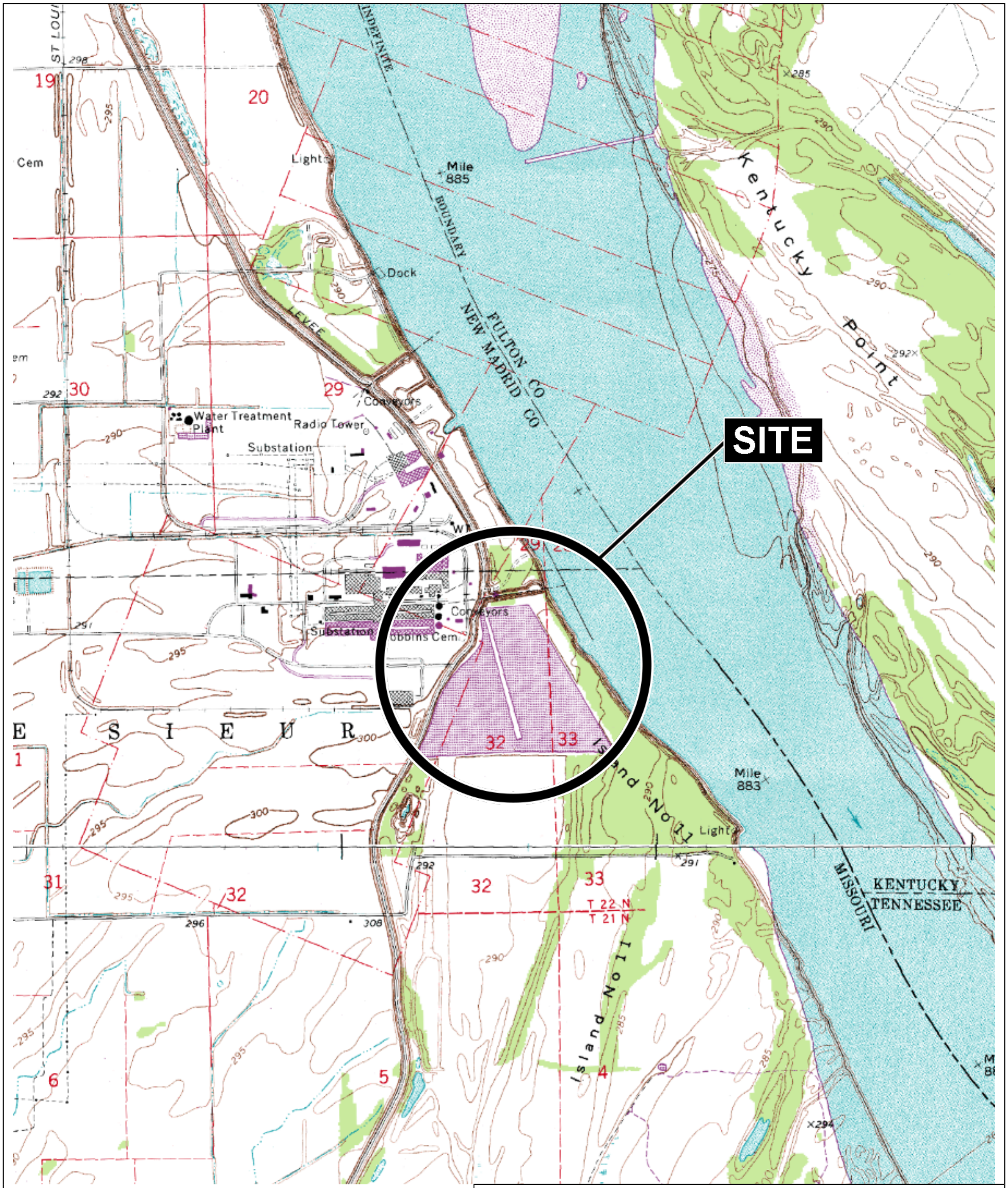
TABLE II

SUMMARY OF LABORATORY TEST RESULTS
ASSOCIATED ELECTRIC COOPEATIVE, INC.
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

Boring Designation	Sample Number	Sample Depth (ft)	USCS Symbol	Material Type	Moisture Content (%)	LL	PL	PI	% Gravel	% Sand	% Fines	Tube Dry Density (pcf)	UU Triaxial			Consolidation		
													Moisture Content (%)	Dry Density (pcf)	S_u (tsf)	e_o 1	C_c 1	P_c 1 (tsf)
HA-B1	S6	11.0-13.0	CL	Fill	22.8	42	20	22			92.7							
HA-B2	S11	28.0-30.0	SM	Natural Soil	20.7				0.0	67.9	32.1							
HA-B3	S3	5.0-7.0	CL	Fill	26.7				0.0	4.8	95.2							
HA-B3	S7	13.0-15.0	CL	Fill	22.8	47	22	25			95.5							
HA-B3	S10	28.0-30.0	CH	Natural Soil	36.1						98.4							
HA-B4	U2	5.0-7.0	ML	Boiler Slag	32.9				0	0.7	99.3	80.0				1.08	0.23	1.1
HA-B4	S15	48.0-50.0	SP	Natural Soil	18.1				0.5	95.1	4.4							
HA-B5	U1	10.0-12.0	ML	Fly Ash	38.3				0.0	1.4	98.6	71.7				1.04	0.18	2.0
HA-B5	U2	20.0-22.0	ML	Fly Ash	34.6							77.8	41.0	73.1	0.3	1.14	0.19	2.8
HA-B6	S4	7.0-9.0	CL	Fill	22.6	45	21	24			94.4							
HA-B6	S7	13.0-15.0	CL	Natural Soil	21.1	39	20	19			96.5							
HA-B7	S6	11.0-13.0	CH	Fill	22.5	59	20	39			87.3							

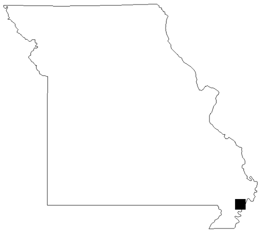
Notes:

1. e_o = Void Ratio, C_c = Compression Ratio, P_c = Estimated Preconsolidation Pressure



MAP SOURCE: USGS

SITE COORDINATES: 36°30'39"N, 89°33'29"W



HALEY ALDRICH

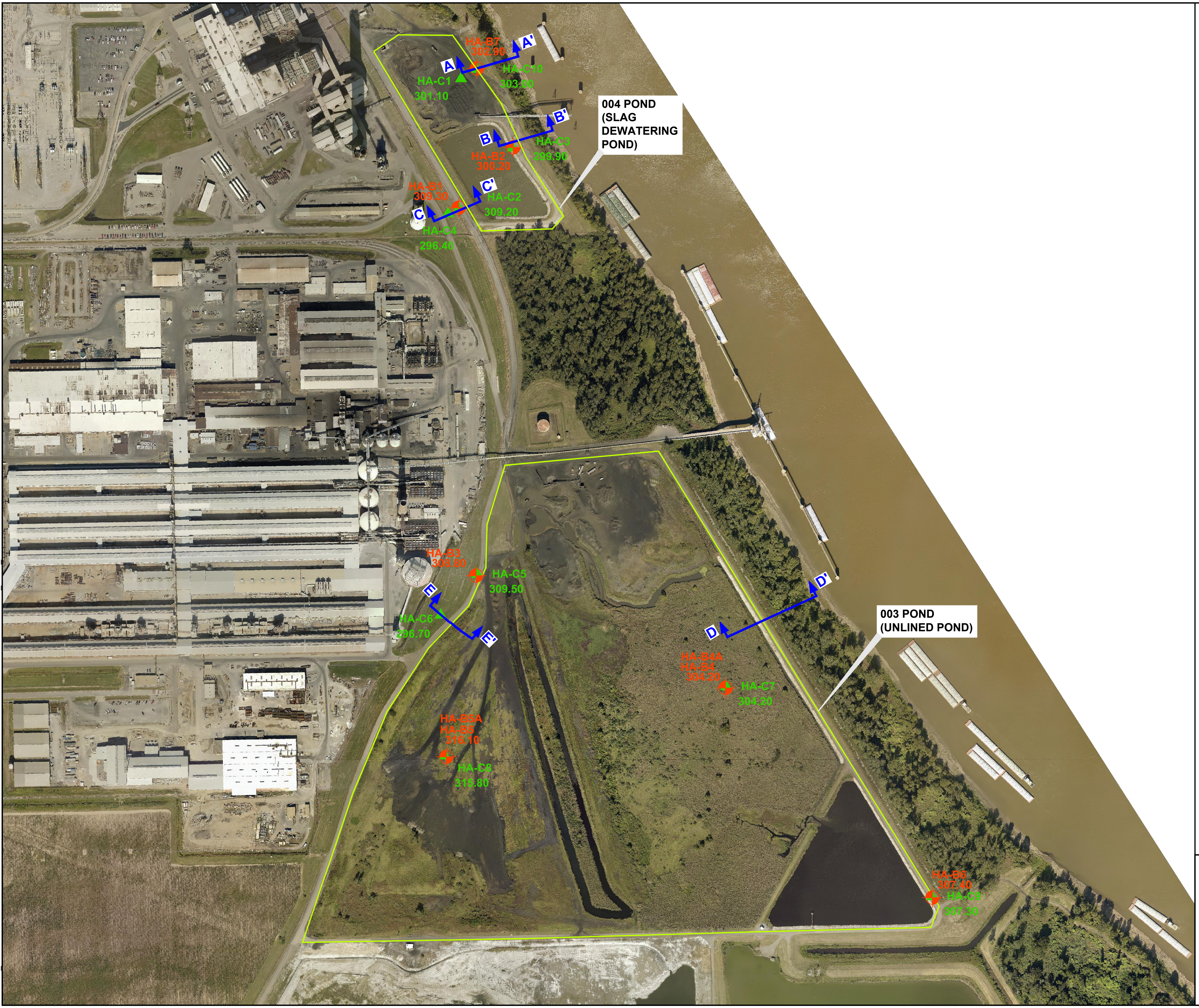
ASSOCIATED ELECTRIC COOPERATIVE, INC.
003 UNLINED POND AND 004 SLAG DEWATERING POND
NEW MADRID POWER PLANT
MARSTON, MISSOURI

PROJECT LOCUS

APPROXIMATE SCALE: 1 IN = 2000 FT
FEBRUARY 2016

FIGURE 1

40616_300_LOCUS.PDF



LEGEND

HA-B3 308.8	DESIGNATION, LOCATION AND GROUND SURFACE ELEVATION OF TEST BORINGS PERFORMED BY BULLDOG DRILLING, INC. OF DUPO, ILLINOIS DURING THE PERIOD 14 SEPTEMBER 2015 TO 22 SEPTEMBER 2015. DESIGNATIONS THAT INCLUDE AN "A" CORRESPOND TO OFFSET BORINGS PERFORMED IMMEDIATELY ADJACENT TO THE ORIGINAL BORING.
▲ HA-C6 296.7	DESIGNATION, LOCATION AND GROUND SURFACE ELEVATION OF CONE PENETROMETER SOUNDINGS PERFORMED BY CONETEC, INC. OF WEST BERLIN, NEW JERSEY DURING THE PERIOD 15 SEPTEMBER 2015 TO 17 SEPTEMBER 2015.
A A'	GEOLOGIC CROSS-SECTION LOCATION
🟩	APPROXIMATE POND EXTENT

NOTES

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM AN AERIAL IMAGE PROVIDED BY AECI THAT WAS CONDUCTED BY PICTOMETRY INTERNATIONAL CORP BETWEEN OCTOBER 4-8, 2014.
2. ELEVATIONS INDICATED ON THIS DRAWING ARE IN FEET AND REFER TO NAVD 1988 DATUM. HORIZONTAL CONTROL IS BASED ON MISSOURI STATE PLANE COORDINATE SYSTEM - EAST ZONE.
3. TECHNICAL MONITORING OF TEST BORINGS AND CONE PENETROMETER SOUNDINGS COMPLETED DURING THE PERIOD 14 SEPTEMBER 2015 TO 22 SEPTEMBER 2015 WAS PERFORMED BY HALEY & ALDRICH, INC.
4. AS DRILLED LOCATIONS AND GROUND SURFACE ELEVATIONS OF TEST BORINGS AND CONE PENETROMETER SOUNDINGS WERE DETERMINED IN THE FIELD BY SMITH & COMPANY ENGINEERS OF POPLAR BLUFF, MISSOURI BY OPTICAL SURVEY.

N

0 500 1000
SCALE IN FEET

HALEY ALDRICH

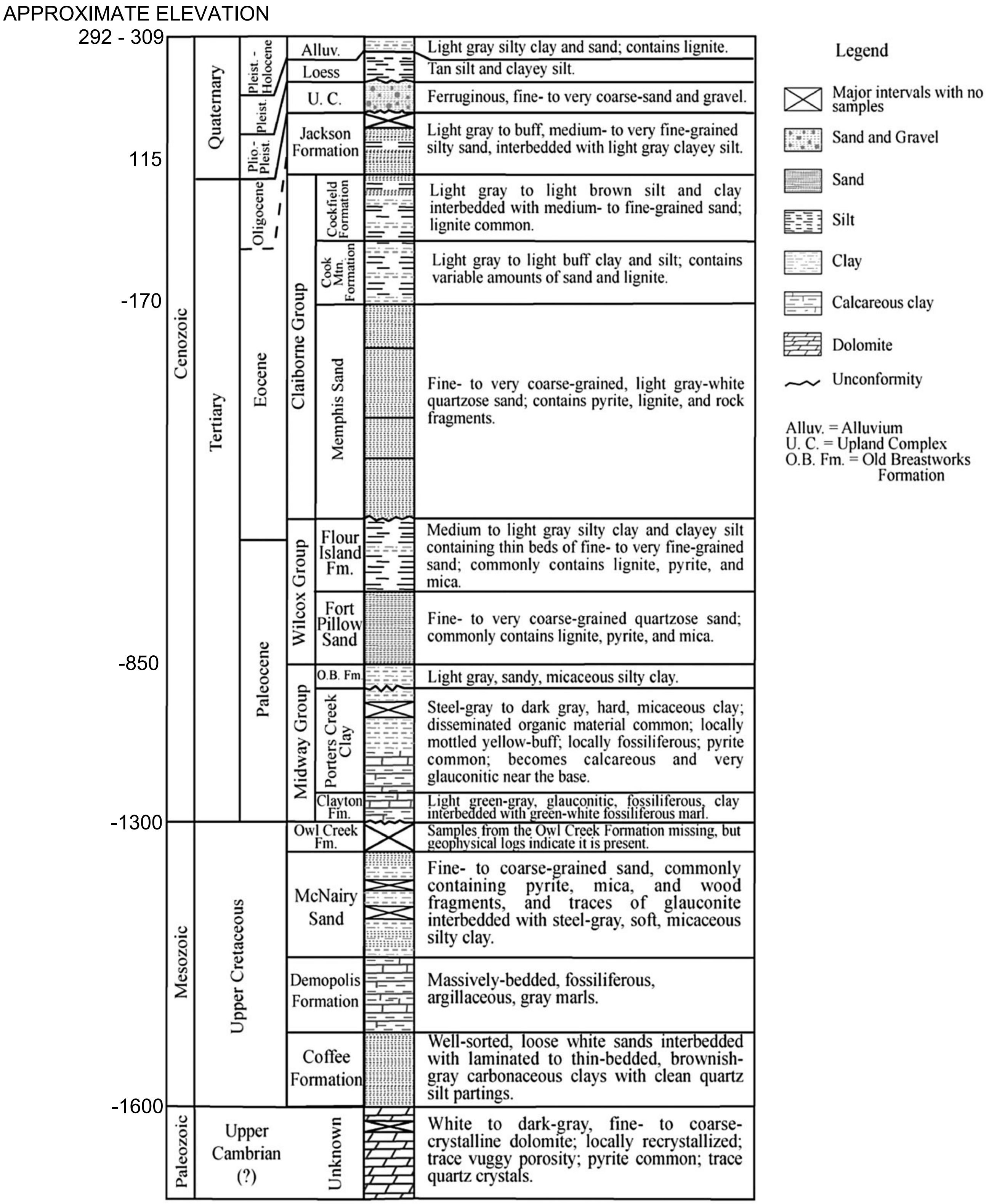
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MO

SUBSURFACE EXPLORATION LOCATION PLAN

SCALE: AS SHOWN
FEBRUARY 2016

FIGURE 2

VARI, KATALIN Printed: 10/29/2015 1:40 PM Layout: XS LOC
G:\40616_AECI-CCR ELG MANAGEMENT SUPPORT\CAD-NM\PONDS\FIGURES\EXPLORATION\40616-130_FIG-2_EXPLORATION LOCATION PLAN.DWG



292 - 309	Cenozoic	Quaternary	Pleist. - Holocene		Alluv.	Light gray silty clay and sand; contains lignite.
					Loess	Tan silt and clayey silt.
			Pleist.		U. C.	Ferruginous, fine- to very coarse-sand and gravel.
			Plio.-Pleist.		Jackson Formation	Light gray to buff, medium- to very fine-grained silty sand, interbedded with light gray clayey silt.
115		Tertiary	Oligocene	Claiborne Group	Cockfield Formation	Light gray to light brown silt and clay interbedded with medium- to fine-grained sand; lignite common.
			Eocene		Cook Mtn. Formation	Light gray to light buff clay and silt; contains variable amounts of sand and lignite.
-170					Memphis Sand	Fine- to very coarse-grained, light gray-white quartzose sand; contains pyrite, lignite, and rock fragments.
			Paleocene	Wilcox Group	Flour Island Fm.	Medium to light gray silty clay and clayey silt containing thin beds of fine- to very fine-grained sand; commonly contains lignite, pyrite, and mica.
					Fort Pillow Sand	Fine- to very coarse-grained quartzose sand; commonly contains lignite, pyrite, and mica.
-850				Midway Group	O.B. Fm.	Light gray, sandy, micaceous silty clay.
					Porters Creek Clay	Steel-gray to dark gray, hard, micaceous clay; disseminated organic material common; locally mottled yellow-buff; locally fossiliferous; pyrite common; becomes calcareous and very glauconitic near the base.
					Clayton Fm.	Light green-gray, glauconitic, fossiliferous, clay interbedded with green-white fossiliferous marl.
-1300	Mesozoic	Upper Cretaceous			Owl Creek Fm.	Samples from the Owl Creek Formation missing, but geophysical logs indicate it is present.
					McNairy Sand	Fine- to coarse-grained sand, commonly containing pyrite, mica, and wood fragments, and traces of glauconite interbedded with steel-gray, soft, micaceous silty clay.
					Demopolis Formation	Massively-bedded, fossiliferous, argillaceous, gray marls.
					Coffee Formation	Well-sorted, loose white sands interbedded with laminated to thin-bedded, brownish-gray carbonaceous clays with clean quartz silt partings.
-1600	Paleozoic	Upper Cambrian (?)			Unknown	White to dark-gray, fine- to coarse-crystalline dolomite; locally recrystallized; trace vuggy porosity; pyrite common; trace quartz crystals.

NOTES

1. IMAGE REFERENCE: VAN ARSDALE AND TENBRINK (2000).

2. ELEVATIONS SHOWN ARE SPECIFIC TO THE NEW MADRID POWER PLAN SITE AND WERE ESTIMATED USING FIGURES FROM VAN ARSDALE AND TENBRINK (2000) AND ROSENBLAD (2007).

3. ELEVATIONS INDICATED ON THIS DRAWING ARE IN FEET AND REFER TO NAVD 1988 DATUM.

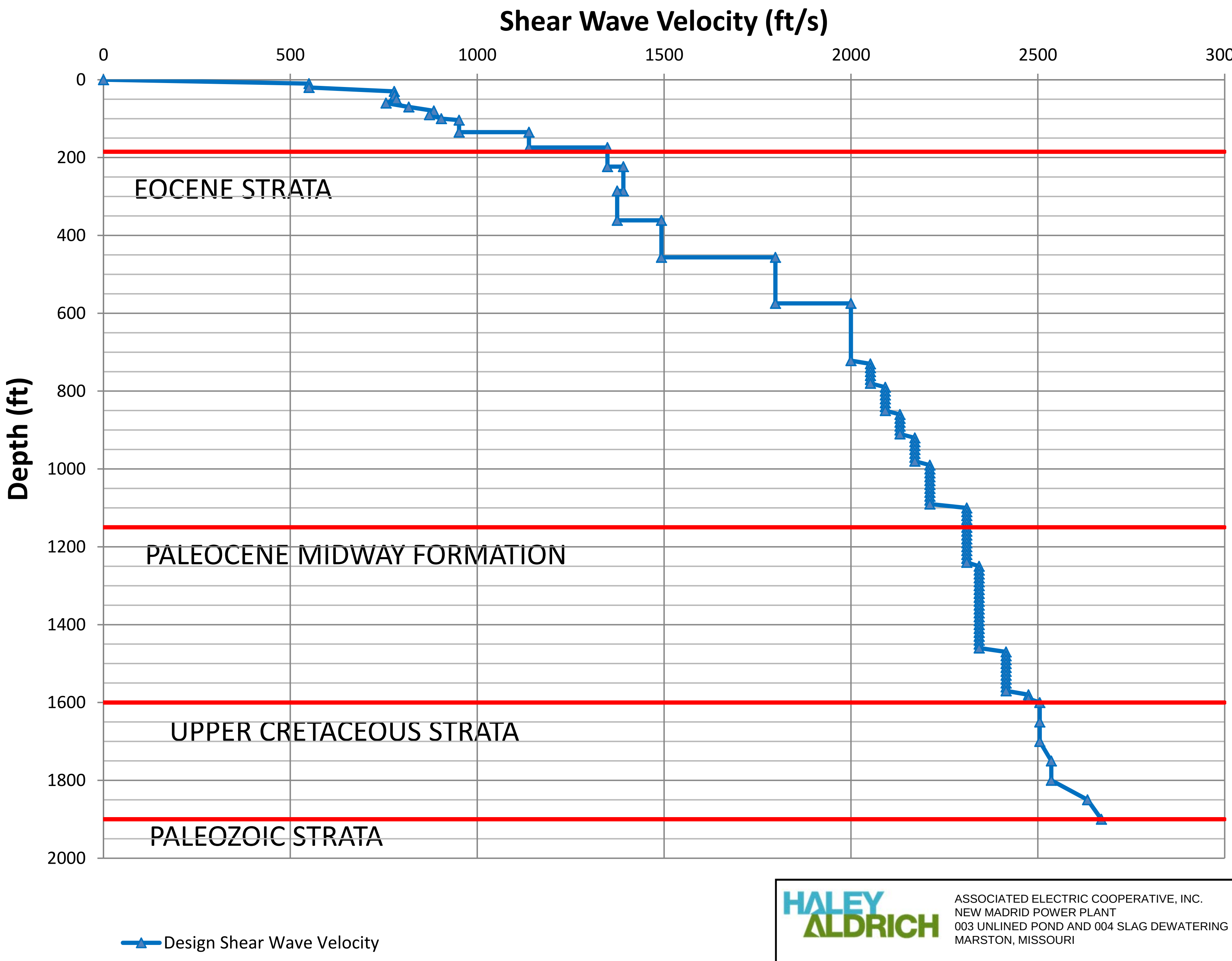
HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MO

GEOLOGIC COLUMN FOR THE NEW MADRID SEISMIC ZONE

APPROXIMATE SCALE: AS SHOWN
FEBRUARY 2016

FIGURE 3



HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

DESIGN SHEAR WAVE VELOCITY PROFILE

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE 4

APPENDIX A

Test Boring Logs

TEST BORING REPORT

Boring No. HA-B1

Project	Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri	File No.	40616-300
Client	Associated Electric Cooperative, Inc.	Sheet No.	1 of 3
Contractor	Bulldog Drilling, Inc.	Start	22 September 2015
		Finish	22 September 2015
		Driller	J. Gates
		H&A Rep.	C. Toscano

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Elevation 309.3
Datum NAVD 88
Location See Plan
N 249,124
E 1,096,406

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						-SAND/GRAVEL ROADWAY FILL-										
	3 4 4 4	S1 12	1.0 3.0	308.3 1.0	SM	Loose brown to orange-brown silty SAND with gravel (SM) mps 20 mm, no odor, dry -FILL-	5	10	5	20	25	35				
	3 3 4 5	S2 20	3.0 5.0	306.3 3.0	CL	Medium stiff dark brown lean CLAY (CL) intermixed with pockets of silt and fine sandy silt, mps 1 mm, no odor, moist						100				
5	2 3 5 5	S3 20	5.0 7.0	304.3 5.0	ML	Loose dark brown sandy SILT (ML) intermixed with pockets of lean clay, mps 1 mm, no odor, moist					40	60				
	2 3 4 6	S4 24	7.0 9.0	302.3 7.0	CL	Medium stiff dark brown lean CLAY (CL), mps < 1 mm, no odor, moist						100	S	M	M	H
10	3 3 5 5	S5 15	9.0 11.0		CL	Similar to S4						100	S	M	M	H
	1 2 4 4	S6 24	11.0 13.0		CL	Similar to S4, except intermixed with pockets of silt and seams of fine sand					7	93				
	2 2 3 3	S7 24	13.0 15.0		CL	Similar to S4, except intermixed with pockets of silt and seams of fine sand						100				
15																
	1 3 4 7	S8 24	18.0 20.0		CL	Similar to S4, except gray-brown						100				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
9/22/15					43.0

Sample ID

- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Split Spoon Sample

Well Diagram

- ◫ Riser Pipe
- ☰ Screen
- ⁘ Filter Sand
- ⁂ Cuttings
- ▩ Grout
- △ Concrete
- ▨ Bentonite Seal

Summary

Overburden (ft)	50.0
Rock Cored (ft)	--
Samples	14S

Boring No. HA-B1

Field Tests:
Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B1
File No. 40616-300
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20																
	2 3 4 5	S9 24	23.0 25.0		CL	Similar to S4, except gray-brown -FILL-						100	S	M	M	H
25																
				283.3 26.0		Note: Drill cuttings indicate alluvial soils at 26.0 ft.										
	1 1 3 4	S10 20	28.0 30.0		CL	Soft light brown lean CLAY (CL) with interbedded seams of fine sandy silt, mps <1 mm, no odor, wet -ALLUVIAL DEPOSITS-						100				
30																
	6 6 12 17	S11 24	33.0 35.0	276.3 33.0	SM	Medium dense light brown silty SAND (SM), mps 1 mm, no odor, dry -FLUVIAL DEPOSITS-					60	40				
35																
	9 11 17 25	S12 20	38.0 40.0		SM	Medium dense light brown silty SAND (SM), mps 2 mm, well stratified, no odor, dry			5	70	25					
40																
						-FLUVIAL DEPOSITS-										
▽																
	11 11 12 14	S13 20	43.0 45.0		SM	Similar to S12			5	80	15					
45																
						Note: Drill action indicated possible gravel layer at approximately 46.0 ft. Lost approximately 100 gallons of drill fluid from 46.0 to 48.0 ft.										
	9 10 12 17	S14 24	48.0 50.0		SM	Similar to S12			5	75	20					

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B1

H&A-TEST BORING-07-1 HA-LIB09.GLB HA-TB+CORE+WELL-07-1.GDT M:\GINT\40616-300_TEST BORINGS-2015 (2).GPJ Nov 5, 15

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50				259.3 50.0		BOTTOM OF EXPLORATION 50.0 FT										
						Note: Borehole grouted upon completion.										

H&A-TEST BORING-07-1 HA-LIB09.GLB HA-TB+CORE+WELL-07-1.GDT M:\GINT\40616-300_TEST BORINGS-2015 (2).GPJ Nov 5, 15

TEST BORING REPORT

Boring No. HA-B2

Project	Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling, Inc.

File No.	40616-300
Sheet No.	1 of 4
Start	21 September 2015
Finish	21 September 2015
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	300.2
Datum	NAVD 88
Location	See Plan N 249,425 E 1,096,678

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						SAND/GRAVEL ROADWAY FILL-										
	1 2 3 3	S1 20	1.0 3.0	299.2 1.0	CL	Medium stiff gray to gray-brown clean CLAY (CL), mps <1 mm, no odor, moist, trace organic fibers -FILL-						100				
	3 3 4 5	S2 20	3.0 5.0		CL	Similar to S1, except with 15% cinders and slag particles by volume						100				
5	3 3 5 7	S3 24	5.0 7.0		CL	Similar to S1, except trace cinders and slag particles						100	S	M	M	H
	3 4 5 9	S4 24	7.0 9.0		CL	Stiff gray-brown lean CLAY (CL), 5% cinders and slag particles by volume, mps 3 mm, no odor, moist						100				
10	2 3 4 6	S5 24	9.0 11.0		CL	Medium stiff gray to gray-brown lean CLAY (CL), mps < 1mm, no odor, moist, trace organic fibers						100	S	M	M	H
	2 3 5 7	S6 24	11.0 13.0		CL	Similar to S5						100	S	M	M	H
	2 3 4 5	S7 24	13.0 15.0		CL	Similar to S5						100	S	M	M	H
15	2 3 3 4	S8 24	15.0 17.0		CL	Similar to S5						100				
				282.2 18.0		Note: Sands observed on auger flights at approximately 18.0 to 19.0 ft. -ALLUVIAL DEPOSITS-										
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
9/21/15					43.0
9/22/15	06:45				40.5

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

- ◫ Riser Pipe
- ☰ Screen
- ⁘ Filter Sand
- ⁂ Cuttings
- ▓ Grout
- △ Concrete
- ▨ Bentonite Seal

Summary

Overburden (ft)	95.0
Rock Cored (ft)	--
Samples	23S

Boring No. HA-B2

Field Tests:
Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	2 3 5 7	S9 24	20.0 22.0		SM	Loose light brown silty SAND (SM) with frequent interbedded layers of gray-brown silt, mps 1 mm, stratified, no odor, dry					60	40				
						-ALLUVIAL DEPOSITS-										
	2 4 7 10	S10 18	23.0 25.0	277.2 23.0	CL	Medium dense gray-brown lean CLAY (CL) with frequent interbedded seams and layers of silty fine sand, mps 1 mm, well stratified, no odor, moist					5	95				
25				274.7 25.5												
	4 6 9 11	S11 20	28.0 30.0		SM	Medium dense light brown silty SAND (SM) with interbedded seams of silt and fine sand, mps 1 mm, no odor, moist					68	32				
30																
	11 14 15 17	S12 15	33.0 35.0	267.2 33.0	SP	Medium dense light brown poorly graded SAND (SP), mps 2 mm, no odor, moist				40	60					
						-FLUVIAL DEPOSITS-										
35																
	7 10 11 13	S13 13	38.0 40.0		SP	Similar to S12, except with frequent seams of naturally occurring lignite particles to fragments			5	60	35					
40 ▽																
	9 10 10 13	S14 15	43.0 45.0	257.2 43.0	SM	Medium dense light brown silty SAND (SM) with interbedded seams of silt and fine sand, mps 1 mm, well stratified, no odor, wet					60	40				
45																
	3 4 8 9	S15 12	48.0 50.0		SM	Medium dense dark gray silty SAND (SM), no odor, wet					60	40				
				251.2 49.0	SP	Medium dense gray poorly graded SAND (SP), mps 3 mm, no odor, wet			80	20						

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B2
File No. 40616-300
Sheet No. 3 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50						Note: Drill action indicated possible gravel at 52.0 to 53.0 ft.										
	6 7 8 12	S16 12	53.0 55.0	247.2 53.0	SM	Medium dense gray silty SAND (SM), trace coarse to fine gravel, mps 2 mm, no odor, wet			5	80	15					
55						-FLUVIAL DEPOSITS-										
	6 6 8 9	S17 12	58.0 60.0	242.2 58.0	SP	Medium dense gray poorly graded SAND (SP), trace limited fragments and particles, mps 3 mm, no odor, wet			10	90						
60																
	7 9 10 12	S18 14	63.0 65.0		SP	Similar to S17			30	65	5					
65																
						Note: Drill action indicated possible gravel from 67.0 to 68.0 ft.										
	6 6 8 10	NR	68.0 70.0			No Recovery										
70																
						Note: Drill action indicated possible gravel from 71.0 to 72.0 ft.										
	7 8 11 10	S19 20	73.0 75.0		SP	Similar to S17, trace coarse to fine gravel, mps 15 mm			10	80	5					
75																
	12 12 14	S20 15	78.0 80.0		SP	Similar to S17, no lignite			10	90						

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B2

TEST BORING REPORT

Boring No. HA-B2
File No. 40616-300
Sheet No. 4 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
	18															
80																
	12 15 18 23	S21 18	83.0 85.0		SP	Dense gray poorly graded SAND (SP), mps 3 mm, no odor, wet			5	90	5					
85																
						-FLUVIAL DEPOSITS-										
						Note: Drill action indicated possible gravel from 87.5 to 88.0 ft.										
	20 14 17 18	S22 15	88.0 90.0		SP	Dense gray well graded SAND with gravel (SP), mps 24 mm, no odor, wet		15	30	45	10					
90																
						Note: Drill action indicated possible gravel from 91.0 to 92.0 ft.										
	19 21 13 23	S23 24	93.0 95.0		SP	Dense gray poorly graded SAND (SP), mps 3 mm, no odor, wet				80	20					
95				205.2 95.0		BOTTOM OF EXPLORATION 95.0 FT										
						Note: Borehole grouted upon completion.										

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B2

H&A-TEST BORING-07-1 HA-LIB09.GLB HA-TB+CORE+WELL-07-1.GDT M:\GINT\40616-300_TEST BORINGS-2015 (2).GPJ Nov 2, 15

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B3

Project	Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri	File No.	40616-300
Client	Associated Electric Cooperative, Inc.	Sheet No.	1 of 3
Contractor	Bulldog Drilling, Inc.	Start	14 September 2015
		Finish	15 September 2015
		Driller	J. Gates
		H&A Rep.	C. Toscano

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	--	Rig Make & Model: CME 55 L6
Inside Diameter (in.)	4.25	1.375	--	Bit Type: Cutting Head Drill Mud: Polymer
Hammer Weight (lb)	--	140	-	Casing: Spun Hoist/Hammer: Winch Automatic Hammer
Hammer Fall (in.)	--	30	-	PID Make & Model: N/A

Elevation 308.8
Datum NAVD 88
Location See Plan
N 247,289
E 1,096,493

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0																
	13 9 5 7	S1 12	1.0 3.0		CL	Stiff brown lean CLAY with sand (CL), trace coarse to fine gravel, mps 25 mm, no odor, dry -FILL-					15	85				
	7 3 3 4	S2 15	3.0 5.0		CL	Similar to S1, except medium stiff, no gravel, fly ash coating on outer surface of soil sample					20	80				
5	2 2 3 5	S3 15	5.0 7.0		CL	Medium stiff brown lean CLAY (CL), trace organic fibers, mps <1 mm, no odor, moist				2	3	95				
	2 1 3 4	S4 12	7.0 9.0		CL	Similar to S3, except soft, mottled, fly ash coating on outer surface of soil sample										
10	2 1 3 4	S5 18	9.0 11.0		CL	Soft brown to gray lean CLAY (CL), mps <1 mm, mottled, no odor, moist						100				
	1 2 2 3	S6 15	11.0 13.0		CL	Soft brown lean CLAY (CL), trace organic fibers, mps <1 mm, no odor, moist					5	95				
	1 1 3 4	S7 18	13.0 15.0		CL	Soft orange-brown to gray-brown lean CLAY (CL), mps <1 mm, no odor, moist					4	96				
15																
	1 3 3 3	S8 16	17.0 19.0		CL	Medium stiff brown lean CLAY with sand (CL), mps 1 mm, no odor, wet					25	75				
				289.8 19.0												
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
9/14/15					43.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

◫	Riser Pipe
▤	Screen
⁘	Filter Sand
⁂	Cuttings
▦	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft)	75.0
Rock Cored (ft)	--
Samples	19S

Boring No. HA-B3

Field Tests:
Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B3
File No. 40616-300
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20																
						Note: Started mud rotary at 23.0 ft.										
	2 3 4 6	S9 18	23.0 25.0		CL	Medium stiff light brown lean CLAY (CL), trace coarse to fine sand, mps 2 mm, no odor, wet						100				
25																
						-ALLUVIAL DEPOSITS-										
	2 2 2 4	S10 20	28.0 30.0	280.8 28.0	CH	Soft brown to gray-brown fat CLAY (CH) with fine sand in occasional partings, mps 1 mm, no odor, dry					4	96	N	M	M	H
30																
	6 11 10 13	S11 24	33.0 35.0	275.8 33.0	SP	Medium dense brown poorly graded SAND (SP), mps 2 mm, no odor, moist, well stratified				10	90					
						-FLUVIAL DEPOSITS-										
35																
	6 7 11 15	S12 20	38.0 40.0		SP	Similar to S11, non stratified				75	25					
40																
				267.8 41.0		Note: Drill action indicated possible gravel at 41.0 ft.										
▽																
	13 16 16 18	S13 20	43.0 45.0		SW	Dense brown well graded SAND (SW), mps 3 mm, no odor, wet (coarse to fine gravel found at top 4 in . of spoon sample)			15	60	25					
45																
						-FLUVIAL DEPOSITS-										
	11 11 17 22	S14 18	48.0 50.0		SW	Similar to S13, except medium dense			15	55	30					

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B3
File No. 40616-300
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50																
	7 8 13 16	S15 18	53.0 55.0	255.8 53.0	SP	Medium dense gray-brown poorly graded SAND (SP), mps 2 mm, no odor, wet				20	80					
55						-FLUVIAL DEPOSITS-										
	10 10 13 13	S16 20	58.0 60.0	250.8 58.0	SW	Medium dense gray-brown well graded SAND (SW), mps 5 mm, no odor, wet			20	65	15					
60																
	11 13 14 18	S17 22	63.0 65.0	245.8 63.0	SP	Medium dense gray-brown poorly graded SAND (SP), mps 2 mm, no odor, wet				35	65					
65																
	15 16 16 12	S18 3	68.0 70.0		SP	Similar to S15, except dense, possibly pushing gravel (poor recovery)				20	80					
70																
	9 13 14 15	S19 18	73.0 75.0	235.8 73.0	SW	Medium dense gray-brown well graded SAND (SW), mps 3 mm, no odor, wet			15	60	25					
75				233.8 75.0		BOTTOM OF EXPLORATION 75.0 FT Note: Borehole grouted upon completion to ground surface.										

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B4

Project	Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling, Inc.

File No.	40616-300
Sheet No.	1 of 4
Start	17 September 2015
Finish	18 September 2015
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	304.2
Datum	NAVD 88
Location	See Plan N 246,729 E 1,097,737

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0																
	1 2 1 1	S1 5	1.0 3.0		ML	Very loose brown to dark brown SILT with sand (ML) with frequent interbedded seams and layers of medium to fine grained cinders and slag, mps 3 mm, no odor, wet					15	85				
						-BOILER SLAG-										
	2 2 1 2	S2 15	3.0 5.0		ML	Similar to S1				5	15	80				
5	2 1 1 2	S3 12	5.0 7.0		ML	Similar to S1					10	90				
	1 1 1 1	S4 15	7.0 9.0		ML	Similar to S1, except no sand, wet (perched groundwater)					5	95				
10	WOH/24"	S5 24	9.0 11.0		ML	Very loose dark brown SILT (ML), mps <1 mm, no odor, wet (outside of spoon dry)						100				
	1 1 1 1	S6 20	11.0 13.0	293.2 11.0	SM	Very loose black silty SAND (SM), mps 3 mm, no odor, wet, contains cinders and slag particles Note: Spoon completely wet, possible perched groundwater.			40	50	10					
▽	1 1 1 1	S7 15	13.0 15.0		SM	Similar to S6 (natural silt found in tip of spoon)			20	70	10					
15	WOH/24"	S8 24	15.0 17.0	289.2 15.0	CL	Very soft brown lean CLAY (CL), trace wood particles, mps 2 mm, no odor, wet						100				
						-ALLUVIAL DEPOSITS-										
	1 1 2 2	S9 24	18.0 20.0		CL	Soft brown to orange-brown lean CLAY (CL), mps < 1 mm, no odor, moist					5	95				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
9/17/15					13.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	95.0
Rock Cored (ft)	--
Samples	23S

Boring No. HA-B4

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20																
	1 1 6 11	S10 24	23.0 25.0		CL	Similar to S9						100				
				280.2 24.0	SP	Medium dense light brown poorly graded SAND (SP), mps 2 mm, well stratified, no odor, moist				40	60					
25						-ALLUVIAL DEPOSITS-										
	5 6 7 10	S11 24	28.0 30.0		SP	Medium dense light brown poorly graded SAND (SP) with frequent interbedded seams and layers of dark brown silty SAND, mps 1 mm, well stratified, no odor, moist				15	85					
30																
	3 4 7 8	S12 24	33.0 35.0		SP	Similar to S11				10	90					
35																
	7 8 13 19	S13 20	38.0 40.0	266.2 38.0	SP	Medium dense light brown poorly graded SAND (SP), mps 2 mm, no odor, moist				40	60					
						-FLUVIAL DEPOSITS-										
40				263.2 41.0												
	8 10 11 12	S14 18	43.0 45.0		SW	Medium dense light brown well graded SAND (SW), mps 3 mm, no odor, wet			20	65	15					
45																
	10 10 15 15	S15 13	48.0 50.0	256.2 48.0	SP	Medium dense light brown poorly graded SAND (SP), mps 2 mm, no odor, wet			2	63	31	4				

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B4
File No. 40616-300
Sheet No. 3 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50																
	7 7 10 12	S16 20	53.0 55.0	251.2 53.0	SW	Medium dense light brown well graded SAND (SW), mps 5 mm, no odor, wet, trace fine gravel			20	65	15					
55																
						-FLUVIAL DEPOSITS-										
	7 10 10 12	S17 18	58.0 60.0	246.2 58.0	SP	Medium dense light brown poorly graded SAND (SP), mps 10 mm, no odor, wet, trace coarse to fine gravel			5	90	5					
60																
	10 10 16 18	S18 24	63.0 65.0		SP	Similar to S17				60	40					
65																
	10 10 12 13	S19 6	68.0 70.0	236.2 68.0	SW	Medium dense light brown well graded SAND (SW), mps 5 mm, no odor, wet, trace fine gravel			20	60	20					
70																
	16 17 18 22	S20 18	73.0 75.0	231.2 73.0	SP	Dense gray-brown poorly graded SAND (SP), mps 2 mm, stratified, no odor, wet				60	40					
75																
						Note: Drill action indicated possible occasional gravel layers up to 12 in. thick from 77.0 to 81.0 ft.										

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B4
File No. 40616-300
Sheet No. 4 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
80																
	11 10 9 10	S21 20	83.0 85.0		SP	Medium dense gray poorly graded SAND (SP), trace coarse to fine gravel, mps 20 mm, no odor, wet			10	75	15					
85						-FLUVIAL DEPOSITS-										
	9 10 11 17	S22 18	88.0 90.0	216.2 88.0	SW	Medium dense gray well graded SAND (SW), trace coarse gravel, mps 20 mm, no odor, wet		5	45	40	10					
90																
	10 14 12 15	S23 20	93.0 95.0		SW	Similar to S22			55	35	10					
95				209.2 95.0		BOTTOM OF EXPLORATION 95.0 FT Note: Borehole grouted upon completion. Pushed four undisturbed shelby tube samples in offset hole. See Test Boring Report HA-B4A for details.										

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B4A

Project	Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling, Inc.

File No.	40616-300
Sheet No.	1 of 1
Start	17 September 2015
Finish	18 September 2015
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	304.2
Datum	NAVD 88
Location	See Plan N 246,729 E 1,097,737

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						Note: Augered to shelby tube sampling depths without collecting split-spoon samples.										
	P U S H	U1 12	3.0 5.0		ML	Brown SILT (ML)										
5	P U S H	U2 24	5.0 7.0		ML	Dark brown SILT (ML)										
	P U S H	U3 0	7.0 9.0			No Recovery										
10	P U S H	U4 0	9.0 11.0			No Recovery										
15				289.2 15.0		BOTTOM OF EXPLORATION 15.0 FT Note: Borehole grouted upon completion. See Test Boring Report HA-B4 for additional details.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Water
9/18/15					Dry

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	15.0
Rock Cored (ft)	--
Samples	4U

Boring No. HA-B4A

Field Tests:
Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B5

Project Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri
Client Associated Electric Cooperative, Inc.
Contractor Bulldog Drilling, Inc.

File No. 40616-300
Sheet No. 1 of 2
Start 15 September 2015
Finish 15 September 2015
Driller J. Gates
H&A Rep. C. Toscano

Elevation 316.1
Datum NAVD 88

Location See Plan
N 246,385
E 1,096,345

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures
Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0																
	5 7 7 9	S1 20	1.0 3.0		ML	Medium dense black SILT with sand (ML), mps 2 mm, no odor, dry -FLY ASH-					25	75				
	4 4 5 4	S2 24	3.0 5.0		ML	Similar to S1, except loose					25	75				
5	2 2 2 2	S3 20	5.0 7.0		ML	Similar to S1, except very loose				10	30	60				
	2 1 2 2	S4 18	7.0 9.0		ML	Very loose brown to dark brown SILT (ML) interbedded with seams of fine sand, mps 1 mm, no odor, moist, trace organic fibers (wet at tip of spoon)					10	90				
10	1 1 2 2	S5 18	9.0 11.0		ML	Similar to S4, except wet to moist					10	90				
	1 1 1 1	S6 18	11.0 13.0		ML	Similar to S4, except with frequent interbedded seams of medium to fine sand, mps 2 mm, wet					20	80				
	1 1 1 1	S7 20	13.0 15.0		ML	Similar to S4					10	90				
15	WOH 1 1 1	S8 24	15.0 17.0		ML	Similar to S4 Note: Sample moist to wet throughout entire sample. May be perched groundwater.					10	90				
	WOH 1 2 1	S9 16	17.0 19.0	299.1 17.0	ML	Similar to S4, except with interbedded layers of coarse to fine sand (boiler slag particles), mps 2 mm -FLY ASH/BOILER SLAG-				15	25	60				
20	4 1	S10 18	19.0 21.0		ML	Similar to S4, except moist to wet					10	90				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
9/15/15					43.0

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
◫ Riser Pipe
▤ Screen
⁘ Filter Sand
▨ Cuttings
▩ Grout
△ Concrete
▧ Bentonite Seal

Summary

Overburden (ft)	50.0
Rock Cored (ft)	--
Samples	19S

Boring No. HA-B5

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B5
File No. 40616-300
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20	2 1															
	2 3 1 1	S11 18	21.0 23.0		ML	Very loose brown to dark brown SILT (ML) with frequent interbedded layers of black coarse to fine grained cinders and slag particles, mps 3 mm, no odor, wet					5	95				
						-FLY ASH/BOILER SLAG-										
	1 1 2 3	S12 18	23.0 25.0		ML	Similar to S11					5	95				
25	1 2 1 1	S13 18	25.0 27.0		ML	Similar to S11					5	95				
	1 1 1 1	S14 24	27.0 29.0		ML	Similar to S11					5	95				
30	WOH WOH 1 1	S15 24	29.0 31.0		ML	Similar to S11					5	95				
				284.1 32.0												
	2 4 4 7	S16 24	33.0 35.0		CH	Medium stiff gray fat CLAY with fine sand in frequent partings (CH), mps 1 mm, no odor, moist					5	95	S	M	M	H
35																
						-ALLUVIAL DEPOSITS-										
	3 4 4 7	S17 24	38.0 40.0		CH	Similar to S16 Note: Medium to fine sand found in tip of spoon.					5	95	S	M	M	H
40				276.1 40.0												
∇	14 20 18 16	S18 20	43.0 45.0		SP	Dense light brown poorly graded SAND (SP), mps 3 mm, no odor, wet				80	20					
45																
						-FLUVIAL DEPOSITS-										
	15 12 14 26	S19 15	48.0 50.0		SP	Similar to S18				80	20					

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B5
File No. 40616-300
Sheet No. 3 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	**VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION** (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
50				266.1 50.0		BOTTOM OF EXPLORATION 50.0 FT Note: Borehole grouted to 65 ft upon completion. Pushed three shelby tube samples in offset hole at depths of 10.0 to 12.0 ft, 20.0 to 22.0 ft, and 27.0 to 29.0 ft. See Test Boring Report HA-B5A for details.										

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B5

H&A-TEST BORING-07-1 HA-LIB09.GLB HA-TB+CORE+WELL-07-1.GDT M:\GINT\40616-300_TEST BORINGS-2015 (2).GPJ Nov 2, 15

TEST BORING REPORT

Boring No. HA-B5A

Project	Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling, Inc.

File No.	40616-300
Sheet No.	1 of 2
Start	16 September 2015
Finish	16 September 2015
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	316.1
Datum	NAVD 88
Location	See Plan N 246,385 E 1,096,345

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						Note: Augered to shelby tube sampling depths without collecting split-spoon samples.										
5																
10	P U S H	U1 24	10.0 12.0		ML	Brown to dark brown SILT (ML)										
15																
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
9/16/15					25.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	29.0
Rock Cored (ft)	--
Samples	3U

Boring No. HA-B5A

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B5A
File No. 40616-300
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20	PUSH	U2 24	20.0 22.0		ML	Brown to dark brown SILT (ML)										
25 ▽																
	PUSH	U3 8	27.0 29.0	287.1 29.0	ML	Brown to dark brown SILT (ML) Poor recovery due to the presence of cinders and boiler slag.										
						BOTTOM OF EXPLORATION 29.0 FT Note: Borehole grouted upon completion. See Test Boring Report HA-B5 for additional details.										

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B5A

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B6

Project	Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling, Inc.

File No.	40616-300
Sheet No.	1 of 3
Start	16 September 2015
Finish	17 September 2015
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	307.4
Datum	NAVD 88
Location	See Plan N 245,683 E 1,098,769

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						SAND/GRAVEL ROADWAY-										
	6 6 9 13	S1 24	1.0 3.0	306.4 1.0	CL	Stiff light brown lean CLAY (CL), mps 1 mm, no odor, dry -FILL-					10	90				
	5 4 6 7	S2 24	3.0 5.0		CL	Stiff gray lean CLAY (CL) interbedded with layers of brown SILT with sand (ML), mps 1 mm, no odor, dry					10	90				
5	3 3 5 8	S3 24	5.0 7.0		CL	Medium stiff gray lean CLAY with sand (CL), mps < 1 mm, no structure, no odor, dry					15	85				
	3 3 6 8	S4 24	7.0 9.0		CL	Medium stiff gray lean CLAY with sand (CL), mps <1 mm, no structure, no odor, dry					6	94				
10	3 6 6 8	S5 24	9.0 11.0		CL	Stiff light brown lean CLAY with sand (CL), mps 1 mm, no odor, dry					15	85				
	3 4 6 9	S6 24	11.0 13.0	296.4 11.0	CL	Stiff gray lean CLAY (CL), mps <1 mm, stratified, no odor, dry -ALLUVIAL DEPOSITS-						100				
	6 7 6 9	S7 24	13.0 15.0		CL	Stiff gray lean CLAY (CL) with sand and fine sand in frequent partings					3	97				
15	4 5 9 9	S8 24	15.0 17.0		CL	Similar to S7, trace organic fibers					5	95				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
9/16/15					40.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

◫ Riser Pipe
▤ Screen
⁘ Filter Sand
⁖ Cuttings
▓ Grout
△ Concrete
▨ Bentonite Seal

Summary

Overburden (ft)	75.0
Rock Cored (ft)	--
Samples	20S

Boring No. HA-B6

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B6
File No. 40616-300
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	10 10 12 15	S9 24	20.0 22.0		CL	Medium stiff gray lean CLAY (CL) with frequent interbedded layers of fine sand (SM), mps 1 mm, no odor, moist					60	40				
						-ALLUVIAL DEPOSITS-										
25	3 3 4 4	S10 24	25.0 27.0		CL	Medium stiff brown lean CLAY (CL) with interbedded layers and seams of silty sand, mps 1 mm, no odor, moist					5	95				
						Note: Switched to mud rotary at 20.0 ft.										
	2 1 1 2	S11 24	28.0 30.0		CL	Very soft yellow-brown to brown lean CLAY (CL), mps < 1 mm, no odor, moist						100				
30																
				276.4 31.0												
	4 4 5 10	S12 18	33.0 35.0		SP	Loose light brown poorly graded SAND (SP) with occasional layers of silt, mps 2 mm, well stratified, no odor, dry				20	80					
35																
				270.4 37.0												
	7 9 11 13	S13 20	38.0 40.0		SP	Medium dense light brown poorly graded SAND (SP), mps 2 mm, stratified, no odor Note: Wet at tip of spoon.				60	40					
▽ 40						-FLUVIAL DEPOSITS-										
	9 11 15 19	S14 16	43.0 45.0		SP	Similar to S13				90	10					
45																
	8 11 12 14	S15 18	48.0 50.0		SP	Similar to S13				90	10					

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B6

TEST BORING REPORT

Boring No. HA-B6
File No. 40616-300
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50																
	13 13 13 16	S16 18	53.0 55.0		SP	Similar to S13				80	20					
55																
						-FLUVIAL DEPOSITS-										
	9 9 15 17	S17 18	58.0 60.0	249.4 58.0	SW	Medium dense light brown well graded SAND (SW), trace fine gravel, mps 5 mm, no odor, wet			20	60	20					
60																
	10 11 13 15	S18 18	63.0 65.0		SW	Similar to S17, except trace shell fragments, stratified			25	60	15					
65																
	10 11 8 11	S19 12	68.0 70.0		SW	Similar to S17, well stratified			25	55	20					
70																
	10 10 15 13	S20 15	73.0 75.0		SW	Similar to S17, except trace coarse to fine gravel, mps 20 mm			35	55	10					
75				232.4 75.0		BOTTOM OF EXPLORATION 75.0 FT Note: Borehole grouted upon completion.										

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B7

Project Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri
Client Associated Electric Cooperative, Inc.
Contractor Bulldog Drilling, Inc.

File No. 40616-300
Sheet No. 1 of 2
Start 22 September 2015
Finish 22 September 2015
Driller J. Gates
H&A Rep. C. Toscano

Elevation 302.9
Datum NAVD 88
Location See Plan
N 249,818
E 1,096,497

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0																
	12 12 7 4	S1 15	1.0 3.0		SM	Medium dense black silty SAND (SM), mps 2.0 mm, no odor, dry, contains cinders and slag particles				30	50	20				
				300.4 2.5		-FILL-										
					CL	Stiff gray lean CLAY (CL), trace cinders and slag, mps 4 mm, no odor, dry						100				
	3 5 5 5	S2 20	3.0 5.0		CL	Stiff gray lean CLAY (CL) intermixed with cinder and slag fragments to particles, mps 15 mm, no odor, dry		5	5	10	20	60				
5	3 4 7 8	S3 20	5.0 7.0		CL	Similar to S2, mps 5 mm			5	5	5	85				
	3 4 6 7	S4 24	7.0 9.0		CL	Similar to S2			10	5	5	80				
10	2 4 4 6	S5 20	9.0 11.0		CL	Similar to S2, except medium stiff, trace cinders and slag particles, mps 3 mm						100				H
	3 4 7 8	S6 24	11.0 13.0	291.9 11.0	CH	Medium stiff gray-brown fat CLAY with sand (CH), no odor, dry					13	87				H
	2 4 6 6	S7 24	13.0 15.0		CH	Similar to S6, except gray to gray-brown, no cinders and slag						100				H
15	2 3 3 3	S8 24	15.0 17.0		CH	Similar to S6, except medium stiff						100				H
	1 1 2 3	S9 24	17.0 19.0		CH	Similar to S6, except moist, soft						100				
	1 1	S10 24	19.0 21.0	283.9 19.0	CL	Very soft lean CLAY (CL), mps < 1 mm, no odor, wet					10	90				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
9/22/15					Dry

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
- ☐ Riser Pipe
- ☐ Screen
- ▨ Filter Sand
- ▨ Cuttings
- ▨ Grout
- ▨ Concrete
- ▨ Bentonite Seal

Summary

Overburden (ft)	27.0
Rock Cored (ft)	--
Samples	12S

Boring No. HA-B7

Field Tests:
Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B7
File No. 40616-300
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	1 1															
	WOH 2 3 3	S11 24	21.0 23.0	281.9 21.0	SM	Loose brown silty SAND (SM), mps 1 mm, well stratified, no odor, dry					60	40				
						-ALLUVIAL DEPOSITS-										
25	2 3 6 7	S12 24	25.0 27.0		SM	Similar to S11, except with frequent seams of silt and fine sand, well stratified, moist					60	40				
				275.9 27.0		BOTTOM OF EXPLORATION 27.0 FT Note: Borehole grouted upon completion.										

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

APPENDIX B

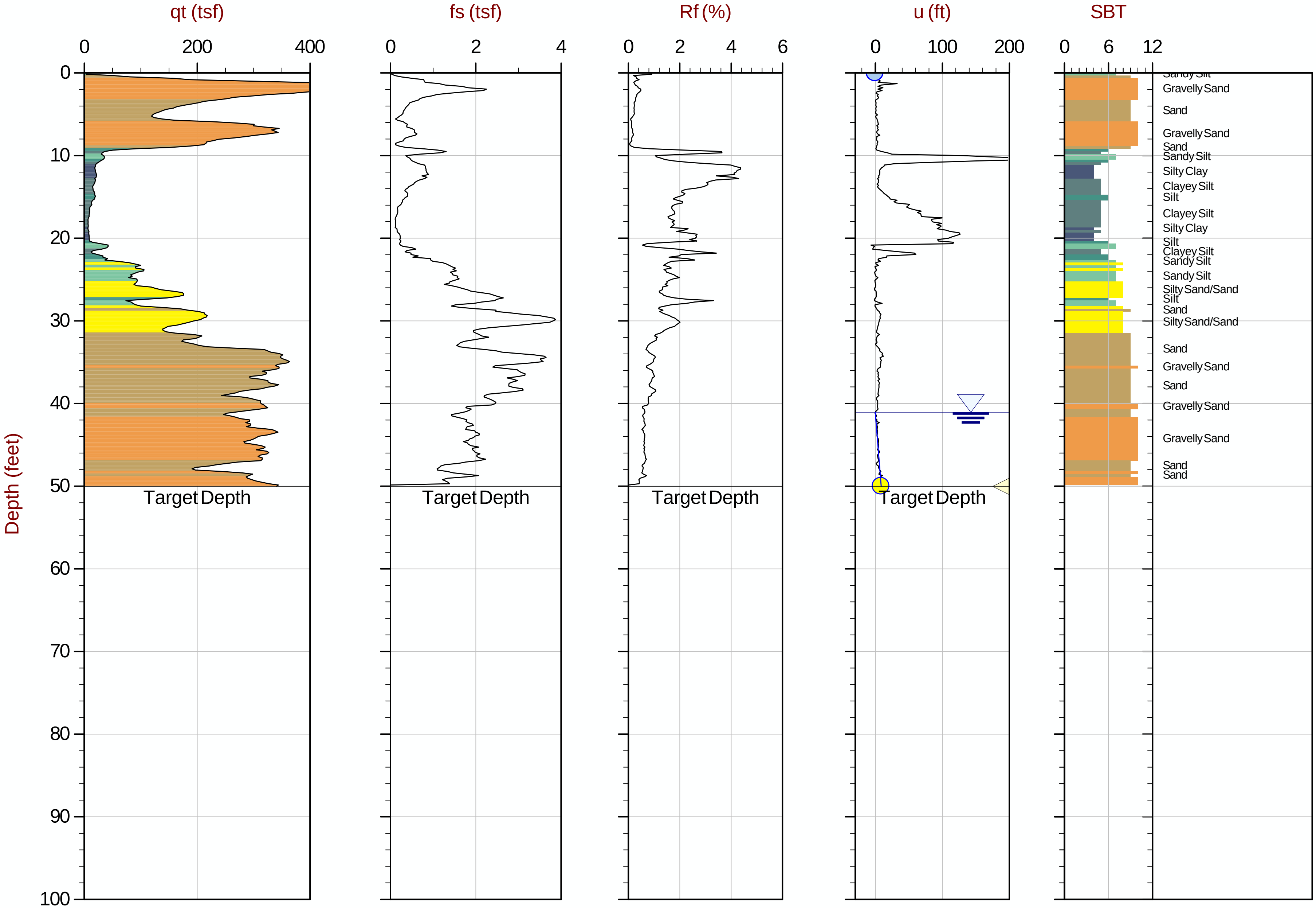
CPT Sounding Logs and Related Information

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 17:40
Site: AECI-New Madrid

Sounding: CPT15-HAC1
Cone: 419:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP01.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4044206m E: 270757m

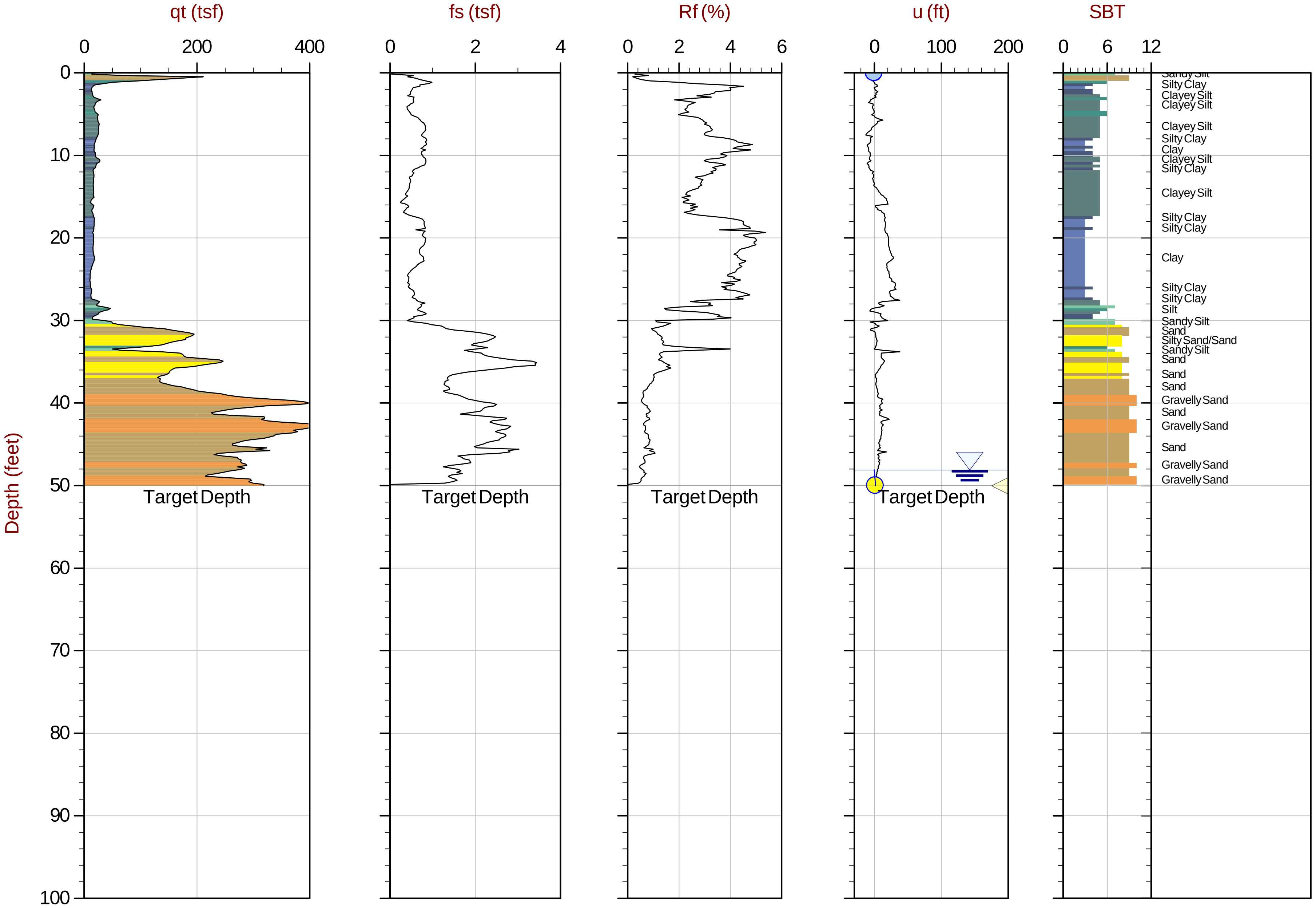
— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 14:41
Site: AECI-New Madrid

Sounding: CPT15-HAC2
Cone: 419:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP02.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4044000m E: 270758m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

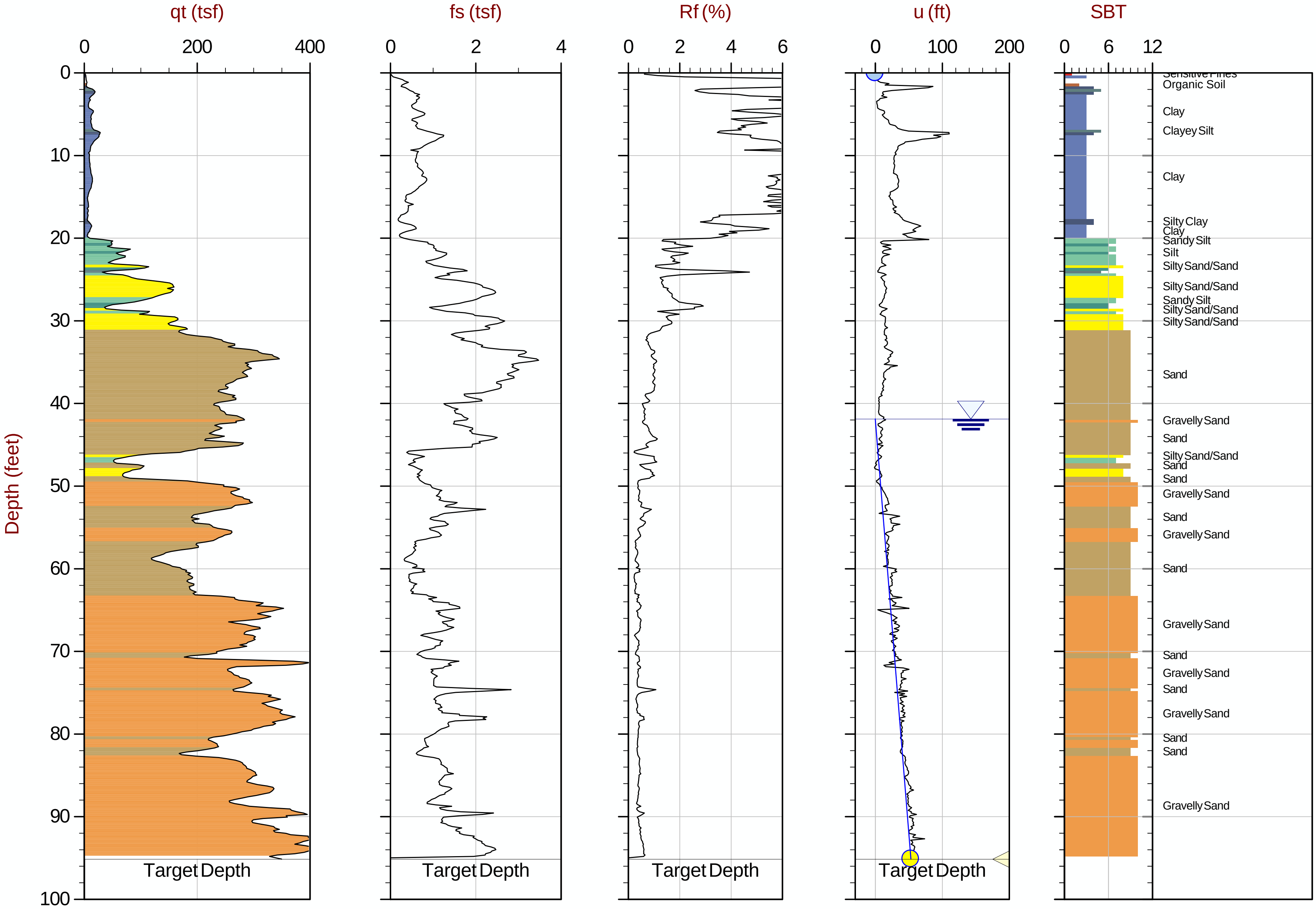
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 15:59
Site: AECI-New Madrid

Sounding: CPT15-HAC3
Cone: 419:T1500F15U500



Max Depth: 29.000 m / 95.14 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP03.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4044097m E: 270832m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

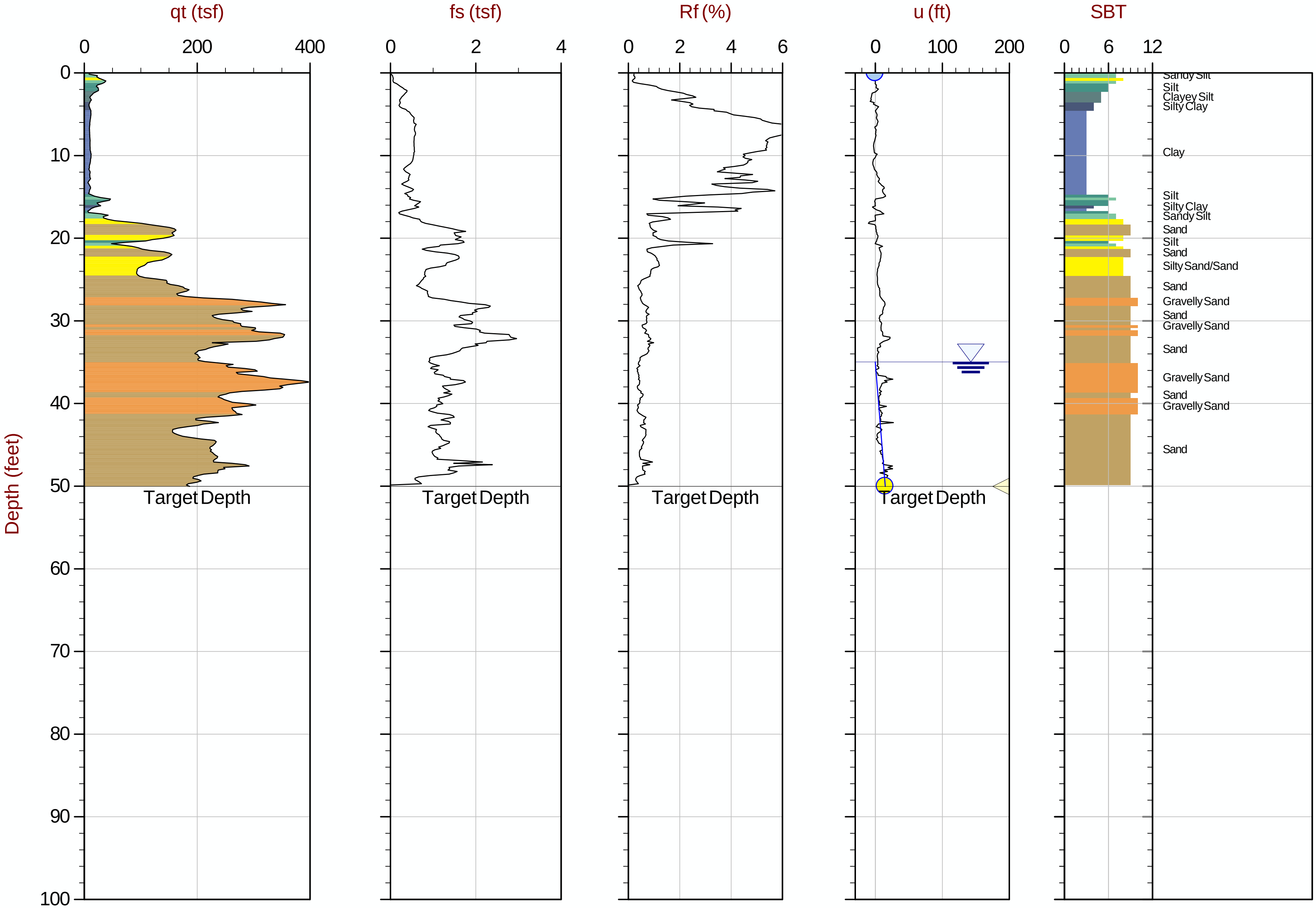
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 13:17
Site: AECI-New Madrid

Sounding: CPT15-HAC4
Cone: 419:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP04.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4044000m E: 270732m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

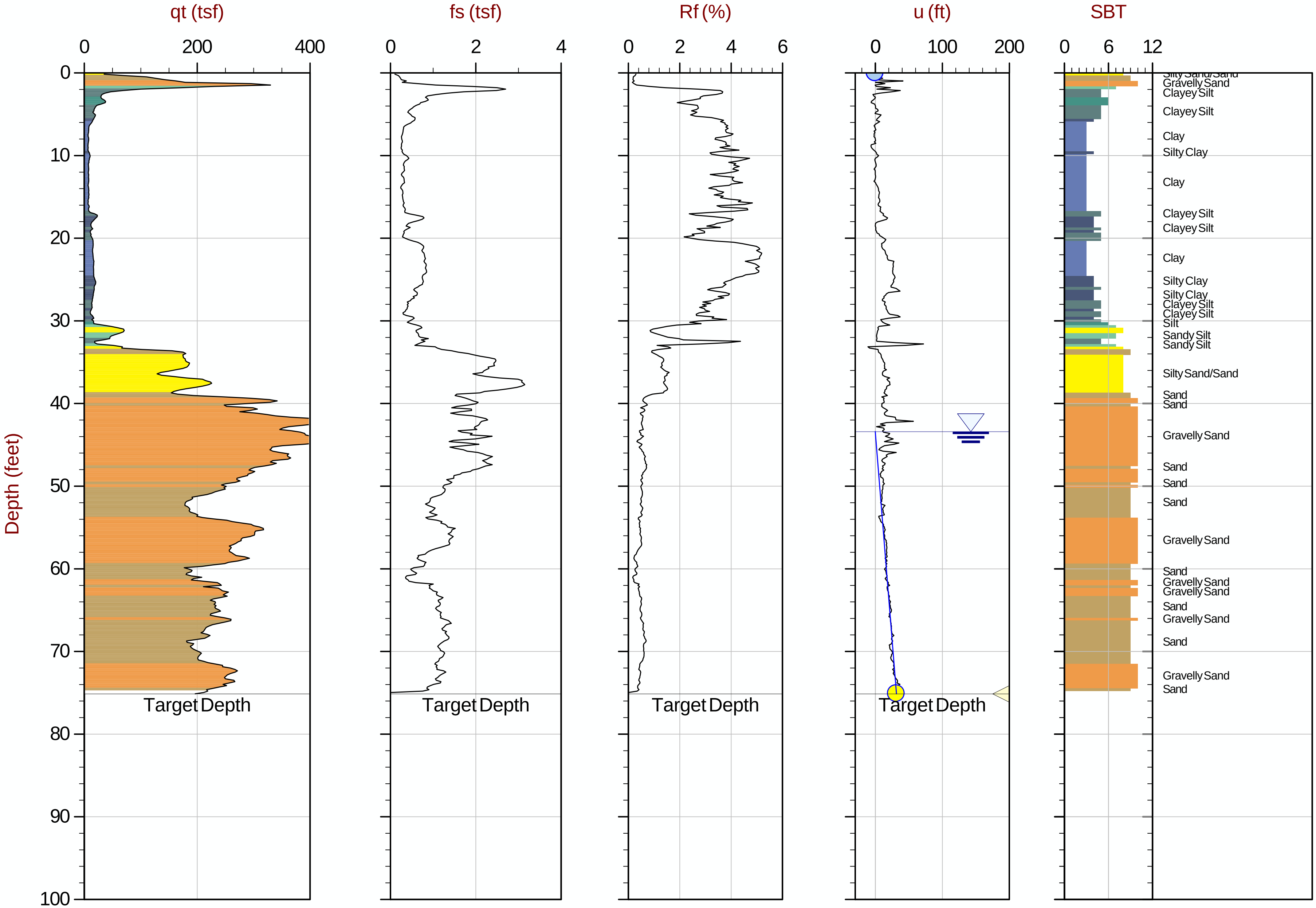
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:15:15 17:52
Site: AECI-New Madrid

Sounding: CPT15-HAC5
Cone: 419:T1500F15U500



Max Depth: 22.900 m / 75.13 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP05.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4043453m E: 270755m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

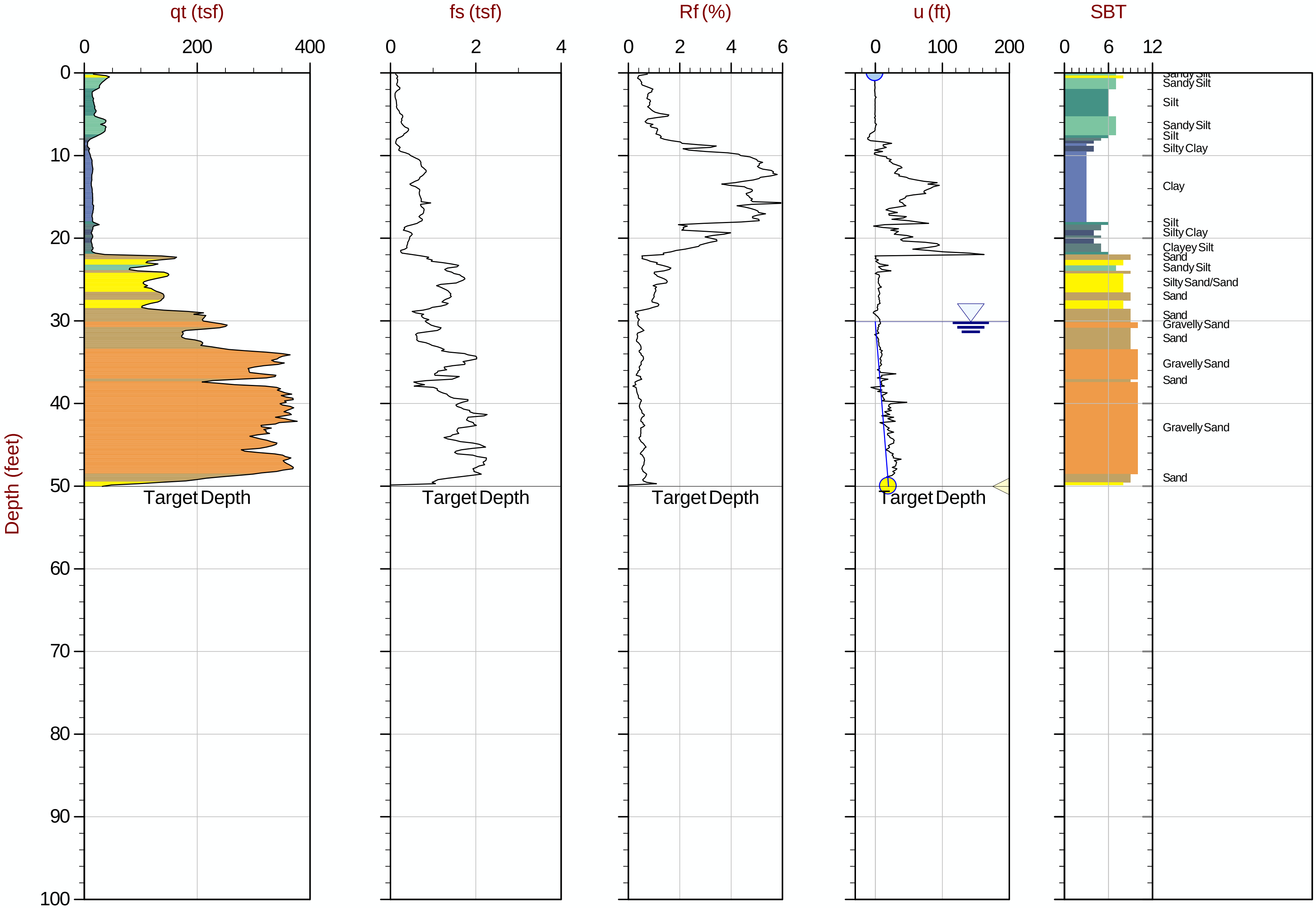
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:16:15 10:26
Site: AECI-New Madrid

Sounding: CPT15-HAC6
Cone: 419:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP06.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4043392m E: 270698m

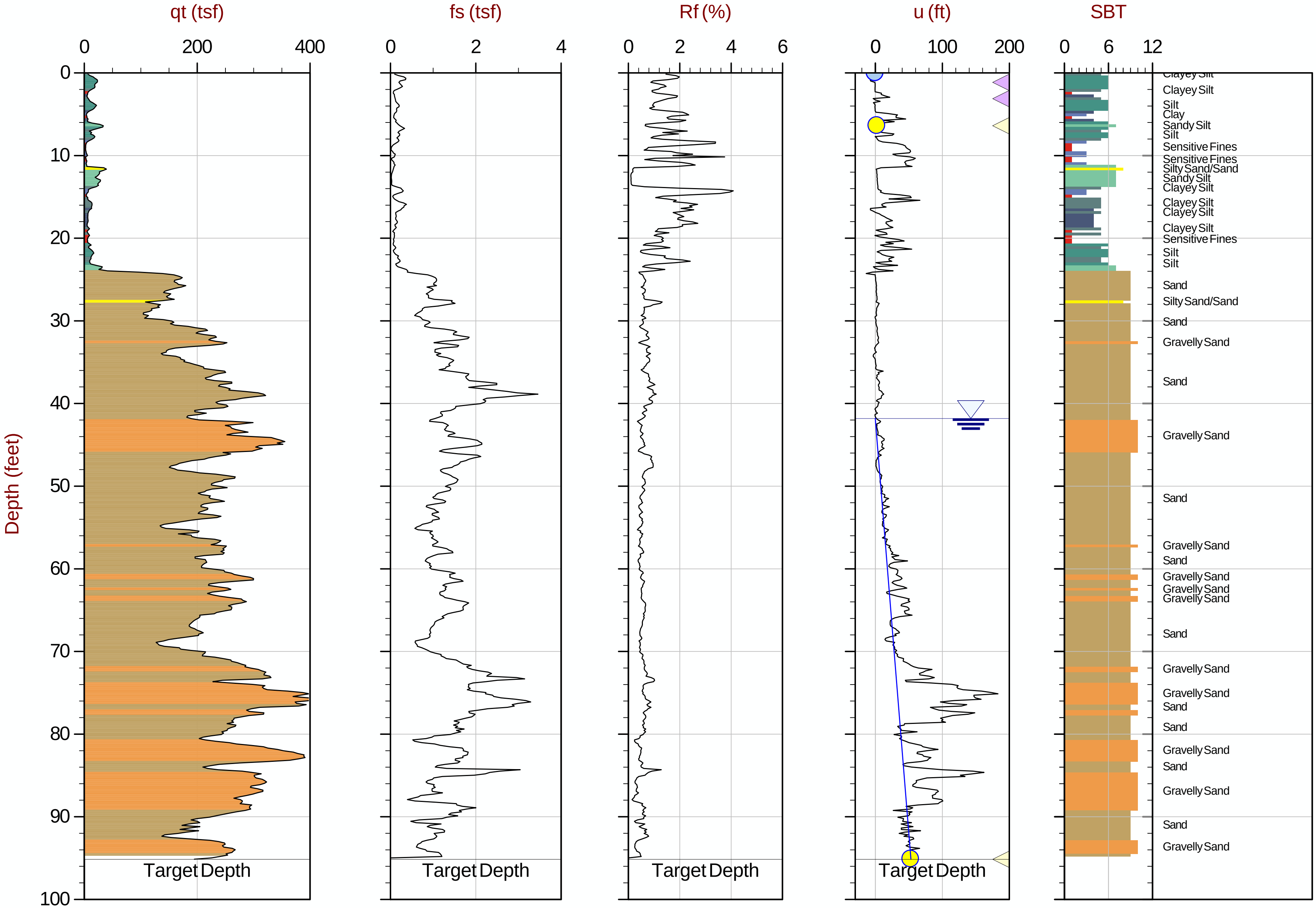
— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Haley & Aldrich

Job No: 15-53087
Date: 09:15:15 14:36
Site: AECI-New Madrid

Sounding: SCPT15-HAC7
Cone: 419:T1500F15U500



Max Depth: 29.000 m / 95.14 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_SP07.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4043266m E: 271126m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

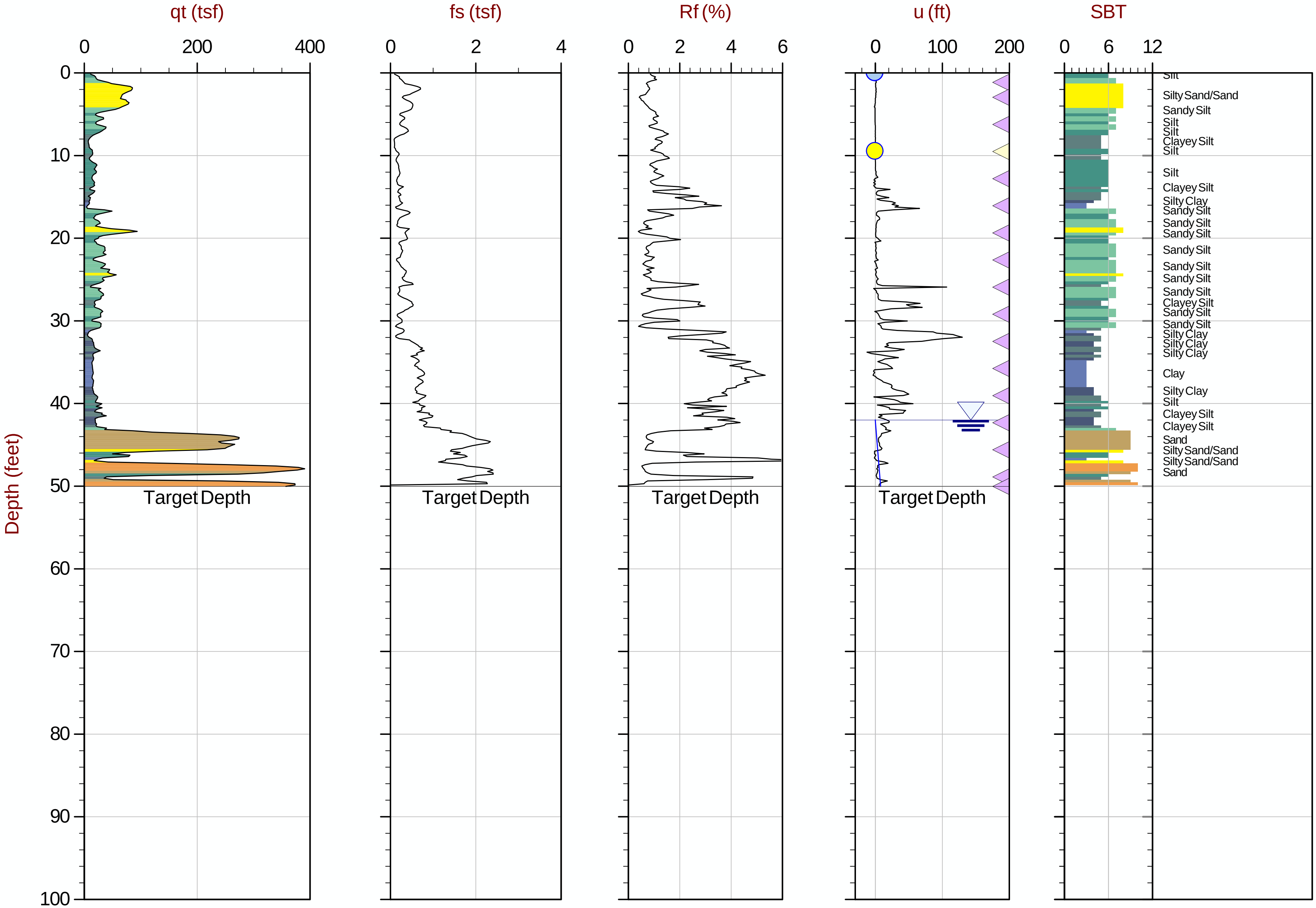
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:16:15 12:39
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: 419:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_SP08.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4043175m E: 270700m

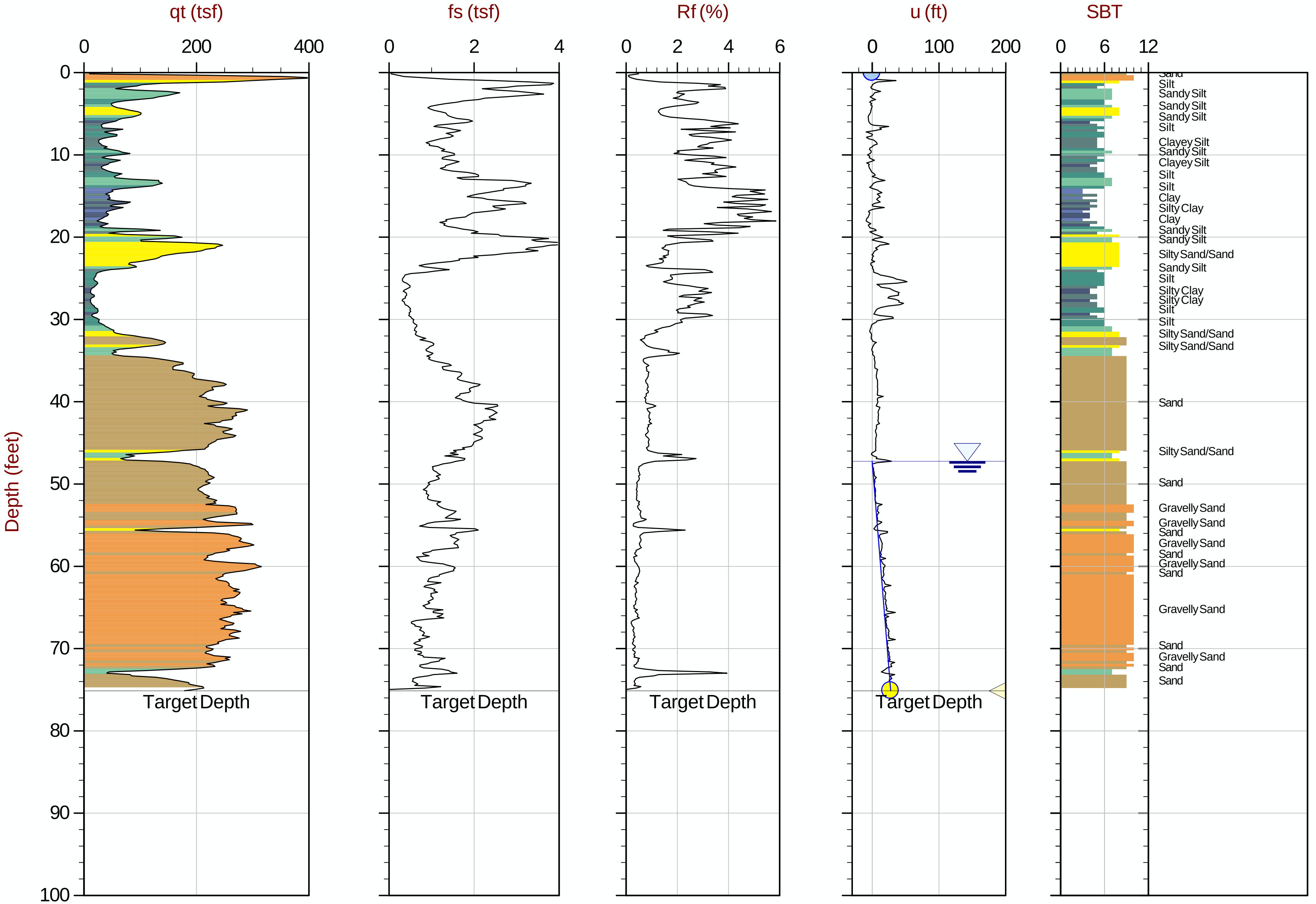
— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 11:57
Site: AECI-New Madrid

Sounding: CPT15-HAC9
Cone: 419:T1500F15U500



Max Depth: 22.900 m / 75.13 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP09.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4042932m E: 271425m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

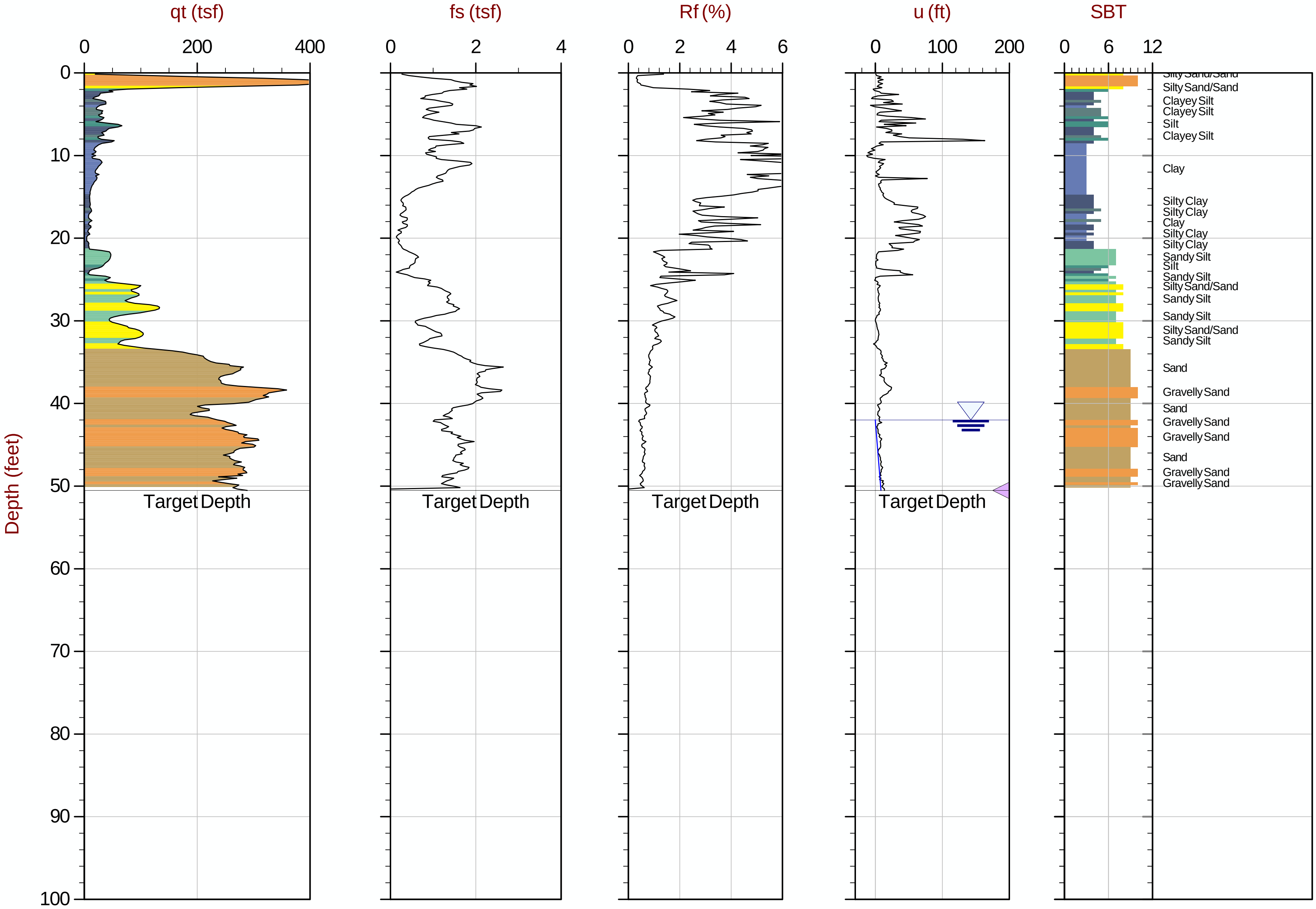
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 17:40
Site: AECI-New Madrid

Sounding: CPT15-HAC10
Cone: 419:T1500F15U500



Max Depth: 15.400 m / 50.52 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP10.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4044217m E: 270784m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

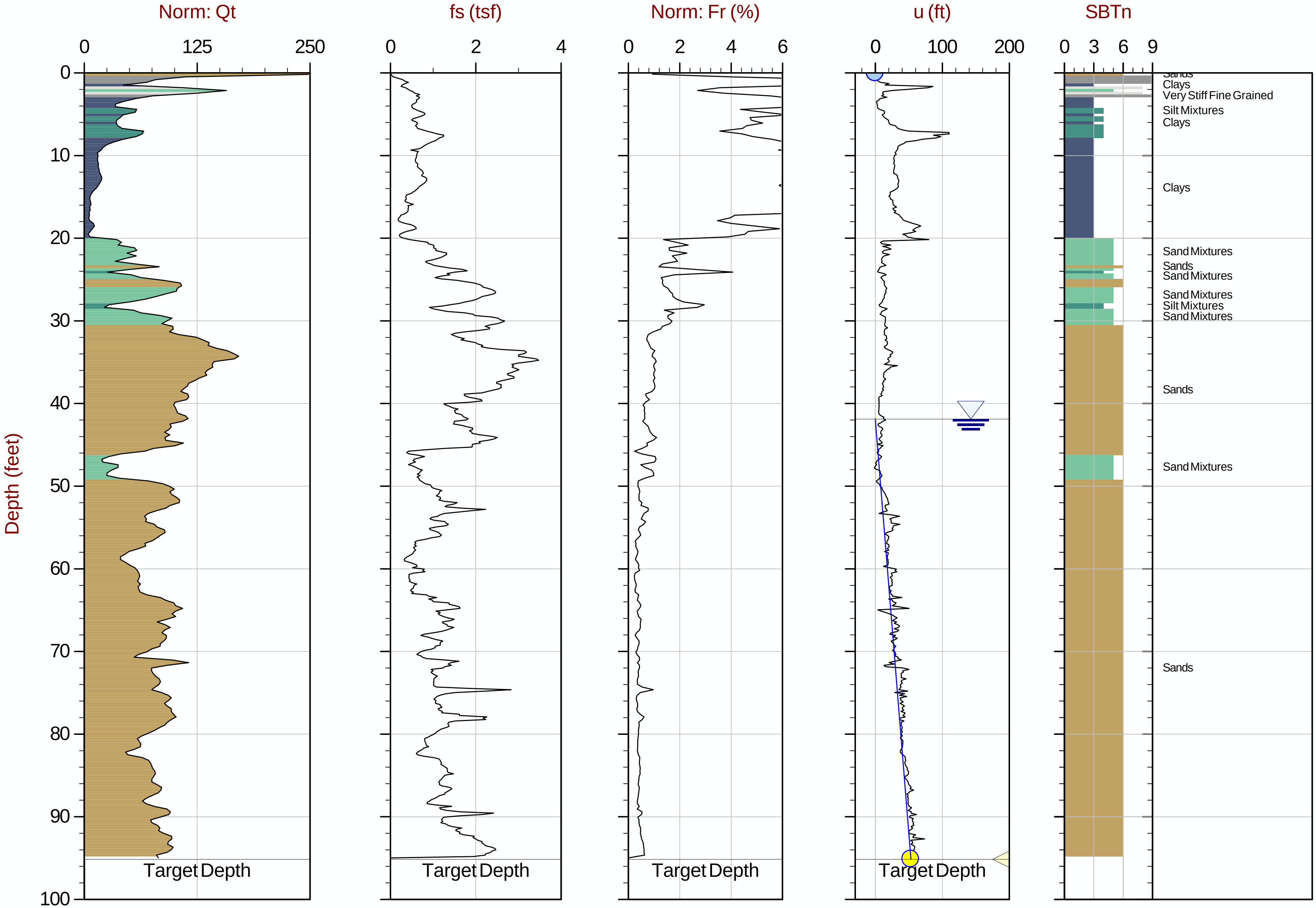
Normalized Cone Penetration Test Plots

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 15:59
Site: AECI-New Madrid

Sounding: CPT15-HAC3
Cone: 419:T1500F15U500



Max Depth: 29.000 m / 95.14 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP03.COR

SBT: Robertson, 1990
Coords: UTM Zone 16 N: 4044097m E: 270832m

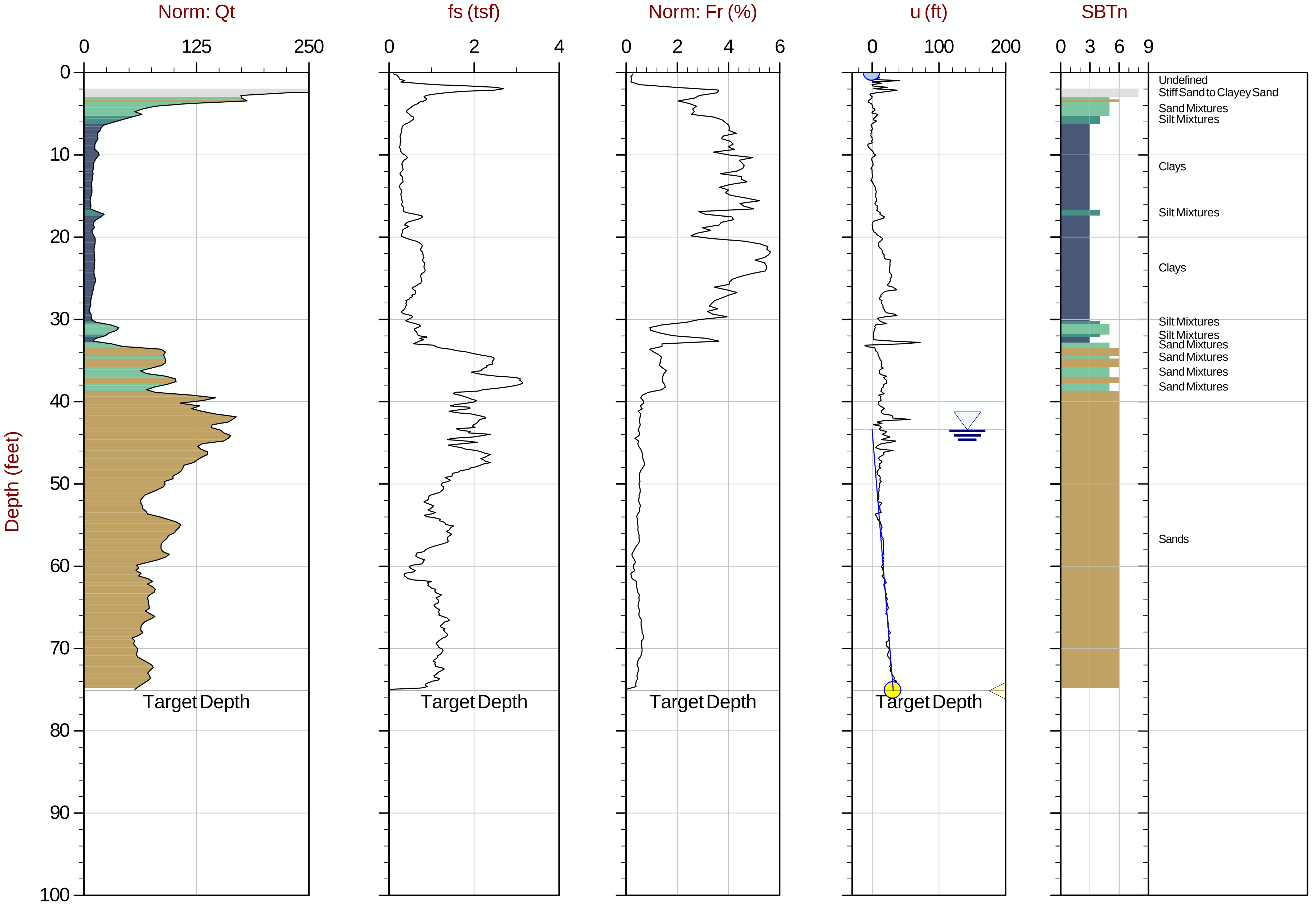
— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Haley & Aldrich

Job No: 15-53087
Date: 09:15:15 17:52
Site: AECI-New Madrid

Sounding: CPT15-HAC5
Cone: 419:T1500F15U500



Max Depth: 22.900 m / 75.13 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP05.COR

SBT: Robertson, 1990
Coords: UTM Zone 16 N: 4043453m E: 270755m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

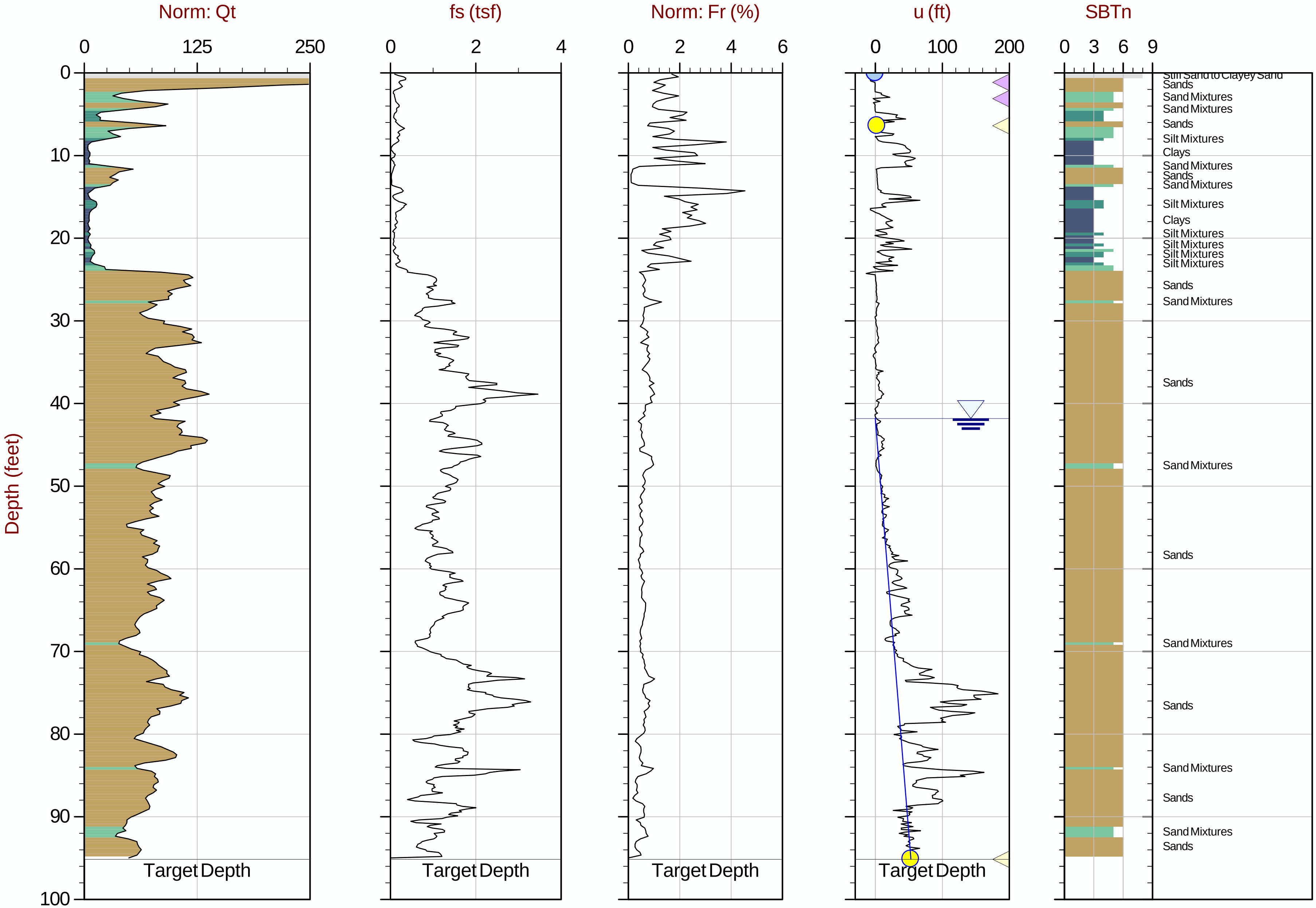
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:15:15 14:36
Site: AECI-New Madrid

Sounding: SCPT15-HAC7
Cone: 419:T1500F15U500



Max Depth: 29.000 m / 95.14 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_SP07.COR

SBT: Robertson, 1990
Coords: UTM Zone 16 N: 4043266m E: 271126m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

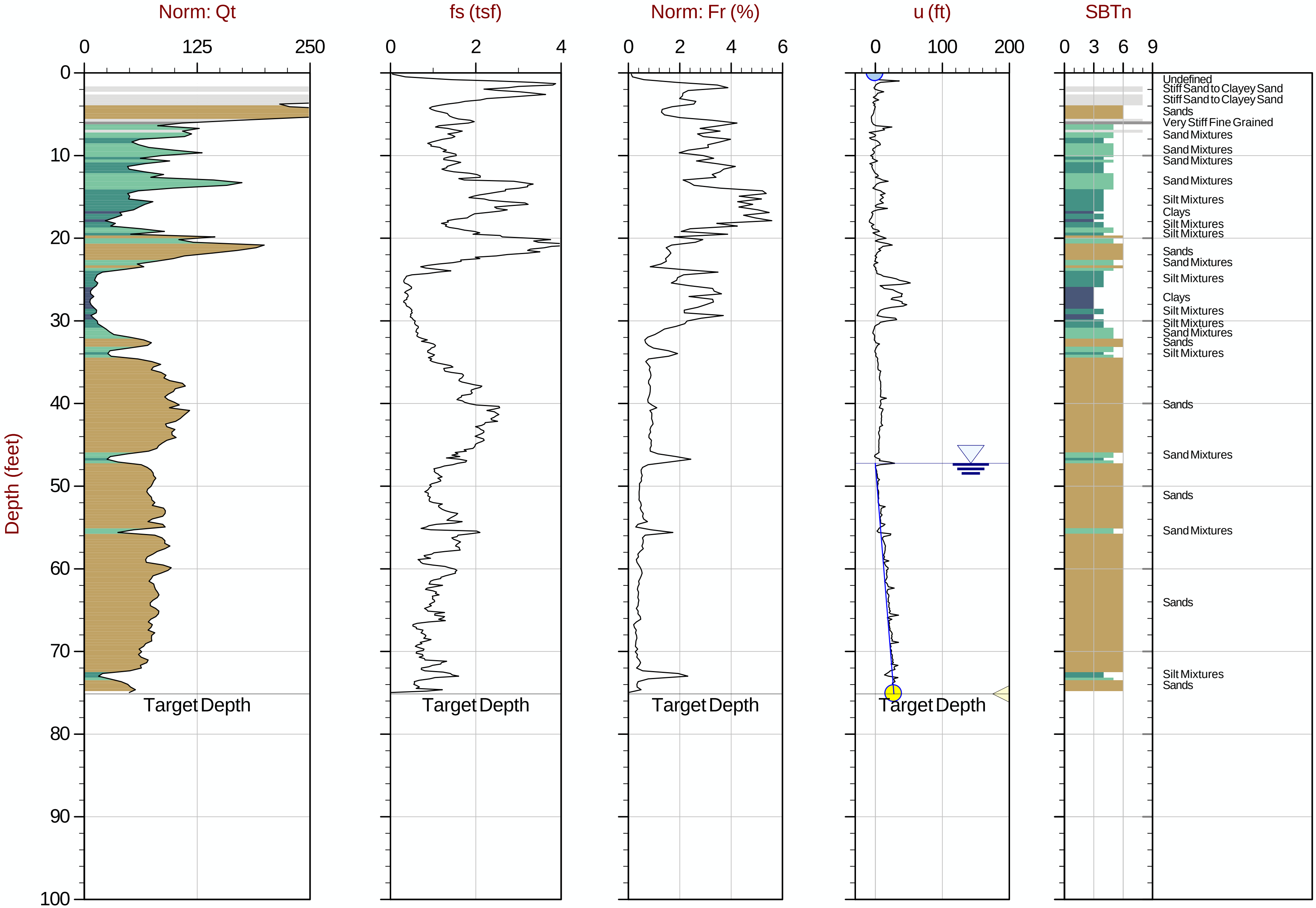
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 11:57
Site: AECI-New Madrid

Sounding: CPT15-HAC9
Cone: 419:T1500F15U500



Max Depth: 22.900 m / 75.13 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP09.COR

SBT: Robertson, 1990
Coords: UTM Zone 16 N: 4042932m E: 271425m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

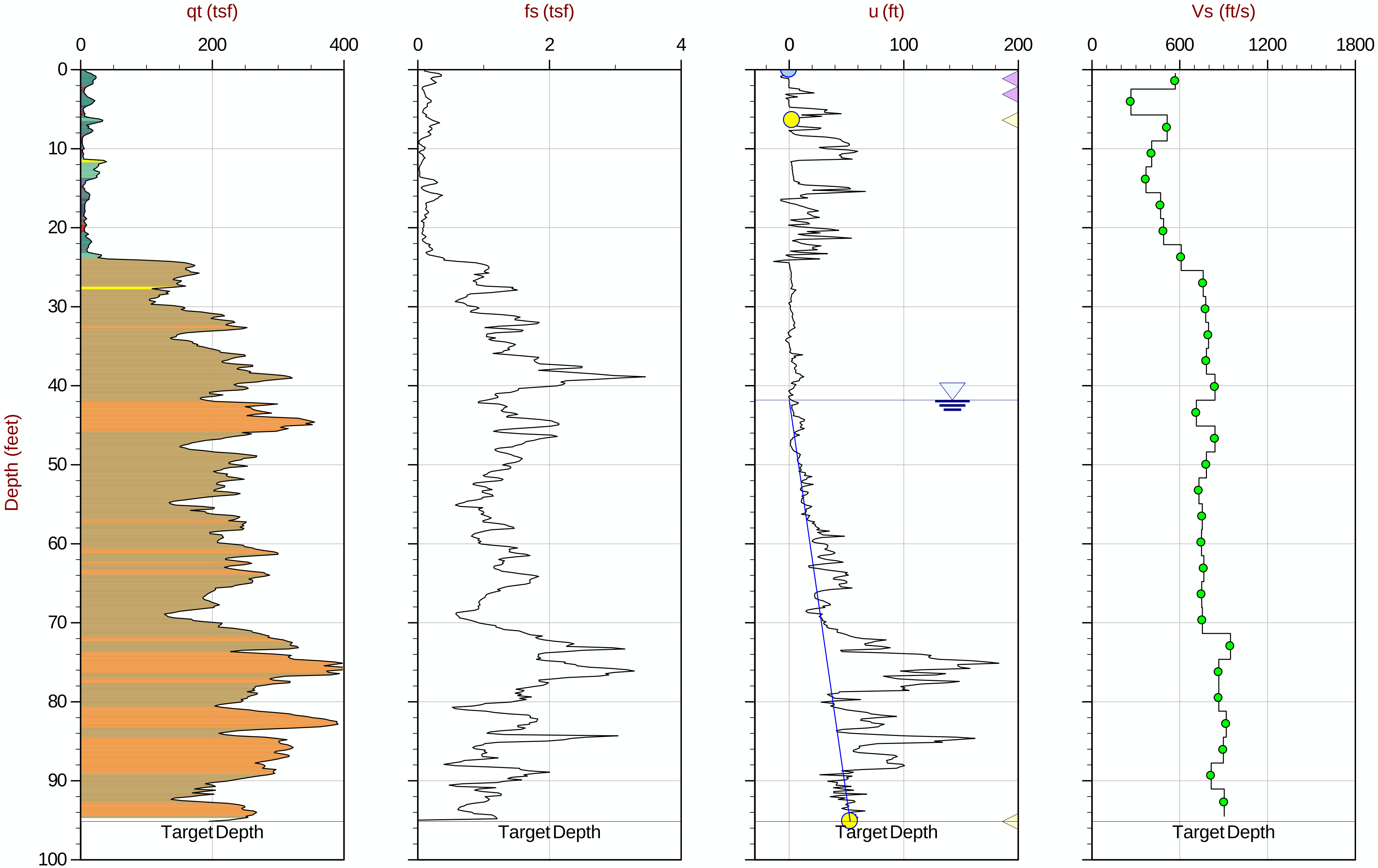
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Seismic Cone Penetration Test Plots

Haley & Aldrich

Job No: 15-53087
Date: 09:15:15 14:36
Site: AECI-New Madrid

Sounding: SCPT15-HAC7
Cone: 419:T1500F15U500



Max Depth: 29.000 m / 95.14 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_SP07.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4043266m E: 271126m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

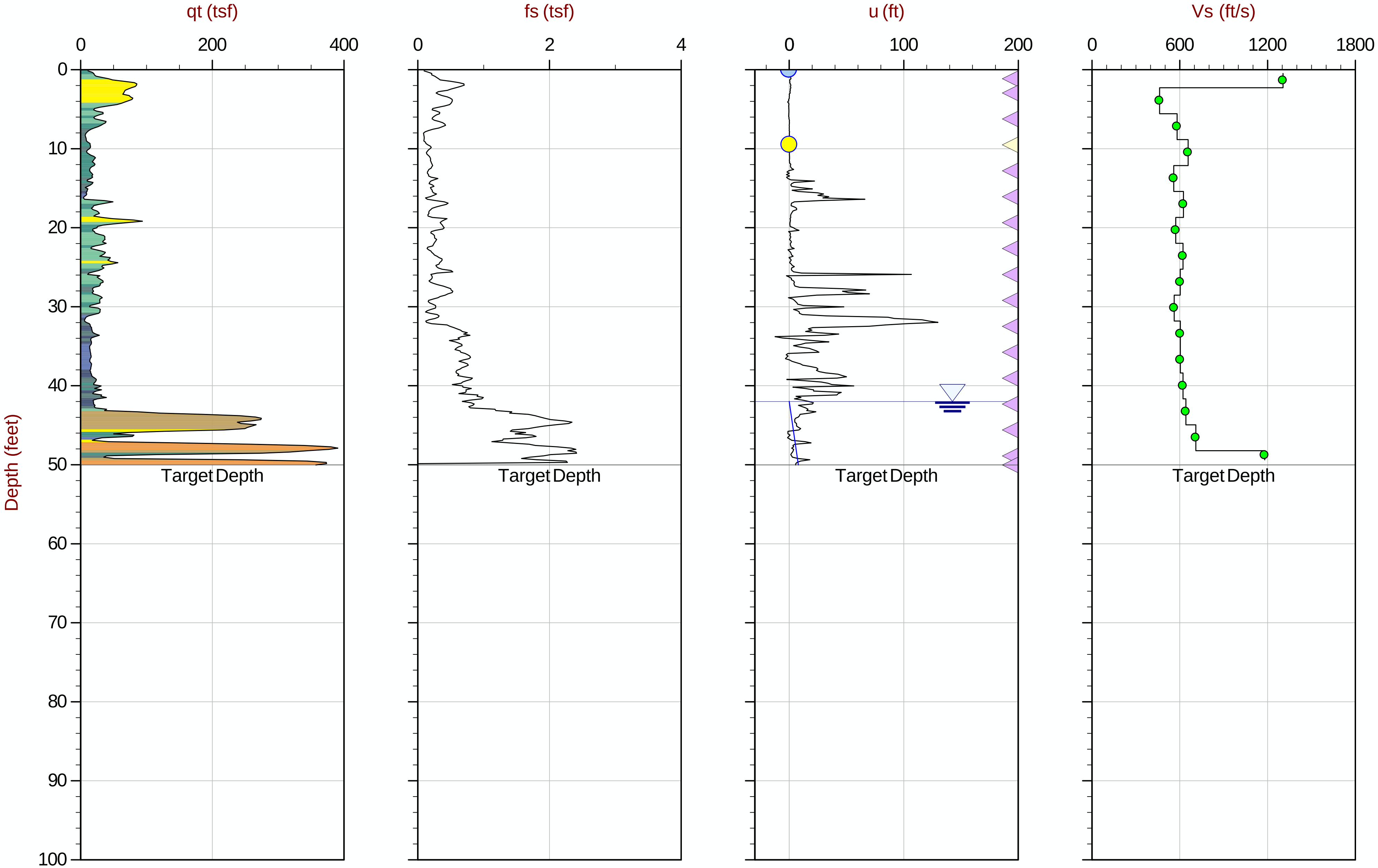
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:16:15 12:39
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: 419:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_SP08.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4043175m E: 270700m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◀ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Seismic Cone Penetration Test Tabular Results (Vs)

Job No: 15-53087
Client: Haley & Aldrich
Project: AECI - New Madrid
Sounding ID: SCPT15-HAC7
Date: 15-Sep-2015

Seismic Source: Beam
Source Offset (ft): 1.50
Source Depth (ft): 0.00
Geophone Offset (ft): 0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
1.15	0.49	1.58			
3.12	2.46	2.88	1.30	2.29	570
6.40	5.74	5.93	3.05	11.46	266
9.68	9.02	9.15	3.21	6.25	514
12.96	12.30	12.39	3.25	7.95	408
16.24	15.58	15.66	3.26	8.84	369
19.52	18.86	18.92	3.27	6.97	469
22.80	22.15	22.20	3.27	6.67	490
26.08	25.43	25.47	3.27	5.37	610
29.36	28.71	28.75	3.28	4.31	760
32.64	31.99	32.02	3.28	4.21	778
35.92	35.27	35.30	3.28	4.11	797
39.21	38.55	38.58	3.28	4.19	782
42.49	41.83	41.86	3.28	3.90	841
45.77	45.11	45.14	3.28	4.59	714
49.05	48.39	48.42	3.28	3.90	841
52.33	51.67	51.69	3.28	4.19	782
55.61	54.95	54.97	3.28	4.48	731
58.89	58.23	58.25	3.28	4.35	754
62.17	61.52	61.53	3.28	4.38	749
65.45	64.80	64.81	3.28	4.29	765
68.73	68.08	68.09	3.28	4.37	750
72.01	71.36	71.37	3.28	4.34	755
75.30	74.64	74.65	3.28	3.46	947
78.58	77.92	77.93	3.28	3.78	867
81.86	81.20	81.21	3.28	3.78	867
85.14	84.48	84.49	3.28	3.57	918
88.42	87.76	87.78	3.28	3.65	898
91.70	91.04	91.06	3.28	4.02	815
95.14	94.49	94.50	3.44	3.81	904

Job No:	15-53087
Client:	Haley & Aldrich
Project:	AECI - New Madrid
Sounding ID:	SCPT15-HAC8
Date:	16-Sep-2015

Seismic Source:	Beam
Source Offset (ft):	1.50
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
1.15	0.49	1.58			
2.95	2.30	2.74	1.16	0.89	1306
6.23	5.58	5.78	3.03	6.56	462
9.51	8.86	8.98	3.21	5.51	582
12.80	12.14	12.23	3.25	4.94	657
16.08	15.42	15.49	3.26	5.83	559
19.36	18.70	18.76	3.27	5.23	625
22.64	21.98	22.03	3.27	5.71	573
25.92	25.26	25.31	3.27	5.27	622
29.20	28.54	28.58	3.28	5.43	603
32.48	31.82	31.86	3.28	5.83	562
35.76	35.10	35.14	3.28	5.43	604
39.04	38.39	38.41	3.28	5.43	604
42.32	41.67	41.69	3.28	5.27	622
45.60	44.95	44.97	3.28	5.11	642
48.88	48.23	48.25	3.28	4.62	710
50.03	49.38	49.40	1.15	0.97	1181

Pore Pressure Dissipation Summary and

Pore Pressure Dissipation Plots

Job No: 15-53087
Client: Haley & Aldrich
Project: AECI - New Madrid, Marston, MO
Start Date: 15-Sep-2015
End Date: 17-Sep-2015

CPTu PORE PRESSURE DISSIPATION SUMMARY

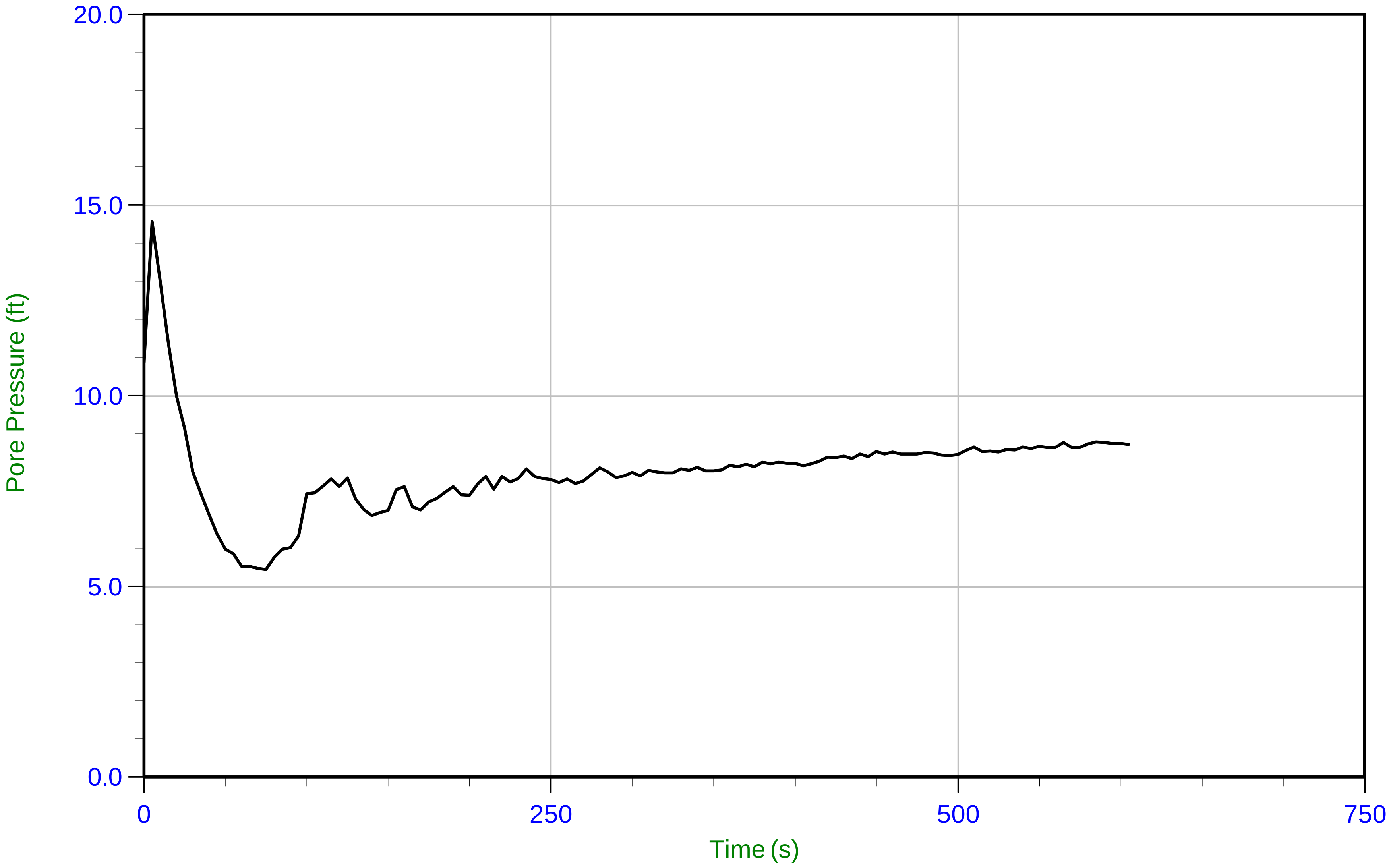
Sounding ID	File Name	Cone Area (cm^2)	Duration (s)	Test Depth (ft)	Estimated Equilibrium Pore Pressure U_{eq} (ft)	Calculated Phreatic Surface (ft)	Estimated Phreatic Surface (ft)
CPT15-HAC1	15-53087_CP01	15	605	50.03	8.97	41.07	
CPT15-HAC2	15-53087_CP02	15	700	50.03	1.92	48.12	
CPT15-HAC3	15-53087_CP03	15	600	95.14	53.33	41.81	
CPT15-HAC4	15-53087_CP04	15	600	50.03	15.06	34.97	
CPT15-HAC5	15-53087_CP05	15	1000	75.13	31.73	43.40	
CPT15-HAC6	15-53087_CP06	15	300	50.03	19.92	30.11	
SCPT15-HAC7	15-53087_SP07	15	300	1.15			
SCPT15-HAC7	15-53087_SP07	15	300	3.12			
SCPT15-HAC7	15-53087_SP07	15	190	6.40	2.59	3.81	
SCPT15-HAC7	15-53087_SP07	15	600	95.14	53.33	41.81	
SCPT15-HAC8	15-53087_SP08	15	200	1.15			
SCPT15-HAC8	15-53087_SP08	15	150	2.95			
SCPT15-HAC8	15-53087_SP08	15	150	6.23			
SCPT15-HAC8	15-53087_SP08	15	150	9.51	0.34	9.17	
SCPT15-HAC8	15-53087_SP08	15	400	12.80			
SCPT15-HAC8	15-53087_SP08	15	600	16.08			
SCPT15-HAC8	15-53087_SP08	15	1700	19.36			
SCPT15-HAC8	15-53087_SP08	15	600	22.64			
SCPT15-HAC8	15-53087_SP08	15	400	25.92			
SCPT15-HAC8	15-53087_SP08	15	600	29.20			
SCPT15-HAC8	15-53087_SP08	15	7020	32.48			
SCPT15-HAC8	15-53087_SP08	15	5800	35.76			
SCPT15-HAC8	15-53087_SP08	15	900	39.04			
SCPT15-HAC8	15-53087_SP08	15	2400	42.32			
SCPT15-HAC8	15-53087_SP08	15	600	45.60			
SCPT15-HAC8	15-53087_SP08	15	200	48.88			
SCPT15-HAC8	15-53087_SP08	15	900	50.03			
CPT15-HAC9	15-53087_CP09	15	500	75.13	27.89	47.24	
CPT15-HAC10	15-53087_CP10	15	600	50.52			
Totals	29 dissipations		484.4 min				

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 17-Sep-2015 17:40:26
Site: AECI-New Madrid

Sounding: CPT15-HAC1
Cone: AD419
Cone Area: 15 sq cm



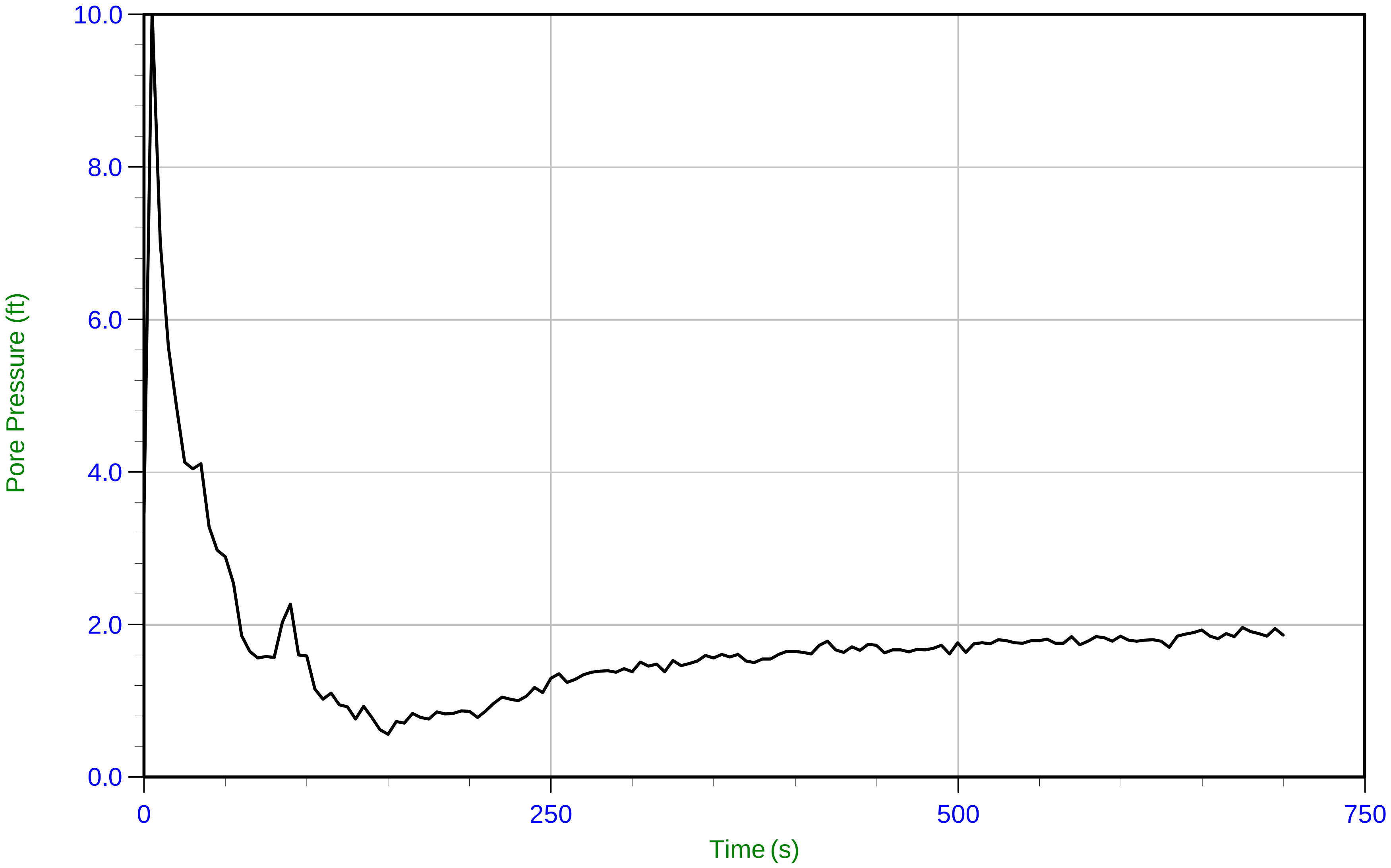
Trace Summary:

Filename: 15-53087_CP01.PPD
Depth: 15.250 m / 50.032 ft
Duration: 605.0 s

U Min: 5.4 ft
U Max: 14.6 ft

WT: 12.517 m / 41.066 ft
Ueq: 9.0 ft

Haley & Aldrich	Job No: 15-53087	Sounding: CPT15-HAC2
	Date: 17-Sep-2015 14:41:36	Cone: AD419
	Site: AECI-New Madrid	Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_CP02.PPD
Depth: 15.250 m / 50.032 ft
Duration: 700.0 s

U Min: 0.6 ft
U Max: 10.1 ft

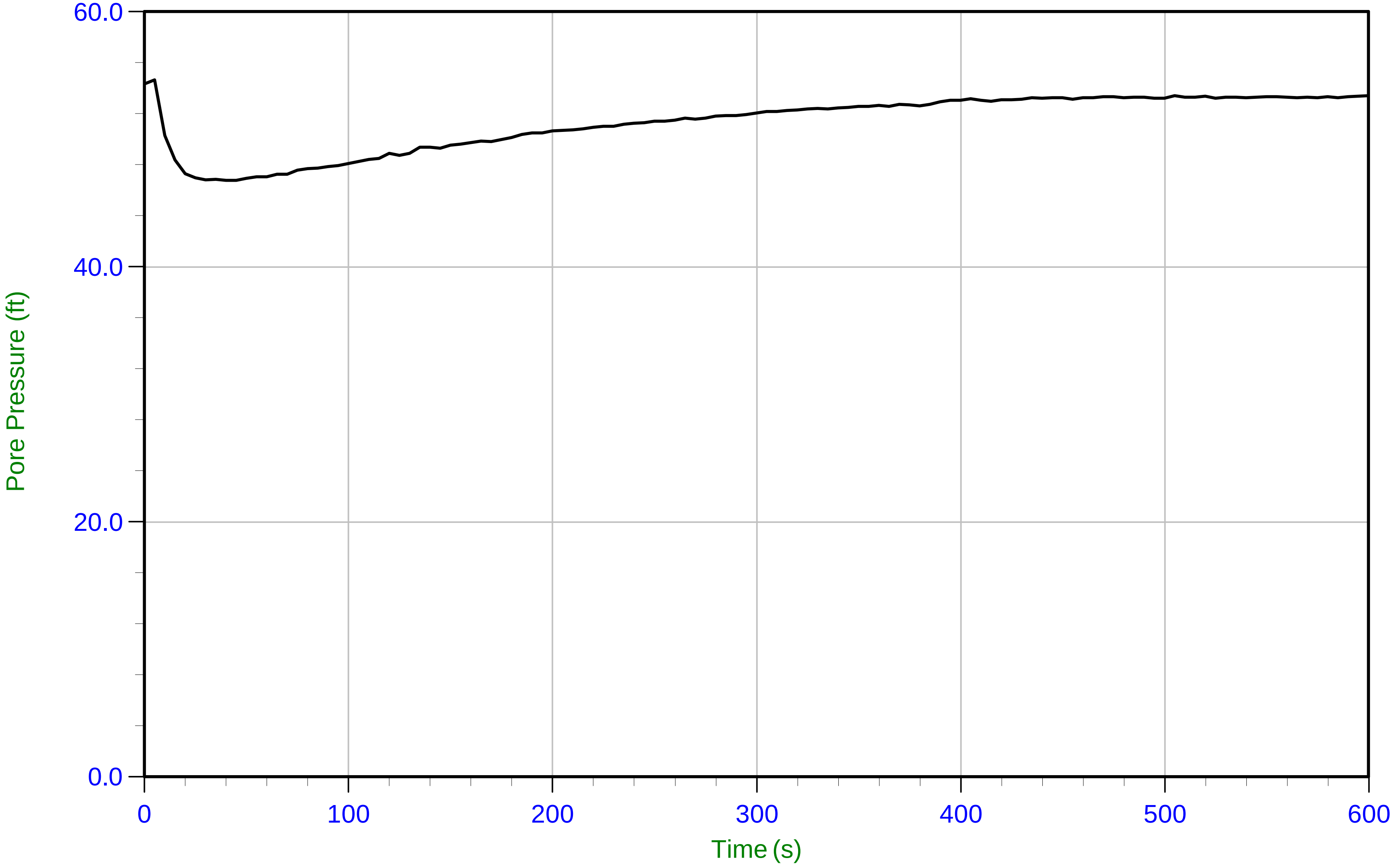
WT: 14.666 m / 48.116 ft
Ueq: 1.9 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 17-Sep-2015 15:59:49
Site: AECI-New Madrid

Sounding: CPT15-HAC3
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_CP03.PPD
Depth: 29.000 m / 95.143 ft
Duration: 600.0 s

U Min: 46.8 ft
U Max: 54.7 ft

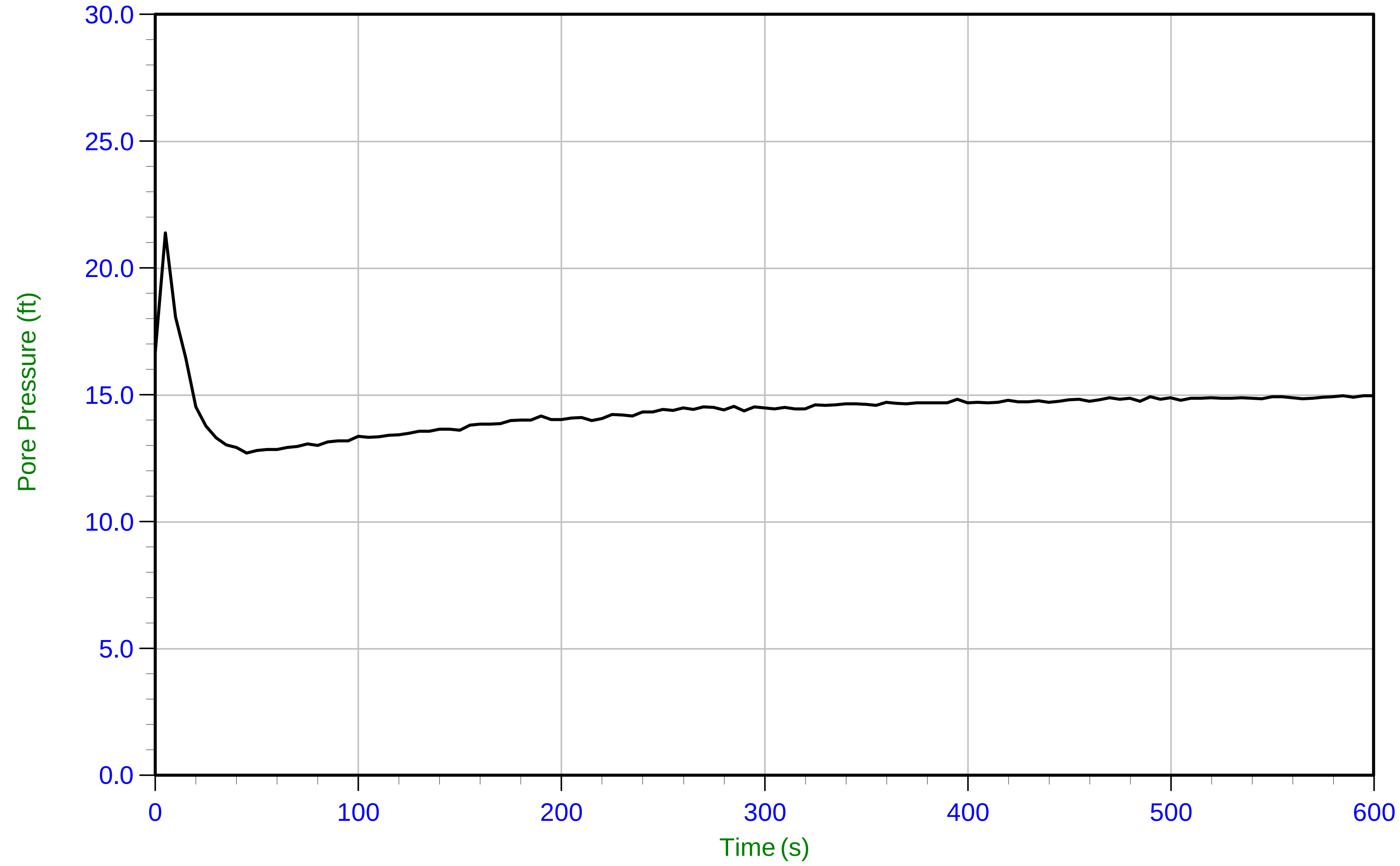
WT: 12.744 m / 41.811 ft
Ueq: 53.3 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 17-Sep-2015 13:17:21
Site: AECI-New Madrid

Sounding: CPT15-HAC4
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_CP04.PPD
Depth: 15.250 m / 50.032 ft
Duration: 600.0 s

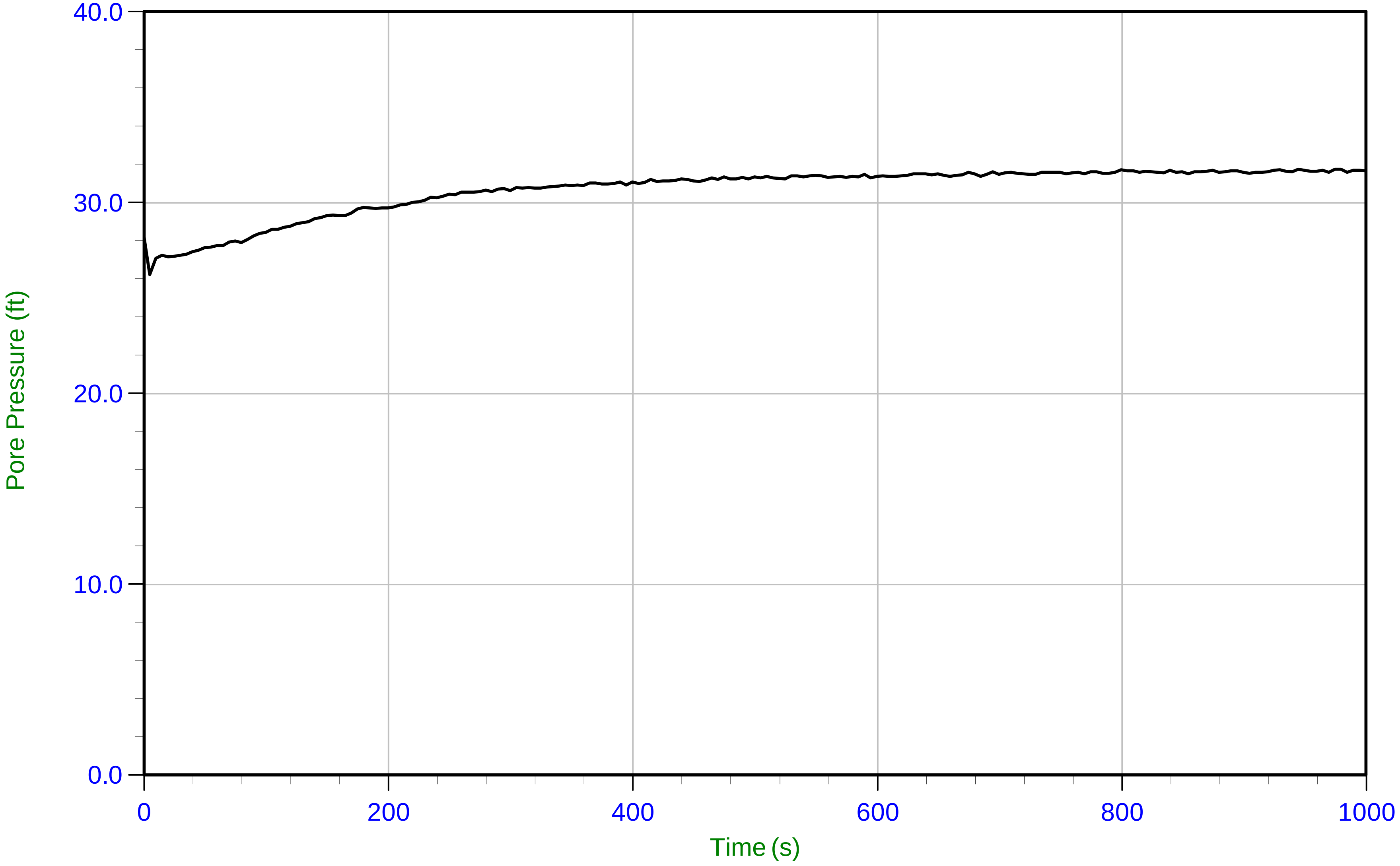
U Min: 12.7 ft
U Max: 21.4 ft

WT: 10.660 m / 34.973 ft
Ueq: 15.1 ft

Haley & Aldrich

Job No: 15-53087
Date: 15-Sep-2015 17:52:55
Site: AECI-New Madrid

Sounding: CPT15-HAC5
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_CP05.PPD
Depth: 22.900 m / 75.130 ft
Duration: 1000.0 s

U Min: 26.2 ft
U Max: 31.8 ft

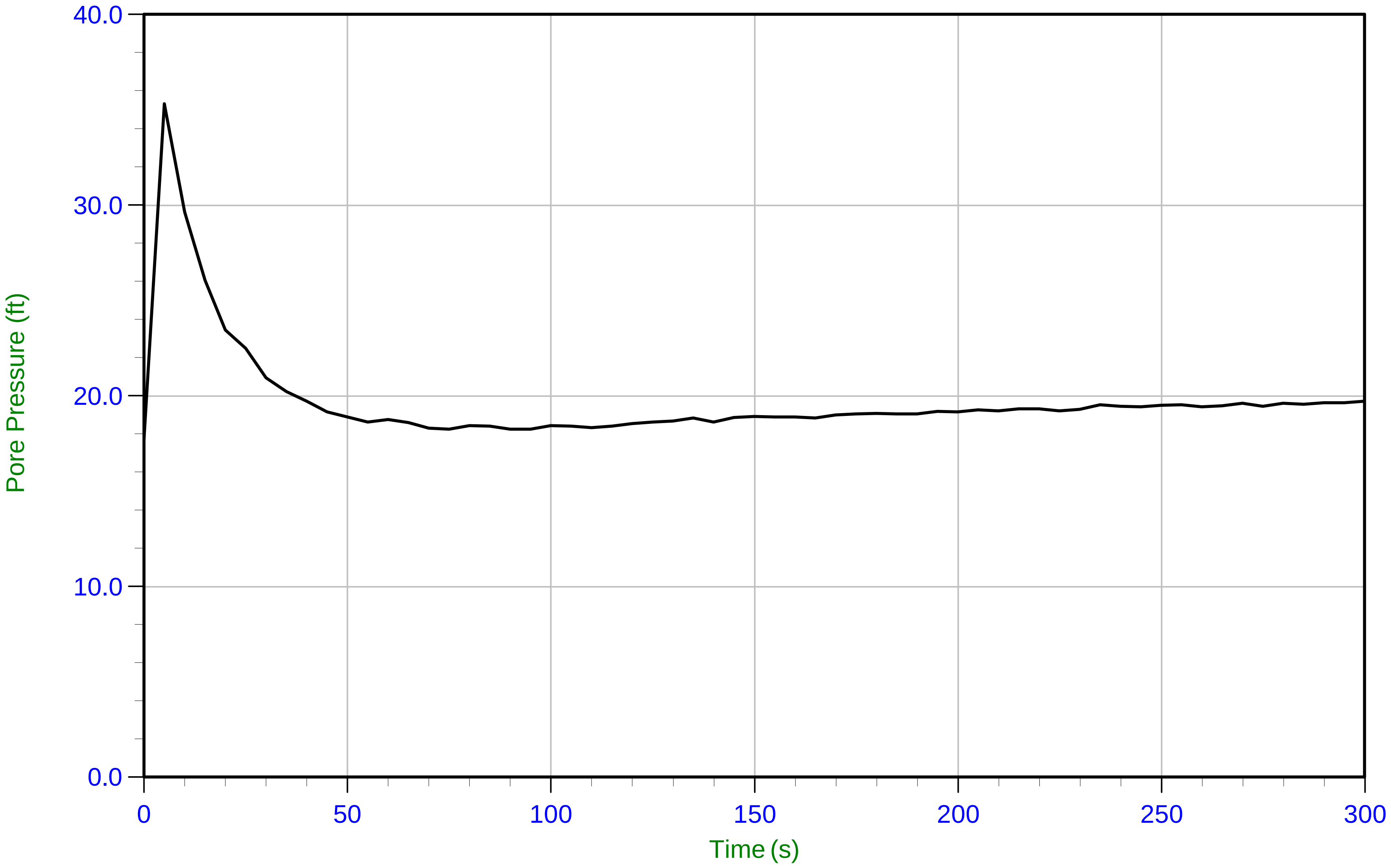
WT: 13.230 m / 43.405 ft
Ueq: 31.7 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 10:26:29
Site: AECI-New Madrid

Sounding: CPT15-HAC6
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_CP06.PPD
Depth: 15.250 m / 50.032 ft
Duration: 300.0 s

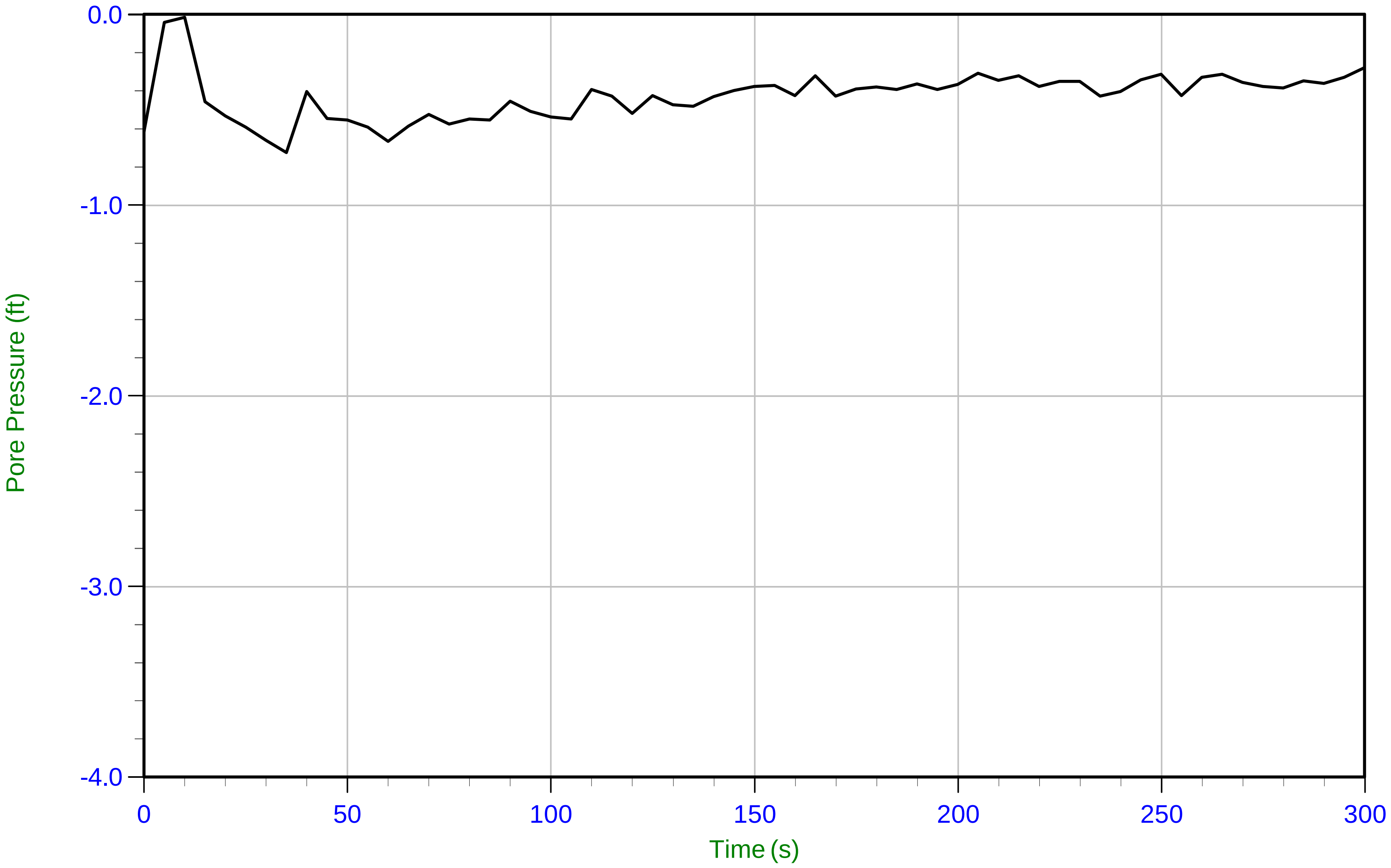
U Min: 17.7 ft
U Max: 35.3 ft

WT: 9.177 m / 30.108 ft
Ueq: 19.9 ft

Haley & Aldrich

Job No: 15-53087
Date: 15-Sep-2015 14:36:00
Site: AECI-New Madrid

Sounding: SCPT15-HAC7
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

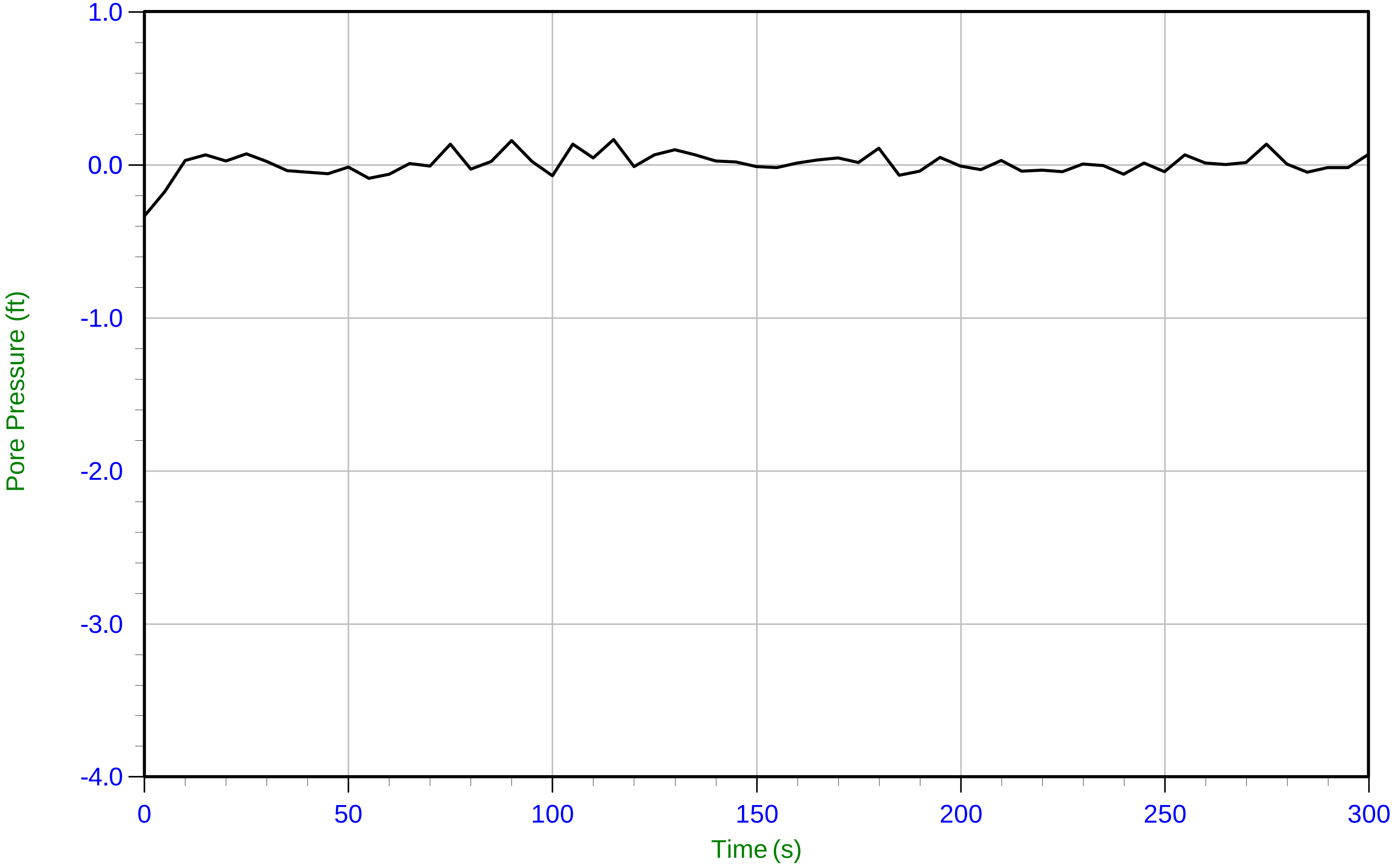
Filename: 15-53087_SP07.PPD
Depth: 0.350 m / 1.148 ft
Duration: 300.0 s

U Min: -0.7 ft
U Max: -0.0 ft

Haley & Aldrich

Job No: 15-53087
Date: 15-Sep-2015 14:36:00
Site: AECI-New Madrid

Sounding: SCPT15-HAC7
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP07.PPD
Depth: 0.950 m / 3.117 ft
Duration: 300.0 s

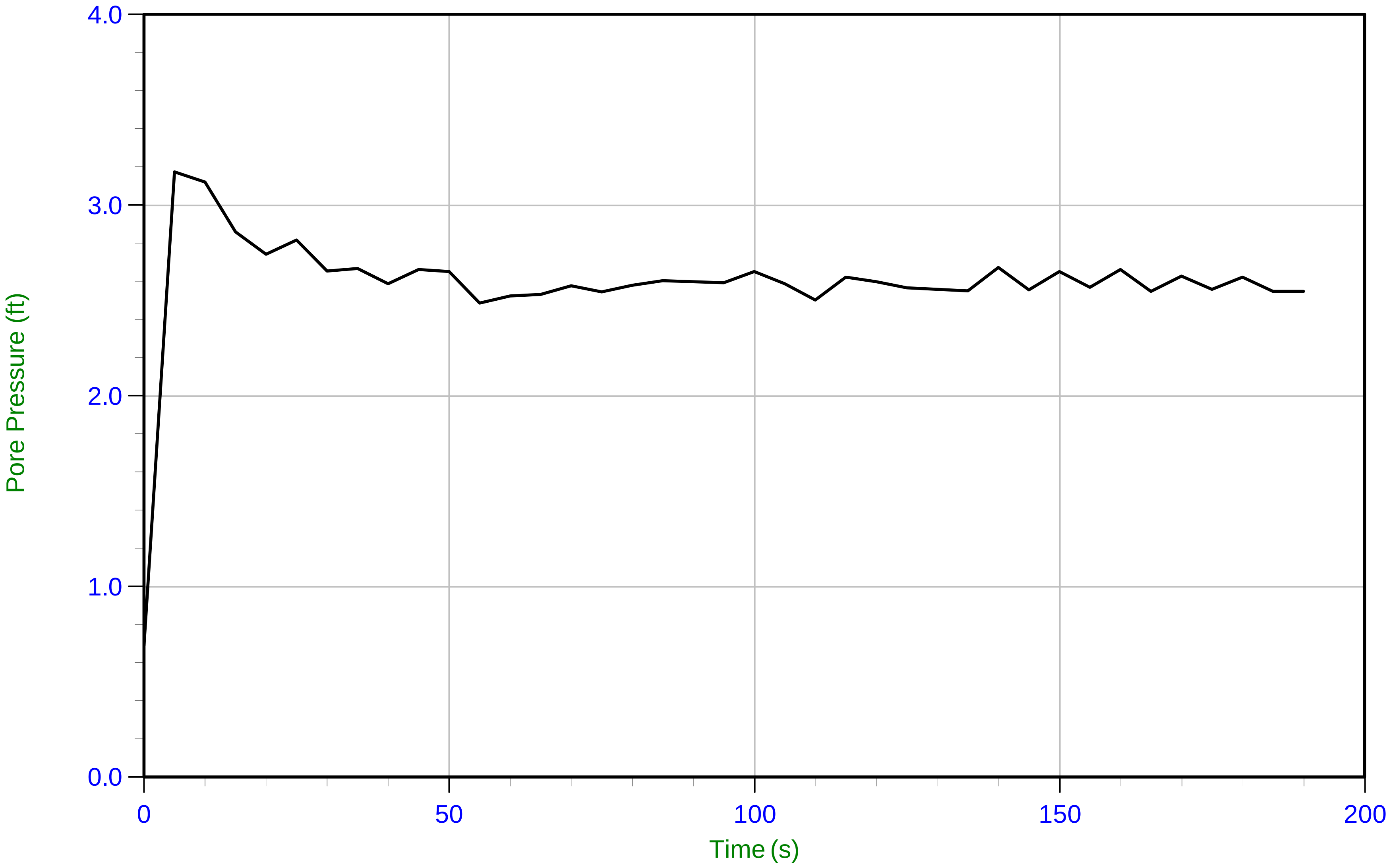
U Min: -0.3 ft
U Max: 0.2 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 15-Sep-2015 14:36:00
Site: AECI-New Madrid

Sounding: SCPT15-HAC7
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP07.PPD
Depth: 1.950 m / 6.398 ft
Duration: 190.0 s

U Min: 0.7 ft
U Max: 3.2 ft

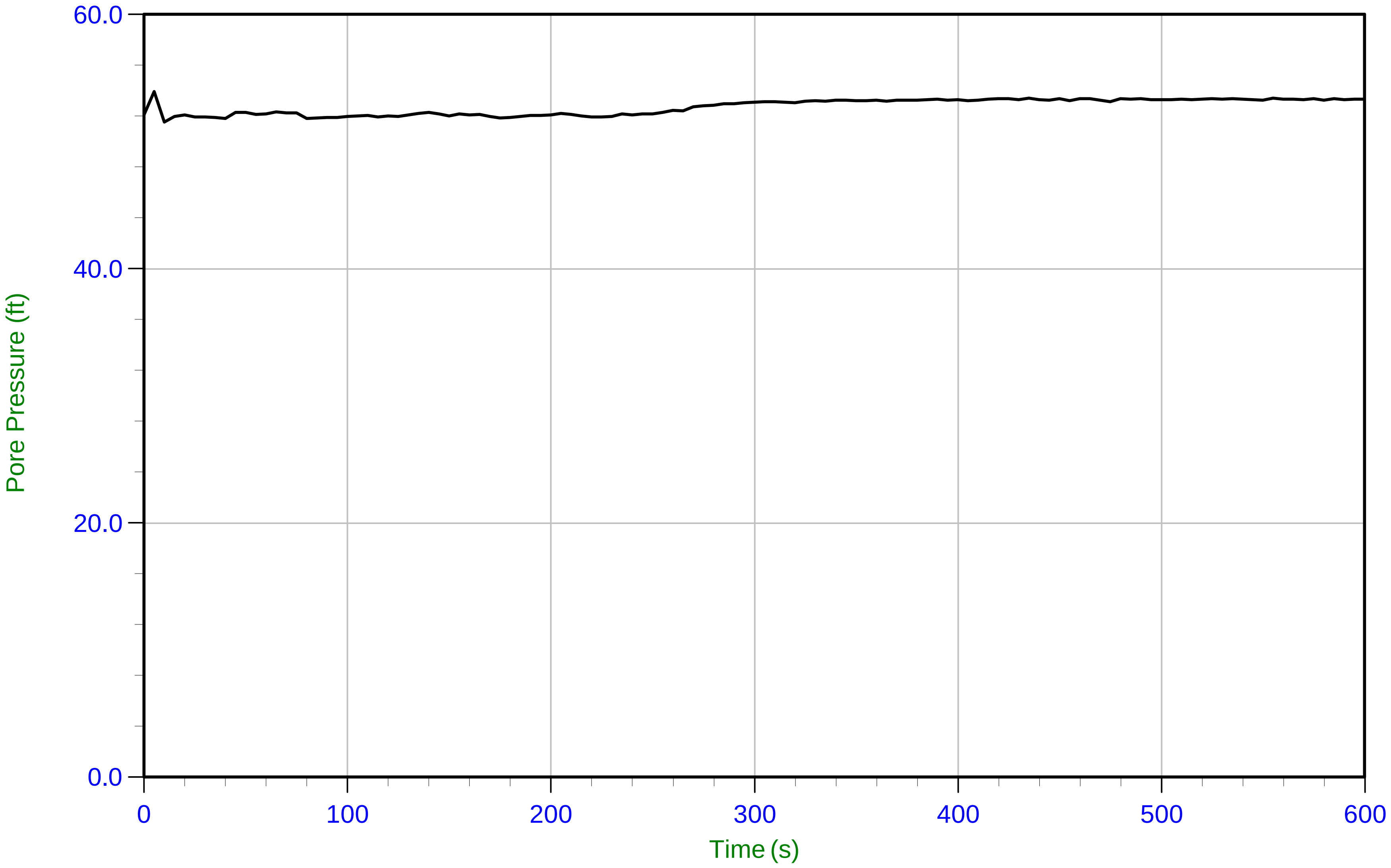
WT: 1.161 m / 3.809 ft
Ueq: 2.6 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 15-Sep-2015 14:36:00
Site: AECI-New Madrid

Sounding: SCPT15-HAC7
Cone: AD419
Cone Area: 15 sq cm



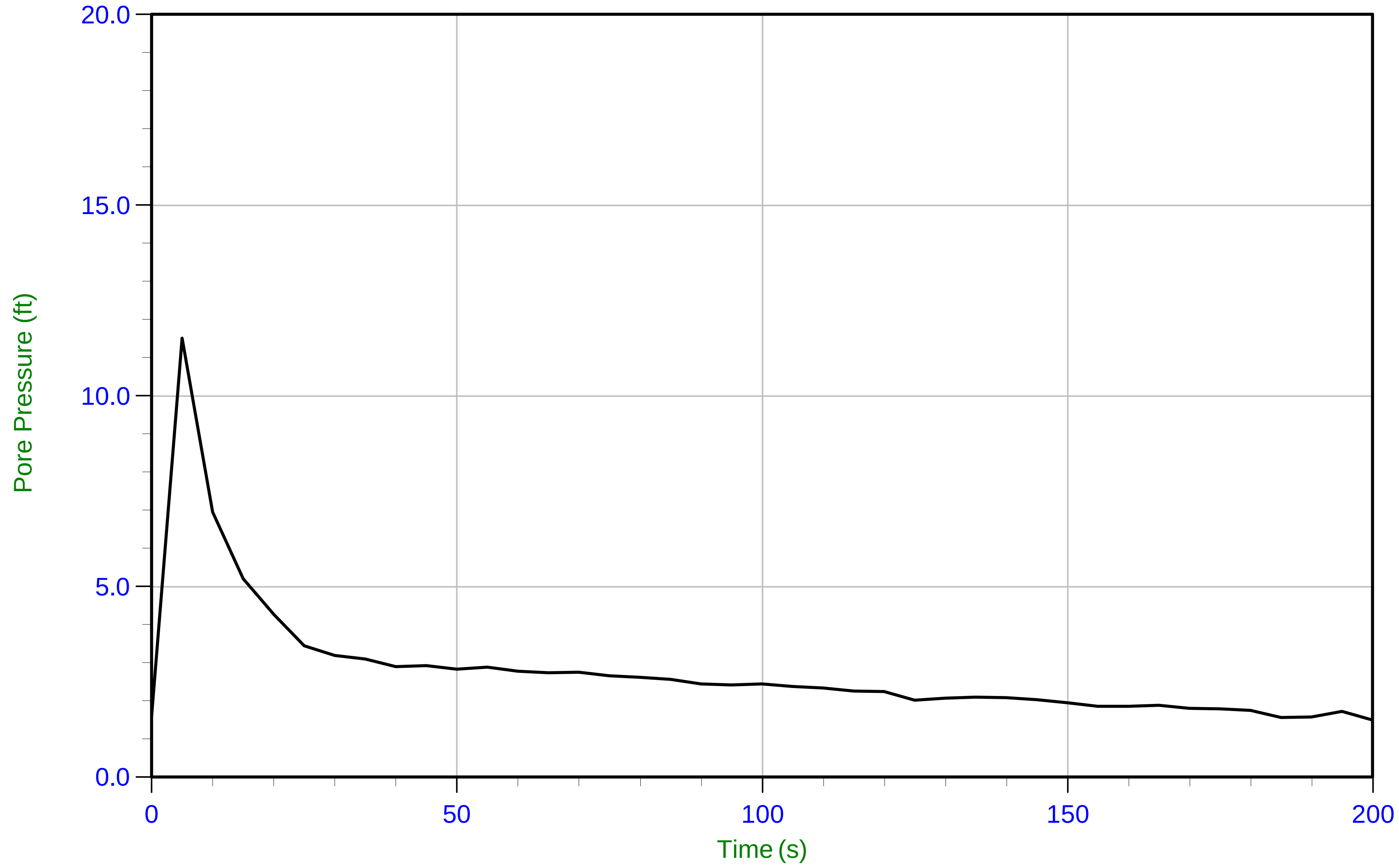
Trace Summary:

Filename: 15-53087_SP07.PPD
Depth: 29.000 m / 95.143 ft
Duration: 600.0 s

U Min: 51.5 ft
U Max: 53.9 ft

WT: 12.744 m / 41.811 ft
Ueq: 53.3 ft

Haley & Aldrich	Job No: 15-53087	Sounding: SCPT15-HAC8
	Date: 16-Sep-2015 12:39:09	Cone: AD419
	Site: AECI-New Madrid	Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP08.PPD

Depth: 0.350 m / 1.148 ft

Duration: 200.0 s

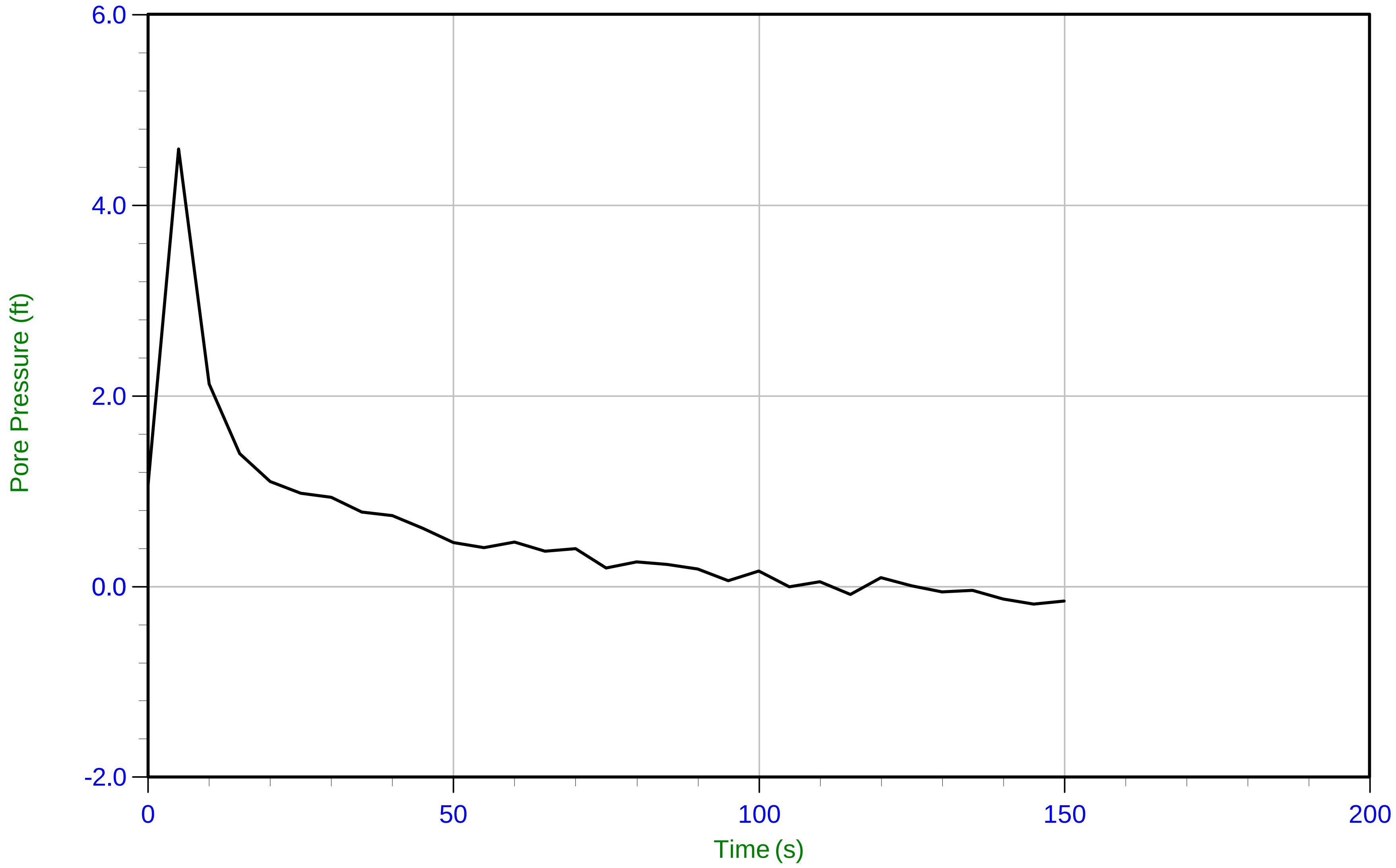
U Min: 1.5 ft

U Max: 11.5 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 0.900 m / 2.953 ft
Duration: 150.0 s

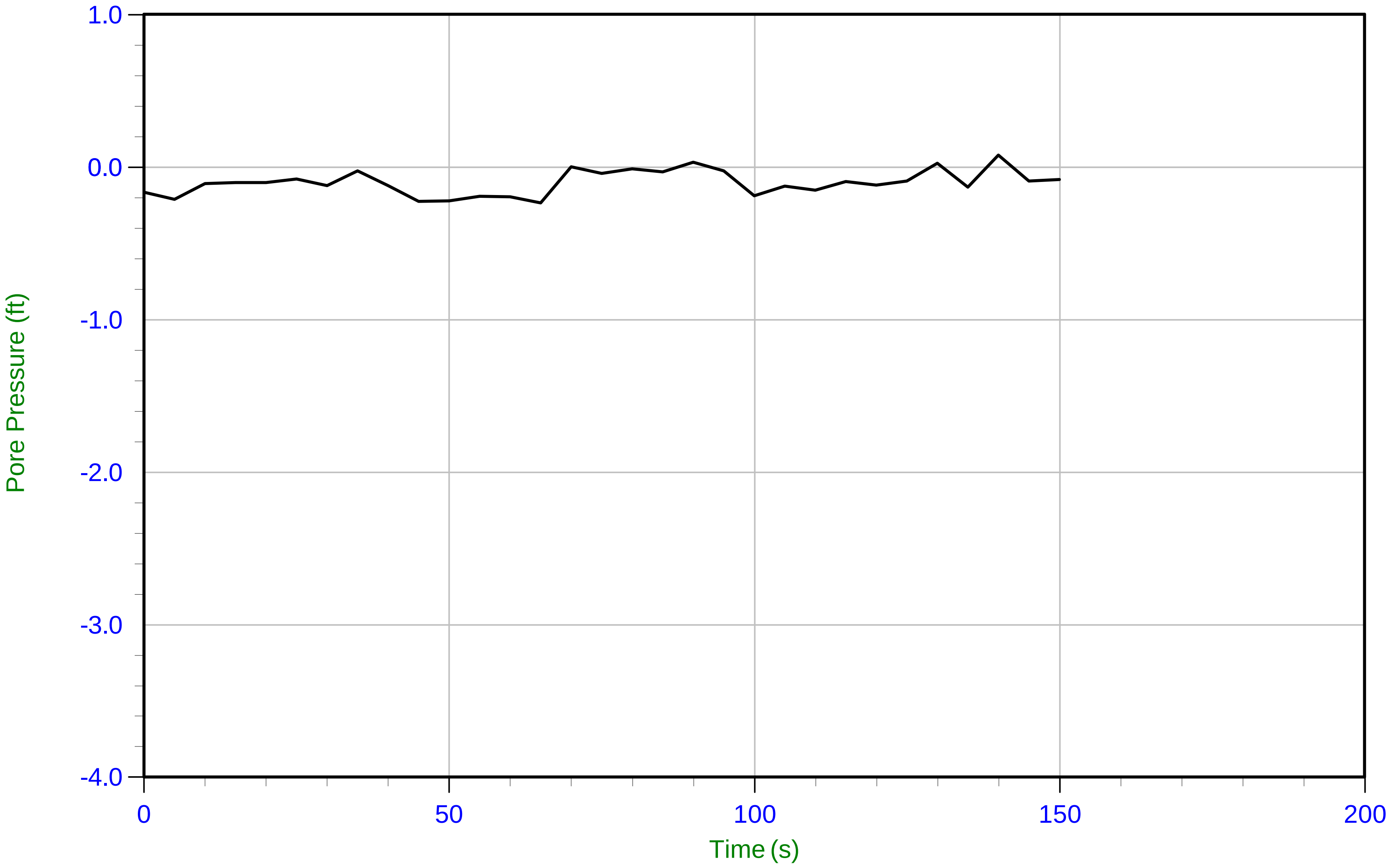
U Min: -0.2 ft
U Max: 4.6 ft

CONETEC

Haley & Aldrich

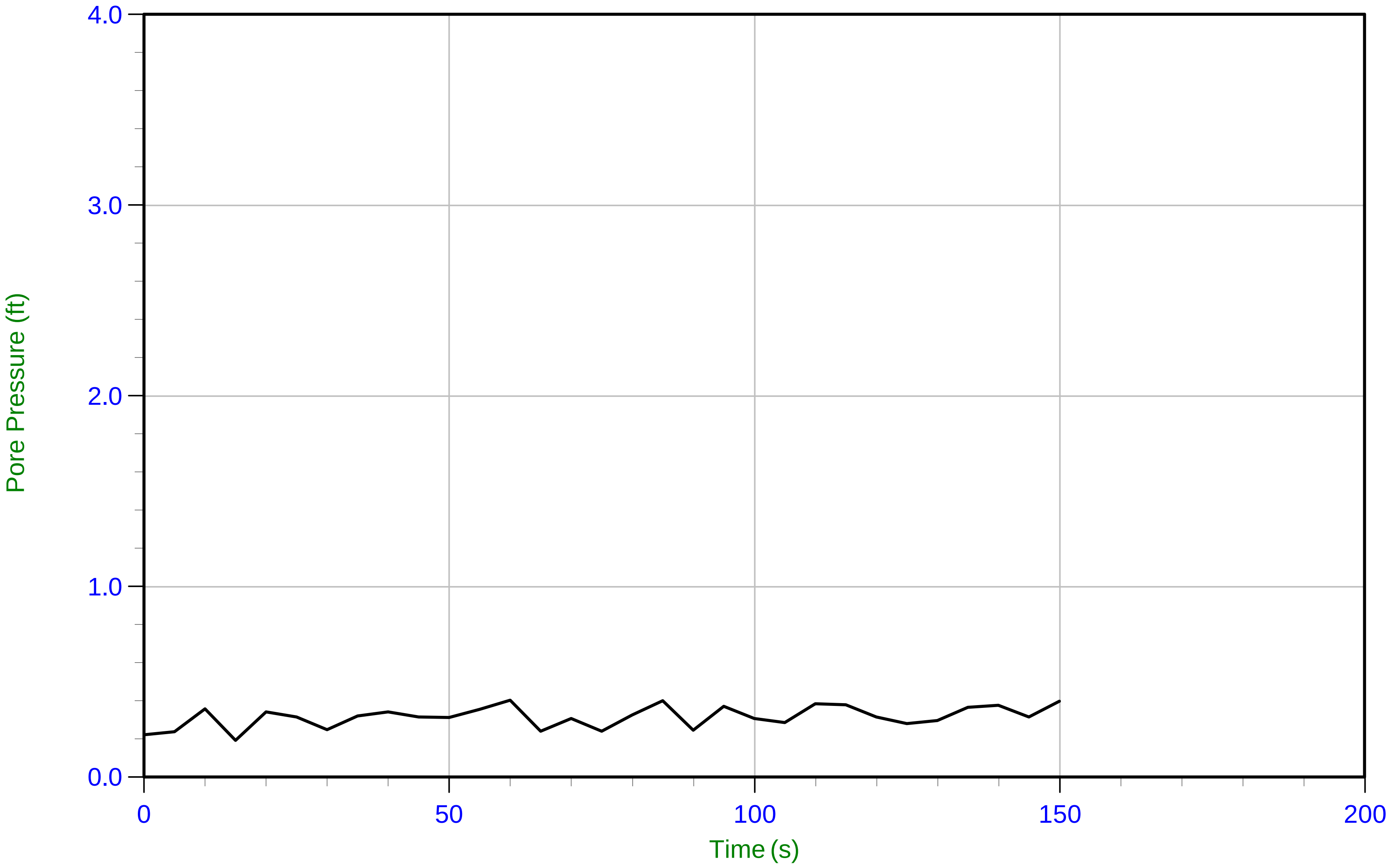
Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:
Filename: 15-53087_SP08.PPD
Depth: 1.900 m / 6.234 ft
Duration: 150.0 s

U Min: -0.2 ft
U Max: 0.1 ft



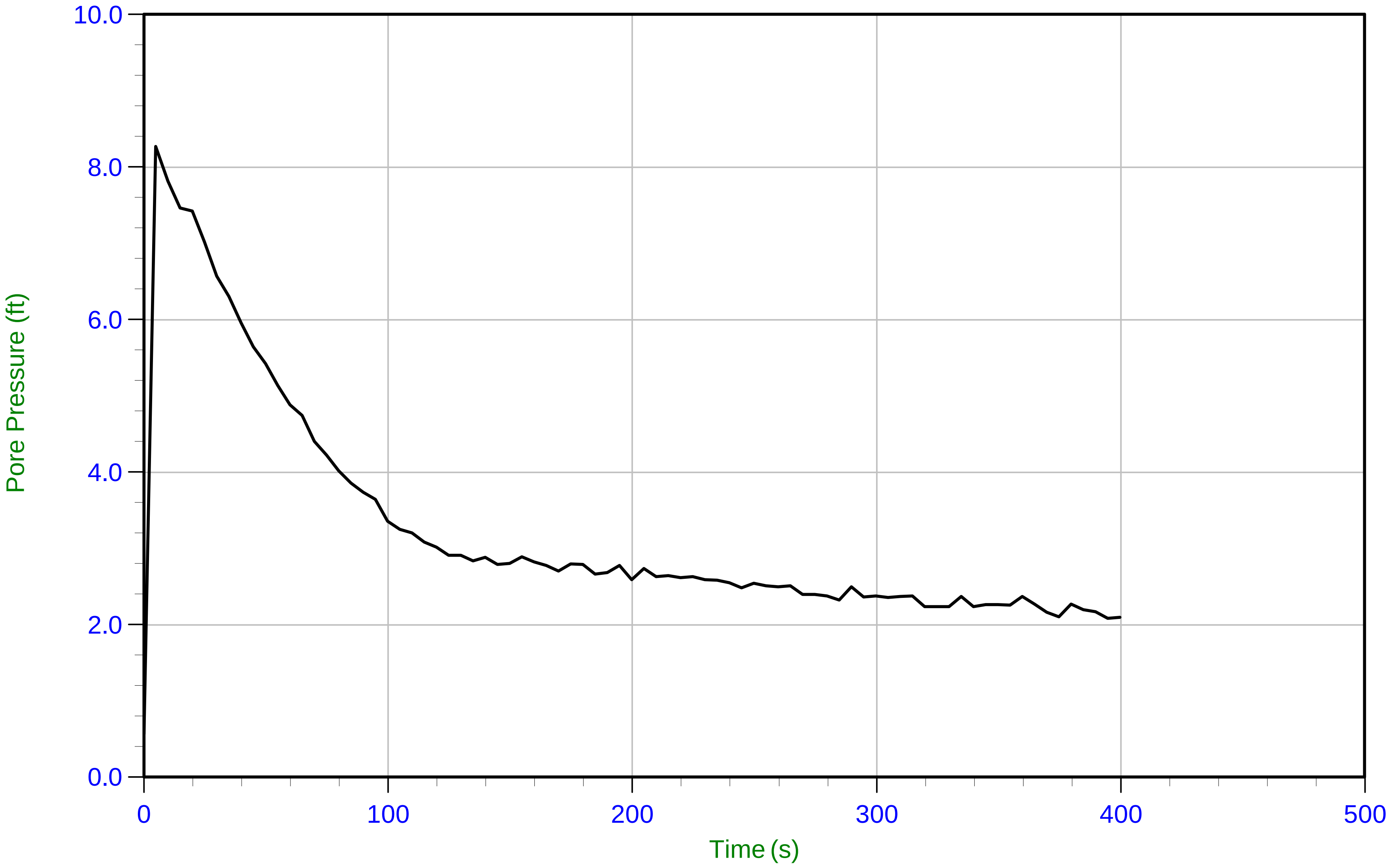
Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 2.900 m / 9.514 ft
Duration: 150.0 s

U Min: 0.2 ft
U Max: 0.4 ft

WT: 2.796 m / 9.172 ft
Ueq: 0.3 ft

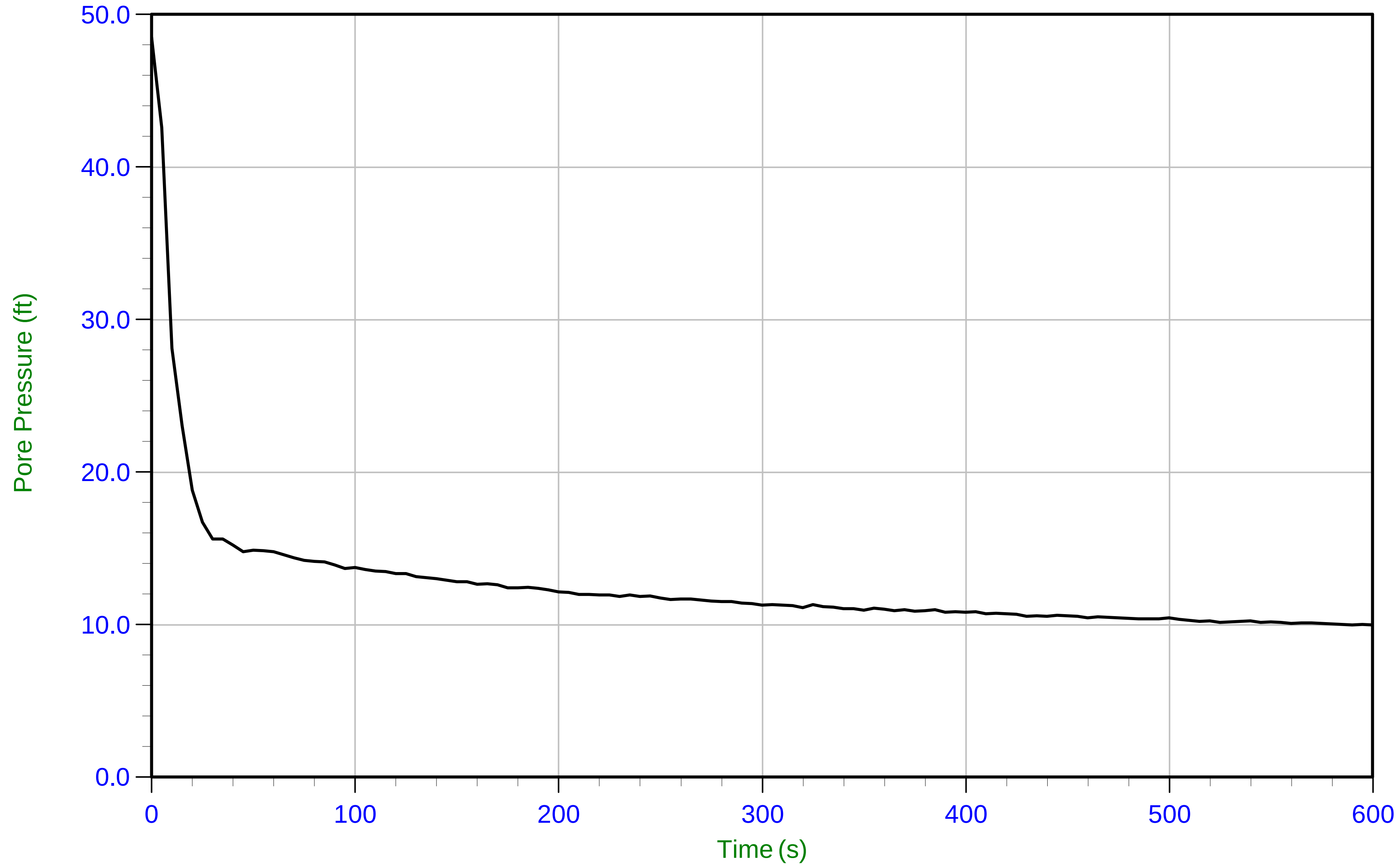
Haley & Aldrich	Job No: 15-53087	Sounding: SCPT15-HAC8
	Date: 16-Sep-2015 12:39:09	Cone: AD419
	Site: AECI-New Madrid	Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 3.900 m / 12.795 ft
Duration: 400.0 s

U Min: 0.6 ft
U Max: 8.3 ft



Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 4.900 m / 16.076 ft
Duration: 600.0 s

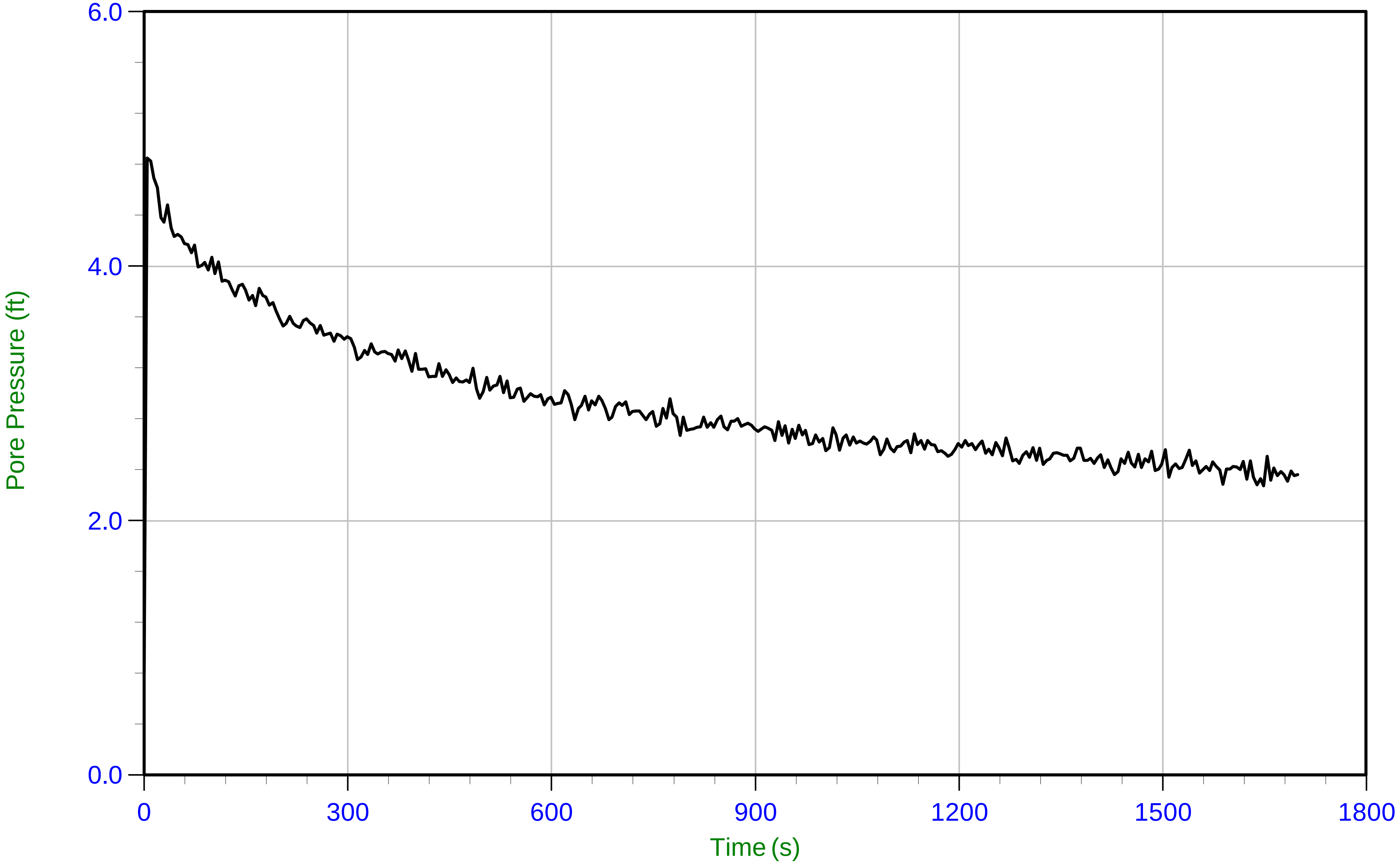
U Min: 10.0 ft
U Max: 48.5 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm

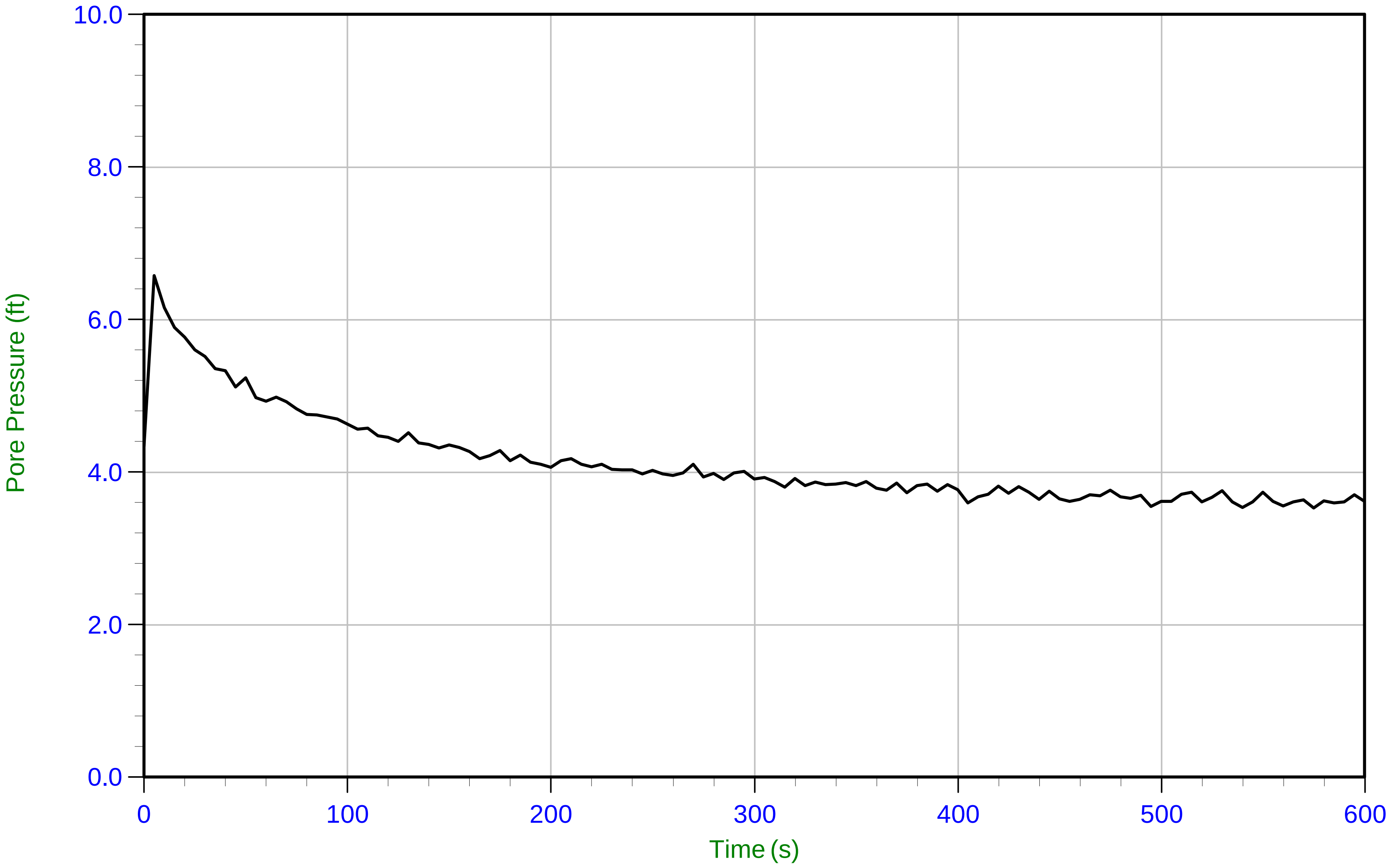


Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 5.900 m / 19.357 ft
Duration: 1700.0 s

U Min: 0.8 ft
U Max: 4.9 ft

Haley & Aldrich	Job No: 15-53087	Sounding: SCPT15-HAC8
	Date: 16-Sep-2015 12:39:09	Cone: AD419
	Site: AECI-New Madrid	Cone Area: 15 sq cm



Trace Summary:

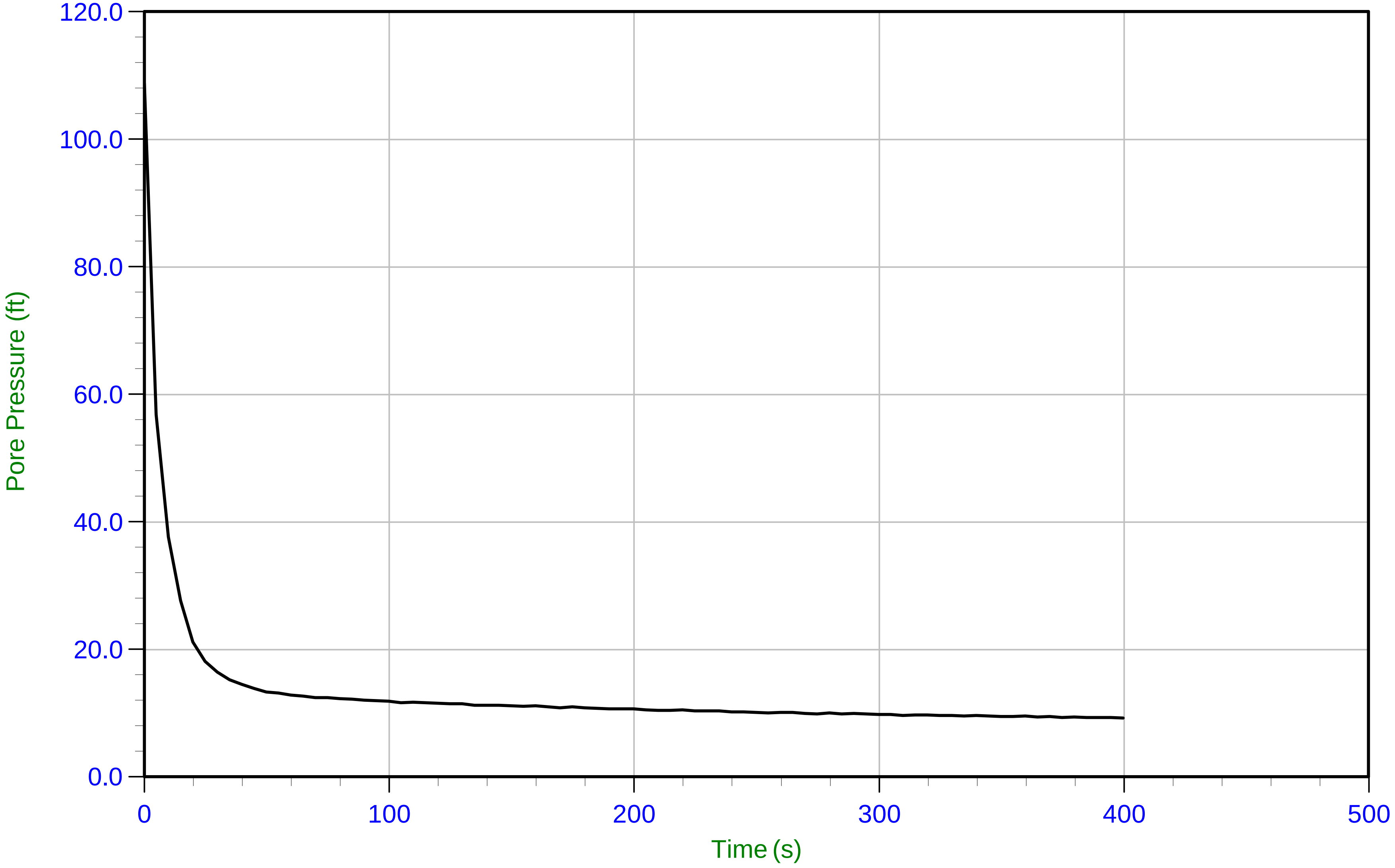
Filename: 15-53087_SP08.PPD
Depth: 6.900 m / 22.638 ft
Duration: 600.0 s

U Min: 3.5 ft
U Max: 6.6 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

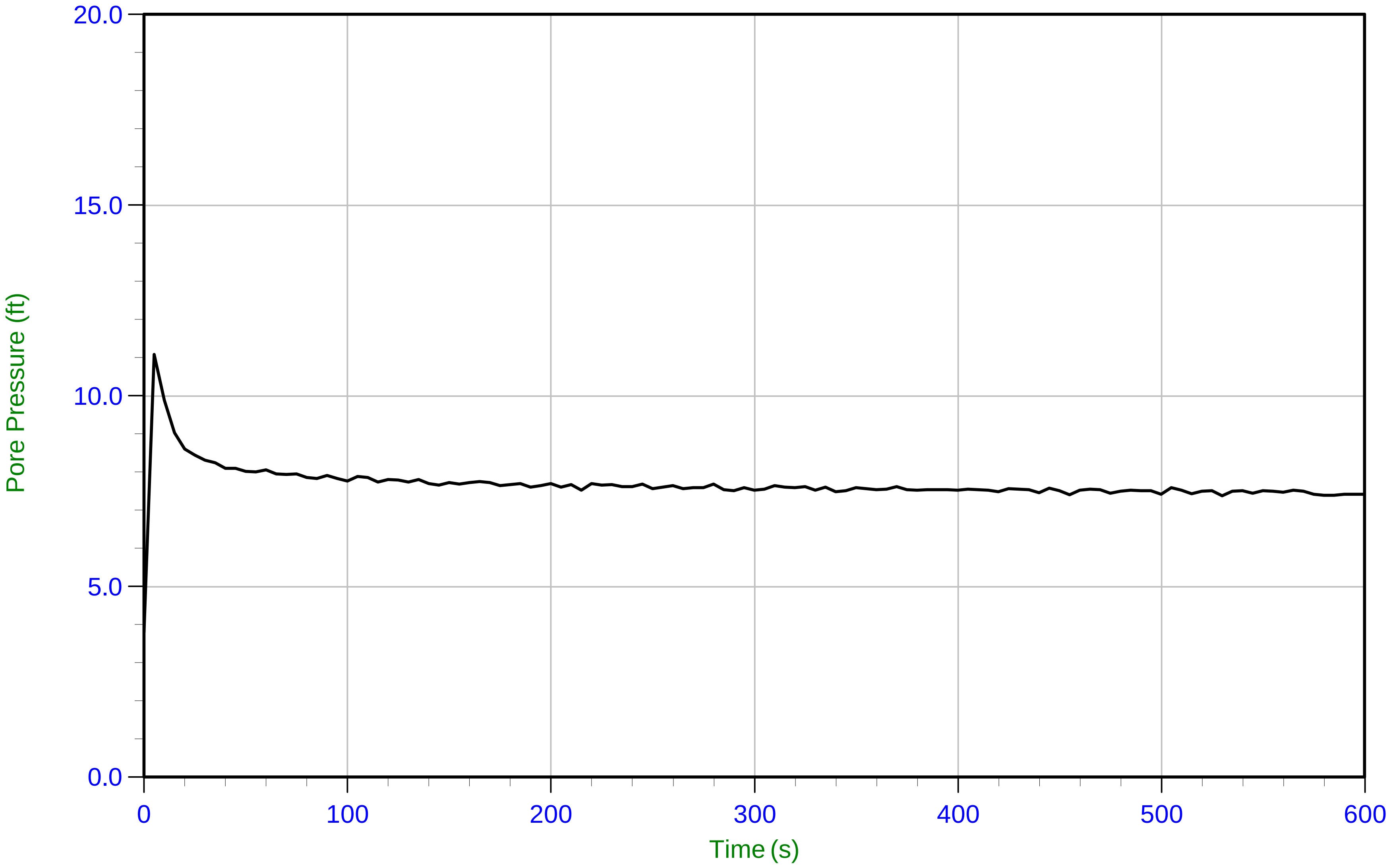
Filename: 15-53087_SP08.PPD
Depth: 7.900 m / 25.918 ft
Duration: 400.0 s

U Min: 9.2 ft
U Max: 108.8 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

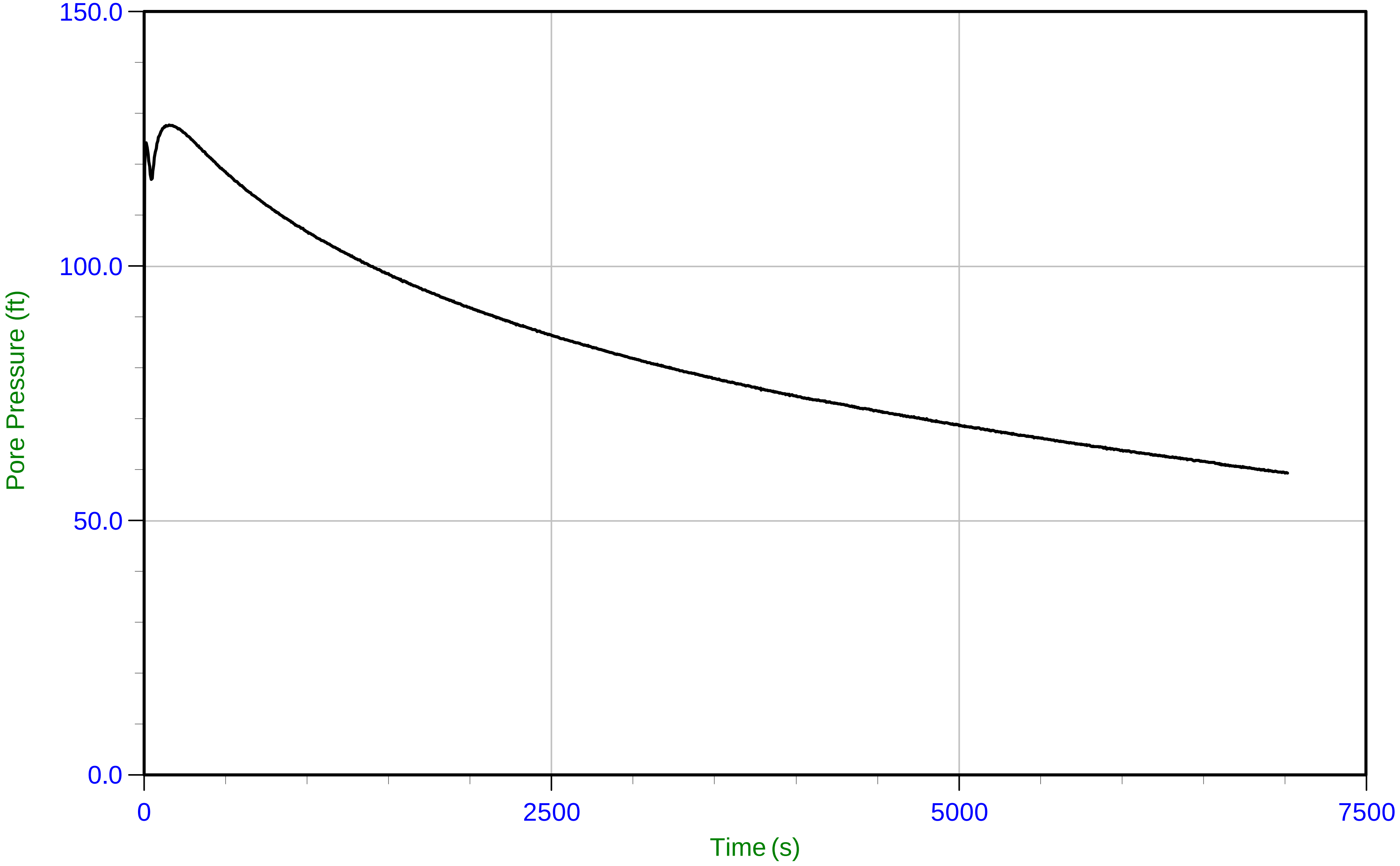
Filename: 15-53087_SP08.PPD
Depth: 8.900 m / 29.199 ft
Duration: 600.0 s

U Min: 3.8 ft
U Max: 11.1 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

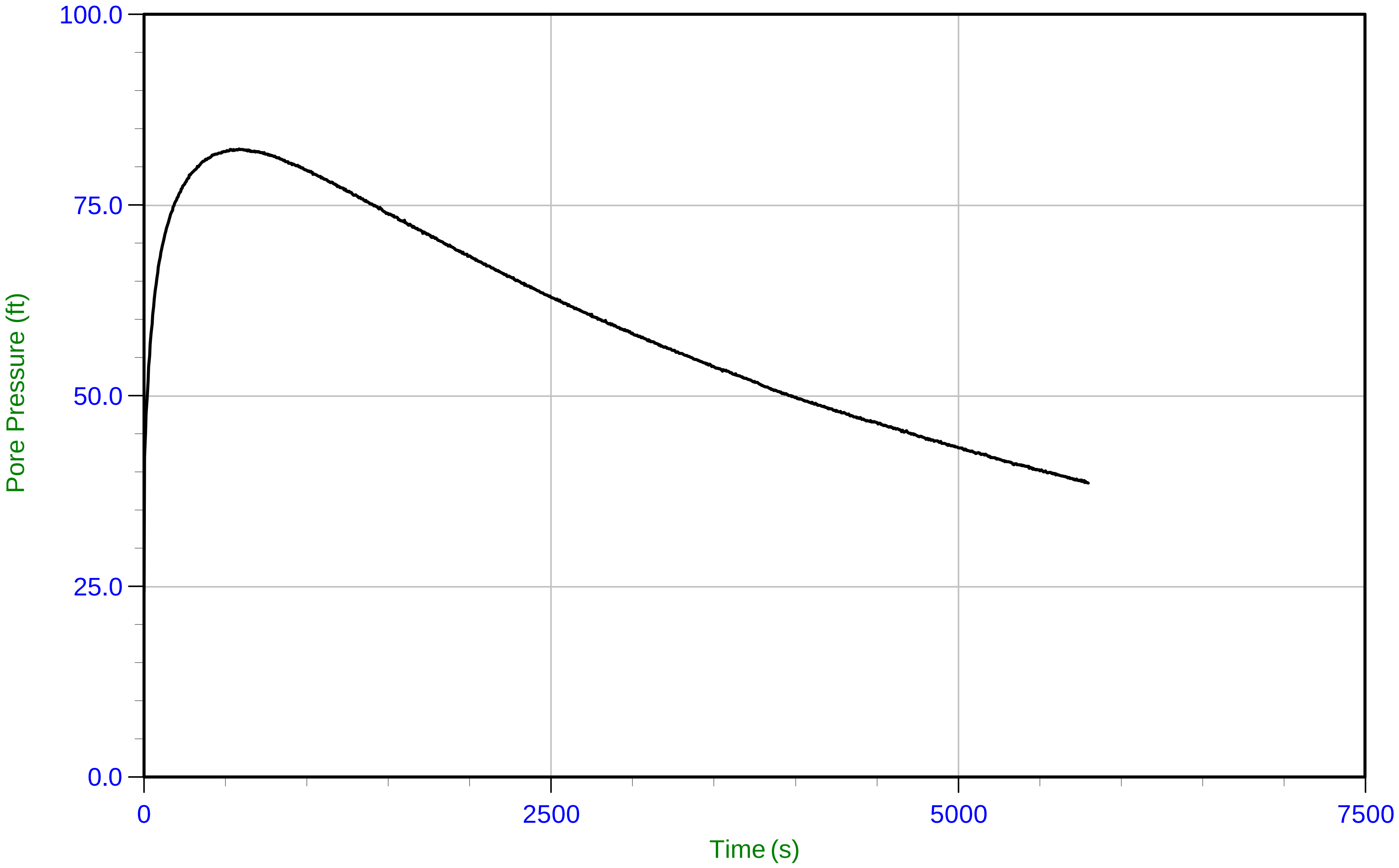
Filename: 15-53087_SP08.PPD
Depth: 9.900 m / 32.480 ft
Duration: 7020.0 s

U Min: 59.3 ft
U Max: 127.7 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

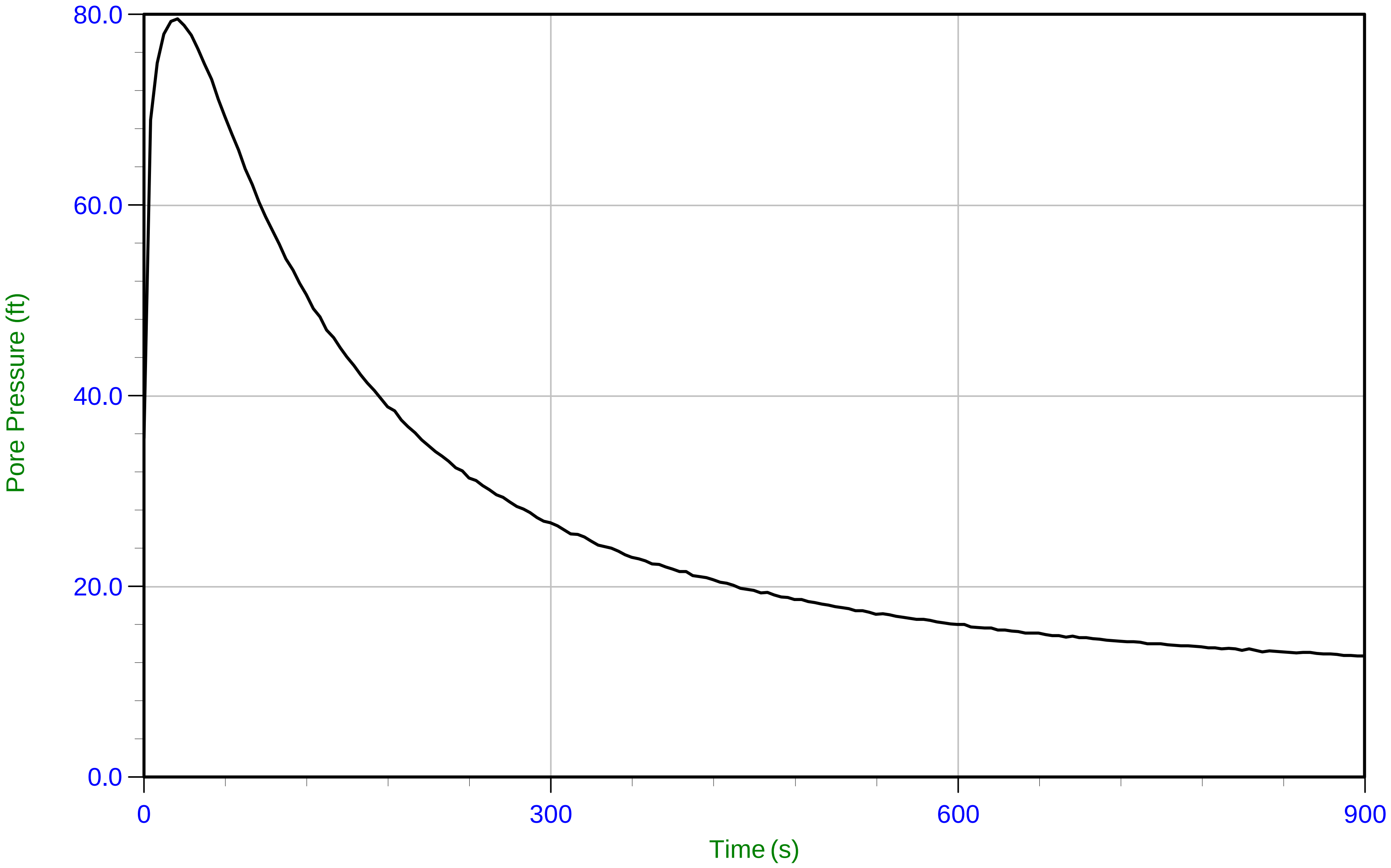
Filename: 15-53087_SP08.PPD
Depth: 10.900 m / 35.761 ft
Duration: 5800.0 s

U Min: 24.3 ft
U Max: 82.4 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 11.900 m / 39.042 ft
Duration: 900.0 s

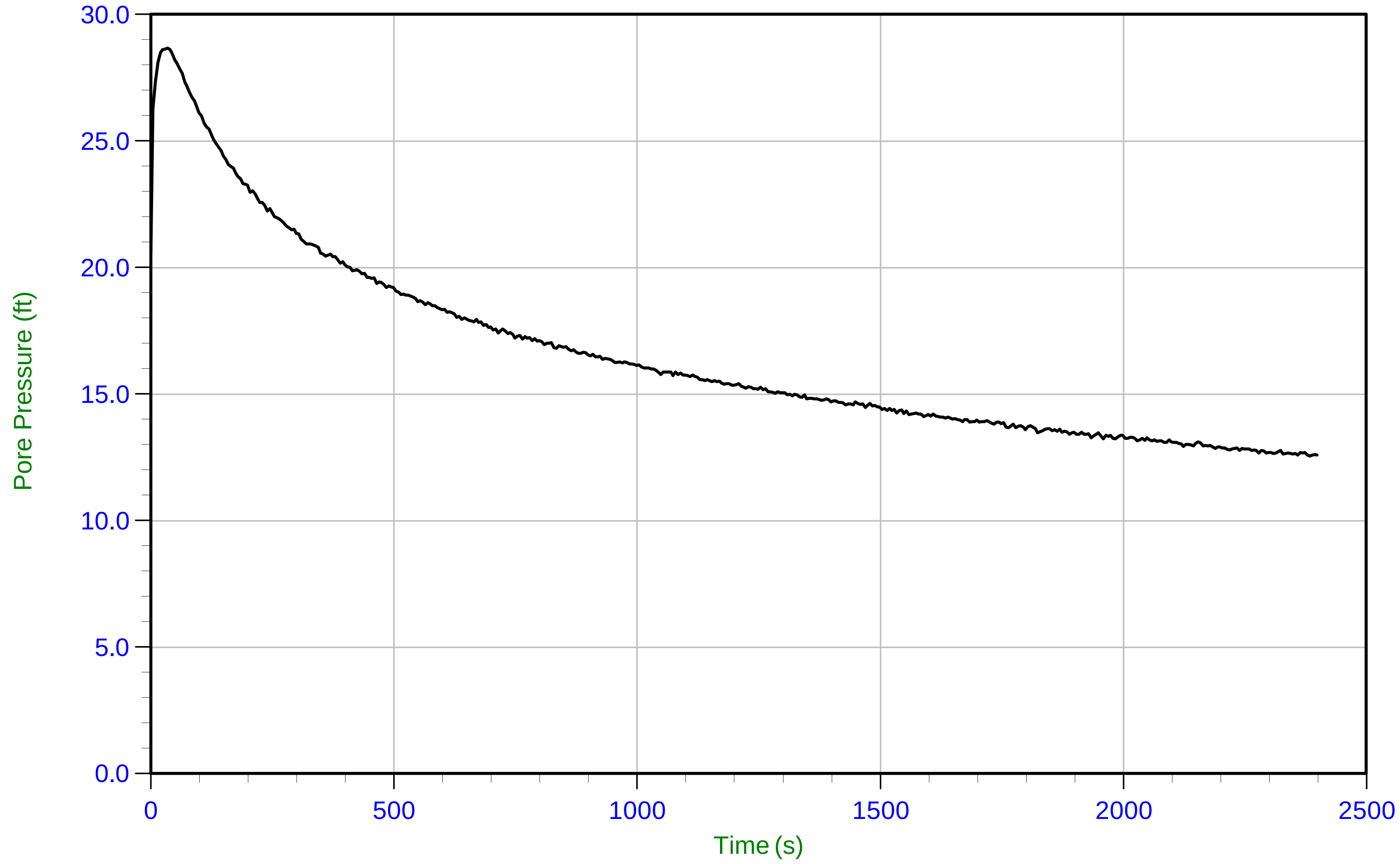
U Min: 12.7 ft
U Max: 79.6 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

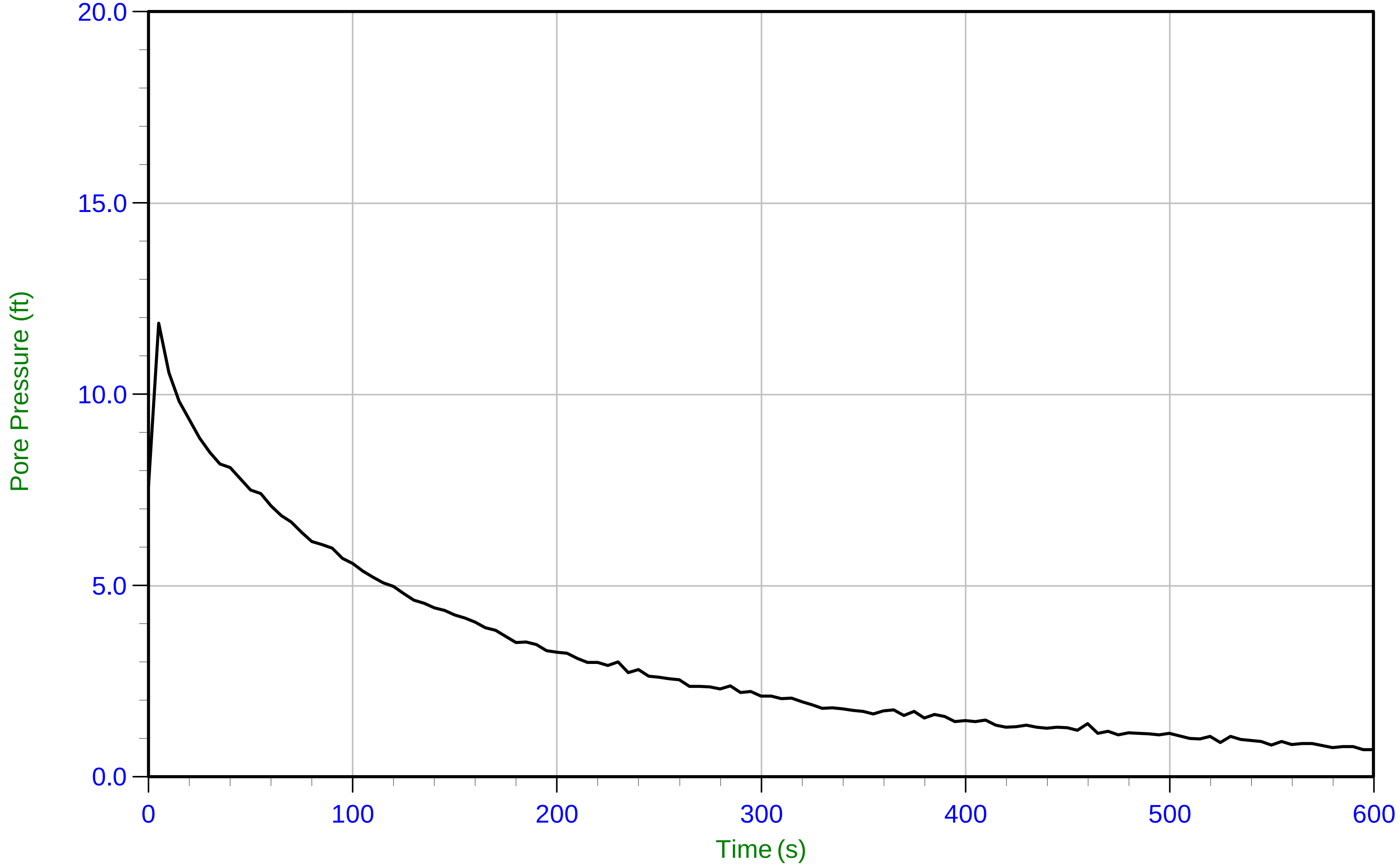
Filename: 15-53087_SP08.PPD
Depth: 12.900 m / 42.322 ft
Duration: 2400.0 s

U Min: 12.6 ft
U Max: 28.7 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

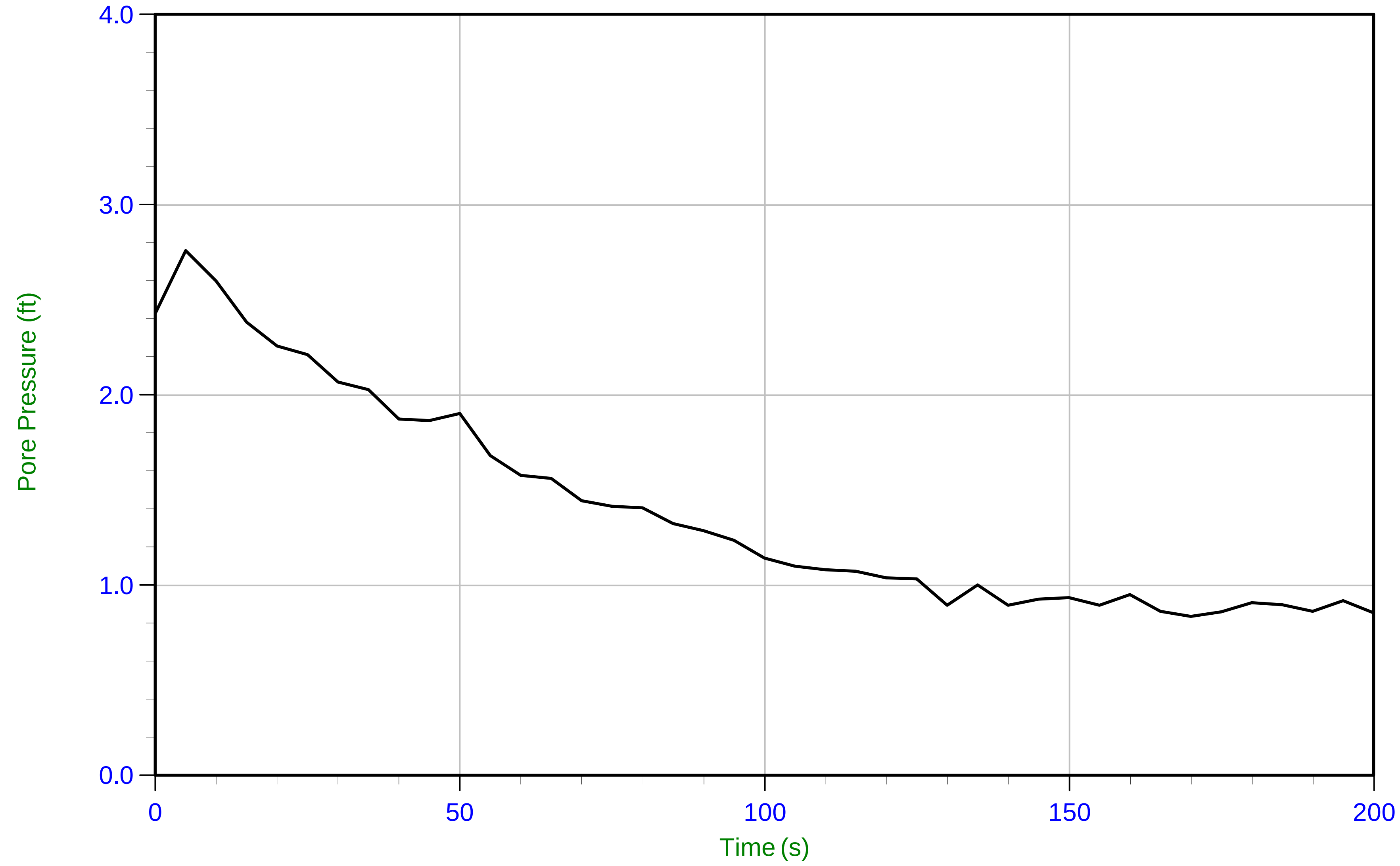
Filename: 15-53087_SP08.PPD
Depth: 13.900 m / 45.603 ft
Duration: 600.0 s

U Min: 0.7 ft
U Max: 11.9 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 14.900 m / 48.884 ft
Duration: 200.0 s

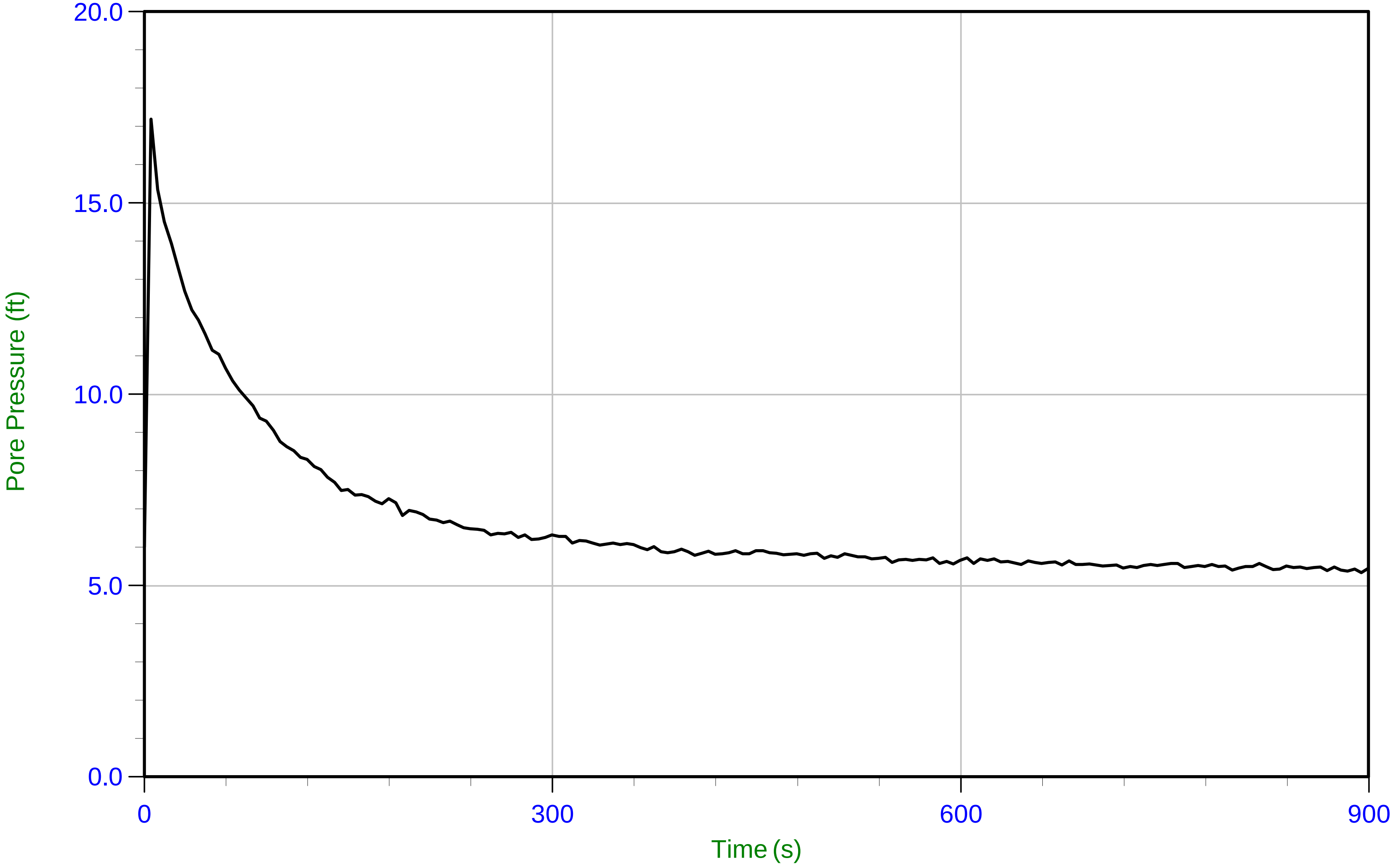
U Min: 0.8 ft
U Max: 2.8 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

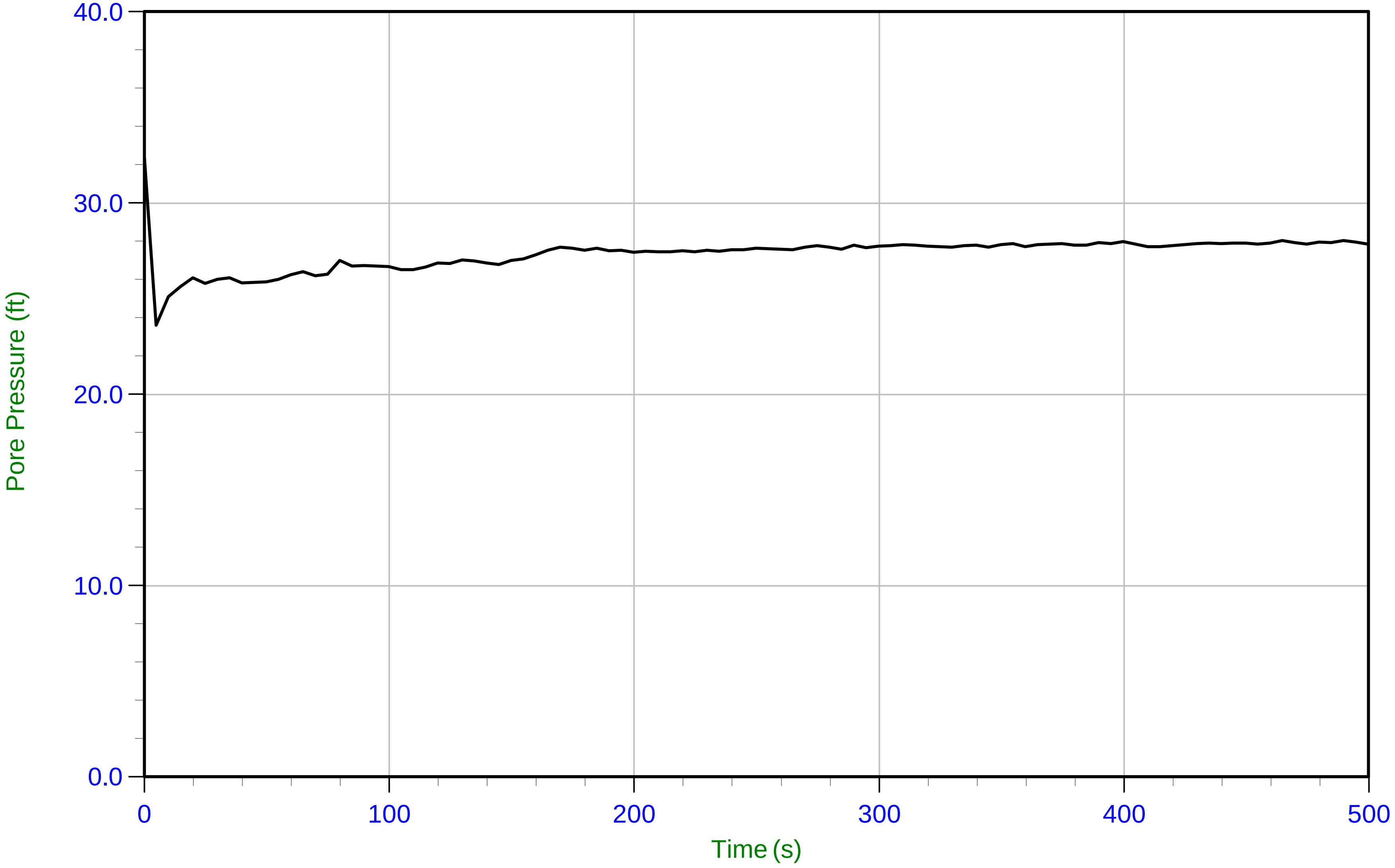
Filename: 15-53087_SP08.PPD
Depth: 15.250 m / 50.032 ft
Duration: 900.0 s

U Min: 5.3 ft
U Max: 17.2 ft

Haley & Aldrich

Job No: 15-53087
Date: 17-Sep-2015 11:57:35
Site: AECI-New Madrid

Sounding: CPT15-HAC9
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_CP09.PPD
Depth: 22.900 m / 75.130 ft
Duration: 500.0 s

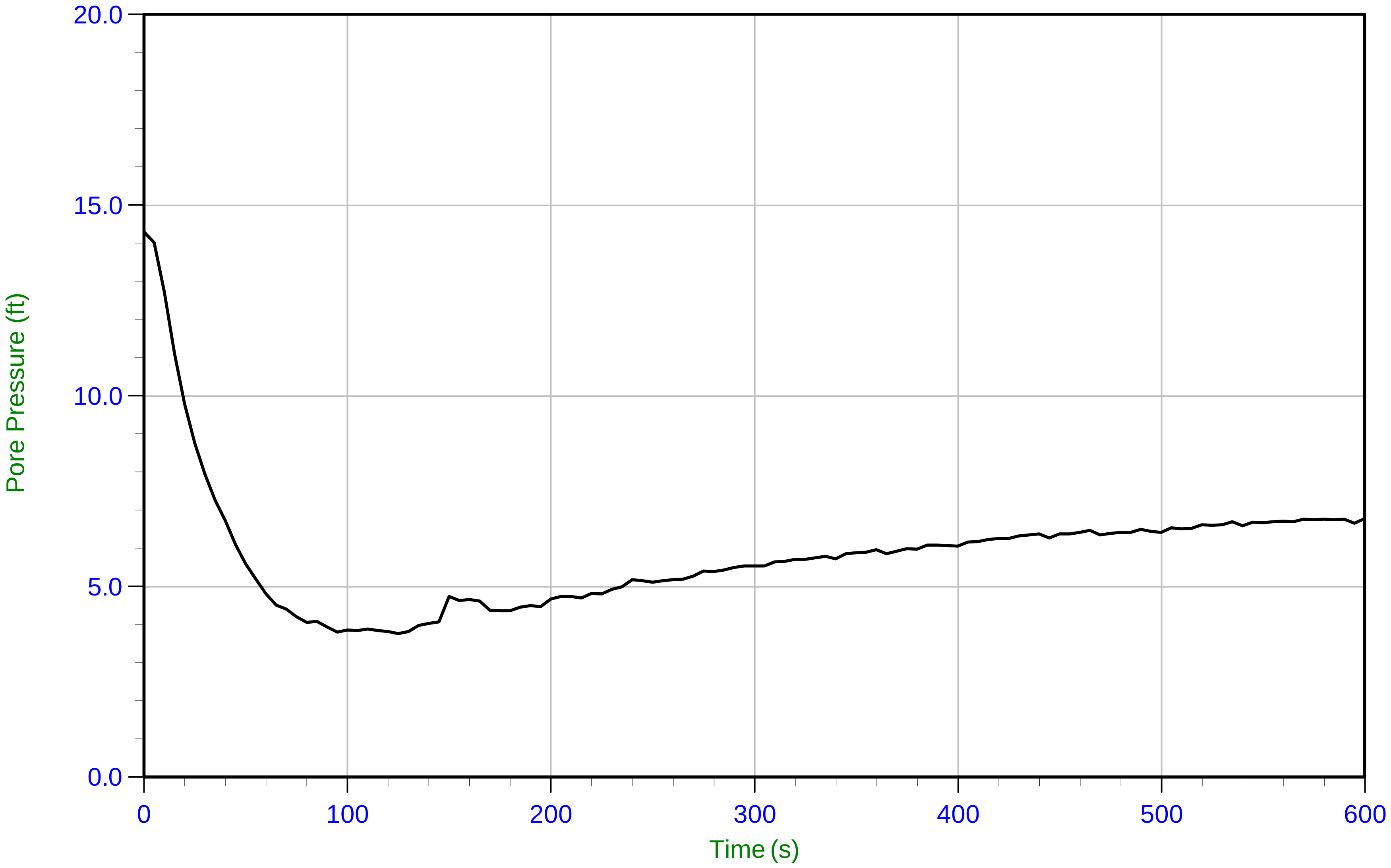
U Min: 23.6 ft
U Max: 32.4 ft

WT: 14.398 m / 47.237 ft
Ueq: 27.9 ft

Haley & Aldrich

Job No: 15-53087
Date: 17-Sep-2015 17:40:44
Site: AECI-New Madrid

Sounding: CPT15-HAC10
Cone: AD419
Cone Area: 15 sq cm



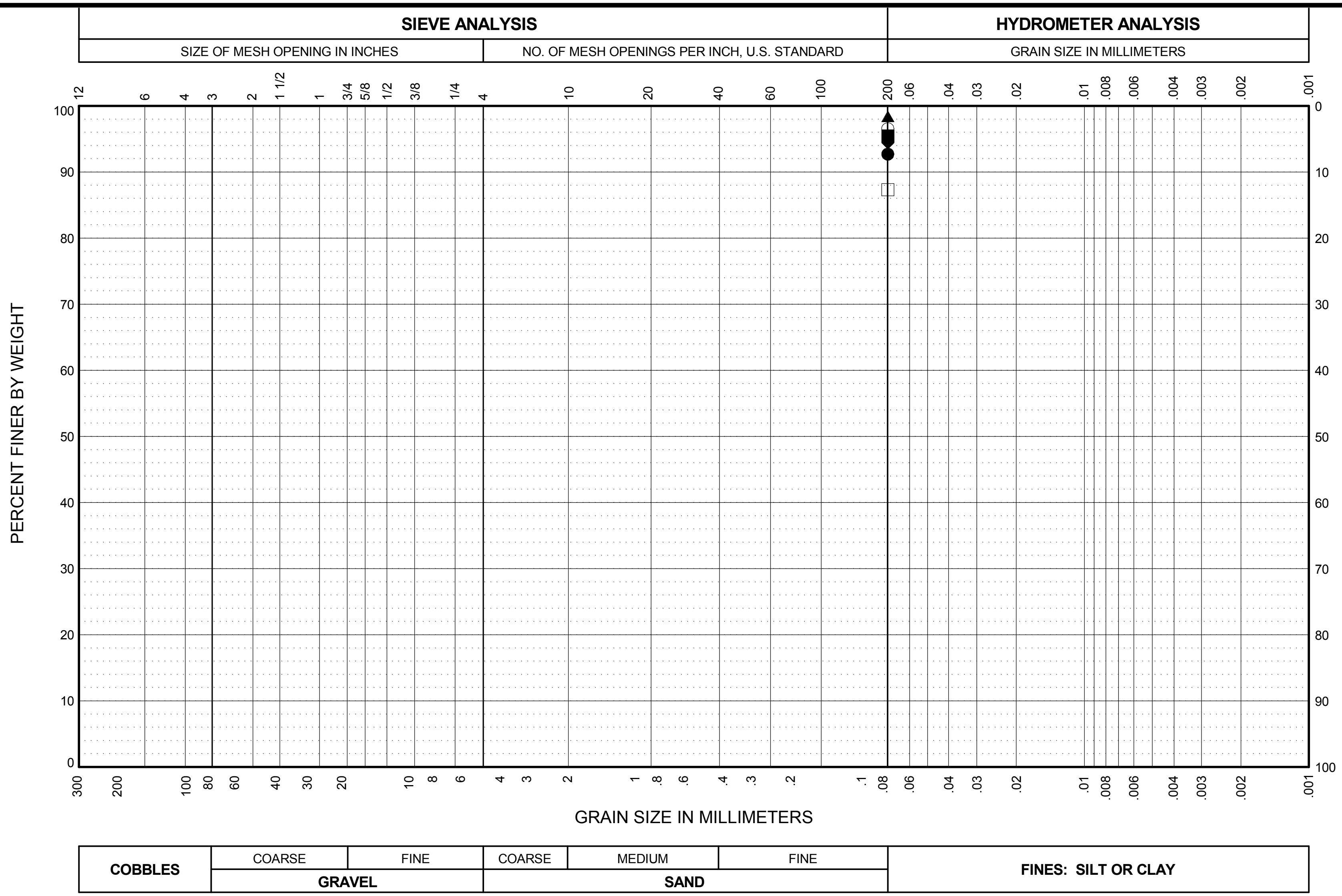
Trace Summary:

Filename: 15-53087_CP10.PPD
Depth: 15.400 m / 50.524 ft
Duration: 600.0 s

U Min: 3.8 ft
U Max: 14.3 ft

APPENDIX C

Laboratory Test Results



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B1, S6	11.0-13.0	CL	Gray-brown, Lean Clay.	92.7	22.8	42	20	22
■ HA-B3, S7	13.0-15.0	CL	Brown, Lean Clay.	95.5	22.8	47	22	25
▲ HA-B3, S10	28.0-30.0	CL	Light gray-brown, Lean Clay.	98.4	36.1			
◆ HA-B6, S4	7.0-9.0	CL	Gray-brown, Lean Clay.	94.4	22.6	45	21	24
○ HA-B6, S7	13.0-15.0	CL	Gray-brown, Lean Clay.	96.5	21.1	39	20	19
□ HA-B7, S6	11.0-13.0	CH	Light gray-brown, Fat Clay.	87.3	22.5	59	20	39

AECI Structural Integrity Assessments
Slag Dewatering Pond and Unlined Pond
Marston, Missouri

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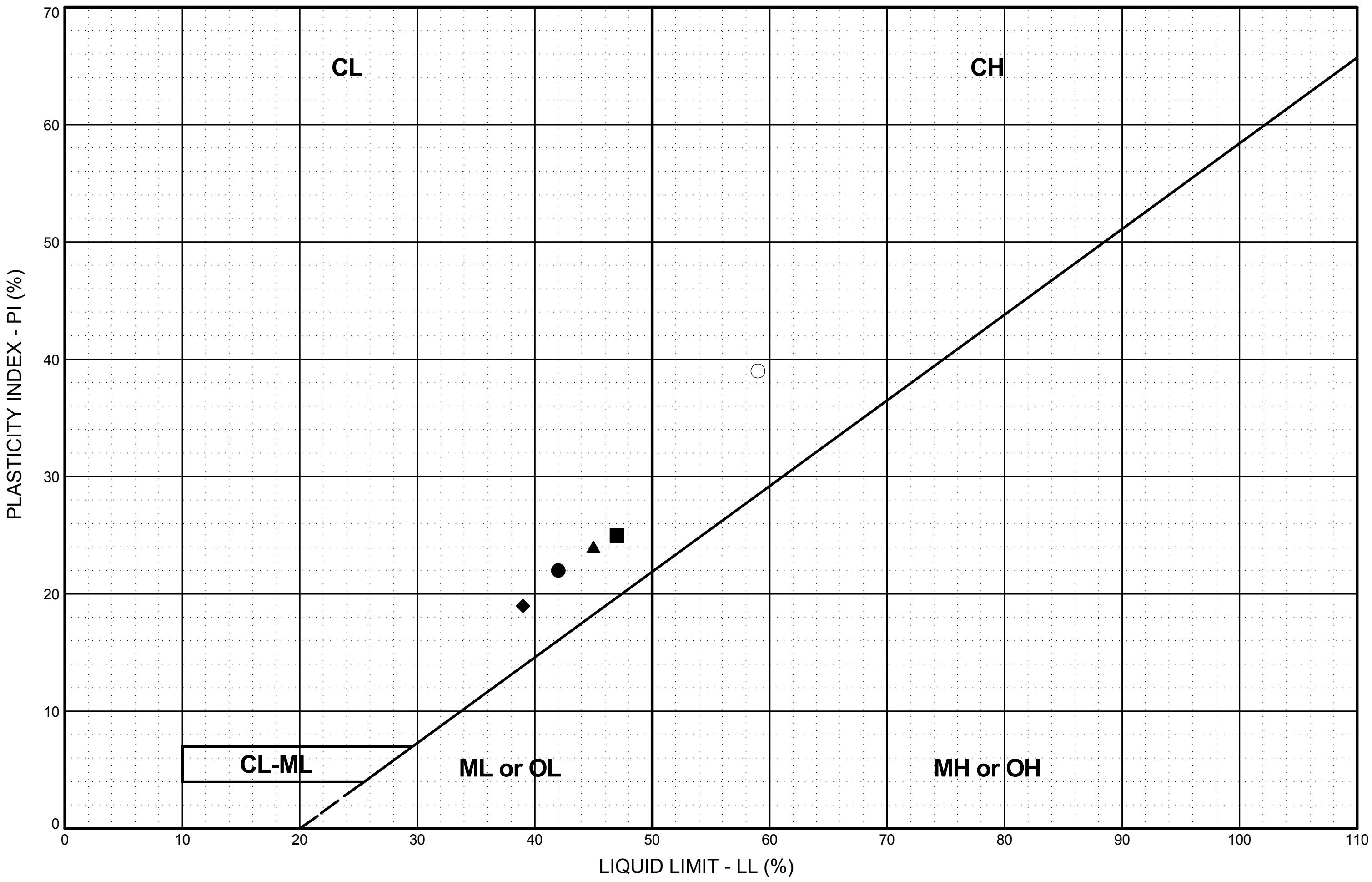
FIG.

FIG.

GSAMAIN2 41-1-37431-002 LAB DATA.GPJ SHAN_WIL.GDT 10/8/15



LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

ATTMAIN2 41-1-37431-002 LAB DATA.GPJ SHAN_WIL.GDT 10/8/15

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● HA-B1, S6	11.0-13.0	CL	Gray-brown, Lean Clay.	42	20	22	22.8	92.7
■ HA-B3, S7	13.0-15.0	CL	Brown, Lean Clay.	47	22	25	22.8	95.5
▲ HA-B6, S4	7.0-9.0	CL	Gray-brown, Lean Clay.	45	21	24	22.6	94.4
◆ HA-B6, S7	13.0-15.0	CL	Gray-brown, Lean Clay.	39	20	19	21.1	96.5
○ HA-B7, S6	11.0-13.0	CH	Light gray-brown, Fat Clay.	59	20	39	22.5	87.3

AECI Structural Integrity Assessments
Slag Dewatering Pond and Unlined Pond
Marston, Missouri

PLASTICITY CHART

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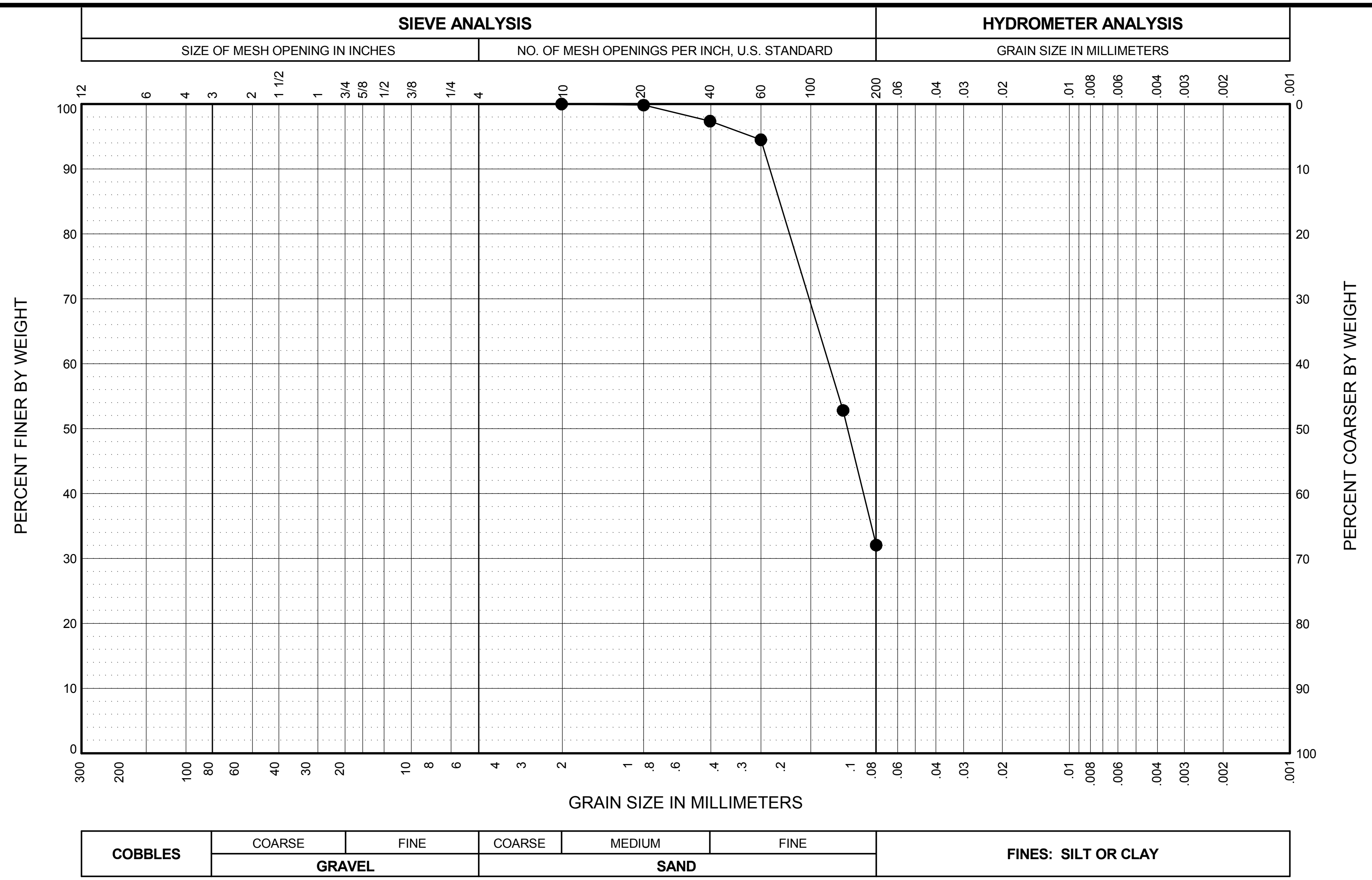
FIG.

FIG.



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B2, S11	28.0-30.0	SM	Gray-brown, Silty Sand.	32.1	20.7			

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Marston, Missouri

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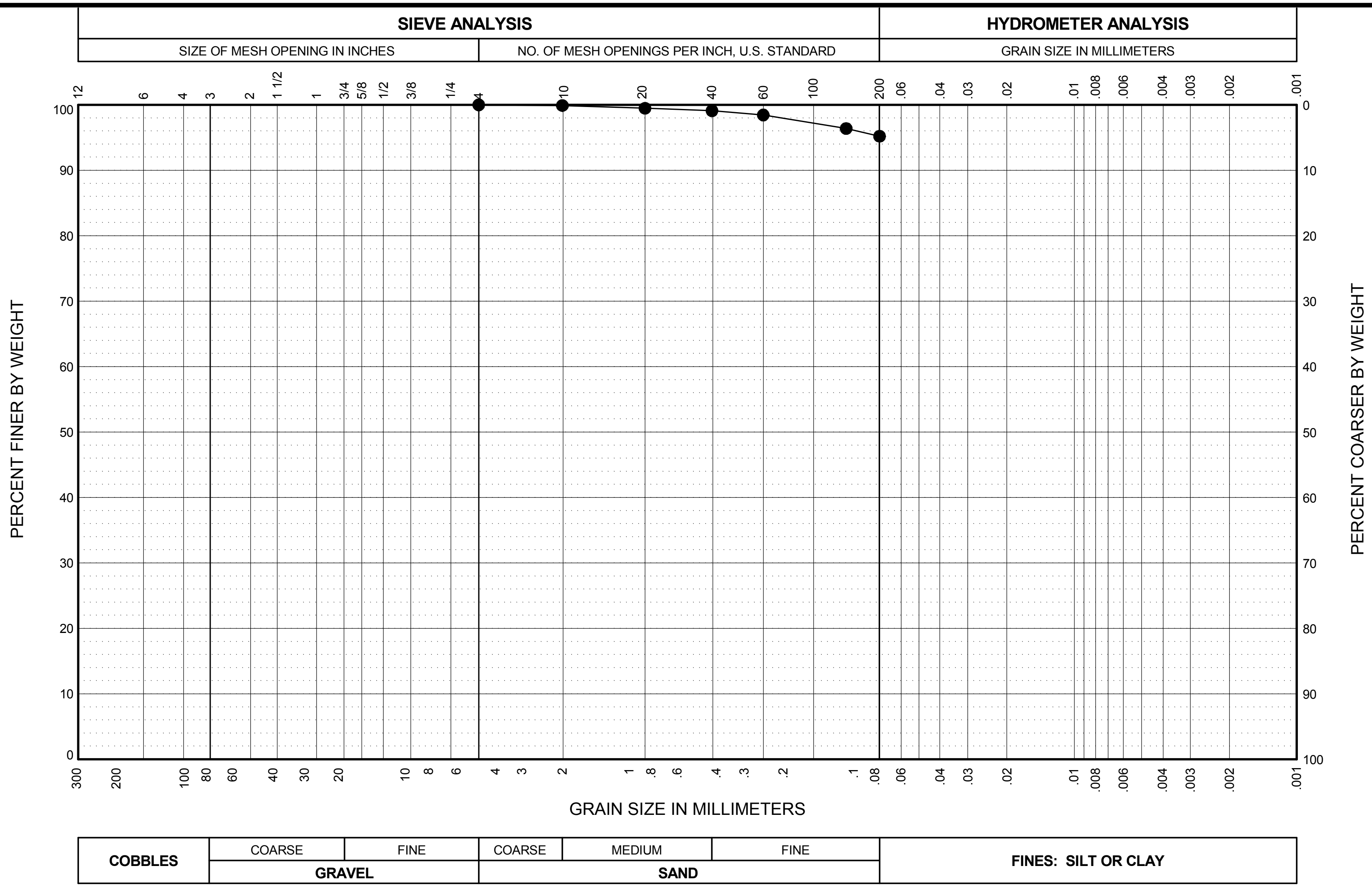
FIG.

FIG.

GSAMAIN2 41-1-37431-002 LAB DATA.GPJ SHAN_WIL.GDT 10/8/15



GSAMAIN2 41-1-37431-002 LAB DATA.GPJ SHAN_WIL.GDT 10/8/15

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B3, S3	5.0-7.0	CL	Dark gray, Lean Clay.	95.2	26.7			

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Marston, Missouri

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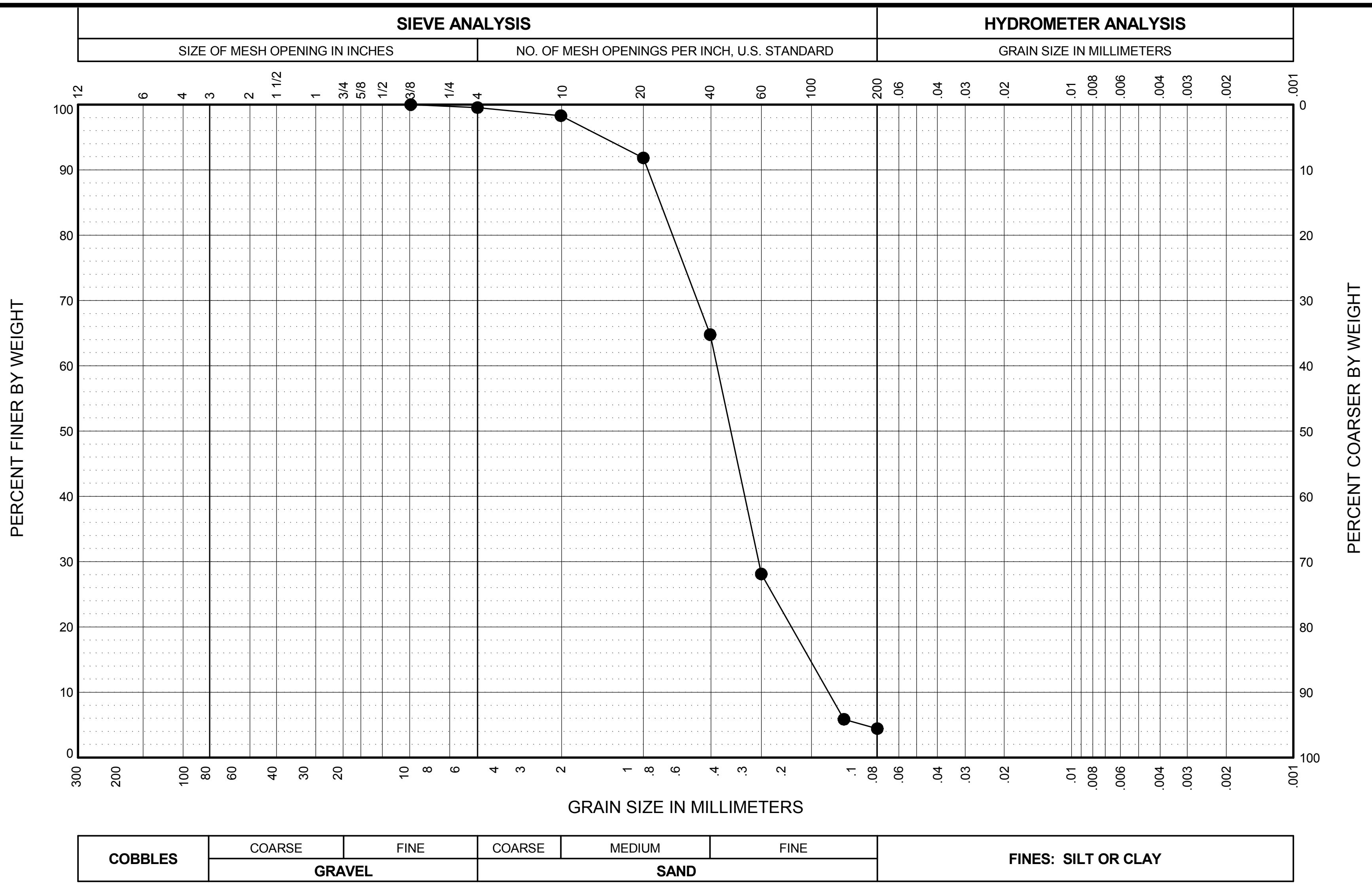
FIG.

FIG.



GSAMAIN2 41-1-37431-002 LAB DATA.GPJ SHAN_WIL.GDT 10/8/15

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B4, S15	48.0-50.0	SP	Brown, Poorly Graded Sand.	4.4	18.1			

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Marston, Missouri

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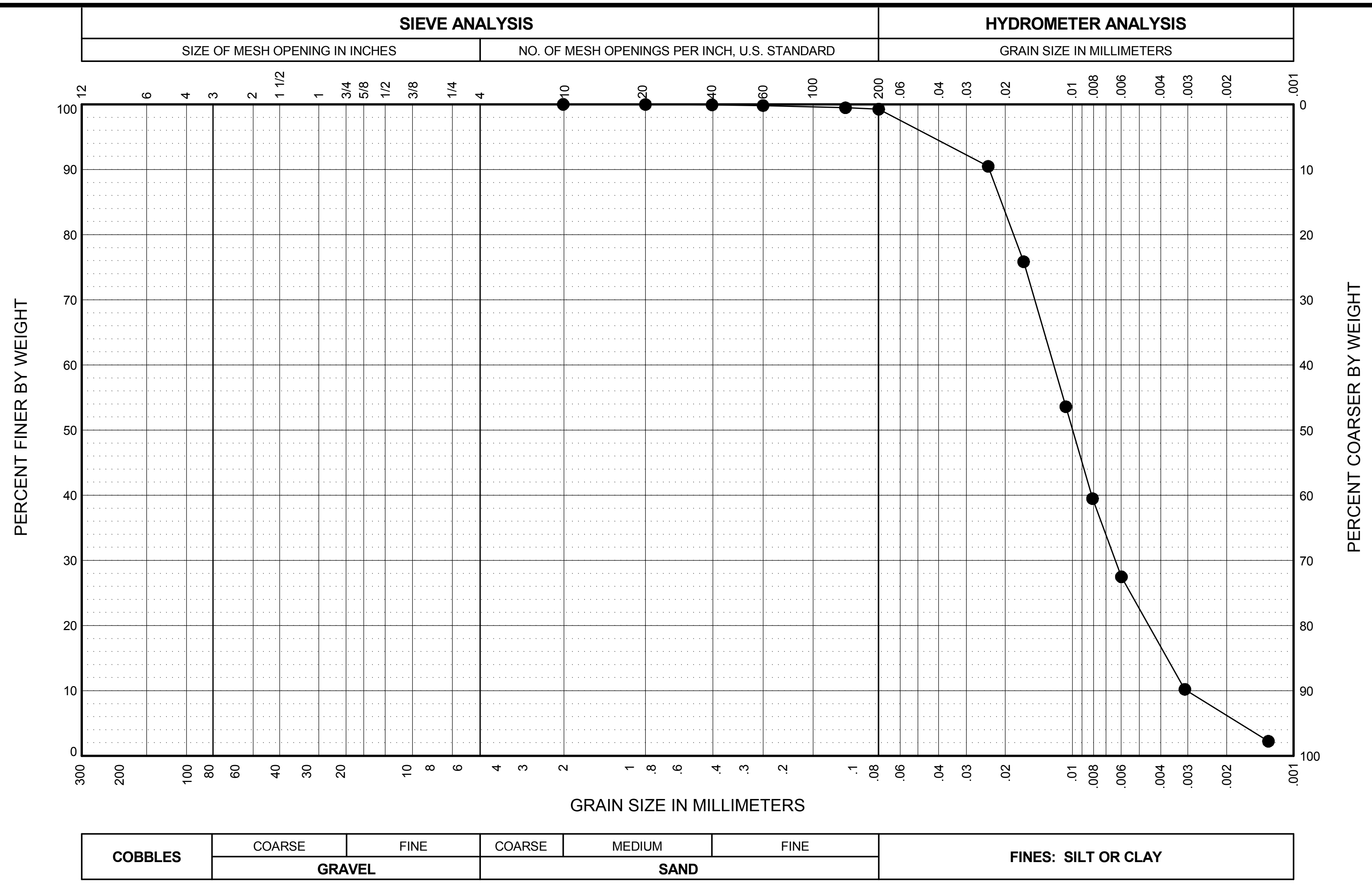
FIG.

FIG.



GSAMAIN2 41-1-37431-003 LAB DATA.GPJ SHAN_WIL.GDT 10/27/15

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B4, U2	5.7	ML	Dark gray, Silt (Ash).	99.3	32.9			

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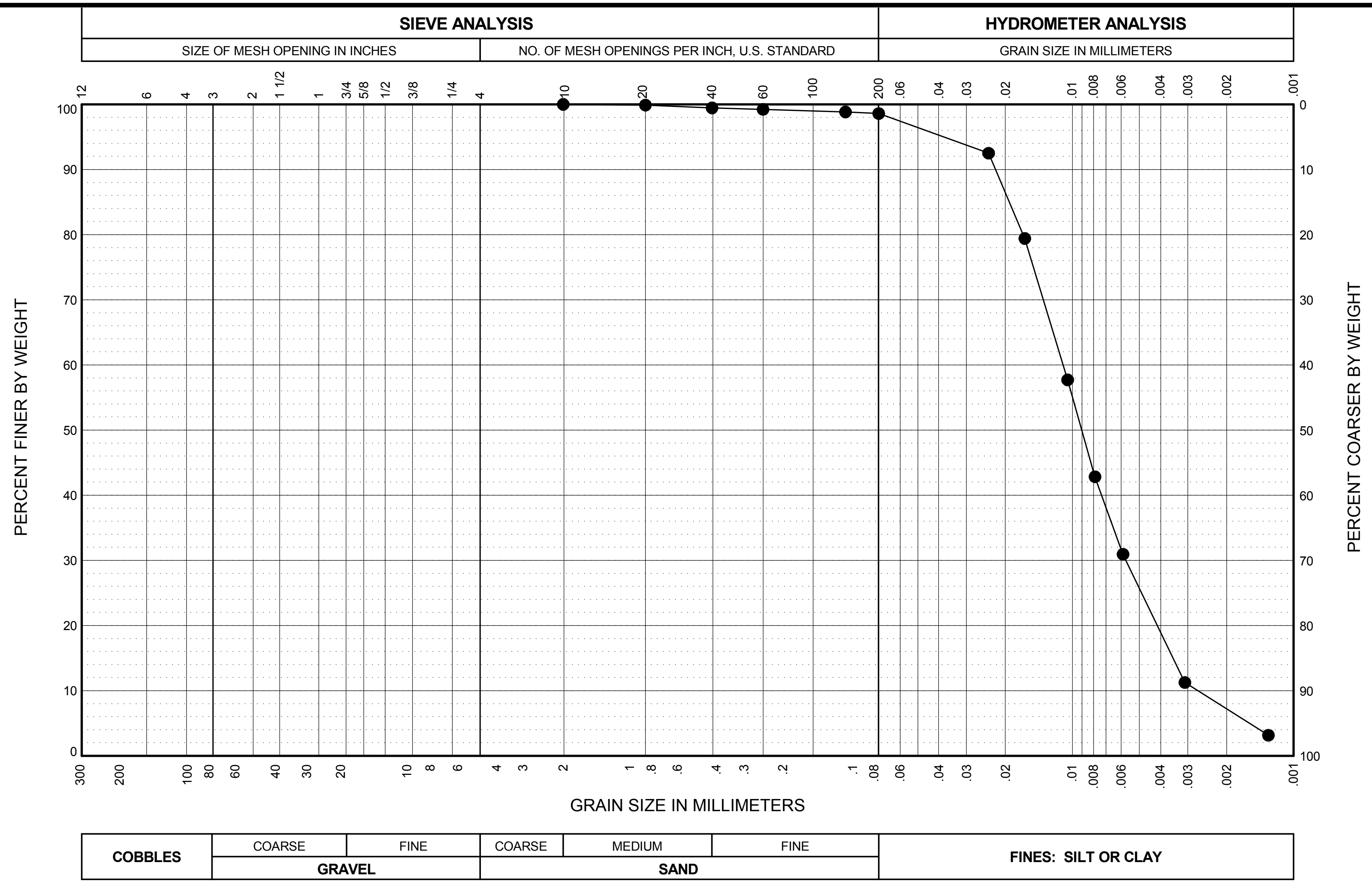
FIG.

FIG.



GSAMAIN2 41-1-37431-003 LAB DATA.GPJ SHAN_WIL.GDT 10/27/15

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B5, U1	10.6	ML	Dark gray, Silt (Ash).	98.6	25.3			

AECI Structural Integrity Assessments
Slag Dewatering Pond and Unlined Pond
Marston, Missouri

GRAIN SIZE DISTRIBUTION

October 2015 41-1-37431-003

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FIG.

FIG.

PROJECT AECI Structural Integrity Assessment DATE 10/12/15 BORING NO. HA-B4

JOB NO. 41-1-37431-003 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich CHECKED BY

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U2 DEPTH (ft) 5.0-7.0

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C. Strength info.	W.C.	TYPE OF TEST	CLASSIFICATION
				24 INCH RECOVERY Sample: [✓ Good] Fair Poor Disturbed
5.0	PP=N/A	HAT-3	MC	Dark gray, Silt (ML) (ASH); moist; <10% fine sand, 90% low dry strength, rapid dilatancy, low plasticity.
			SAVED	
5.5			Consol/Hydro	
6.0			SAVED	
6.5				6.6 Dark gray, Silty Sand (SM) (Slag); moist; 20% low to no plasiticity fines; 80% fine to coarse grained, subangular, sand.
7.0	PP=N/A	HAT-4	MC	

Can/Tare No.	HAT-3	HAT-4
WET + TARE	74.43	73.65
DRY + TARE	58.35	56.61
TARE	2.54	2.57
% WATER	28.8	31.5

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS:

PROJECT AECI Structural Integrity Assessment DATE 10/14/15 BORING NO. HA-B5

JOB NO. 41-1-37431-003 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich CHECKED BY

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U1 DEPTH (ft) 10.0-12.0

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C.		TYPE OF TEST	CLASSIFICATION
	Strength info.	W.C.		
10.0				24 INCH RECOVERY Sample: [✓ Good] Fair Poor Disturbed
	PP=N/A	HAT-5	MC	Dark gray, Silt (ML) (ASH); moist; <10% fine sand, 90% low dry strength, rapid dilatancy, low plasticity.
10.5			SAVED	
			Consol/Hydro	
			SAVED	-Sample below 10.8 feet very soft, seeped past extruder head during pushing.
11.0				
11.5				
				Moisture sample obtained from sample lining tube.
12.0	PP=N/A	HAT-6	MC	

Can/Tare No.	HAT-5	HAT-6
WET + TARE	45.03	35.53
DRY + TARE	35.54	24.87
TARE	2.56	2.54
% WATER	28.8	47.7

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS:

PROJECT AECI Structural Integrity Assessment DATE 10/9/15 BORING NO. HA-B5

JOB NO. 41-1-37431-003 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich CHECKED BY

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U2 DEPTH (ft) 20.0-22.0

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C.		TYPE OF TEST	CLASSIFICATION
	Strength info.	W.C.		
				24 INCH RECOVERY Sample: [✓ Good] Fair Poor Disturbed
20.0	PP=N/A	HAT-1	MC	Dark gray, Silt (ML) (ASH) with fine to coarse Sand layers (slag), moist; 20% fine to coarse, subangualr sand; 80% low dry strength, rapid dilatancy, low plasticity.
			SAVED	
20.5			UU	
21.0			SAVED	
			Consol	
21.5			SAVED	
22.0	PP=N/A	HAT-2	MC	

Can/Tare No.	HAT-1	HAT-2
WET + TARE	61.95	76.46
DRY + TARE	48.31	58.13
TARE	2.52	2.54
% WATER	29.8	33.0

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS:

TUBE DENSITY
ASTM D2937

Project	AECI Structural Integrity Assessment	Client	Haley & Aldrich	
Location	Marston, Missouri	Tested By / Date	CMB	10/9-14/15
Job No.	41-1-37431-003	Calculated By / Date	CMB	10/16/15
File	41-1-37431-003 D2937	Checked By / Date	CMB	10/16/15

Sample Boring	HA-B4	HA-B5	HA-B5	
Sample Number	U2	U1	U2	
Sample Depth	5.0 - 7.0	10.0 - 12.0	20.0 - 22.0	
Height (in)	22.620	23.790	23.845	
Diameter (in)	2.881	2.862	2.884	
Weight (gms)	4030.5	3983	4280.00	
Tare ID				
Tare weight (gms)				
Wet Weight (gms)				
Dry Weight (gms)				
Moisture %	30.2	38.3	34.6	
Area (in^2)	6.52	6.43	6.53	0.00
Volume (in)	147.46	153.05	155.77	0.00
Volume (ft)	0.09	0.09	0.09	0.00
Volume (cm)	2416.41	2507.99	2552.58	0.00
Wet Density (pcf)	104.1	99.1	104.7	#DIV/0!
Dry Density (pcf)	80.0	71.7	77.8	#DIV/0!

CONSOLIDATION TEST

Sheet 1

Project	AECI Structural Integrity Assessment	Client	Haley & Aldrich, Inc.	
Location	Marston, Missouri	Tested By / Date	CMB	10/21/15
Job Number	41-1-37431-003	Calculated By / Date	CMB	10/30/15
Boring	HA-B4	Checked By / Date	JTB	11/2/15
Sample	U2	File	41-1-37431-003 HA-B4 U2 D2435	
Depth (ft)	5.7	Procedure	ASTM D2435	

	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.004	2.503	0.850	inches	Tare No.	C-1	
Measured Reading 2	1.003	2.502	0.850	inches	Tare Weight	2.51	
Measured Reading 3	1.005	2.505	0.849	inches	Wet Weight	50.82	
Measured Reading 4	1.004	2.503	0.849	inches	Dry Weight	38.60	
Average Reading	1.004	2.503	0.850	inches	M.C. %	33.9%	
Wet Weight + Ring	288.07	Wet+Ring+Tare	358.83	grams	*Trimmings #2*		
Weight of Ring	144.11	Dry+Ring+Tare	330.88	grams	Tare No.	C-2	
Specific Gravity	2.66	Tare Weight	82.92	grams	Tare Weight	2.56	
Sample Volume	80.97		66.97	cm^3	Wet Weight	43.76	
Height of Solids	0.484		0.484	inches	Dry Weight	33.77	
Void Ratio	1.08		0.72		M.C. %	32.0%	
Saturation	95.6		100.0	percent	Ring Number	410	
Weight of Water	40.11		27.95	grams	Inundated @	0.27	tsf
Moisture Content	38.6		26.9	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	111.0		122.9	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	80.1		96.8	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.830	inches

Load 1		Load 2		Load 3		Load 4	
Air Press.	1.6	Air Press.	2.4	Air Press.	3.9	Air Press.	7.1
Load, tsf	0.25	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	77	0.1	120	0.1	183	0.1	390
0.25	79	0.25	123	0.25	191	0.25	421
0.5	80	0.5	124	0.5	198	0.5	443
1	81	1	126	1	201	1	459
2	82	2	128	2	204	2	471
4	83	4	130	4	209	4	480
8	85	8	131	8	212	8	488
17	87	15	133	15	216	15	495
30	88	30	135	30	220	30	501
60		60		60		60	506
120		120		120		120	512
240		240		240		240	517
480		480		480		370	520
1440		1440		1440		1305	528

Load 5		Load 6		Load 7		Load 8	
Air Press.	3.9	Air Press.	2.4	Air Press.	3.9	Air Press.	7.1
Load, tsf	1.0	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	518	0.1	507	0.1	510	0.1	525
0.25	517	0.25	507	0.25	510	0.25	526
0.5	517	0.5	507	0.5	510	0.5	526
1	517	1	506	1	510	1	526
2	517	2	506	2	510	2	527
4	516	4	505	4	510	4	527
8	516	8	505	8	511	8	528
15	516	15	504	15	511	15	528
30		30		30		30	529
60		60		60		60	
120		120		120		120	
240		240		240		240	
480		480		480		480	
1440		1440		1440		1440	

CONSOLIDATION TEST

Sheet 2

Project	AECI Structural Integrity Assessment	Client	Haley & Aldrich, Inc.	
Location	Marston, Missouri	Tested By / Date	CMB	10/21/15
Job Number	41-1-37431-003	Calculated By / Date	CMB	10/30/15
Boring	HA-B4	Checked By / Date	JTB	11/2/15
Sample	U2	File	41-1-37431-003 HA-B4 U2 D2435	
Depth (ft)	5.7	Procedure	ASTM D2435	

	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.004	2.503	0.850	inches	Tare No.	C-1	
Measured Reading 2	1.003	2.502	0.850	inches	Tare Weight	2.51	
Measured Reading 3	1.005	2.505	0.849	inches	Wet Weight	50.82	
Measured Reading 4	1.004	2.503	0.849	inches	Dry Weight	38.60	
Average Reading	1.004	2.503	0.850	inches	M.C. %	33.9%	
Wet Weight + Ring	288.07	Wet+Ring+Tare	358.83	grams	*Trimmings #2*		
Weight of Ring	144.11	Dry+Ring+Tare	330.88	grams	Tare No.	C-2	
Specific Gravity	2.66	Tare Weight	82.92	grams	Tare Weight	2.56	
Sample Volume	80.97		66.97	cm^3	Wet Weight	43.76	
Height of Solids	0.484		0.484	inches	Dry Weight	33.77	
Void Ratio	1.08		0.72		M.C. %	32.0%	
Saturation	95.6		100.0	percent	Ring Number	410	
Weight of Water	40.11		27.95	grams	Inundated @	0.27	tsf
Moisture Content	38.6		26.9	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	111.0		122.9	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	80.1		96.8	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.830	inches

Load 9		Load 10		Load 11		Load 12	
Air Press.	13.3	Air Press.	25.9	Air Press.	50.8	Air Press.	101.3
Load, tsf	4.0	Load, tsf	8.0	Load, tsf	16.0	Load, tsf	32.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	707	0.1	1104	0.1	1473	0.1	1812
0.25	762	0.25	1147	0.25	1503	0.25	1830
0.5	788	0.5	1167	0.5	1518	0.5	1841
1	804	1	1180	1	1530	1	1851
2	817	2	1193	2	1540	2	1859
4	827	4	1203	4	1548	4	1867
8	838	8	1211	8	1556	8	1874
15	845	15	1219	15	1563	15	1880
30	851	30	1226	30	1570	30	1886
60	858	60	1232	60	1575	60	1891
120	863	120	1238	120	1580	120	1897
240	868	240	1243	240	1586	240	1902
410	871	480	1248	480	1591	480	1906
4245	884	1440	1255	1440	1598	1440	1913

CONSOLIDATION TEST

Sheet 3

Project	AECI Structural Integrity Assessment	Client	Haley & Aldrich, Inc.	
Location	Marston, Missouri	Tested By / Date	CMB	10/21/15
Job Number	41-1-37431-003	Calculated By / Date	CMB	10/30/15
Boring	HA-B4	Checked By / Date	JTB	11/2/15
Sample	U2	File	41-1-37431-003 HA-B4 U2 D2435	
Depth (ft)	5.7	Procedure	ASTM D2435	

	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.004	2.503	0.850	inches	Tare No.	C-1	
Measured Reading 2	1.003	2.502	0.850	inches	Tare Weight	2.51	
Measured Reading 3	1.005	2.505	0.849	inches	Wet Weight	50.82	
Measured Reading 4	1.004	2.503	0.849	inches	Dry Weight	38.60	
Average Reading	1.004	2.503	0.850	inches	M.C. %	33.9%	
Wet Weight + Ring	288.07	Wet+Ring+Tare	358.83	grams	*Trimmings #2*		
Weight of Ring	144.11	Dry+Ring+Tare	330.88	grams	Tare No.	C-2	
Specific Gravity	2.66	Tare Weight	82.92	grams	Tare Weight	2.56	
Sample Volume	80.97		66.97	cm^3	Wet Weight	43.76	
Height of Solids	0.484		0.484	inches	Dry Weight	33.77	
Void Ratio	1.08		0.72		M.C. %	32.0%	
Saturation	95.6		100.0	percent	Ring Number	410	
Weight of Water	40.11		27.95	grams	Inundated @	0.27	tsf
Moisture Content	38.6		26.9	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	111.0		122.9	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	80.1		96.8	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.830	inches

CALIBRATION OF CONSOLIDATION DEFORMATION

Procedure SWCP-15 (Reference ASTM D2435 AASHTO T216)

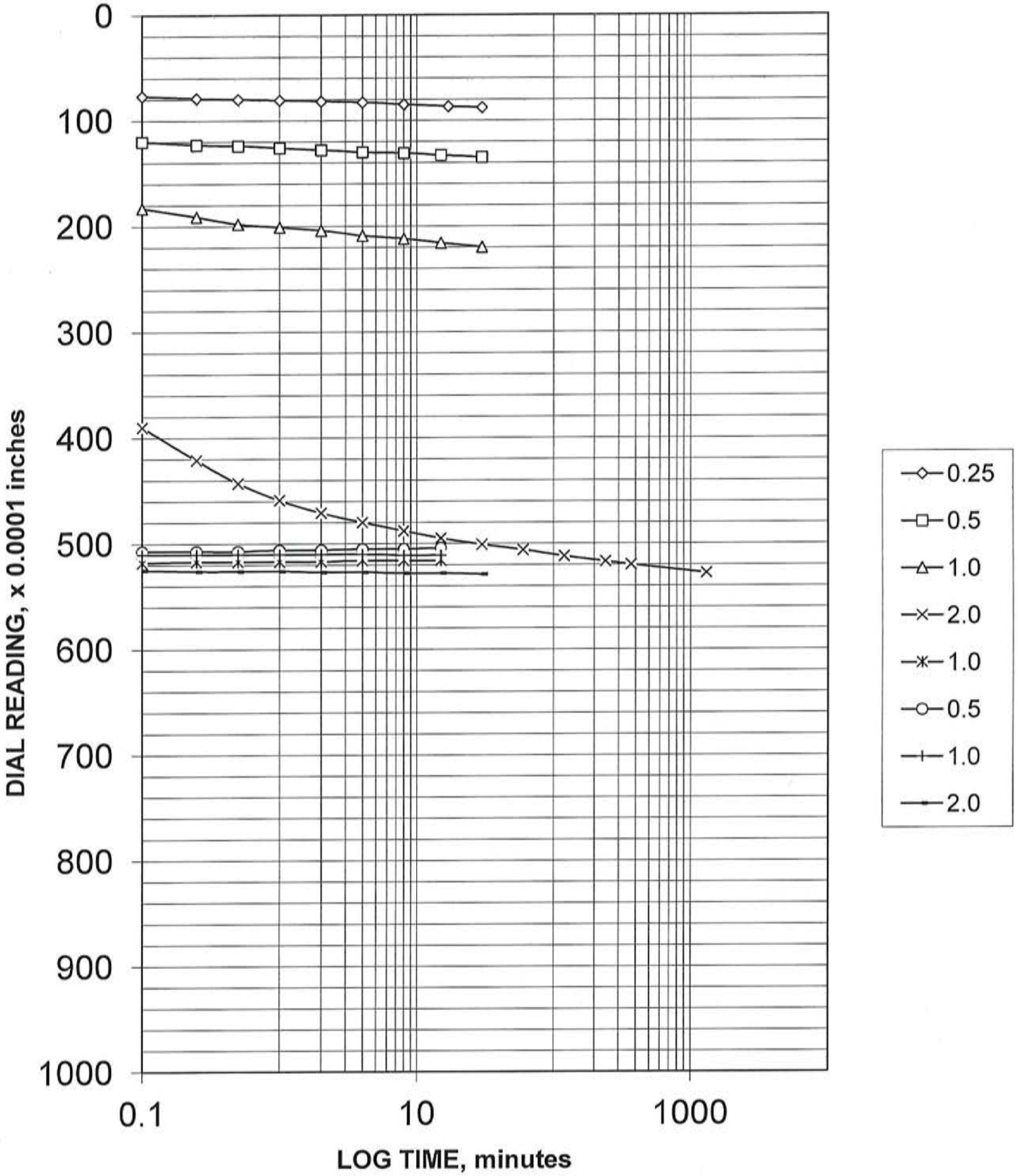
Equipment Calibrated:	Consolidation Deformation
Reason for Calibration:	Test Completion
Equipment Used:	Consolidation Appartus
	Steel Calibration Disk

Date Calibrated:	10/29/15
Next Calibration Due:	Next Test
Calibrated By:	CMB
Checked By:	CMB

Machine Number: 410

Load tsf	Machine Def x 10^{-4}	Correction Factor x 10^{-4}	U-100 x 10^{-4}	Corr. U-100 x 10^{-4}	Compression, Percent	C_v	Void Ratio
0.01	0	0	0	0	0.00%	0	1.08
0.25	41	0	79.0	38	0.38%	3.3E+00	1.07
0.5	56	0	123.0	67	0.67%	3.3E+00	1.06
1.0	72	0	198.0	126	1.26%	2.4E+00	1.05
2.0	92	0	485.0	393	3.93%	1.3E+00	0.99
1.0	84	43	517.0	390	3.90%	NA	0.99
0.5	77	43	506.0	386	3.86%	NA	1.00
1.0	81	43	511.0	387	3.87%	NA	1.00
2.0	83	43	526.0	400	4.00%	NA	0.99
4.0	113	0	838.0	725	7.25%	1.2E+00	0.93
8.0	136	0	1209.0	1073	10.73%	1.0E+00	0.85
16.0	158	0	1541.0	1383	13.83%	1.2E+00	0.79
32.0	177	0	1863.0	1686	16.86%	9.8E-01	0.73

CONSOLIDATION TEST



AECI Structural Integrity Assessment
Marston, Missouri

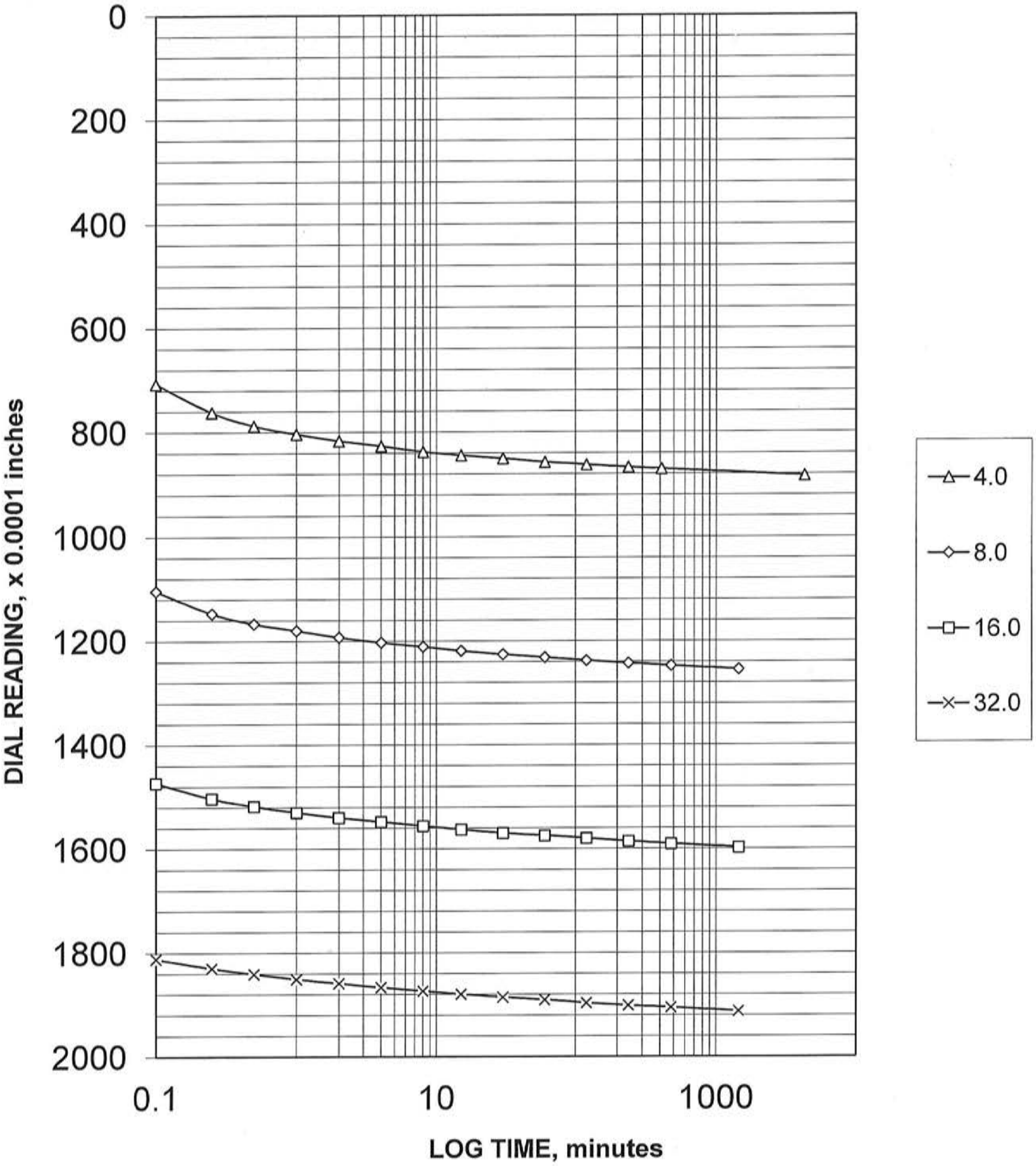
TIME PLOTS
HA-B4
U2

October 2015 41-1-37431-003

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG.

CONSOLIDATION TEST



AECI Structural Integrity Assessment
Marston, Missouri

TIME PLOTS
HA-B4
U2

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41-1-37431-003

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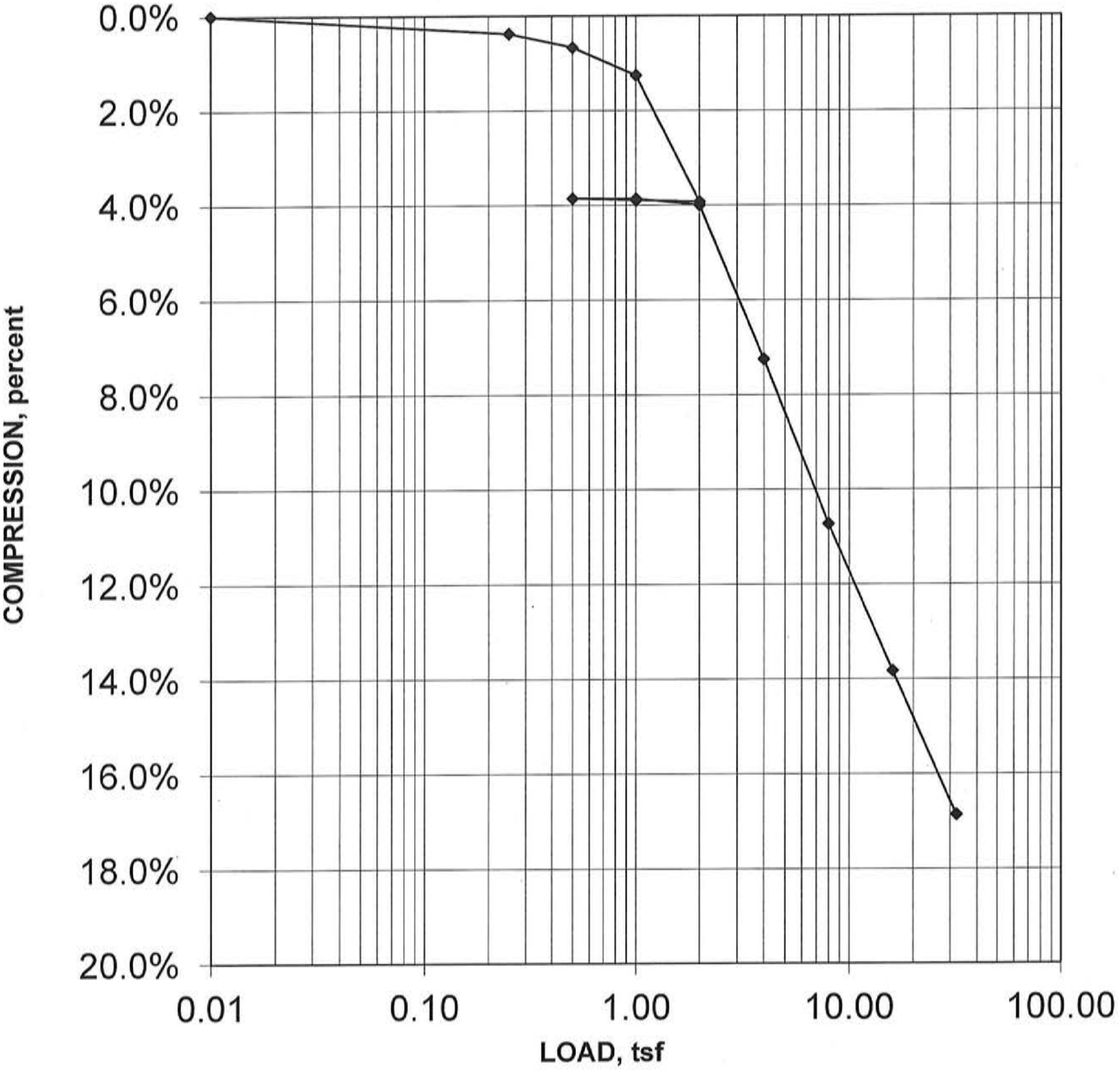
Geotechnical and Environmental Consultants

FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm²/second	Load, tsf	Coefficient of Consolidation, mm²/second
0.25	3.3E+00	2.0	NA
0.5	3.3E+00	4.0	1.2E+00
1.0	2.4E+00	8.0	1.0E+00
2.0	1.3E+00	16.0	1.2E+00
1.0	NA	32.0	9.8E-01
0.5	NA		
1.0	NA		

AECI Structural Integrity Assessment
Marston, Missouri

SETTLEMENT PLOTS

HA-B4

U2

October 2015 41-1-37431-003

SHANNON & WILSON, INC.
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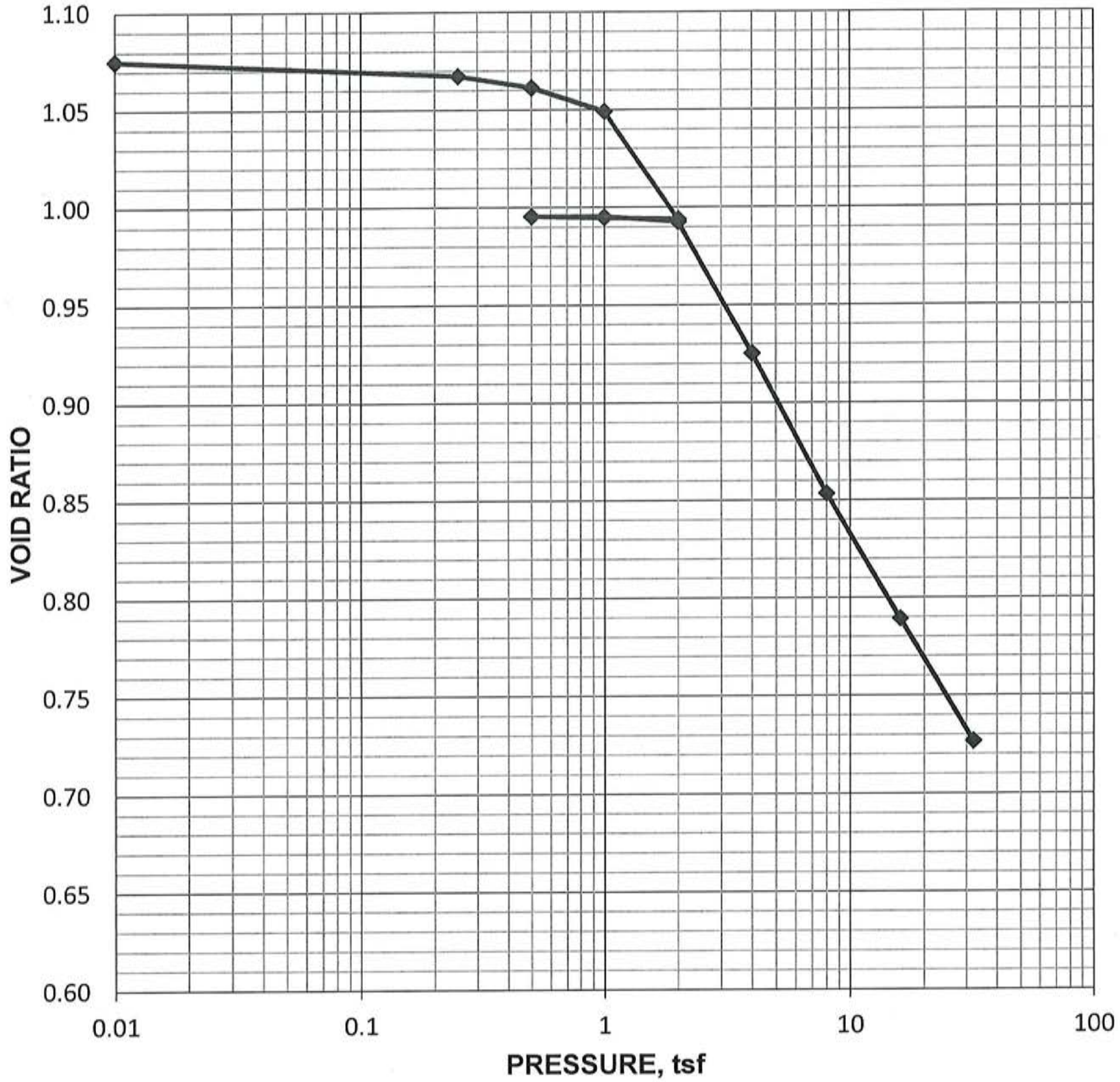
FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm²/second	Load, tsf	Coefficient of Consolidation, mm²/second
0.25	3.3E+00	2.0	NA
0.5	3.3E+00	4.0	1.2E+00
1.0	2.4E+00	8.0	1.0E+00
2.0	1.3E+00	16.0	1.2E+00
1.0	NA	32.0	9.8E-01
0.5	NA		
1.0	NA		

AECI Structural Integrity Assessment
Marston, Missouri

VOID RATIO PLOT

HA-B4

U2

October 2015 41-1-37431-003

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG.

CONSOLIDATION TEST

Sheet 1

Project	AECI Structural Integrity Assessment			Client		Haley & Aldrich, Inc.	
Location	Marston, Missouri			Tested By / Date		CMB	10/21/15
Job Number	41-1-37431-003			Calculated By / Date		CMB	10/30/15
Boring	HA-B5			Checked By / Date		JTB	11/2/15
Sample	U1			File		41-1-37431-003 HA-B5 U1 D2435	
Depth (ft)	10.6			Procedure		ASTM D2435	
	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.003	2.502	0.876	inches	Tare No.	C-3	
Measured Reading 2	1.002	2.504	0.878	inches	Tare Weight	2.50	
Measured Reading 3	1.004	2.503	0.887	inches	Wet Weight	60.74	
Measured Reading 4	1.003	2.502	0.880	inches	Dry Weight	48.80	
Average Reading	1.003	2.503	0.880	inches	M.C. %	25.8%	
Wet Weight + Ring	279.51	Wet+Ring+Tare	362.76	grams	*Trimmings #2*		
Weight of Ring	146.33	Dry+Ring+Tare	332.70	grams	Tare No.	C-4	
Specific Gravity	2.61	Tare Weight	83.07	grams	Tare Weight	2.49	
Sample Volume	80.86		69.71	cm^3	Wet Weight	51.79	
Height of Solids	0.492		0.492	inches	Dry Weight	41.96	
Void Ratio	1.04		0.76		M.C. %	24.9%	
Saturation	72.5		100.0	percent	Ring Number	411	
Weight of Water	29.88		30.06	grams	Inundated @	0.26	tsf
Moisture Content	28.9		29.1	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	102.8		119.4	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	79.8		92.5	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.865	inches

Load 1		Load 2		Load 3		Load 4	
Air Press.	1.6	Air Press.	2.4	Air Press.	4.0	Air Press.	7.1
Load, tsf	0.26	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	150	0.1	267	0.1	430	0.1	590
0.25	154	0.25	276	0.25	438	0.25	598
0.5	159	0.5	281	0.5	443	0.5	604
1	162	1	286	1	447	1	609
2	169	2	289	2	451	2	614
4	173	4	292	4	454	4	618
8	176	8	296	8	458	8	623
17	179	15	300	15	462	15	627
30	182	30	303	30	465	30	631
60		60		60		60	635
120		120		120		120	639
240		240		240		240	643
480		480		480		370	645
1440		1440		1440		1305	654

Load 5		Load 6		Load 7		Load 8	
Air Press.	4.0	Air Press.	2.4	Air Press.	4.0	Air Press.	7.1
Load, tsf	1.0	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	644	0.1	630	0.1	634	0.1	651
0.25	644	0.25	630	0.25	635	0.25	652
0.5	643	0.5	629	0.5	635	0.5	652
1	643	1	629	1	635	1	653
2	643	2	628	2	635	2	653
4	643	4	627	4	635	4	653
8	642	8	626	8	635	8	654
15	642	15	626	15	636	15	654
30		30		30		30	655
60		60		60		60	
120		120		120		120	
240		240		240		240	
480		480		480		480	
1440		1440		1440		1440	

CONSOLIDATION TEST

Sheet 2

Project	AECI Structural Integrity Assessment			Client		Haley & Aldrich, Inc.	
Location	Marston, Missouri			Tested By / Date		CMB	10/21/15
Job Number	41-1-37431-003			Calculated By / Date		CMB	10/30/15
Boring	HA-B5			Checked By / Date		JTB	11/2/15
Sample	U1			File		41-1-37431-003 HA-B5 U1 D2435	
Depth (ft)	10.6			Procedure		ASTM D2435	
	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.003	2.502	0.876	inches	Tare No.	C-3	
Measured Reading 2	1.002	2.504	0.878	inches	Tare Weight	2.50	
Measured Reading 3	1.004	2.503	0.887	inches	Wet Weight	60.74	
Measured Reading 4	1.003	2.502	0.880	inches	Dry Weight	48.80	
Average Reading	1.003	2.503	0.880	inches	M.C. %	25.8%	
Wet Weight + Ring	279.51	Wet+Ring+Tare	362.76	grams	*Trimmings #2*		
Weight of Ring	146.33	Dry+Ring+Tare	332.70	grams	Tare No.	C-4	
Specific Gravity	2.61	Tare Weight	83.07	grams	Tare Weight	2.49	
Sample Volume	80.86		69.71	cm^3	Wet Weight	51.79	
Height of Solids	0.492		0.492	inches	Dry Weight	41.96	
Void Ratio	1.04		0.76		M.C. %	24.9%	
Saturation	72.5		100.0	percent	Ring Number	411	
Weight of Water	29.88		30.06	grams	Inundated @	0.26	tsf
Moisture Content	28.9		29.1	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	102.8		119.4	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	79.8		92.5	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.865	inches

Load 9		Load 10		Load 11		Load 12	
Air Press.	13.3	Air Press.	25.9	Air Press.	51.1	Air Press.	101.7
Load, tsf	4.0	Load, tsf	8.0	Load, tsf	16.0	Load, tsf	32.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	774	0.1	994	0.1	1245	0.1	1521
0.25	783	0.25	1006	0.25	1259	0.25	1534
0.5	790	0.5	1013	0.5	1267	0.5	1543
1	796	1	1021	1	1277	1	1552
2	802	2	1028	2	1285	2	1561
4	807	4	1034	4	1291	4	1569
8	814	8	1041	8	1298	8	1576
15	820	15	1046	15	1304	15	1582
30	825	30	1052	30	1310	30	1588
60	830	60	1058	60	1316	60	1594
120	834	120	1062	120	1321	120	1600
240	839	240	1068	240	1326	240	1605
410	842	480	1072	480	1332	480	1611
4245	855	1440	1080	1440	1340	1440	1619

CONSOLIDATION TEST

Sheet 3

Project	AECI Structural Integrity Assessment			Client		Haley & Aldrich, Inc.	
Location	Marston, Missouri			Tested By / Date		CMB	10/21/15
Job Number	41-1-37431-003			Calculated By / Date		CMB	10/30/15
Boring	HA-B5			Checked By / Date		JTB	11/2/15
Sample	U1			File		41-1-37431-003 HA-B5 U1 D2435	
Depth (ft)	10.6			Procedure		ASTM D2435	
	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.003	2.502	0.876	inches	Tare No.	C-3	
Measured Reading 2	1.002	2.504	0.878	inches	Tare Weight	2.50	
Measured Reading 3	1.004	2.503	0.887	inches	Wet Weight	60.74	
Measured Reading 4	1.003	2.502	0.880	inches	Dry Weight	48.80	
Average Reading	1.003	2.503	0.880	inches	M.C. %	25.8%	
Wet Weight + Ring	279.51	Wet+Ring+Tare	362.76	grams	*Trimmings #2*		
Weight of Ring	146.33	Dry+Ring+Tare	332.70	grams	Tare No.	C-4	
Specific Gravity	2.61	Tare Weight	83.07	grams	Tare Weight	2.49	
Sample Volume	80.86		69.71	cm^3	Wet Weight	51.79	
Height of Solids	0.492		0.492	inches	Dry Weight	41.96	
Void Ratio	1.04		0.76		M.C. %	24.9%	
Saturation	72.5		100.0	percent	Ring Number	411	
Weight of Water	29.88		30.06	grams	Inundated @	0.26	tsf
Moisture Content	28.9		29.1	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	102.8		119.4	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	79.8		92.5	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.865	inches

CALIBRATION OF CONSOLIDATION DEFORMATION

Procedure SWCP-15 (Reference ASTM D2435 AASHTO T216)

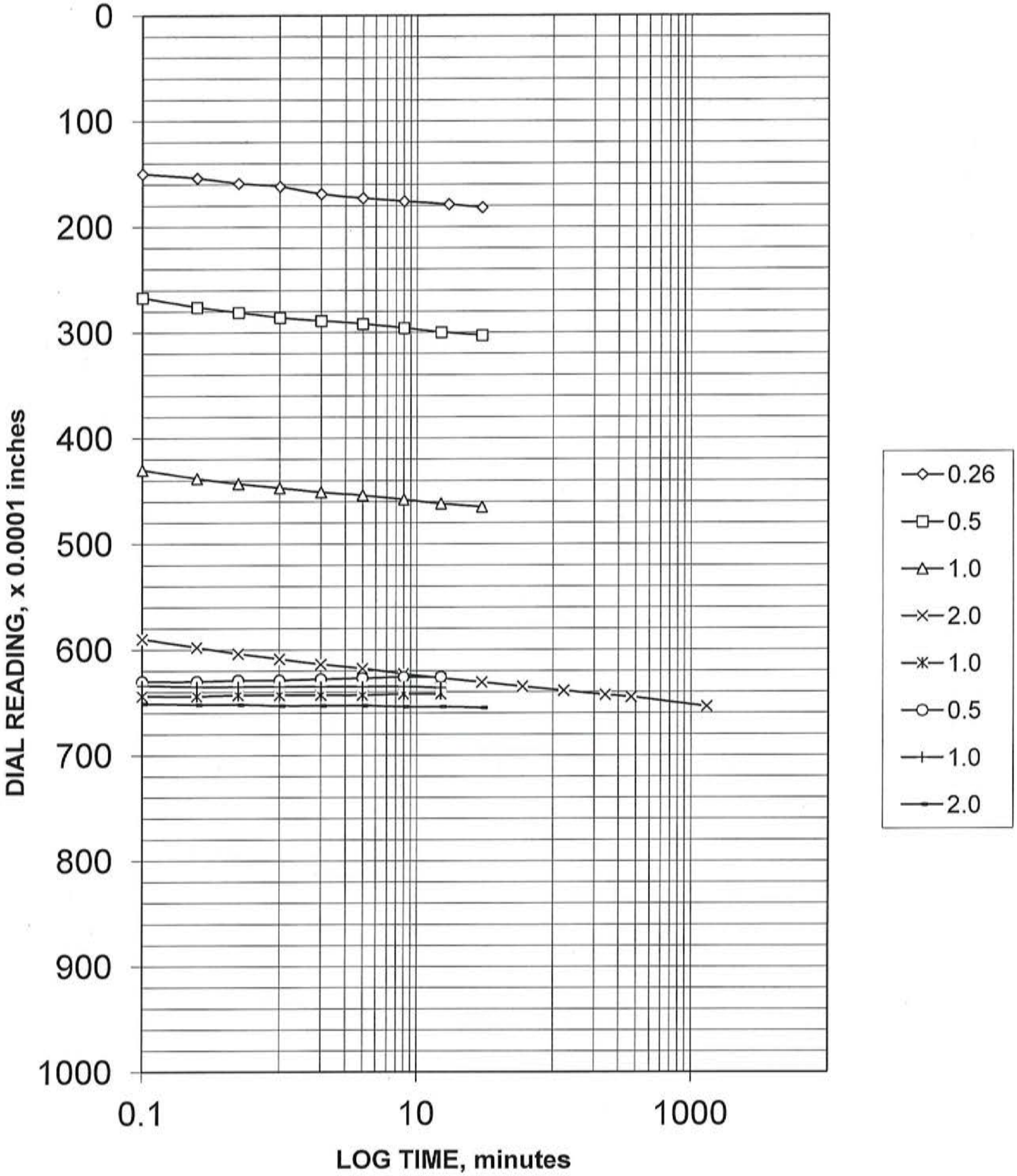
Equipment Calibrated: Consolidation Deformation
Reason for Calibration: Test Completion
Equipment Used: Consolidation Appartus
Steel Calibration Disk

Date Calibrated: 10/29/15
Next Calibration Due: Next Test
Calibrated By: CMB
Checked By: CMB

Machine Number: 411

Load tsf	Machine Def x 10^{-4}	Correction Factor x 10^{-4}	U-100 x 10^{-4}	Corr. U-100 x 10^{-4}	Compression, Percent	C_v	Void Ratio
0.01	0	0	0	0	0.00%	0	1.039
0.26	62	0	159.0	97	0.97%	2.9E+00	1.020
0.5	85	0	283.5	199	1.99%	2.3E+00	0.999
1.0	108	0	445.5	338	3.38%	2.1E+00	0.971
2.0	132	0	607.0	475	4.75%	2.1E+00	0.943
1.0	122	47	643.0	474	4.74%	NA	0.943
0.5	109	47	629.0	473	4.73%	NA	0.943
1.0	119	47	635.0	469	4.69%	NA	0.944
2.0	133	47	652.0	472	4.72%	NA	0.943
4.0	158	0	797.0	639	6.39%	1.7E+00	0.909
8.0	188	0	1020.0	832	8.32%	1.8E+00	0.870
16.0	215	0	1279.0	1064	10.64%	1.5E+00	0.823
32.0	236	0	1575.0	1339	13.39%	6.3E-01	0.767

CONSOLIDATION TEST



AECI Structural Integrity Assessment
Marston, Missouri

TIME PLOTS
HA-B5
U1

October 2015 41-1-37431-003

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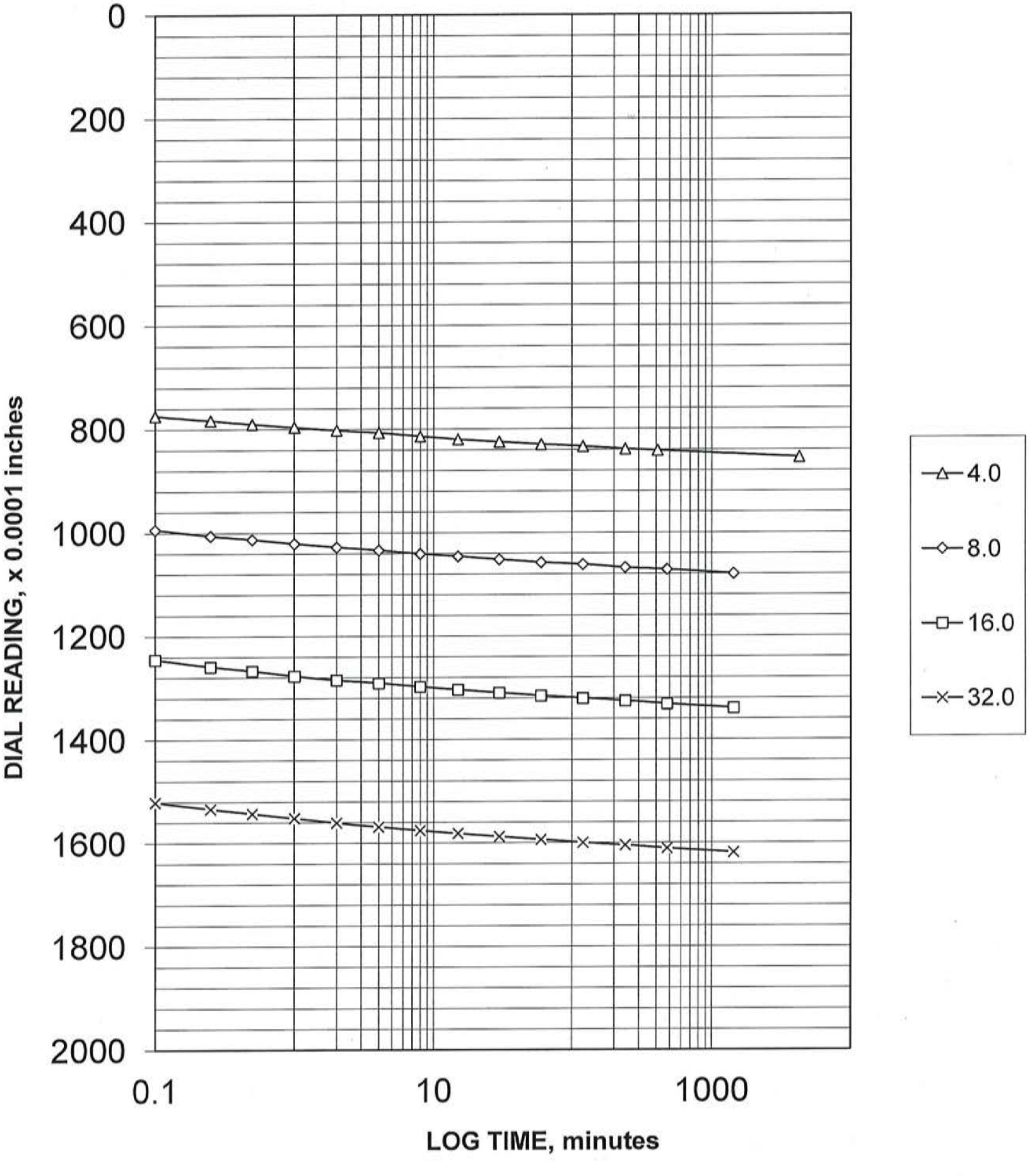
FIG.

CONSOLIDATION TEST



AECI Structural Integrity Assessment
Marston, Missouri

TIME PLOTS
HA-B5
U1

October 2015
41-1-37431-003

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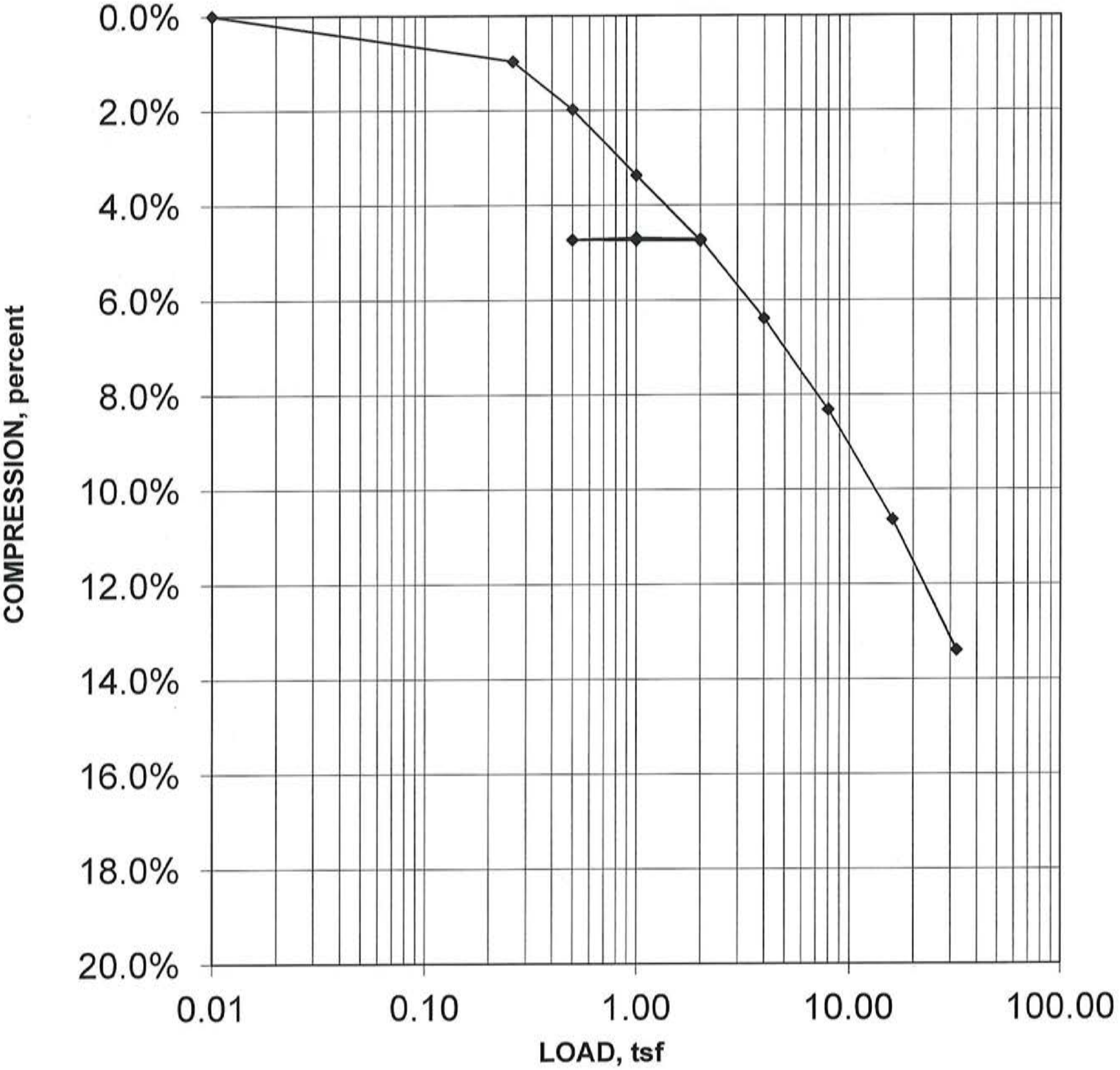
FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm²/second	Load, tsf	Coefficient of Consolidation, mm²/second
0.26	2.9E+00	2.0	NA
0.5	2.3E+00	4.0	1.7E+00
1.0	2.1E+00	8.0	1.8E+00
2.0	2.1E+00	16.0	1.5E+00
1.0	NA	32.0	6.3E-01
0.5	NA		
1.0	NA		

AECI Structural Integrity Assessment
Marston, Missouri

SETTLEMENT PLOTS

HA-B5

U1

October 2015 41-1-37431-003

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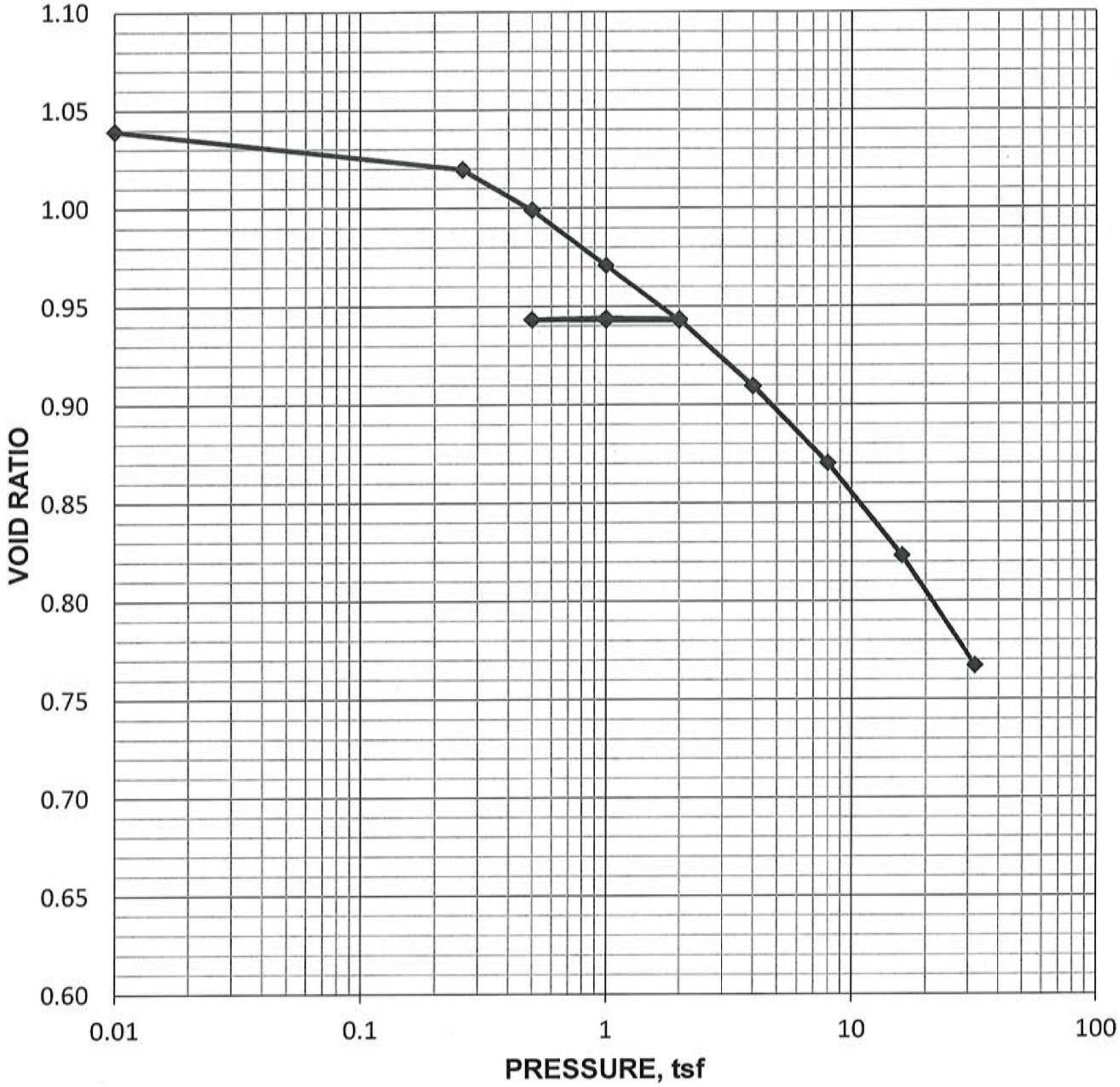
FIG.

P:\37xxx\37400\37431\Phase 003\41-1-37431-003 HA-B5 U1 D2435 10/30/2015

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.26	2.9E+00	2.0	NA
0.5	2.3E+00	4.0	1.7E+00
1.0	2.1E+00	8.0	1.8E+00
2.0	2.1E+00	16.0	1.5E+00
1.0	NA	32.0	6.3E-01
0.5	NA		
1.0	NA		

AECI Structural Integrity Assessment
Marston, Missouri

VOID RATIO PLOT

HA-B5

U1

October 2015 41-1-37431-003

SHANNON & WILSON, INC.
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FIG.

CONSOLIDATION TEST

Sheet 1

Project	AECI Structural Integrity Assessment			Client		Haley & Aldrich, Inc.	
Location	Marston, Missouri			Tested By / Date		CMB	10/21/15
Job Number	41-1-37431-003			Calculated By / Date		CMB	10/30/15
Boring	HA-B5			Checked By / Date		JTB	11/2/15
Sample	U2			File		41-1-37431-003 HA-B5 U2 D2435	
Depth (ft)	21.4			Procedure		ASTM D2435	
	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.005	2.504	0.903	inches	Tare No.	C-5	
Measured Reading 2	1.004	2.502	0.908	inches	Tare Weight	2.49	
Measured Reading 3	1.004	2.505	0.909	inches	Wet Weight	36.19	
Measured Reading 4	1.006	2.506	0.902	inches	Dry Weight	26.35	
Average Reading	1.005	2.504	0.906	inches	M.C. %	41.2%	
Wet Weight + Ring	289.07	Wet+Ring+Tare	366.23	grams	*Trimmings #2*		
Weight of Ring	146.30	Dry+Ring+Tare	332.71	grams	Tare No.	C-6	
Specific Gravity	2.70	Tare Weight	84.36	grams	Tare Weight	2.56	
Sample Volume	81.10		71.38	cm^3	Wet Weight	36.74	
Height of Solids	0.469		0.469	inches	Dry Weight	26.99	
Void Ratio	1.14		0.89		M.C. %	39.9%	
Saturation	94.2		100.0	percent	Ring Number	440	
Weight of Water	40.72		33.52	grams	Inundated @	0.26	tsf
Moisture Content	39.9		32.8	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	109.9		118.6	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	78.6		89.3	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.884	inches

Load 1		Load 2		Load 3		Load 4	
Air Press.	1.7	Air Press.	2.5	Air Press.	4.0	Air Press.	7.2
Load, tsf	0.26	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	41	0.1	86	0.1	142	0.1	247
0.25	43	0.25	88	0.25	145	0.25	252
0.5	46	0.5	89	0.5	147	0.5	256
1	47	1	90	1	151	1	261
2	48	2	93	2	153	2	265
4	49	4	95	4	154	4	270
8	50	8	97	8	158	8	273
17	51	15	98	15	160	15	278
30	54	30	101	30	162	30	281
60		60		60		60	286
120		120		120		120	289
240		240		240		240	293
480		480		480		370	295
1440		1440		1440		1305	303

Load 5		Load 6		Load 7		Load 8	
Air Press.	4.0	Air Press.	2.5	Air Press.	4.0	Air Press.	7.2
Load, tsf	1.0	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	294	0.1	281	0.1	282	0.1	301
0.25	293	0.25	280	0.25	282	0.25	302
0.5	293	0.5	280	0.5	282	0.5	302
1	292	1	279	1	282	1	302
2	291	2	278	2	283	2	303
4	291	4	278	4	283	4	303
8	290	8	278	8	283	8	304
15	290	15	277	15	284	15	304
30		30		30		30	305
60		60		60		60	
120		120		120		120	
240		240		240		240	
480		480		480		480	
1440		1440		1440		1440	

CONSOLIDATION TEST

Sheet 2

Project	AECI Structural Integrity Assessment			Client		Haley & Aldrich, Inc.	
Location	Marston, Missouri			Tested By / Date		CMB	10/21/15
Job Number	41-1-37431-003			Calculated By / Date		CMB	10/30/15
Boring	HA-B5			Checked By / Date		JTB	11/2/15
Sample	U2			File		41-1-37431-003 HA-B5 U2 D2435	
Depth (ft)	21.4			Procedure		ASTM D2435	
	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.005	2.504	0.903	inches	Tare No.	C-5	
Measured Reading 2	1.004	2.502	0.908	inches	Tare Weight	2.49	
Measured Reading 3	1.004	2.505	0.909	inches	Wet Weight	36.19	
Measured Reading 4	1.006	2.506	0.902	inches	Dry Weight	26.35	
Average Reading	1.005	2.504	0.906	inches	M.C. %	41.2%	
Wet Weight + Ring	289.07	Wet+Ring+Tare	366.23	grams	*Trimmings #2*		
Weight of Ring	146.30	Dry+Ring+Tare	332.71	grams	Tare No.	C-6	
Specific Gravity	2.70	Tare Weight	84.36	grams	Tare Weight	2.56	
Sample Volume	81.10		71.38	cm^3	Wet Weight	36.74	
Height of Solids	0.469		0.469	inches	Dry Weight	26.99	
Void Ratio	1.14		0.89		M.C. %	39.9%	
Saturation	94.2		100.0	percent	Ring Number	440	
Weight of Water	40.72		33.52	grams	Inundated @	0.26	tsf
Moisture Content	39.9		32.8	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	109.9		118.6	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	78.6		89.3	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.884	inches

Load 9		Load 10		Load 11		Load 12	
Air Press.	12.9	Air Press.	26.2	Air Press.	51.2	Air Press.	101.8
Load, tsf	4.0	Load, tsf	8.0	Load, tsf	16.0	Load, tsf	32.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	404	0.1	678	0.1	966	0.1	1274
0.25	414	0.25	690	0.25	978	0.25	1287
0.5	421	0.5	698	0.5	988	0.5	1294
1	426	1	707	1	997	1	1302
2	433	2	716	2	1005	2	1310
4	439	4	723	4	1011	4	1316
8	445	8	730	8	1018	8	1322
15	449	15	737	15	1025	15	1329
30	455	30	744	30	1032	30	1336
60	458	60	751	60	1039	60	1343
120	464	120	757	120	1044	120	1347
240	470	240	762	240	1050	240	1353
410	473	480	769	480	1056	480	1360
4245	489	1440	777	1440	1065	1440	1369

CONSOLIDATION TEST

Sheet 3

Project	AECI Structural Integrity Assessment			Client		Haley & Aldrich, Inc.	
Location	Marston, Missouri			Tested By / Date		CMB	10/21/15
Job Number	41-1-37431-003			Calculated By / Date		CMB	10/30/15
Boring	HA-B5			Checked By / Date		JTB	11/2/15
Sample	U2			File		41-1-37431-003 HA-B5 U2 D2435	
Depth (ft)	21.4			Procedure		ASTM D2435	
	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.005	2.504	0.903	inches	Tare No.	C-5	
Measured Reading 2	1.004	2.502	0.908	inches	Tare Weight	2.49	
Measured Reading 3	1.004	2.505	0.909	inches	Wet Weight	36.19	
Measured Reading 4	1.006	2.506	0.902	inches	Dry Weight	26.35	
Average Reading	1.005	2.504	0.906	inches	M.C. %	41.2%	
Wet Weight + Ring	289.07	Wet+Ring+Tare	366.23	grams	*Trimmings #2*		
Weight of Ring	146.30	Dry+Ring+Tare	332.71	grams	Tare No.	C-6	
Specific Gravity	2.70	Tare Weight	84.36	grams	Tare Weight	2.56	
Sample Volume	81.10		71.38	cm^3	Wet Weight	36.74	
Height of Solids	0.469		0.469	inches	Dry Weight	26.99	
Void Ratio	1.14		0.89		M.C. %	39.9%	
Saturation	94.2		100.0	percent	Ring Number	440	
Weight of Water	40.72		33.52	grams	Inundated @	0.26	tsf
Moisture Content	39.9		32.8	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	109.9		118.6	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	78.6		89.3	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.884	inches

CALIBRATION OF CONSOLIDATION DEFORMATION

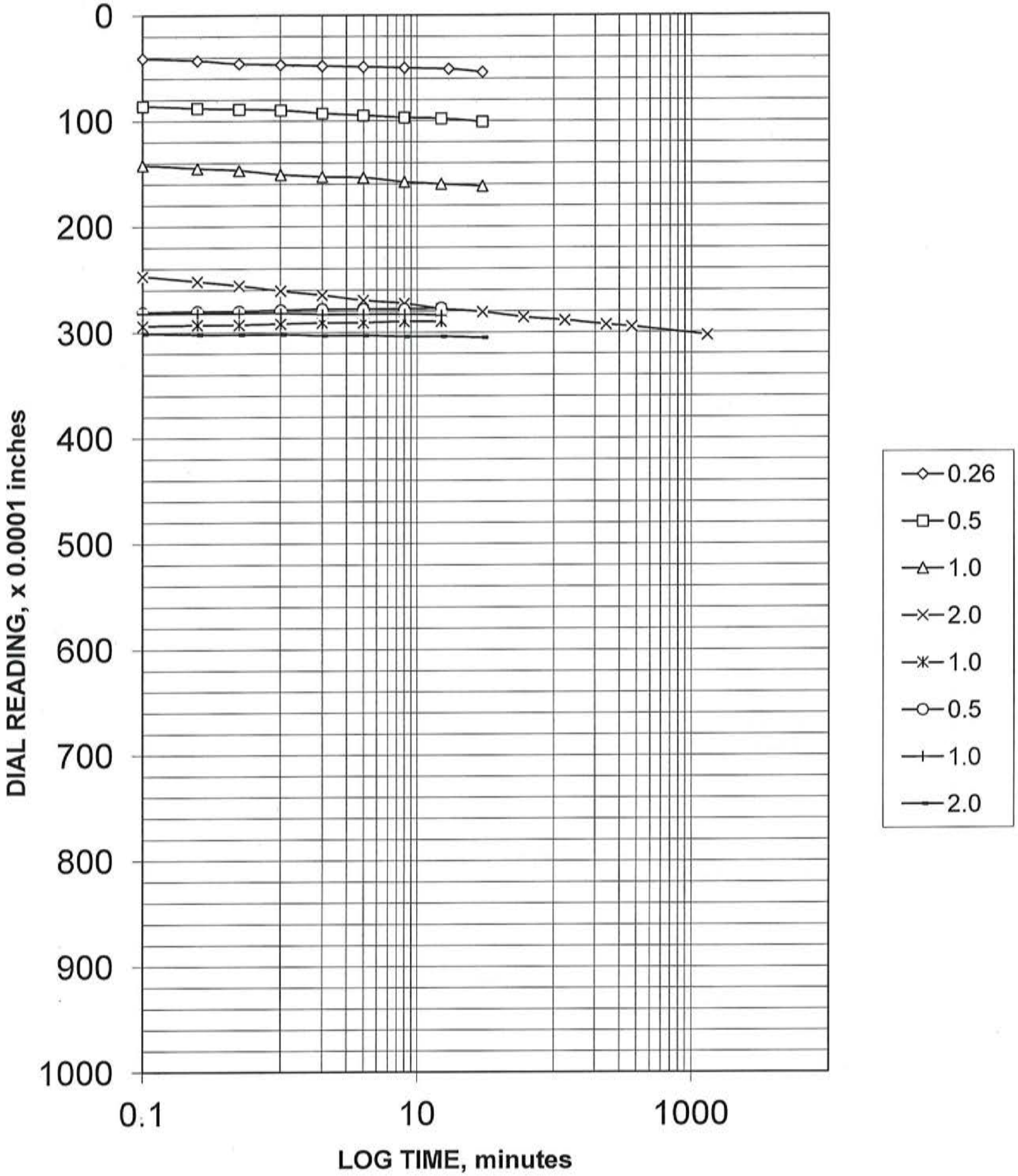
Procedure SWCP-15 (Reference ASTM D2435 AASHTO T216)

Equipment Calibrated:	Consolidation Deformation	Date Calibrated:	10/29/15
Reason for Calibration:	Test Completion	Next Calibration Due:	Next Test
Equipment Used:	Consolidation Appartus	Calibrated By:	CMB
	Steel Calibration Disk	Checked By:	CMB

Machine Number: 440

Load tsf	Machine Def x 10^{-4}	Correction Factor x 10^{-4}	U-100 x 10^{-4}	Corr. U-100 x 10^{-4}	Compression, Percent	C_v	Void Ratio
0.01	0	0	0	0	0.00%	0	1.14
0.26	23	0	46.0	23	0.23%	2.7E+00	1.14
0.5	38	0	88.0	50	0.50%	3.3E+00	1.13
1.0	55	0	145.0	90	0.90%	5.2E+00	1.12
2.0	74	0	261.0	187	1.87%	2.0E+00	1.10
1.0	70	42	293.0	181	1.81%	NA	1.10
0.5	62	42	280.0	176	1.76%	NA	1.10
1.0	66	42	283.0	175	1.75%	NA	1.10
2.0	78	42	302.0	182	1.82%	NA	1.10
4.0	96	0	420.0	324	3.24%	2.6E+00	1.07
8.0	119	0	710.0	591	5.91%	1.6E+00	1.02
16.0	139	0	1000.0	861	8.61%	1.6E+00	0.96
32.0	165	0	1299.0	1134	11.34%	1.8E+00	0.90

CONSOLIDATION TEST



AECI Structural Integrity Assessment
Marston, Missouri

TIME PLOTS
HA-B5
U2

October 2015 41-1-37431-003

SHANNON & WILSON, INC.
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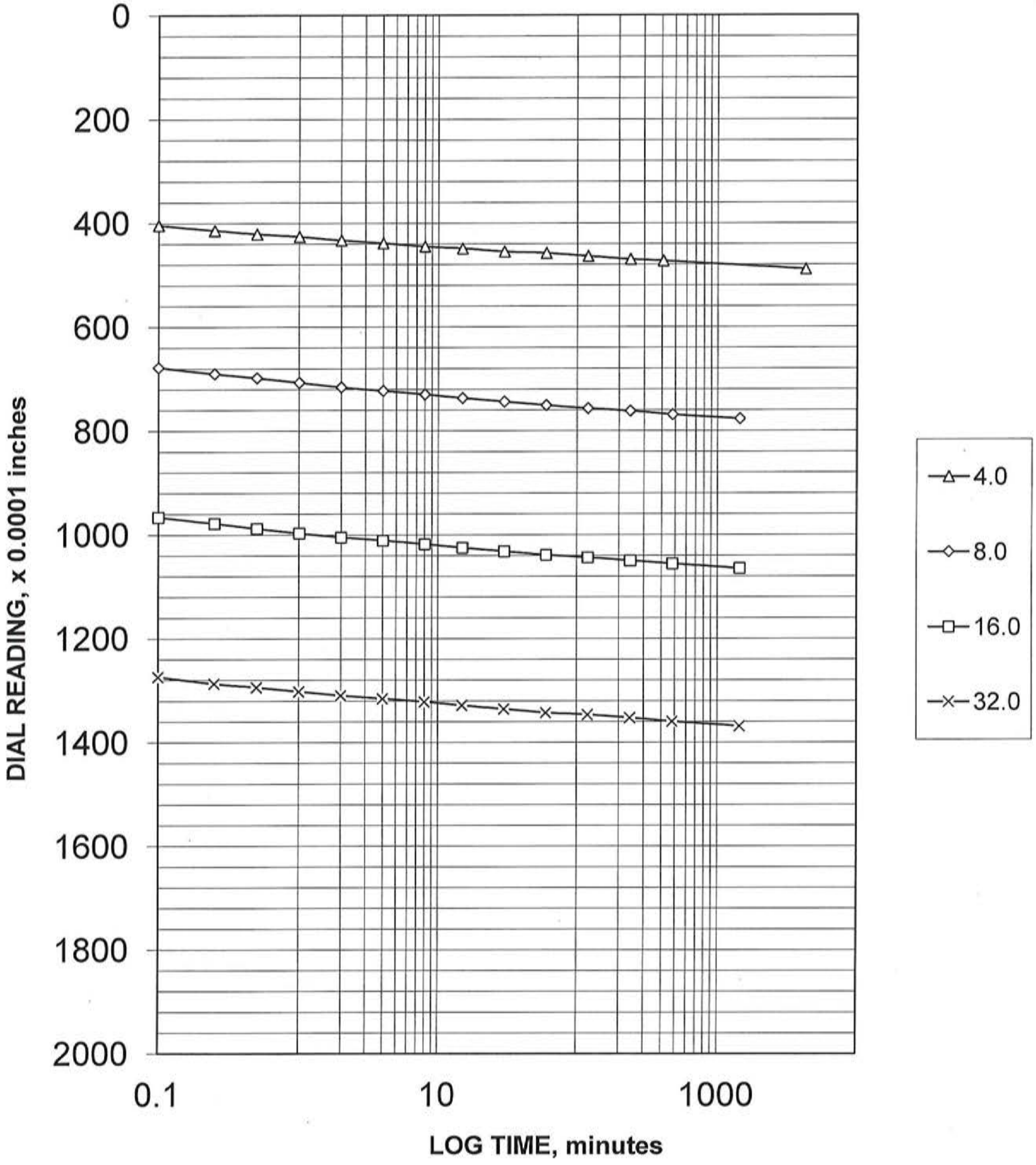
FIG.

CONSOLIDATION TEST



AECI Structural Integrity Assessment
Marston, Missouri

TIME PLOTS
HA-B5
U2

October 2015 41-1-37431-003

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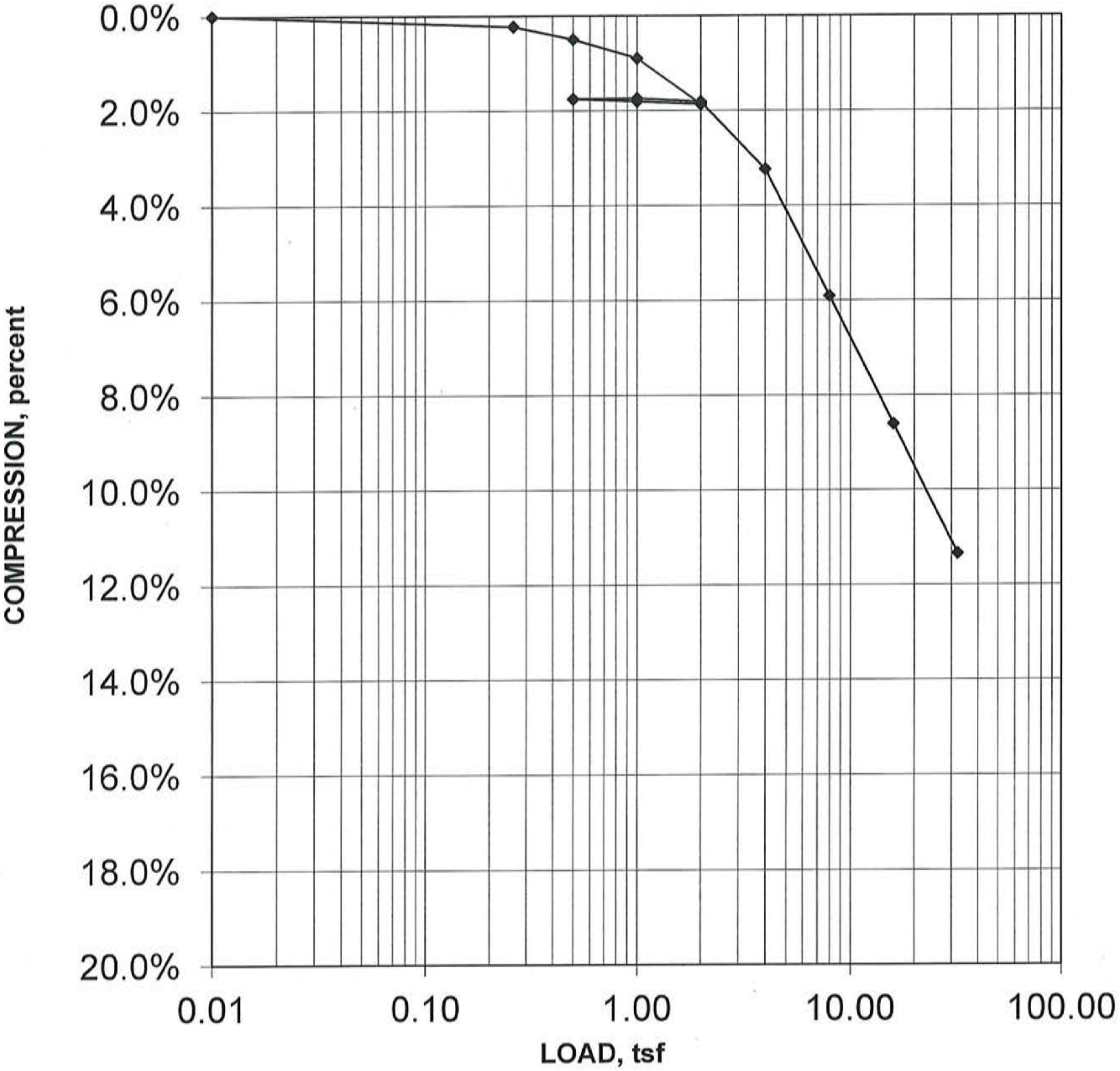
FIG.

P:\37xxx\37400\37431\Phase 003\41-1-37431-003 HA-B5 U2 D2435 10/30/2015

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.26	2.7E+00	2.0	NA
0.5	3.3E+00	4.0	2.6E+00
1.0	5.2E+00	8.0	1.6E+00
2.0	2.0E+00	16.0	1.6E+00
1.0	NA	32.0	1.8E+00
0.5	NA		
1.0	NA		

AECI Structural Integrity Assessment
Marston, Missouri

SETTLEMENT PLOTS

HA-B5

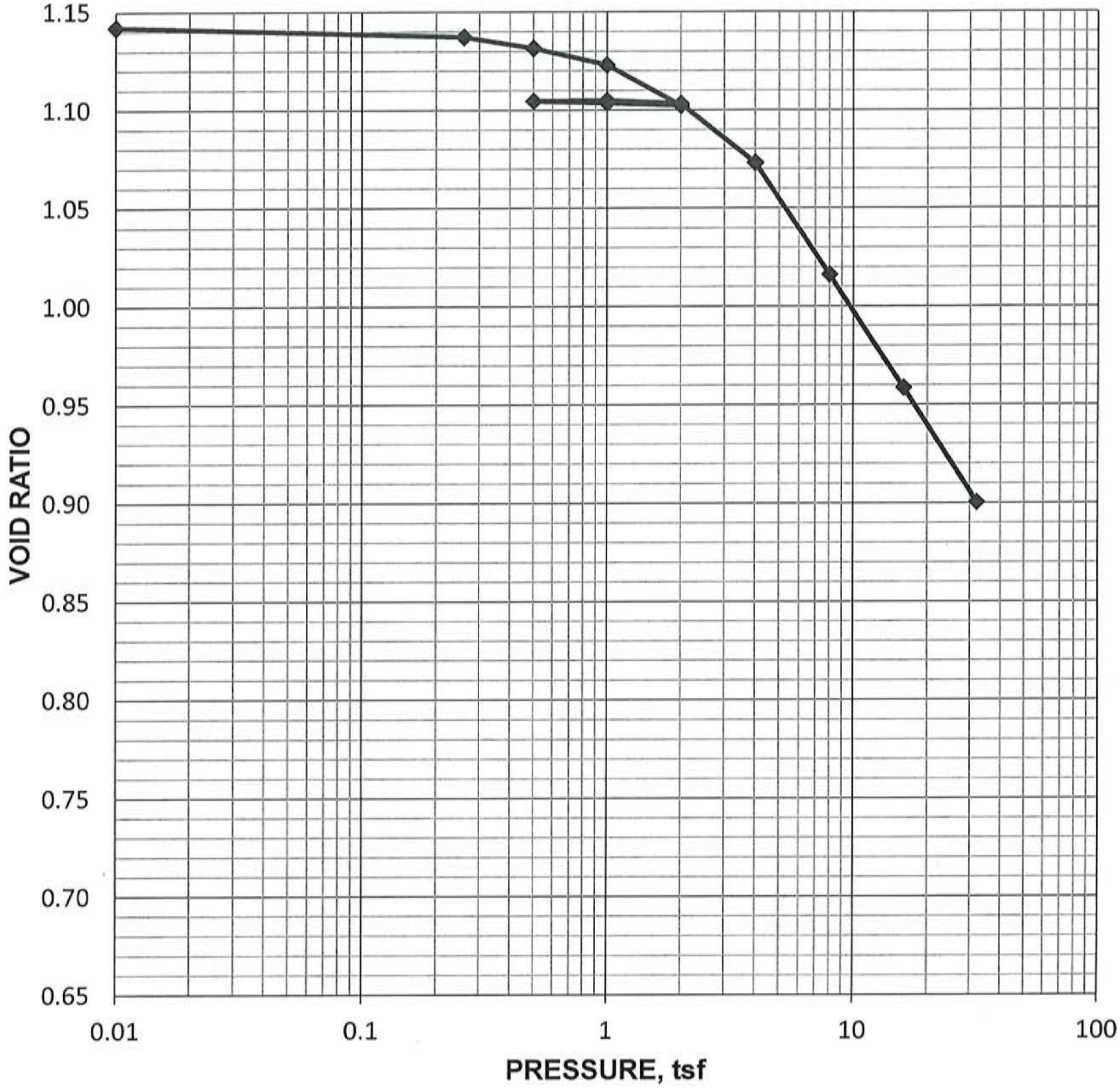
U2

October 2015 41-1-37431-003

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.26	2.7E+00	2.0	NA
0.5	3.3E+00	4.0	2.6E+00
1.0	5.2E+00	8.0	1.6E+00
2.0	2.0E+00	16.0	1.6E+00
1.0	NA	32.0	1.8E+00
0.5	NA		
1.0	NA		

AECI Structural Integrity Assessment
Marston, Missouri

VOID RATIO PLOT

HA-B5

U2

October 2015 41-1-37431-003

SHANNON & WILSON, INC.
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FIG.

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION

Project	AECI Structural Integrity Assessment	Client	Haley & Aldrich	
Location	Marston, Missouri			Date
Job No.	41-1-37431-003	Tested by	CMB	10/09/15
Boring	HA-B5	Calculated by	CMB	10/12/15
Sample	U2	Checked by	CMB	10/12/15
Depth (ft)	20.3 - 20.8	File	41-1-37431-003-HA-B5-U2 D2850	
Undisturbed/Remold	Undisturbed	Procedure	ASTM D2850	
Description (D2487 + symbol)	Dark gray, Silt (ML) (Ash).			

Sample Data

Diameter	2.862	inches
Height	6.001	inches
Wet wt.	1045.11	grams

Initial Deflection (Before Confinement)
0.000 inches

Initial Deflection (After Confinement)
0.000 inches

Height Change (After Confinement)
0.000 inches

Test Setup Data

Confinement	7.5	psi
Deflection	0.001	inch/division
Load Cons.	1	lb/division

After Test Data

Tare No.	4	
Tare Wt.	103.53	grams
Wet wt.	1128.14	grams
Dry wt.	830.38	grams
Sp. Gravity	2.68	*assumed*

Test Data

Time	Cell Pressure	Deflection	Load
hr-min	psi	div (in 0.001 in.)	div
0:00:00	7.5	0	0
0:00:08	7.5	5	5.6
0:00:15	7.5	10	8.4
0:00:23	7.5	15	11.1
0:00:30	7.5	20	13.5
0:00:45	7.5	30	17.7
0:01:15	7.5	50	22.3
0:01:53	7.5	75	29.3
0:02:30	7.5	100	34.8
0:03:23	7.5	135	42.8
0:03:45	7.5	150	44.9
0:04:23	7.5	175	47.9
0:05:00	7.5	200	50.6
0:05:53	7.5	235	53.0
0:06:15	7.5	250	54.2
0:07:30	7.5	300	56.7
0:08:45	7.5	350	59.1
0:10:00	7.5	400	60.1
0:11:15	7.5	450	61.7
0:12:30	7.5	500	62.8
0:13:45	7.5	550	63.0
0:15:00	7.5	600	63.3
0:16:15	7.5	650	64.2
0:17:30	7.5	700	64.5
0:18:45	7.5	750	64.8
0:20:00	7.5	800	64.8
0:21:15	7.5	850	66.1
0:22:30	7.5	900	67.0

Photograph of Failure

REMARKS:

NOTE: The moisture content is taken from the entire sample after testing is completed.

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Boring	HA-B5		By	Date
Sample	U2	Tested by	CMB	10/09/15
Depth (ft)	20.3 - 20.8	Calculated by	CMB	10/12/15
Description	Dark gray, Silt (ML) (Ash).	Checked by	CMB	10/12/15

Specimen Data

Height	6.001	inches
Diameter	2.862	inches
H/D ratio	2.097	
Volume	632.6	cc
Wet wt.	1045.11	grams
Bulk Density	103.1	pcf
Dry Density	73.1	pcf
M.C.	41.0%	percent
Saturation	85.3%	percent
Void ratio	1.287	
Gs	2.68	assumed

Instrument Constants

Deformation	0.001	inches/div
Load	1	lb/div.
Confinment	7.5	psi

Peak values

p	0.866	tsf
q	0.326	tsf
strain	15.0%	%
strain rate	0.040	in. per min.

Deformation div.	Load div.	Strain %	Load lb	Stress tsf	p tsf	q tsf
0.000	0	0.0%	0	0.000	0.540	0.000
0.005	5.6	0.1%	5.6	0.063	0.571	0.031
0.010	8.4	0.2%	8.4	0.094	0.587	0.047
0.015	11.1	0.2%	11.1	0.124	0.602	0.062
0.020	13.5	0.3%	13.5	0.151	0.615	0.075
0.030	17.7	0.5%	17.7	0.197	0.639	0.099
0.050	22.3	0.8%	22.3	0.248	0.664	0.124
0.075	29.3	1.2%	29.3	0.324	0.702	0.162
0.100	34.8	1.7%	34.8	0.383	0.732	0.192
0.135	42.8	2.2%	42.8	0.468	0.774	0.234
0.150	44.9	2.5%	44.9	0.490	0.785	0.245
0.175	47.9	2.9%	47.9	0.521	0.800	0.260
0.200	50.6	3.3%	50.6	0.548	0.814	0.274
0.235	53.0	3.9%	53.0	0.571	0.825	0.285
0.250	54.2	4.2%	54.2	0.582	0.831	0.291
0.300	56.7	5.0%	56.7	0.604	0.842	0.302
0.350	59.1	5.8%	59.1	0.625	0.852	0.312
0.400	60.1	6.7%	60.1	0.631	0.855	0.315
0.450	61.7	7.5%	61.7	0.642	0.861	0.321
0.500	62.8	8.3%	62.8	0.649	0.864	0.324
0.550	63.0	9.2%	63.0	0.646	0.863	0.323
0.600	63.3	10.0%	63.3	0.644	0.862	0.322
0.650	64.2	10.8%	64.2	0.648	0.864	0.324
0.700	64.5	11.7%	64.5	0.646	0.863	0.323
0.750	64.8	12.5%	64.8	0.645	0.862	0.322
0.800	64.8	13.3%	64.8	0.640	0.860	0.320
0.850	66.1	14.2%	66.1	0.648	0.864	0.324
0.900	67	15.0%	67.0	0.652	0.866	0.326

AECI Structural Integrity Assessment
Marston, Missouri

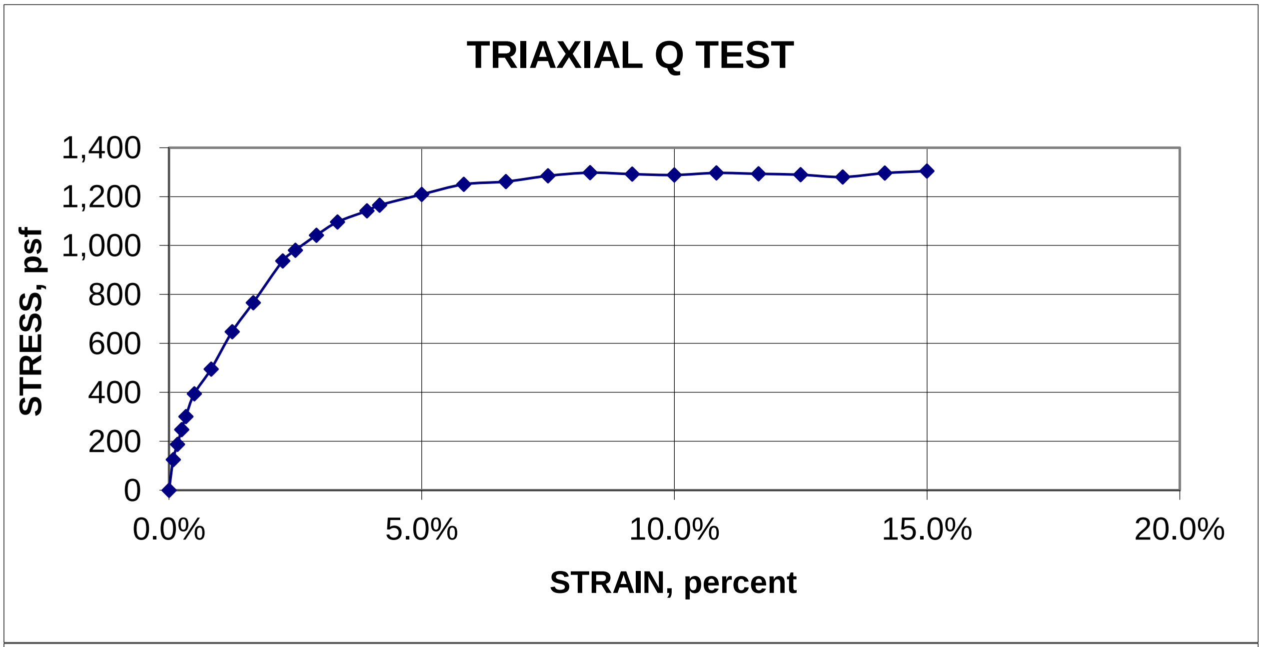
UNCONSOLIDATED, UNDRAINED STRENGTH
IN TRIAXIAL COMPRESSION
BORING - HA-B5 : SAMPLE - U2

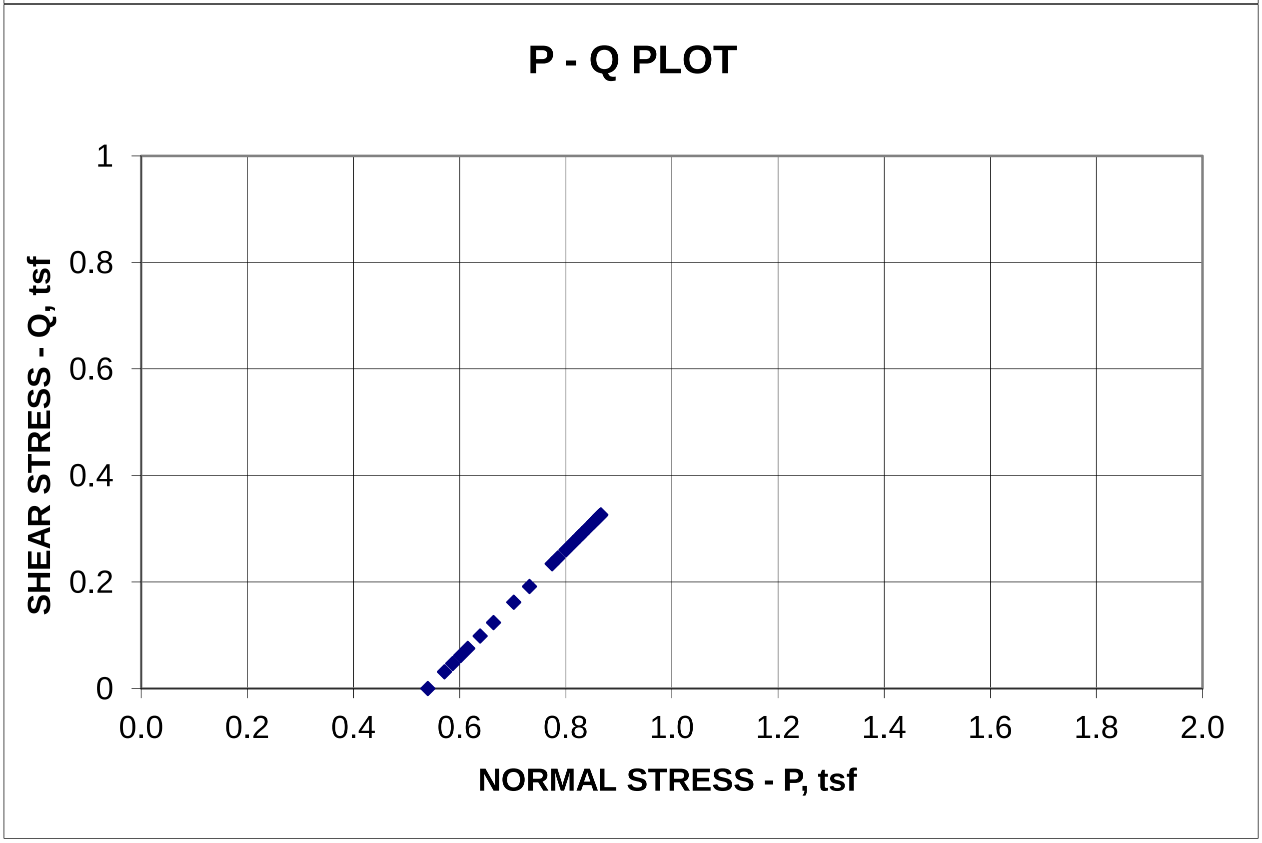
October 2015 41-1-37431-003

SHANNON & WILSON, INC.
Geotechnical and Environmental

FIG.

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION
PLOT OF TEST DATA





AECI Structural Integrity Assessment
Marston, Missouri

UNCONSOLIDATED, UNDRAINED STRENGTH
IN TRIAXIAL COMPRESSION
BORING - HA-B5 : SAMPLE - U2

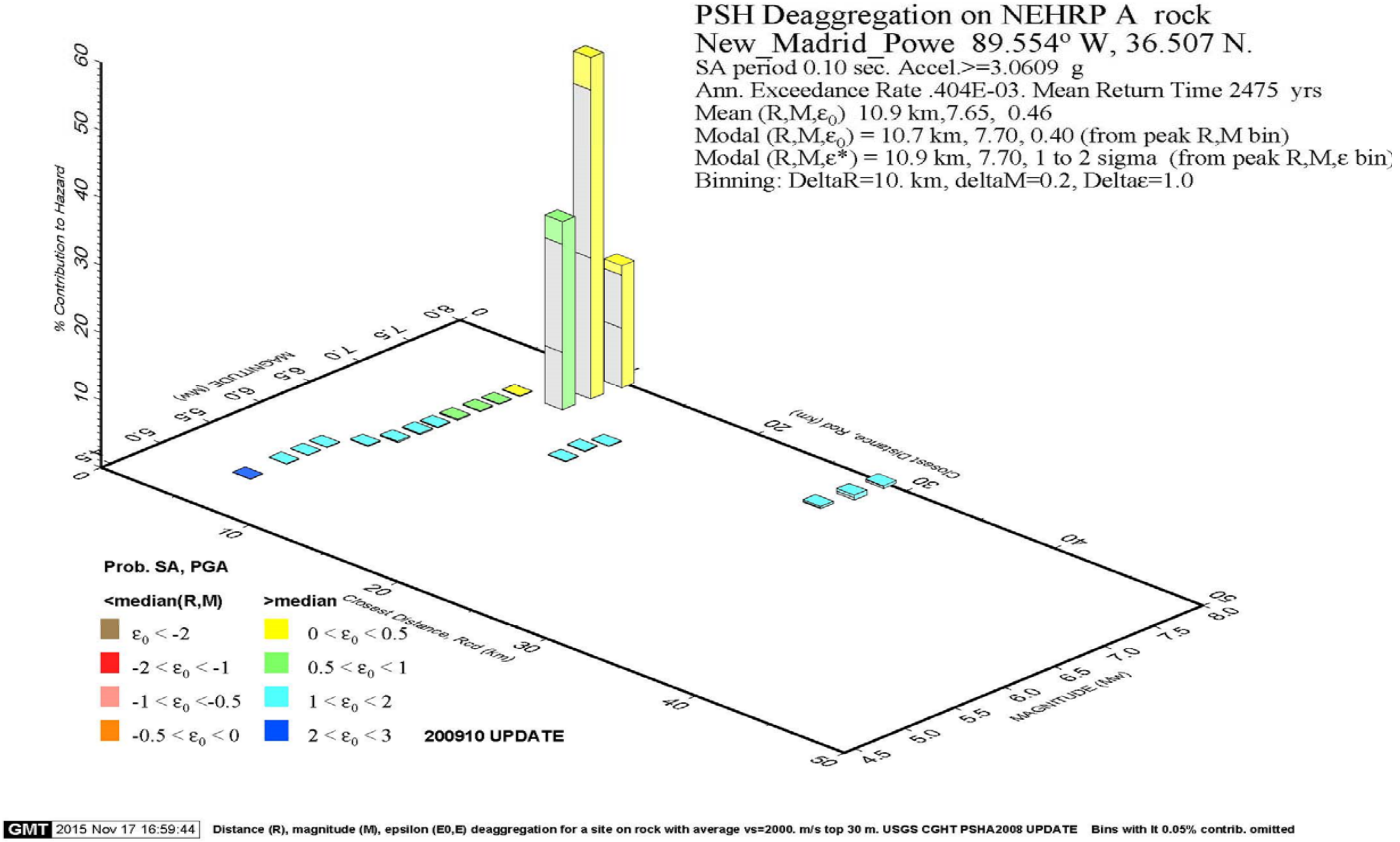
October 2015 41-1-37431-003

SHANNON & WILSON, INC.
Geotechnical and Environmental

FIG.

APPENDIX D

Analyses



HALEY ALDRICH

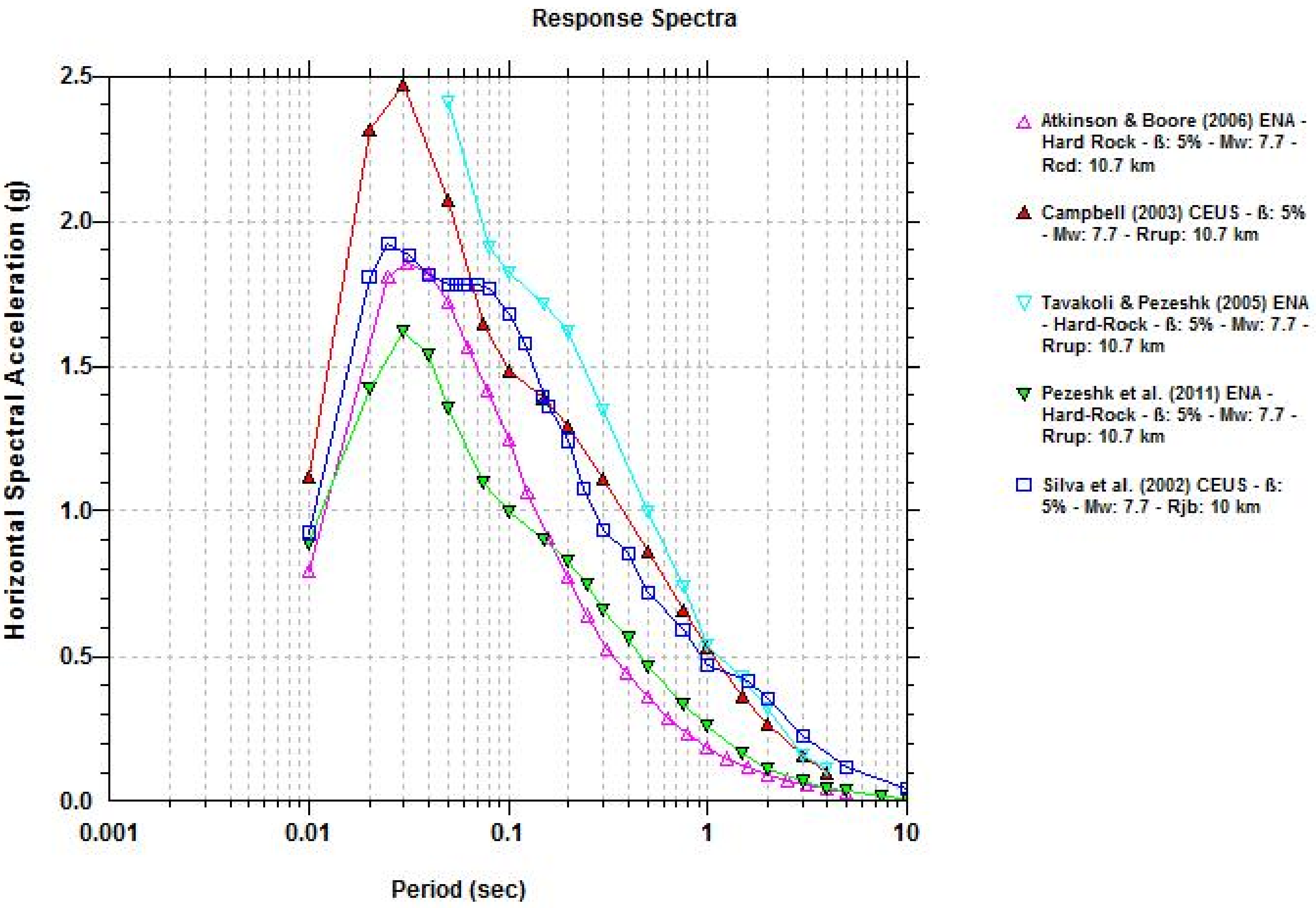
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

DEGRADATION PLOT AT PERIOD T=0.1s

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-1

40616-300_FIG_D1.PPT



NOTES

1. Reference: SHAKE 2000

HALEY ALDRICH

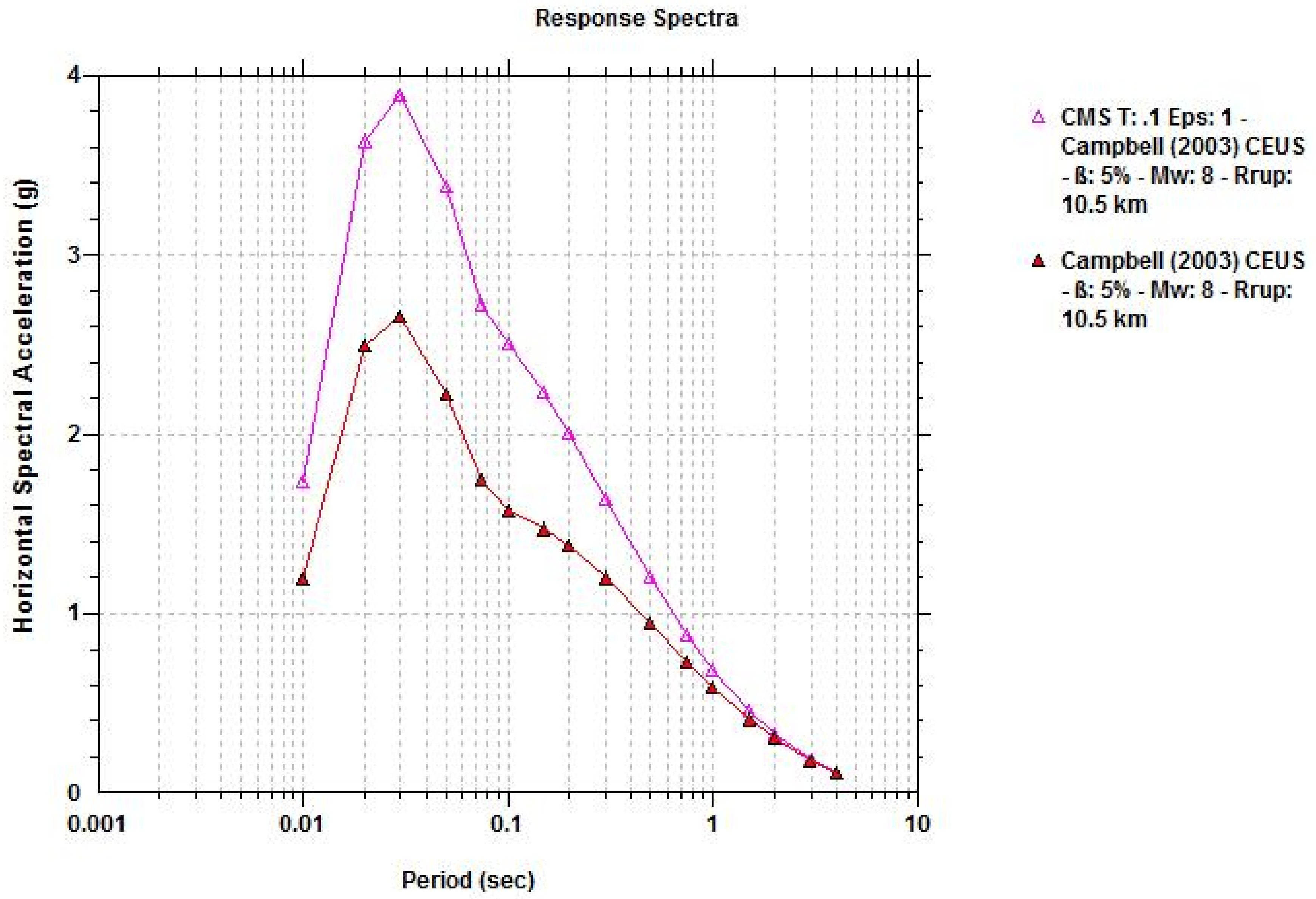
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

CENTRAL AND EASTERN U.S. GROUND MOTION ATTENUATION MODELS

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-2

40616-300_FIG D2.PPT



NOTES

1. Reference: SHAKE 2000

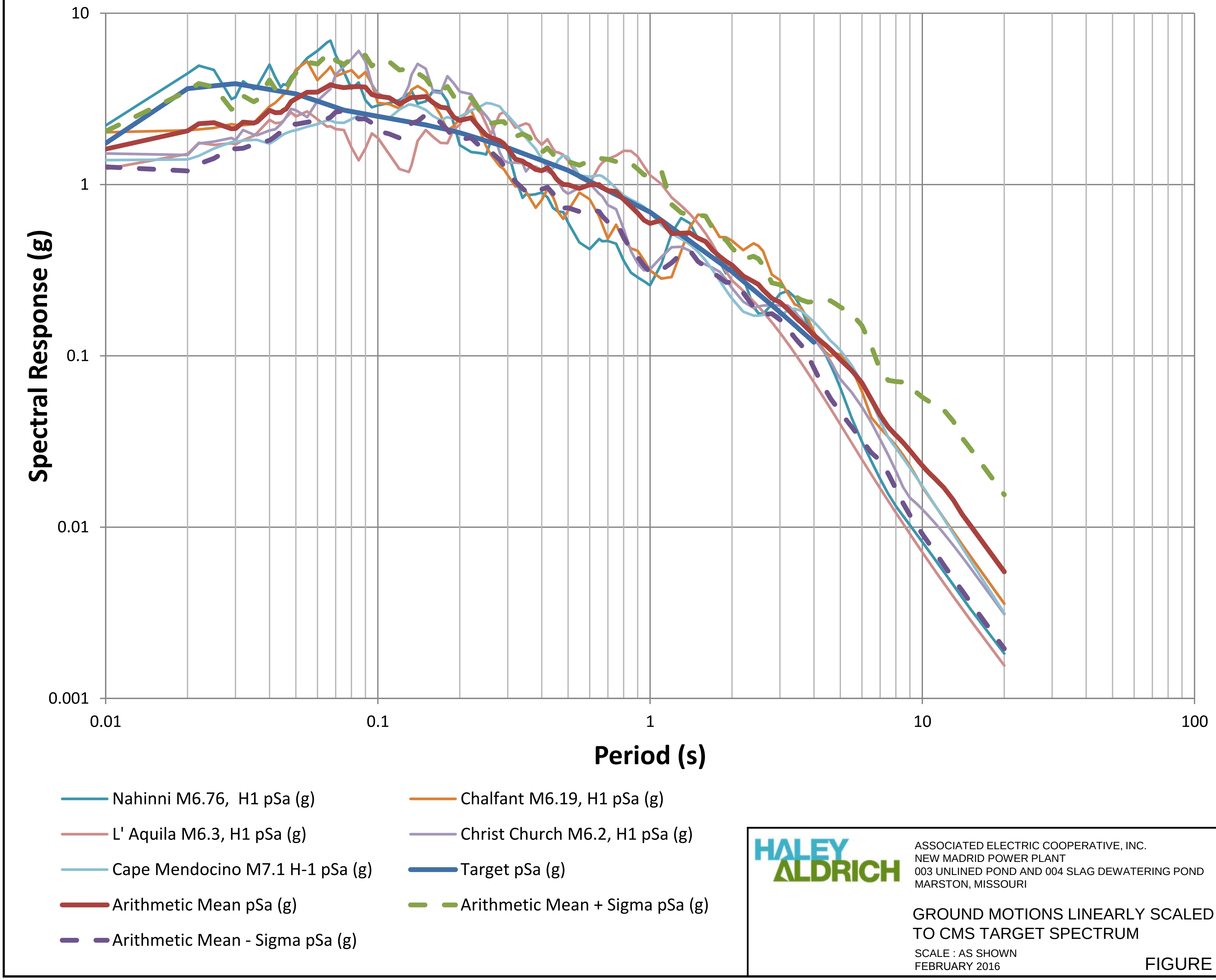
HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

DETERMINISTIC CONDITIONAL MEAN SPECTRUM (CMS)

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-3



HALEY ALDRICH

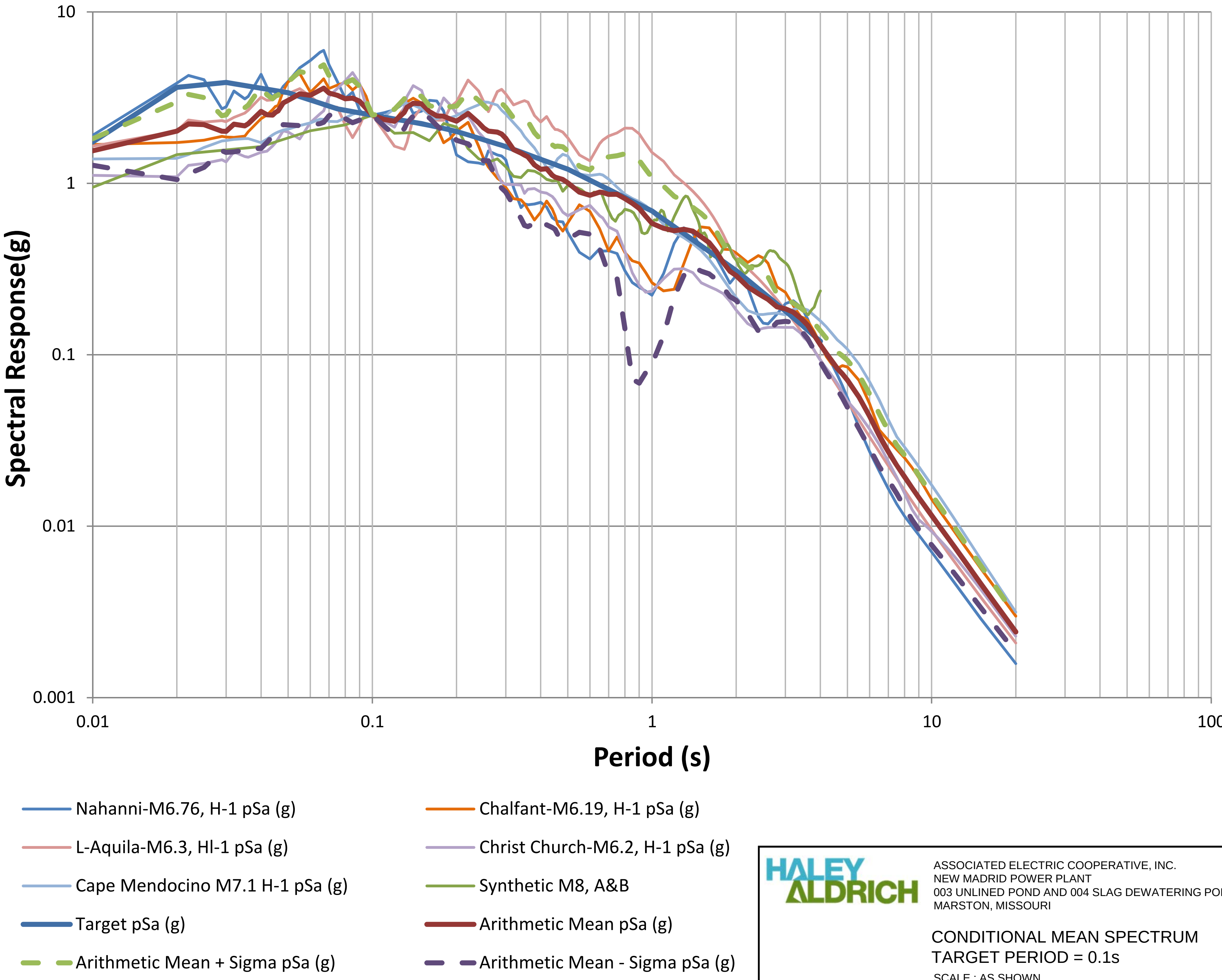
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

GROUND MOTIONS LINEARLY SCALED
TO CMS TARGET SPECTRUM

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-4

40616-300_FIG D4.PPT



HALEY ALDRICH

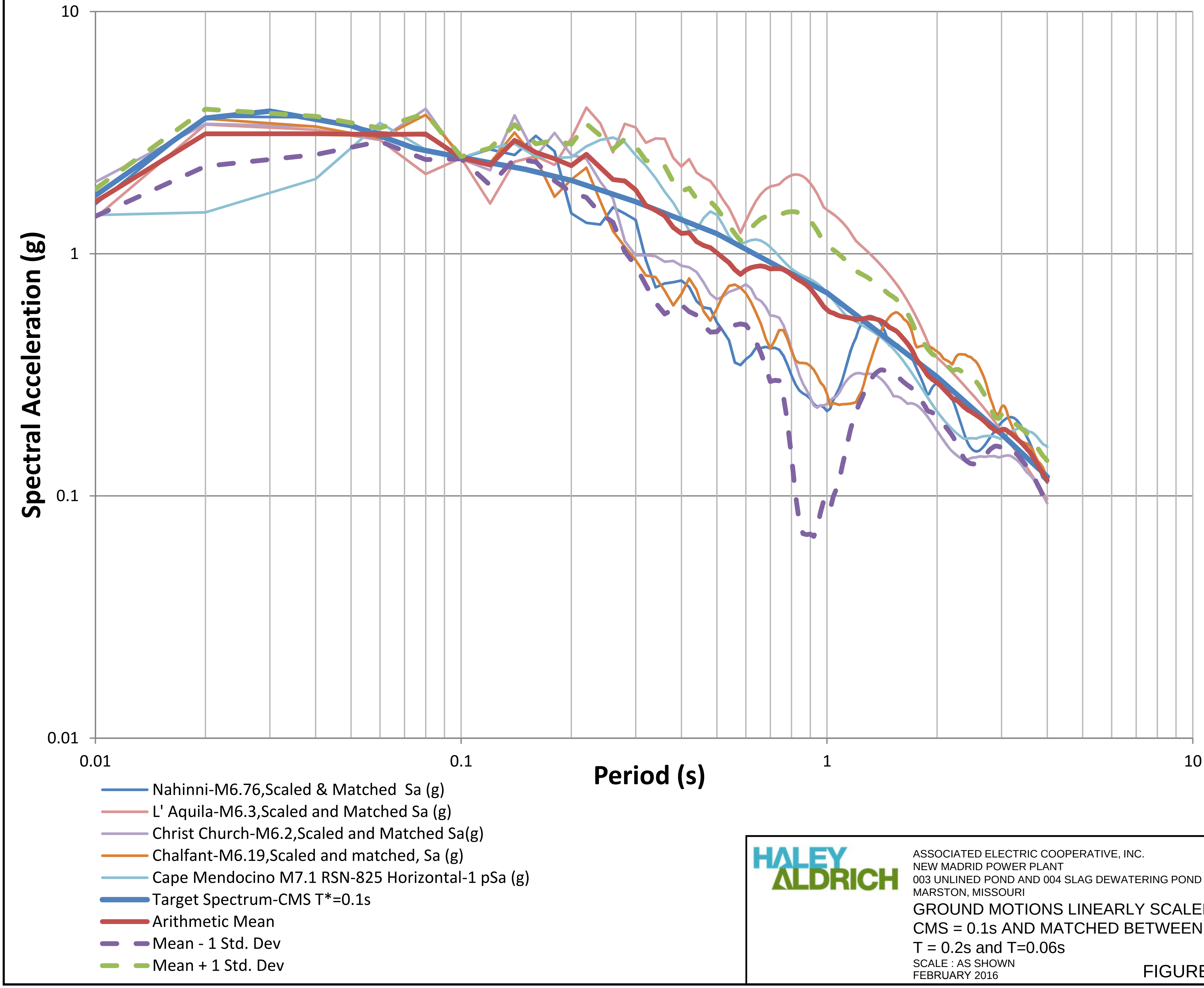
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

CONDITIONAL MEAN SPECTRUM
TARGET PERIOD = 0.1s

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-5

40616-300_FIG D5.PPT



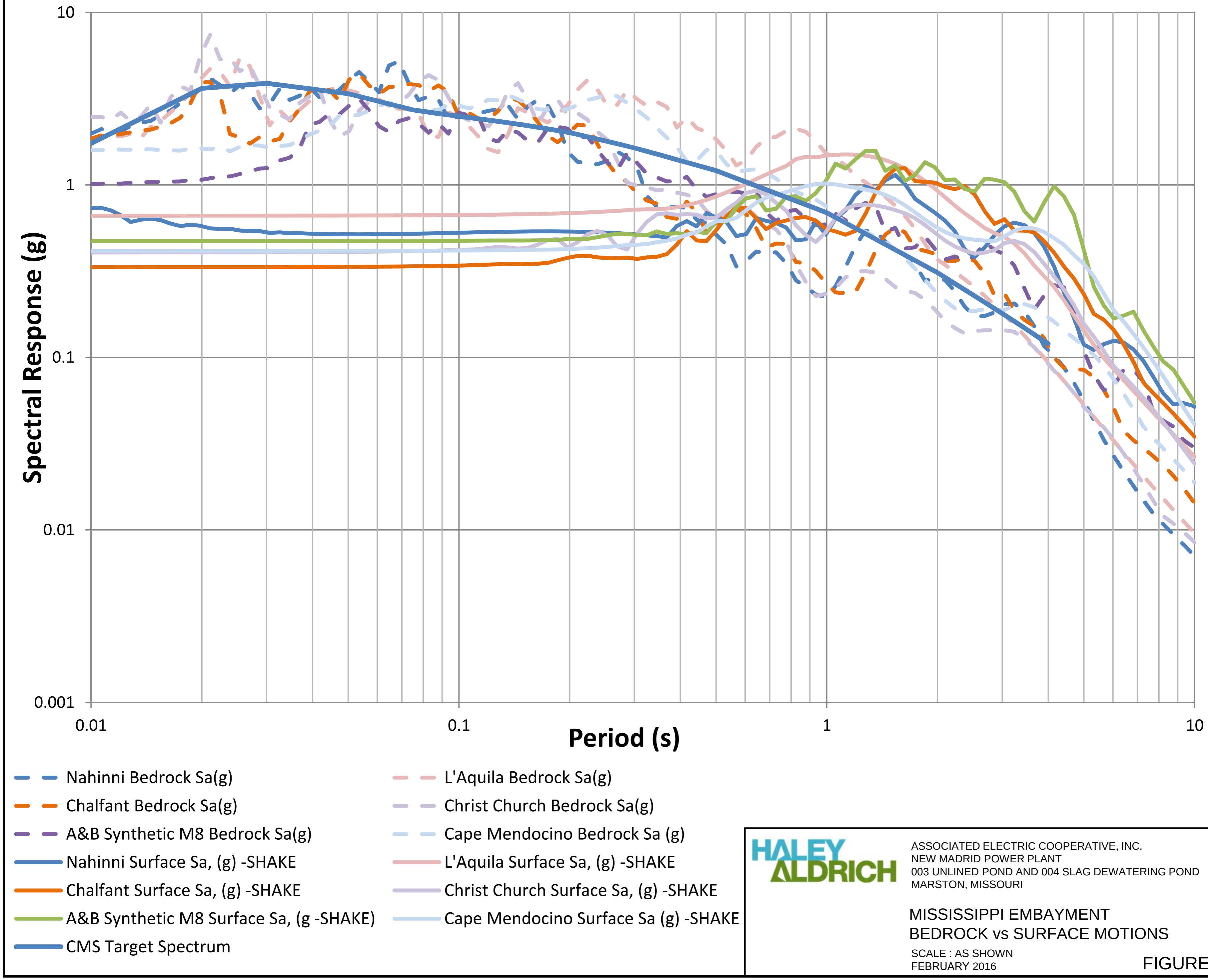
HALEY
ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

GROUND MOTIONS LINEARLY SCALED TO
CMS = 0.1s AND MATCHED BETWEEN
T = 0.2s and T=0.06s

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-6



HALEY ALDRICH

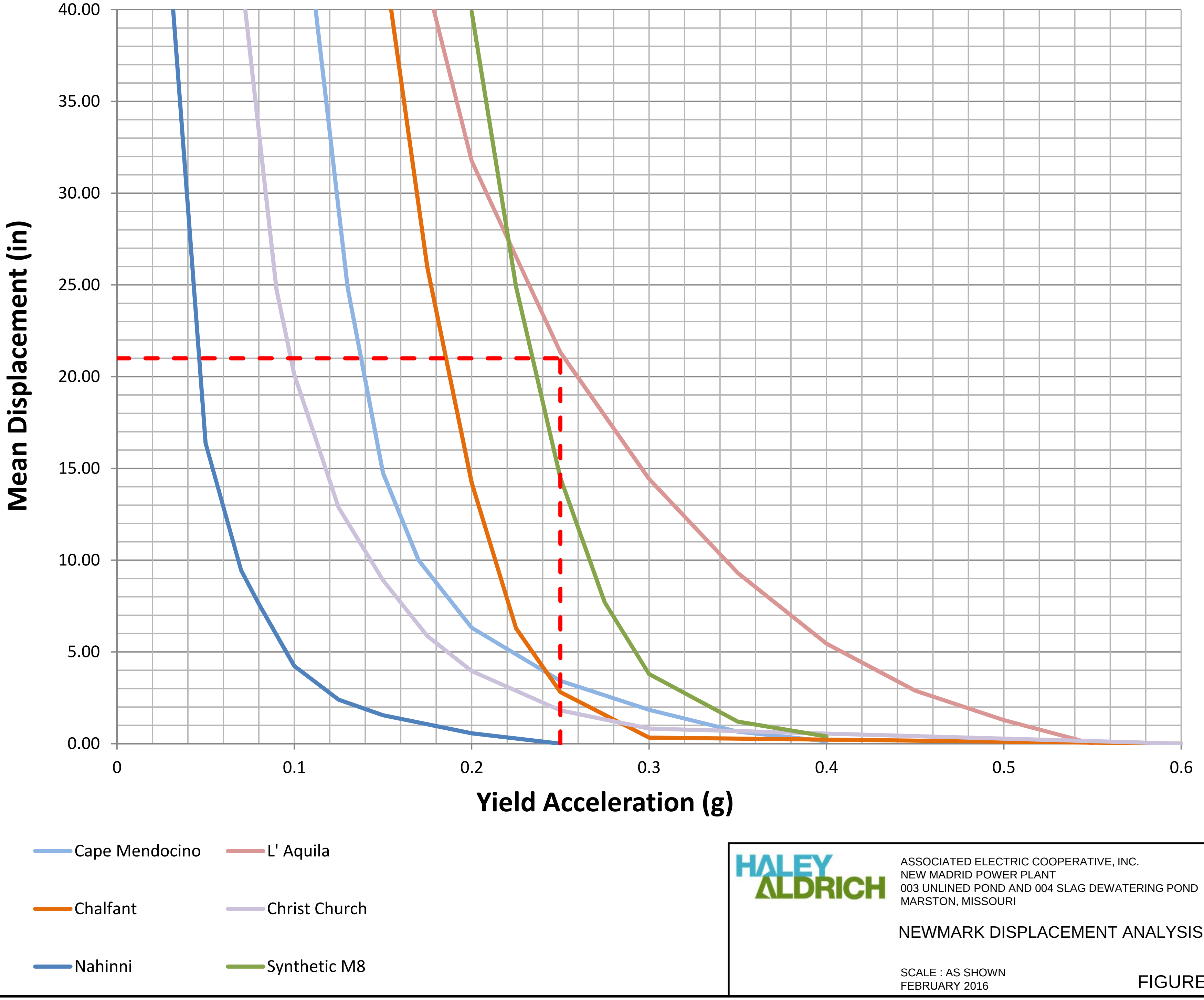
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

MISSISSIPPI EMBAYMENT
BEDROCK vs SURFACE MOTIONS

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-7

40616-300_FIG D7.PPT



40616-300_FIG D8.PPT

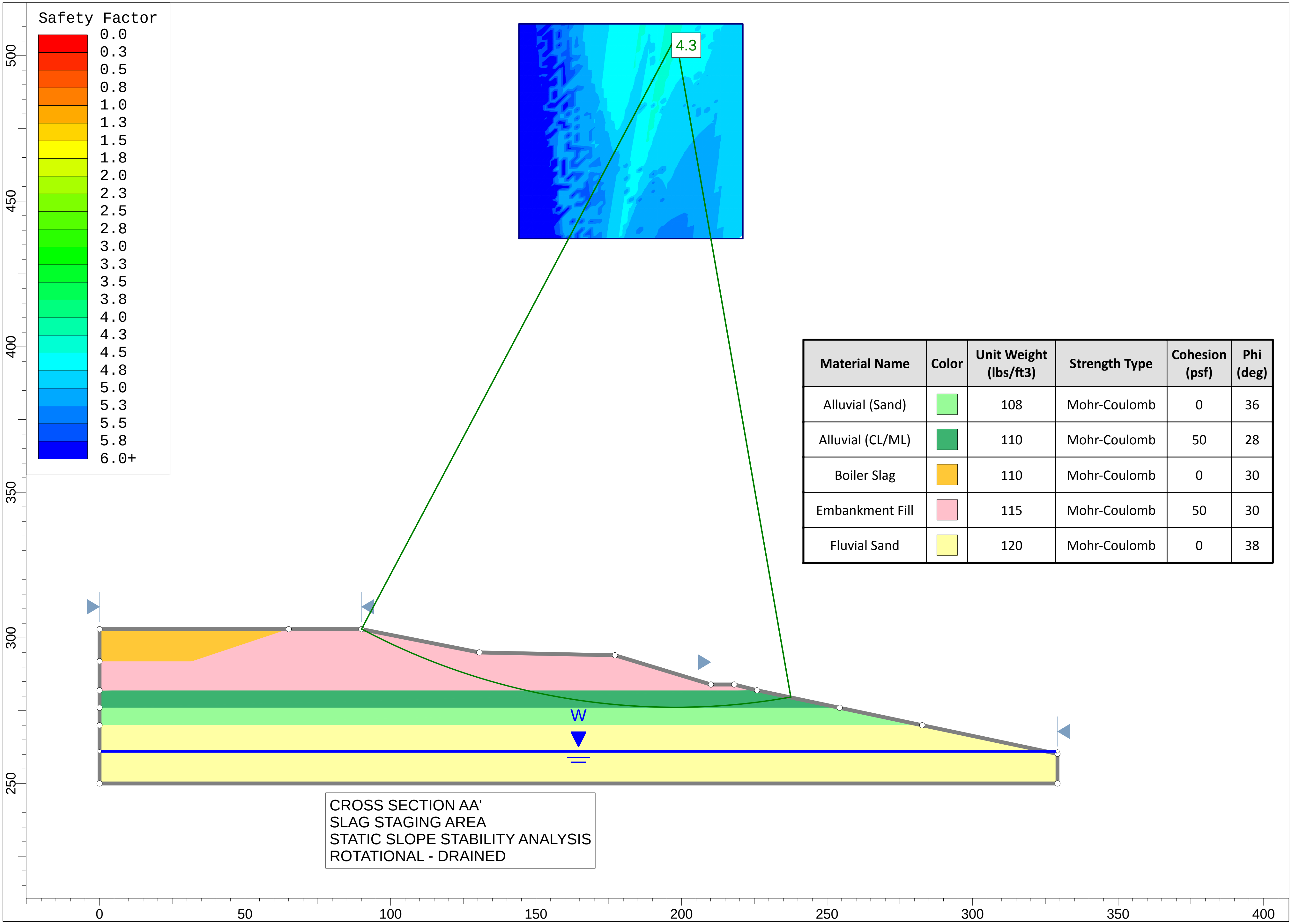
HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

NEWMARK DISPLACEMENT ANALYSIS

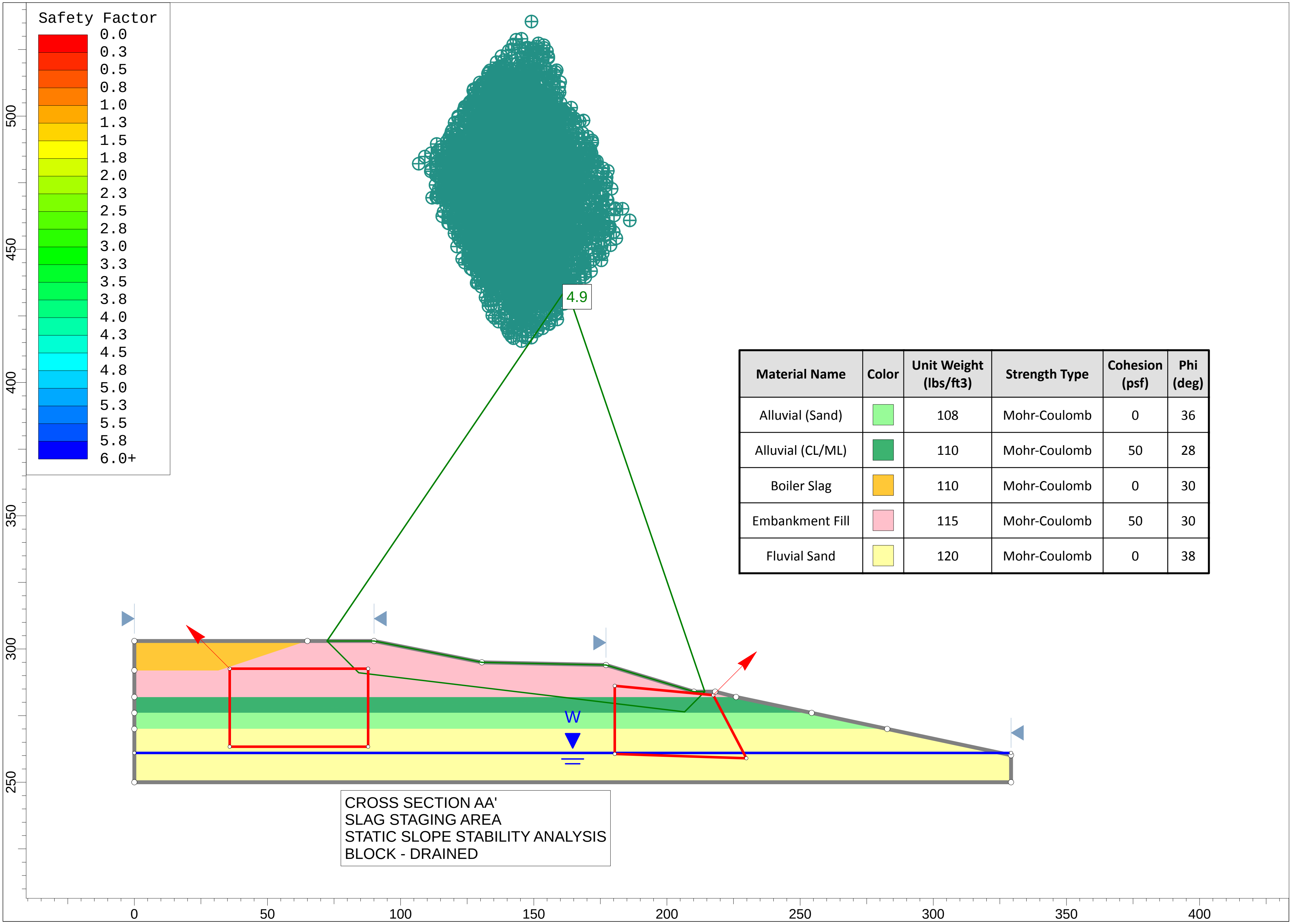
SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-8



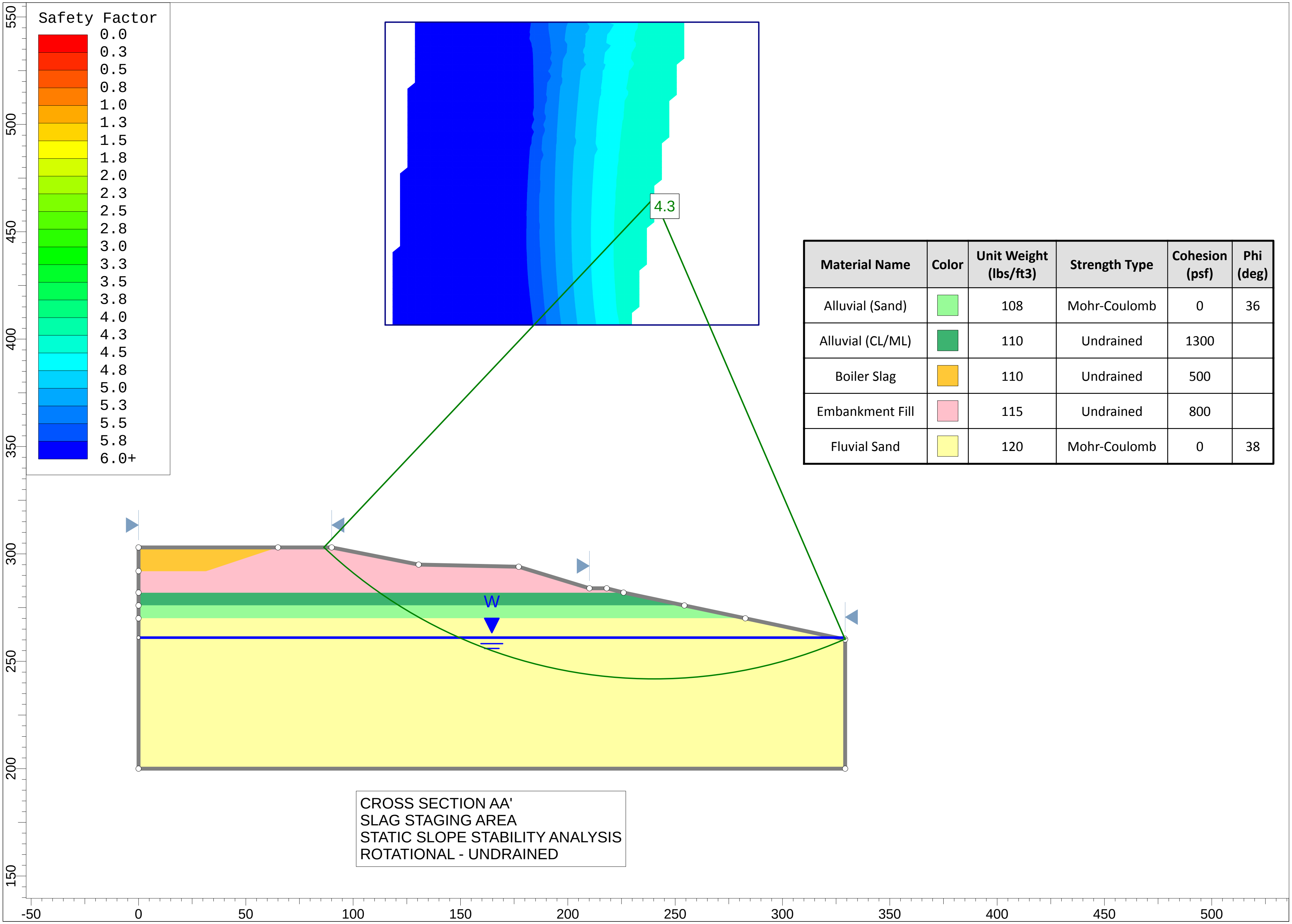
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	36
Alluvial (CL/ML)	🟩	110	Mohr-Coulomb	50	28
Boiler Slag	🟧	110	Mohr-Coulomb	0	30
Embankment Fill	🟪	115	Mohr-Coulomb	50	30
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION AA'
SLAG STAGING AREA
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - DRAINED



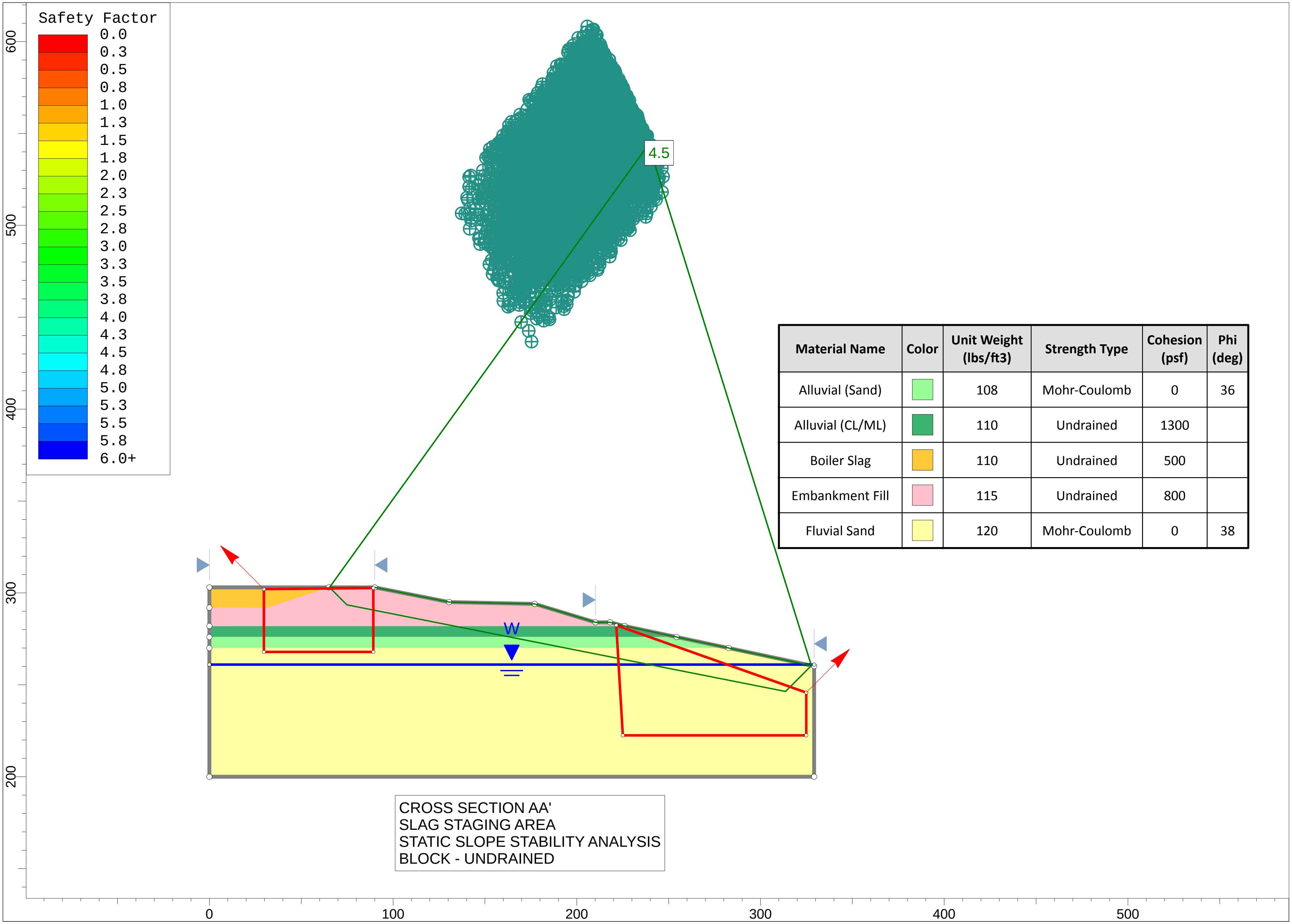
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	36
Alluvial (CL/ML)	🟩	110	Mohr-Coulomb	50	28
Boiler Slag	🟧	110	Mohr-Coulomb	0	30
Embankment Fill	🟥	115	Mohr-Coulomb	50	30
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION AA'
SLAG STAGING AREA
STATIC SLOPE STABILITY ANALYSIS
BLOCK - DRAINED



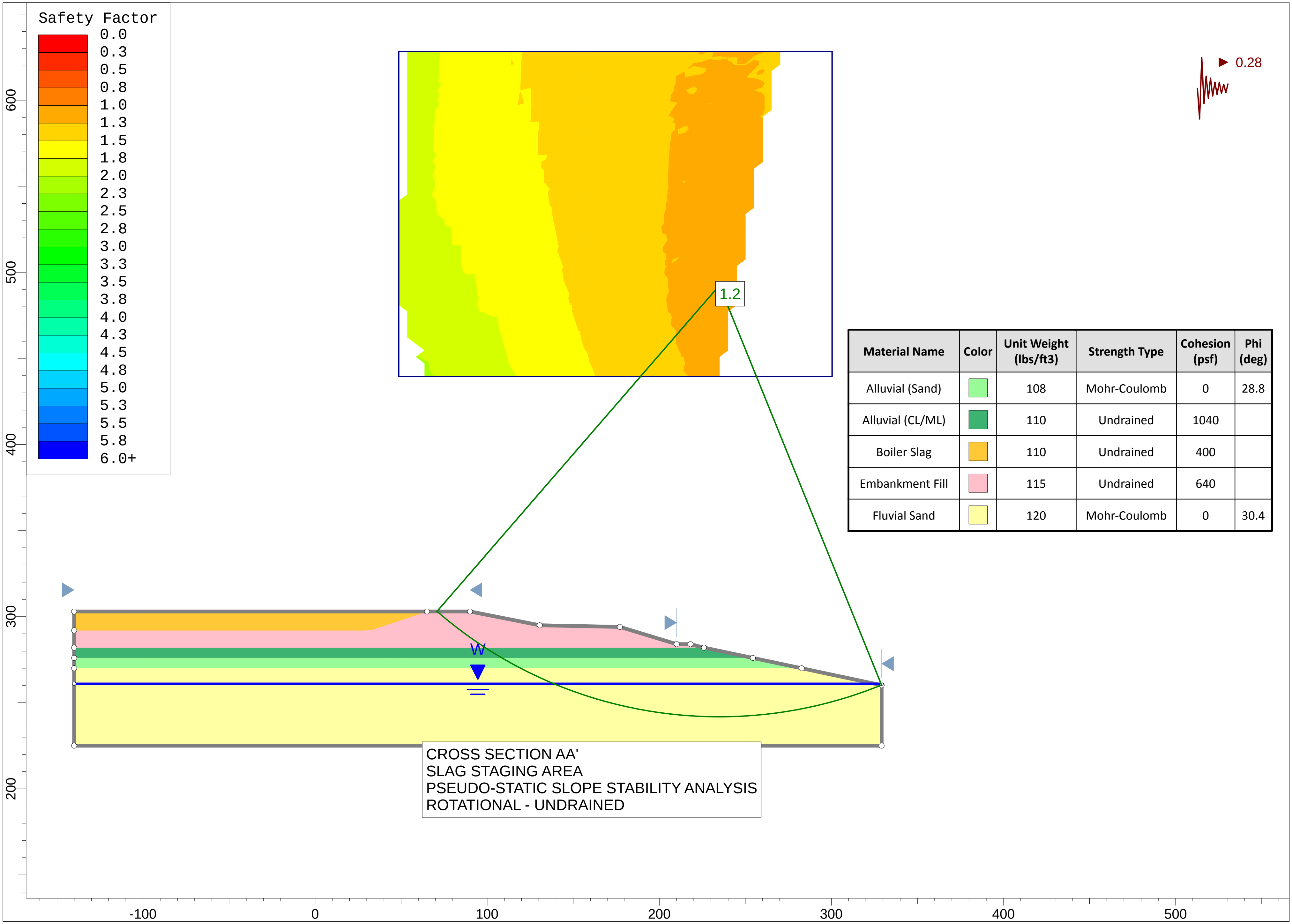
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	36
Alluvial (CL/ML)	🟩	110	Undrained	1300	
Boiler Slag	🟧	110	Undrained	500	
Embankment Fill	🟥	115	Undrained	800	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION AA'
SLAG STAGING AREA
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



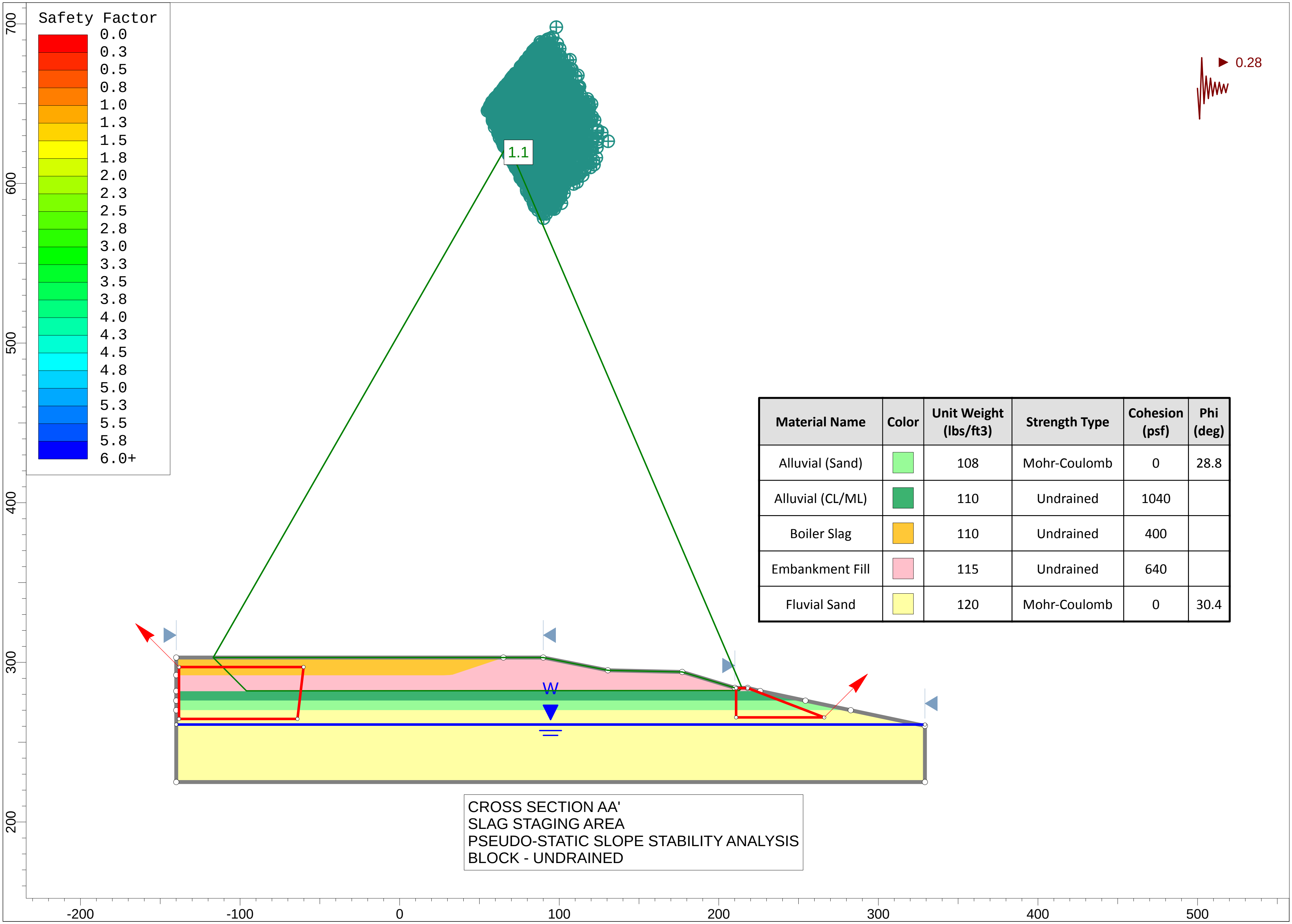
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	36
Alluvial (CL/ML)	🟩	110	Undrained	1300	
Boiler Slag	🟧	110	Undrained	500	
Embankment Fill	🟥	115	Undrained	800	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION AA'
SLAG STAGING AREA
STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



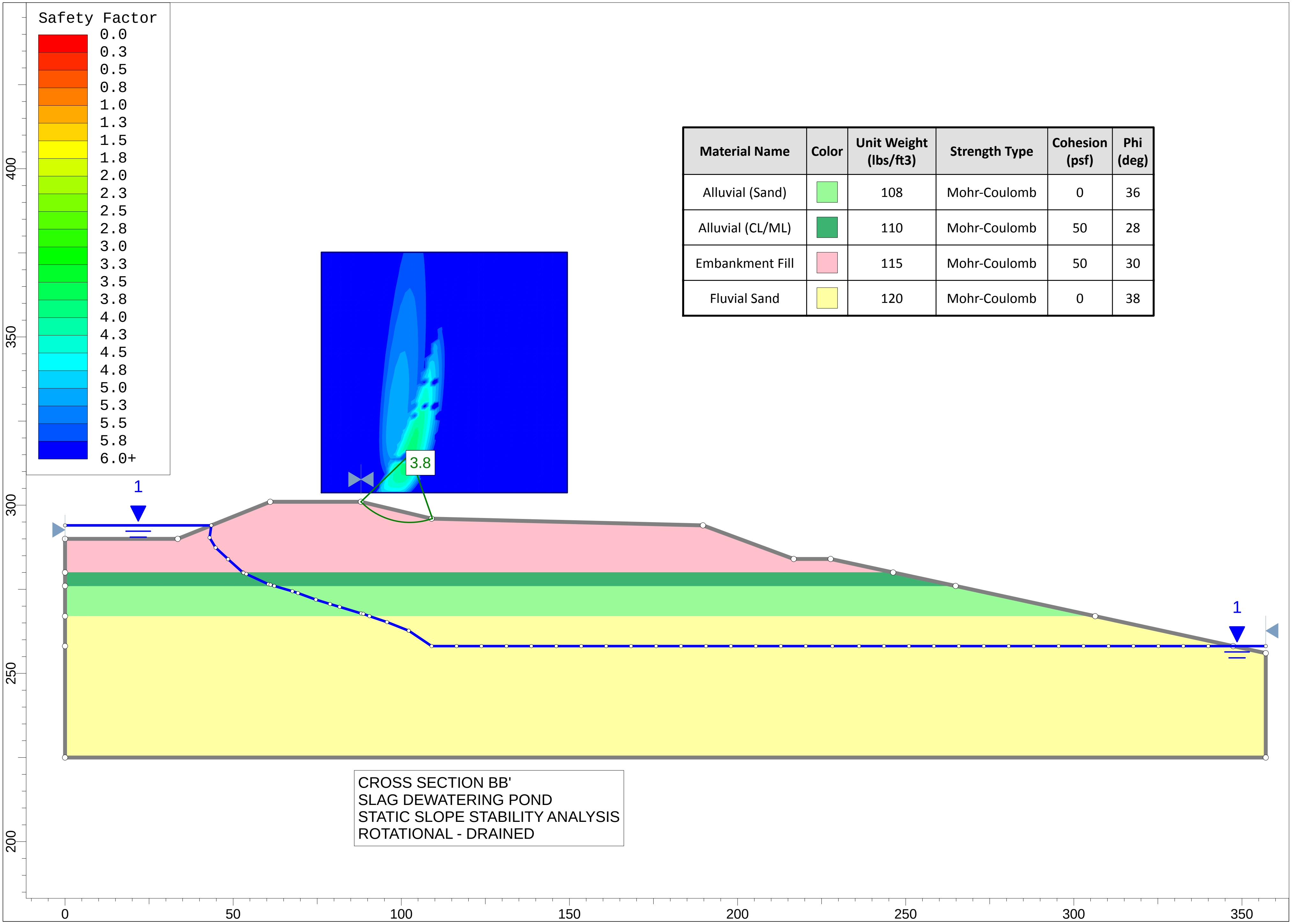
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	28.8
Alluvial (CL/ML)	🟩	110	Undrained	1040	
Boiler Slag	🟧	110	Undrained	400	
Embankment Fill	🟥	115	Undrained	640	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	30.4

CROSS SECTION AA'
SLAG STAGING AREA
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



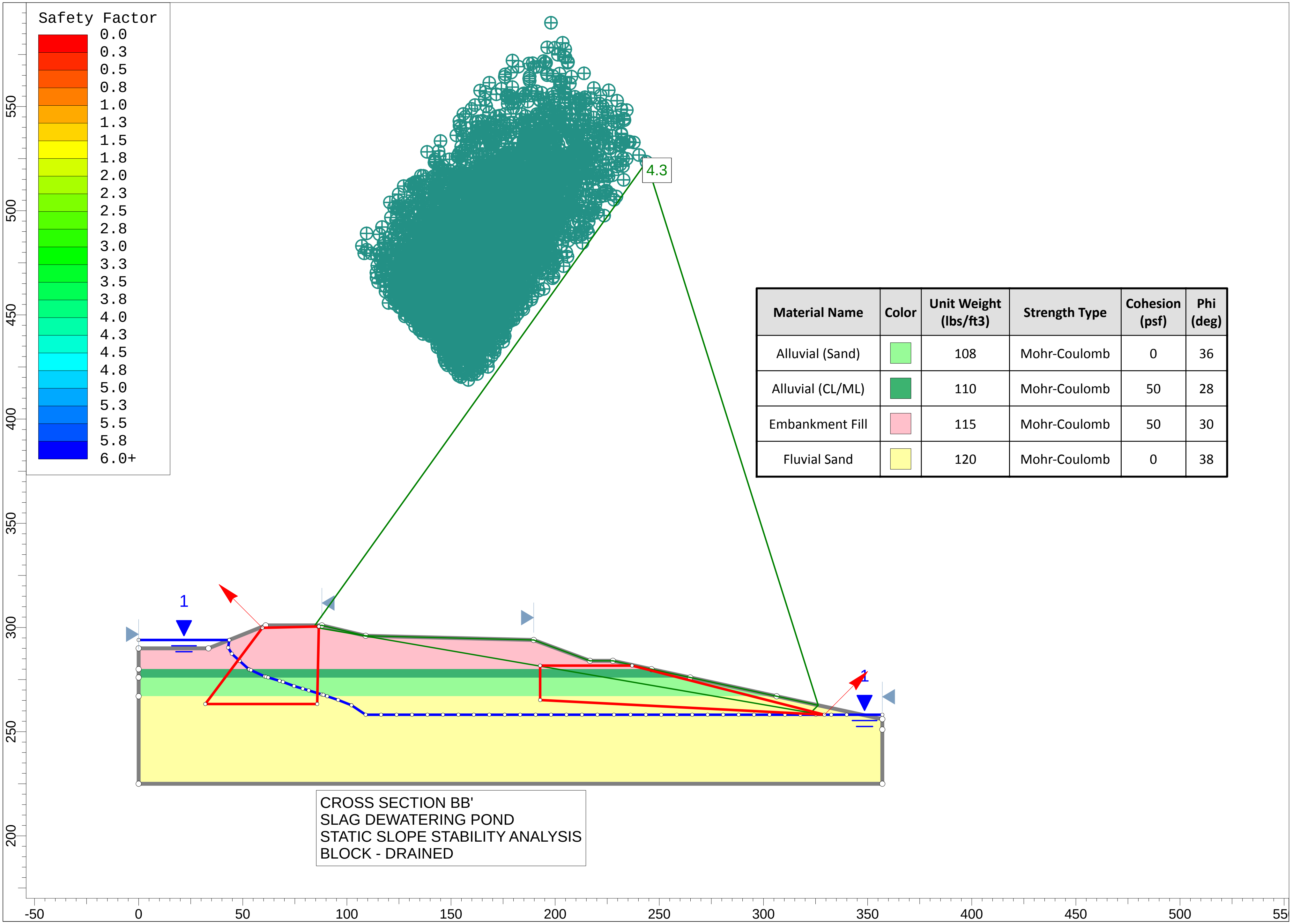
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	28.8
Alluvial (CL/ML)	🟩	110	Undrained	1040	
Boiler Slag	🟧	110	Undrained	400	
Embankment Fill	🟥	115	Undrained	640	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	30.4

CROSS SECTION AA'
SLAG STAGING AREA
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



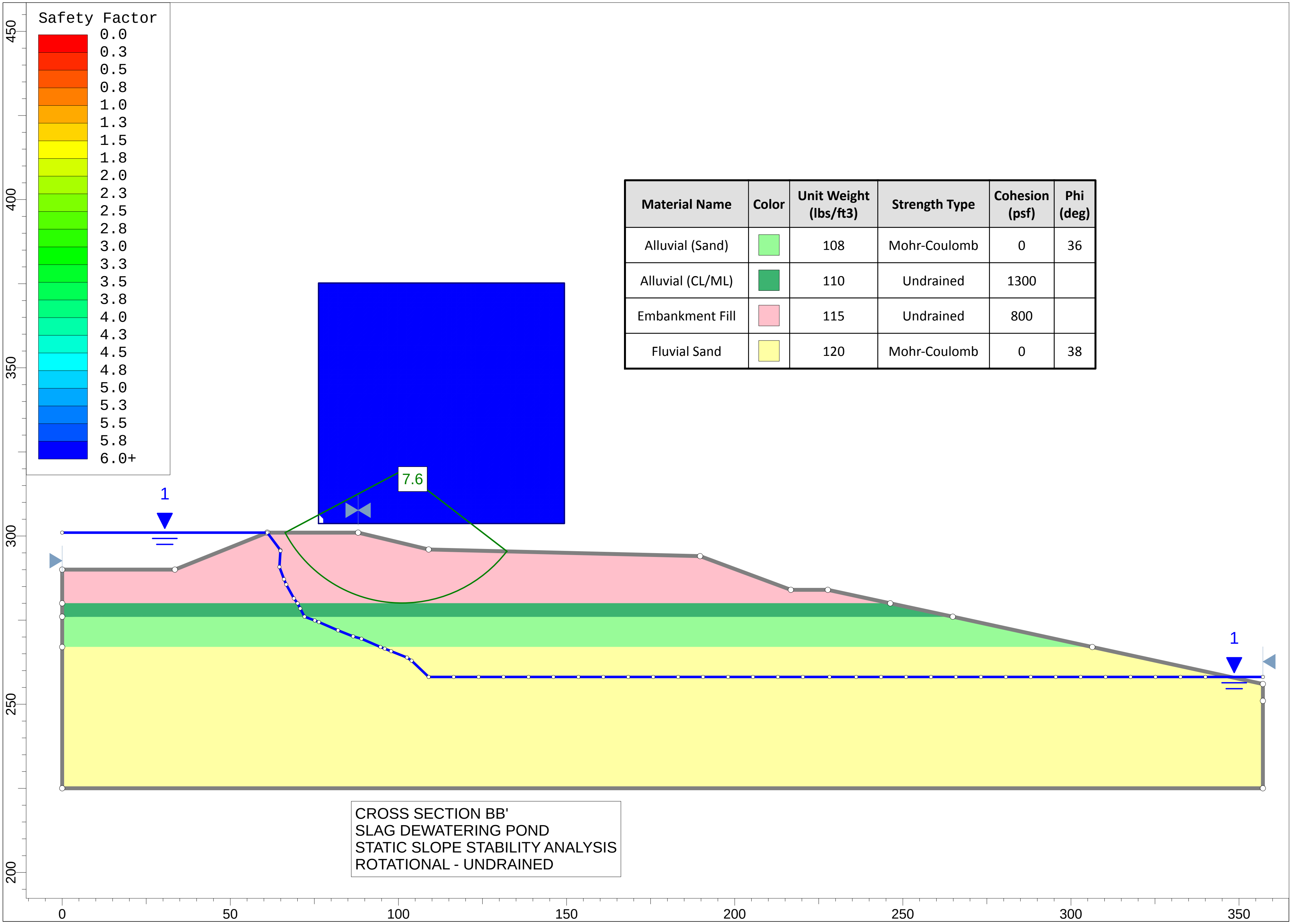
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	36
Alluvial (CL/ML)	🟩	110	Mohr-Coulomb	50	28
Embankment Fill	🟥	115	Mohr-Coulomb	50	30
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION BB'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - DRAINED



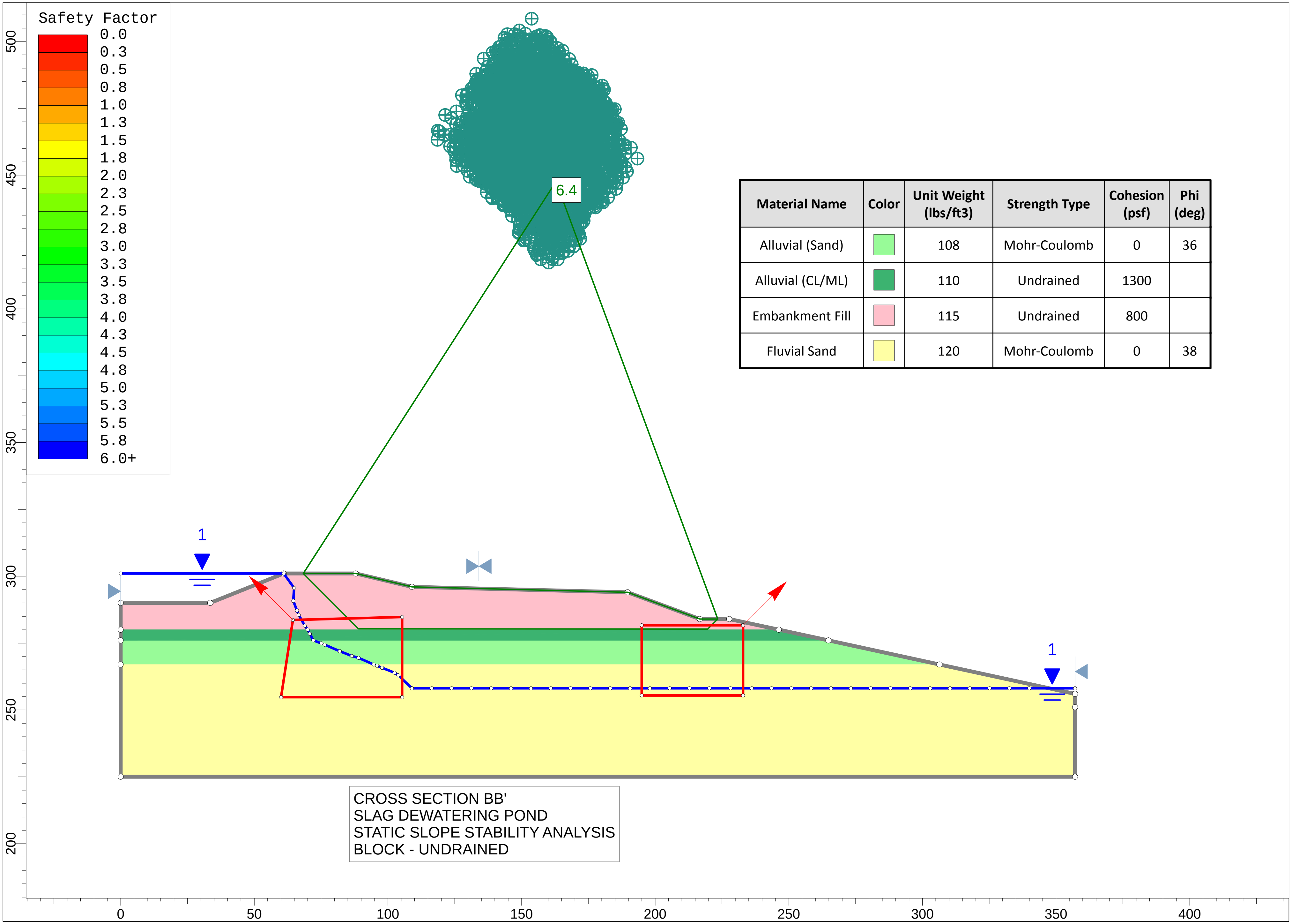
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	36
Alluvial (CL/ML)	🟩	110	Mohr-Coulomb	50	28
Embankment Fill	🟥	115	Mohr-Coulomb	50	30
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION BB'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
BLOCK - DRAINED



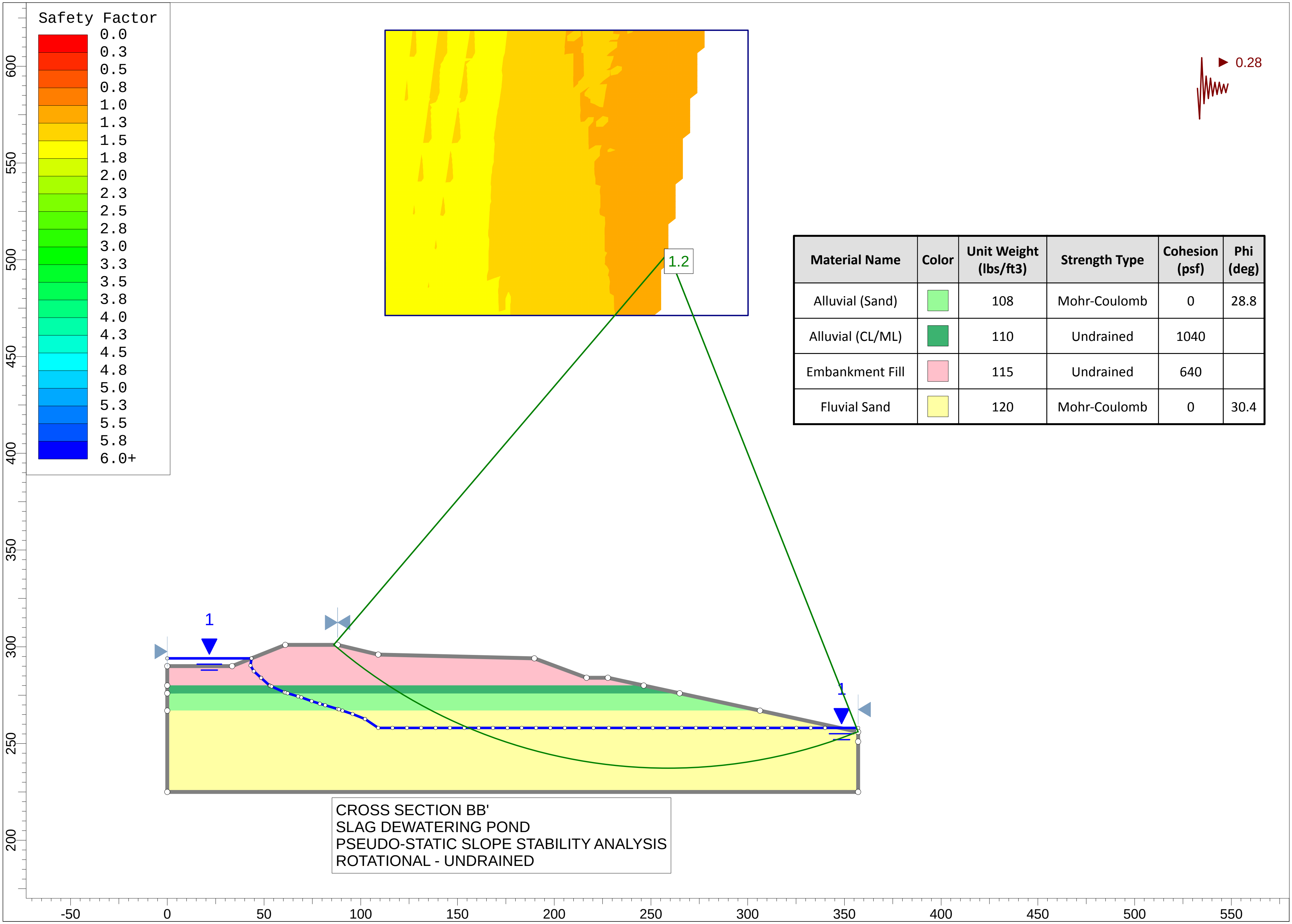
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	36
Alluvial (CL/ML)	🟩	110	Undrained	1300	
Embankment Fill	🟥	115	Undrained	800	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION BB'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



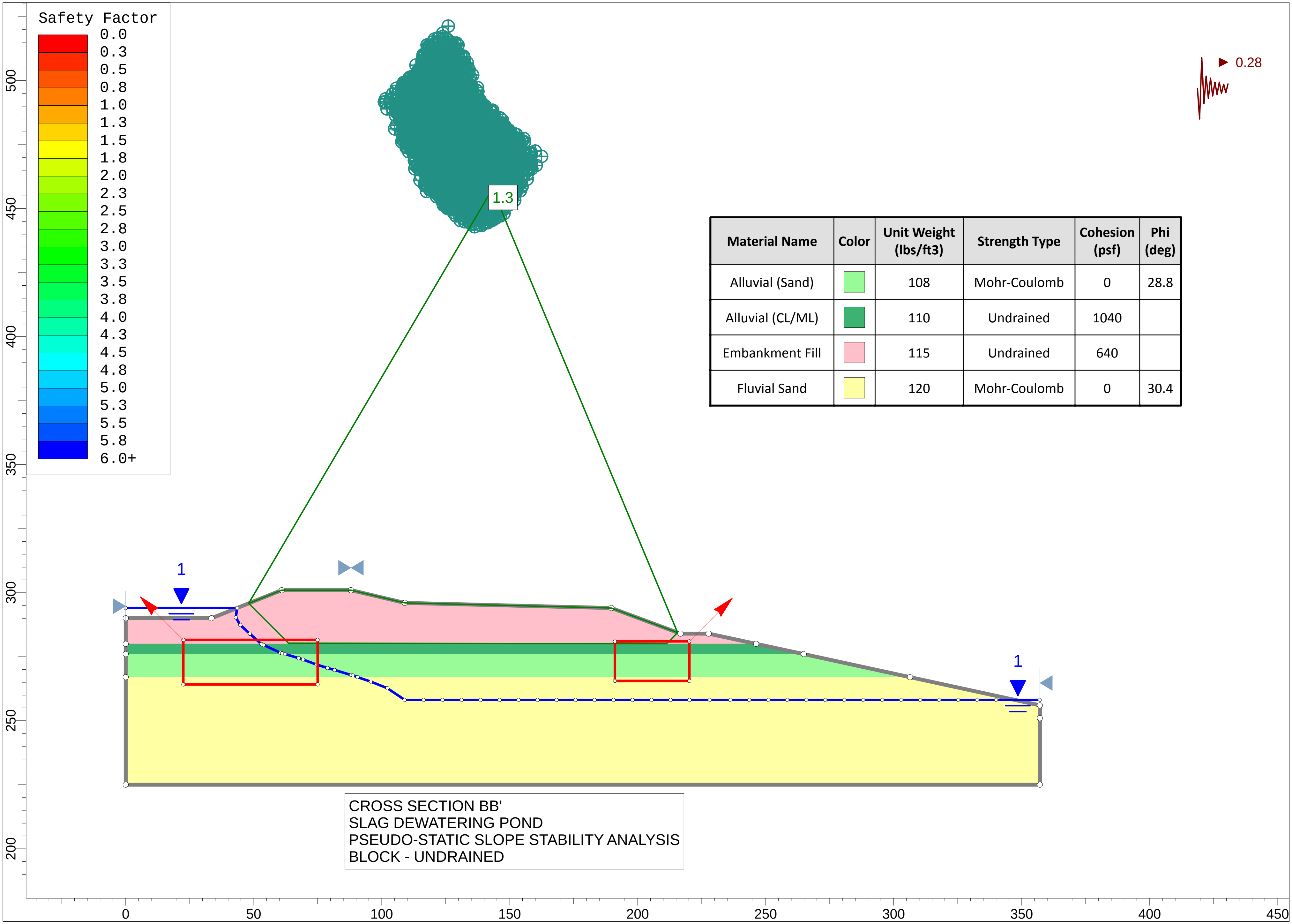
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	36
Alluvial (CL/ML)	🟩	110	Undrained	1300	
Embankment Fill	🟥	115	Undrained	800	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION BB'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	28.8
Alluvial (CL/ML)	🟩	110	Undrained	1040	
Embankment Fill	🟥	115	Undrained	640	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	30.4

CROSS SECTION BB'
SLAG DEWATERING POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
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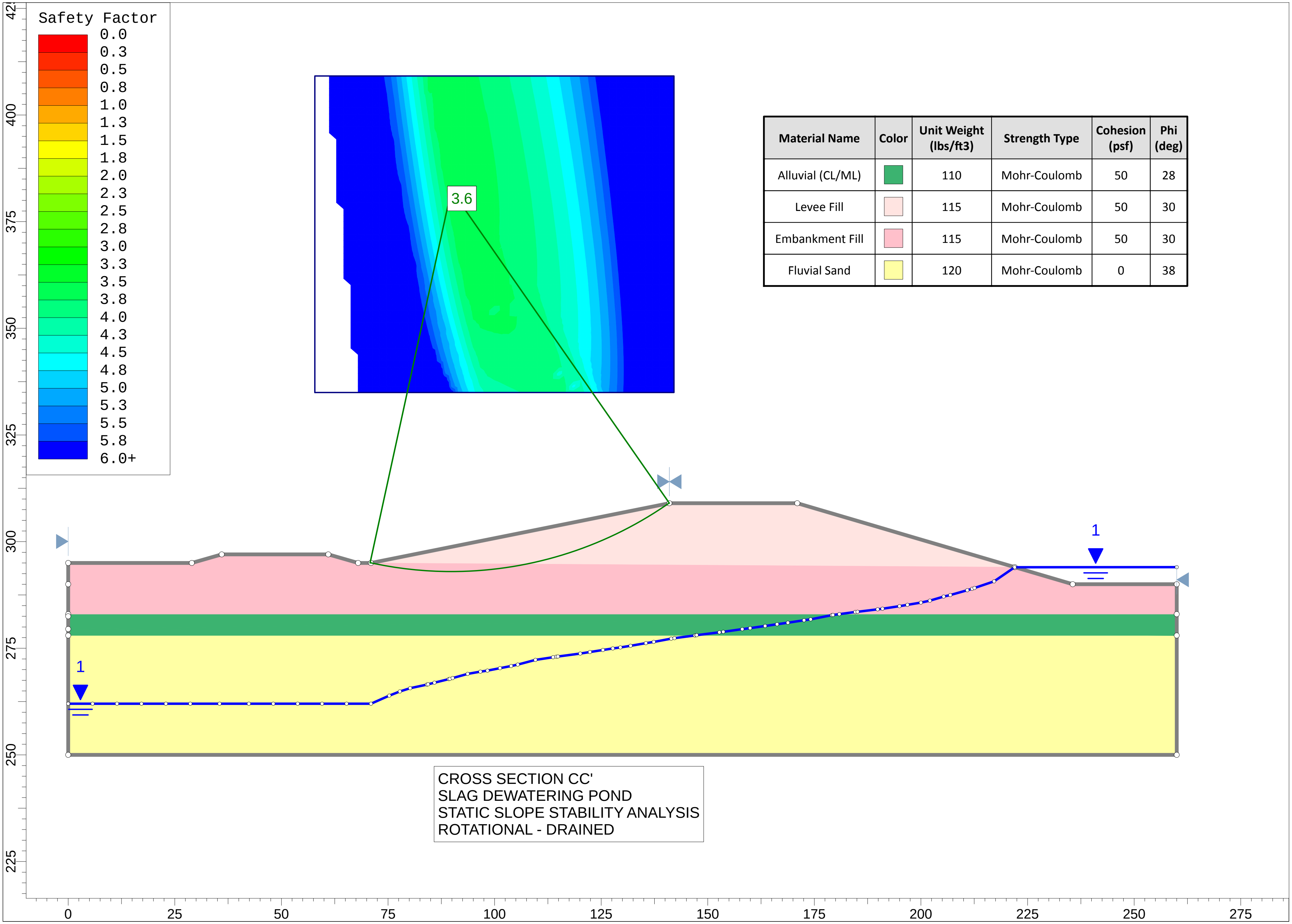
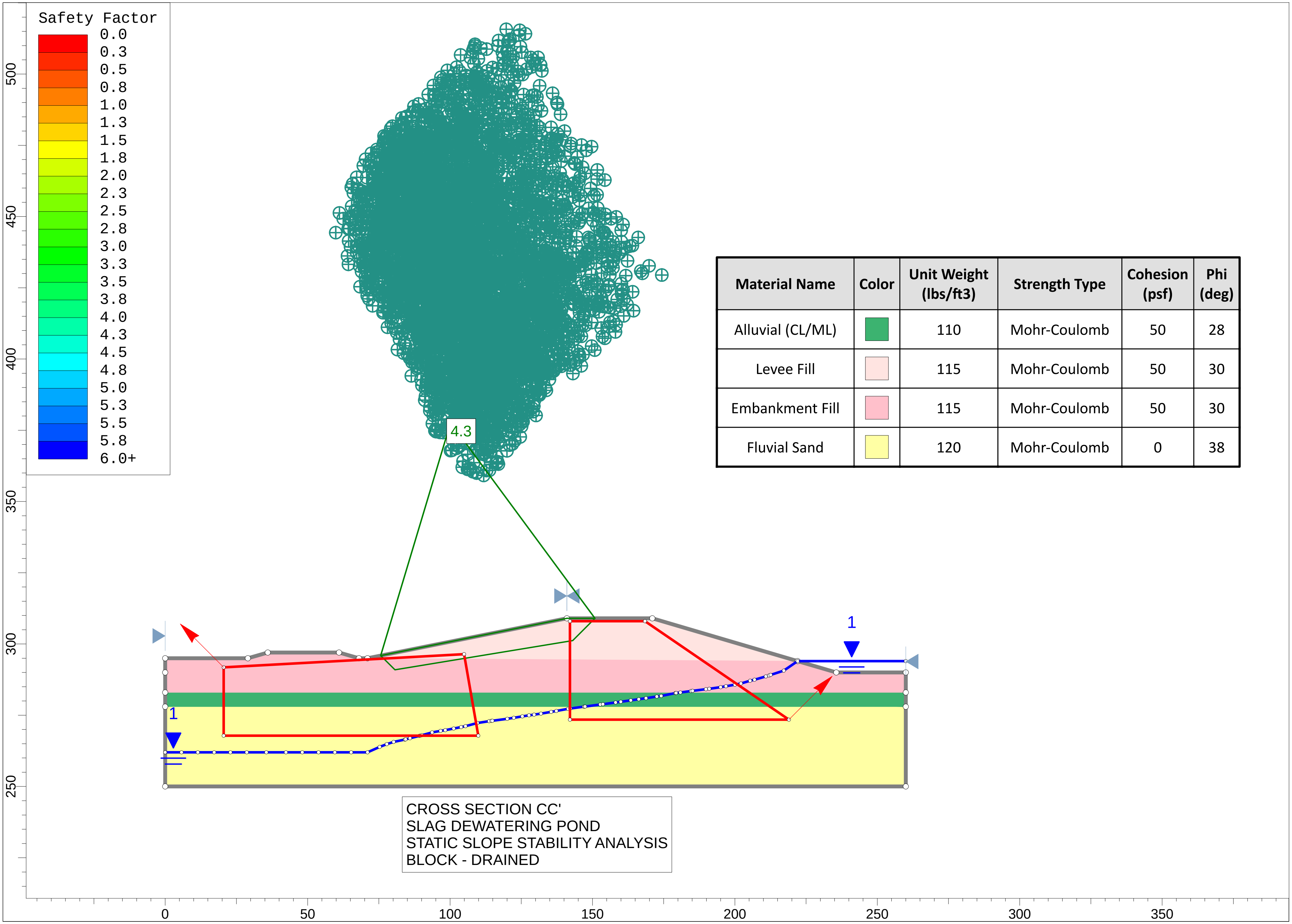
Alluvial (CL/ML)	🟩	110	Undrained	1040	
Embankment Fill	🟥	115	Undrained	640	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	30.4

CROSS SECTION BB'
SLAG DEWATERING POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



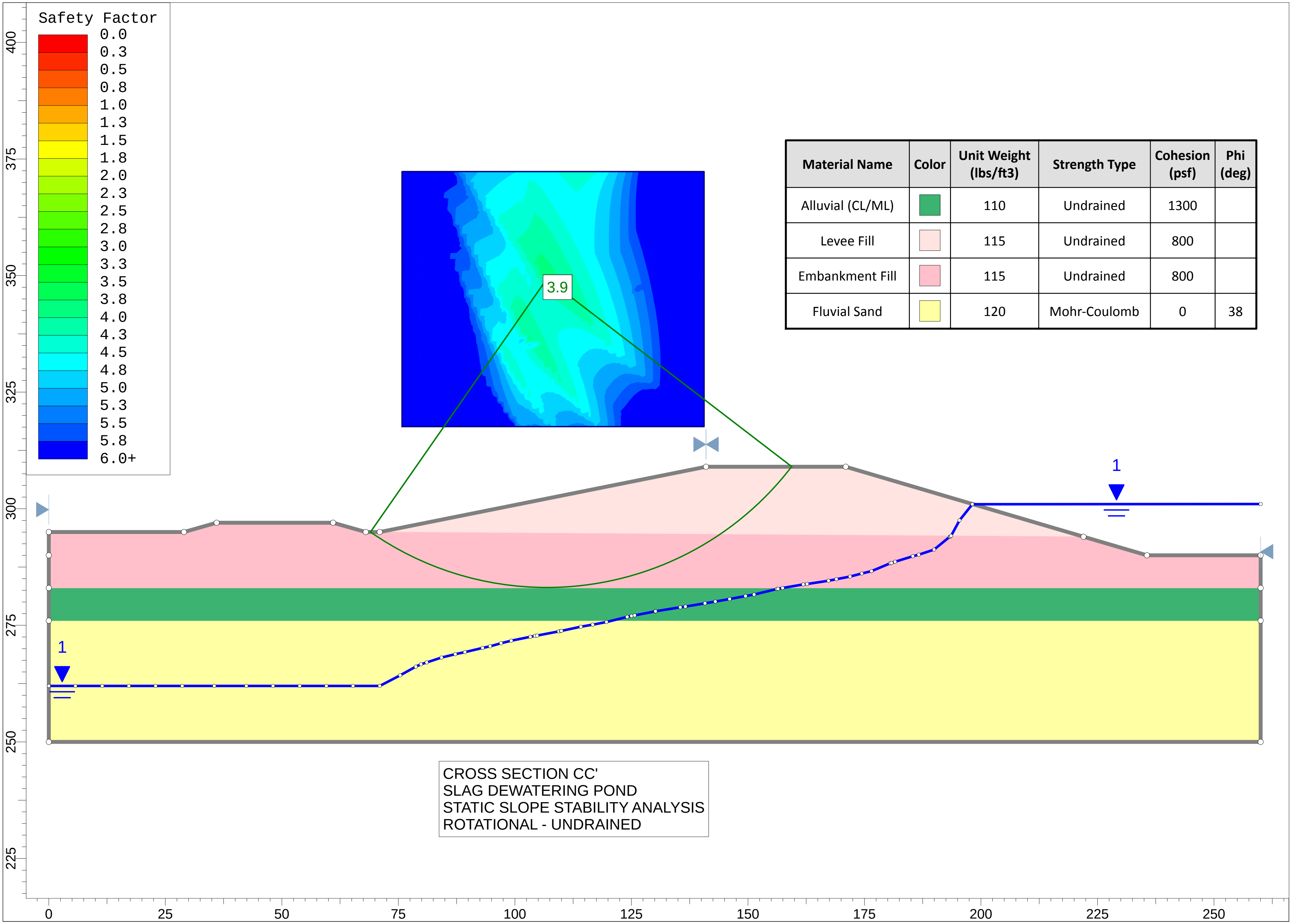
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (CL/ML)	🟩	110	Mohr-Coulomb	50	28
Levee Fill	⬜	115	Mohr-Coulomb	50	30
Embankment Fill	🟥	115	Mohr-Coulomb	50	30
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION CC'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - DRAINED



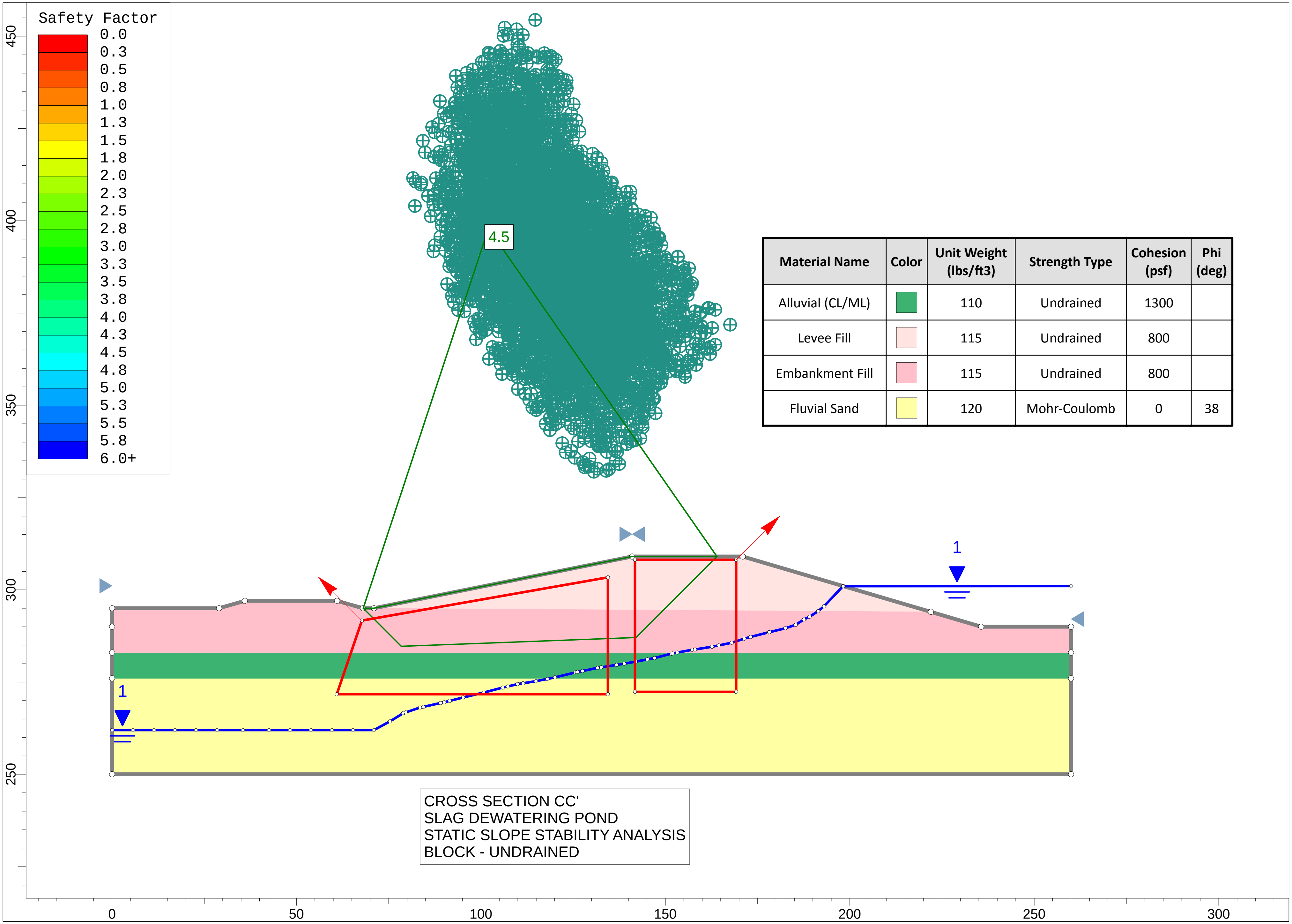
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (CL/ML)	🟩	110	Mohr-Coulomb	50	28
Levee Fill	🟥	115	Mohr-Coulomb	50	30
Embankment Fill	🟥	115	Mohr-Coulomb	50	30
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION CC'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
BLOCK - DRAINED



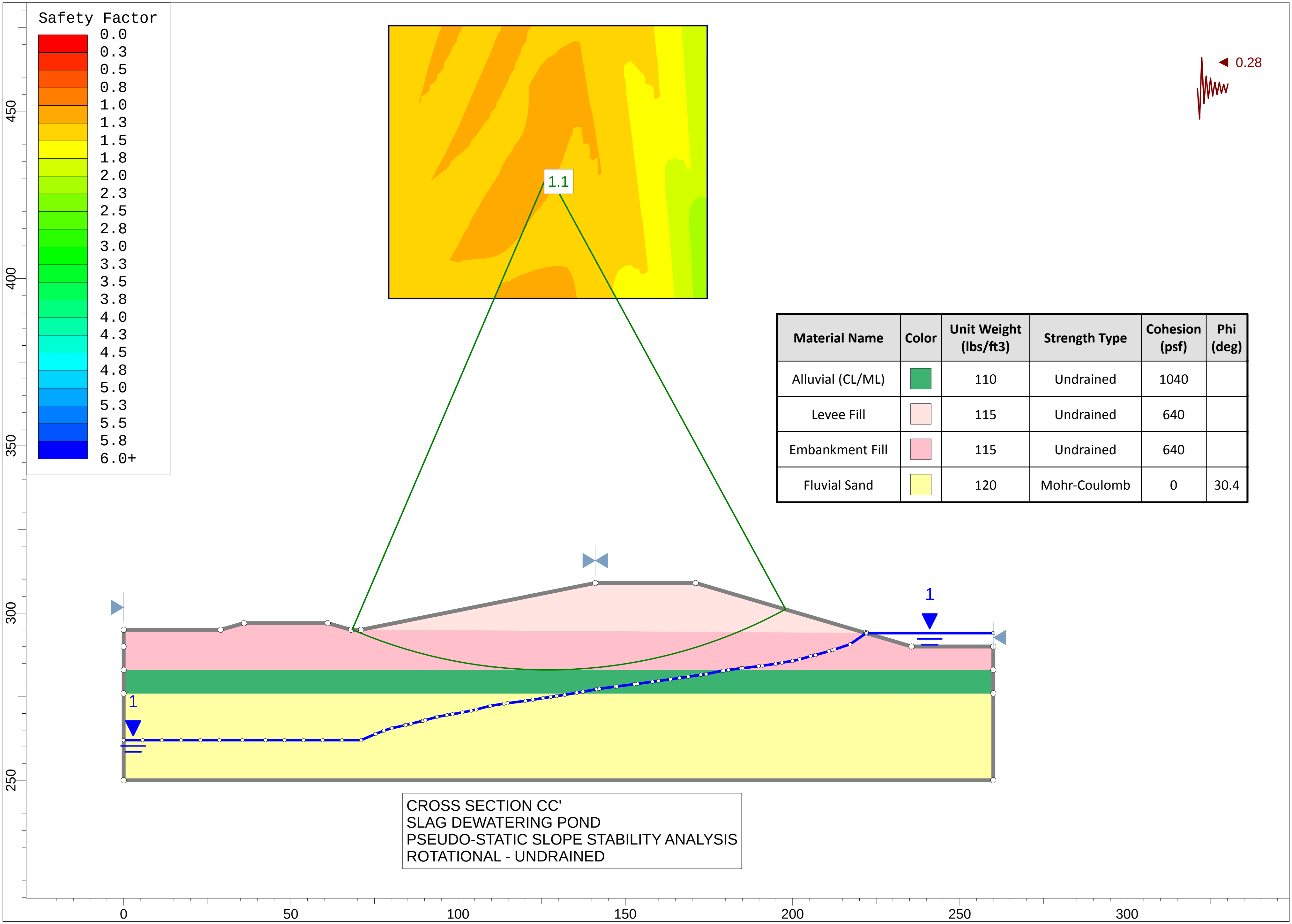
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (CL/ML)	🟩	110	Undrained	1300	
Levee Fill	◻	115	Undrained	800	
Embankment Fill	🟥	115	Undrained	800	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION CC'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



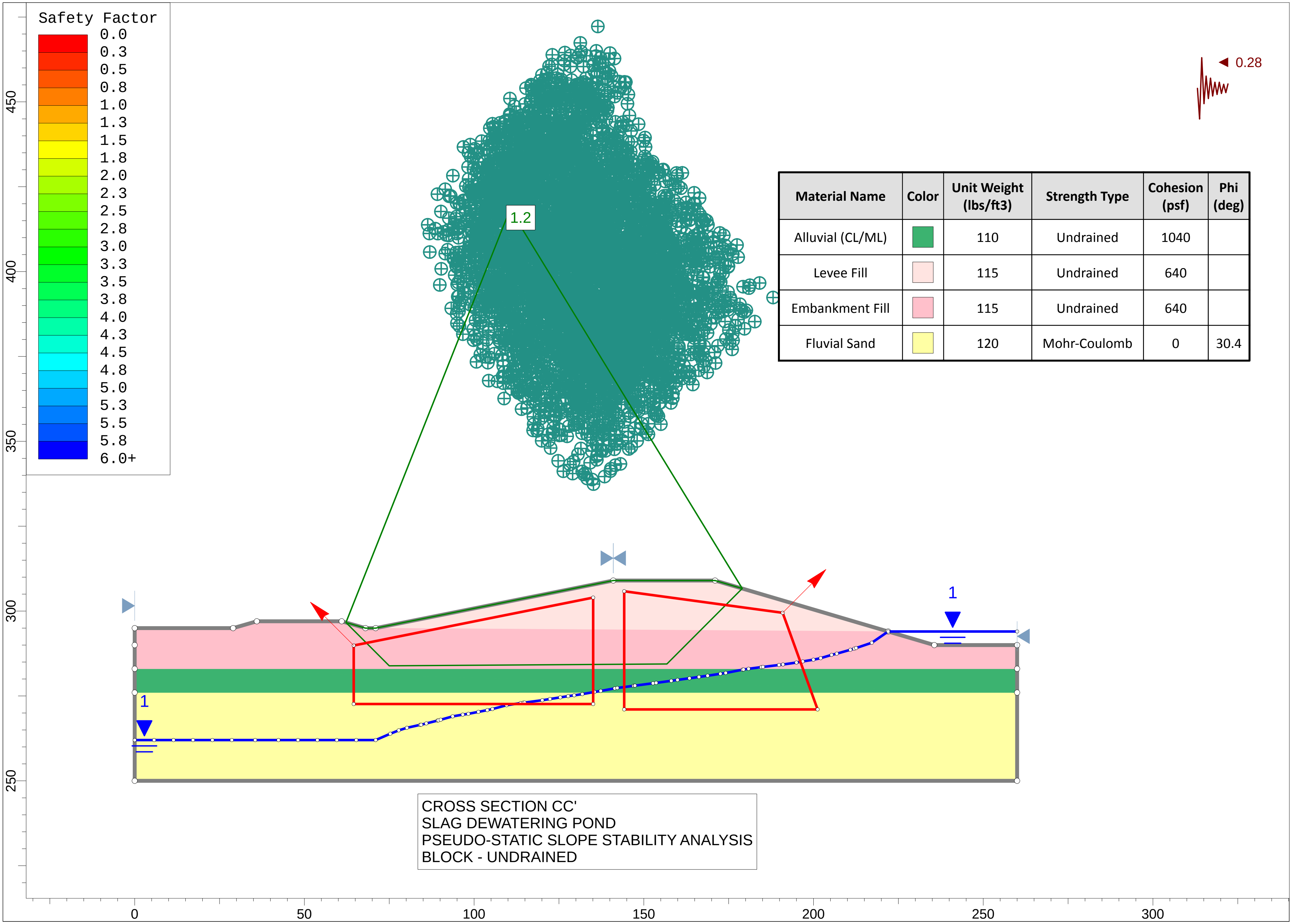
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (CL/ML)	🟩	110	Undrained	1300	
Levee Fill	⬜	115	Undrained	800	
Embankment Fill	🟥	115	Undrained	800	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION CC'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



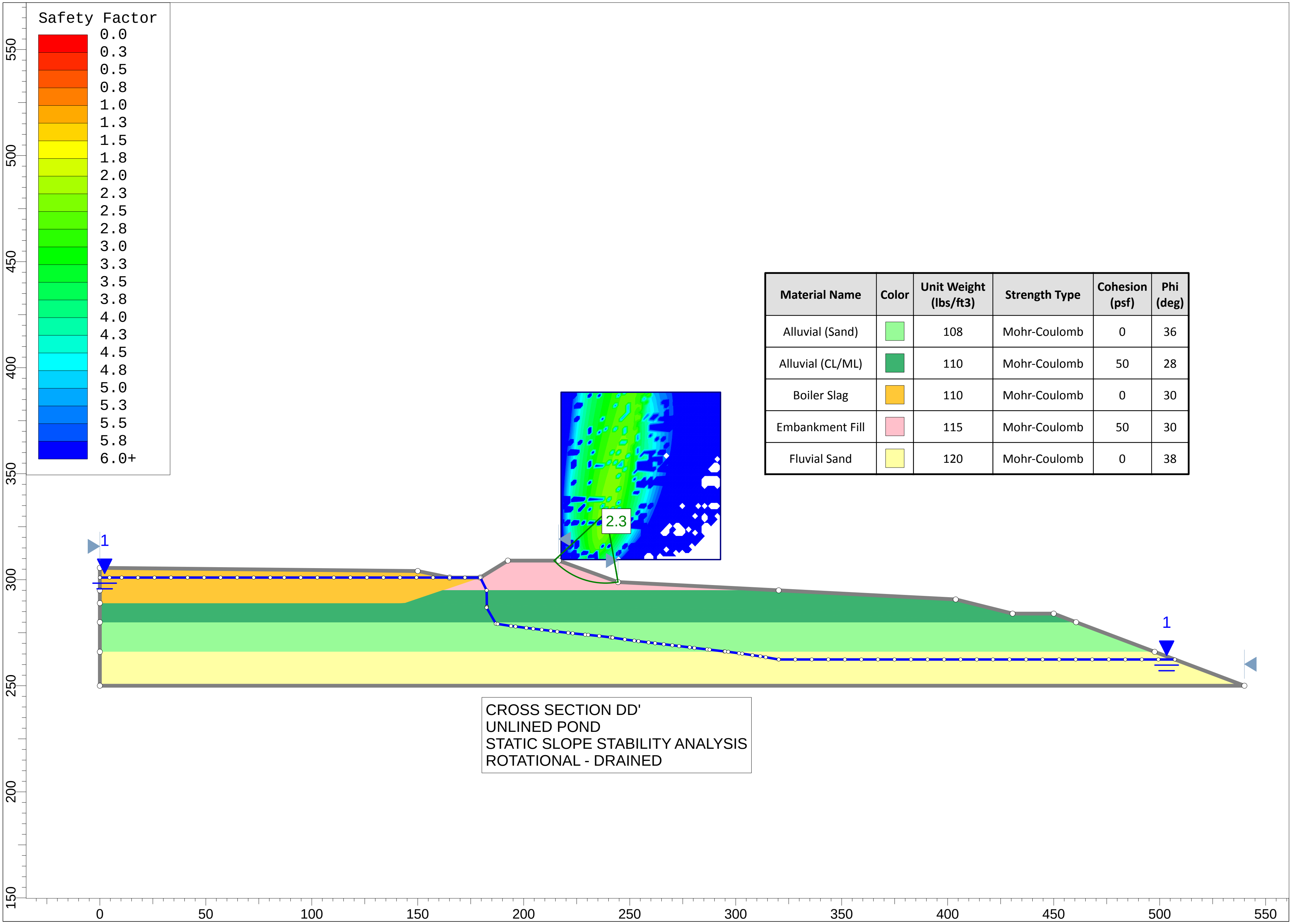
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (CL/ML)	🟩	110	Undrained	1040	
Levee Fill	⬜	115	Undrained	640	
Embankment Fill	🟥	115	Undrained	640	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	30.4

CROSS SECTION CC'
SLAG DEWATERING POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



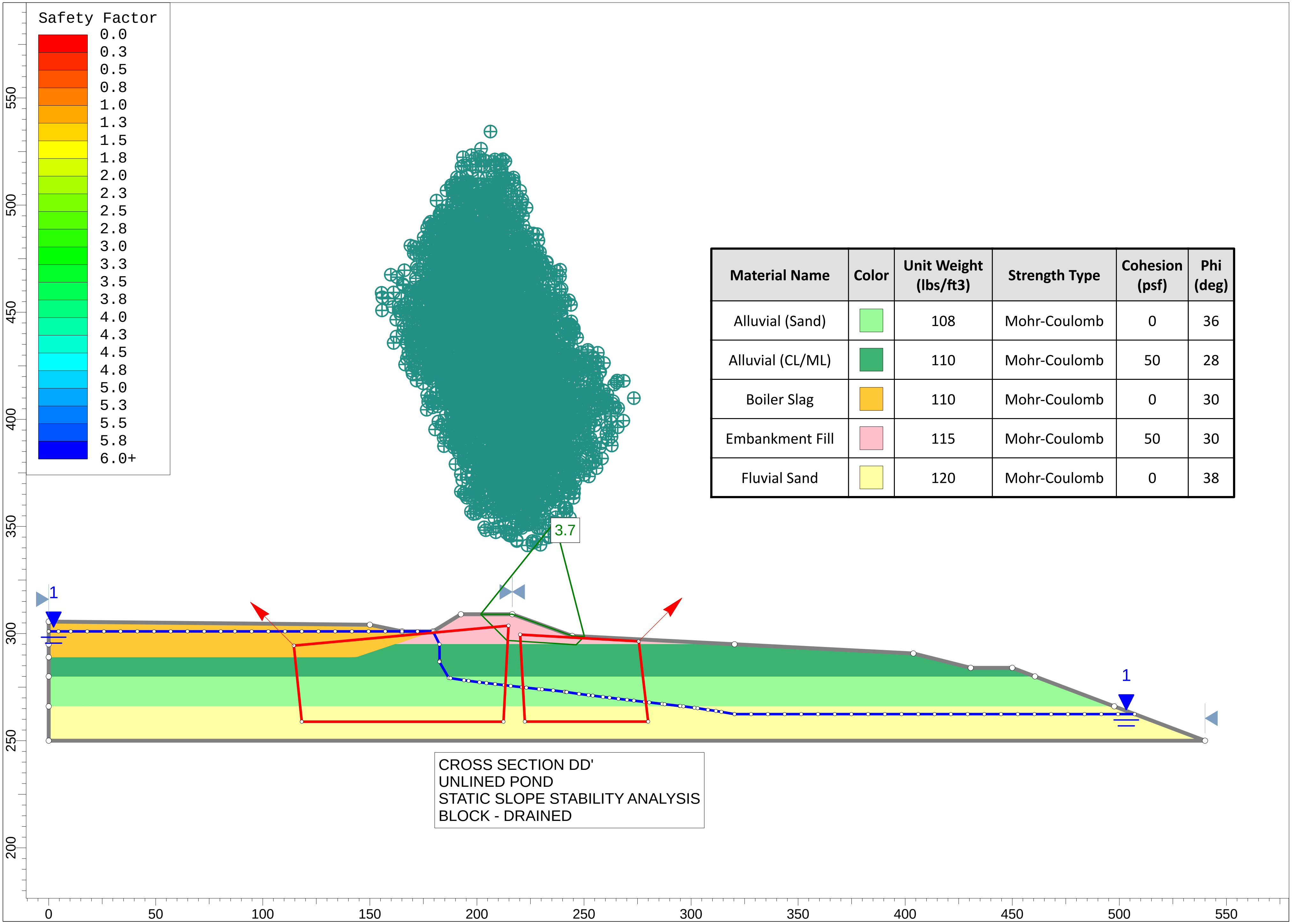
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (CL/ML)	🟩	110	Undrained	1040	
Levee Fill	⬜	115	Undrained	640	
Embankment Fill	🟥	115	Undrained	640	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	30.4

CROSS SECTION CC'
SLAG DEWATERING POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



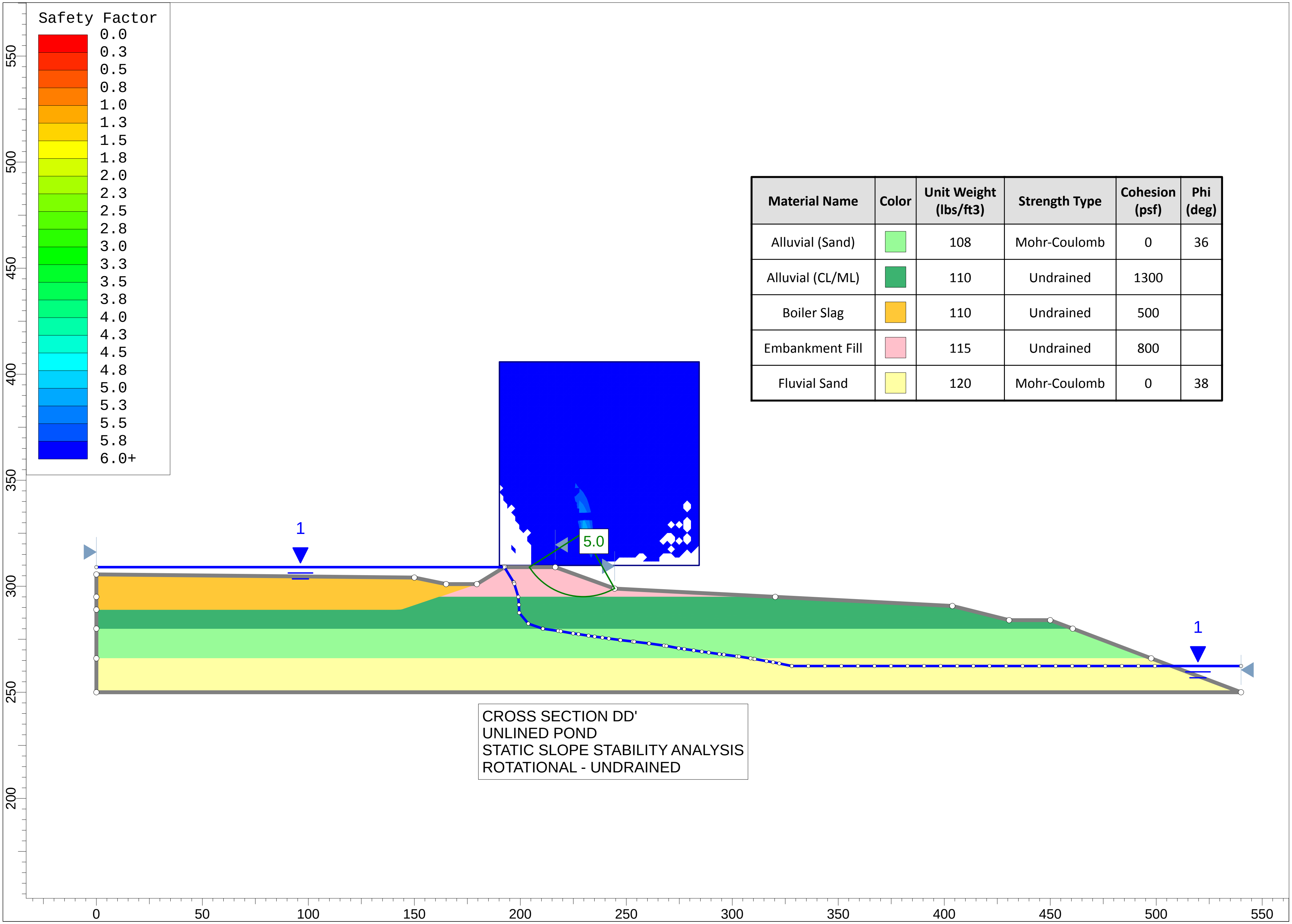
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	36
Alluvial (CL/ML)	🟩	110	Mohr-Coulomb	50	28
Boiler Slag	🟧	110	Mohr-Coulomb	0	30
Embankment Fill	🟪	115	Mohr-Coulomb	50	30
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION DD'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - DRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	36
Alluvial (CL/ML)	🟩	110	Mohr-Coulomb	50	28
Boiler Slag	🟧	110	Mohr-Coulomb	0	30
Embankment Fill	🟥	115	Mohr-Coulomb	50	30
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION DD'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
BLOCK - DRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
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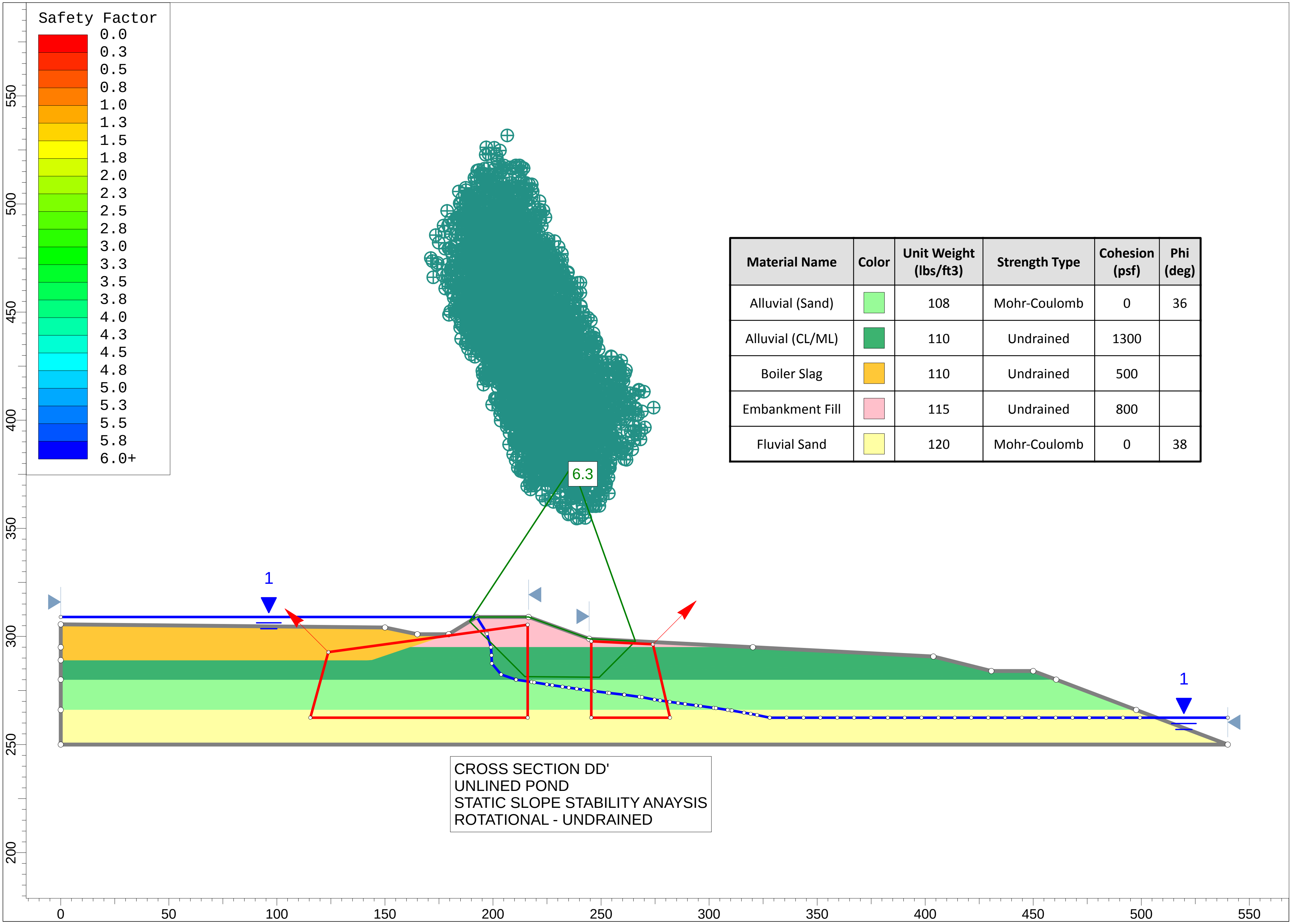
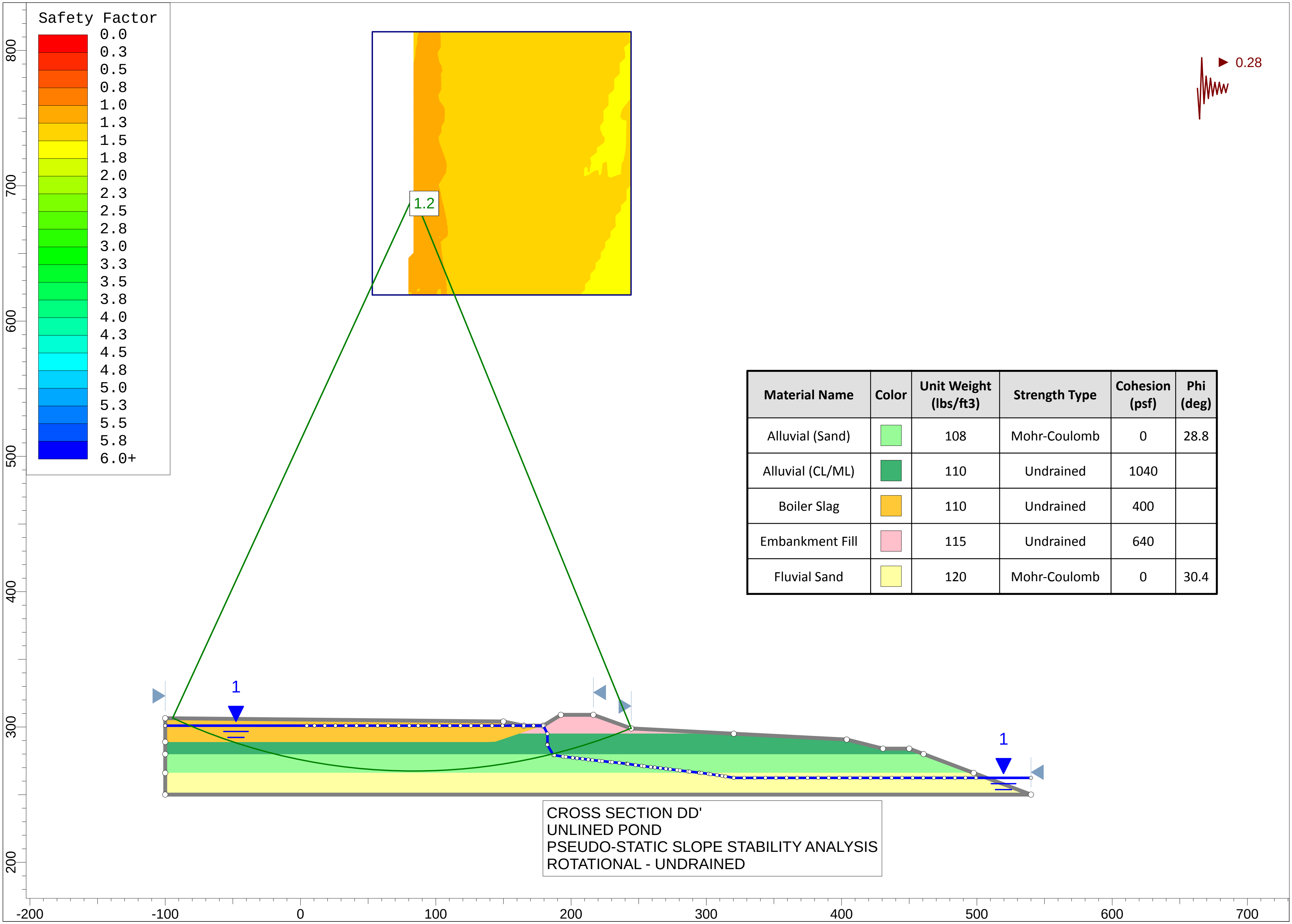
Alluvial (CL/ML)	🟩	110	Undrained	1300	
Boiler Slag	🟧	110	Undrained	500	
Embankment Fill	🟥	115	Undrained	800	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION DD'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	36
Alluvial (CL/ML)	🟩	110	Undrained	1300	
Boiler Slag	🟧	110	Undrained	500	
Embankment Fill	🟪	115	Undrained	800	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION DD'
UNLINED POND
STATIC SLOPE STABILITY ANAYSIS
ROTATIONAL - UNDRAINED



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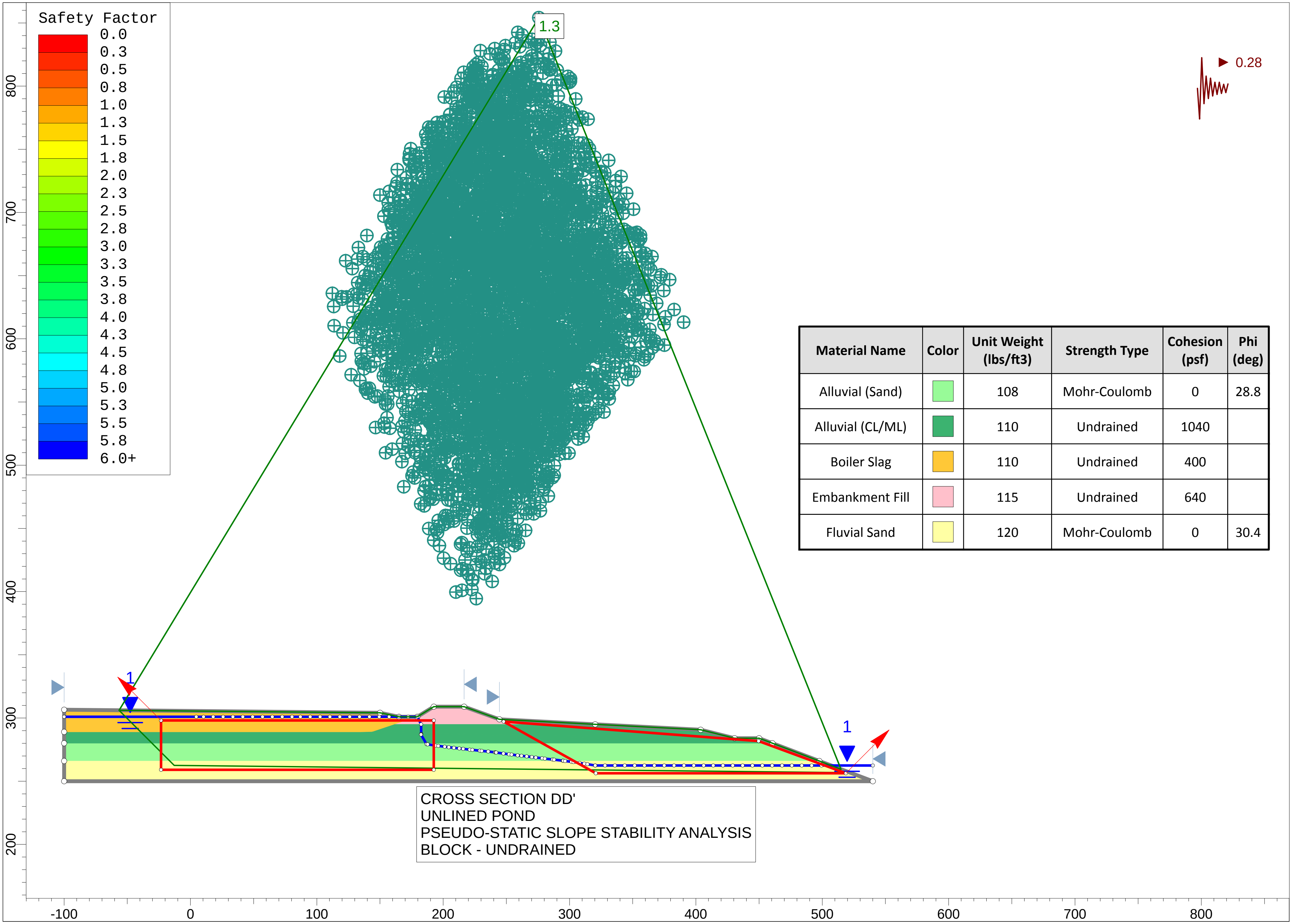
Alluvial (CL/ML)	🟩	110	Undrained	1040	
Boiler Slag	🟧	110	Undrained	400	
Embankment Fill	🟪	115	Undrained	640	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	30.4

CROSS SECTION DD'
UNLINED POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
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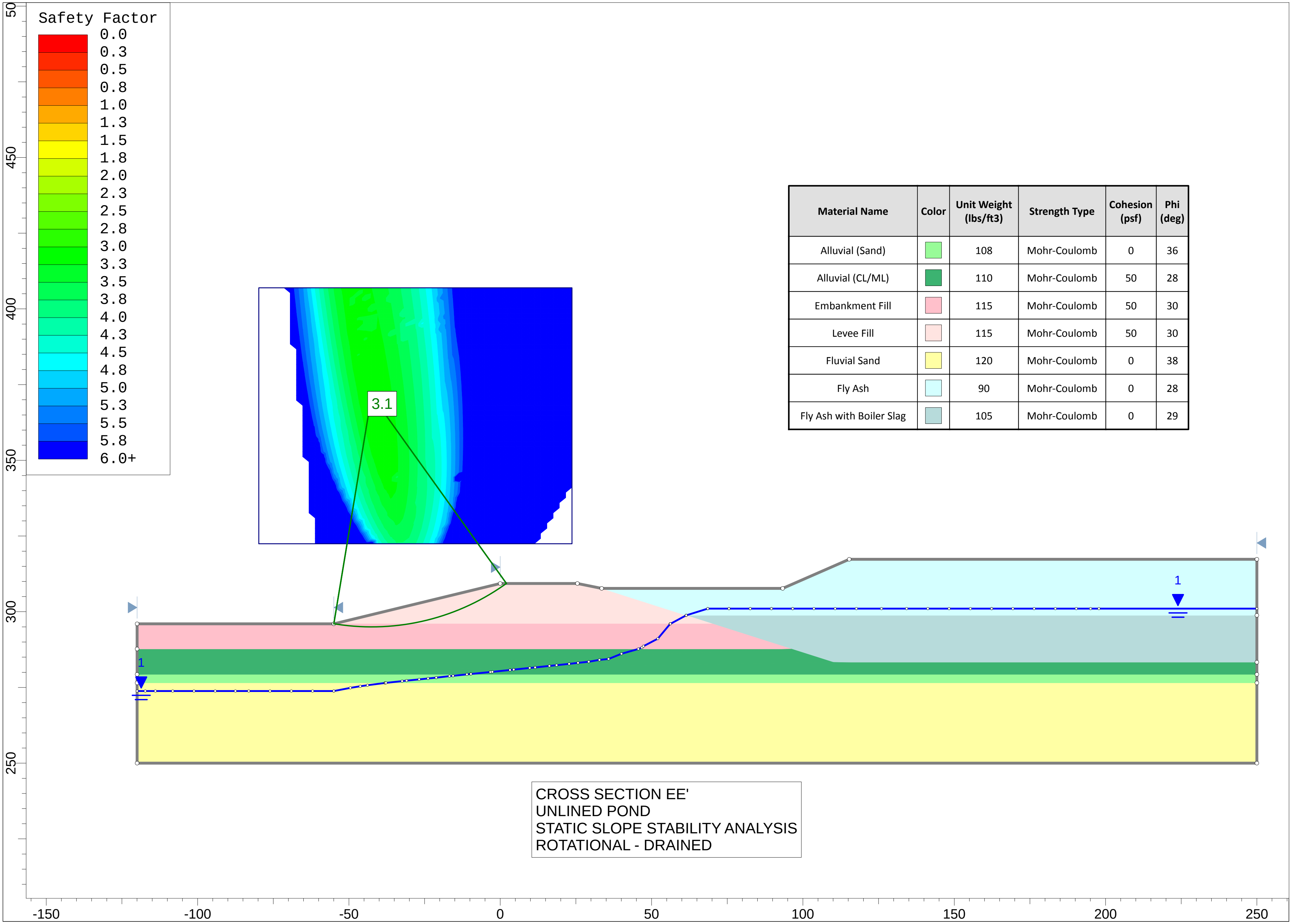
Alluvial (CL/ML)	🟩	110	Undrained	1040	
Boiler Slag	🟧	110	Undrained	400	
Embankment Fill	🟥	115	Undrained	640	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	30.4

CROSS SECTION DD'
UNLINED POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
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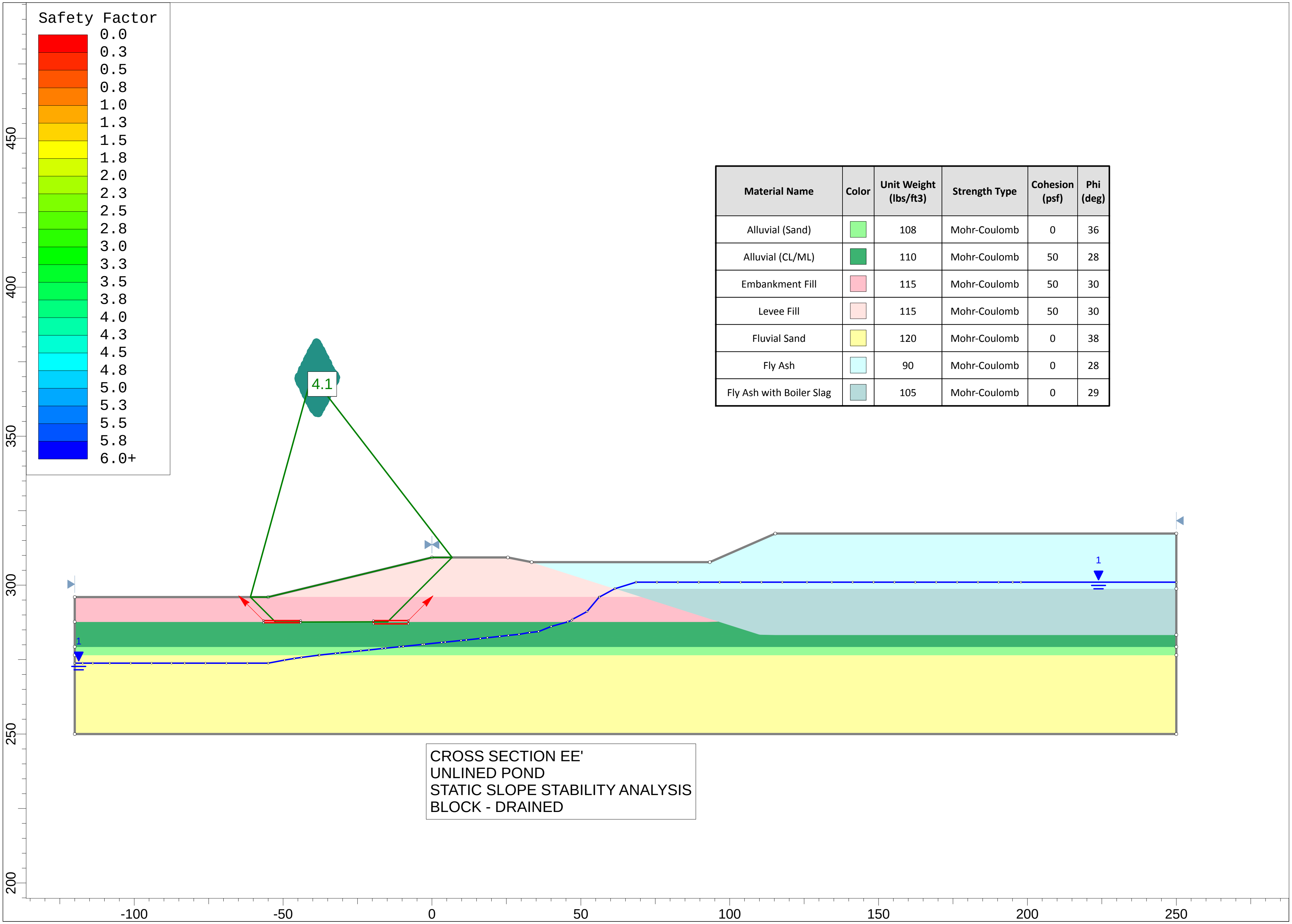
Embankment Fill	🟥	115	Mohr-Coulomb	50	30
Levee Fill	🟥	115	Mohr-Coulomb	50	30
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38
Fly Ash	🟦	90	Mohr-Coulomb	0	28
Fly Ash with Boiler Slag	🟦	105	Mohr-Coulomb	0	29

CROSS SECTION EE'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - DRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
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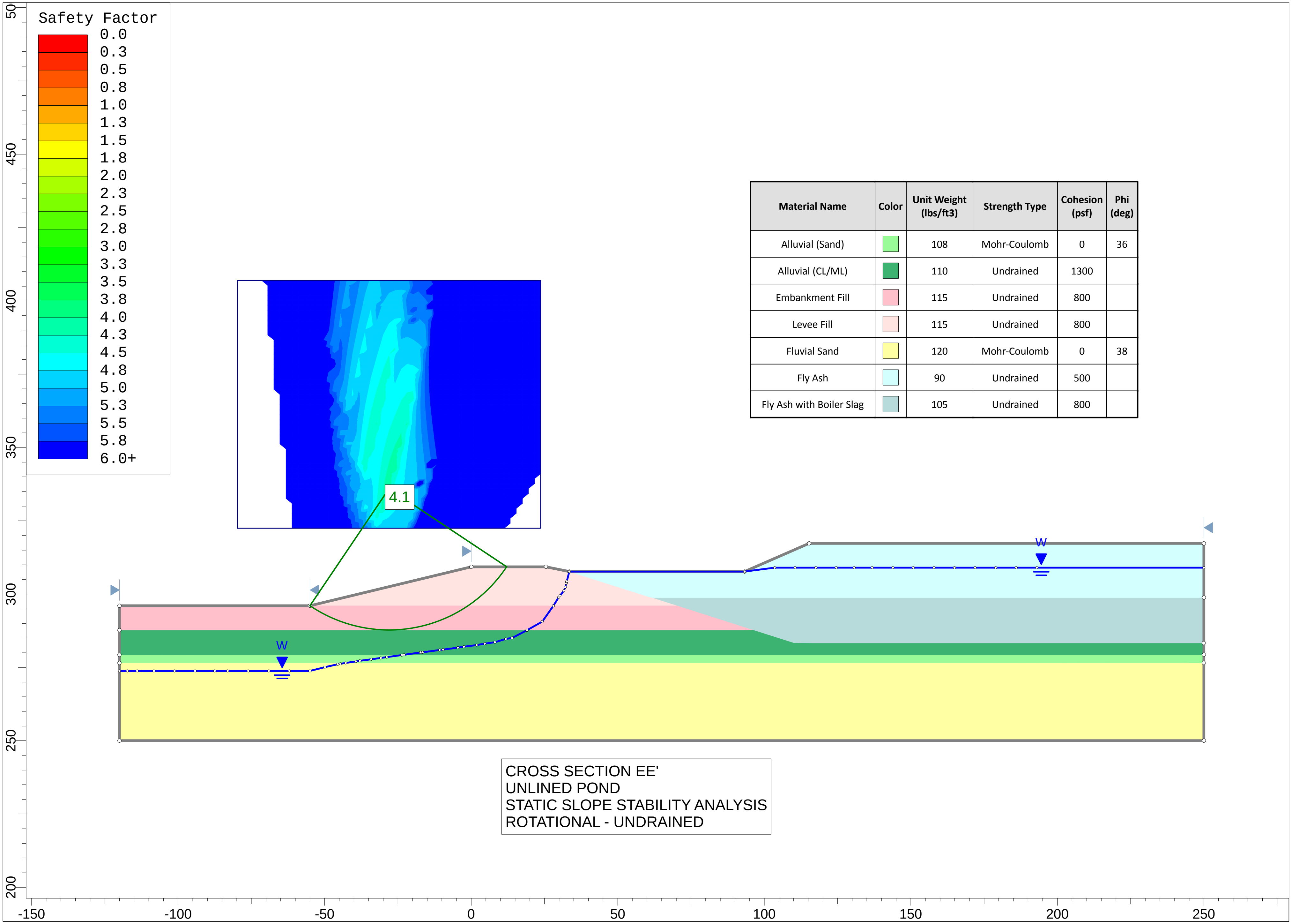
Alluvial (CL/ML)	■	110	Mohr-Coulomb	50	28
Embankment Fill	■	115	Mohr-Coulomb	50	30
Levee Fill	■	115	Mohr-Coulomb	50	30
Fluvial Sand	■	120	Mohr-Coulomb	0	38
Fly Ash	■	90	Mohr-Coulomb	0	28
Fly Ash with Boiler Slag	■	105	Mohr-Coulomb	0	29

CROSS SECTION EE'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
BLOCK - DRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
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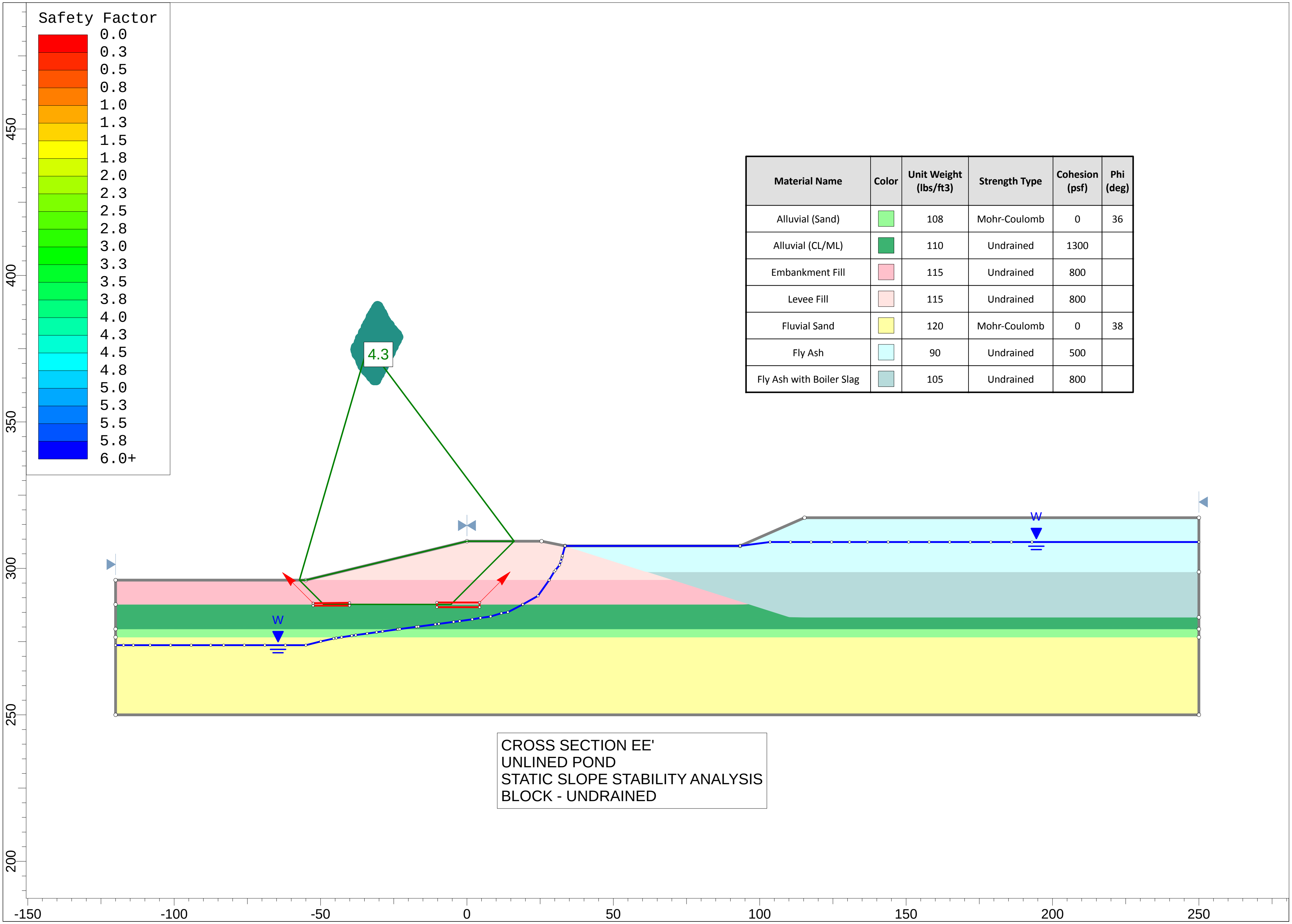
Fly Ash	🟦	90	Undrained	500	
Fly Ash with Boiler Slag	🟦	105	Undrained	800	

CROSS SECTION EE'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
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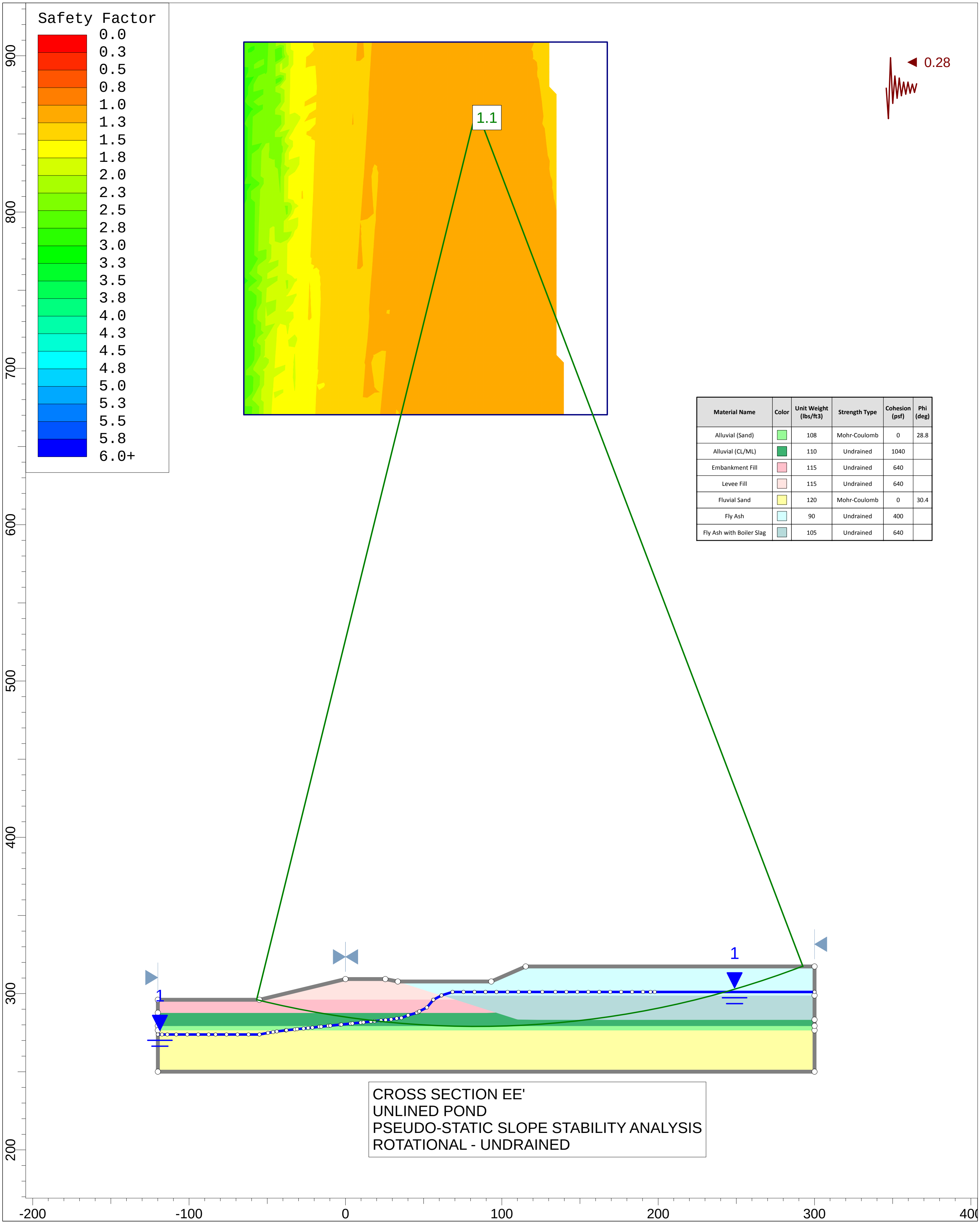
Fly Ash	🟦	90	Undrained	500	
Fly Ash with Boiler Slag	🟦	105	Undrained	800	

CROSS SECTION EE'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



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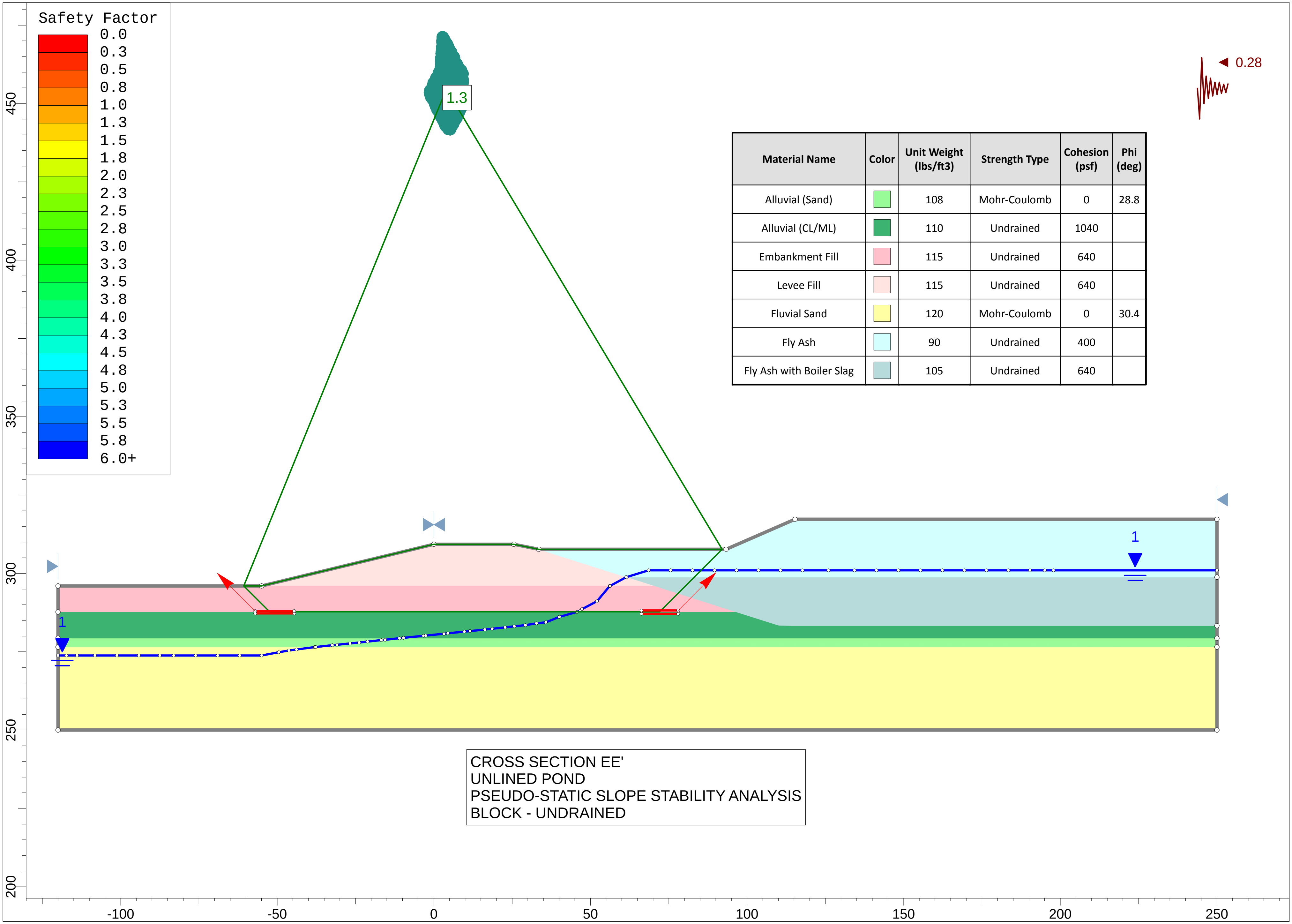
Alluvial (CL/ML)	🟩	110	Undrained	1040	
Embankment Fill	🟥	115	Undrained	640	
Levee Fill	🟥	115	Undrained	640	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	30.4
Fly Ash	🟦	90	Undrained	400	
Fly Ash with Boiler Slag	🟦	105	Undrained	640	

CROSS SECTION EE'
UNLINED POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
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Levee Fill	⬜	115	Undrained	640	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	30.4
Fly Ash	🟦	90	Undrained	400	
Fly Ash with Boiler Slag	🟦	105	Undrained	640	

CROSS SECTION EE'
UNLINED POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED

APPENDIX C

Site Specific Seismic Response Analysis

APPENDIX B

Site Specific Seismic Response Analysis

CHILDS
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April 14, 2020

Derrick A. Shelton, P.E. (VA, MD, DC)
Senior Associate | Program Manager,
Haley & Aldrich, Inc
1497 Chain Bridge Road
Suite 304
McLean, VA 22101

VIA EMAIL: Shelton, Derrick DShelton@haleyaldrich.com
Pokorny, Jason JPokorny@haleyaldrich.com

Re: New Madrid Power Plant Seismic Response and Newmark Analysis

Dear Mr. Shelton,

Childs Engineering has performed a site specific non-linear seismic response and Newmark analysis for the New Madrid Power Plant and prepared the following report summarizing the results of the assessment. This evaluation and summary report will help Haley & Aldrich, Inc. better understand the existing conditions of the coal ash impoundment to prepare a stability assessment.

The attached report predicts the response of the impoundment to a 2475-year seismic event.

We thank you for the opportunity to present the results of our investigation and if you have any questions or require additional information, please contact the undersigned.

Respectfully Submitted,
CHILDS ENGINEERING CORPORATION

James M Kramer

CMRoberts

James M. Kramer, P.E., Ph.D
Senior Geotechnical Engineer

Charlie M. Roberts, P.E., D. PE
President

Encl.

SITE SPECIFIC SEISMIC RESPONSE ANALYSIS

Introduction

The New Madrid Power Plant is located within the New Madrid Seismic Zone (NMSZ) and the Mississippi embayment. The NMSZ is associated with strong ground motions and the Mississippi embayment is associated with thick soil. The natural embayment soils underlying the Lined Pond is estimated to be approximately 1,900-ft thick. It has been demonstrated that the strong ground motions migrating up through the thick soil alter the spectral response at the ground surface so that it is much different than the response in the bedrock below the site. At short periods increasing soil thickness correlates with a decreasing hazard due to the nonlinear soil behavior. Similarly, at long periods, increasing soil thickness correlates with increasing hazard due to soil resonance (Cramer, 2015).

Overview of Site-Specific Seismic Analysis

A one-dimensional non-linear ground response analysis was performed to estimate the subsurface response to an earthquake event at New Madrid.

It is important that the rock and soil characteristics used to develop the ground response model match the engineering and seismic characteristics of the soil and rock at the New Madrid Power Plant. Properly conditioned bedrock strong ground motions (acceleration time histories) are required to perform a site-specific seismic analysis. These rock motions should match the spectral response of characteristic ground motions with respect to the dominant seismic sources affecting New Madrid. Unfortunately, strong motion records from large magnitude events are not available for Central and Eastern U.S. (Romero and Rix, 2001). Therefore, peer reviewed synthetic ground motions created for the Nuclear Regulatory Commission specifically for Central and Eastern U.S. (CENA), which were provided to Haley & Aldrich by Dr. Youssef Hashash, were used to approximate the spectral response characteristics at the site.

A site-specific target response spectrum was created for the site to be used as a guide in selecting and matching the proper ground motions for the study. This target spectrum was developed following well established criteria developed for building and infrastructure standards. The common design is based on the maximum critical risk targeted (MCE_R) spectral response acceleration. In general, two different design methodologies (probabilistic and deterministic) are used to approximate the MCE_R spectrum and generally the lesser of the spectral response accelerations from each method at each period is used to create the site-specific target spectrum. However, unlike the structural geology of the west coast, central and eastern U.S. (CENA) does not have well-defined fault systems needed to properly develop a deterministic spectral response. Also, since the impoundment under investigation sits almost on top of the pseudo fault zone responsible for the seismic activity at New Madrid, a decision was made to use the probabilistic target spectrum created from the uniform hazard spectrum (UHS) by performing a probabilistic seismic hazard analysis (PSHA). The PSHA is developed from research on potential sources of past earthquake associated faulting along with estimates of potential magnitudes and frequencies of occurrence. Uncertainty and randomness in each of these components is accounted for in the computation of the UHS.

The bedrock at the site is classified as NEHRP Site Class A, hard rock. The 2014 UHS, provided by USGS, for a hypothetical Site Class A rock, based on the 2,500 –year return period event, was used to identify the Probabilistic Target Spectrum used for the site-specific evaluation. The deaggregation data used to develop the PSHA was used to select synthetic CENA Ground motions for the ground response model.

The computer software program DEEPSOIL Version 7.0 by Hashash, Y.M.A., Musgrove, M.I., Harmon, J.A., Groholski, D.R., Phillips, C.A., and Park, D. Urbana, IL, Board of Trustees of University of Illinois at Urbana-Champaign was used to simulate ground response. DEEPSOIL is a unified 1D equivalent linear and nonlinear site response analysis platform. The non-linear time domain response analysis was used for this project. The ground motions are applied to the bedrock located at the base of the soil column in the DEEPSOIL model and simulated to resonate up through the column. The bedrock is modeled as a half-space.

USGS Deaggregation and PSHA Target Spectrum

A probabilistic seismic hazard analysis (PSHA) based on USGS 2014 Earthquake Hazard and Probability Maps were used to provide the target spectrum used to select, scale, and match ground motions for the project (USGS 2014). Since individual rock motions were used to simulate the ground response, the target spectrum was further amplified by adjusting the rock motions for maximum direction. The motions were not corrected for risk, which is conservative.

Deaggregation data obtained from the PSHA was used to provide the additional information such as magnitude and direction of seismic sources needed to select the ground motions used for the response analysis. The USGS Unified Hazard Tool was used to obtain the characteristics of the most significant earthquakes deemed to contribute the most to the seismic activity at the New Madrid Power Plant. The deaggregation data suggests that the representative design earthquake for ground motions with a return period of 2,500 years should be between magnitude 7.3 and 8.0 and within a 13 km radius. The Appendix contains information relevant to construction of the target spectrum.

The table below provides information used to choose the ground motions.

DEAGGREGATION DATA 2500- year event, Class A		
Significant Period	Magnitude	Distance
	(mean)	(km)
PGA	7.34	11.48
0.2	7.53	12.07
1	7.58	12.66
2	7.59	13.1

Since magnitude 7.3 to 8.0 earthquakes within distances of between 11 to 13 km are responsible for generating the majority of the PSHA response spectrum and due to the fact that real ground motions with such characteristics are non-existent for Central and Eastern North America (CENA) a decision was made to use synthetically generated rock motions for the non-linear response analysis.

Rock Motions for the PSHA

Seven synthetic CENA rock motion records provided by the Nuclear Regulatory Commission were selected to match the PSHA target response spectrum for the site. The motions were created for magnitude 7.5 events. They were chosen so that the scaling factor used to match the target spectrum was less than 10. The rock motions where then spectrally matched in three stages to the entire target spectrum using RSPMatch software provided in Geomotions Suite 2000 by Geomotions LLC.

The rock motions were matched in three stages as per the techniques provided in the manual for RSPMatch. After each stage, the matched motion from the preceding stage was used to generate the next stage. SeismoMatch software by SeismoSoft was also used in the matching to provide additional graphical output for this report. The only match parameter that changes in the three stages used for matching is the maximum moment. The match series involved the following period ranges:

Matching Series	Series Period Range
1	0.028s to 1s
2	0.028s to 2s
3	0.028s to 5s

The motions were then baseline corrected. The Appendix contains the construction stages used to create the rock motions used for the non-linear response analyses.

One-Dimensional Non-linear Ground Response Analysis

Seismic soil response models require specific physical information about the subsurface soils at the site being investigated. The most general linear elastic models require information on each soil layer such as the unit weight, shear wave velocity, layer thickness, and effective earth pressures. The more sophisticated equivalent linear and non-linear models require additional dynamic characteristics of the soil. DEEPSOIL provides means to evaluate both linear frequency and time domain models and several different types of non-linear time domain response models with or without pore pressure interaction.

The General Quadratic/Hyperbolic Model (GQ/H) soil model with Non-Masing Re/Unloading formulation was chosen to represent the embayment soil response. Besides providing the non-linear response to a SDOF system, this model allows the user to specify soil strength in a Generalized Hyperbolic Model. It therefore requires additional information regarding the soil strength characteristics of the soils.

Soil Model

The embayment soil at New Madrid Power Plant is 1900 feet thick where the impoundment is located. Due to the seismic importance of the area, the subsurface around New Madrid has been widely researched. The shear wave velocity profile of the subsurface, which is an important component in a soil response model has been widely documented for New Madrid. The shear wave velocity profile for the entire 1900 ft soil profile was compiled from several historic sources. Figure 1 provides the compilation of shear wave sources used to construct the soil profile in the DEEPSOIL model.

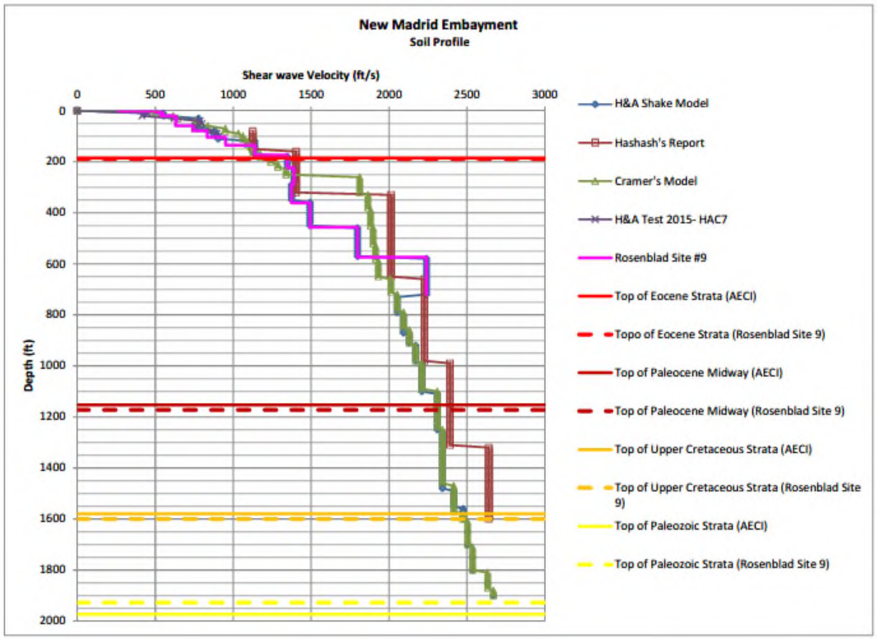

Figure 1: Shear wave velocity profile used to develop the DEEPSOIL Model.

Several additional physical properties of the embayment soil are also available from historic sources. An equivalent linear model for the embayment soil column at New Madrid, developed previously for an equivalent linear response model, was used to provide many of the common soil characteristics used for the seismic response model in the present analysis, Shelton (2018).

DEEPSOIL models incorporate various dynamic geotechnical characteristics such as strain related modulus and damping reduction used in the ground response analysis which are representative of the non-linear, pressure dependent soil properties attributed to the Mississippi Embayment. Curve fitting functions are used to model the dynamic non-masing modulus reduction and damping associated with soil strain changes caused by shear wave propagation through the soil column. The MRDF reduction factor approach was selected for use in the GQ/H model using a reference curve developed by Darendeli (2001). The Darendeli curve is based on several geotechnical properties of the soil such as soil type, over-consolidation ratio (OCR), coefficient of earth pressure at rest (k_0), and standard penetration test number (SPT-N).

Besides the physical properties described previously, the non-linear GQ/H response model requires information regarding the shear strength profile of the soil column. Recent cone penetration test (CPT) data is available for the upper 100 feet of the subsurface, so it is possible to determine the shear strength profile in this section of the soil column. However, below 100 ft depth, it is necessary to estimate the strength characteristics of the soil column using empirical relationships.

Plate 13 in the Appendix presents the spreadsheet for the GQ/H soil profile used for the response analysis. Many of the soil parameters from this spreadsheet were used to describe the input for the DEEPSOIL model. The soil parameters located in the columns at the far right of the spreadsheet are used to derive the shear strength characteristics of the soil. Note the blue dependency arrows on the spreadsheet that indicate how each parameter is dependent on the preceding parameter in the adjacent column. A series of empirical relationships for each derived soil parameter were chained together such that each parameter was used to estimate the next parameter finally ending with an estimate of the shear strength of the soil layer. The order of dependency is described below.

The shear wave velocity was used to derive the SPT-N_{60} which was then used to derive the relative density (D_r) which was used to derive the friction angle (ϕ), and finally used to derive the shear strength.

The SPT-N_{60} value is related to the shear wave velocity using a relationship developed by PEER (2012)

$$V_s = 30\, N_{60}^{0.215} \sigma_v'^{\,0.275} \quad \text{where} \quad V_s \text{ in M/s}, \quad \sigma'_v \text{ in kPa}$$

Bowles provides a series of relationships that can be used to derive the friction angle of the soil from knowledge of the SPT-N_{70} and the relative density, D_r. Skempton provided the relationship, Bowles (2012).

$$\frac{N_{70}}{D_r^2} = 32 + 0.288\sigma'_v$$

where σ'_v is the effective pressure in kPa and N_{60} is converted to N_{70} using the following relationship

$$N_{70} = \frac{60}{70} N_{60}$$

The FHWA then provides a relationship deriving the effective friction angle from the relative density using the relationship, FHWA (2016):

$$\emptyset' = 34 + 10D_r - (3 + 2D_r) log\left(\frac{\sigma'_v}{p_a}\right)$$

Where p_a is atmospheric pressure in the same units as σ'_v.

This chain of empirical methods described above was used to produce the shear strengths for the soil columns below 100 ft depth where reliable soil strength information of the soil was unavailable. The CPT data was used to provide more accurate strength estimates for the upper profile of model. It is important to have good strength estimates for the upper 100 ft of the soil model to provide a good estimate for soil response at the surface.

Plates 14 and 15 in the Appendix provides a graphical display of some of the more important physical characteristics of the soil column used for the model. Initially the model was created using 50 relatively thick soil layers (Plate 14). However, since the thickness of the soil layer effects the frequency transmission of the seismic wave energy, DEEPSOIL provides a routine to adjust the soil layer thickness throughout the entire soil column to maximize wave frequency transmission. Plate 15 in the Appendix displays the soil profile for the frequency adjusted model.

Site Response Analysis

As mentioned previously, DEEPSOIL software was used to numerically simulate how the propagation of rock motions, applied to the base of the soil column, resonate up through the soil layers to the top of the soil column. During the propagation, as the model resonates, straining occurs which alters the physical properties of the soil and affects the spectral response at the surface of the model.

Plate 16 in the Appendix shows the results of the ground response analysis for the seven representative rock motions. This figure compares the spectral response of the spectrally matched bedrock input motions, applied at the base of the soil column, with that of the resultant spectral response at the surface and reveals the transformation in the response caused by wave propagation through the 1,900-ft thick soil column. At short periods increasing soil thickness correlates with a decreasing hazard due to the nonlinear soil behavior. Similarly, at long periods, increasing soil thickness correlates with increasing hazard due to soil resonance (Cramer, 2015).

The table below summaries the site specific seismic parameters useful for additional stability assessment.

TABLE
PREDICTED SURFACE PGA AND NEWMARK MAGNITUDE CORRECTION FACTOR

Synthetic Motion Designation	Original Magnitude	Original Scaled PGA	Non-linear DEEPSOIL PGA	Newmark Magnitude Correction Factor[1]
NRCM75aBRN000	7.5	1.31	0.34	1.06
NRCM75Rb_TCU095-W	7.5	1.23	0.53	1.06
NRCM75Rb-GBZ000	7.5	1.26	0.44	1.06
NRCM65Ra_LGP000	6.5	1.88	0.42	1.40
NRCM65Rb_FSD172	6.5	1.30	0.45	1.40
NRCM75Ra_IZT090	7.5	1.10	0.36	1.06
NRCM75Rb-ARC000	7.5	1.17	0.46	1.06

[1]Determined using the method developed by Bray and Traversarou (2007)

Newmark Displacement Analysis

The Newmark method predicts the amount of ground displacement for a given value of yield acceleration cause by seismic events. The Newmark displacement analysis is based on the shear stress time history acting along the failure plane within the slope. The yield acceleration is the minimum amount of ground acceleration necessary to initiate motion along the failure surface and is used to determine the appropriate pseudo-static coefficient used for seismic slope stability analyses.

Shake 2000 by Geomotions[1] was used to perform the Newmark displacement analysis to estimate slope displacement by incorporating the results of the one-dimensional ground response analysis. Shake 2000 incorporates several different variants of the Newmark block displacement method and the numerical approach known as YSLIP developed by Kavazanjian and Matasovic (1996) was chosen for our analysis. All seven site-specific bedrock motions were used to evaluate relationships between the Newmark permanent displacements and the associated yield acceleration. Several impoundment cross-sections were evaluated, and the most conservative location of the failure plane was determined to be 15 ft below the top of slope.

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[1] Geomotions, LLC, Ordonez, Gustavo A. (2012). SHAKE2000 – A Computer Program for the 1-D Analysis of Geotechnical Earthquake Engineering Problems

After performing the Newmark displacement analysis, it was necessary to adjust the displacement predictions to correspond to the difference between the magnitudes of the ground motions used in the analysis and the magnitude of the representative earthquake event established for the New Madrid Power Plant. Correction factors were applied to scale the displacements to the target magnitude 8 event. The correction factors were determined using the approach developed by Bray and Travasarou (2007), which relates permanent displacement from a Newmark analysis with the magnitude of the earthquake event (Bray, 2007). Plates 17 through 19 in the Appendix presents the spreadsheet used to develop the Bray and Travasarou magnitude correction factors for the Newmark displacement analysis. Plate 20 in Appendix presents the modified Newmark displacement graphs for the seven rock motions depicting permanent displacement versus yield acceleration.

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APPENDIX

CHILDS ENGINEERING

CALCULATIONS		File No.	
		Sheet	of
Client	Haley & Aldrich Inc.	Date	6-Feb-19
Project	New Madric Coal Ash Impoundment	Computed by	JMK
Subject	Site-specific seismic hazard response	Checked by	

New Madrid Coal Ash Impoundment
I. Site Class A hard rock-2475yr return
2014 PSHA

			IV Target	**Adjusted UHS**
Class A Bedrock		Maximum	Risk	**SPECTUM**
T	Sa*	Direction	Coeff.	Sa(g)
0.01	1.7958	1.19	1	2.14
0.1	3.06	1.19	1	3.64
0.2	2.5425	1.21	1	3.08
0.3	2.14	1.22	1	2.61
0.5	1.59	1.23	1	1.96
1	0.9349	1.24	1	1.16
1.5	0.67	1.24	1	0.83
2	0.5262	1.24	1	0.65
3	0.328	1.25	1	0.41
5	0.201	1.26	1	0.25

*NOTE: Values in red are used to provide curve estimate
Periods 3 and 5 taken from ASCE 7-16 MCE_R spectrum

New Madrid
Maximum Direction
Adjustments

Period	Factor	
0.01	1.19	ASCI 7
0.02	1.19	1.1
0.03	1.19	
0.05	1.19	
0.075	1.19	
0.1	1.19	
0.15	1.2	
0.2	1.21	
0.25	1.22	
0.3	1.22	
0.4	1.23	
0.5	1.23	
0.75	1.24	
1	1.24	1.3
1.5	1.24	
2	1.24	
3	1.25	
4	1.26	
5	1.26	
7.5	1.28	
10	1.29	

Risk Factor
Adjustment

$T_{0.2s}$ =	0.2	CRS =	0.8
T_{1s} =	1	CR1 =	0.82
	0.8		

ASCI 7-16 MCE_R*
Class A Bedrock

T	Sa*
0	1.017
0.08	2.554
0.4	2.544
0.5	2.031
1	1.015
1.5	0.677
1.9	0.534
2	0.508
3	0.328
5	0.201

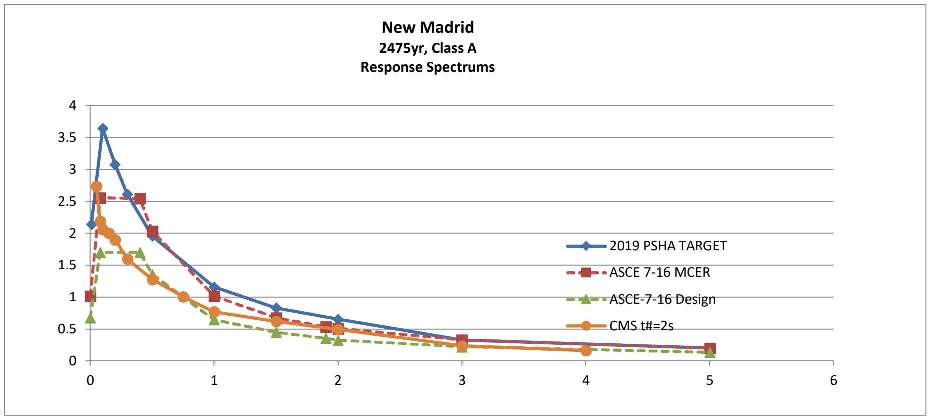
ASCI 7-16 Design
Class A Bedrock

T	Sa*
0	0.678
0.08	1.696
0.4	1.696
0.5	1.354
1	0.645
1.5	0.451
1.9	0.356
2	0.322
3	0.222
5	0.135

UHS TARGET UHS

	Adjusted UHS	
Class A Bedrock	SPECTUM	
T	Sa(g)	
0.01	2.137002	
0.1	3.6414	
0.2	3.076425	
0.3	2.6108	
0.5	1.9557	
1	1.159276	
1.5	0.8308	
2	0.652488	
3	0.328	0.41
5	0.201	0.25326

*Notes:
1. OSHPD Design Tool
2. Includes Risk



NOTE: Values for the 2014 PSHA are estimated for periods longer than 2 seconds

PLATE 1

CHILDS ENGINEERING

CALCULATIONS

File No. 2848-18
Sheet of
Date 1-Aug-19
Computed by JMK
Checked by

Client
Project New Madrid Impoundment
Subject Spectrally Matching Synthetic Ground Motions

PROBLEM STATEMENT & OBJECTIVE

Spectrally Match ground motions to the 2014 PSHA Target for New Madrid

REFERNCES

1. Set of synthetically matched CENA ground motions for 7.5 magnitude events provided by the Nuclear Regulatory Commission
2. RSPMatch manual, Geomotions Suite 2000, Geomotions LLC
3 USGS Earth Quake Hazard Tool, (https://earthquake.usgs.gov/hazards/interactive/index.php)

CALCULATIONS

All Motions in this section were from Nuclear Regulatory Commission Synthetic Central and Eastern United States motions simulating a magnitude 7.5 event. The scaling factor for the ground motions was less than 10.

The motions were matched in three stages at per the RSPMatch tutorial. After each stage the matched motion from the preceding stage was used to generate the next stage. SeismoMatch was used for the matching. The only match parameter that changes in the three series is the maximum moment. The match series involved the following period ranges

Matching Series

Series	Period Range
1	0.028s to 1s
2	0.028s to 2s
3	0.028s to 5s

ATTACHMENTS

1. Parameters for the synthetic ground motions used for the matching
2. 2014 PSHA Target Spectrum
3. Parameters used for spectrally matching ground motions to the PSHA
4. Graph depicting PSHA target with matched ground motions
5. DeepSoil generated spectral information regarding each match ground motion.

PLATE 2

Nuclear Regulatory Commission Synthetic Ground Motions

Mag 7.5 SCALE FACTOR > 10

NRCM75aBRN000

property	value	units
timestep	0.005	s
nyquist	100	Hz
pga	1.296227	g
pgv	0.54632	m/s
pgd	0.081573	m
peakAI	0.011669	ai
sigDuration	10.37	s
braDuration	22.515	s
uniDuration	12.715	s
Duration	24.96	s
predominantPeriod	1.5625	Hz
MeanPeriod	0.252762	s
predominantSpectralPeriod	0.04176	s
smoothedSpectralPredomPeriod	0.078115	s
averageSpectralPeriod	0.70599	s

NRCM75Rb_TCU095-W.csv

property	value	units
timestep	0.005	s
nyquist	100	Hz
pga	0.7818623	g
pgv	0.424570013	m/s
pgd	0.400835291	m
peakAI	0.003885443	ai
sigDuration	21.605	s
braDuration	66.98	s
uniDuration	16.14	s
Duration	89.995	s
predominantPeriod	2.532958984	Hz
MeanPeriod	0.329923362	s
predominantSpectralPeriod	0.099682495	s
smoothedSpectralPredomPeriod	0.082920403	s
averageSpectralPeriod	0.815493573	s

NRCM75Rb-GBZ000.csv

property	value	units
timestep	0.005	s
nyquist	100	Hz
pga	0.4535	g
pgv	0.4905608	m/s
pgd	0.3752116	m
peakAI	0.0021143	ai
sigDuration	16.125	s
braDuration	25.91	s
uniDuration	16.315	s
Duration	27.995	s
predominantPeriod	0.2441406	Hz
MeanPeriod	0.4271591	s
predominantSpectralPeriod	0.0270293	s
smoothedSpectralPredomPeriod	0.0662218	s
averageSpectralPeriod	1.0379488	s

NRCM65Ra_LGP000.csv

property	value	units
timestep	0.005	s
nyquist	100	Hz
pga	1.647102	g
pgv	0.999713	m/s
pgd	0.434856	m
peakAI	0.012596	ai
sigDuration	10.215	s
braDuration	20.965	s
uniDuration	10.285	s
Duration	24.96	s
predominantPeriod	1.464844	Hz
MeanPeriod	0.589828	s
predominantSpectralPeriod	0.06452	s
smoothedSpectralPredomPeriod	0.087407	s
averageSpectralPeriod	0.926517	s

NRCM65Rb_FSD172.csv

property	value	units
timestep	0.005	s
nyquist	100	Hz
pga	0.3435764	g
pgv	0.091054544	m/s
pgd	0.062869207	m
peakAI	0.000960825	ai
sigDuration	24.285	s
braDuration	37.565	s
uniDuration	15.98	s
Duration	39.98	s
predominantPeriod	9.545898438	Hz
MeanPeriod	0.186910169	s
predominantSpectralPeriod	0.106073916	s
smoothedSpectralPredomPeriod	0.057487975	s
averageSpectralPeriod	0.981073	s

NRCM75Ra_IZT090.csv

property	value	units
timestep	0.005	s
nyquist	100	Hz
pga	0.348697	g
pgv	0.2601821	m/s
pgd	0.1058957	m
peakAI	0.0015396	ai
sigDuration	20.135	s
braDuration	27.875	s
uniDuration	19.265	s
Duration	29.995	s
predominantPeriod	0.5615234	Hz
MeanPeriod	0.3617224	s
predominantSpectralPeriod	0.0368794	s
smoothedSpectralPredomPeriod	0.0915596	s
averageSpectralPeriod	0.990518	s

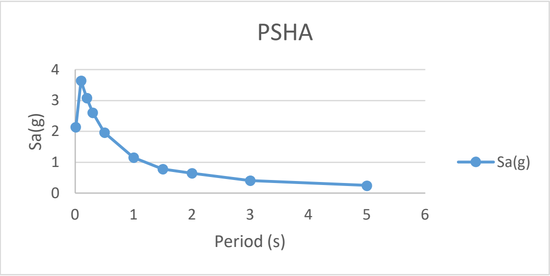
PLATE 3

NRCM75Rb-ARC000.csv

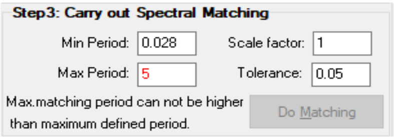
property	value	units
timestep	0.005	s
nyquist	100	Hz
pga	0.298447	g
pgv	0.237409	m/s
pgd	0.042298	m
peakAI	0.001422	ai
sigDuration	15.49	s
braDuration	27.89	s
uniDuration	19.32	s
Duration	29.995	s
predominantPeriod	2.661133	Hz
MeanPeriod	0.40986	s
predominantSpectralPeriod	0.028762	s
smoothedSpectralPredomPeriod	0.108968	s
averageSpectralPeriod	0.991272	s

New Madric 2014 PSHA

Class A Bedrock T	Adjusted UHS* SPECTUM Sa(g)
0.01	2.14
0.1	3.64
0.2	3.08
0.3	2.61
0.5	1.96
1	1.16
1.5	0.78
2	0.65
3	0.41
5	0.25



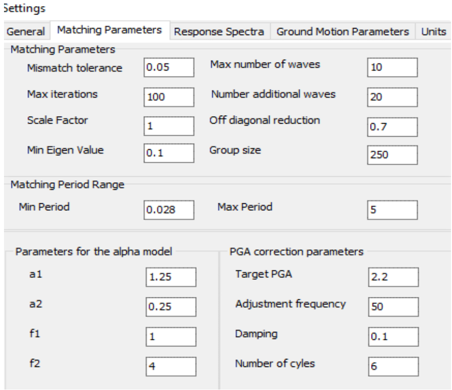
*Adjusted for maximum direction



Step3: Carry out Spectral Matching

Min Period: 0.028
Scale factor: 1
Max Period: 5
Tolerance: 0.05
Max.matching period can not be higher than maximum defined period.

Note: Max Period varies for each series

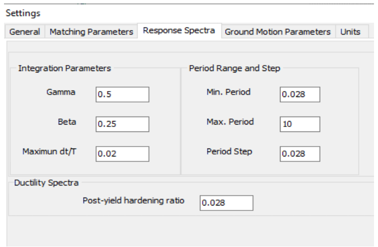


Matching Parameters
Mismatch tolerance: 0.05
Max number of waves: 10
Max iterations: 100
Number additional waves: 20
Scale Factor: 1
Off diagonal reduction: 0.7
Min Eigen Value: 0.1
Group size: 250

Matching Period Range
Min Period: 0.028
Max Period: 5

Parameters for the alpha model
a1: 1.25
a2: 0.25
f1: 1
f2: 4

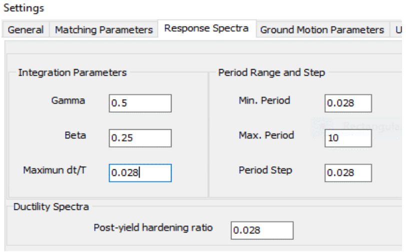
PGA correction parameters
Target PGA: 2.2
Adjustment frequency: 50
Damping: 0.1
Number of cyles: 6



Integration Parameters
Gamma: 0.5
Beta: 0.25
Maximun dt/T: 0.02

Period Range and Step
Min. Period: 0.028
Max. Period: 10
Period Step: 0.028

Ductility Spectra
Post-yield hardening ratio: 0.028



Integration Parameters
Gamma: 0.5
Beta: 0.25
Maximun dt/T: 0.028

Period Range and Step
Min. Period: 0.028
Max. Period: 10
Period Step: 0.028

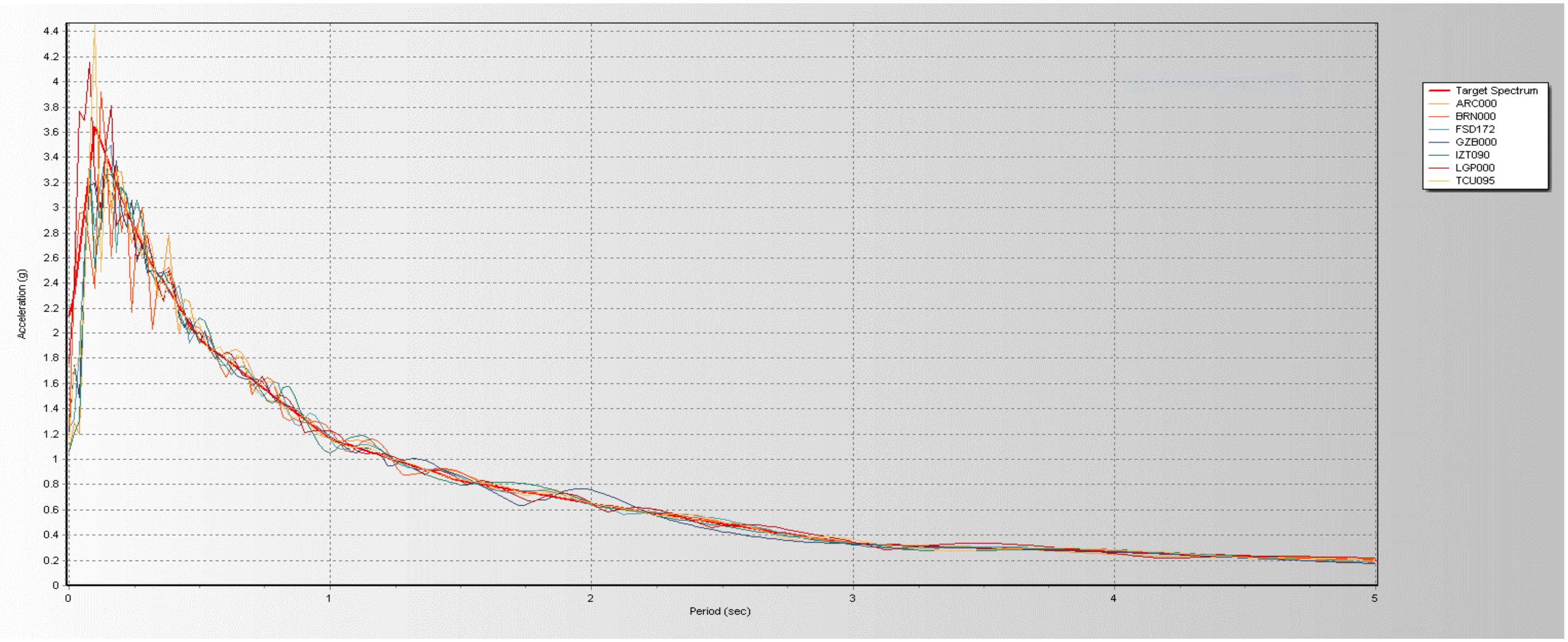
Ductility Spectra
Post-yield hardening ratio: 0.028

All Motions in this section were from Nuclear Regulatory Commission Synthetic Central and Eastern United States motions simulating a magnitude 7.5 event. The scaling factor for the ground motions was less than 10.

The motions were matched in three stages at per the RSPMatch tutorial. After each stage the matched motion from the preceding stage was used to generate the next stage. SeismoMatch was used for the matching. The only match parameter that changes in the three series is the maximum moment. The match series involved the following period ranges

Matching Series

Series	Period Range
1	0.028s to 1s
2	0.028s to 2s
3	0.028s to 5s



Acceleration (g)
4.4
4.2
4
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
1
2
3
4
5
Period (sec)
Target Spectrum
ARC000
BRN000
FSD172
GZB000
IZT090
LGP000
TCU095

PLATE 5

FSD172- Match

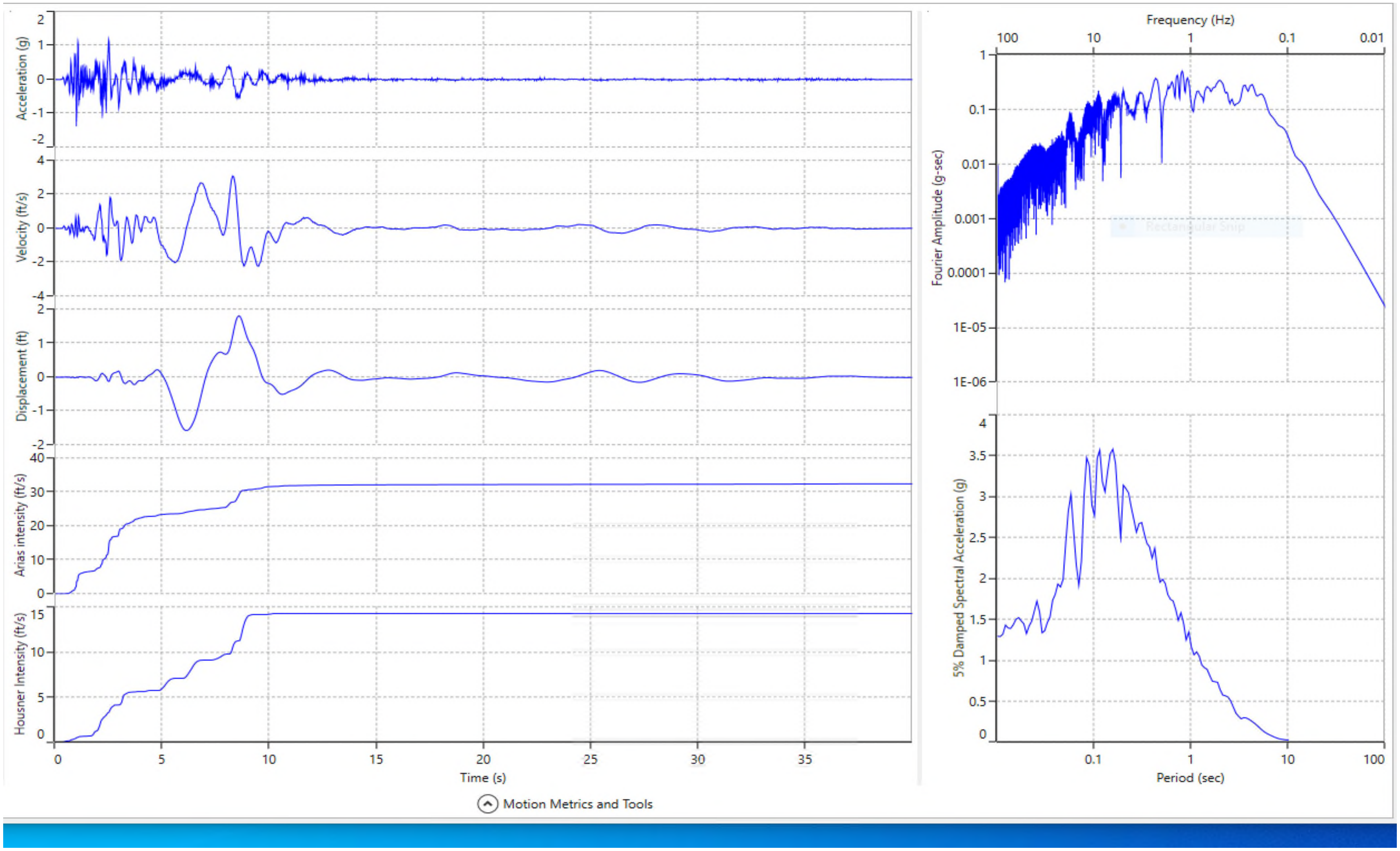


PLATE 6

ARC000-Match

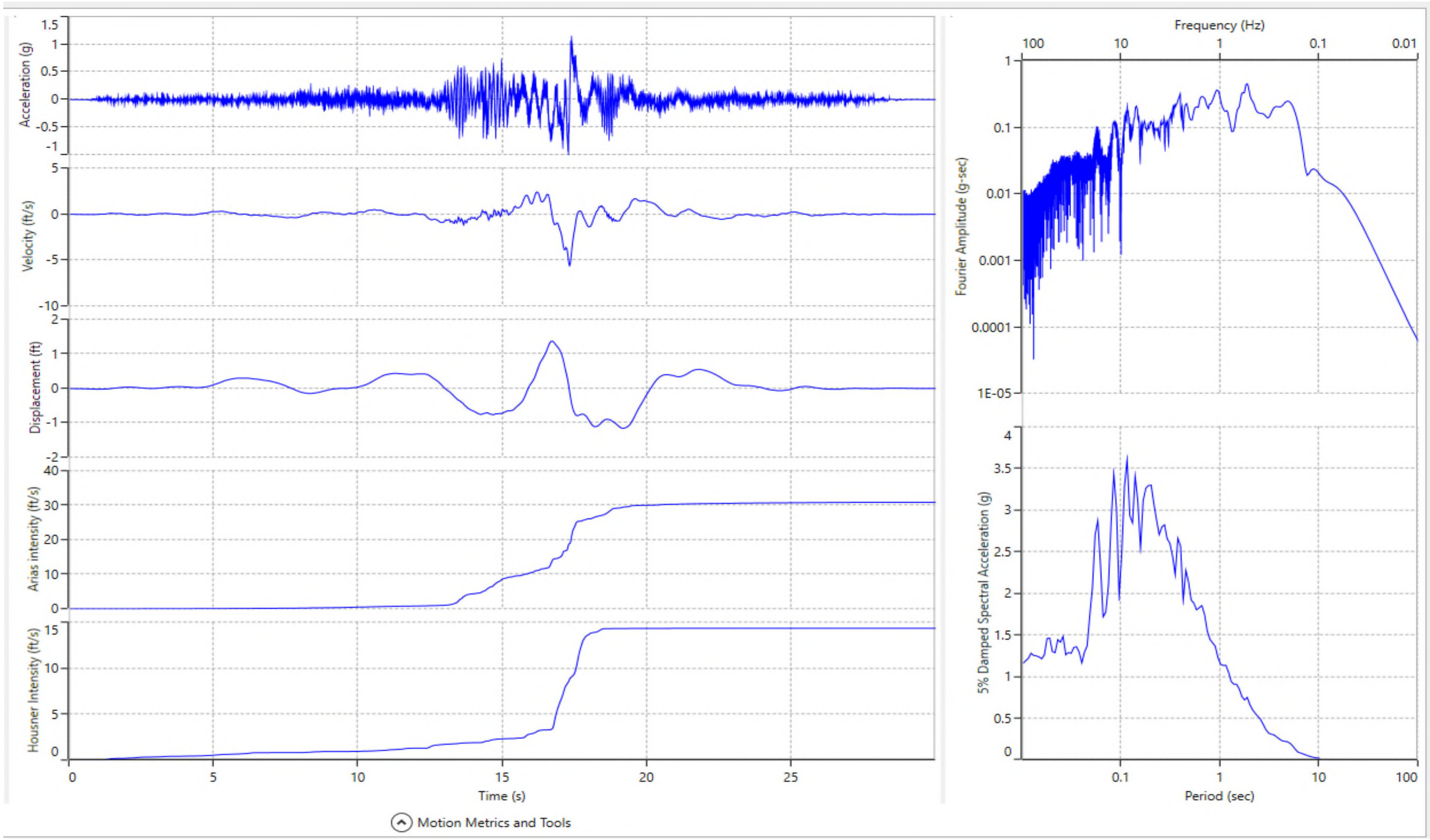
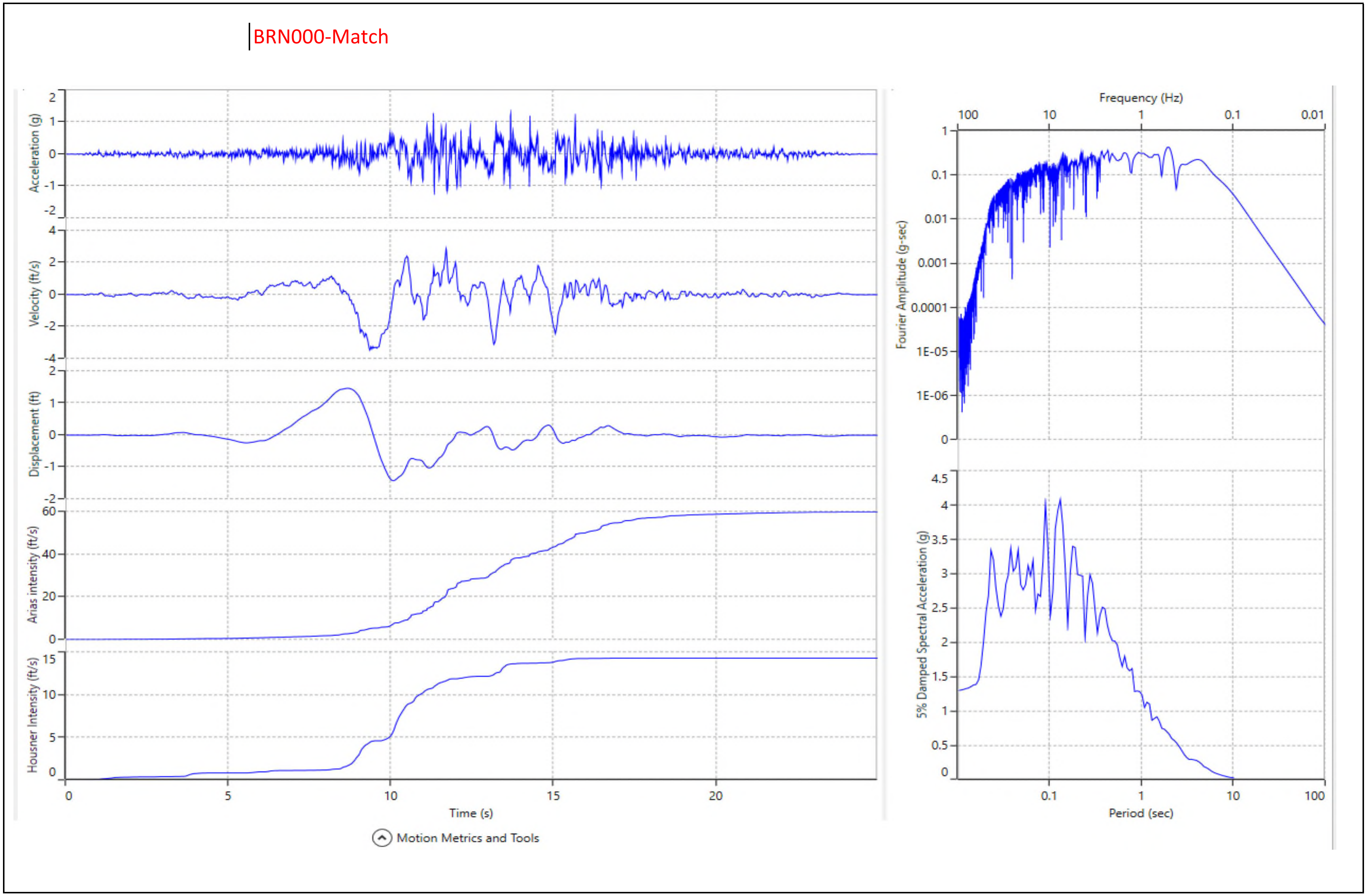


PLATE 7



BRN000-Match

PLATE 8

GZB000-Match

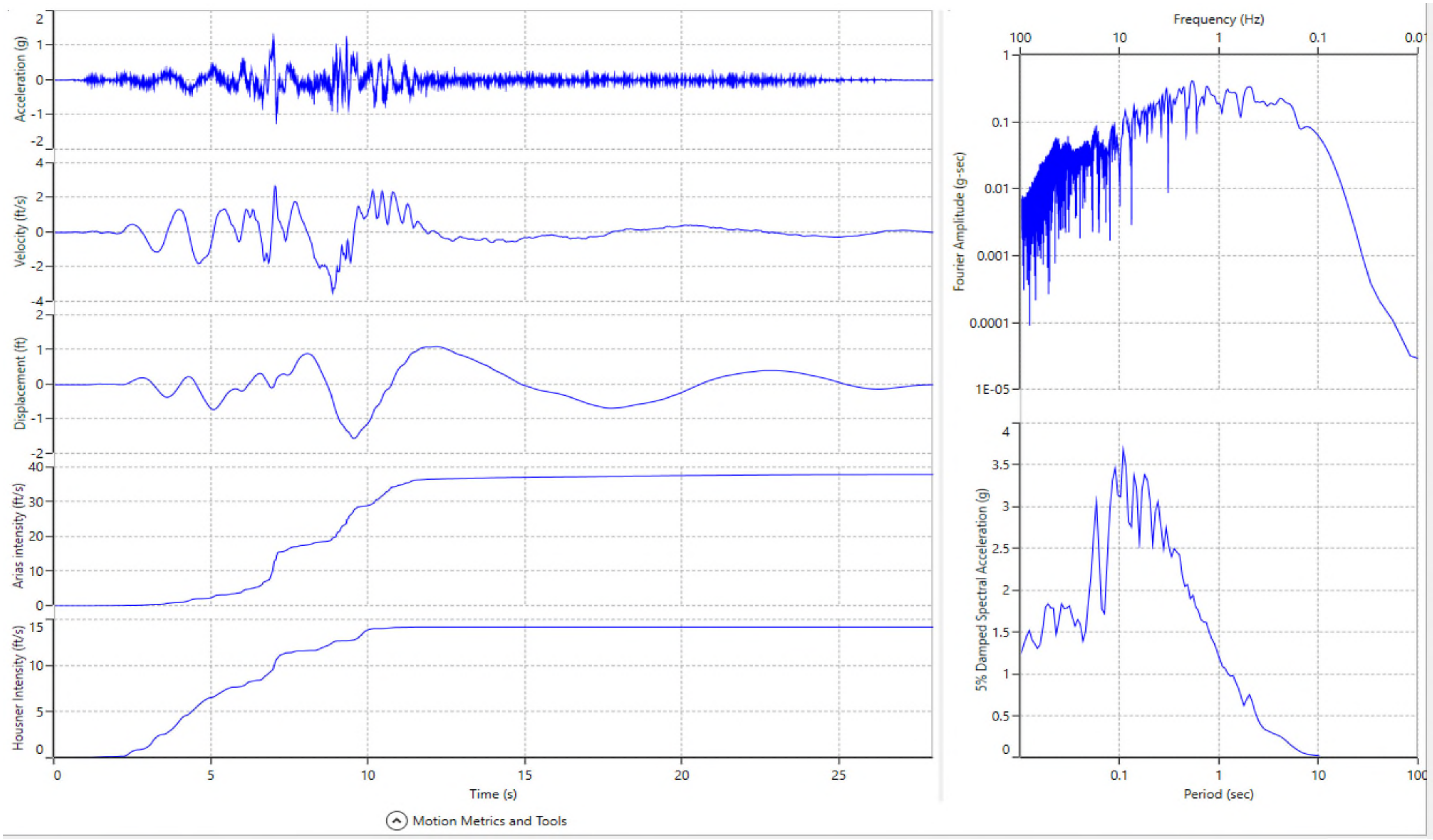


PLATE 9

IZT090-Match

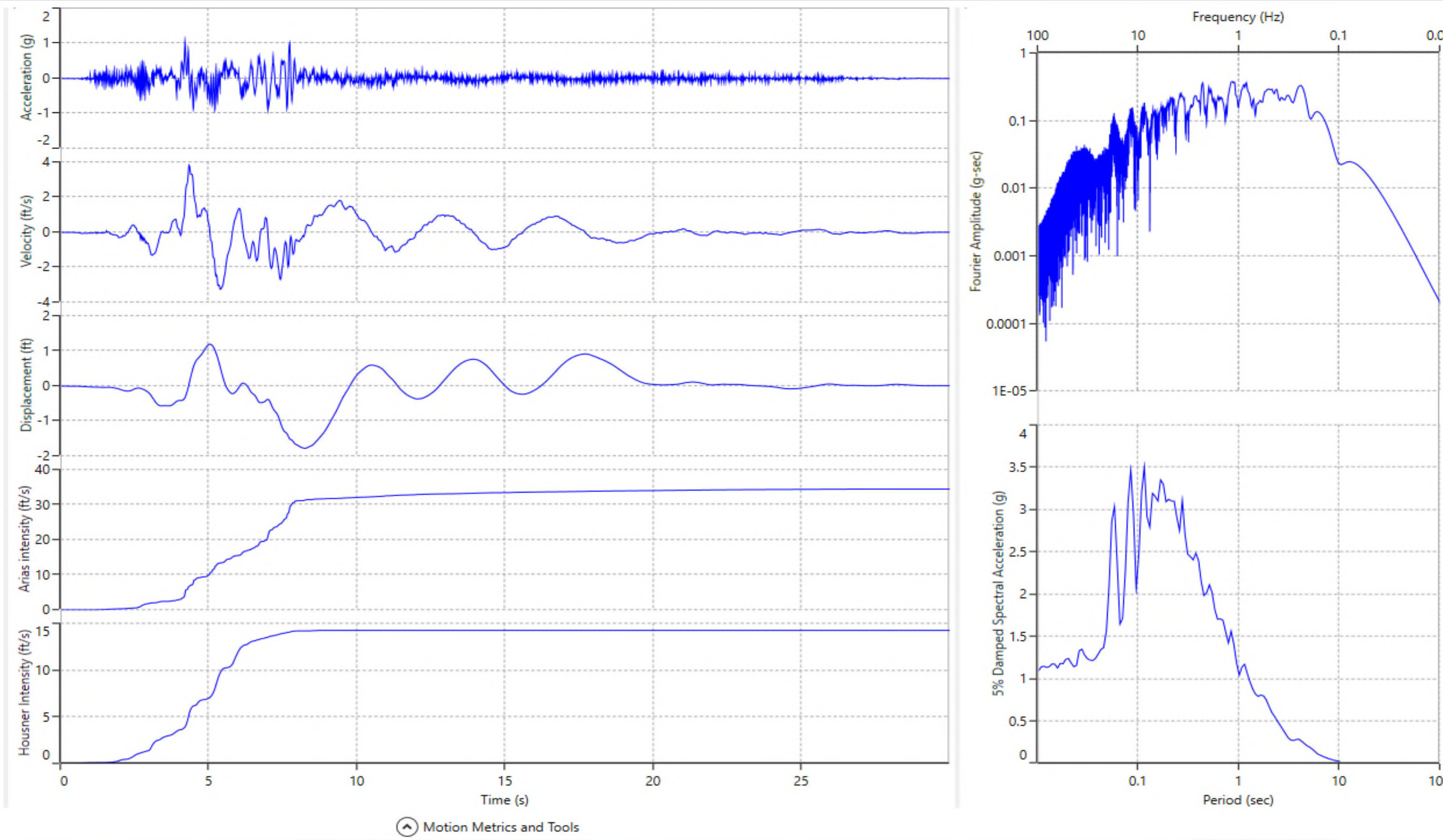
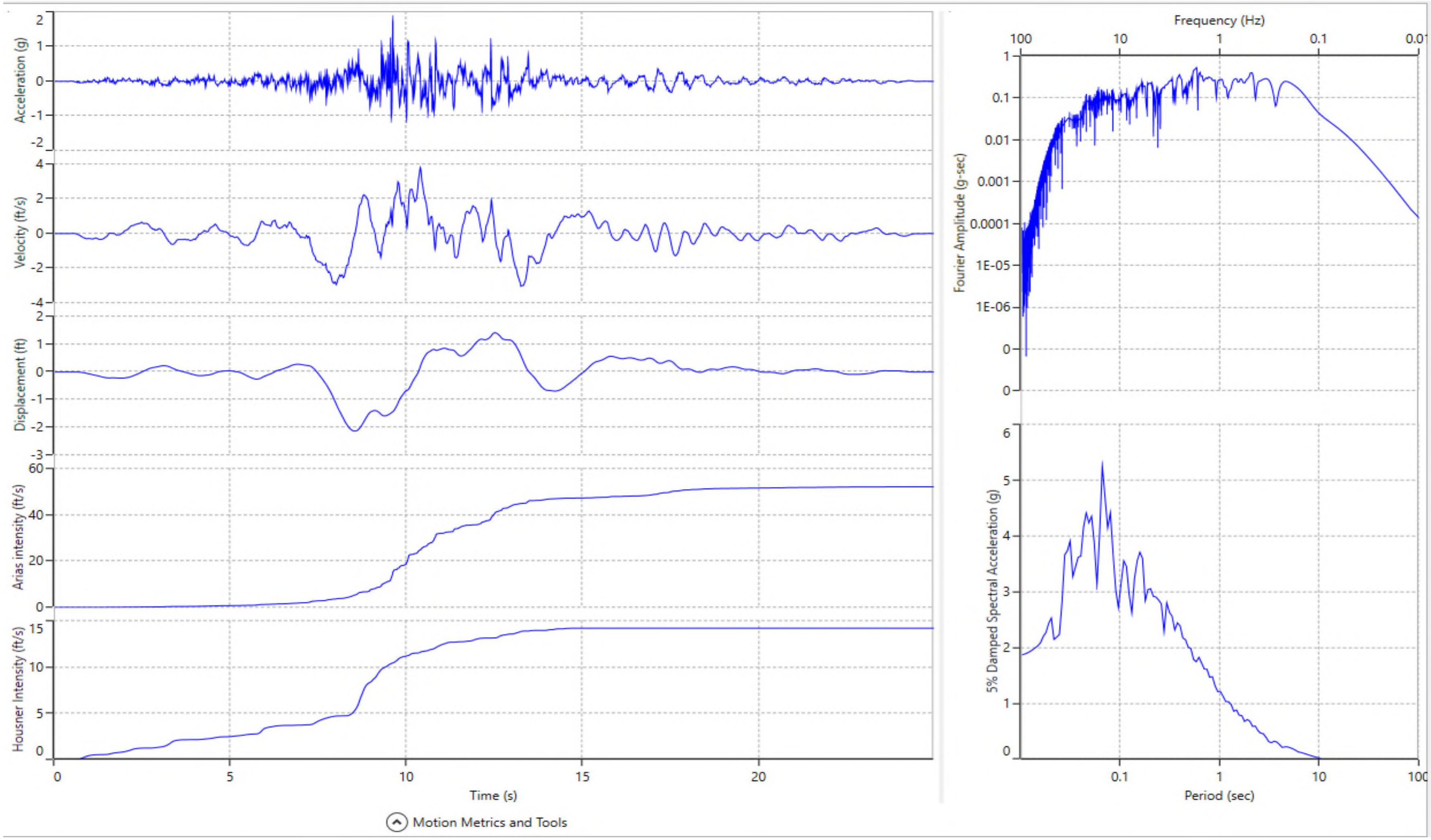


PLATE 10

LGP000-Match



TCU095-Match

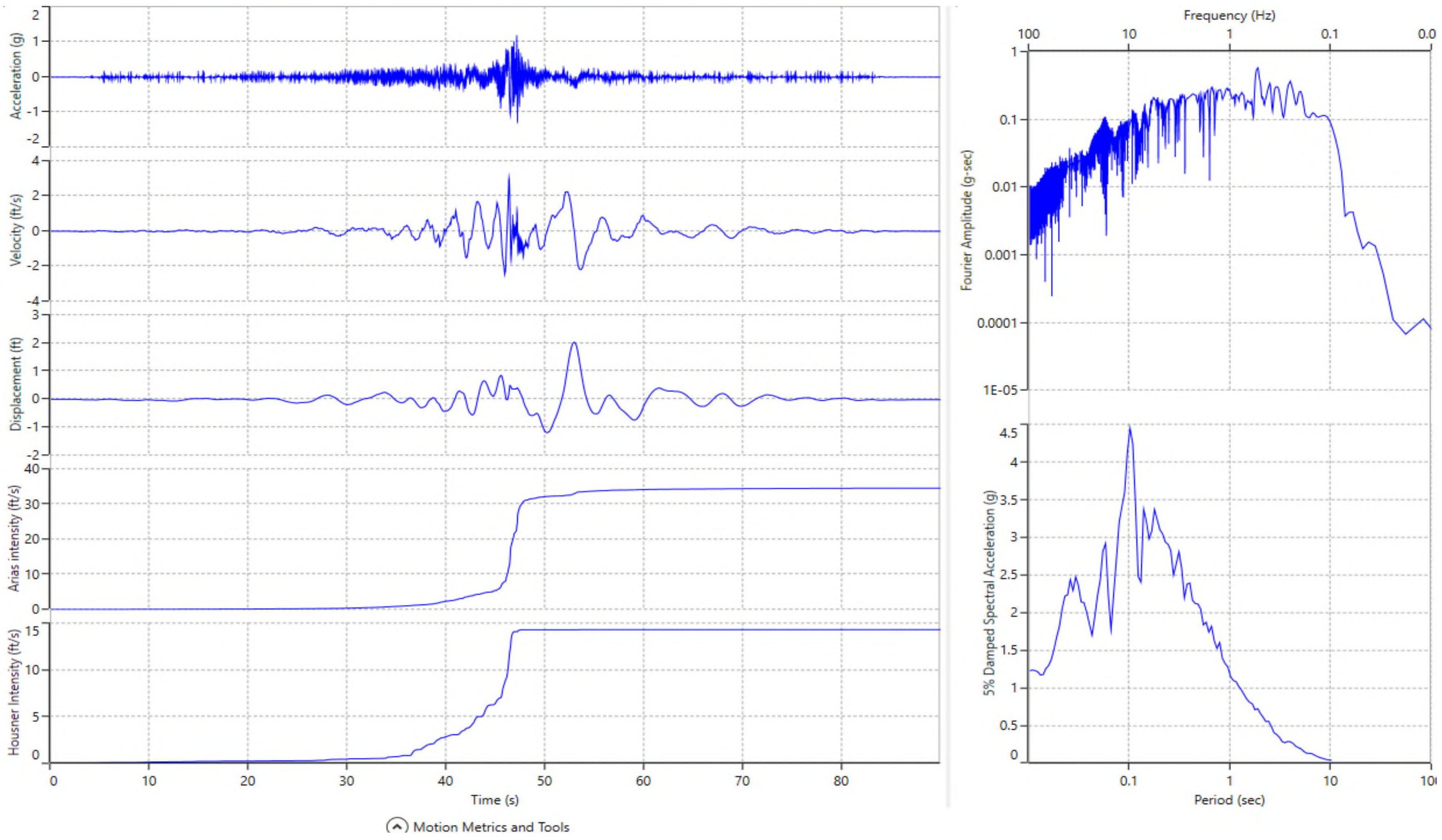


PLATE 12

CHILDS ENGINEERING

SOIL PROPERTIES FOR SHEETPILE DESIGN

Client
Project New Madrid
Subject Nonlinear DeepSoil Profile

File No.
Sheet of
Date 10-May-19
Computed by JMK
Checked by

DeepSoil Ver. 7.0 GQ/H soil model with non-masing Re/Unloading behavior

Elevation [ft] 15
Depth to Water [ft] 30
Water Unit wt 62.4 pcf

τ/σ'_{vo} = 0.29

$$K_0 = (1 - \sin(\emptyset)) * OCR^{\sin(\emptyset)}$$

Layer thickness= $h = {}^{V_s}/_{4f_{max}} = {}^{V_s}/_{4(25)}$

f_{max} = 25 Hz

Shear Strength below 190 ft based on empirical correlations to shear wave velocity

Vs = $30.0\ N_{60}^{0.215}\ \sigma_v'^{\,0.275}$ (4.17)

Vs in M/s, σ_v' in Kpa

PEER -"Estimation of Shear Wave Profiles, 2012

$$\frac{N'_{70}}{D_r^2} = 32 + 0.288 p'_o$$

ρ_o' in kPa, Bowles 5th ed.

$N_{60}=\frac{70}{60}(N_{70})$

$\phi' = A + B \cdot D_r - (C + D \cdot D_r)\log\left(\frac{\sigma'_N}{p_a}\right)$

FHWA-16072

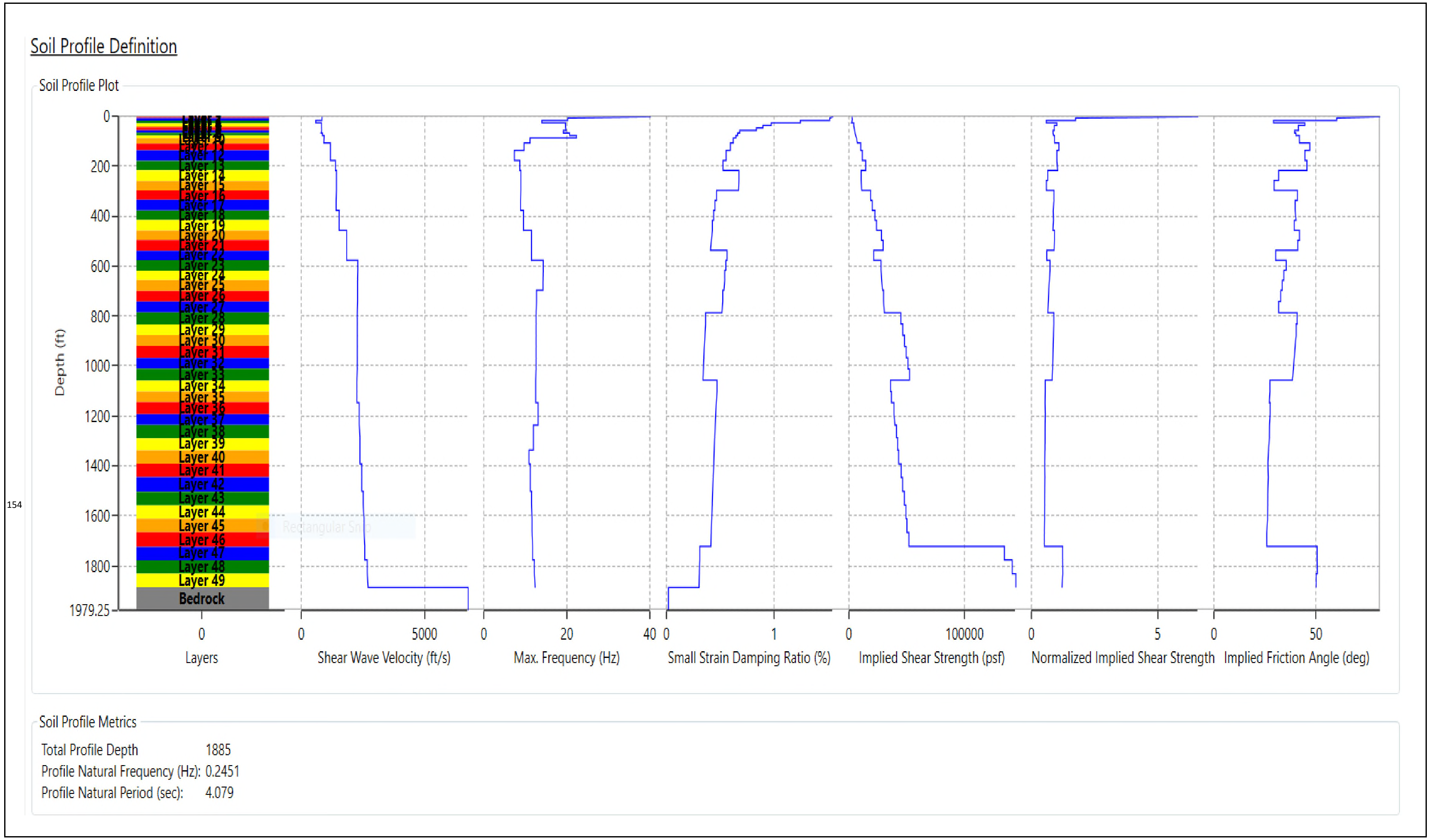
Coeff. of Uniformity	A	B	C	D
$C_u < 6$	34	10	3	2

DeepSoil Soil Properties

Option 2	Material Description New Material Model GQ/H Darendeli2009	El. [ft]	Soil Layer Thickness (ft)	Depth ft	Soil Propety Model No. Option 1	Layer Unit Weight (pcf)	Initial Damping	Shearwave Velocity (ft/s)	OCR	Water Wt (pcf)	Total Stress σ_{vo} (psf)	Effective Stress σ'_{vo} (psf)	Midpoint Depth [ft]	Effective Stress at Midpoint, σ'_{vo} [psf]	Shear Wave Velocity (m/s)	Derived SPT-N_{60} N_{60}	Relative Density, Dr (%)	Derived Friction Angle (degree)	Shear Strength (psf)	K_0
1	Enbankment Fill	15	5	0	1	115	0.05	800	2	0.00	0.00	0.00	3	288	244	CPT		16	550	0.88
2	Enbankment Fill	10	10	5	4	115	0.05	800	2	0.00	575.00	575.00	10	1125	244	CPT		16	550	0.88
3	Alluvial Clayey Silt PI30	0	10	15	4	110	0.05	550	1	0.00	1675.00	1675.00	20	2215	168	CPT		16	1000	0.72
4	Alluvial (granular)	-10	10	25	1	108	0.05	778	1	0.00	2755.00	2755.00	30	3139	237	CPT		34	2117	0.44
5	Fluvial Deposits (granular)	-20	10	35	1	108	0.02	779	1	312.00	3835.00	3523.00	40	3811	238	CPT		38	2977	0.38
6	Fluvial Deposits (granular)	-30	10	45	1	120.00	0.02	784	1	936.00	5035.00	4099.00	50	4387	239	CPT		38	3428	0.38
7	Fluvial Deposits (granular)	-40	10	55	3	120.00	0.02	756	1	1560.00	6235.00	4675.00	60	4963	230	CPT		38	3878	0.38
8	Fluvial Deposits (granular)	-50	10	65	3	120.00	0.02	817	1	2184.00	7435.00	5251.00	70	5539	249	CPT		38	4328	0.38
9	Fluvial Deposits (granular)	-60	10	75	3	120.00	0.02	884	1	2808.00	8635.00	5827.00	85	6403	270	CPT		38	5003	0.38
10	Fluvial Deposits (granular)	-80	20	95	3	120.00	0.02	872	1	4056.00	11035.00	6979.00	110	7918	266	CPT		38	6186	0.38
11	Fluvial Deposits (granular)	-110	30	125	3	125.00	0.02	1138	1	5928.00	14785.00	8857.00	145	10109	347	CPT		38	7898	0.38
12	Fluvial Deposits (granular)	-150	40	165	3	125.00	0.02	1138	1	8424.00	19785.00	11361.00	185	12613	347	CPT		38	9854	0.38
13	Fluvial Deposits (granular)	-190	40	205	3	125.00	0.02	1348	1	10920.00	24785.00	13865.00	225	15117	411	CPT		38	11811	0.38
14	Clayey Silt PI30		40	245	4	125.00	0.02	1391	1	13416.00	29785.00	16369.00	265	17621	424	40	0.35	34	11940	0.44
15	Clayey Silt PI30		40	285	4	125.00	0.02	1391	1	15912.00	34785.00	18873.00	305	20125	424	34	0.31	34	13333	0.45
16	Sand		40	325	5	125.00	0.02	1375	1	18408.00	39785.00	21377.00	345	22629	419	28	0.26	33	14691	0.46
17	Sand		40	365	5	125.00	0.02	1375	1	20904.00	44785.00	23881.00	385	25133	419	24	0.23	33	16077	0.46
18	Sand		40	405	5	125.00	0.02	1493	1	23400.00	49785.00	26385.00	425	27637	455	32	0.26	33	17694	0.46
19	Sand		40	445	5	125.00	0.02	1493	1	25896.00	54785.00	28889.00	465	30141	455	28	0.23	32	19067	0.47
20	Sand		40	485	5	125.00	0.02	1798	1	28392.00	59785.00	31393.00	505	32645	548	61	0.33	33	21139	0.46
21	Sand		40	525	5	125.00	0.02	1798	1	30888.00	64785.00	33897.00	545	35149	548	55	0.30	33	22490	0.46
22	Clayey Silt PI30		40	565	6	125.00	0.02	1798	1	33384.00	69785.00	36401.00	585	37653	548	50	0.28	32	23839	0.47
23	Clayey Silt PI30		40	605	6	125.00	0.02	2241	1	35880.00	74785.00	38905.00	625	40157	683	129	0.43	33	26470	0.45
24	Clayey Silt PI30		40	645	6	125.00	0.02	2241	1	38376.00	79785.00	41409.00	665	42661	683	120	0.41	33	27790	0.45
25	Clayey Silt PI30		40	685	6	125.00	0.02	2241	1	40872.00	84785.00	43913.00	708	45322	683	111	0.38	33	29192	0.46
26	Clayey Silt PI30		45	730	6	125.00	0.02	2241	1	43680.00	90410.00	46730.00	753	48139	683	103	0.36	33	30677	0.46
27	Clayey Silt PI30		45	775	6	125.00	0.02	2227	1	46488.00	96035.00	49547.00	798	50956	679	93	0.33	32	32117	0.47
28	Sand		45	820	7	125.00	0.01	2227	1	49296.00	101660.00	52364.00	843	53773	679	87	0.31	32	33600	0.47
29	Sand		45	865	7	125.00	0.01	2227	1	52104.00	107285.00	55181.00	888	56590	679	81	0.29	32	35083	0.47
30	Sand		45	910	7	125.00	0.01	2227	1	54912.00	112910.00	57998.00	933	59407	679	76	0.28	32	36563	0.48
31	Sand		45	955	7	125.00	0.01	2227	1	57720.00	118535.00	60815.00	978	62224	679	72	0.26	31	38042	0.48
32	Sand		45	1000	7	125.00	0.01	2227	1	60528.00	124160.00	63632.00	1023	65041	679	68	0.25	31	39520	0.48
33	Sand		45	1045	7	125.00	0.01	2211	1	63336.00	129785.00	66449.00	1068	67858	674	62	0.23	31	40951	0.48
34	Clayey Silt PI30		45	1090	8	125.00	0.01	2211	1	66144.00	135410.00	69266.00	1113	70675	674	59	0.22	31	42426	0.49
35	Clayey Silt PI30		45	1135	8	125.00	0.01	2211	1	68952.00	141035.00	72083.00	1158	73492	674	56	0.21	31	43899	0.49
36	Clayey Silt PI30		45	1180	8	125.00	0.01	2310	1	71760.00	146660.00	74900.00	1203	76309	704	66	0.23	31	45644	0.49
37	Clayey Silt PI30		45	1225	8	125.00	0.01	2310	1	74568.00	152285.00	77717.00	1250	79282	704	62	0.22	31	47192	0.49
38	Clayey Silt PI30		50	1275	8	125.00	0.01	2343	1	77688.00	158535.00	80847.00	1300	82412	714	63	0.22	31	48913	0.49
39	Clayey Silt PI30		50	1325	8	125.00	0.01	2343	1	80808.00	164785.00	83977.00	1353	85699	714	60	0.21	31	50618	0.49
40	Clayey Silt PI30		55	1380	8	125.00	0.01	2343	1	84240.00	171660.00	87420.00	1408	89142	714	57	0.20	30	52403	0.49
41	Clayey Silt PI30		55	1435	8	125.00	0.01	2415	1	87672.00	178535.00	90863.00	1463	92585	736	63	0.20	30	54386	0.49
42	Clayey Silt PI30		55	1490	8	125.00	0.01	2415	1	91104.00	185410.00	94306.00	1518	96028	736	60	0.19	30	56164	0.50
43	Clayey Silt PI30		55	1545	9	125.00	0.01	2475	1	94536.00	192285.00	97749.00	1573	99471	755	64	0.20	30	58110	0.50
44	Clayey Silt PI30		55	1600	9	125.00	0.01	2505	1	97968.00	199160.00	101192.00	1628	102914	764	65	0.20	30	59968	0.50
45	Clayey Silt PI30		55	1655	9	125.00	0.01	2505	1	101400.00	206035.00	104635.00	1683	106357	764	62	0.19	30	61737	0.50
46	Clayey Silt PI30		55	1710	9	125.00	0.01	2536	1	104832.00	212910.00	108078.00	1738	110652	773	63	0.19	30	64029	0.50
47	Sand		55	1765	10	156.00	0.01	2536	1	108264.00	221490.00	113226.00	1793	115800	773	59	0.18	30	66665	0.50
48	Sand		55	1820	10	156.00	0.01	2633	1	111696.00	230070.00	118374.00	1848	120948	803	67	0.18	30	69576	0.50
49	Sand		55	1875	10	156.00	0.01	2670	1	115128.00	238650.00	123522.00	1875	123522	814	69	0.18	30	70998	0.50
50	Bedrock			1875	10	175.00	0.001	6732	1	115128.00	238650.00	123522.00		123522	2052					1.00

NOTE:
1. Based on "Boston 123 years-South Boston", Boring 359, BSCE 1971
2. BSCE Boring located at exact location
3.SHANSEP parameters for Boston Blue Clay (South Boston) based on Testing for Central Artery by Haley and Aldrich, 1993
4. Sheetpile parameters for Overconsolidated Boston Blue Clay based on Normally Consolidated strength as per FHWA recommendations
5. Assume ground water is located at Mean High Water Level
6. OCR parameters were estimated
7. Drained Residual Stess based on Liquid Limit =50, Stark and Eid; "Drained Residual Strength of Cohesive Soils",1994

PLATE 13



Soil Profile Definition

Soil Profile Metrics

Total Profile Depth 1885
Profile Natural Frequency (Hz): 0.2451
Profile Natural Period (sec): 4.079

PLATE 14

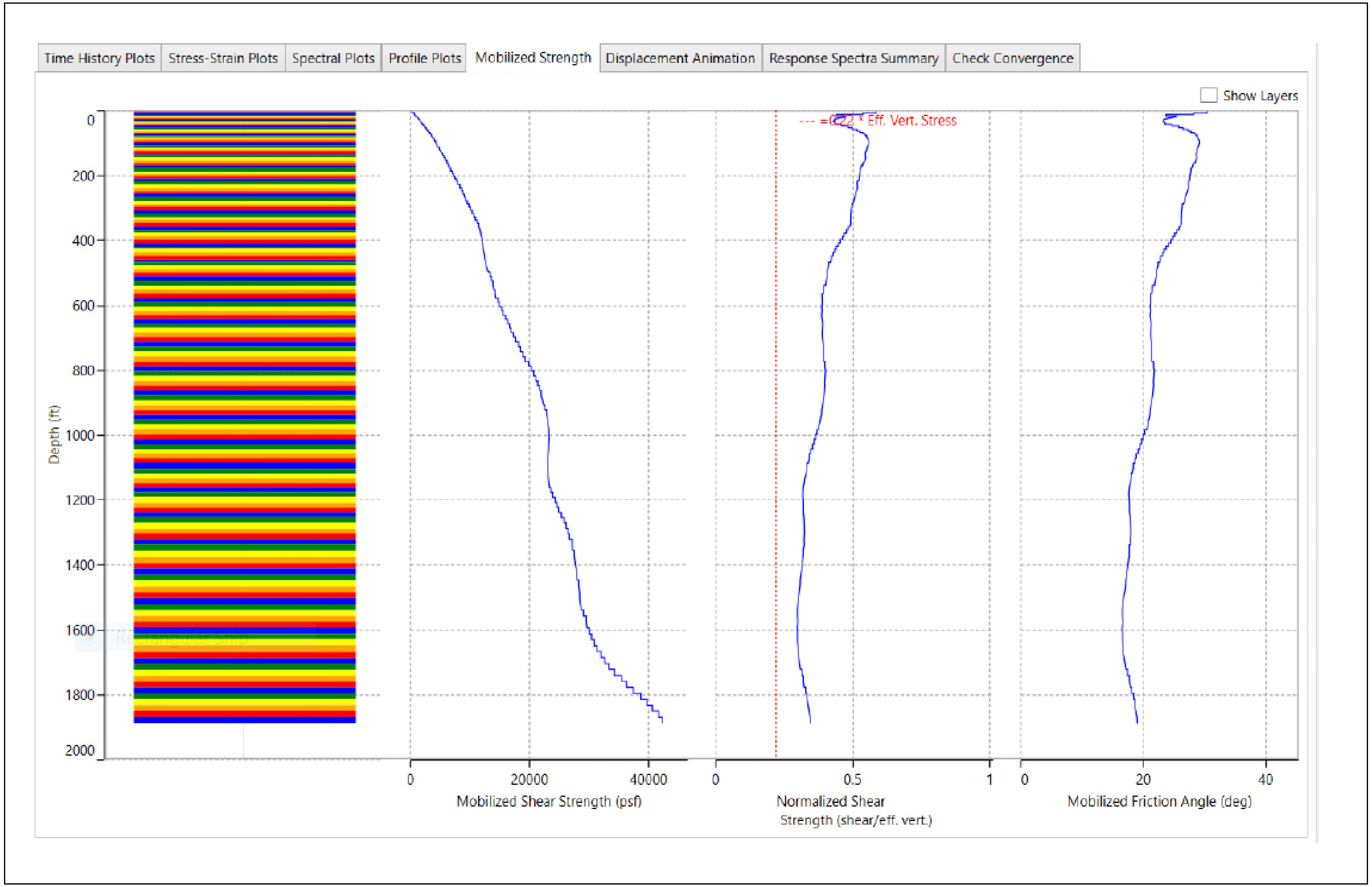

Time History Plots
Stress-Strain Plots
Spectral Plots
Profile Plots
Mobilized Strength
Displacement Animation
Response Spectra Summary
Check Convergence
☐ Show Layers
Depth (ft)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
--- =0.22 * Eff. Vert. Stress
0
20000
40000
Mobilized Shear Strength (psf)
0
0.5
1
Normalized Shear Strength (shear/eff. vert.)
0
20
40
Mobilized Friction Angle (deg)

PLATE 15

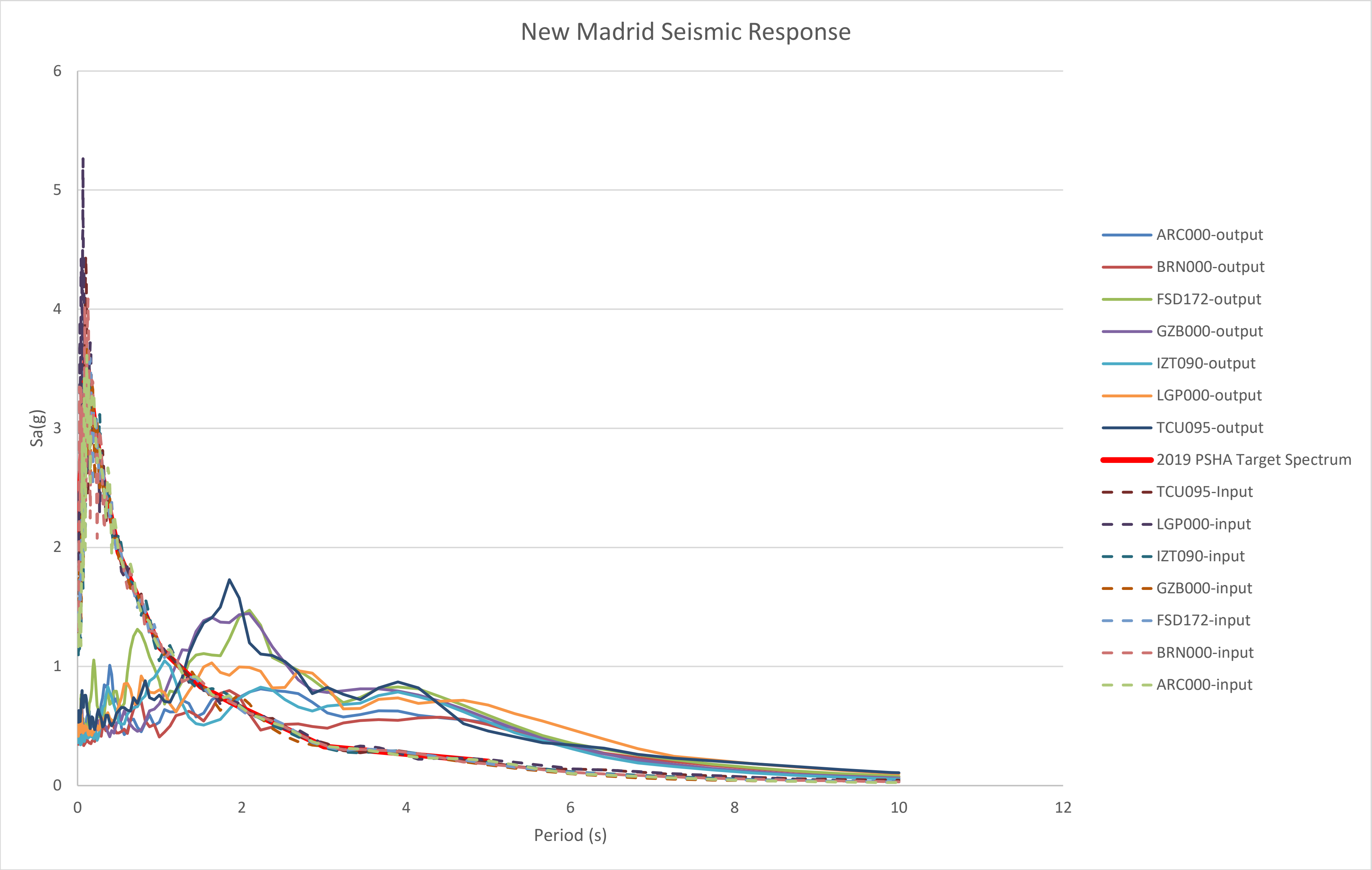

New Madrid Seismic Response
Sa(g)
Period (s)
0
1
2
3
4
5
6
0
2
4
6
8
10
12
ARC000-output
BRN000-output
FSD172-output
GZB000-output
IZT090-output
LGP000-output
TCU095-output
2019 PSHA Target Spectrum
TCU095-Input
LGP000-input
IZT090-input
GZB000-input
FSD172-input
BRN000-input
ARC000-input

PLATE 16

CHILDS ENGINEERING

Created by: JMK
Checked by

DATE: 2/21/2019
DATE:

Seismic displacement of impoundment based on Newmark method using Bray and Travasarous relationship to compensate for magnitude differences between ground motion and target earthquake

Non-zero displacment (not biased due to magnitude): Bray and Travarsarou(2007)

Fundamental period ($T_S \geq 0.05s$): $\ln(D)= -1.10 -2.83\ln(k_y) -0.333(\ln(k_y))^2 -0.566\ln(k_y)\ln(S_a(1.5T_S)) +3.04\ln(S_a(1.5T_S))-0.244(\ln(S_a(1.5T_S)))^2 + 1.5T_S +0.278(M-7) \pm \varepsilon$

Assumed Rigid Sliding Block ($T_S < 0.05s$): $\ln(D)= -0.22 -2.83\ln(k_y) -0.333(\ln(k_y))^2 -0.566\ln(k_y)\ln(PGA) +3.04\ln(PGA) -0.244(\ln(PGA))^2+0.278(M-7) \pm \varepsilon$

where :
D = non-zero displacement (cm)
k_y= yield coefficient
T_S = initial fundamental period of sliding mass (s)
$S_a(1.5T_S)$ = spectral acceleration of the input ground motion at a period of $1.5T_S$ (g)
ε = normally distributed random varible with zero mean and standard deviation σ=0.67

Fundamental Period Sliding Mass= $4H/V_S$

Bray and Traversarou

Magnitude Correction Factor for M8 target

$$\frac{e^{0.278(8-7)}}{e^{0.278\,(M-7)}} = \frac{1.32}{e^{0.278(M-7)}}$$

Seismic displacement of a slope based on Newmark method using Bray and Travasarous relationship to compensate for magnitude

15 ft Sliding Mass Height

DEEPSOIL Non-Linear GQ-H Model using Nuclear Reglatory Comminssion Synthetic Magnitude 7.5 Grond Motions

New Madrid Target Magnitude 7.7 1.21

Ground Motion	Magnitude	Yield Coefficient, k_y (g)	Bray and Travarsarou Magnitude Correction Factor	Newmark Analysis Displacement (Inches)**			Adjusted Newmark Displacement (Inches)		
				Max (in)	Avg (in)	Min (in)	Max (in)	Avg (in)	Min (in)
BRN000	7.5								
		0.15	1.06	34.00	21.00	9.00	35.94	22.20	9.51
		0.175	1.06	19.00	12.00	6.00	20.09	12.69	6.34
		0.2	1.06	11.00	7.00	4.00	11.63	7.40	4.23
		0.225	1.06	6.00	4.00	2.00	6.34	4.23	2.11
		0.25	1.06	4.00	3.00	1.00	4.23	3.17	1.06
		0.275	1.06	3.00	2.00	1.00	3.17	2.11	1.06
		0.3	1.06	2.00	1.00	1.00	2.11	1.06	1.06
		0.325	1.06	1.00	1.00	0.00	1.06	1.06	0.00
ARC000	7.5								
		0.15	1.06	22.00	19.00	16.00	23.26	20.09	16.91
		0.175	1.06	13.00	10.00	7.00	13.74	10.57	7.40
		0.2	1.06	8.00	5.00	2.00	8.46	5.29	2.11
		0.225	1.06	4.00	2.00	1.00	4.23	2.11	1.06
		0.25	1.06	2.00	1.00	0.00	2.11	1.06	0.00
		0.275	1.06	1.00	0.00	0.00	1.06	0.00	0.00
		0.3	1.06	0.00	0.00	0.00	0.00	0.00	0.00
		0.325	1.06	0.00	0.00	0.00	0.00	0.00	0.00
TCU095	7.5								
		0.15	1.06	47	43	39	49.69	45.46	41.23
		0.175	1.06	30	25	20	31.72	26.43	21.14
		0.2	1.06	18	14	10	19.03	14.80	10.57
		0.225	1.06	9	7	4	9.51	7.40	4.23
		0.25	1.06	5	3	2	5.29	3.17	2.11
		0.275	1.06	3	2	1	3.17	2.11	1.06
		0.3	1.06	2	1	0	2.11	1.06	0.00
		0.325	1.06	1	0	0	1.06	0.00	0.00

** Newmark displacement calculated independently using software such as Shake 2000

PLATE 17

FSD172	6.5								
		0.15	1.40	43.00	41.00	40.00	60.03	57.24	55.84
		0.175	1.40	27.00	26.00	25.00	37.69	36.30	34.90
		0.2	1.40	16.00	15.00	15.00	22.34	20.94	20.94
		0.225	1.40	9.00	8.00	7.00	12.56	11.17	9.77
		0.25	1.40	5.00	4.00	3.00	6.98	5.58	4.19
		0.275	1.40	2.00	1.00	1.00	2.79	1.40	1.40
		0.3	1.40	1.00	0.00	0.00	1.40	0.00	0.00
		0.325	1.40	0.00	0.00	0.00	0.00	0.00	0.00
IZT090	7.5								
		0.15	1.06	14.00	12.00	10.00	14.80	12.69	10.57
		0.175	1.06	5.00	4.00	3.00	5.29	4.23	3.17
		0.2	1.06	3.00	2.00	1.00	3.17	2.11	1.06
		0.225	1.06	1.00	0.00	0.00	1.06	0.00	0.00
		0.25	1.06	0.00	0.00	0.00	0.00	0.00	0.00
		0.275	1.06	0.00	0.00	0.00	0.00	0.00	0.00
		0.3	1.06	0.00	0.00	0.00	0.00	0.00	0.00
		0.325	1.06	0.00	0.00	0.00	0.00	0.00	0.00
LGP000	6.5								
		0.15	1.40	50.00	39.00	28.00	69.80	54.44	39.09
		0.175	1.40	30.00	24.00	19.00	41.88	33.50	26.52
		0.2	1.40	20.00	16.00	12.00	27.92	22.34	16.75
		0.225	1.40	14.00	10.00	7.00	19.54	13.96	9.77
		0.25	1.40	9.00	6.00	4.00	12.56	8.38	5.58
		0.275	1.40	5.00	3.00	1.00	6.98	4.19	1.40
		0.3	1.40	2.00	1.00	1.00	2.79	1.40	1.40
		0.325	1.40	1.00	1.00	0.00	1.40	1.40	0.00
GZB000	7.5								
		0.15	1.06	62.00	52.00	41.00	65.54	54.97	43.34
		0.175	1.06	42.00	34.00	26.00	44.40	35.94	27.49
		0.2	1.06	26.00	22.00	19.00	27.49	23.26	20.09
		0.225	1.06	14.00	13.00	13.00	14.80	13.74	13.74
		0.25	1.06	8.00	8.00	7.00	8.46	8.46	7.40
		0.275	1.06	5.00	4.00	4.00	5.29	4.23	4.23
		0.3	1.06	3.00	2.00	2.00	3.17	2.11	2.11
		0.325	1.06	1.00	1.00	1.00	1.06	1.06	1.06
AVERAGE	7.5								
		0.15	1.06	38.86	32.43	26.14	41.08	34.28	27.64
		0.175	1.06	23.71	19.29	15.14	25.07	20.39	16.01
		0.2	1.06	14.57	11.57	9.00	15.40	12.23	9.51
		0.225	1.06	8.14	6.29	4.86	8.61	6.65	5.13
		0.25	1.06	4.71	3.57	2.43	4.98	3.78	2.57
		0.275	1.06	2.71	1.71	1.14	2.87	1.81	1.21
		0.3	1.06	1.43	0.71	0.57	1.51	0.76	0.60
		0.325	1.06	0.57	0.43	0.14	0.60	0.45	0.15

** Newmark displacement calculated independently using software such as Shake 2000

Newmark Analysis - Magnitude Corrected

BRN000-Matched (Mag Corrected)

Yield Coefficient	Max Displacment (in)
0.15	35.94
0.175	20.09
0.2	11.63
0.225	6.34
0.25	4.23
0.275	3.17
0.3	2.11
0.325	1.06

ARC000-Matched (Mag. Corrected)

Yield Coefficient	Adj. Displacment (in)
0.15	23.26
0.175	13.74
0.2	8.46
0.225	4.23
0.25	2.11
0.275	1.06
0.3	0.00
0.325	0.00

TCU095-Matched (Mag Corrected)

Yield Coefficient	Displacment (in)
0.15	49.69
0.175	31.72
0.2	19.03
0.225	9.51
0.25	5.29
0.275	3.17
0.3	2.11
0.325	1.06

FSD172-Matched (Mag Corrected)

Yield Coefficient	Adj. Displacment (in)
0.15	45.46
0.175	28.54
0.2	16.91
0.225	9.51
0.25	5.29
0.275	2.11
0.3	1.06
0.325	0.00

IZT090-Matched (Mag Corrected)

Yield Coefficient	Adj. Displacment (in)
0.15	14.80
0.175	5.29
0.2	3.17
0.225	1.06
0.25	0.00
0.275	0.00
0.3	0.00
0.325	0.00

LGP000-Matched (Mag Corrected)

Yield Coefficient	Adj. Displacment (in)
0.15	52.86
0.175	31.72
0.2	21.14
0.225	14.80
0.25	9.51
0.275	5.29
0.3	2.11
0.325	1.06

GZB000-Matched (Mag Corrected)

Yield Coefficient	Adj. Displacment (in)
0.15	65.54
0.175	44.40
0.2	27.49
0.225	14.80
0.25	8.46
0.275	5.29
0.3	3.17
0.325	1.06

AVERAGE

Yield Coefficient	Adj. Displacment (in)
0.15	41.08
0.175	25.07
0.2	15.40
0.225	8.61
0.25	4.98
0.275	2.87
0.3	1.51
0.325	0.60

PLATE 19

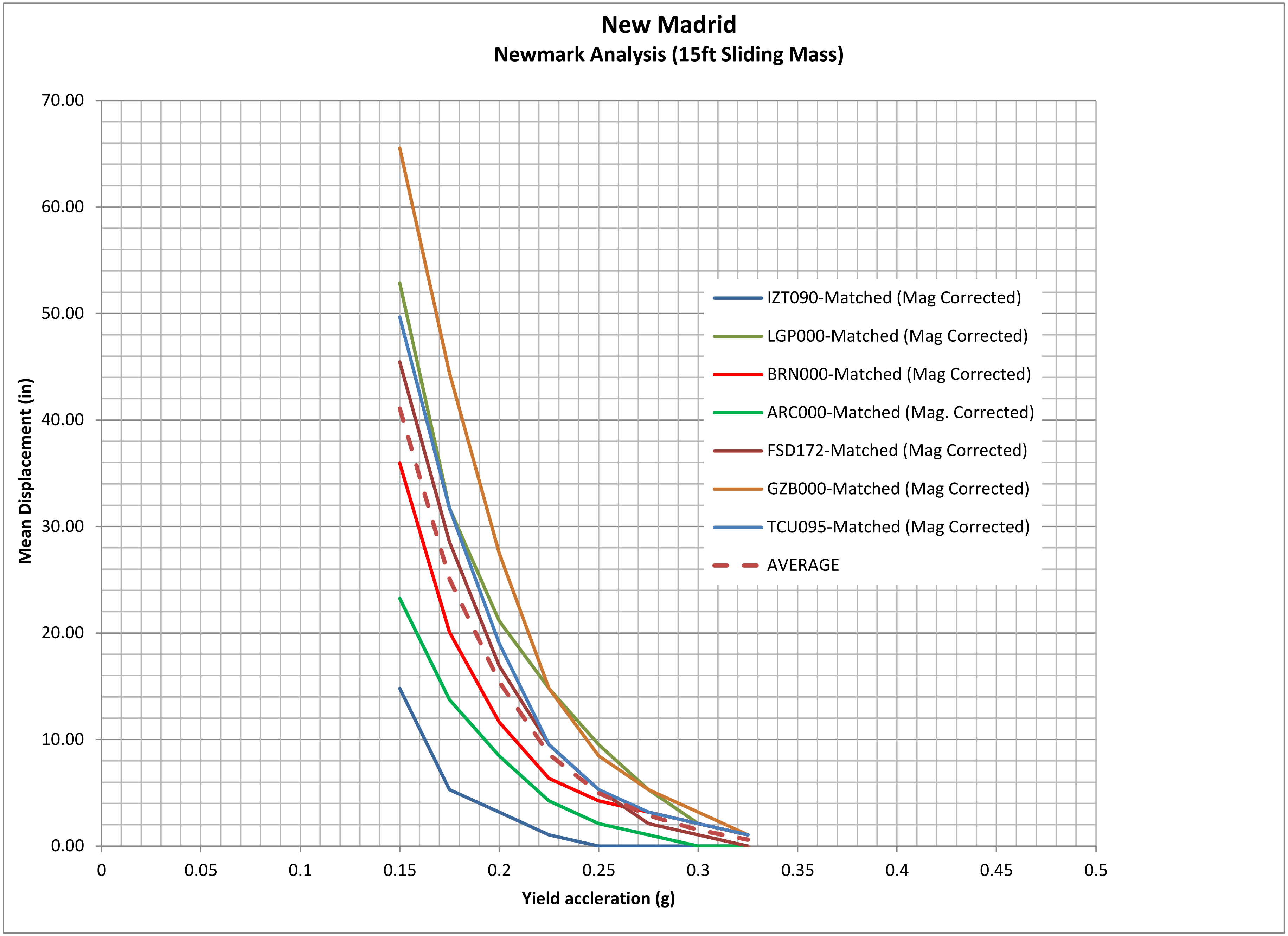

New Madrid
Newmark Analysis (15ft Sliding Mass)
Mean Displacement (in)
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Yield accleration (g)
IZT090-Matched (Mag Corrected)
LGP000-Matched (Mag Corrected)
BRN000-Matched (Mag Corrected)
ARC000-Matched (Mag. Corrected)
FSD172-Matched (Mag Corrected)
GZB000-Matched (Mag Corrected)
TCU095-Matched (Mag Corrected)
AVERAGE

PLATE 20

APPENDIX D

Supplemental Subsurface Information

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B8OW

Project	Lined Pond, New Madrid Power Plant Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling

File No.	129342-005
Sheet No.	1 of 2
Start	12 June 2017
Finish	12 June 2017
Driller	C. Dutton
H&A Rep.	C. Toscano
Elevation	308.8
Datum	NAVD88
Location	N 244,935.6 E 1,096,598.5

	Casing	Sampler	Barrel
Type	HSA	S	None
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550

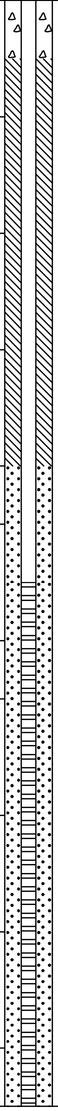
Bit Type: Cutting Head

Drill Mud: None

Casing: HSA

Hoist/Hammer: Winch / Automatic Hammer

PID Make & Model:



Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	3 6 6 5	S1 24	0.0 2.0			ML	Medium dense dark brown to gray-brown SILT (ML), stratified, no odor, wet -FLY ASH-						100				
	1 1 3 8	S2 24	2.0 4.0			ML	Very loose dark brown to gray-brown SILT (ML), stratified, no odor, wet, contains trace fine sand						100				
5	10 6 3 6	S3 24	4.0 6.0			ML	Loose dark brown to gray-brown SILT with sand (ML), no odor, wet, contains intermixed seams and layers of cinders				12	16	72				
	3 9 9 13	S4 24	6.0 8.0			ML	Medium dense dark brown to gray-brown sandy SILT (ML), no odor, wet, contains intermixed seams and layers of cinders				20	10	70				
▽																	
10	10 12 6 8	S5 24	9.0 11.0			ML	Medium dense dark brown to gray-brown sandy SILT (ML), no odor, wet, contains intermixed seams of cinders				10	20	70				
	6 4 8 4	S6 12	12.0 14.0			ML	Medium dense dark brown to gray-brown sandy SILT (ML), no odor, wet, contains intermixed seams of cinders				15	15	70				
15	6 10 5 5	S7 24	14.0 16.0			ML	Medium dense dark brown to gray-brown sandy SILT (ML), no odor, wet, contains intermixed seams of cinders				15	15	70				
	5 5 16 21	S8 20	16.0 18.0			ML	Medium dense gray-brown SILT with sand (ML), wet				5	11	84				
	10 5	S9 24	18.0 20.0			ML	Medium dense gray-brown SILT with sand (ML), wet				5	20	75				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
6/12/17		0	8.0	10.0	8.0
6/15/17		3 days	20.0	20.0	9.0
6/21/17		9 days	20.0	20.0	8.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

◫	Riser Pipe
☰	Screen
⁘	Filter Sand
▩	Cuttings
■	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft)	20.0
Rock Cored (ft)	0.0
Samples	9S

Boring No. HA-B8OW

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B8OW
File No. 129342-005
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	**VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION** (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
	18 16			▨			-FLY ASH-										
20					288.8 20.0		BOTTOM OF EXPLORATION 20.0 FT Note: Attempted to push undisturbed tube samples at 4, 6, 8, 11 and 14 ft, but could not due to hardness of material. Attempted five tubes, bent two tubes. Note: Set observation well at 20.0 ft. See Observation Well Report for details.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B8OW

TEST BORING REPORT

Boring No. HA-B9

Project	Lined Pond, New Madrid Power Plant Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling

File No.	129342-005
Sheet No.	1 of 2
Start	13 June 2017
Finish	13 June 2017
Driller	C. Dutton
H&A Rep.	C. Toscano
Elevation	307.5
Datum	NAVD88
Location	N 244,393.7 E 1,095,065.9

	Casing	Sampler	Barrel
Type	HSA	S	None
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550
Bit Type: Cutting Head
Drill Mud: None
Casing: HSA
Hoist/Hammer: Winch / Automatic Hammer
PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	5 15 18 13	S1 18	0.0 2.0		ML	Dense dark brown to olive-brown SILT with sand (ML), no odor, moist, contains intermixed cinders with layers of silty fine sand			5	10	10	75				
	5 5 5 4	S2 24	2.0 4.0	305.5 2.0	SM	Loose dark brown silty SAND (SM), no odor, moist, contains intermixed cinders -EMBANKMENT FILL-			15	30	30	25				
5	P U S H	U1A 12	4.0 6.0	303.5 4.0	ML	Yellow-brown sandy SILT (ML), contains trace cinder particles										
	P U S H	U1 21	6.0 8.0	301.5 6.0	CH	Gray and brown fat CLAY (CH)					2	98				
				300.0 7.5												
	3 3 4 3	S3 24	8.0 10.0		SM	Loose yellow-brown silty SAND (SM), no odor, dry -ALLUVIAL DEPOSITS-					60	40				
10	P U S H	U2 20	10.0 12.0		SM	Yellow-brown silty SAND (SM)										
	5 4 5 5	S4 20	12.0 14.0	295.5 12.0	CL	Stiff yellow-brown lean CLAY (CL), moist					10	90				
15	P U S H	U3 21	14.0 16.0	293.5 14.0	ML	Brown SILT (ML)					3	97				
	3 3 3 5	S5 24	18.0 20.0	289.5 18.0	MH	Medium stiff light brown elastic SILT (MH), moist, contains fine sand in frequent partings and layers						100				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
6/13/17	15:10	0.25	29.0	31.0	30.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

◫	Riser Pipe
▤	Screen
⁙	Filter Sand
▦	Cuttings
■	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft)	31.0
Rock Cored (ft)	0.0
Samples	7S, 3U

Boring No. HA-B9

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B9
File No. 129342-005
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20																
				285.5 22.0												
25	6 8 9 11	S6 20	24.0 26.0		SP-SM	Medium dense tan poorly graded SAND with silt (SP-SM), dry				3	87	10				
						-ALLUVIAL DEPOSITS-										
30 ∇	3 6 7 8	S7 15	29.0 31.0	278.5 29.0	SP	Medium dense tan poorly graded SAND (SP), wet				80	20					
				276.5 31.0		BOTTOM OF EXPLORATION 31.0 FT Note: Borehole grouted to ground surface upon completion.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B9

TEST BORING REPORT

Boring No. HA-B9A

Project	Lined Pond, New Madrid Power Plant Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling

File No.	129342-005
Sheet No.	1 of 4
Start	14 June 2017
Finish	14 June 2017
Driller	C. Dutton
H&A Rep.	C. Toscano
Elevation	299.5
Datum	NAVD88
Location	N 244,415.0 E 1,094,991.2

	Casing	Sampler	Barrel
Type	HSA	S	None
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550
Bit Type: Roller Bit
Drill Mud: Bentonite
Casing: Mud Rotary
Hoist/Hammer: Winch / Automatic Hammer
PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						Note: HA-B9A was drilled at the toe of the levee embankment slope in line with HA-B9 on the levee embankment crest. Advanced borehole to 18 ft.										
5																
10																
15																
	3 3 3 6	S1 24	18.0 20.0	281.5 18.0	ML	Loose brown sandy SILT (ML), no odor, wet, contains fine sand in frequent seams and layers -ALLUVIAL DEPOSITS-					40	60				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

◫	Riser Pipe
☰	Screen
⁘	Filter Sand
▩	Cuttings
■	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft)	95.0
Rock Cored (ft)	0.0
Samples	16S

Boring No. HA-B9A

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B9A
File No. 129342-005
Sheet No. 2 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20																
	4 5 6 6	S2 24	23.0 25.0	276.5 23.0	SM	Medium dense brown silty SAND (SM), no odor, wet					60	40				
25						-ALLUVIAL DEPOSITS-										
				273.5 26.0												
	11 14 16 21	S3 24	28.0 30.0		SP	Medium dense brown poorly graded SAND (SP), wet				60	35	5				
30						-FLUVIAL DEPOSITS-										
	6 10 9 11	S4 24	33.0 35.0		SP	Medium dense brown poorly graded SAND (SP), wet, contains trace coarse to fine gravel			15	65	20					
35																
	10 13 14 15	S5 10	38.0 40.0		SP	Medium dense brown poorly graded SAND (SP), wet				80	20					
40																
	15 16 14 13	S6 20	43.0 45.0		SP	Medium dense brown poorly graded SAND (SP), wet			15	75	10					
45																
	10 14 16 18	S7 24	48.0 50.0		SP	Medium dense gray poorly graded SAND (SP), wet			5	80	5					

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B9A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50																
	6 8 12 16	S8 24	53.0 55.0	246.5 53.0	SM	Medium dense gray silty SAND (SM), no odor, wet				5	80	15				
55																
						-FLUVIAL DEPOSITS-										
	12 14 14 16	S9 20	58.0 60.0	241.5 58.0	SP	Medium dense gray poorly graded SAND (SP), wet				25	70	5				
60																
	15 15 18 21	S10 20	63.0 65.0		SP	Dense gray poorly graded SAND (SP), wet			5	80	15					
65																
	13 17 22 22	S11 24	68.0 70.0		SP	Dense gray poorly graded SAND (SP), wet			1	16	80	3				
70																
	11 13 15 15	S12 15	73.0 75.0		SP	Medium dense gray poorly graded SAND (SP), wet			5	85	10					
75																
	11 11 10	S13 18	78.0 80.0		SP	Medium dense gray poorly graded SAND (SP), wet			15	80	5					

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B9A
File No. 129342-005
Sheet No. 4 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
	10															
80																
	11 13 16 17	S14 15	83.0 85.0		SP	Medium dense gray poorly graded SAND (SP), wet			25	70	5					
85																
						-FLUVIAL DEPOSITS-										
	10 14 15 15	S15 12	88.0 90.0		SP	Medium dense gray poorly graded SAND (SP), wet			5	90	5					
90																
	11 15 15 16	S16 16	93.0 95.0		SP	Medium dense gray poorly graded SAND (SP), wet			5	90	5					
95				204.5 95.0		BOTTOM OF EXPLORATION 95.0 FT										
						Note: Due to the use of drilling fluid, groundwater was not measured. Borehole grouted to ground surface upon completion.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B9A

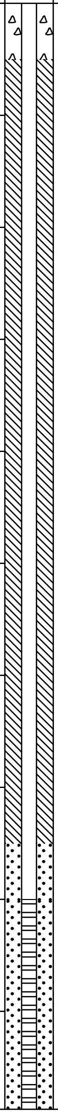
TEST BORING REPORT

Boring No. HA-B10OW

Project	Lined Pond, New Madrid Power Plant Marston, MO	File No.	129342-005
Client	Associated Electric Cooperative, Inc.	Sheet No.	1 of 2
Contractor	Bulldog Drilling	Start	13 June 2017
		Finish	13 June 2017
		Driller	C. Dutton
		H&A Rep.	C. Toscano

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	None	Rig Make & Model: CME 550
Inside Diameter (in.)	4.25	1.375	--	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	--	140	-	Casing: HSA Hoist/Hammer: Winch / Automatic Hammer
Hammer Fall (in.)	--	30	-	PID Make & Model:

Elevation 308.2
Datum NAVD88
Location
N 245,043.8
E 1,097,673.9



Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	6 5 4 6	S1 20	0.0 2.0			CL	Stiff brown lean CLAY (CL), no odor, dry						100	S	N	L	M
	3 4 4 8	S2 12	2.0 4.0			CL	Medium stiff brown lean CLAY (CL), no odor, moist -EMBANKMENT FILL-						100				
5	3 4 6 8	S3 18	4.0 6.0			CL	Stiff brown lean CLAY (CL), no odor, moist, contains trace fine gravel and coarse to fine sand						100				
	3 6 8 4	S4 15	6.0 8.0			CL	Stiff dark brown to gray-brown lean CLAY (CL), mottled, trace fine sand, no odor, moist						100	N	L	M	H
	3 5 5 7	S5 10	8.0 10.0			CL	Stiff dark brown to gray-brown lean CLAY (CL), mottled gray-brown to olive-brown, no odor, moist, fine sand in frequent seams					13	87		L	M	H
10	P U S H	U1 24	10.0 12.0		298.2 10.0	CH	Dark gray fat CLAY (CH)					2	98				
	3 3 6 7	S6 20	12.0 14.0			CH	Stiff gray-brown fat CLAY (CH), no odor, moist Note: Pond liner lodged in tip of spoon.						100			H	
15	2 5 7 9	S7 16	14.0 16.0		294.2 14.0	CL	Stiff dark brown to gray-brown lean CLAY (CL), mottled, no odor, moist, contains trace fine sand						100				
	3 5 5 7	S8 24	16.0 18.0			CL	Stiff dark brown to gray-brown lean CLAY (CL), mottled, no odor, moist, contains trace fine sand						100				
	P U S H	U2 18	18.0 20.0		290.2 18.0	CH	Gray and brown fat CLAY (CH)					4	96				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
6/13/17		0	32.0	34.0	32.0

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

⊞	Riser Pipe
☰	Screen
⁘	Filter Sand
⁖	Cuttings
■	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft)	34.0
Rock Cored (ft)	0.0
Samples	19S, 3U

Boring No. HA-B10OW

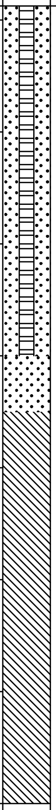
Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B10OW
File No. 129342-005
Sheet No. 2 of 2



Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	4 8 14 16	S9 24	20.0 22.0		288.2 20.0	ML	Very stiff light brown sandy SILT (ML), no odor, moist -ALLUVIAL DEPOSITS-					40	60				
	5 8 12 12	S10 24	22.0 24.0			ML	Very stiff olive-brown SILT with sand (ML), no structure, no odor, moist					20	80				
25	3 7 10 10	S11 24	24.0 26.0		284.2 24.0	MH	Very stiff brown to gray-brown elastic SILT (MH), moist, contains trace fine sand						100				
	1 2 3 6	S12 24	26.0 28.0		282.2 26.0	CH	Medium stiff brown fat CLAY (CH), no odor, moist						100	N	H	H	H
	1 2 2 2	S13 24	28.0 30.0			CH	Soft brown fat CLAY (CH), no odor, moist						100				
30	P U S H ▽	U3 24	30.0 32.0		278.2 30.0	ML	Brown SILT (ML)						100				
	1 2 2 3	S14 24	32.0 34.0			ML	Soft brown SILT (ML), wet, with fine sand in frequent seams and layers						100				
					274.2 34.0		-BOTTOM OF EXPLORATION 34.0 FT Note: Set observation well at 26.0 ft. See Observation Well Report for details.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B10OW

TEST BORING REPORT

Boring No. HA-B11

Project	Pond 004 Closure, New Madrid Power Plant Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling

File No.	129342-011
Sheet No.	1 of 3
Start	15 June 2017
Finish	16 June 2017
Driller	C. Dutton
H&A Rep.	C. Toscano
Elevation	300.5
Datum	NAVD88
Location	N 249,835.1 E 1,096,303.1

	Casing	Sampler	Barrel
Type	HSA	S	None
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550
Bit Type: Cutting Head
Drill Mud: Bentonite
Casing: HSA
Hoist/Hammer: Winch / Automatic Hammer
PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	2 4 6 9	S1 15	0.0 2.0		SP	Loose black to dark gray poorly-graded SAND (SP), no odor, dry, contains cinders -BOTTOM ASH-			10	70	15	5				
	6 9 10 13	S2 18	2.0 4.0		SP	Medium dense dark brown to black poorly-graded SAND (SP), no odor, dry, contains cinders		2	10	70	14	4				
5	6 17 22 22	S3 15	4.0 6.0		SP	Dense dark brown to black poorly-graded SAND (SP), no odor, dry, contains cinders			10	70	15	5				
▽	6 11 11 6	S4 16	6.0 8.0		SP	Medium dense dark brown to black poorly-graded SAND (SP), no odor, dry, contains cinders			30	60	10					
	4 6 9 10	S5 18	8.0 10.0	292.5 8.0	CH	Stiff gray fat CLAY (CH), moist, trace cinder particles -FILL-						100				
10	2 3 3 6	S6 12	10.0 12.0		CH	Medium stiff gray-brown fat CLAY (CH), moist						100				
	P U S H	U1 20	12.0 14.0		CH	Gray-brown fat CLAY (CH)					1	99				
15	2 3 4 5	S7 24	14.0 16.0	286.5 14.0	MH	Medium stiff gray-brown to brown elastic SILT (MH), mottled, no structure, moist						100				
	P U S H	U2 24	16.0 18.0		MH	Brown-gray elastic SILT (MH)										
20	WOH 1 1 3	S8 24	18.0 20.0		MH	Very soft gray-brown to brown elastic SILT (MH), mottled, no structure, moist						100				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
6/15/17		0	6.0	8.0	7.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

◫	Riser Pipe
▤	Screen
⁙	Filter Sand
▩	Cuttings
■	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft)	70.0
Rock Cored (ft)	0.0
Samples	18S, 2U

Boring No. HA-B11

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B11
File No. 129342-011
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20						-FILL-										
25	6 7 6 2	S9 24	24.0 26.0	276.5 24.0	ML	Stiff brown sandy SILT (ML), well stratified, wet, interbedded with silt and fine sand seams, layers					32	68				
						-ALLUVIAL DEPOSIT-										
30	6 7 11 20	S10 24	29.0 31.0		ML	Very stiff brown sandy SILT (ML), well stratified, wet, interbedded with silt and fine sand seams, layers					30	70				
35	8 9 9 8	S11 18	33.0 35.0	268.5 32.0	SP	Medium dense brown poorly-graded SAND (SP), wet				60	40					
						-FLUVIAL DEPOSITS-										
40	7 8 9 9	S12 18	38.0 40.0		SP	Medium dense brown poorly-graded SAND (SP), wet				40	60					
45	8 8 16 10	S13 15	43.0 45.0		SP	Medium dense brown poorly-graded SAND (SP), wet				40	60					
	11 16 19 17	S14 18	48.0 50.0		SP	Dense brown poorly-graded SAND (SP), wet				60	40					

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B11

TEST BORING REPORT

Boring No. HA-B11
File No. 129342-011
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
50																
	11 11 14 15	S15 15	53.0 55.0		SW	Medium dense gray well graded SAND (SW), wet			20	55	25					
55						-FLUVIAL DEPOSITS-										
						Note: Drill action indicated possible gravel layer from 56 to 57 ft.										
	10 12 13 15	S16 15	58.0 60.0		SP	Medium dense brown poorly-graded SAND (SP), wet, trace coarse to fine gravel				60	40					
60																
	8 9 9 10	S17 16	63.0 65.0		SP	Medium dense gray poorly-graded SAND (SP), wet, trace fine gravel			20	55	22	3				
65																
	8 10 9 10	S18 18	68.0 70.0		SP	Similar to S17			20	55	20	5				
70				230.5 70.0		BOTTOM OF EXPLORATION AT 70.0 FT										
						Note: Borehole grouted upon completion.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B11

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B12

Project Pond 004 Closure, New Madrid Power Plant
Marston, MO
Client Associated Electric Cooperative, Inc.
Contractor Bulldog Drilling

File No. 129342-011
Sheet No. 1 of 3
Start 15 June 2017
Finish 15 June 2017
Driller C. Dutton
H&A Rep. C. Toscano

Elevation 299.4
Datum NAVD88

Location
N 249,673.7
E 1,096,376.3

	Casing	Sampler	Barrel
Type	HSA	S	None
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550
Bit Type: Cutting Head, Roller Bit
Drill Mud: Bentonite
Casing: HSA to 26 ft then Mud Rotary
Hoist/Hammer: Winch / Automatic Hammer
PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	1 2 18 14	S1 20	0.0 2.0			Very loose black cinders, no odor, dry										
				298.9 0.5	SM	Medium dense dark gray to black silty SAND (SM), dry -BOTTOM ASH-			5	20	55	20				
	7 13 14 16	S2 15	2.0 4.0		SM	Medium dense dark gray silty SAND (SM), dry			10	50	25	15				
5	4 8 12 13	S3 20	4.0 6.0	295.4 4.0	ML	Medium dense dark gray to black sandy SILT (ML), no odor, moist, contains cinders		4	5	25	11	55				
	4 8 10 11	S4 15	6.0 8.0	293.4 6.0	SP	Medium dense black poorly-graded SAND (SP), no odor, wet			30	55	15					
	3 5 6 10	S5 16	8.0 10.0	291.4 8.0	CH	Stiff gray-brown fat CLAY (CH), no odor, moist, trace cinder fragments to particles -FILL-						100				
10 ▽	P U S H	U1 20	10.0 12.0		CH	Gray fat CLAY (CH)					2	98				
	2 2 5 5	S6 14	12.0 14.0		CH	Medium stiff gray-brown to yellow-brown fat CLAY (CH), no odor, moist, trace cinder particles to fragments						100				
15	P U S H	U2 22	14.0 16.0		CH	Gray fat CLAY (CH)					3	97				
	1 2 2 3	S7 20	16.0 18.0	283.4 16.0	MH	Soft yellow-brown to gray-brown elastic SILT (MH), mottled, moist						100				
20	1 2 2 4	S8 24	18.0 20.0	281.4 18.0	CL	Soft gray-brown lean CLAY (CL), moist						100				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
6/15/17		0	10.0	12.0	12.0

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (ft)	70.0
Rock Cored (ft)	0.0
Samples	17S, 2U

Boring No. HA-B12

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B12
File No. 129342-011
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20						-FILL-										
				276.4 23.0												
	4 8 6 8	S9 18	24.0 26.0		ML	Stiff light brown sandy SILT (ML), stratified, no odor, moist, with sandy silt layers and seams -ALLUVIAL DEPOSITS-					50	50				
25																
	8 6 6 9	S10 15	28.0 30.0		ML	Stiff brown to gray-brown SILT with sand (ML), stratified, wet, with medium to fine sand in frequent layers					15	85				
30				269.4 30.0												
	13 16 13 11	S11 18	33.0 35.0		SW	Medium dense light brown well graded SAND (SW), wet			15	50	35					
35						-FLUVIAL DEPOSITS-										
	11 15 16 20	S12 16	38.0 40.0		SP	Dense light brown poorly-graded SAND (SP), wet				60	40					
40																
	6 9 12 12	S13 24	43.0 45.0		SP	Medium dense light brown poorly-graded SAND (SP), wet				60	40					
45																
	8 9 10 14	NR	48.0 50.0			No recovery: Medium to fine SAND found in tip of spoon										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B12

TEST BORING REPORT

Boring No. HA-B12
File No. 129342-011
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50																
						Note: Drill action indicated possible gravel at 51 ft.										
	4 9 10 10	S14 12	53.0 55.0		SP	Medium dense gray poorly-graded SAND with gravel (SP), no odor, wet	10	8	4	46	28	4				
						-FLUVIAL DEPOSITS-										
55																
	13 20 22 25	S15 18	58.0 60.0		SP	Dense gray poorly-graded SAND (SP), wet				70	30					
60																
	20 21 19 20	S16 10	63.0 65.0		SP	Dense gray poorly-graded SAND (SP), wet, trace coarse to fine gravel			5	65	30					
65																
	6 9 14 18	S17 15	68.0 70.0		SP	Medium dense gray poorly-graded SAND (SP), wet, trace coarse to fine gravel			15	70	15					
70				229.4 70.0		BOTTOM OF EXPLORATION AT 70.0 FT										

Note: Borehole grouted upon completion.

Note: An offset borehole was drilled immediately adjacent to test boring HA-B12 to measure a next day water level reading. The offset borehole was drilled to approximately 15 ft below ground surface and set with a temporary standpipe constructed with solid 2-in. PVC riser pipe to 5 ft and a 10-ft section of 2-in. screened PVC from 5 to 15 ft below ground surface. The water level reading after 24 hours in the offset borehole was approximately 8.5 ft below ground surface.

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B12

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B13

Project	Pond 004 Closure, New Madrid Power Plant Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling

File No.	129342-011
Sheet No.	1 of 2
Start	19 June 2017
Finish	19 June 2017
Driller	C. Dutton
H&A Rep.	C. Toscano
Elevation	306.4
Datum	NAVD88
Location	N 249,893.2 E 1,096,110.9

	Casing	Sampler	Barrel
Type	HSA	S	None
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550
Bit Type: Cutting Head
Drill Mud: None
Casing: HSA
Hoist/Hammer: Winch / Automatic Hammer
PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	2 2 3 2	S1 18	0.0 2.0		SM	Loose black silty SAND (SM), specks to particles, no odor, dry, contains cinders -BOTTOM ASH-										
	2 3 3 4	S2 15	2.0 4.0		SM	Loose black silty SAND (SM) specks to particles, no odor, dry, contains cinders			20	45	5	30				
5	2 5 7 10	S3 18	4.0 6.0		SM	Medium dense silty SAND (SM), particles, no odor, dry, contains cinders			20	45	5	30				
	2 4 7 7	S4 22	6.0 8.0	300.4 6.0	SP	Medium dense black poorly-graded SAND (SP), particles, no odor, dry, contains cinders			15	70	15					
				299.4 7.0	ML	Stiff gray-brown sandy SILT (ML), no odor, moist					30	70				
	6 5 5 5	S5 15	8.0 10.0	298.4 8.0	CL	Stiff gray-brown lean CLAY with sand (CL), mottled, no structure, no odor, moist, with fine sand in frequent erratic seams and layers, trace cinder particles -FILL-					20	80				
10	2 2 2 3	S6 15	10.0 12.0		CL	Soft gray-brown sandy lean CLAY (CL), mottled, no structure, no odor, moist, with fine sand in frequent erratic seams and layers, trace cinder particles					32	68				
	2 2 3 6	S7 24	12.0 14.0		CL	Medium stiff gray-brown lean CLAY with sand (CL), mottled, no structure, no odor, moist, with fine sand in frequent erratic seams and layers					20	80				
15	2 3 3 3	S8 20	14.0 16.0	292.4 14.0	CL	Medium stiff gray-brown lean CLAY (CL), no structure, moist, trace cinder particles						100				
	2 5 7 9	S9 20	16.0 18.0		CL	Stiff gray lean CLAY (CL), no structure, moist, trace coarse to fine sand, cinder particles						100				
20	4 4 6 7	S10 24	18.0 20.0	288.4 18.0	MH	Stiff gray-brown elastic SILT (MH), mottled					10	90				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
6/19/17		0	36.0	38.0	36.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

- ▯ Riser Pipe
- ▤ Screen
- ⁘ Filter Sand
- ⁘ Cuttings
- ■ Grout
- △ Concrete
- ▨ Bentonite Seal

Summary

Overburden (ft)	38.0
Rock Cored (ft)	0.0
Samples	19S

Boring No. HA-B13

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B13
File No. 129342-011
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20	1 3 4 4	S11 24	20.0 22.0		MH	Medium stiff gray-brown elastic SILT (MH), mottled -FILL-					5	95				
	1 2 1 2	S12 24	22.0 24.0		MH	Soft brown to gray-brown elastic SILT (MH), no odor, moist						100				
25	WOH 2 2 4	S13 24	24.0 26.0		MH	Soft gray-brown elastic SILT with sand (MH), no odor, moist, fine sand in tip of spoon					15	85				
	1 3 7 8	S14 20	26.0 28.0		MH	Soft gray-brown elastic SILT with sand (MH), no odor, moist, fine sand in tip of spoon					15	85				
				279.4 27.0	SM	Medium dense brown silty SAND (SM), no odor, moist					60	40				
	4 9 8 9	S15	28.0 30.0	278.4 28.0	ML	Very stiff brown SILT (ML), stratified, no odor, dry, with fine sand in frequent seams and layers -ALLUVIAL DEPOSITS					10	90				
30	5 4 9 11	S16 22	30.0 32.0		ML	Stiff brown SILT (ML), dry, with fine sand in frequent layers						100				
	4 6 9 11	S17 20	32.0 34.0		ML	Stiff brown SILT with sand (ML), moist, with fine sand in frequent seams and layers					15	85				
35 ▽	4 9 10 10	S18 18	34.0 36.0	272.4 34.0	SM	Medium dense brown silty SAND (SM), no odor, moist					60	40				
	2 3 7 9	S19 15	36.0 38.0	270.4 36.0	ML	Stiff brown sandy SILT (ML), no odor, wet, with fine sand in frequent layers					49	51				
				268.4 38.0		BOTTOM OF EXPLORATION AT 38.0 FT Note: Borehole grouted upon completion.										
40																
45																

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B13

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B14

Project	Pond 004 Closure, New Madrid Power Plant Marston, MO	File No.	129342-011
Client	Associated Electric Cooperative, Inc.	Sheet No.	1 of 2
Contractor	Bulldog Drilling	Start	20 June 2017
		Finish	20 June 2017
		Driller	C. Dutton
		H&A Rep.	C. Toscano
		Elevation	301.1
		Datum	NAVD88
		Location	N 249,916.3 E 1,096,337.5

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	None	Rig Make & Model: CME 550
Inside Diameter (in.)	4.25	1.375	--	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	--	140	-	Casing: HSA Hoist/Hammer: Winch / Automatic Hammer
Hammer Fall (in.)	--	30	-	PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	3 5 8 13	S1 18	0.0 2.0		SP	Medium dense black to dark brown poorly-graded SAND (SP), no odor, dry, contains cinders			15	65	15	5				
						-BOTTOM ASH-										
5	4 11 13 13	S2 20	4.0 6.0		SP	Medium dense black to dark brown poorly-graded SAND (SP), no odor, wet, contains cinders			15	65	15	5				
	5 7 8 6	S3 15	6.0 8.0		SP	Medium dense black to dark brown poorly-graded SAND (SP), no odor, wet, contains cinders		2	13	63	17	5				
	2 3 4 4	S4 16	8.0 10.0		SP	Loose black to dark brown poorly-graded SAND (SP), no odor, wet, contains cinders			15	65	15	5				
				292.1 9.0	CL	Medium stiff gray lean CLAY (CL), wet						100				
10						-FILL-										
15	3 4 3 5	S5 24	14.0 16.0		CL	Medium stiff brown to gray-brown lean CLAY (CL), mottled, no structure, wet						100				
	WOH 1 2 3	S6 18	18.0 20.0		CL	Soft brown to gray-brown lean CLAY (CL), mottled, no structure, wet Note: Fine sands found in tip of spoon.						100				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Water
6/20/17		0	24.0	26.0	24.0

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
▥ Riser Pipe
▤ Screen
░ Filter Sand
▒ Cuttings
■ Grout
△ Concrete
▨ Bentonite Seal

Summary

Overburden (ft)	30.0
Rock Cored (ft)	0.0
Samples	9S

Boring No. HA-B14

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B14
File No. 129342-011
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20	2 4 4 4	S7 15	20.0 22.0	281.1 20.0	SM	Loose brown silty SAND (SM), well stratified, moist -ALLUVIAL DEPOSITS-					60	40				
∇ 25	5 8 8 8	S8 20	24.0 26.0	277.1 24.0	ML	Very stiff brown sandy SILT (ML), well stratified, wet, with fine sand in frequent seams and layers					40	60				
	5 5 9 12	S9 20	28.0 30.0	273.1 28.0	SM	Medium dense brown silty SAND (SM), wet					70	30				
30				271.1 30.0		BOTTOM OF EXPLORATION AT 30.0 FT Note: Borehole grouted upon completion.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B14

TEST BORING REPORT

Boring No. HA-B15

Project	Pond 004 Closure, New Madrid Power Plant Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling

File No.	129342-011
Sheet No.	1 of 2
Start	19 June 2017
Finish	19 June 2017
Driller	C. Dutton
H&A Rep.	C. Toscano
Elevation	299.6
Datum	NAVD88
Location	N 249,697.1 E 1,096,149.9

	Casing	Sampler	Barrel
Type	HSA	S	None
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550
Bit Type: Cutting Head
Drill Mud: None
Casing: HSA
Hoist/Hammer: Winch / Automatic Hammer
PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0	2 2 5 5	S1 12	0.0 2.0		SP	Loose black poorly-graded SAND (SP), no odor, dry, contains cinder particles -BOTTOM ASH-			15	70	15					
	4 5 3 2	S2 18	2.0 4.0		SP	Similar to S1			15	70	15					
				296.6 3.0	CL	Medium stiff gray lean CLAY with sand (CL), moist, trace cinder particles					15	85				
5	2 2 3 6	S3 15	4.0 6.0		CL	Medium stiff brown to gray-brown sandy lean CLAY (CL), moist -FILL-					34	66				
	2 2 2 4	S4 18	6.0 8.0	293.6 6.0	MH	Soft brown elastic SILT (MH), no structure, no odor, moist					10	90				
	2 3 4 5	S5 24	8.0 10.0	291.6 8.0	CL	Medium stiff gray-brown lean CLAY (CL), no odor, moist, trace cinder particles					5	95				
10	1 3 4 5	S6 18	10.0 12.0		CL	Medium stiff gray-brown lean CLAY (CL), no odor, moist, with 2-in. thick layer of cinder particles						100				
	2 3 5 7	S7 16	12.0 14.0		CL	Medium stiff gray-brown lean CLAY (CL), no odor, moist, trace cinder particles						100				
15	1 2 3 3	S8 24	14.0 16.0		CL	Medium stiff gray-brown lean CLAY (CL), no odor, moist, trace cinder particles						100				
	2 2 2 3	S9 24	16.0 18.0	283.6 16.0	MH	Soft gray to gray-brown elastic SILT with sand (MH), no odor, moist					15	85				
	1 1 3 3	S10 18	18.0 20.0	281.6 18.0	ML	Soft gray to gray-brown sandy SILT (ML), no structure, moist					30	70				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
6/19/17		0	28.0	30.0	28.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (ft)	30.0
Rock Cored (ft)	0.0
Samples	14S

Boring No. HA-B15

Field Tests:
Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B15
File No. 129342-011
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20	2 6 6 4	S11 12	20.0 22.0	279.1 20.5	SM	Medium dense yellow-brown silty SAND (SM), no odor, dry					85	15				
						-ALLUVIAL DEPOSITS-										
	4 9 8 7	S12 20	22.0 24.0		SM	Medium dense brown silty SAND (SM), well stratified, dry					85	15				
25																
	6 7 6 5	S13 24	26.0 28.0	273.6 26.0	ML	Medium stiff brown SILT with sand (ML), well stratified, no odor, moist					25	75				
∇	3 6 6 6	S14 18	28.0 30.0	271.1 28.5	SP	Medium dense brown poorly-graded SAND (SP), no odor, wet				75	25					
30				269.6 30.0		BOTTOM OF EXPLORATION AT 30.0 FT										
						Note: Borehole grouted upon completion.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B15

TEST BORING REPORT

Boring No. HA-B16

Project	Pond 004 Closure, New Madrid Power Plant Marston, MO	File No.	129342-011
Client	Associated Electric Cooperative, Inc.	Sheet No.	1 of 2
Contractor	Bulldog Drilling	Start	20 June 2017
		Finish	20 June 2017
		Driller	C. Dutton
		H&A Rep.	C. Toscano
		Elevation	301.1
		Datum	NAVD88
		Location	N 249,776.0 E 1,096,418.5

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	None	Rig Make & Model: CME 550
Inside Diameter (in.)	4.25	1.375	--	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	--	140	-	Casing: HSA Hoist/Hammer: Winch / Automatic Hammer
Hammer Fall (in.)	--	30	-	PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	3 8 17 17	S1 15	0.0 2.0		SM	Medium dense black silty SAND (SM), particles to specks, no odor, dry, contains cinders			15	40	30	15				
						-BOTTOM ASH-										
5	4 6 7 7	S2 13	4.0 6.0	297.1 4.0	SP	Medium dense black poorly-graded SAND (SP), particles to specks, no odor, wet, contains cinders			30	55	15					
	4 14 17 16	S3 15	6.0 8.0		SP	Dense black poorly-graded SAND (SP), no odor, wet, contains cinders			20	70	10					
	4 8 6 6	S4 13	8.0 10.0		SP	Medium dense black poorly-graded SAND (SP), no odor, wet, contains cinders			20	70	10					
				292.1 9.0	CL	Stiff gray-brown lean CLAY (CL), wet						100				
10						-FILL-										
15	3 3 5 6	S5 16	14.0 16.0		CL	Medium stiff gray-brown to brown lean CLAY (CL), mottled, no structure, wet					7	93				
	1 1 2 2	S6 24	18.0 20.0		CL	Soft gray-brown to brown lean CLAY (CL), mottled, no structure, wet						100				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
◫ Riser Pipe
▤ Screen
░ Filter Sand
▒ Cuttings
■ Grout
△ Concrete
▨ Bentonite Seal

Summary

Overburden (ft)	30.0
Rock Cored (ft)	0.0
Samples	8S, 2U

Boring No. HA-B16

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B16
File No. 129342-011
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20	1 2 6 6	S7 19	20.0 22.0		CL	Soft gray-brown to brown lean CLAY (CL), mottled, no structure, wet -FILL-						100				
				280.1 21.0	ML	Stiff brown sandy SILT (ML), well stratified, wet					30	70				
	P U S H	U1 21	22.0 24.0	279.1 22.0	CL	Gray and brown lean CLAY (CL) -ALLUVIAL DEPOSITS-					8	92				
25	P U S H	U2 24	24.0 26.0	277.1 24.0	ML	Brown sandy SILT (ML)					8	92				
	5 9 4 13	S8 18	28.0 30.0		SM	Stiff brown silty SAND (SM), no odor, wet					78	22				
30				271.1 30.0		BOTTOM OF EXPLORATION AT 30.0 FT Note: Borehole grouted upon completion. Note: Water level not measured.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B16

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B17

Project	Pond 004 Closure, New Madrid Power Plant Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling

File No.	129342-011
Sheet No.	1 of 2
Start	19 June 2017
Finish	19 June 2017
Driller	C. Dutton
H&A Rep.	C. Toscano
Elevation	301.8
Datum	NAVD88
Location	N 249,551.4 E 1,096,260.2

	Casing	Sampler	Barrel
Type	HSA	S	None
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550
Bit Type: Cutting Head
Drill Mud: None
Casing: HSA
Hoist/Hammer: Winch / Automatic Hammer
PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	2 3 4 4	S1 16	0.0 2.0		SM	Loose brown to black silty SAND (SM), particles to specks, no odor, dry, contains cinders				25	30	45				
	5 3 3 3	S2 20	2.0 4.0	299.8 2.0	ML	Loose brown sandy SILT (ML), no odor, dry, contains cinders -BOTTOM ASH-				10	30	60				
5	4 8 13 16	S3 18	4.0 6.0	297.8 4.0	SM	Medium dense black silty SAND (SM) (Bottom Ash/Cinders), particles to specks, no odor, dry			20	25	25	30				
	7 9 12 13	S4 18	6.0 8.0		SM	Medium dense black silty SAND (SM), particles to specks, no odor, dry, contains cinders			20	20	20	40				
10	5 12 12 10	S5 15	9.0 11.0	292.8 9.0	SP	Medium dense black poorly-graded SAND (SP), no odor, wet, contains cinders			30	55	15					
	1 2 4 6	S6 24	12.0 14.0	289.8 12.0	CL	Medium stiff gray lean CLAY (CL), no odor, wet						100				
15	2 3 4 6	S7 24	14.0 16.0		CL	Medium stiff gray-brown to brown lean CLAY (CL), no odor, wet, trace fine sand, cinder particles						100				
						-FILL-										
	2 2	S8 24	19.0 21.0		CL	Soft gray to gray-brown lean CLAY (CL), wet, trace cinder particles Note: Fine sand found in tip of spoon.						100				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
6/19/17	17:15	.25	28.0	30.0	23.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (ft)	30.0
Rock Cored (ft)	0.0
Samples	11S

Boring No. HA-B17

Field Tests:

Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B17
File No. 129342-011
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	2 5															
	6 8 7 8	S9 24	21.0 23.0	280.8 21.0	SM	Medium dense brown silty SAND (SM), well stratified, wet -ALLUVIAL DEPOSITS-					60	40				
▽	5 7 10 7	S10 16	23.0 25.0		SM	Medium dense brown silty SAND (SM), well stratified, wet					60	40				
25																
	7 8 5 9	S11	28.0 30.0	273.8 28.0	ML	Stiff gray-brown SILT (ML), no odor, wet, with fine sand in frequent seams and layers					5	95				
30				271.8 30.0		BOTTOM OF EXPLORATION AT 30.0 FT Note: Borehole grouted upon completion.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B17

TEST BORING REPORT

Boring No. HA-B18

Project	Pond 004 Closure, New Madrid Power Plant Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling

File No.	129342-011
Sheet No.	1 of 2
Start	20 June 2017
Finish	20 June 2017
Driller	C. Dutton
H&A Rep.	C. Toscano
Elevation	300.2
Datum	NAVD88
Location	N 249,538.8 E 1,096,431.7

	Casing	Sampler	Barrel
Type	HSA	S	None
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550

Bit Type: Cutting Head

Drill Mud: None

Casing: HSA

Hoist/Hammer: Winch / Automatic Hammer

PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	3 3 4 5	S1 12	0.0 2.0		SM	Loose black silty SAND (SM), particles to specks, no odor, dry, contains cinders -BOTTOM ASH-			5	20	20	45				
	8 5 6 5	S2 20	2.0 4.0	298.2 2.0	ML	Medium dense black to dark brown sandy SILT (ML), moist, contains cinders			5	10	25	60				
5	2 2 4 4	S3 24	4.0 6.0		ML	Loose dark brown sandy SILT (ML), trace cinder particles, moist					30	70				
	1 1 6 9	S4 15	6.0 8.0	294.2 6.0	SM	Loose black silty SAND (SM), particles to specks, wet, contains cinders			20	25	30	25				
	5 7 8 7	S5 15	8.0 10.0		SM	Medium dense black silty SAND (SM), particles to specks, wet, contains cinders			40	35	10	15				
10	2 2 2 2	S6 16	10.0 12.0	290.2 10.0	SP	Very loose black poorly-graded SAND (SP), particles to specks, wet										
	4 4 5 6	S7 19	12.0 14.0	288.2 12.0	CL	Stiff gray lean CLAY (CL), no odor, wet, trace cinder particles -FILL-						100				
15	3 2 4 5	S8 15	14.0 16.0		CL	Medium stiff brown to gray-brown lean CLAY (CL), wet						100				
	1 2 3 3	S9 24	18.0 20.0		CL	Medium stiff brown to gray-brown lean CLAY (CL), wet						100				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water

Sample ID

O - Open End Rod

T - Thin Wall Tube

U - Undisturbed Sample

S - Split Spoon Sample

Well Diagram

◫	Riser Pipe
▤	Screen
⁘	Filter Sand
▩	Cuttings
■	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft)	30.0
Rock Cored (ft)	0.0
Samples	12S

Boring No. HA-B18

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B18
File No. 129342-011
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	1 2 6 7	S10 24	20.0 22.0		CL	Medium stiff brown to gray-brown lean CLAY (CL), wet -FILL-						100				
				279.2 21.0	SM	Loose brown silty SAND (SM), wet, with silt in frequent layers					60	40				
	3 6 5 5	S11 24	22.0 24.0	278.2 22.0	ML	Stiff brown sandy SILT (ML), well stratified, wet, with frequent fine sandy silt seams and layers -ALLUVIAL DEPOSITS-					30	70				
25																
	7 7 5 10	S12 20	28.0 30.0		ML	Stiff brown sandy SILT (ML), well stratified, wet, with medium to fine sand in occasional layers					33	67				
30				270.2 30.0		BOTTOM OF EXPLORATION AT 30.0 FT Note: Borehole grouted upon completion. Note: Water level not measured.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B18

TEST BORING REPORT

Boring No. HA-B19

Project	Pond 004 Closure, New Madrid Power Plant Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling

File No.	129342-011
Sheet No.	1 of 2
Start	20 June 2017
Finish	20 June 2017
Driller	C. Dutton
H&A Rep.	C. Toscano
Elevation	301.6
Datum	NAVD88
Location	N 249,663.9 E 1,096,477.0

	Casing	Sampler	Barrel
Type	HSA	S	None
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550
Bit Type: Cutting Head
Drill Mud: None
Casing: HSA
Hoist/Hammer: Winch / Automatic Hammer
PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	8 1 16 19	S1 15	0.0 2.0		SM	Medium dense black to dark brown silty SAND (SM), particles to specks, no odor, dry, contains cinders -BOTTOM ASH-			10	20	50	20				
	12 19 22 15	S2 20	2.0 4.0		SM	Dense black to dark brown silty SAND (SM), particles to specks, mps 3 mm, no odor, dry, contains cinders			10	50	20	20				
5																
	6 7 8 8	S3 15	6.0 8.0	295.6 6.0	SP	Medium dense black poorly-graded SAND (SP), no odor, wet, contains cinders			35	50	15					
	3 4 4 4	S4 20	8.0 10.0		SP	Loose black poorly-graded SAND (SP), no odor, wet, contains cinders			25	50	25					
10	3 3 7 11	S5 14	10.0 12.0	291.6 10.0	CH	Stiff gray fat CLAY with sand (CH), no odor, wet					17	83				
						-FILL-										
15	3 3 4 5	S6 20	14.0 16.0	287.6 14.0	CL	Medium stiff brown to gray-brown lean CLAY (CL), no odor, wet, trace cinder particles						100				
	2 2 2 3	S7 24	16.0 18.0		CL	Soft brown to gray-brown lean CLAY (CL), wet						100				
	1 2 2 2	S8 24	18.0 20.0		CL	Soft brown to gray-brown lean CLAY (CL), wet						100				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	30.0
Rock Cored (ft)	0.0
Samples	12S

Boring No. HA-B19

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-B19
File No. 129342-011
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	WOH 1 2 3	S9 20	20.0 22.0		CL	Soft brown to gray-brown lean CLAY (CL), wet Note: Fine sand found in tip of spoon. -FILL-						100				
	4 3 7 11	S10 24	22.0 24.0	279.6 22.0	SM	Loose brown silty SAND (SM), well stratified, no odor, moist, with frequent seams and layers of silt and sandy silt -ALLUVIAL DEPOSITS-					80	20				
25	4 7 7 9	S11 18	24.0 26.0	277.6 24.0	ML	Stiff brown SILT (ML), well stratified, wet, with frequent seams and layers of fine sandy silt						100				
	9 13 14 16	S12 16	28.0 30.0	273.6 28.0	SM	Medium dense brown silty SAND (SM), well stratified, wet					60	40				
30				271.6 30.0		BOTTOM OF EXPLORATION AT 30.0 FT Note: Borehole grouted upon completion. Note: Water level not measured.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-B19

TEST BORING REPORT

Boring No. HA-RWP-01(OW)

Project Raw Water Pond, New Madrid Power Plant, Marston, Missouri
Client Associated Electric Cooperative, Inc.
Contractor Bulldog Drilling

File No. 129342-039
Sheet No. 1 of 3
Start 16 April 2021
Finish 19 April 2021
Driller J. Gates
H&A Rep. C. Toscano

Elevation 307.690 (est.)
Datum NAVD88

Location See Plan
N 245,309
E 1,098,574

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550X
Bit Type: Cutting Head
Drill Mud: None
Casing: HSA
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: NONE

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	2 4 5 7	S1 16	0.0 2.0		CL- ML	Stiff brown lean CLAY with silt (CL-ML), no odor, moist -EMBANKMENT FILL-	-	-	-	-	30	70				
	4 5 6 10	S2 16	2.0 4.0		CL- ML	Similar to S1	-	-	-	-	30	70				
5	3 4 7 8	S3 20	4.0 6.0	303.7 4.0	CL	Stiff gray-brown lean CLAY (CL) with frequent mottle layer of elastic silt, no odor, moist PP = 2.75 TSF	-	-	-	-	10	90				
	P U S H	NR 14	6.0 8.0	301.7 6.0	SM	Gray silty SAND (SM) Note: Pushed 3.0 in. undisturbed shelby tube 6.0 ft to 8.0 ft, recovery 14.0 in. material inside of tube. See jar sample. Sample rejected for lab testing										
	3 5 5 10	S4 20	8.0 10.0	299.7 8.0	MH	Stiff gray elastic SILT (MH), no odor, moist PP = 3.0 TSF	-	-	-	-	-	100				
10	P U S H	U1 24	10.0 12.0	297.7 10.0	CL	Gray and brown lean CLAY with sand (CL) Note: Pushed 3.0 in. undisturbed shelby tube 10.0 ft to 12.0 ft, recovery 24.0 in. PP = <4.5 TSF LL=42, PI=24, WC=19.4%	-	-	-	-	16	84				
	3 3 5 12	S5 20	12.0 14.0		CL	Medium stiff gray-brown lean CLAY with sand (CL), no odor, moist	-	-	-	-	15	85				
15	4 9 9 12	S6 18	14.0 16.0		CL	Very stiff dense gray-brown sandy lean CLAY (CL) with occasional interbedded layers (3.0 in. thick) of medium to fine sand, no odor, moist	-	-	-	-	30	70				
	3 5 7 1	S7 20	16.0 18.0		CL	Stiff gray-brown to orange lean CLAY with sand (CL), no odor, moist	-	-	-	-	15	85				
	2 2 2 3	S8 15	18.0 20.0	289.7 18.0	ML	Very loose light brown SILT (ML), slightly stratified, no odor, moist -ALLUVIAL DEPOSITS-	-	-	-	-	-	100				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
4/16/21	1200	-	28.0	30.0	28.0
4/19/21	1210	3 Days	28.0	30.0	27.7

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

◫	Riser Pipe
☰	Screen
⠿	Filter Sand
⁂	Cuttings
■	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft)	50.0
Rock Cored (ft)	-
Samples	15S, 2U

Boring No. HA-RWP-01(OW)

Field Tests:
Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20	2 2 3 2	S9 20	20.0 22.0		ML	Similar to S8, except loose and wet (perched water)	-	-	-	-	-	100				
	P U S H	U2 20	22.0 24.0	285.7 22.0	CL	Dark brown sandy lean CLAY (CL) Note: Pushed 3.0 in. undisturbed shelby tube 22.0 ft to 24.0 ft, recovery 24.0 in., moist PP = 1.75 TSF LL=29, PI=9, WC=25.3%	-	-	-	-	35	65				
25	2 2 2 2	10 20	24.0 26.0	283.7 24.0	ML	Very loose yellow-brown SILT with sand (ML), stratified, no odor, moist	-	-	-	-	15	85				
30	2 2 2 2	S11 20	28.0 30.0		ML	Very loose yellow-brown sandy SILT (ML), stratified, no odor, moist	-	-	-	-	40	60				
35	3 4 7 8	S12 15	33.0 35.0		ML	Medium dense brown SILT (ML) with occasional interbedded layers of sandy silt and medium to fine sand, no odor, wet	-	-	-	-	-	100				
40	4 6 9 9	S13 14	38.0 40.0	269.7 38.0	SM	Medium dense yellow-brown fine silty SAND (SM), no odor, wet	-	-	-	-	60	40				
45	3 3 6 13	S14 12	43.0 45.0		SM	Loose light brown fine silty SAND (SM), with occasional interbedded layer (2.0 in. thick) of gray silt, well stratified, no odor, wet	-	-	-	-	75	25				
	4 4 4 8	S15 15	48.0 50.0		SM	Similar to S14, except gray elastic silt in tip of spoon	-	-	-	-	75	25				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50				257.7 50.0		BOTTOM OF EXPLORATION AT 50.0 FT										
						Note: Installed Observation Well to 50.0 ft.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-RWP-02(OW)

Project	Raw Water Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling

File No.	129342-039
Sheet No.	1 of 3
Start	20 April 2021
Finish	20 April 2021
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	307.690 (est.)
Datum	NAVD88
Location	See Plan N 244,929 E 1,099,210

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550X
Bit Type: Cutting Head
Drill Mud: None
Casing: HSA
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: NONE

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	3 3 4 6	S1 15	0.0 2.0		CL	Medium stiff gray-brown lean CLAY (CL), no odor, dry -EMBANKMENT FILL-	-	-	-	-	5	95				
	4 3 8 8	S2 15	2.0 4.0		CL	Stiff gray-brown lean CLAY with sand (CL), no odor, moist	-	-	-	-	15	85				
5	3 4 5 6	S3 20	4.0 6.0		CL	Stiff gray-brown lean CLAY (CL) with frequent layers for SILT and SILT with sand, no odor, moist PP = 3.0 TSF	-	-	-	-	5	95				
	P U S H	U1 22	6.0 8.0		CL	Dark brown sandy lean CLAY (CL) Note: Pushed 3.0 in. undisturbed shelby tube 6.0 ft to 8.0 ft, recovery 22.0 in. PP = 4.25 TSF, LL=35, PI=18, WC=19.6%	-	-	-	-	36	64				
	2 3 7 9	S4 20	8.0 10.0		CL	Stiff gray-brown lean CLAY (CL), no odor, moist PP = 3.5 TSF	-	-	-	-	5	95				
10	3 5 7 10	S5 24	10.0 12.0		CL	Stiff gray-brown lean CLAY (CL) with frequent interbedded layers of silt with sand, no odor, dry	-	-	-	-	-	100				
	4 5 9 11	S6 24	12.0 14.0		CL	Stiff gray-brown lean CLAY (CL), no odor, dry	-	-	-	-	40	60				
15	3 4 6 6	S7 24	14.0 16.0		CL	Similar to S6	-	-	-	-	40	90				
	2 2 2 2	S8 20	16.0 18.0		CL	Similar to S6, except soft	-	-	-	-	39	61				
	P U S H	U2 24	18.0 20.0		CL	Gray sandy SILT (ML) Note: Pushed 3.0 in. undisturbed shelby tube, 18.0 to 20.0 ft, recovery 29.0 in. PP = 1.75 TSF LL=21, PI=NP, WC=20.8%										
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
4/20/21	1030	-	33.0	33.0	32.7

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

◫ Riser Pipe
▤ Screen
⁘ Filter Sand
▩ Cuttings
■ Grout
△ Concrete
▨ Bentonite Seal

Summary

Overburden (ft)	50.0
Rock Cored (ft)	-
Samples	14S, 2U

Boring No. HA-RWP-02(OW)

Field Tests:

Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-RWP-02(OW)
File No. 129342-039
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	2 2 3 4	S9 24	20.0 22.0		CL	Similar to S7, except medium stiff and with frequent layers of elastic SILT	-	-	-	-	-	100				
				285.2 22.5												
	WOH 1 2 3	S10 15	23.0 25.0		ML	Very loose yellow-brown SILT (ML), grading into a light brown fine sand, stratified, no odor, dry -ALLUVIAL DEPOSITS-	-									
				283.2 24.5												
25																
	P U S H	- NR	28.0 30.0			Note: Pushed 3.0 in undisturbed shelby tube 28.0 ft to 30.0 ft, no recovery, probably sand										
30																
	P U S H	S11 NR	33.0 35.0		SP	Note Drill rod tip wet at 33.0 ft. Note: Pushed 3.0 in., undisturbed shelby tube to refusal at 34.2 ft. Note: Medium to fine SAND found inside tube, see jar sample.										
35																
	3 5 10 11	S12 10	38.0 40.0		SP	Medium dense light brown fine to medium poorly graded SAND (SP), no odor, wet WC=19.6%	-	-	1	49	48	2				
40																
				264.7 43.0												
	3 5 10 14	S13 12	43.0 45.0		SM	Medium dense light brown fine silty SAND (SM), no odor, wet	-	-	-	-	65	35				
45																
	4 8 11 12	S14 12	48.0 50.0		SM	Medium dense light brown medium to fine silty SAND (SM), no odor, wet	-	-	-	10	65	25				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-RWP-02(OW)

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-RWP-02(OW)
File No. 129342-039
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	**VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION** (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
50				257.7 50.0		BOTTOM OF EXPLORATION AT 50.0 FT Note: Set Observation Well at 50.0 ft.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-RWP-02(OW)

TEST BORING REPORT

Boring No. HA-RWP-03

Project	Raw Water Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling

File No.	129342-039
Sheet No.	1 of 3
Start	15 April 2021
Finish	15 April 2021
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	307.417 (est.)
Datum	NAVD88
Location	See Plan N 244,545 E 1,099,446

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550X
Bit Type: Cutting Head
Drill Mud: Bentonite
Casing: HSA
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: NONE

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	4 4 6 6	S1 20	0.0 2.0		CL	Stiff brown lean CLAY with sand (CL), no odor, moist	-	-	-	-	15	85				
						-EMBANKMENT FILL-										
	4 4 8 8	S2 24	2.0 4.0		CL	Stiff brown sandy lean CLAY (CL), no odor, moist	-	-	-	-	30	70				
5	3 3 4 5	S3 24	4.0 6.0		CL	Similar to S1, except dark gray and medium stiff PP = 2.25 TSF	-	-	-	-	15	85				
	2 3 4 6	S4 20	6.0 8.0		CL	Similar to S1, except medium stiff	-	-	-	-	15	85				
	2 4 5 7	S5 24	8.0 10.0		CL	Stiff brown-gray lean CLAY with sand (CL), trace organic fibers, no odor, moist PP = 4.25 TSF WC=20.4%	-	-	-	-	24	76				
10	3 5 7 11	S6 18	10.0 12.0		CL	Stiff brown-gray sandy lean CLAY (CL), no odor, moist	-	-	-	-	30	70				
	6 7 7 10	S7 18	12.0 14.0		CL	Stiff gray lean CLAY with sand (CL), no odor, moist	-	-	-	-	15	85				
15	3 7 6 8	S8 20	14.0 16.0		CL	Similar to S7 PP = 2.25 TSF	-	-	-	-	15	85				
	3 5 7 8	S9 20	16.0 18.0		CL	Similar to S7, except trace anthracite coal particles	-	-	-	-	15	85				
	3 7 13 16	S10 20	18.0 20.0		CL	Very stiff gray-brown lean CLAY with sand (CL), trace anthracite particles grading into light gray fine sand, no odor, dry	-	-	-	-	15	85				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
4/15/21	1100	-	37.0	34.0	34.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

⊞	Riser Pipe
☰	Screen
⁘	Filter Sand
▨	Cuttings
■	Grout
△	Concrete
▧	Bentonite Seal

Summary

Overburden (ft)	75.0
Rock Cored (ft)	-
Samples	22S, 1U

Boring No. HA-RWP-03

Field Tests:
Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-RWP-03
File No. 129342-039
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20																
	3 3 5 4	S11 20	23.0 25.0		CL	Medium stiff gray-brown lean CLAY (CL), organic wood fragments, organic fibers, anthracite coal particles, no structure, no odor, moist						100				
25	2 3 3 4	S12 18	25.0 27.0		CL	Medium stiff gray lean CLAY (CL) with layers of silt, no structure, trace organic fibers PP = 1.0 TSF	-	-	-	-	-	100				
	2 3 3 4	S13 18	28.0 30.0	279.4 28.0	MH	Medium stiff gray elastic SILT (MH), slightly stratified, trace organic fibers PP=1.75 TSF (Gray-Brown) -ALLUVIAL DEPOSITS-	-	-	-	-	-	100				
30	P U S H	U1 18	30.0 32.0	277.4 30.0	CL	Dark gray and brown lean CLAY (CL) Note: Pushed 3.0 in undisturbed shelby tube 30.0 ft to 32.0 ft Recovery 18.0 in., PP=1.25 TSF LL=41, PI=19, WC=29.5%	-	-	-	-	-	100				
	2 3 4 4	S14 18	32.0 34.0	275.4 32.0	MH	Medium stiff, light brown elastic SILT (MH), trace organic fibers,no odor, wet at tip of spoon PP = 1.75 TSF	-	-	-	-	-	100	S	L	M	M
35				272.4 35.0		Note: Switch over to mud rotary, added bentonite drilling mix, advanced borehole uncased below 32.0 ft, Note: Observed sand in drill wash, no odor, wet										
	7 10 15 18	S15 13	38.0 40.0		SP	Medium dense light brown fine to medium poorly graded SAND (SP), no odor, wet	-	-	-	60	40	-				
40																
	10 11 16 18	S16 10	43.0 45.0		SP	Similar to S15	-	-	-	60	40	-				
45																
	74 10 14 20	S17 10	48.0 50.0		SP	Similar to S15	-	-	-	60	40	-				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-RWP-03

TEST BORING REPORT

Boring No. HA-RWP-03
File No. 129342-039
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50																
	9 12 16 18	S18 12	53.0 55.0		SP	Similar to S15	-	-	-	60	40	-				
55																
	10 9 13 12	S19 12	58.0 60.0	249.4 58.0	SW	Medium dense gray-brown fine to coarse well graded SAND (SW), odor, wet	-	-	5	70	20	5				
60																
	11 13 15 15	S20 13	63.0 65.0		SW	Similar to S19 WC=15.7%	-	1	4	70	22	3				
65																
	15 10 10 10	S21 10	68.0 70.0		SW	Similar to S19	-	-	5	70	20	5				
70																
						Note: Drill action indicated gravel 71.0 ft to 73.0 ft										
	11 11 14 15	S22 12	73.0 75.0	234.4 73.0	SP	Medium dense gray fine poorly-graded SAND (SP), no odor, wet	-	-	-	70	30	-				
75				232.4 75.0		BOTTOM OF EXPLORATION AT 75.0 FT Note: Borehole grouted to ground surface upon completion.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-RWP-04

Project	Raw Water Pond, New Madrid Power Plant, Marston, Missouri	File No.	129342-039
Client	Associated Electric Cooperative, Inc.	Sheet No.	1 of 3
Contractor	Bulldog Drilling	Start	12 April 2021
		Finish	12 April 2021
		Driller	J. Gates
		H&A Rep.	C. Toscano

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550X
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: HSA
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: NONE

Elevation 307.419 (est.)
Datum NAVD88
Location See Plan
N 244,110
E 1,099,415

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0				307.2 0.3		-CRUSHED STONE-										
	10 7 5 9	S1 16	0.0 2.0		CL	Stiff brown lean CLAY (CL) with occasional layers and seams of silty fine sand, no structure, no odor, moist -EMBANKMENT FILL-	-	-	-	-	-	100				
	4 4 6 7	S2 18	2.0 4.0		CL	Similar to S1, except gray-brown with occasional layers of fine sandy silt	-	-	-	-	-	100				
5	3 4 8 8	S3 18	4.0 6.0		CL	Similar to S1, except gray	-	-	-	-	-	100				
	2 3 5 6	S4 18	6.0 8.0		CL	Medium stiff gray lean CLAY with sand (CL), trace decomposed wood fragments, no odor, moist WC=20.1%	-	-	-	-	22	78				
	3 4 9 10	S5 16	8.0 10.0		CL	Stiff brown lean CLAY (CL), no odor, moist	-	-	-	-	-	100				
10	4 4 6 10	S6 20	10.0 12.0		CL	Stiff gray-brown lean CLAY (CL), seams of silty sand, with trace decomposed wood fragments, no odor, moist	-	-	-	-	-	100				
	3 5 7 10	S7 20	12.0 14.0		CL	Similar to S6	-	-	-	-	-	100				
15	4 5 5 10	S8 17	14.0 16.0		CL	Similar to S6	-	-	-	-	-	100				
	5 11 15 19	S9 18	16.0 18.0		CL	Very stiff gray-brown lean CLAY (CL), with frequent seams of silty fine sand and fine sand partings, trace decomposed wood fragments, no odor, moist	-	-	-	-	-	100				
	6 9 10 15	S10 20	18.0 20.0		CL	Very stiff gray-brown lean CLAY with sand (CL), trace decomposed wood fragments, no odor, moist	-	-	-	-	-	100				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
4/12/21	1400	-	28.0	30.0	30.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	50.0
Rock Cored (ft)	-
Samples	16S

Boring No. HA-RWP-04

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20																
	3 3 3 3	S11 24	23.0 25.0		CL	Medium stiff gray lean CLAY (CL), trace fine sand, organic fibers, no odor, moist	-	-	-	-	-	100				
25																
	1 1 2 2	S12 24	28.0 30.0		CL	Similar to S11, except soft Note: Wet at tip of spoon.	-	-	-	-	-	100				
30				277.4 30.0												
	2 2 3 3	S13 24	33.0 35.0		SM	Note: Spun HSA to 33.0 ft. Loose brown fine silty SAND (SM), no odor, wet -ALLUVIAL DEPOSITS -	-	-	-	-	40	60				
35																
	3 3 2 1	S14 10	38.0 40.0		SM	Note: Switch over to mud rotary, added drilling fluid, spun rollerbit open hole to 38.0 ft. Similar to S13, except with occasional layers (up to 2.0 in. thick) of lean clay, no odor, wet	-	-	-	-	80	20				
40																
	6 7 8 12	S15 12	43.0 45.0	264.4 43.0	SP	Medium dense brown fine to medium poorly graded SAND with silt (SP-SM), no odor, wet WC=15.2%	-	3	4	50	33	10				
45																
	4 2 6 10	S16 13	48.0 50.0	259.4 48.0	SW	Loose brown to gray fine to coarse well graded SAND (SW) with interbedded layer (6.0 in. thick) of fat clay, no odor, wet	-	-	20	55	25	-				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-RWP-04
File No. 129342-039
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50				257.4 50.0		BOTTOM OF EXPLORATION AT 50.0 FT Note: Borehole grouted upon completion.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-RWP-04

TEST BORING REPORT

Boring No. HA-RWP-05

Project	Raw Water Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling

File No.	129342-039
Sheet No.	1 of 3
Start	13 April 2021
Finish	13 April 2021
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	307.300 (est.)
Datum	NAVD88
Location	See Plan N 244,097 E 1,098,629

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550X
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: HSA
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: NONE

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	6 5 6 8	S1 15	0.0 2.0	307.1 0.3		-CRUSHED STONE-										
					CL	Stiff brown lean CLAY with sand (CL), trace organic fibers, no odor, moist -EMBANKMENT FILL-	-	-	-	-	15	85				
	3 4 6 7	S2 20	2.0 4.0		CL	Similar to S1	-	-	-	-	15	85				
	2 2 4 5	S3 20	4.0 6.0		CL	Medium stiff gray lean CLAY (CL), trace fine sand, organic fibers, no odor, moist	-	-	-	-	-	100				
5																
	3 3 6 5	S4 15	6.0 8.0		CL	Similar to S3, except gray, stiff, and occasional fine sand in frequent partings	-	-	-	-	-	100				
	3 4 8	S5 10	8.0 9.0	298.3 9.0	CL	Medium stiff gray lean CLAY (CL), no odor, moist	-	-	-	-	-	100				
	6	S5A 6	9.0 10.0	297.3 10.0	SM	Medium dense gray fine silty SAND (SM), no odor, moist	-	-	-	5	70	25				
10	2 4 7 8	S6 20	10.0 12.0		CL	Stiff gray-brown lean CLAY (CL), no odor, moist Note: Washed out borehole to 12.0 ft.	-	-	-	-	-	100				
	P U S H	U1 21	12.0 14.0		CL	Gray and brown lean CLAY with sand (CL) Note: Pushed by undisturbed shelby tube from 12.0 ft. to 14.0 ft, recovery 21.0 in., no water at top of sample. PP = 4.75 TSF LL=39, PI=17, WC=16.7%	-	-	-	1	17	82				
	3 10 19 18	S7 20	14.0 16.0		CL	Very stiff gray-brown sandy lean CLAY (CL), no odor, moist	-	-	-	-	25	75				
15																
	7 7 7 7	S8 24	16.0 18.0		CL	Stiff gray-brown sandy lean CLAY (CL), no odor, moist	-	-	-	-	25	75				
	3 4 15 17	S9 15	18.0 20.0	287.8 19.5	CL	Very stiff gray-brown lean CLAY (CL), no odor, moist Note: Medium to fine sand found in tip of spoon (light brown).	-	-	-	-	-	100				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
4/13/21	1130	-	23.0	25.0	23.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

▯	Riser Pipe
▤	Screen
░	Filter Sand
▒	Cuttings
■	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft)	75.0
Rock Cored (ft)	-
Samples	18S, 4U

Boring No. HA-RWP-05

Field Tests:
Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20						-ALLUVIAL DEPOSITS-										
	WOH 4 2 2	S10 24	23.0 25.0		MH	Medium stiff yellow-brown elastic SILT (MH), no odor, wet					10	90				
						Note: Advanced auger to 25.0 ft.										
25	P U S H	U2 6	25.0 26.0	282.3 25.0	SM	Note: Switched over to mud rotary using a polymer drilling fluid, washed out borehole to 25.0 ft. Gray-brown silty SAND (SM) with frequent interbedded seams and layers of elastic silt, no odor, wet Note: Pushed 3.0 in undisturbed shelby tube to refusal from 25.0 ft to 26.0 ft, recovery 6.0 in.	-	-	-	15	50	35				
	P U S H	U3 0	28.0 29.0			Note: Washed out borehole to 28.0 ft. Note: Pushed 3.0 in. undisturbed shelby tube to refusal from 28.0 ft to 29.0 ft, no recovery, probable in sands										
30																
	8 8 9 12	S11 12	33.0 35.0		SM	Medium dense orange-brown fine silty SAND (SM), no odor, wet	-	-	-	-	45	55				
35																
	7 11 14 14	S12 13	38.0 40.0		SM	Similar to S11, except gray-brown, trace coarse sand	-	-	-	-	45	55				
40																
	8 9 10 12	S13 12	43.0 45.0		SM	SImilar to S11, except brown	-	-	-	-	45	55				
45																
	5 7 10 11	S4 13	48.0 50.0		SM	Medium dense yellow-brown fine silty SAND (SM) with interbedded layer (4.0 in thick) of gray fat clay, no odor, wet	-	-	-	-	65	35				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-RWP-05
File No. 129342-039
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50																
				255.3 52.0		Note: Observed gray CLAY coming up in drill water water at approximately 52.0 ft.										
	P U S H	U4 10	53.0 55.0		CH	Gray fat CLAY (CH) Note: Pushed 3.0 in. undisturbed shelby tube from 53.0 ft to 55.0 ft, recovery 10.0 in. PP = 1.25 TSF										
55																
				251.3 56.0		Note: Observed medium to fine sands coming up in drill wash water at approximately 56.0 ft.										
	8 8 9 12	S15 15	58.0 60.0		SM	Medium dense gray fine to medium silty SAND (SM), no odor, wet	-	-	-	25	55	20				
60																
	13 14 10 12	S16 14	63.0 65.0		SM	Similar to S15	-	-	-	25	55	20				
65																
	9 10 11 12	S17 10	68.0 70.0		SM	Similar to S15	-	-	-	25	55	20				
70																
	10 10 10 12	S18 10	73.0 75.0		SM	Similar to S15	-	-	-	25	55	20				
75				232.3 75.0		BOTTOM OF EXPLORATION AT 75.0 FT Note: Borehole grouted to ground surface upon completion.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-RWP-06(OW)

Project Raw Water Pond, New Madrid Power Plant, Marston, Missouri
Client Associated Electric Cooperative, Inc.
Contractor Bulldog Drilling

File No. 129342-039
Sheet No. 1 of 3
Start 14 April 2021
Finish 14 April 2021
Driller J. Gates
H&A Rep. C. Toscano

Elevation 306.832 (est.)
Datum NAVD88
Location See Plan
N 244,089
E 1,098,037

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550X
Bit Type: Cutting Head
Drill Mud: None
Casing: HSA
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: NONE

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				306.6 0.3		-CRUSHED STONE-										
	2 2 3 4	S1 15	0.0 2.0		CL	Medium stiff gray-brown lean CLAY with sand (CL), no odor, moist PP = 4.0 TSF -EMBANKMENT FILL-	-	-	-	-	15	85				
	2 3 4 7	S2 16	2.0 4.0		CL	Similar to S1 PP = 2.0 TSF	-	-	-	-	15	85				
5	4 5 7 7	S3 20	4.0 6.0		CL	Similar to S1, except stiff and gray PP = 2.5 TSF	-	-	-	-	15	85				
	3 6 8 9	S4 24	6.0 8.0		CL	Similar to S1, except stiff and gray PP = 2.5 TSF	-	-	-	-	15	85				
	3 5 6 8	S5 20	8.0 10.0		CL	Stiff gray-brown to gray lean CLAY (CL), no odor, moist PP = 3.25 TSF WC=21.8%	-	-	-	-	2	98				
10	3 5 8 9	S6 18	10.0 12.0		CL	Similar to S5 PP = 4.5 TSF	-	-	-	-	5	100 95				
	4 5 10 13	S7 20	12.0 14.0		CL	Stiff gray lean CLAY with sand (CL), no odor, moist PP = 4.5 TSF	-	-	-	-	15	85				
15	4 7 8 10	S8 18	14.0 16.0		CL	Stiff gray sandy lean CLAY (CL), no odor, moist	-	-	-	-	30	70				
	3 4 5 6	S9 18	16.0 18.0		CL	Stiff gray lean CLAY with sand (CL), no odor, moist PP = 2.5 TSF	-	-	-	-	15	85				
	5 6 6 8	S10 20	18.0 20.0		CL	Stiff gray sandy lean CLAY (CL), trace decomposed wood fragments, no structure, no odor, moist	-	-	-	-	30	70				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
4/14/21	1115	-	32.0	34.0	32.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

◫	Riser Pipe
▤	Screen
⁘	Filter Sand
▩	Cuttings
■	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft) 50.0
Rock Cored (ft) -
Samples 17S, 1U

Boring No. HA-RWP-06(OW)

Field Tests:
Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-RWP-06(OW)
File No. 129342-039

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	3 3 4 7	S11 18	20.0 22.0		CL	Similar to S10, except medium stiff	-	-	-	-	30	70				
	WOH 2 3 5	S12 10	23.0 25.0		CL	Medium stiff gray lean CLAY with sand (CL), no odor, moist PP=1.25 TSF					15	85				
25																
				279.8 27.0												
	WOH 1 1 1	S13 20	28.0 30.0		CL	Very soft gray lean CLAY with sand (CL), no odor, moist PP = 1.0 TSF WC=29.4% -ALLUVIAL DEPOSITS-	-	-	-	-	15	85	S	L	M	M
30	P U S H	U1 24	30.0 32.0		CL	Note: Pushed 3.0 in. undisturbed shelby tube from 30.0 ft to 32.0 ft, recovery 24.0 in. PP = 1.0 TSF										
				274.8 32.0		Note: Spun augers and washed out borehole to 32.0 ft										
	WOH WOH WOH 2	S4 15	32.0 34.0		SM	Note: Center plug at bottom of drill rods were wet at 32.0 ft. Very loose light brown fine silty SAND (SM), no odor, wet	-	-	-	-	65	35				
35																
	9 10 10 10	S15 10	38.0 40.0		SM	Medium dense gray-brown fine silty SAND (SM), no odor, wet	-	-	-	-	45	55				
40																
				264.8 42.0												
	3 3 5 7	S16 15	43.0 45.0		CH	Medium stiff gray fat CLAY (CH) with an interbedded layer (6.0 in. thick) of medium to fine sand, no odor, wet	-	-	-	-	-	100				
45																
				260.8 46.0		Note: Observed sands in wash water at approximately 46.0 ft										
	3 13 18 17	S7 13	48.0 50.0		SP	Dense gray-brown fine silty SAND (SM), no odor, wet	-	-	-	-	80	20				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-RWP-06(OW)

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50				256.8 50.0		BOTTOM OF EXPLORATION AT 50.0 FT Note: Installed Observation Well Screen set at 37.0 ft to 47.0 ft.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-RWP-07

Project Raw Water Pond, New Madrid Power Plant, Marston, Missouri
Client Associated Electric Cooperative, Inc.
Contractor Bulldog Drilling

File No. 129342-039
Sheet No. 1 of 2
Start 20 April 2021
Finish 20 April 2021
Driller J. Gates
H&A Rep. C. Toscano

Elevation 308.995 (est.)
Datum NAVD88
Location See Plan
N 244,625
E 1,097,687

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550X
Bit Type: Cutting Head
Drill Mud: None
Casing: HSA
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: NONE

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	2 2 7 6	S1 15	0.0 2.0		CL	Stiff light brown lean CLAY (CL), no odor, dry Note: Coarse to fine gravel lodged in tip of spoon. -EMBANKMENT FILL-	-	-	-	-	5	95				
	5 6 6 6	S2 20	2.0 4.0		CL	Stiff brown to gray-brown lean CLAY (CL), no odor, moist PP = 2.75 TSF	-	-	-	-	-	100				
5	3 4 9 6	S3 22	4.0 6.0		CL	Similar to S2, except with frequent layers of SILT with sand (ML)	-	-	-	-	-	100				
	P U S H	U1 22	6.0 8.0			Note: Pushed 3.0 in. undisturbed shelby tube from 6.0 ft to 8.0 ft, recovery 22.0 in. PP = 4.5 TSF										
	4 5 7 6	S4 24	8.0 10.0		CL	Stiff gray-brown lean CLAY (CL), no odor, moist PP = 3.0 TSF WC=29.6%	-	-	-	1	4	95				
10	P U S H	U2 22	10.0 12.0			Note: Pushed 3.0 in. undisturbed shelby tube from 10.0 ft to 12.0 ft, recovery 22.0 in. PP = 2.25 TSF	-	-	-	-	-	-				
	4 5 6 8	S5 18	12.0 14.0	297.0 12.0	CH	Stiff gray-brown fat CLAY (CH), no odor, moist	-	-	-	-	-	100	N	M	M	M
15	3 5 6 11	S6 24	14.0 16.0		CH	Similar to S5 PP = 2.5 TSF	-	-	-	-	-	100	N	M	M	M
	3 5 7 8	S7 20	16.0 18.0		CH	Similar to S5 PP = 2.5 TSF	-	-	-	-	-	100	N	M	M	M
	3 5 10 12	S8 24	18.0 20.0	291.0 18.0	CL	Stiff gray-brown lean CLAY (CL) intermixed with elastic SILT (MH), no odor, moist	-	-	-	-	-	100				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Water
		Not Encountered			

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	35.0
Rock Cored (ft)	-
Samples	11S, 2U

Boring No. HA-RWP-07

Field Tests:
Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA-RWP-07
File No. 129342-039
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20																
	4 5 6 6	S9 20	23.0 25.0		CL	Similar to S8, except yellow-brown PP = 2.5 TSF	-	-	-	-	-	100				
25																
				282.0 27.0												
	1 1 2 3	S10 24	28.0 30.0		CL	Soft yellow-brown lean CLAY (CL), no odor, moist PP = 1.75 TSF	-	-	-	-	-	100	N	M	M	M
30						-ALLUVIAL DEPOSITS-										
	1 2 2 3	S11 24	33.0 35.0		CL	Similar to S10 WC=34.3%	-	-	-	-	-	100				
35				274.0 35.0		BOTTOM OF EXPLORATION AT 35.0 FT Note: Borehole grouted to ground surface upon completion.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA-RWP-07

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-RWP-08

Project	Raw Water Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling

File No.	129342-039
Sheet No.	1 of 2
Start	20 April 2021
Finish	20 April 2021
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	307.803 (est.)
Datum	NAVD88
Location	See Plan N 245,193 E 1,097,684

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 550X
Bit Type: Cutting Head
Drill Mud: None
Casing: HSA
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: NONE

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	1 2 2 4	S1 24	0.0 2.0		CL	Soft brown lean CLAY (CL), no odor, moist EMBANKMENT FILL-	-	-	-	-	5	95				
	1 1 1 2	S2 12	2.0 4.0		CL	Similar to S1, except yellow-brown and very soft	-	-	-	-	5	95				
5	2 6 6 7	S3 16	4.0 6.0		CL	Stiff gray-brown lean CLAY (CL), no odor, moist PP = 4.5 TSF Note: Plastic liner found in spoon at 5.0 ft.	-	-	-	-	-	100				
	4 5 8 10	S4 15	6.0 8.0	301.8 6.0	CH	Stiff gray-brown fat CLAY with sand (CH), no odor, moist WC=18.6%	-	-	-	-	28	72				
	P U S H	U1 24	8.0 10.0			Note: Pushed 3.0 in. undisturbed shelby tube from 8.0 ft to 10.0 ft, recovery 21.0 in. PP = 3.0 TSF										
10	3 5 6 7	S5 24	10.0 12.0		CH	Stiff gray-brown fat CLAY (CH), no odor, moist PP = 2.5 TSF	-	-	-	-	-	100				
	3 4 4 7	S6 20	12.0 14.0		CH	Similar to S5, except medium stiff PP = 2.0 TSF	-	-	-	-	-	100				
15	P U S H	U2 24	14.0 16.0			Note: Pushed 3.0 in. undisturbed shelby tube from 14.0 ft to 16.0 ft, recovery 24 in. PP = 2.25 TSF										
	3 4 7 11	S7 20	16.0 18.0		CH	Similar to S5, except stiff PP = 3.0 TSF	-	-	-	-	-	100				
	3 4 5 8	S8 24	18.0 20.0		CH	Similar to S5, except stiff PP = 2.75 TSF	-	-	-	-	-	100				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
4/21/21	0945	-	28.0	30.0	29.5

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

▯	Riser Pipe
▤	Screen
░	Filter Sand
▒	Cuttings
■	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft)	35.0
Rock Cored (ft)	-
Samples	11S, 2U

Boring No. HA-RWP-08

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

NOTES:

1. Plan adapted from an aerial photograph courtesy of Google Earth.
2. Piezometers were located in the field by Geotechnology and subsequently surveyed by the project surveyor.

LEGEND:

◉	Piezometer/Soil Boring Location
●	Piezometer Location
⇩1	Photo Location and Direction
▬	Test Pit Location
━	Cross Section Location
▨	Rip Rap

N

0 500 1000

APPROXIMATE SCALE IN FEET

Drawn By: SLC	Ck'd By:	App'vd By:
Date: 04-23-09	Date:	Date:

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New Madrid County, Missouri

AERIAL PHOTOGRAPH OF SITE, TEST PIT & BORING LOCATIONS

Project Number
1011304.91IG

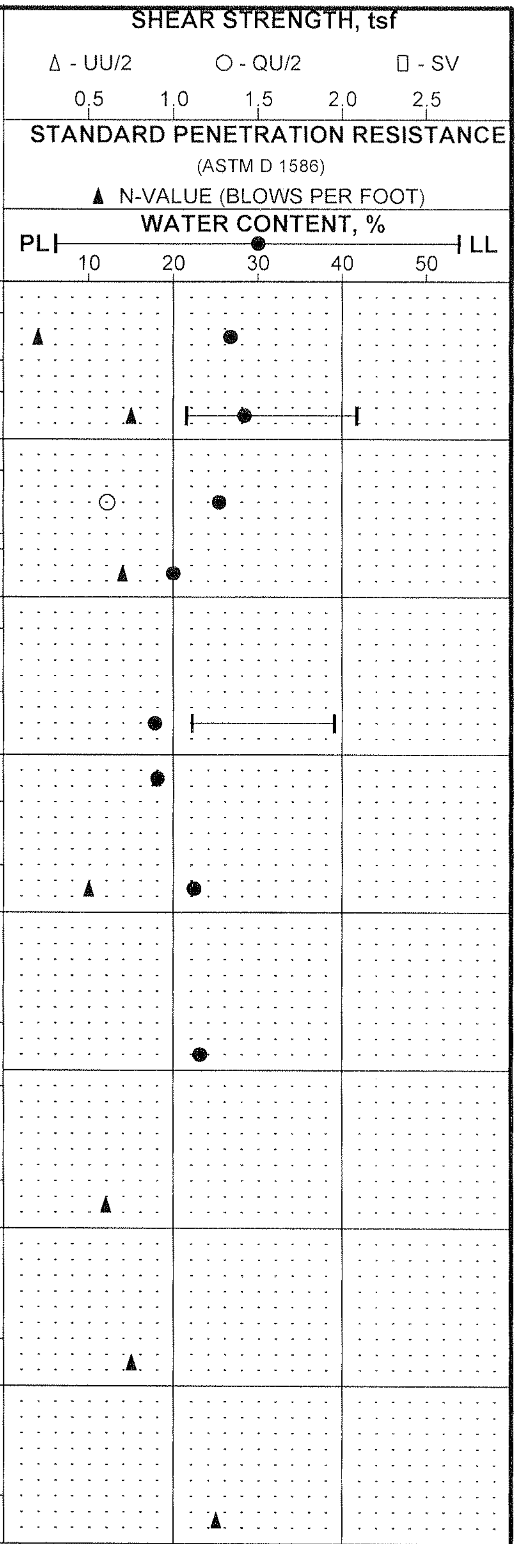
PLATE 2

Surface Elevation 310

Datum msl

Completion Date: 3/17/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Topsoil		
	FILL: brown and black, silty clay, trace slag	1-1-3	SS1
	FILL: brown and gray, silty clay		
		6-7-8	SS2
5			
		98	ST3
		5-7-7	SS4
10			
			ST5
		103	ST6
15	Very stiff to stiff, brown, sandy SILT - ML 80 percent passing #200 sieve	8-8-10	SS7
		4-5-5	SS8
20			
		86	ST9
25			
	▼		
	Medium dense, brown, fine SAND - SP		
		4-4-8	SS10
30			
	▼		
		5-6-9	SS11
35			
		9-12-13	SS12



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 26.2 FEET AFTER 80 DAYS ▼

AT 30.8 FEET AFTER 105 DAYS ▼

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 25.5 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS: Consolidated-Undrained Triaxial test performed on ST6.

Drawn by: KSA	Checked by: SN	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

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Embankment Stability Evaluation

LOG OF BORING: P-2

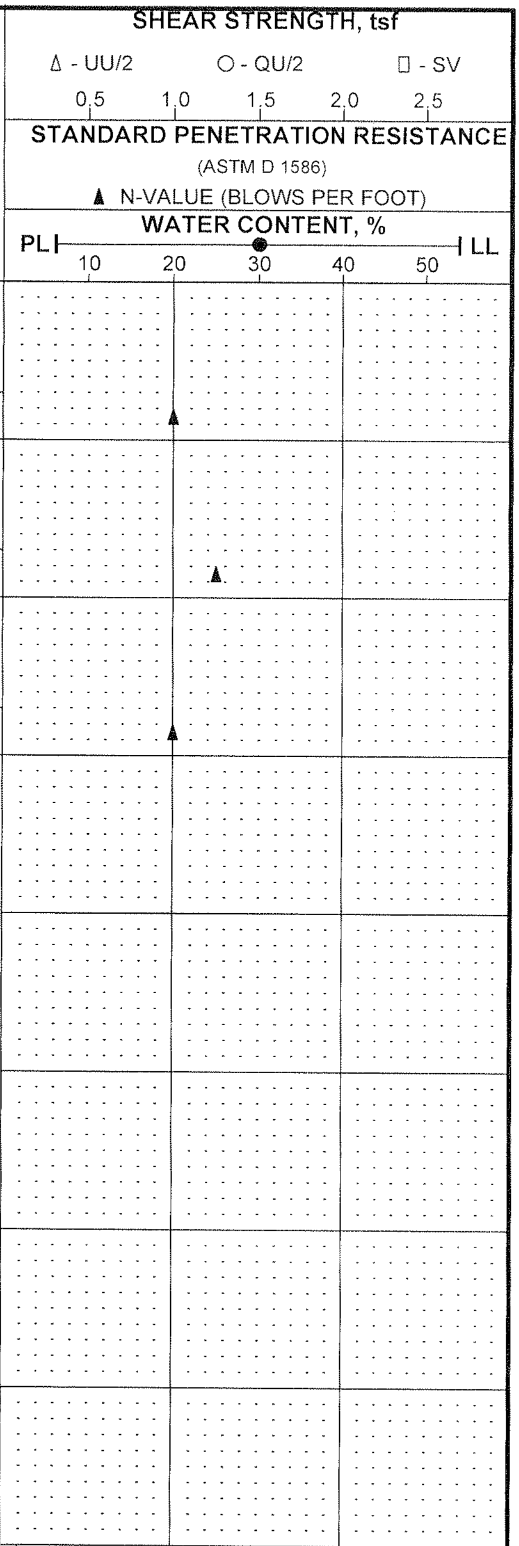
Project No. 1011304.91IG

Surface Elevation 310

Datum msl

Completion Date: 3/17/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium dense, brown, fine SAND - SP *(continued)*			
	Medium dense, brown, fine to coarse SAND - SP			
45			9-9-11	SS13
50			9-11-14	SS14
55			9-9-11	SS15
	Boring terminated at 55 feet.			
60				
65				
70				
75				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 26.2 FEET AFTER 80 DAYS ▽

AT 30.8 FEET AFTER 105 DAYS ▼

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 25.5 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS: Consolidated-Undrained Triaxial test performed on ST6.

Drawn by: KSA	Checked by:	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

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CONTINUATION OF
LOG OF BORING: P-2

Project No. 1011304.91IG

Surface Elevation 311

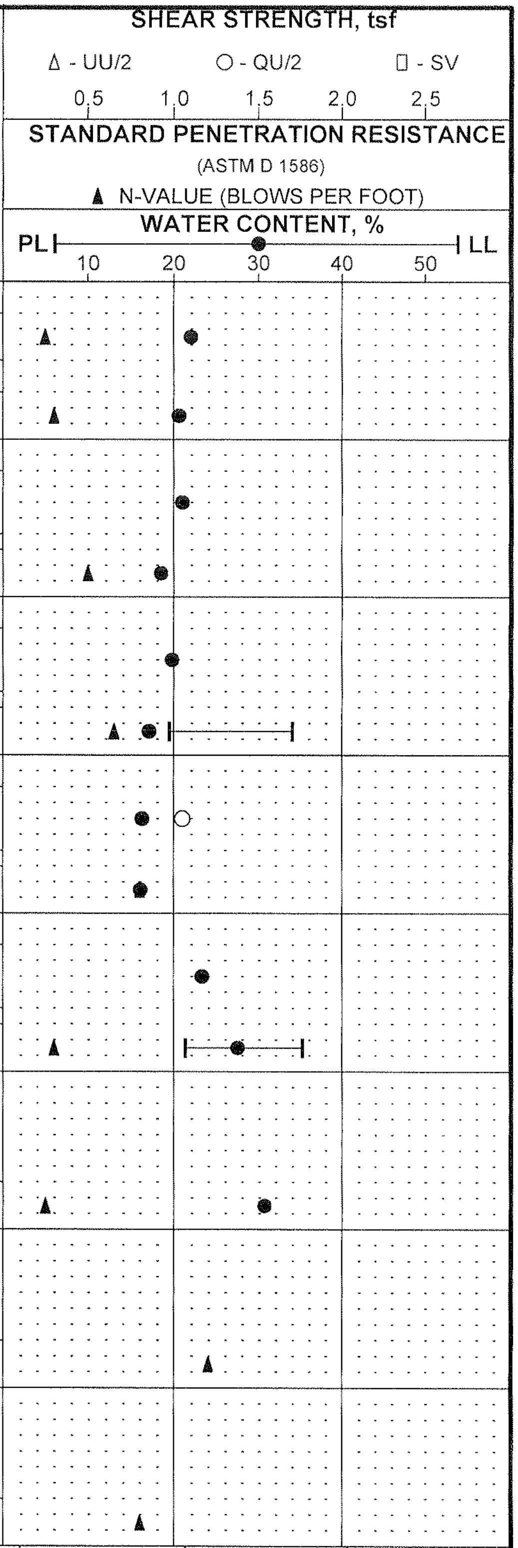
Datum msl

Completion Date: 3/18/09

DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
Topsoil		
FILL: brown and gray, silty clay	2-2-3	SS1
	2-3-3	SS2
	104	ST3
	5-5-5	SS4
	107	ST5
	5-7-6	SS6
	113	ST7
	7-7-9	SS8
	98	ST9
Medium stiff, brown, silty CLAY, trace sand - (CL)	2-3-3	SS10
	1-2-3	SS11
Medium dense, brown, medium to coarse SAND - SP	11-11-13	SS12
	6-8-8	SS13

DEPTH IN FEET: 5, 10, 15, 20, 25, 30, 35

GRAPHIC LOG



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 27.3 FEET AFTER 79 DAYS ▼

AT 31.5 FEET AFTER 104 DAYS ▼

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 19.5 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by:	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

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LOG OF BORING: P-3

Project No. 1011304.91IG

Surface Elevation 311

Datum msl

Completion Date: 3/18/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium dense, brown, medium to coarse SAND - SP *(continued)*			
			9-12-13	SS14
45				
	6 percent passing #200 sieve		5-6-8	SS15
50				
			9-12-13	SS16
55	Boring terminated at 55 feet.			
60				
65				
70				
75				

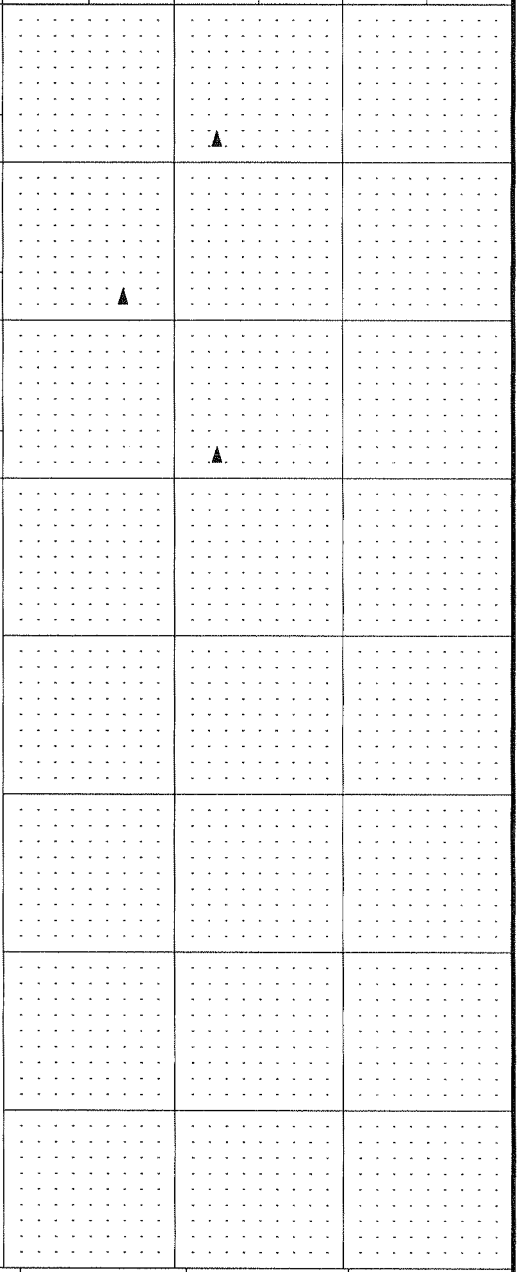
SHEAR STRENGTH, tsf

Δ - UU/2 ○ - QU/2 ☐ - SV

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
(ASTM D 1586)
▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %
PL ├──●──┤ LL
10 20 30 40 50



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 27.3 FEET AFTER 79 DAYS ⊻

AT 31.5 FEET AFTER 104 DAYS ⊻

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 19.5 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: Su	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

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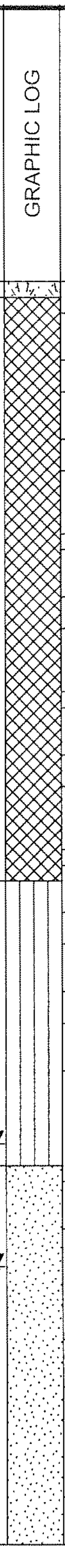
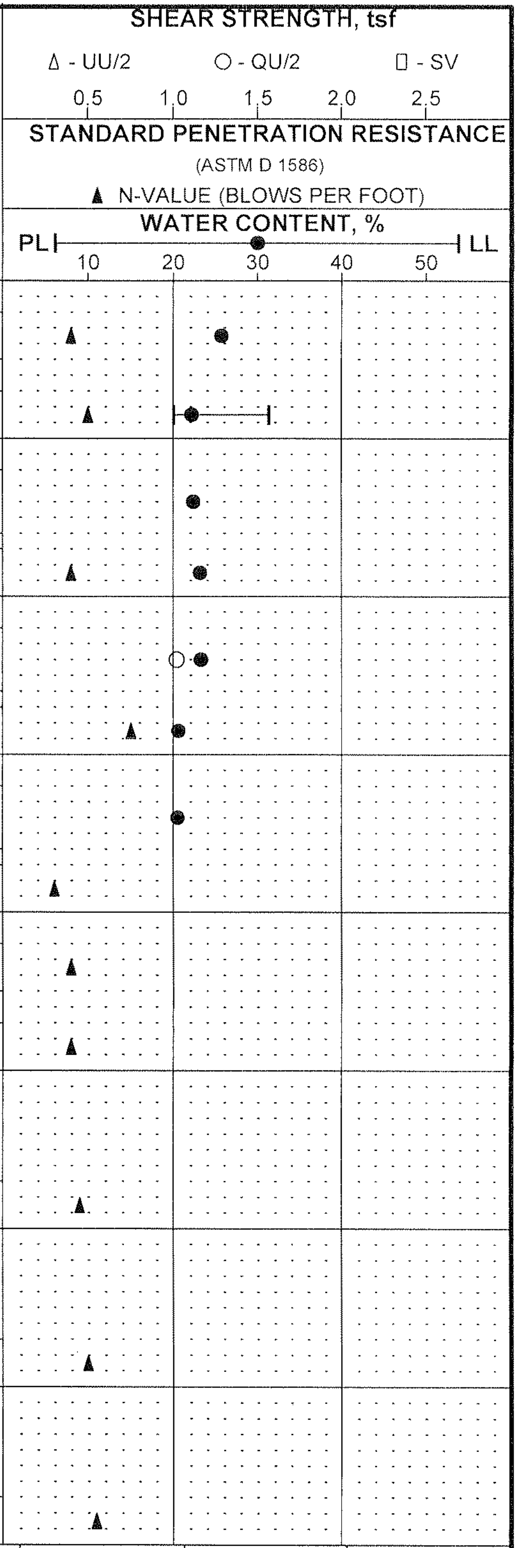
CONTINUATION OF
LOG OF BORING: P-3

Project No. 1011304.91IG

Surface Elevation 311
Datum msl
Completion Date: 3/18/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Topsoil		
	FILL: brown and gray, silty clay	3-4-4	SS1
5		2-4-6	SS2
		102	ST3
10		3-3-5	SS4
		101	ST5
15		5-7-8	SS6
		88	ST7
20	Medium stiff, brown, sandy SILT - ML 54 percent passing #200 sieve	3-3-3	SS8
		3-4-4	SS9
25		3-4-4	SS10
	▽		
30	Loose to medium dense, brown, fine to coarse SAND - SP 5 percent passing #200 sieve	4-4-5	SS11
	▼		
35		5-5-5	SS12
		5-5-6	SS13





NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 27.3 FEET AFTER 79 DAYS ▽
AT 31.2 FEET AFTER 104 DAYS ▼

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 20 FEET
MB DRILLER RFW LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: SM	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

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LOG OF BORING: P-4

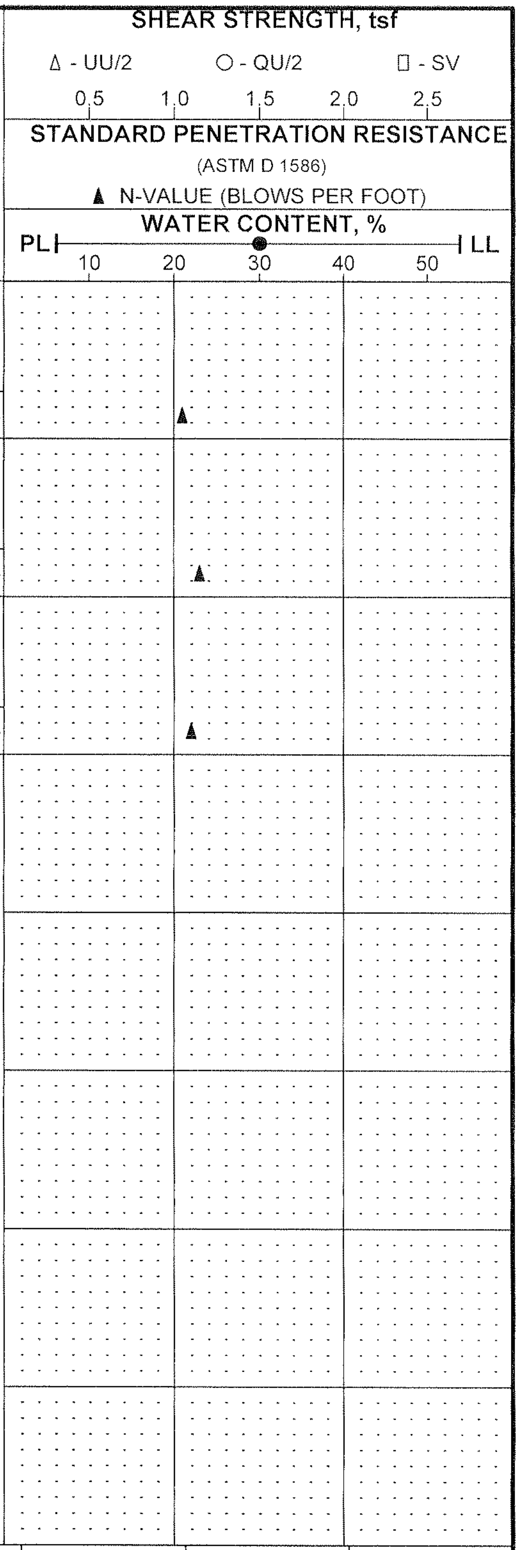
Project No. 1011304.91IG

Surface Elevation 311

Datum msl

Completion Date: 3/18/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Loose to medium dense, brown, fine to coarse SAND - SP *(continued)*			
			8-10-11	SS14
45				
			6-10-13	SS15
50				
			10-11-11	SS16
55	Boring terminated at 55 feet.			
60				
65				
70				
75				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 27.3 FEET AFTER 79 DAYS ▽

AT 31.2 FEET AFTER 104 DAYS ▼

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 20 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by:	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

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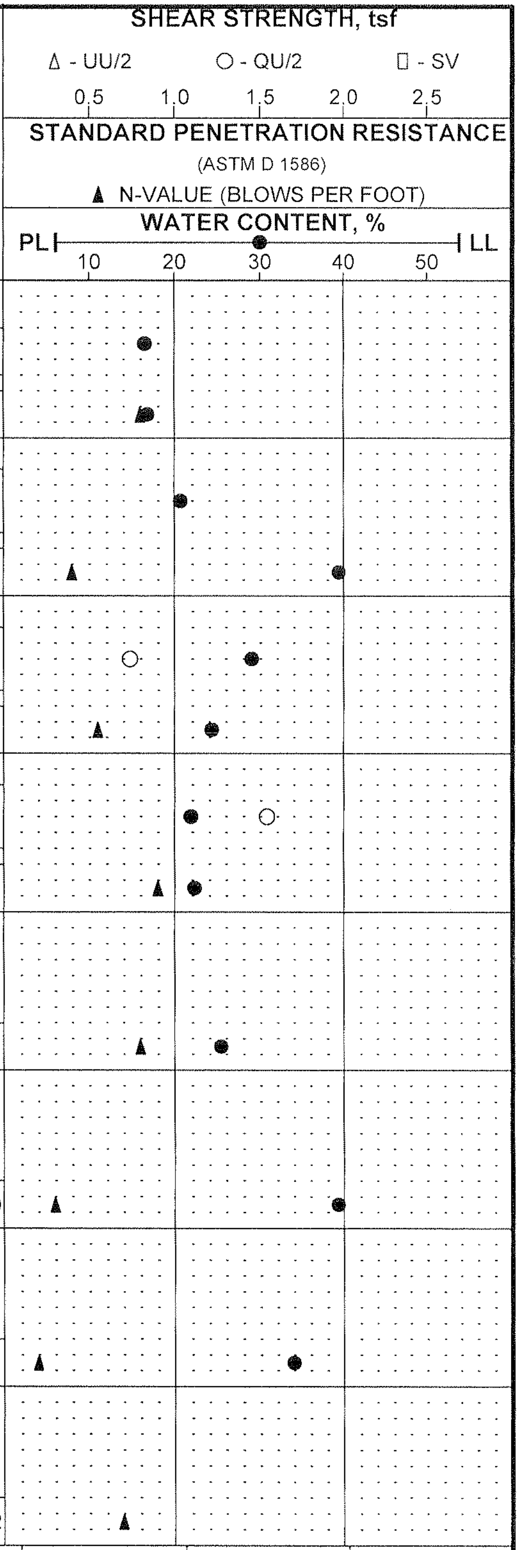
CONTINUATION OF
LOG OF BORING: P-4

Project No. 1011304.91IG

Surface Elevation 311 | Completion Date: 3/23/09

Datum msl

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Topsoil			
	FILL: brown, silty clay with gravel and sand			GB1
			5-8-8	SS2
5				
			106	ST3
	FILL: gray clay		2-3-5	SS4
10	FILL: brown and gray, silty clay		90	ST5
			4-5-6	SS6
15			100	ST7
			5-8-10	SS8
20	Very stiff to soft, brown and gray, silty CLAY - CL			
			6-8-8	SS9
25				
			3-3-3	SS10
30		▼		
		▼		
			2-2-2	SS11
35				
	Medium dense, occasionally dense, brown to gray SAND, trace silt - SP			
			5-6-8	SS12



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 31.8 FEET AFTER 74 DAYS ▼

AT 30.2 FEET AFTER 99 DAYS ▼

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 20 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: SK	App'vd. by: MHM
Date: 3/29/09	Date: 6/12/09	Date: 6/15/09

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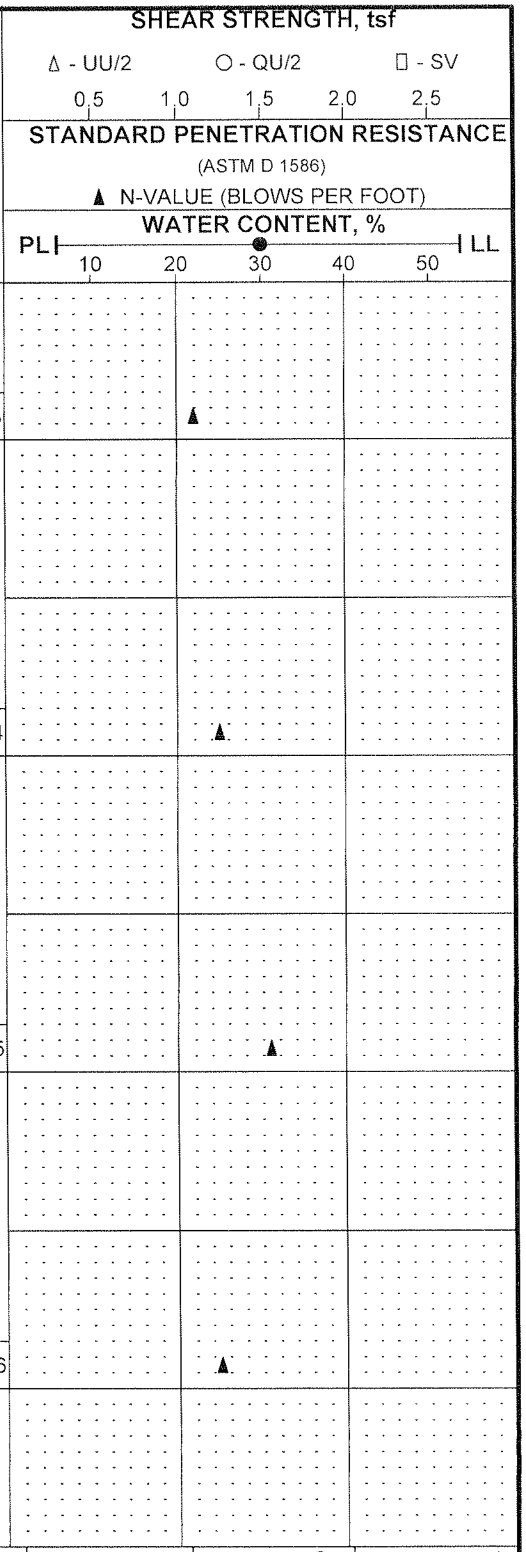
AECI New Madrid
Embankment Stability Evaluation

LOG OF BORING: P-6

Project No. 1011304.91IG

Surface Elevation 311
Datum msl
Completion Date: 3/23/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium dense, occasionally dense, brown to gray SAND, trace silt - SP *(continued)*			
			11-11-11	SS13
45				
50				
			12-12-13	SS14
55				
60				
	3 percent passing #200 sieve		12-14-17	SS15
65				
70	Medium dense, gray, fine to coarse SAND - SP			
			8-9-16	SS16
75				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 31.8 FEET AFTER 74 DAYS ▼

AT 30.2 FEET AFTER 99 DAYS ▼

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 20 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by:	App'vd. by: MHM
Date: 3/29/09	Date: 6/1/09	Date: 6/15/09

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CONTINUATION OF
LOG OF BORING: P-6

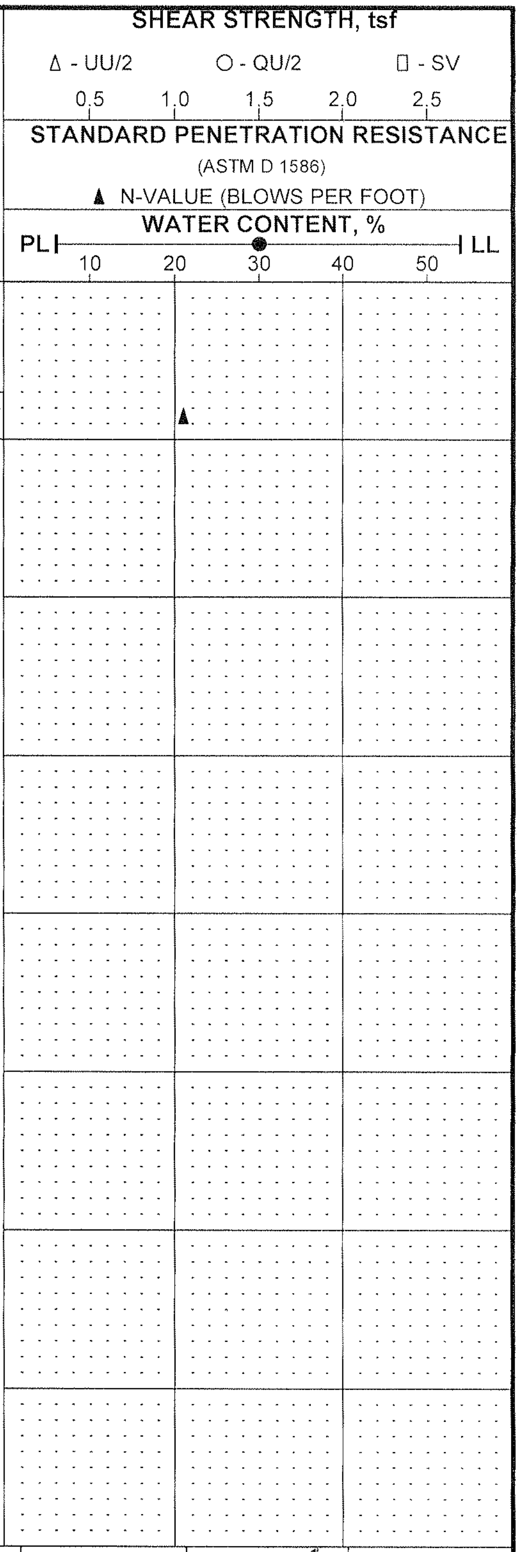
Project No. 1011304.91IG

Surface Elevation 311

Datum msl

Completion Date: 3/23/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium dense, gray, fine to coarse SAND - SP *(continued)*	▨	9-10-11	SS17
85	Boring terminated at 85 feet.			
90				
95				
100				
105				
110				
115				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 31.8 FEET AFTER 74 DAYS ⊻

AT 30.2 FEET AFTER 99 DAYS ▼

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 20 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: SEL	App'vd. by: MHM
Date: 3/29/09	Date: 6/12/09	Date: 6/15/09

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CONTINUATION OF
LOG OF BORING: P-6

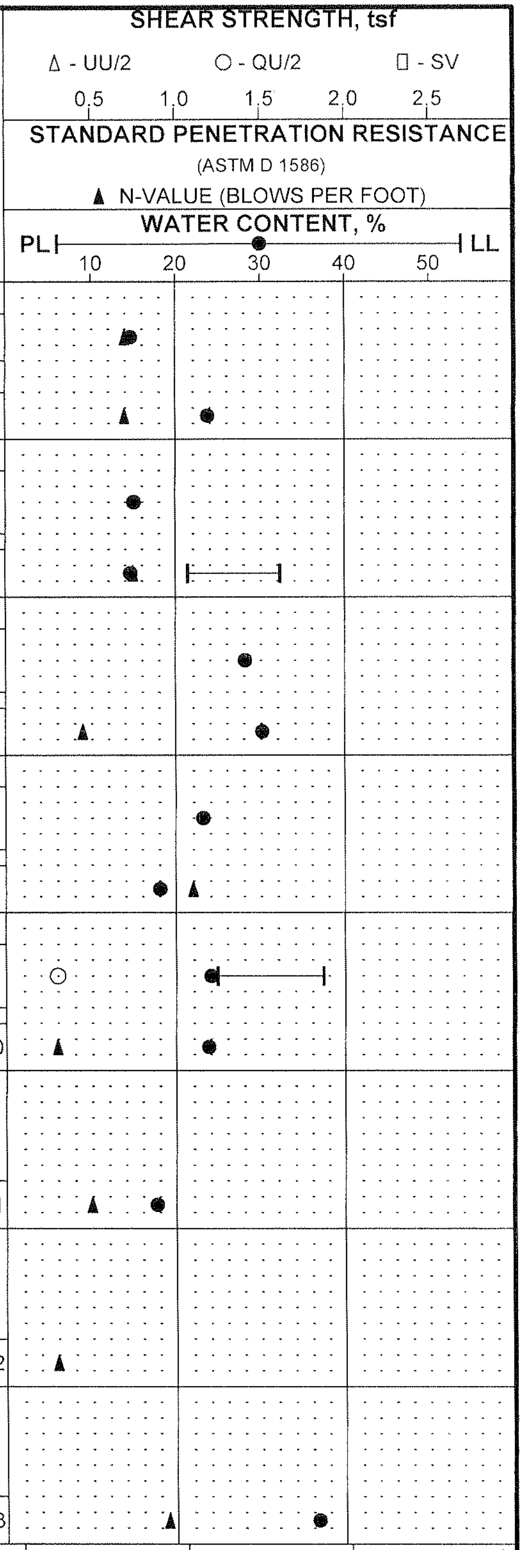
Project No. 1011304.91IG

Surface Elevation 308

Datum msl

Completion Date: 3/24/09

DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
Crushed rock road bed		
FILL: brown, silty clay, trace sand and gravel	5-6-8	SS1
	4-5-9	SS2
	*	ST3
	5-7-8	SS4
	92	ST5
	3-4-5	SS6
	97	ST7
Very stiff, gray, silty CLAY - CL	6-11-11	SS8
Medium stiff, brown SILT - (ML)	86	ST9
Stiff, brown, sandy SILT - ML	2-3-3	SS10
	3-5-5	SS11
Loose, brown, silty SAND - SM	6-3-3	SS12
Very stiff, brown, sandy SILT - ML	6-9-10	SS13



DEPTH IN FEET: 5, 10, 15, 20, 25, 30, 35

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 30.6 FEET AFTER 73 DAYS ▽

AT 27.4 FEET AFTER 98 DAYS ▼

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 30 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS: * Poor sample recovery.

Drawn by: KSA	Checked by: SA	App'vd. by: MHM
Date: 3/29/09	Date: 6/12/09	Date: 6/15/09

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LOG OF BORING: P-7

Project No. 1011304.91IG

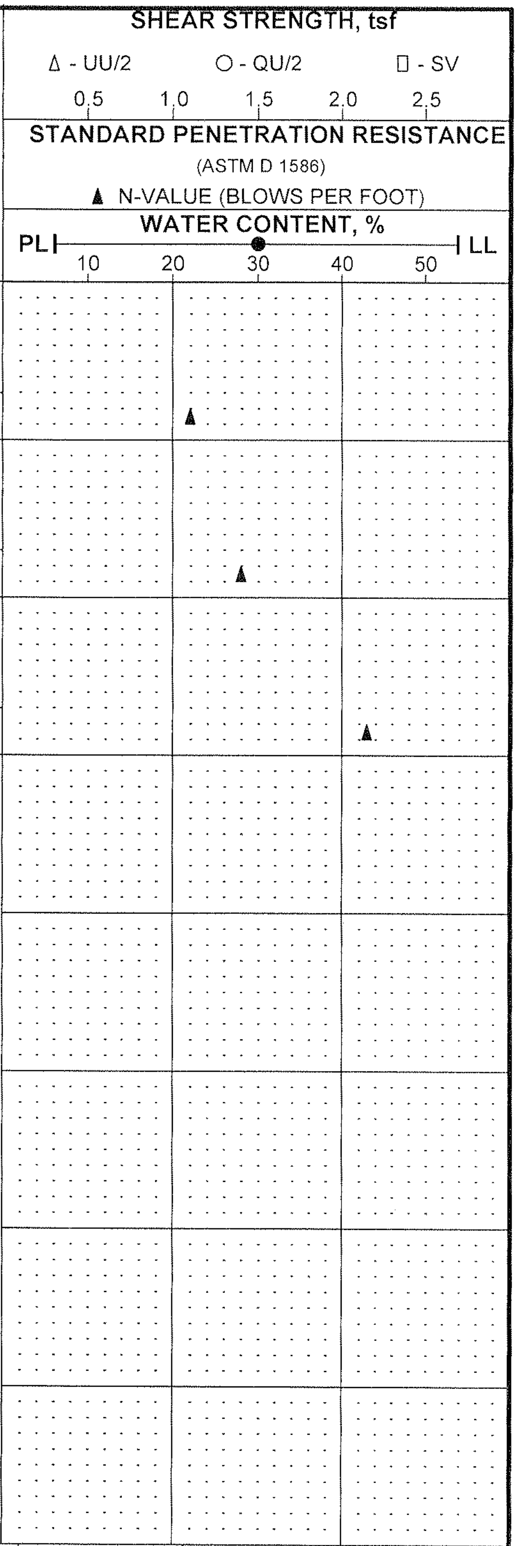
LOG OF BORING 2002 WL 1011304 - ASH POND.GPJ GTINC 0638301.GPJ 6/12/09

Surface Elevation 308

Datum msl

Completion Date: 3/24/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Very stiff, brown, sandy SILT - ML *(continued)*			
	Medium dense to dense, brown and gray SAND - SP			
	6 percent passing #200 sieve		10-11-11	SS14
45				
			10-12-16	SS15
50				
			16-24-19	SS16
55	Boring terminated at 55 feet.			
60				
65				
70				
75				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL 1011304 ASH POND.GPJ GTINC 0638301.GPJ 6/12/09

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 30.6 FEET AFTER 73 DAYS ▼

AT 27.4 FEET AFTER 98 DAYS ▼

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 30 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS: * Poor sample recovery.

Drawn by: KSA	Checked by: SN	App'vd. by: MHM
Date: 3/29/09	Date: 6/12/09	Date: 6/15/09

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CONTINUATION OF
LOG OF BORING: P-7

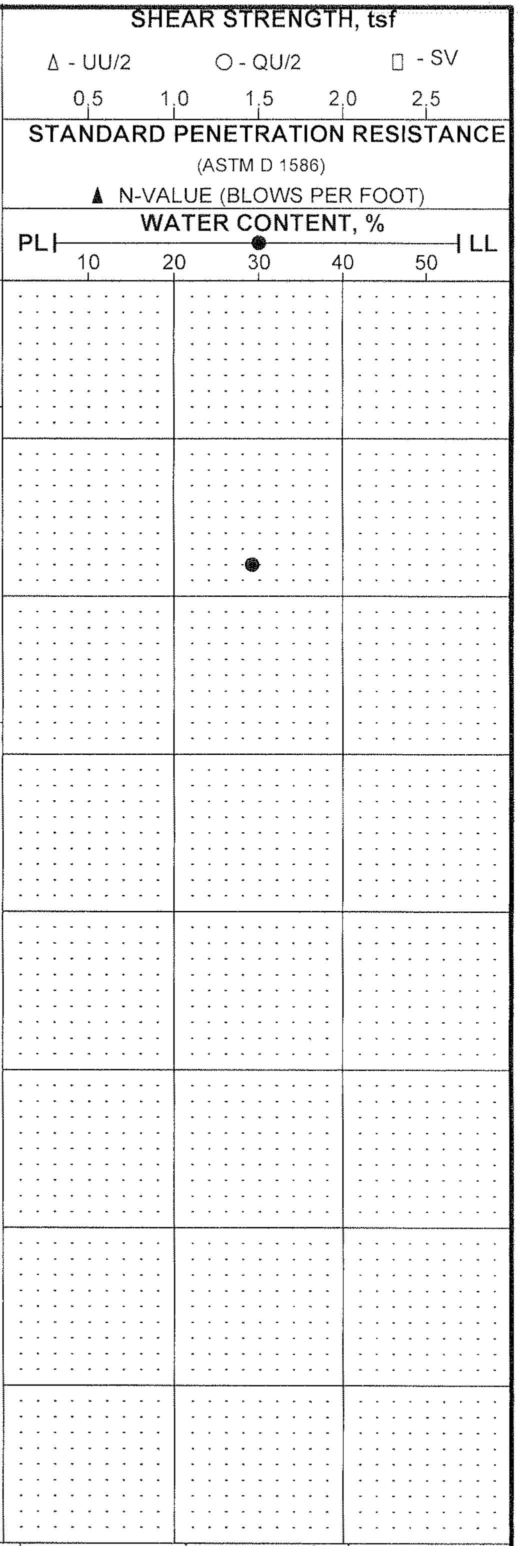
Project No. 1011304.91IG

Surface Elevation 308

Datum msl

Completion Date: 3/25/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Silt and roots			
	COAL dust, debris, and fly ash			
5	Black SLAG			
10				GB1
	Gray and brown SILT - ML			
15	Test pit terminated at 15 feet.			
20				
25				
30				
35				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 14 FEET ∇

DRILLING DATA

__ AUGER __ HOLLOW STEM
WASHBORING FROM __ FEET
__ DRILLER RFW LOGGER
Cat 3242 BACKHOE
HAMMER TYPE __

REMARKS:

Drawn by: LAH	Checked by: SA	App'vd. by: MHM
Date: 3/31/09	Date: 6/12/09	Date: 6/15/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
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AECI New Madrid
Embankment Stability Evaluation

LOG OF TEST PIT: TP-1

Project No. 1011304.91IG

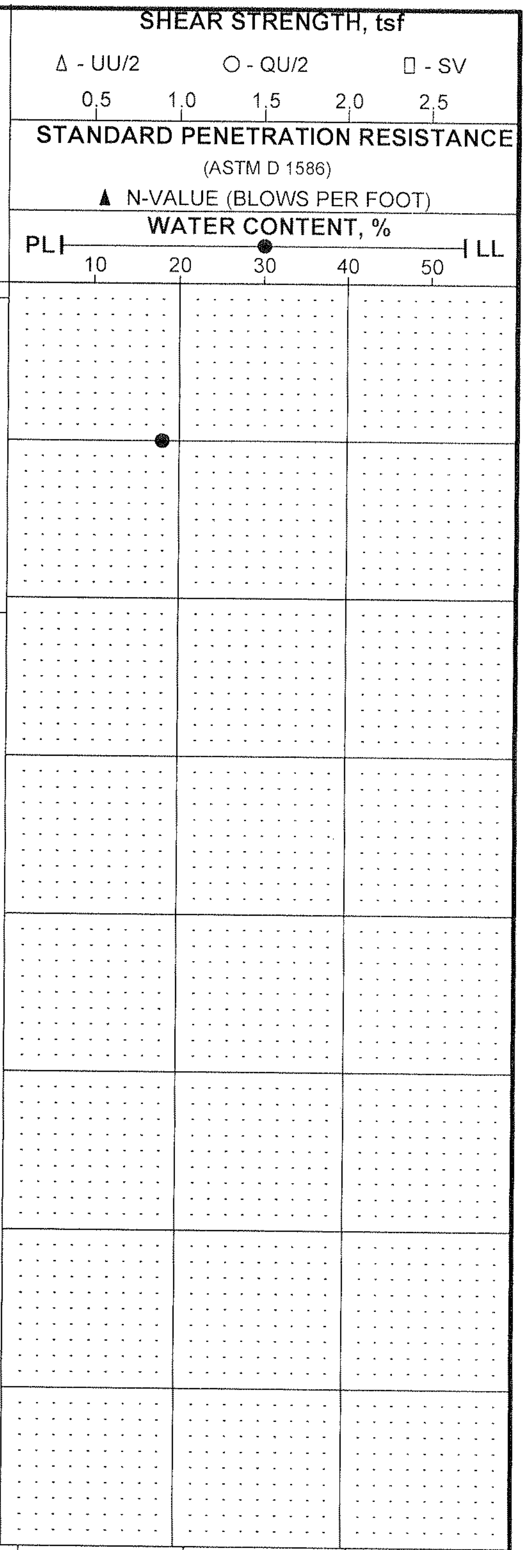
LOG OF BORING 2002 WL 1011304 - ASH POND.GPJ GTINC 0638301.GPJ 6/12/09

Surface Elevation 306

Datum msl

Completion Date: 3/25/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Silt and roots			
	Black SLAG			
5				GB1
10	Gray and brown SILT - ML ▽			
	Test pit terminated at 13 feet.			
15				
20				
25				
30				
35				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 12 FEET ▽

DRILLING DATA

__ AUGER __ HOLLOW STEM
WASHBORING FROM __ FEET
__ DRILLER RFW LOGGER
Cat 3242 BACKHOE
HAMMER TYPE __

REMARKS:

Drawn by: LAH	Checked by: Su	App'vd. by: MHM
Date: 3/31/09	Date: 6/12/09	Date: 6/15/09

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Embankment Stability Evaluation

LOG OF TEST PIT: TP-2

Project No. 1011304.91IG

Surface Elevation 304 Completion Date: 3/25/09

Datum msl

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Silt and roots			
	Black SLAG	▨		GB1
	Gray and brown SILT - ML ▽	▥		
5				GB2
	Test pit terminated at 5.5 feet.			

SHEAR STRENGTH, tsf

△ - UU/2 ○ - QU/2 ▯ - SV

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL ├──●──┤ LL

10 20 30 40 50

Depth scale: 5, 10, 15, 20, 25, 30, 35

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 4.5 FEET ▽

DRILLING DATA

__ AUGER __ HOLLOW STEM

WASHBORING FROM __ FEET

__ DRILLER RFW LOGGER

Cat 3242 BACKHOE

HAMMER TYPE __

REMARKS:

Drawn by: LAH	Checked by: Su	App'vd. by: MHM
Date: 3/31/09	Date: 6/12/09	Date: 6/15/09

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Embankment Stability Evaluation

LOG OF TEST PIT: TP-3

Project No. 1011304.91IG

Surface Elevation 303

Datum msl

Completion Date: 3/25/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Silt and roots			
	Black SLAG			GB1
	Gray and brown SILT - ML ▽			
5	99% passing #200 sieve			
	Test pit terminated at 5.5 feet.			
10				
15				
20				
25				
30				
35				

SHEAR STRENGTH, tsf

Δ - UU/2 ○ - QU/2 ▯ - SV

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

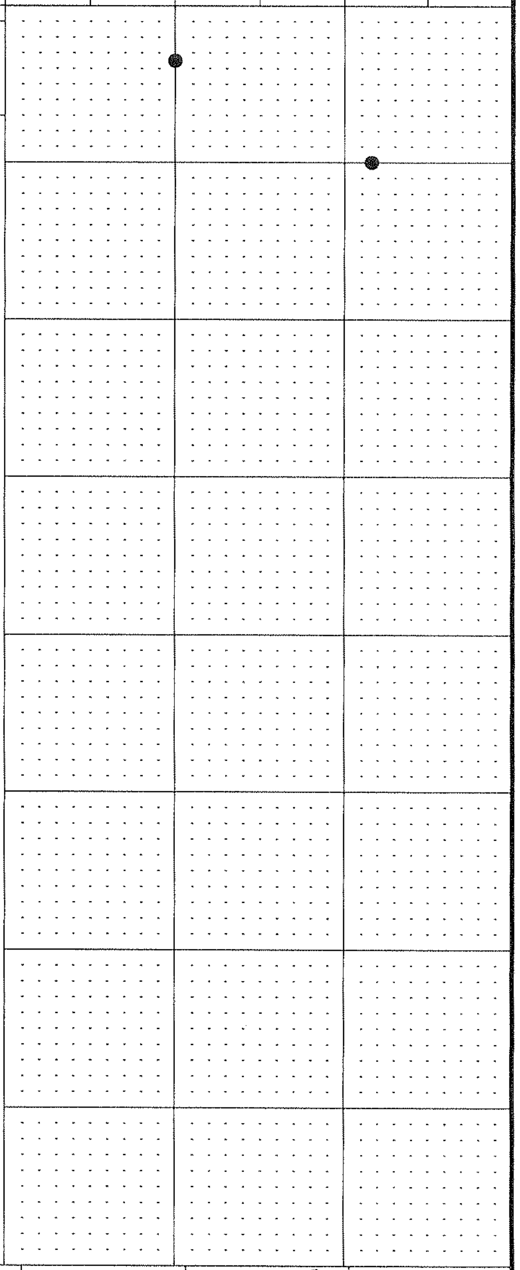
(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL ├──●──┤ LL

10 20 30 40 50



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 4.5 FEET ▽

DRILLING DATA

__ AUGER __ HOLLOW STEM

WASHBORING FROM __ FEET

__ DRILLER RFW LOGGER

Cat 3242 BACKHOE

HAMMER TYPE __

REMARKS:

Drawn by: LAH	Checked by: SK	App'vd. by: MHM
Date: 3/31/09	Date: 6/12/09	Date: 6/15/09

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AECI New Madrid
Embankment Stability Evaluation

LOG OF TEST PIT: TP-4

Project No. 1011304.91IG

Surface Elevation 306

Datum msl

Completion Date: 3/25/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Cemented fly ash			GB1
5				
	Gray and brown SILT - ML ⊽			
10				
	Tan SILT - ML 77% passing #200 sieve			GB2
	Test pit terminated at 12 feet.			
15				
20				
25				
30				
35				

SHEAR STRENGTH, tsf

Δ - UU/2 ○ - QU/2 ▯ - SV

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

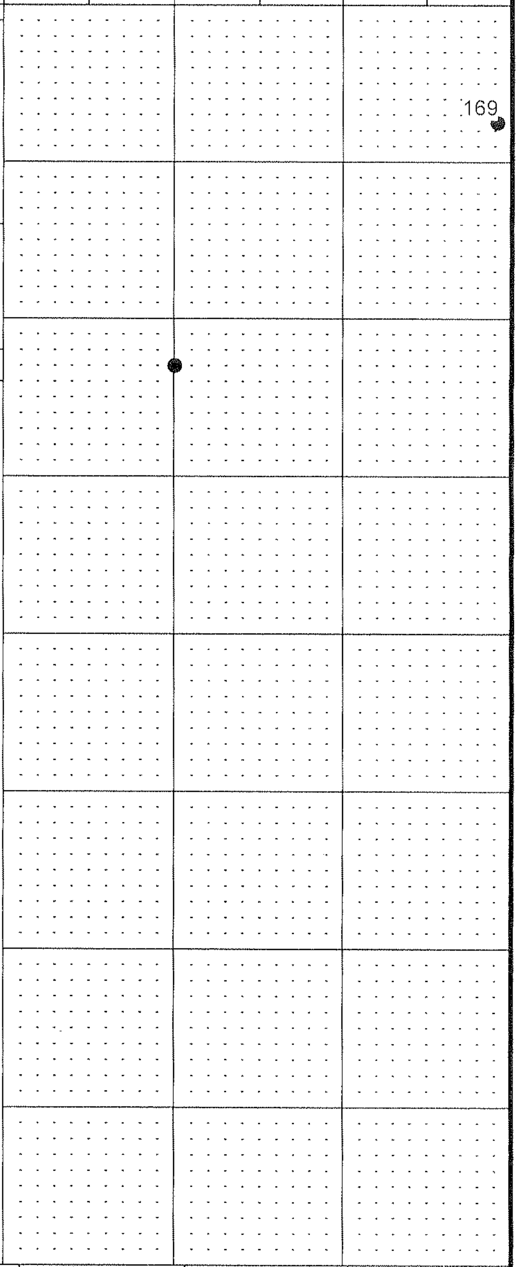
(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL ├───●───┤ LL

10 20 30 40 50



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 9 FEET ⊽

DRILLING DATA

__ AUGER __ HOLLOW STEM

WASHBORING FROM __ FEET

__ DRILLER RFW LOGGER

Cat 3242 BACKHOE

HAMMER TYPE __

REMARKS:

Drawn by: LAH	Checked by: SM	App'vd. by: MHM
Date: 3/31/09	Date: 6/12/09	Date: 6/15/09

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Embankment Stability Evaluation

LOG OF TEST PIT: TP-5

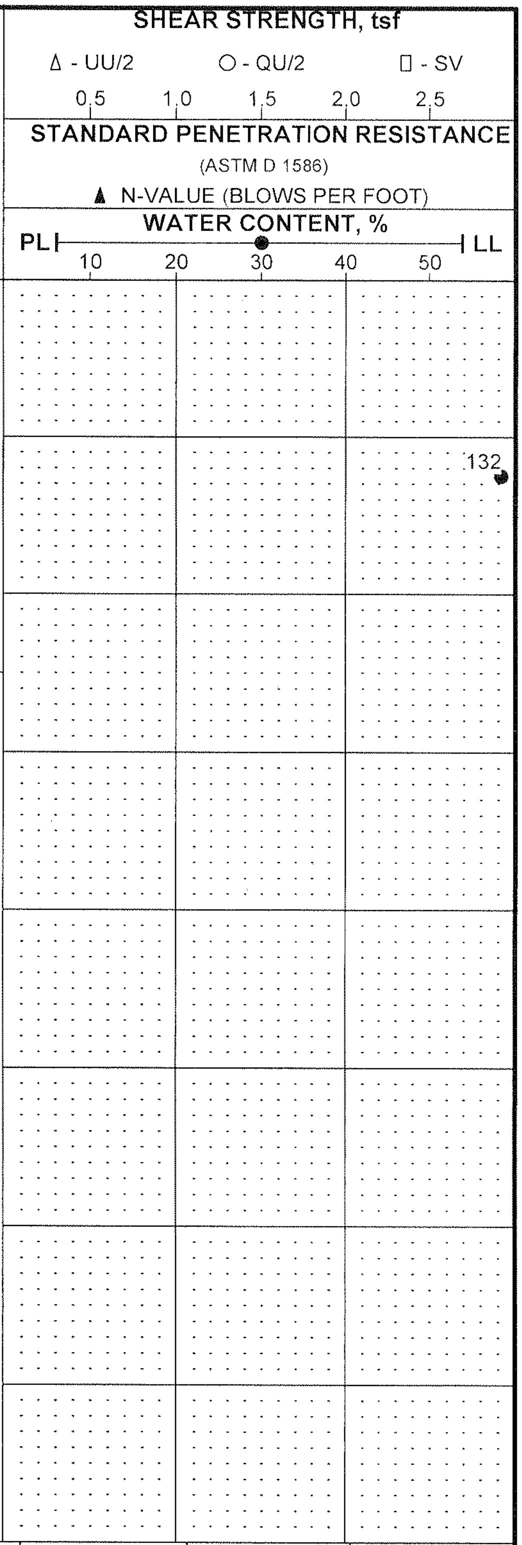
Project No. 1011304.91IG

Surface Elevation 305

Datum msl

Completion Date: 3/25/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Fly ash	▨		
5		▨		GB1
10		▨		
	Test pit terminated at 12.5 feet.			
15				
20				
25				
30				
35				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER ___ HOLLOW STEM

WASHBORING FROM ___ FEET

___ DRILLER RFW LOGGER

Cat 3242 BACKHOE

HAMMER TYPE ___

REMARKS:

Drawn by: LAH	Checked by: SCC	App'vd. by: MHM
Date: 3/31/09	Date: 4/29/09	Date: 6/12/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
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AECI New Madrid
Embankment Stability Evaluation

LOG OF TEST PIT: TP-6

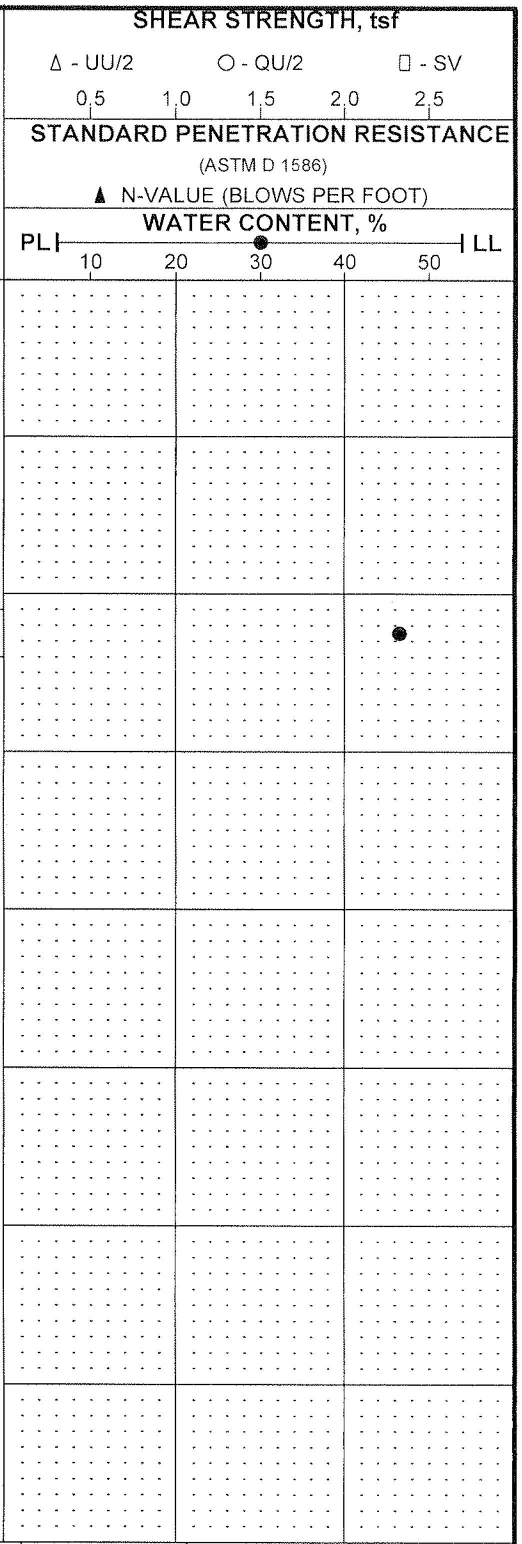
Project No. 1011304.91IG

Surface Elevation 299

Datum msl

Completion Date: 3/25/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
0	Fly ash	▨		
10.5	⊻			
11				GB1
12	Tan SILT - ML			
13	Test pit terminated at 13 feet.			



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 10.5 FEET ⊻

DRILLING DATA

__ AUGER __ HOLLOW STEM
WASHBORING FROM __ FEET
__ DRILLER RFW LOGGER
Cat 3242 BACKHOE
HAMMER TYPE __

REMARKS:

Drawn by: LAH	Checked by: SLC	App'vd. by: MHM
Date: 3/31/09	Date: 4/29/09	Date: 6/12/09

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LOG OF TEST PIT: TP-7

Project No. 1011304.91IG

Surface Elevation 308

Datum msl

Completion Date: 3/25/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Fly ash	▩		GB1
5				
	Cemented fly ash	▩		
10				
	Test pit terminated at 13 feet.			
15				
20				
25				
30				
35				

SHEAR STRENGTH, tsf

Δ - UU/2 ○ - QU/2 ▯ - SV

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

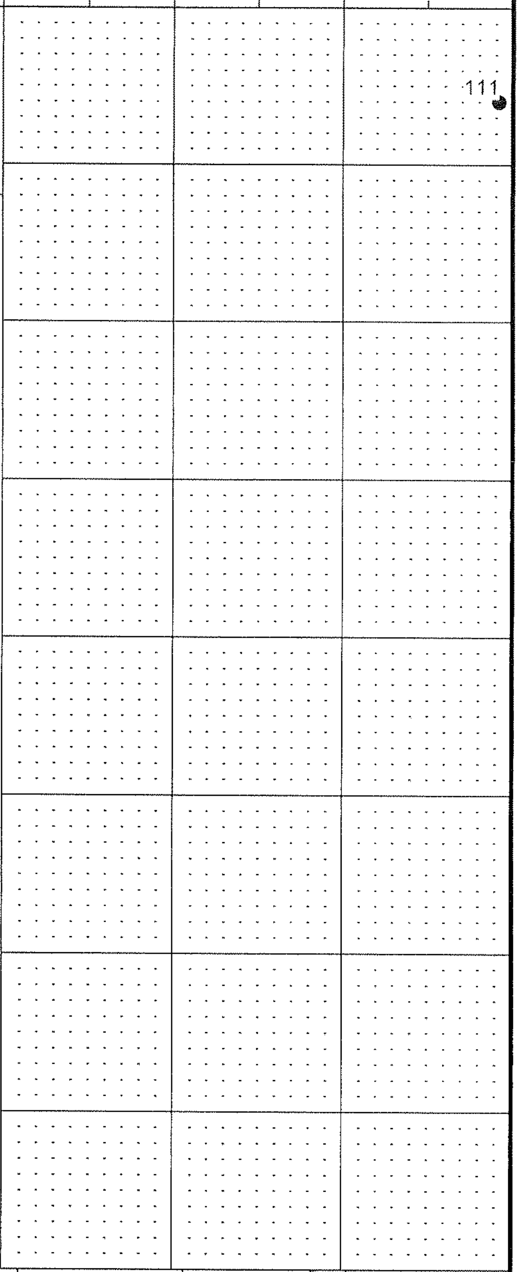
(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL ├──●──┤ LL

10 20 30 40 50



GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER ___ HOLLOW STEM

WASHBORING FROM ___ FEET

___ DRILLER RFW LOGGER

Cat 3242 BACKHOE

HAMMER TYPE ___

REMARKS:

Drawn by: LAH	Checked by:	App'vd. by: MHM
Date: 3/31/09	Date: 4/29/09	Date: 6/12/09

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LOG OF TEST PIT: TP-8

Project No. 1011304.91IG

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

Surface Elevation 315

Datum msl

Completion Date: 3/25/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
0	Fly ash	▨		
10		▨		GB1
16	Test pit terminated at 16 feet.			

SHEAR STRENGTH, tsf

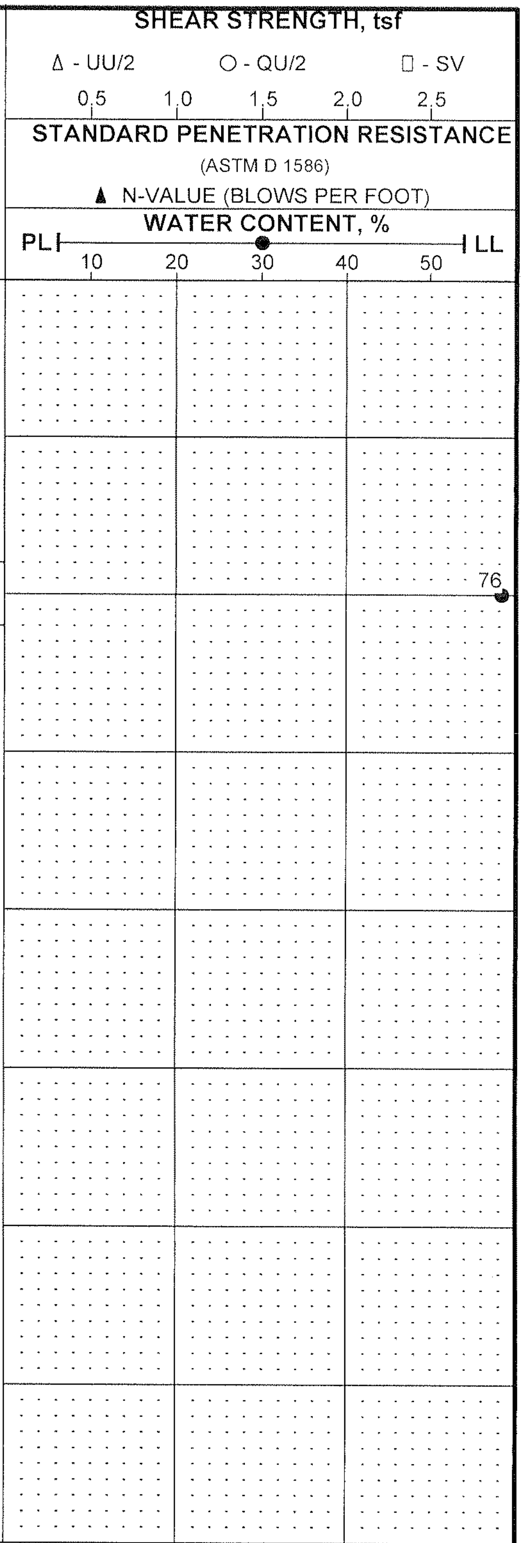
Δ - UU/2 ○ - QU/2 ☐ - SV

STANDARD PENETRATION RESISTANCE (ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL ├──●──┤ LL



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

__ AUGER __ HOLLOW STEM

WASHBORING FROM __ FEET

__ DRILLER RFW LOGGER

Cat 3242 BACKHOE

HAMMER TYPE __

REMARKS:

Drawn by: LAH	Checked by:	App'vd. by: MHM
Date: 3/31/09	Date: 4/29/09	Date: 6/12/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
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AECI New Madrid Embankment Stability Evaluation

LOG OF TEST PIT: TP-9

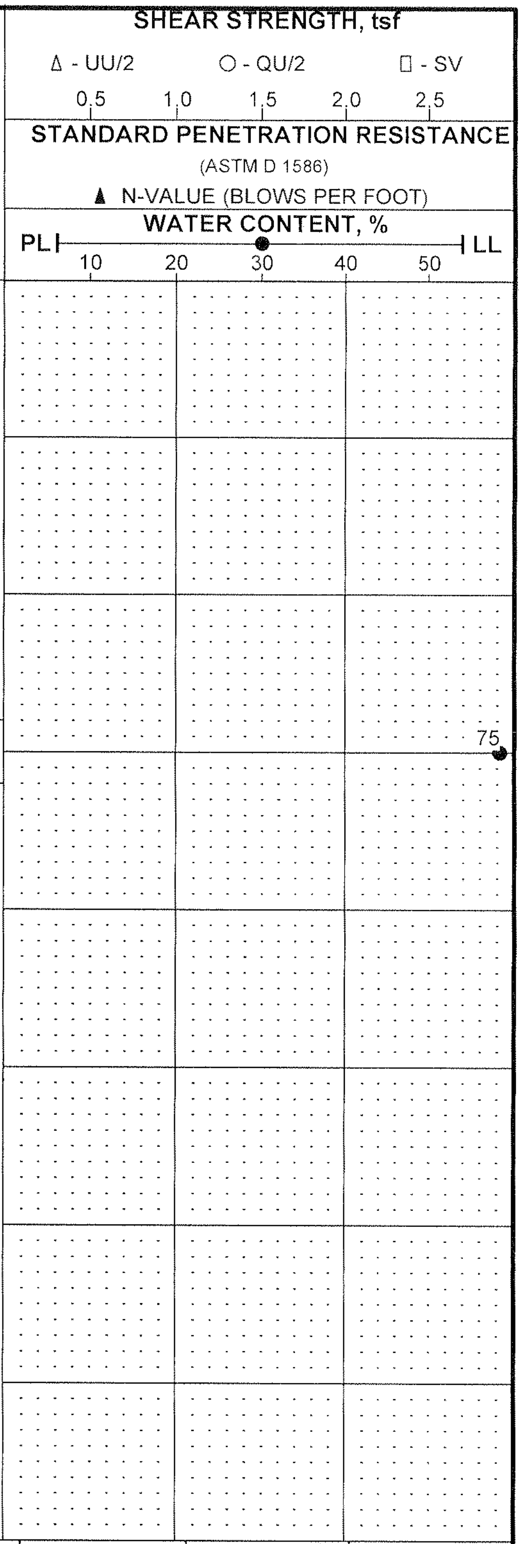
Project No. 1011304.91IG

Surface Elevation 314

Datum msl

Completion Date: 3/25/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
0	Fly ash	▨		
11	∇	▨		
15		▨		GB1
16	Test pit terminated at 16 feet.			
20				
25				
30				
35				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 11 FEET ∇

DRILLING DATA

__ AUGER __ HOLLOW STEM

WASHBORING FROM __ FEET

__ DRILLER RFW LOGGER

Cat 3242 BACKHOE

HAMMER TYPE __

REMARKS:

Drawn by: LAH	Checked by: SC	App'vd. by: MHM
Date: 3/31/09	Date: 4/29/09	Date: 6/12/09

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AECI New Madrid
Embankment Stability Evaluation

LOG OF TEST PIT: TP-10

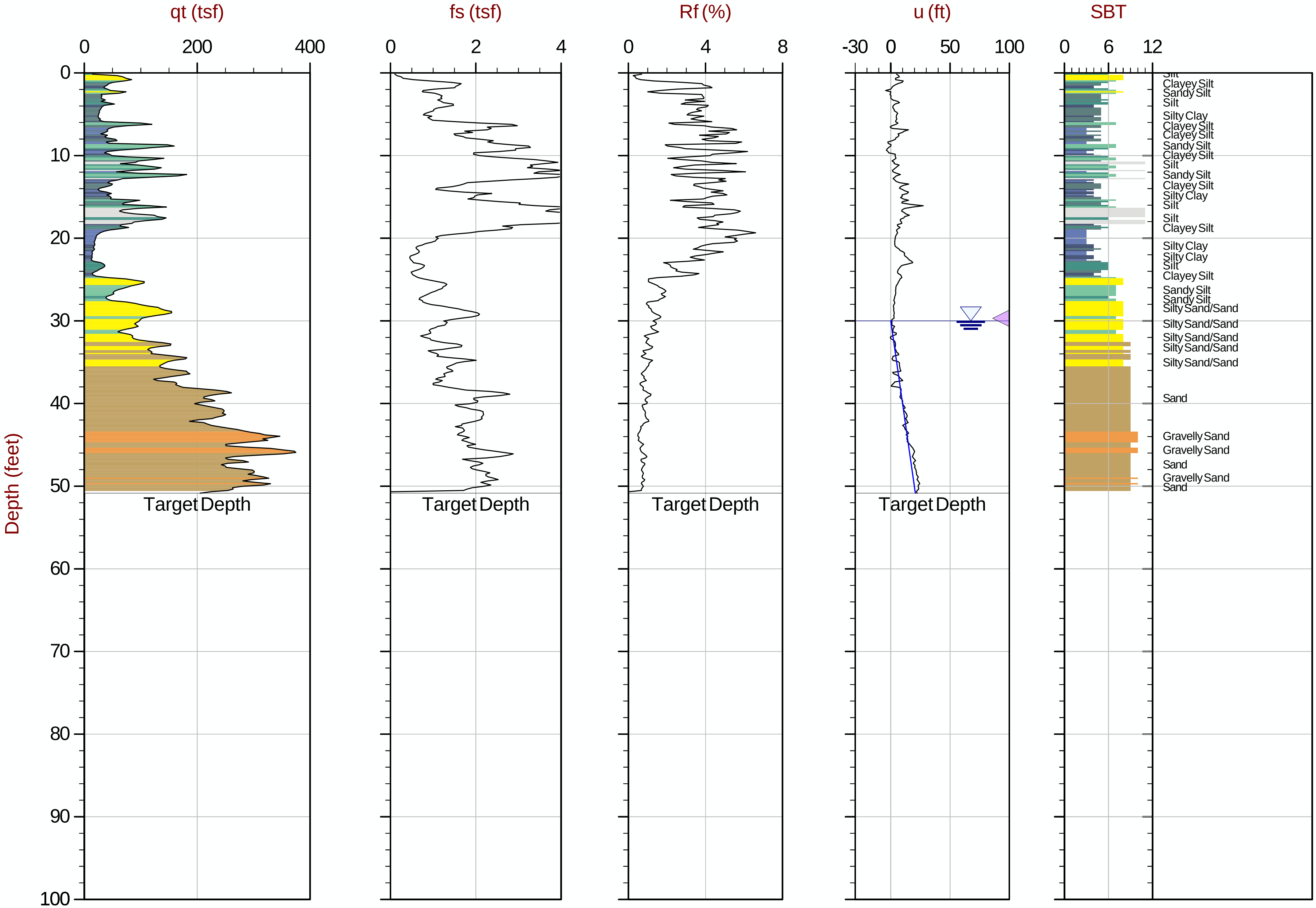
Project No. 1011304.91IG

CONETEC

Haley & Aldrich

Job No: 17-53075
Date: 2017-06-12 11:40
Site: New Madrid Power Plant, Marston, MO

Sounding: CPT17-HA-C11
Cone: 206:T1500F15U500



Max Depth: 15.500 m / 50.85 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 17-53075_CPHA-C11.COR

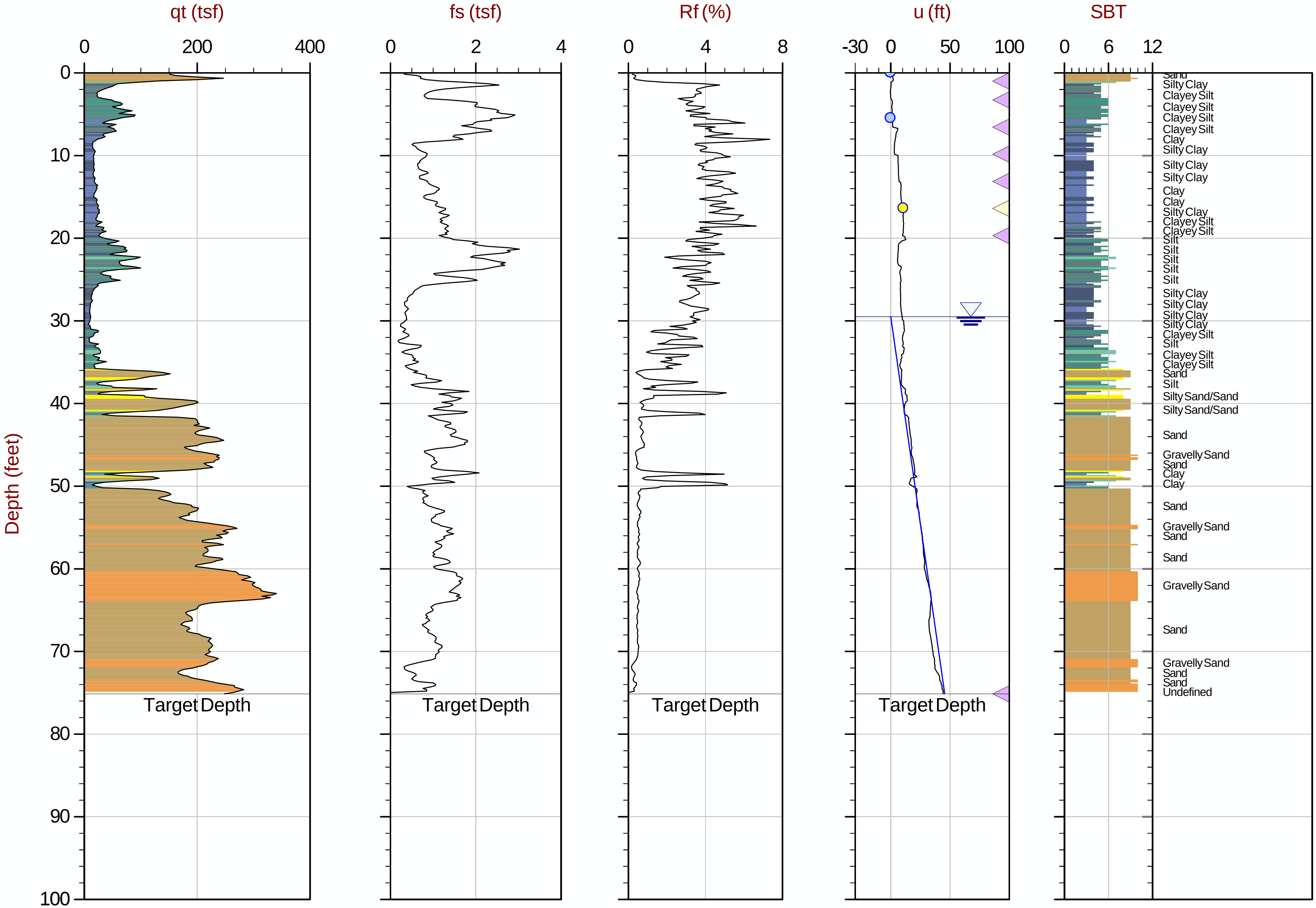
SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4042888m E: 270893m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◀ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Haley & Aldrich

Job No: 17-53075
Date: 2017-06-12 12:55
Site: New Madrid Power Plant, Marston, MO
Sounding: CPT17-HA-C12
Cone: 206:T1500F15U500



Max Depth: 22.900 m / 75.13 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 17-53075_CPHA-C12.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4042742m E: 271089m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

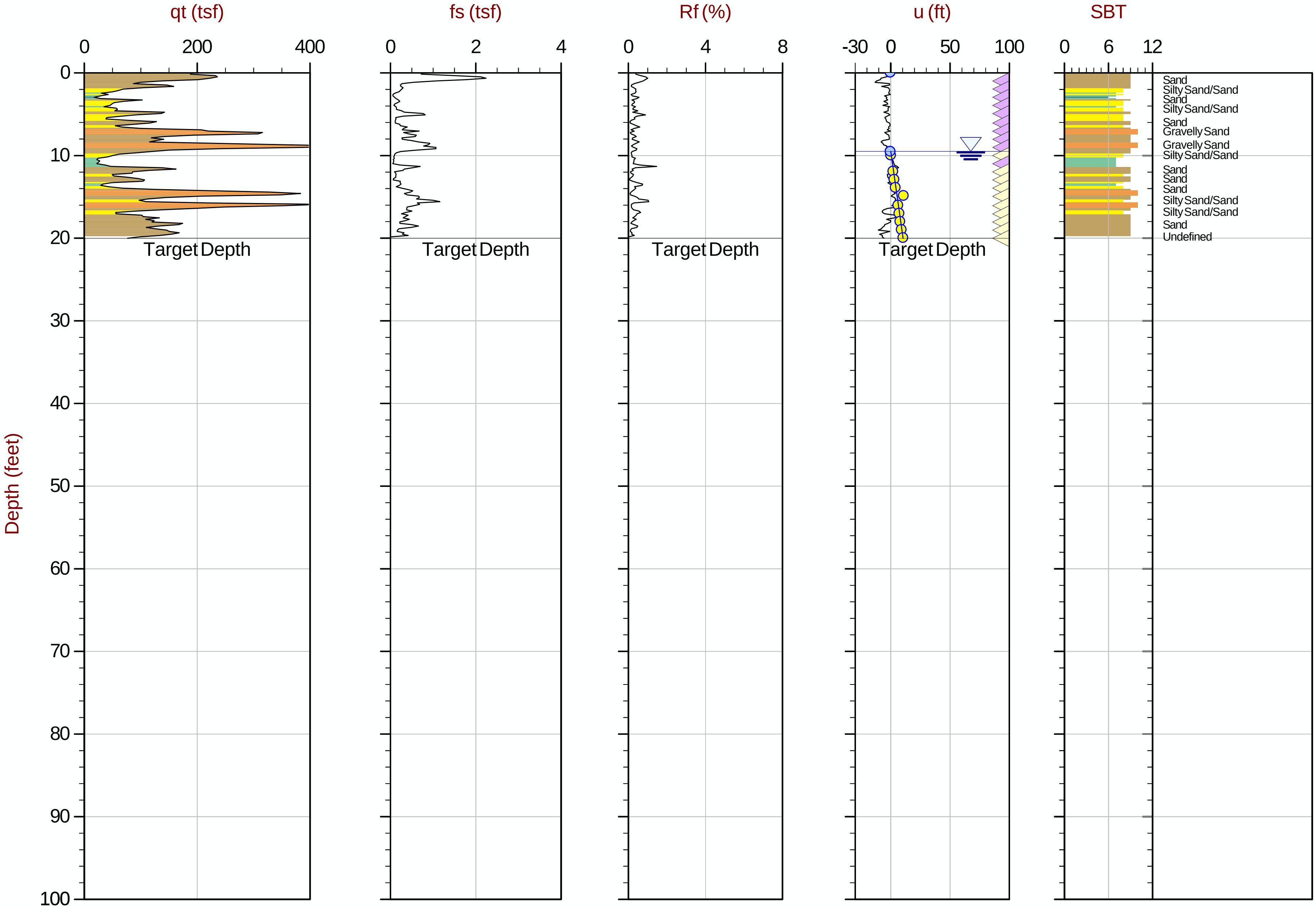
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 17-53075
Date: 2017-06-13 08:41
Site: New Madrid Power Plant, Marston, MO

Sounding: CPT17-HA-C13
Cone: 268:T1500F15U500



Max Depth: 6.100 m / 20.01 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 17-53075_CPHA-C13.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4042731m E: 270764m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

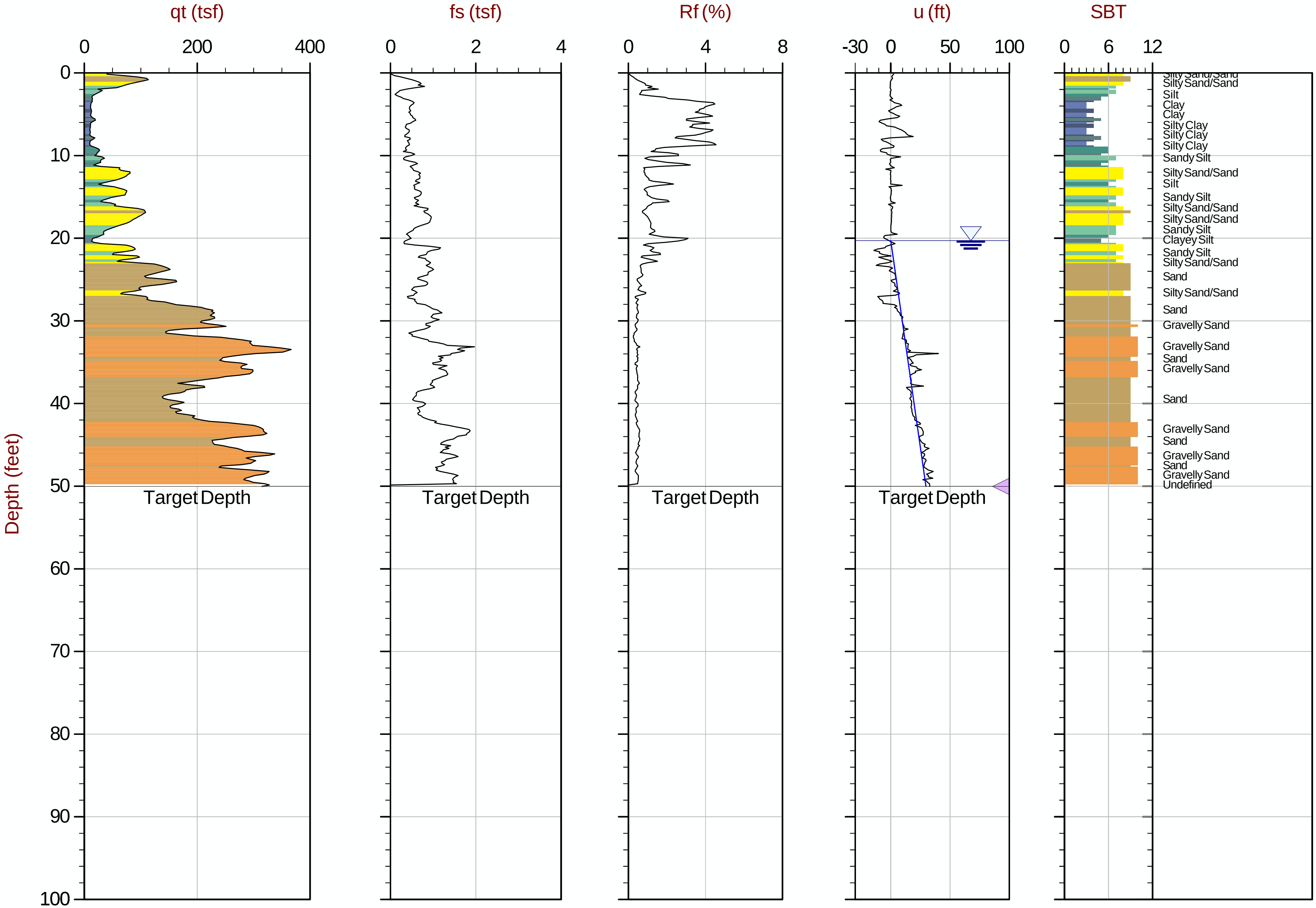
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 17-53075
Date: 2017-06-13 12:30
Site: New Madrid Power Plant, Marston, MO

Sounding: CPT17-HA-C14
Cone: 268:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 17-53075_CPHA-C14.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4042595m E: 270264m

Hydrostatic Line ○ Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

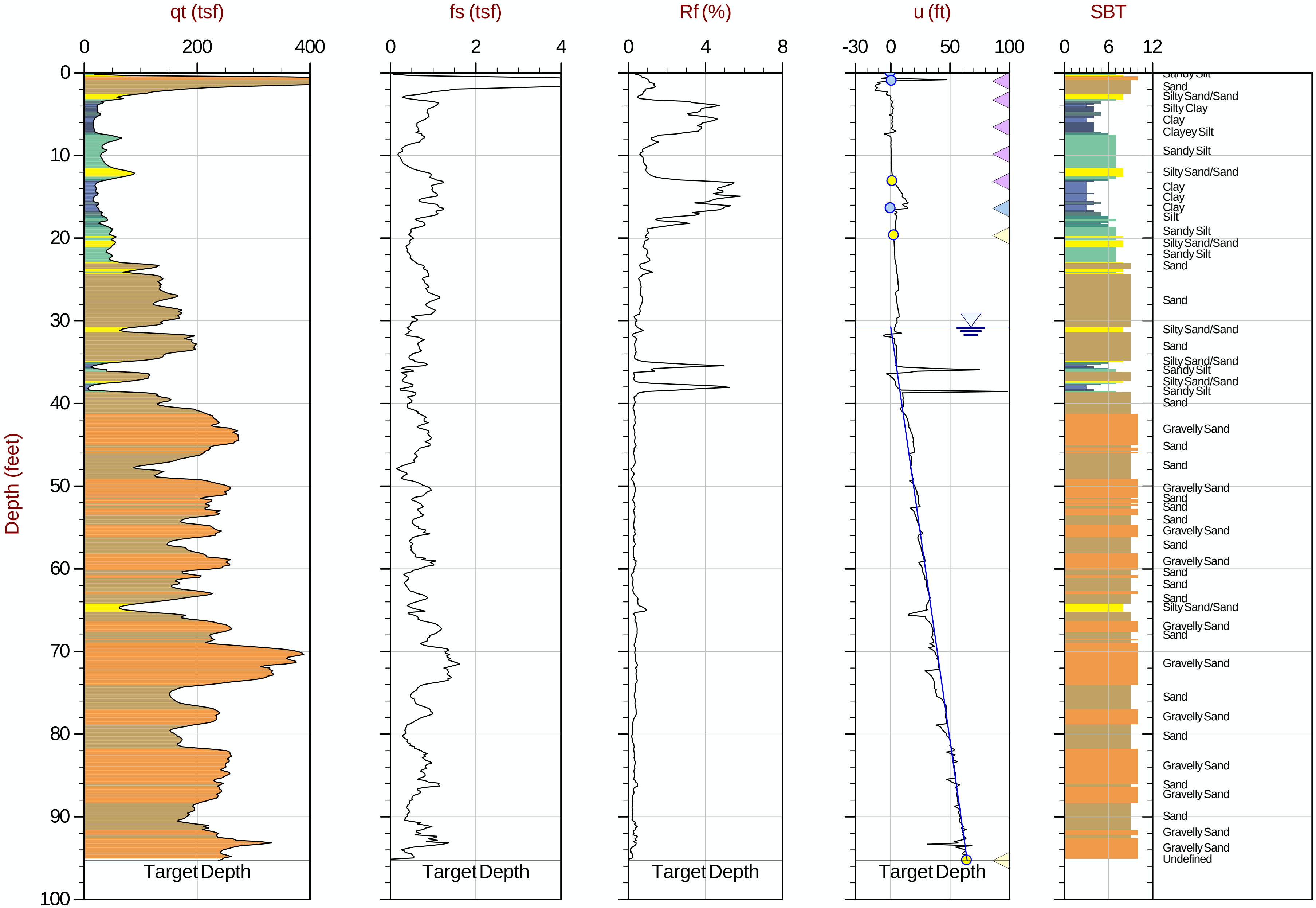
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 17-53075
Date: 2017-06-12 16:20
Site: New Madrid Power Plant, Marston, MO

Sounding: SCPT17-HA-C15
Cone: 206:T1500F15U500



Max Depth: 29.050 m / 95.31 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 17-53075_SPHA-C15.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4042586m E: 270283m

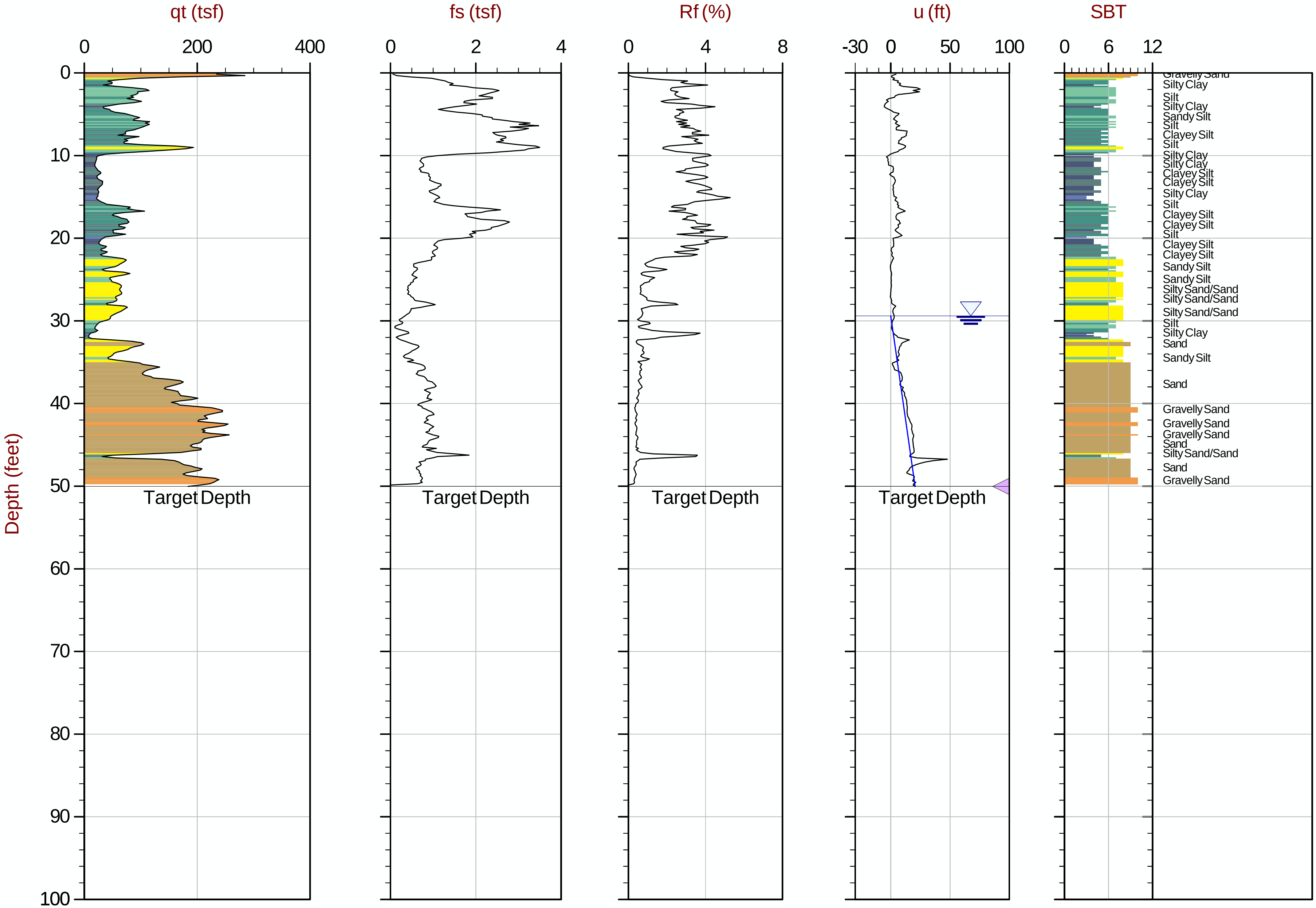
— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Haley & Aldrich

Job No: 17-53075
Date: 2017-06-12 15:12
Site: New Madrid Power Plant, Marston, MO

Sounding: CPT17-HA-C16
Cone: 206:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 17-53075_CPHA-C16.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4042456m E: 270919m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◀ PPD, Ueq not achieved

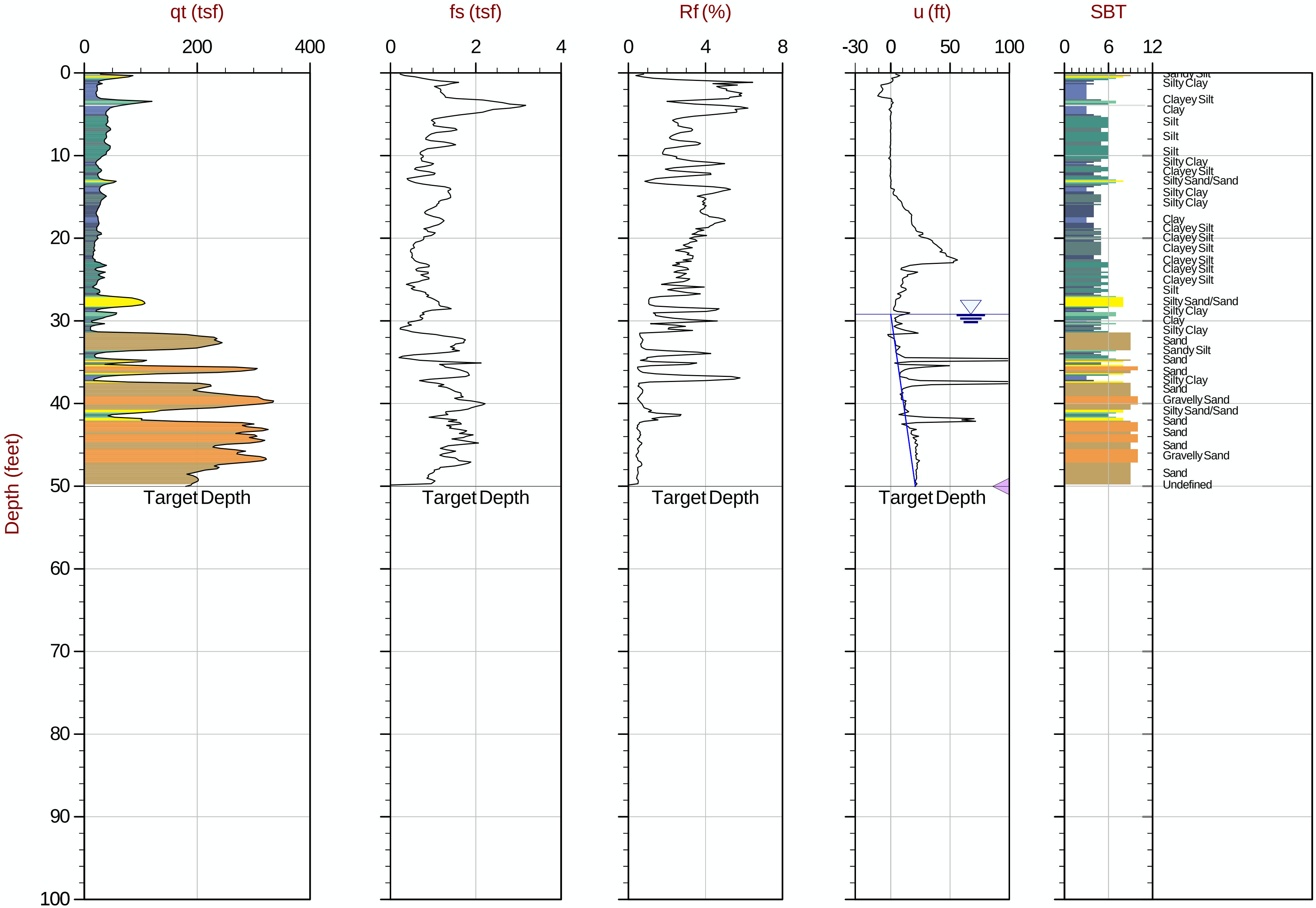
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 17-53075
Date: 2017-06-13 11:34
Site: New Madrid Power Plant, Marston, MO

Sounding: CPT17-HA-C17
Cone: 268:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 17-53075_CPHA-C17.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4042793m E: 270390m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

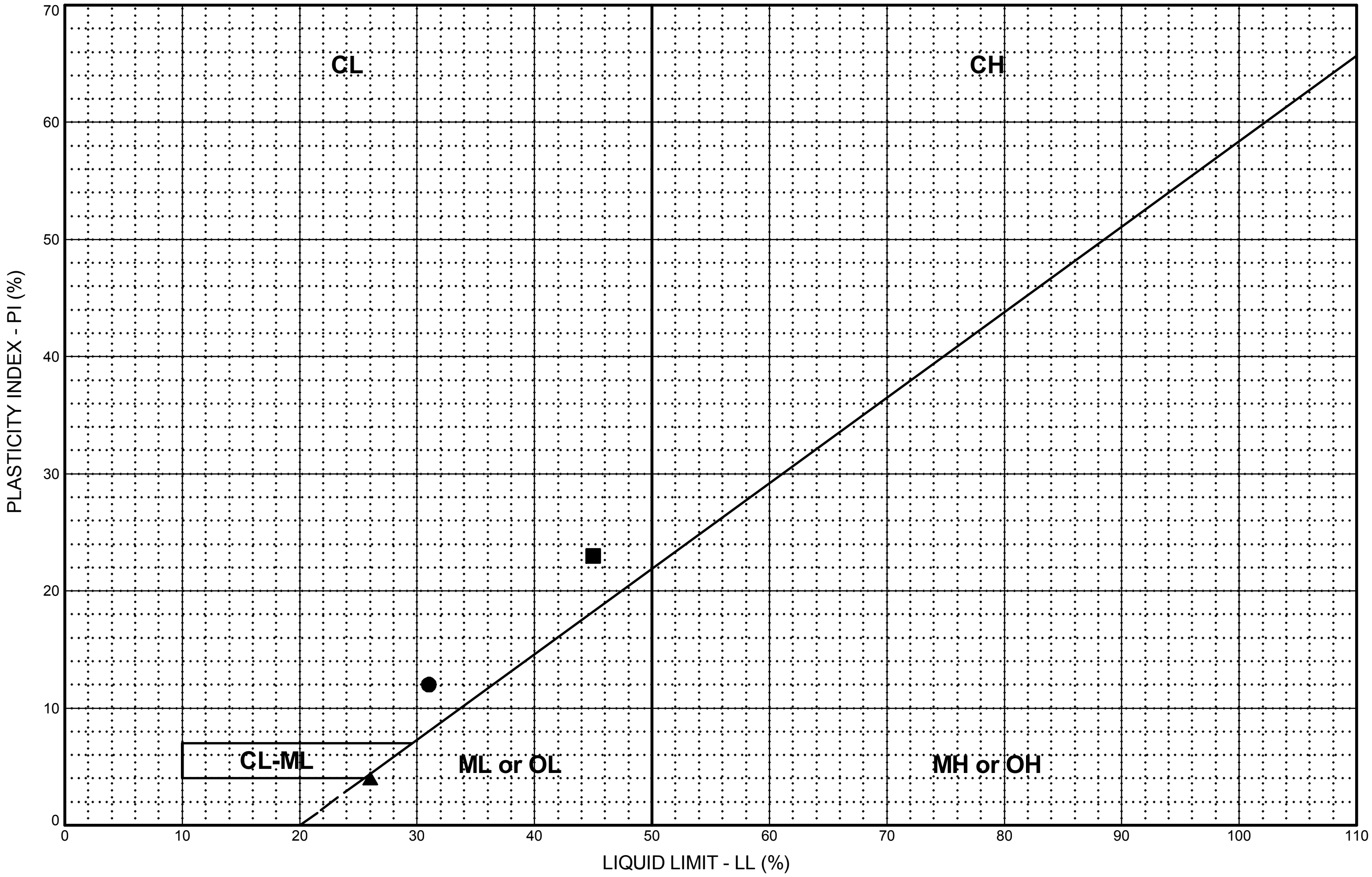
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

TEST BORING REPORT

Boring No. HA-RWP-08
File No. 129342-039
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20																
	4 8 6 9	S9 15	23.0 25.0	283.3 24.5	CH	Similar to S5, except stiff and frequent layers of yellow-brown SILT with sand Note: Light brown find sands found in tip of spoon.	-	-	-	-	-	100				
25																
	1 1 2 2	S10 24	28.0 30.0		ML	Very loose yellow-brown SILT (ML), no odor, wet at 29.5 Ft						100				
30																
						-ALLUVIAL DEPOSITS-										
	1 1 3 7	S11 20	33.0 35.0		ML	Similar to S10, except grading into a medium to fine sand 34.5 ft to 35.0 ft, wet	-	-	-	-	-	100				
35				272.8 35.0		BOTTOM OF EXPLORATION AT 35.0 FT Note: Borehole grouted to ground surface upon completion.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.



LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● HA-B10OW, S2	2.0 - 4.0	CL	Gray and brown, Lean Clay.	31	19	12	18.0	
■ HA-B9, S4	12.0 - 14.0	CL	Brown, Lean Clay.	45	22	23	21.4	
▲ HA-B9A, S1	18.0 - 20.0	ML	Brown, Silt.	26	22	4	30.9	

AECI NMPP - LINED POND
Marston, Missouri

PLASTICITY CHART

July 2017 41-1-37431-008

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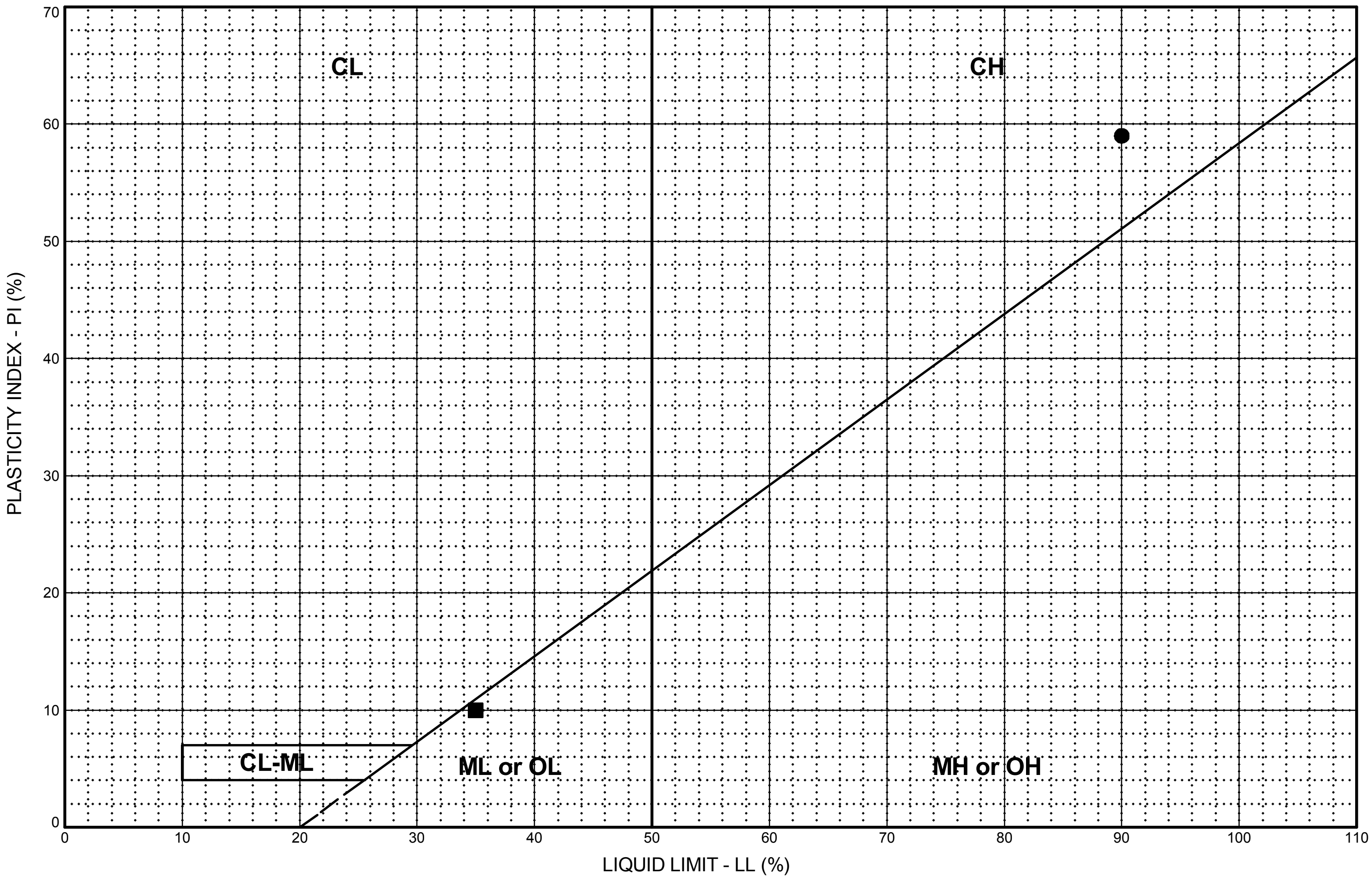
FIG.

ATTERBERG - WITH SAMPLE INTERVALS 41-1-37431-008 LAB DATA.GPJ SHAN_WIL.GDT 7/12/17

FIG.



LEGEND

CL:	Low plasticity inorganic clays; sandy and silty clays
CH:	High plasticity inorganic clays
ML or OL:	Inorganic and organic silts and clayey silts of low plasticity
MH or OH:	Inorganic and organic silts and clayey silts of high plasticity
CL-ML:	Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● HA-B9, U1	6.8	CH	Mottled gray and brown, Fat Clay.	90	31	59	34.6	98.0
■ HA-B9, U3	14.4	ML	Brown, Silt.	35	25	10	19.6	97.1

AECI NMPP - LINED POND
Marston, Missouri

PLASTICITY CHART

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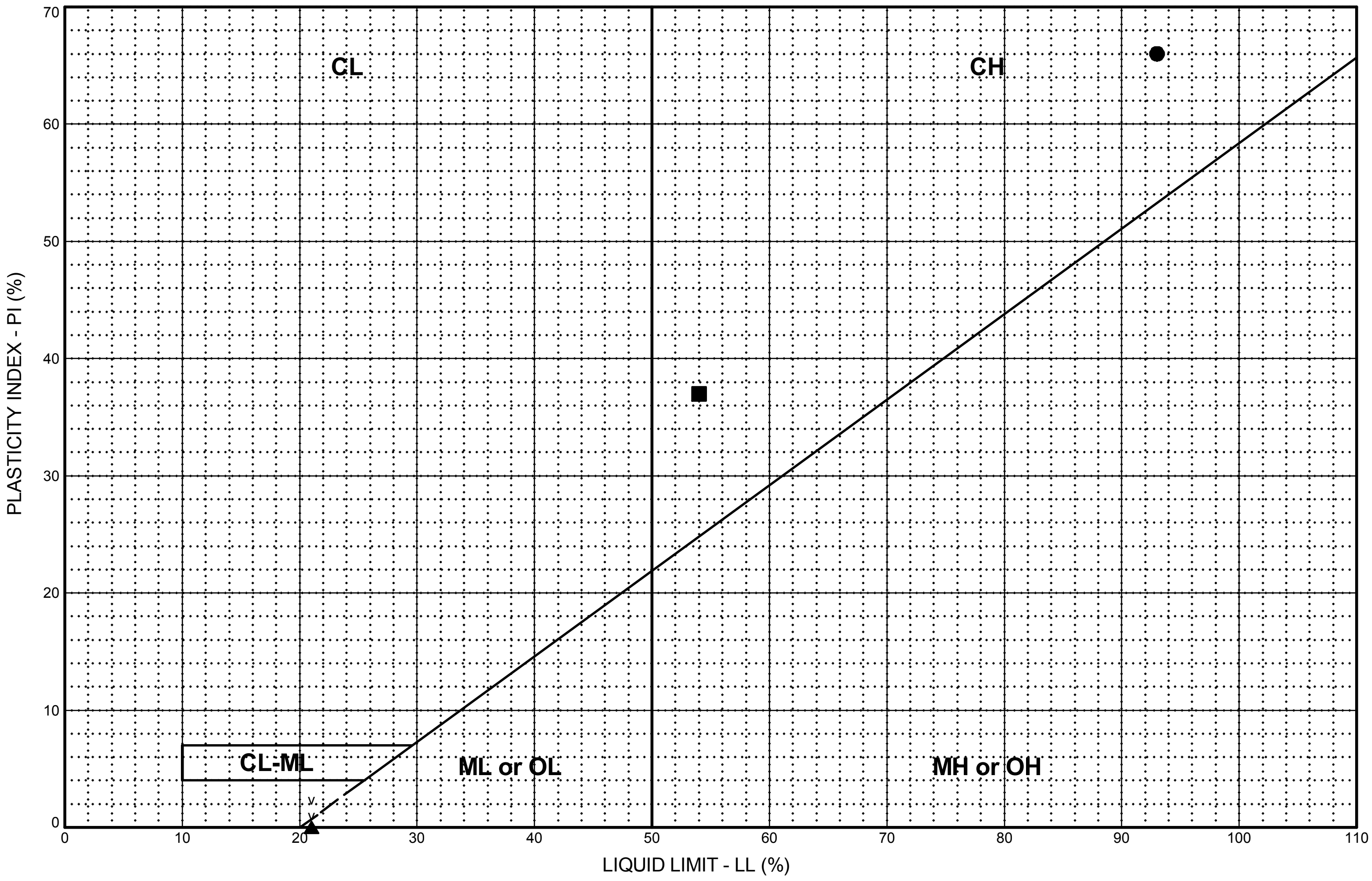
FIG.

FIG.

ATTERBERG - NORMAL 41-1-37431-008 LAB DATA.GPJ SHAN_WIL.GDT 7/26/17



LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● HA-B10OW, U1	10.0 - 12.0	CH	Mottled gray and brown, Fat Clay.	93	27	66	29.9	98.0
■ HA-B10OW, U2	18.0 - 20.0	CH	Mottled gray and brown, Fat Clay.	54	17	37	19.0	95.6
▲ HA-B10OW, U3	30.0 - 32.0	ML	Brown, Silt.	21	23	NP	36.4	99.6

AECI NMPP - LINED POND
Marston, Missouri

PLASTICITY CHART

July 2017
41-1-37431-008

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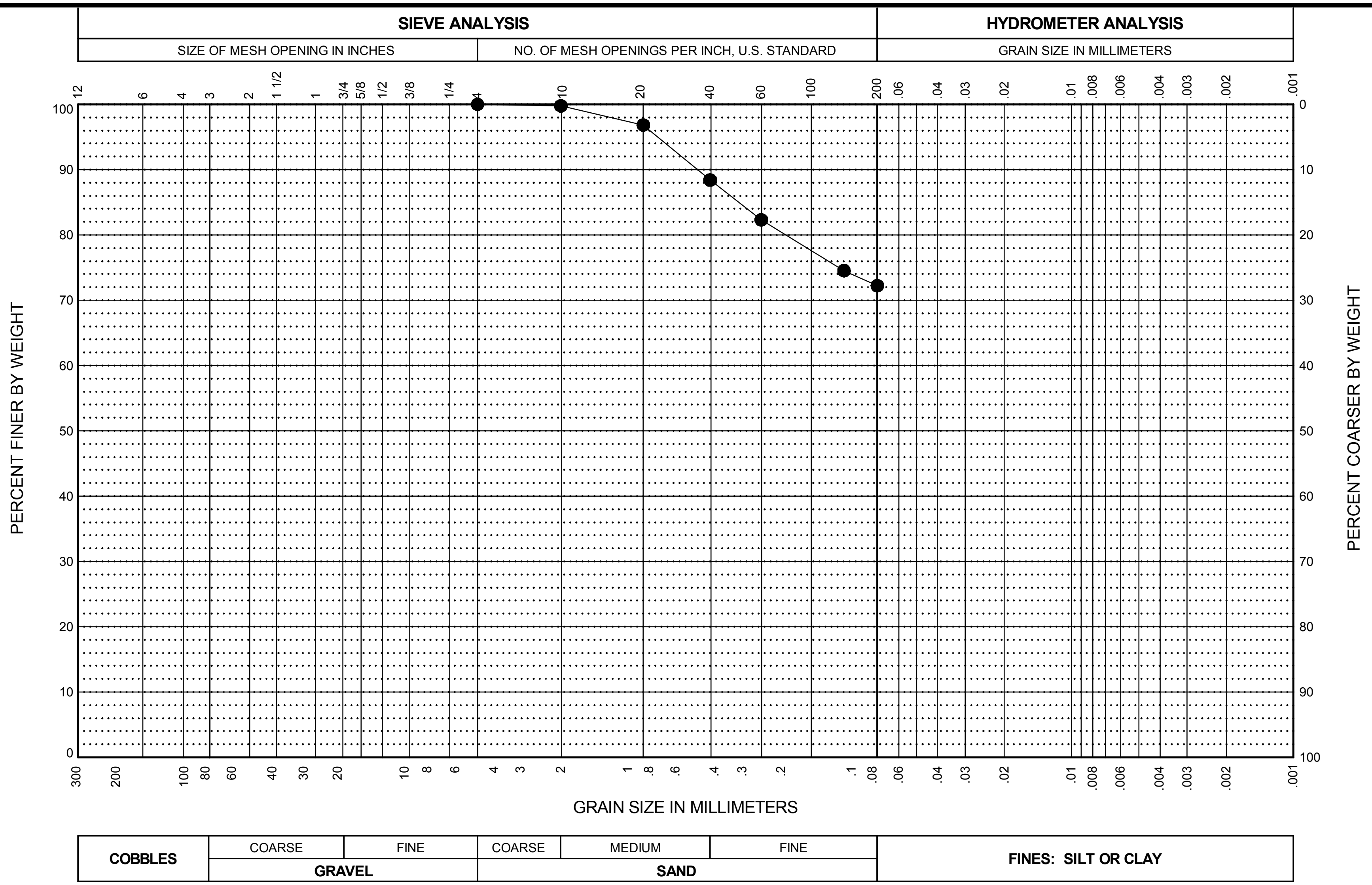
FIG.

FIG.



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B8OW, S3	4.0 - 6.0	ML	Gray, Silt with Sand.	72.2	115.2			

AECI NMPP - LINED POND
Marston, Missouri

GRAIN SIZE DISTRIBUTION

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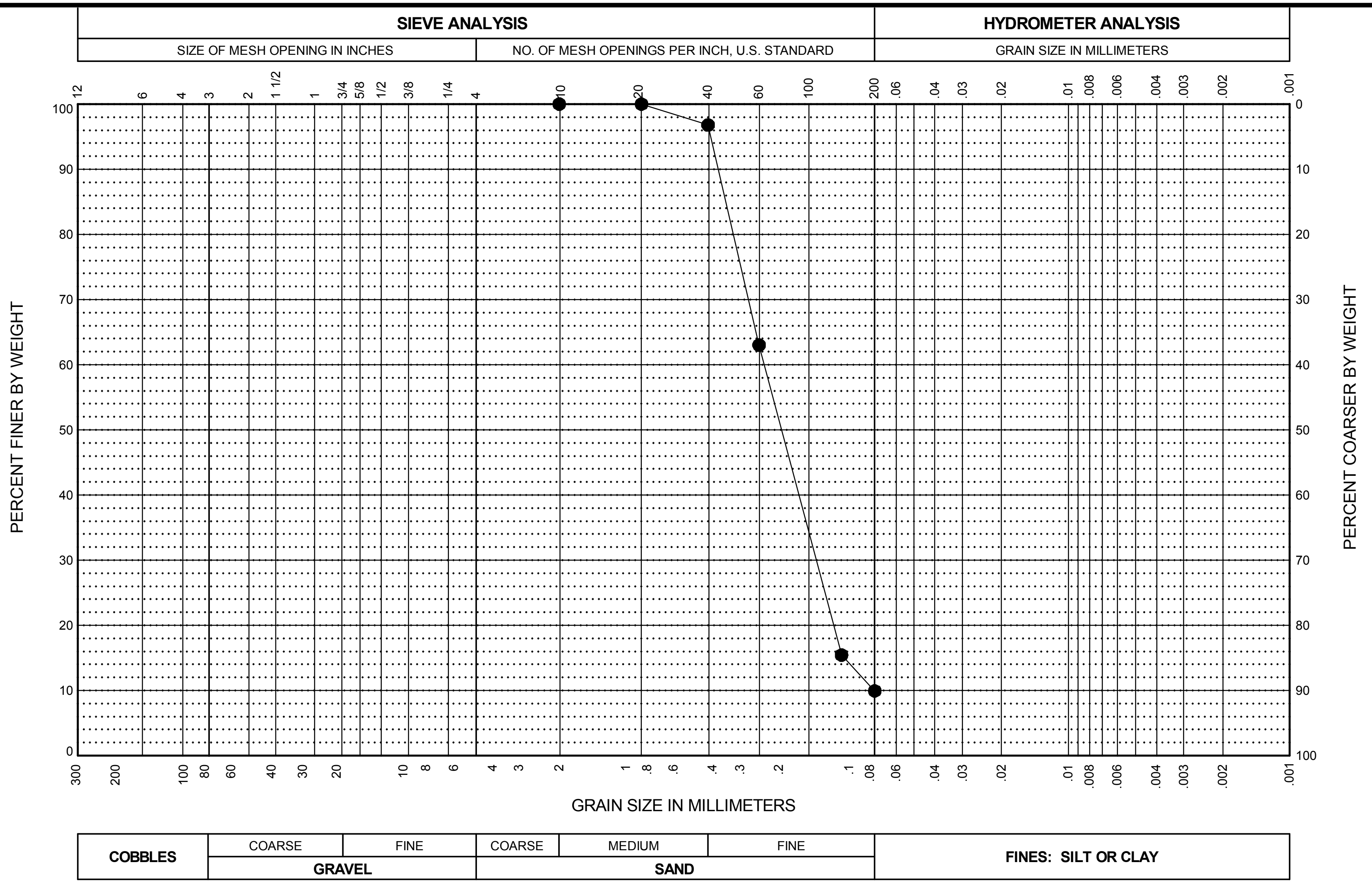
FIG.

GSA- WITH SAMPLE INTERVALS 41-1-37431-008 LAB DATA.GPJ SHAN_WIL.GDT 7/12/17



GSA- WITH SAMPLE INTERVALS 41-1-37431-008 LAB DATA.GPJ SHAN_WIL.GDT 7/12/17

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B9, S6	24.0 - 26.0	SP-SM	Brown, Poorly Graded Sand with Silt.	9.9	4.7			

AECI NMPP - LINED POND
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GRAIN SIZE DISTRIBUTION

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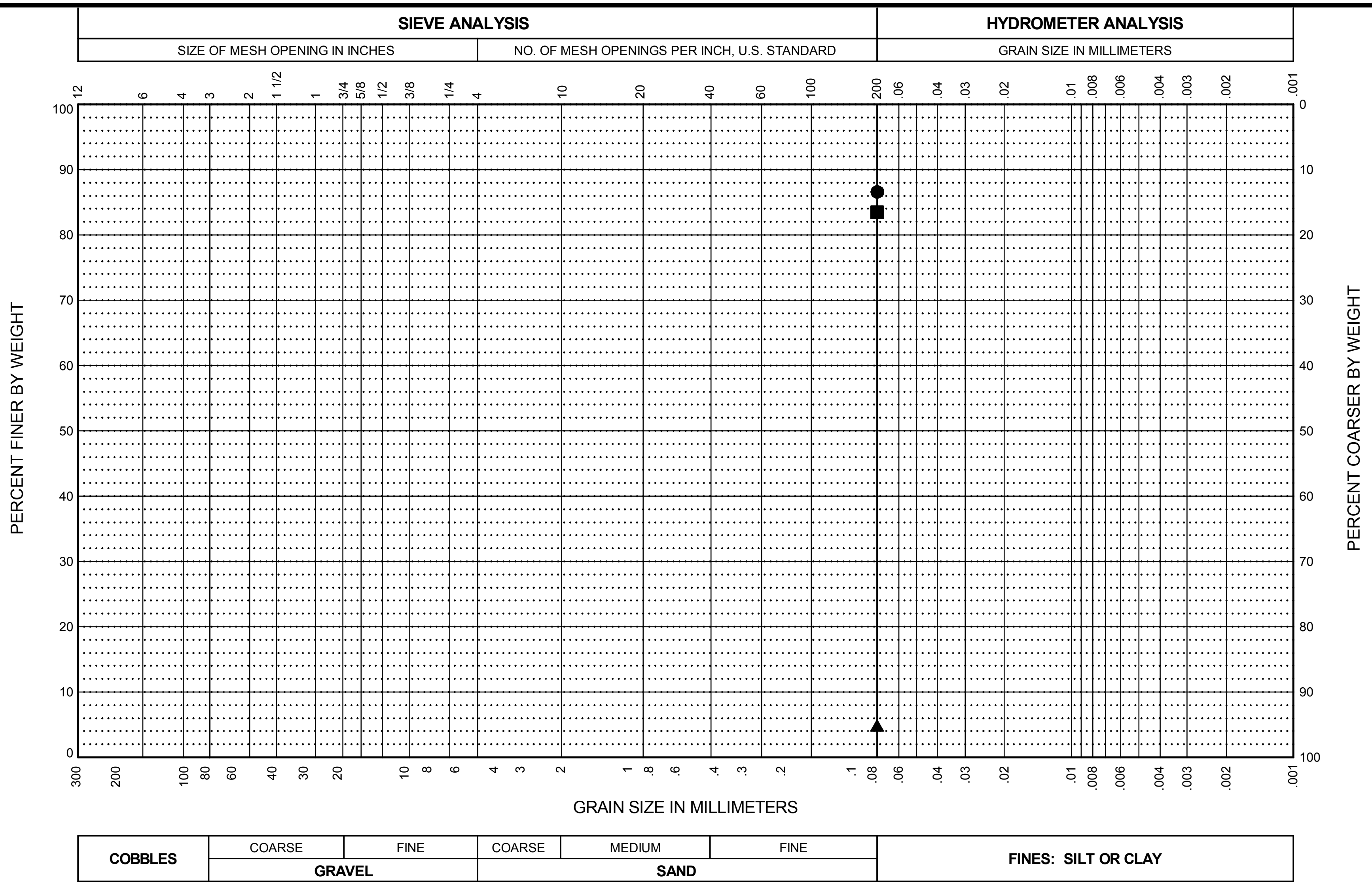
FIG.



GSA- WITH SAMPLE INTERVALS 41-1-37431-008 LAB DATA.GPJ SHAN_WIL.GDT 7/12/17

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B10OW, S5	8.0 - 10.0	CL	Gray and brown, Lean Clay.	86.6	20.4			
■ HA-B8OW, S8	14.0 - 16.0	ML	Gray, Silt with Sand.	83.5	95.4			
▲ HA-B9A, S3	28.0 - 30.0	SP	Brown, Poorly Graded Sand.	4.9	17.6			

AECI NMPP - LINED POND
Marston, Missouri

GRAIN SIZE DISTRIBUTION

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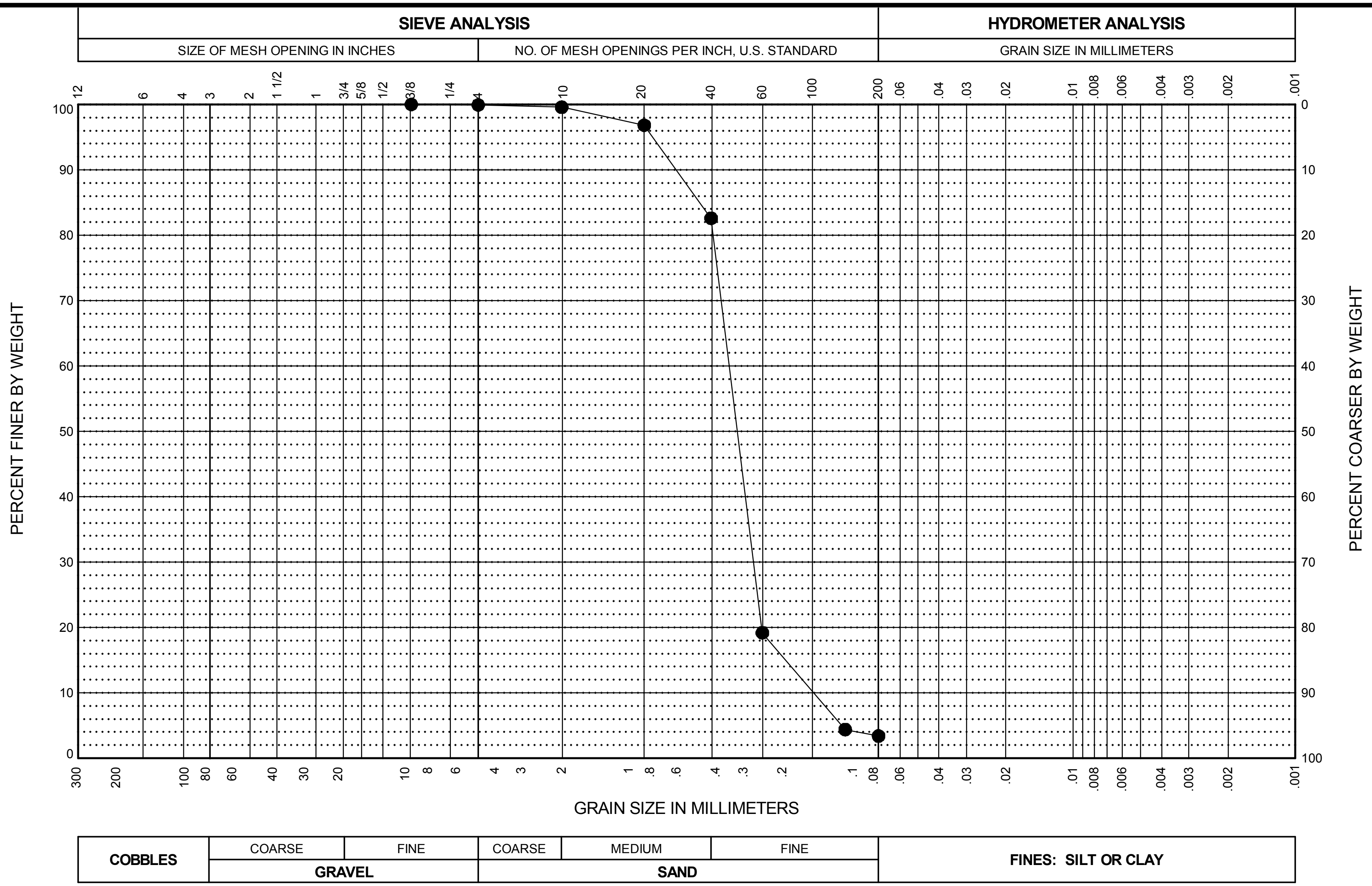
FIG.



GSA- WITH SAMPLE INTERVALS 41-1-37431-008 LAB DATA.GPJ SHAN_WIL.GDT 7/12/17

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B9A, S11	68.0 - 70.0	SP	Gray, Poorly Graded Sand.	3.4	20.2			

AECI NMPP - LINED POND
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GRAIN SIZE DISTRIBUTION

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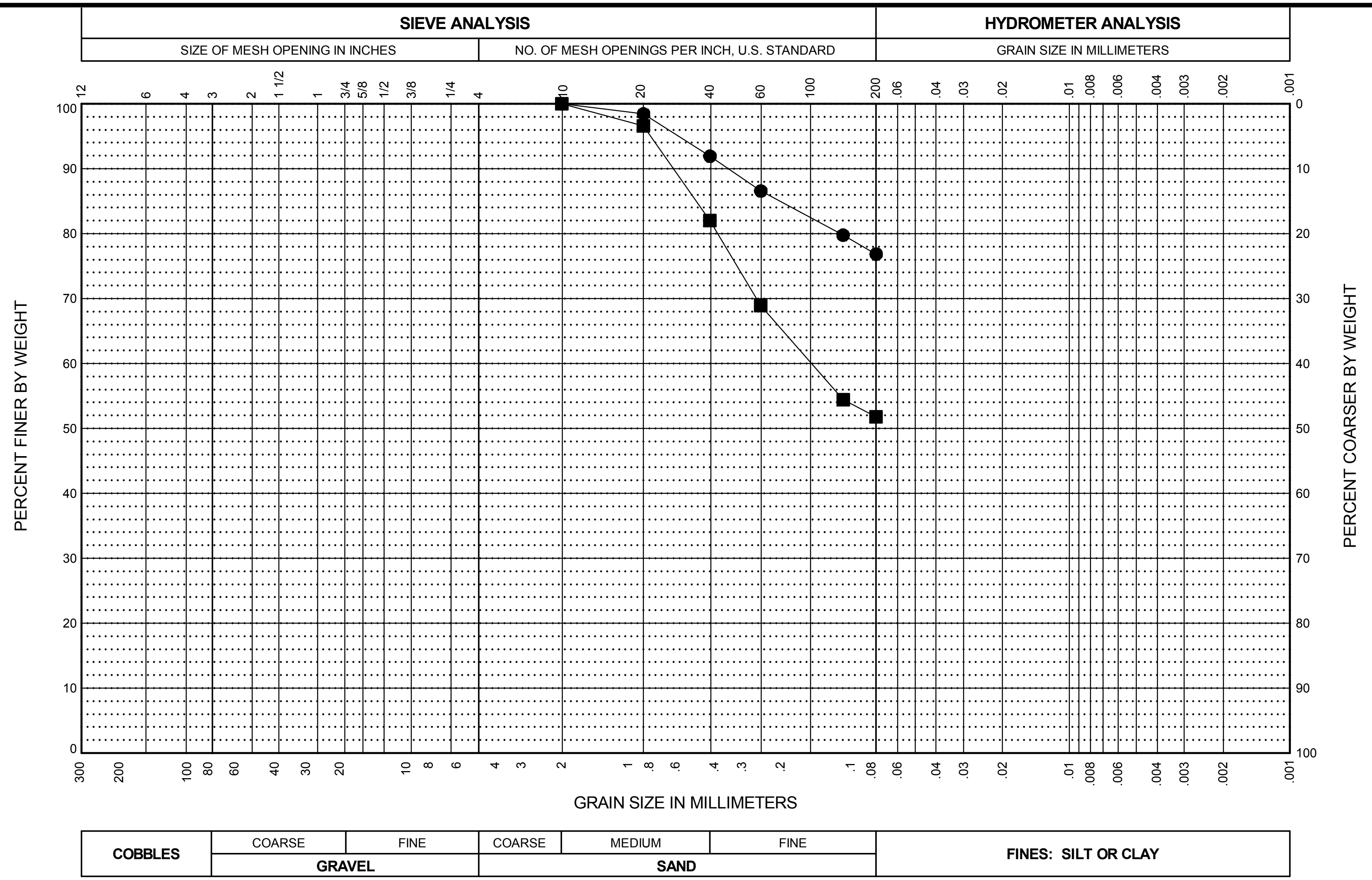
FIG.



GSA- WITH SAMPLE INTERVALS 41-1-37431-008 LAB DATA.GPJ SHAN_WIL.GDT 7/3/17

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● TP3-2, BULK	0.0 - 11.0	ML	Gray, Silt with Sand.	76.8	103.7	NP	NP	NP
■ TP3-4, BULK	0.0 - 9.0	ML	Tan, Sandy Silt.	51.8	113.4	NP	NP	NP

AECI NMPP - LINED POND
Marston, Missouri

GRAIN SIZE DISTRIBUTION

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FIG.

PROJECT AECI NMPP - LINED POND DATE 7/21/17 BORING NO. HA-B9

JOB NO. 41-1-37431-008 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich CHECKED BY CMB

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U1 DEPTH (ft) 6-8

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C. Strength info.	NAT. W.C. W.C.	TYPE OF TEST	CLASSIFICATION
				17 INCH RECOVERY Sample: Good [✓ Fair] Poor Disturbed
6.0	PP = 3.25	HT-3	MC	Very stiff, mottled gray and brown, Fat Clay (CH); moist; <5% fine sand, 95% high dry strength and plasticity, no dilatancy. (Possible Fill)
			SAVED	
6.5			CU	
7.0			SAVED	Hard, brown, Silt with Sand to Sandy Silt (ML); moist; 25-35% fine sand, 95% low dry strength and plasticity, rapid dilatancy. (Possible Fill)
	PP = 4.5+	HT-4	MC	
7.5				
8.0				

Can/Tare No.	HT-3	HT-4
WET + TARE	57.92	76.99
DRY + TARE	46.37	71.26
TARE	2.52	2.53
% WATER	26.3	8.3

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS: Tube would not extrude, had to cut into 6 inch pieces to extrude.

PROJECT AECI NMPP - LINED POND DATE 7/20/17 BORING NO. HA-B9

JOB NO. 41-1-37431-008 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich CHECKED BY CMB

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U3 DEPTH (ft) 14-16

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C.		TYPE OF TEST	CLASSIFICATION
	Strength info.	W.C.		
				19 INCH RECOVERY Sample: [✓ Good] Fair Poor Disturbed
14.0	PP = 2.5	HT-1	MC	Stiff, brown, Silt (ML); moist; 5% fine sand, 95% low dry strength and plasticity, rapid dilatancy.
			Atterberg #200 Wash UU-1	
14.5				
			UU-2	
15.0				
			Consolidation	
15.5	PP = 2.0	HT-1	MC	
16.0				

Can/Tare No.	HT-1	HT-2
WET + TARE	95.66	69.31
DRY + TARE	79.51	57.90
TARE	2.52	2.53
% WATER	21.0	20.6

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS:

PROJECT AECI NMPP - LINED POND DATE 7/11/17 BORING NO. HA-B10OW

JOB NO. 41-1-37431-008 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich CHECKED BY CMB

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U1 DEPTH (ft) 10-12

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C. Strength info.	NAT. W.C. W.C.	TYPE OF TEST	CLASSIFICATION
				24 INCH RECOVERY Sample: Good Fair Poor [✓ Disturbed]
10.0	PP = 1.5	HT-1	MC	Stiff, mottled gray and brown, Fat Clay (CH); moist; <5% fine sand; >95% high dry strength and plasticity, no dilatancy. (Possible Fill.)
10.5				
11.0			SAVED	
11.5				
12.0	PP = 1.75	HT-2	Atterberg #200 Wash MC	

Can/Tare No.	HT-1	HT-2
WET + TARE	80.61	66.72
DRY + TARE	59.89	51.94
TARE	2.51	2.54
% WATER	36.1	29.9

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS: Sample disturbed and distorted, possibly hit obstruction .
See picture #7154.

PROJECT AECI NMPP - LINED POND
DATE 7/11/17
BORING NO. HA-B10OW
JOB NO. 41-1-37431-008
SHEET NO. 1
TESTED BY CMB
CLIENT NAME Haley & Aldrich
CHECKED BY CMB

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U2
DEPTH (ft) 18-20
Sampling Method Push
Type of Sample Shelby Tube
Inch 3"
Brass or [✓ Steel]

DEPTH FT.	NAT. W.C. Strength info.	NAT. W.C. W.C.	TYPE OF TEST	CLASSIFICATION
				16 INCH RECOVERY Sample: Good [✓ Fair] Poor Disturbed
18.0	PP = 3.25	HT-3	MC SAVED Atterberg #200 Wash CU	Stiff, mottled gray and brown, Fat Clay (CH); moist; <5% fine sand; >95% high dry strength and plasticity, no dilatancy. Sample contains shredded plastic. (Possible Fill.)
18.5				
19.0			SAVED	
	PP = 4.5+	HT-4	MC	
19.5				
20.0				

Can/Tare No.	HT-3	HT-4
WET + TARE	77.31	68.50
DRY + TARE	62.67	58.87
TARE	2.54	2.54
% WATER	24.3	17.1

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS: Sample contains pieces of plastic, possilbe geotextile.

PROJECT AECI NMPP - LINED POND
DATE 7/11/17
BORING NO. HA-B10OW
JOB NO. 41-1-37431-008
SHEET NO. 1
TESTED BY CMB
CLIENT NAME Haley & Aldrich
CHECKED BY CMB

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U3
DEPTH (ft) 30-32
Sampling Method Push
Type of Sample Shelby Tube
Inch 3"
Brass or [✓ Steel]

DEPTH FT.	NAT. W.C.		TYPE OF TEST	CLASSIFICATION
	Strength info.	W.C.		
30.0				23 INCH RECOVERY Sample: [✓ Good] Fair Poor Disturbed
	PP = 0.5	HT-5	MC	Mottled gray and brown, Fat Clay (CH); moist; <5% fine sand, 95% high plastic.
			Atterberg #200 Wash CU	Brown, Silt (ML); moist to wet; 5% fine sand, 95% low dry strength and plasticity, rapid dilatancy.
30.5				
31.0			SAVED	Mottled gray and brown, Fat Clay (CH); moist; <5% fine sand, 95% high dry strength and plasticity, no dilatancy.
				Mottled gray and brown, Lean Clay (CL) moist; <5% fine sand, 95% medium dry strength and plasticity, no dilatancy.
31.5				
	PP = 0.75	HT-6	MC	
32.0				

Can/Tare No.	HT-5	HT-6
WET + TARE	46.98	53.62
DRY + TARE	34.88	40.23
TARE	2.54	2.54
% WATER	37.4	35.5

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS:

Sample Identification: TP3-2, Bulk, 0.0 - 11.0 feet.

Description of Material: Gray, Silt with Sand. (ML)

Compaction Test Method: ASTM D698 Method A

Rammer Type: Mechanical

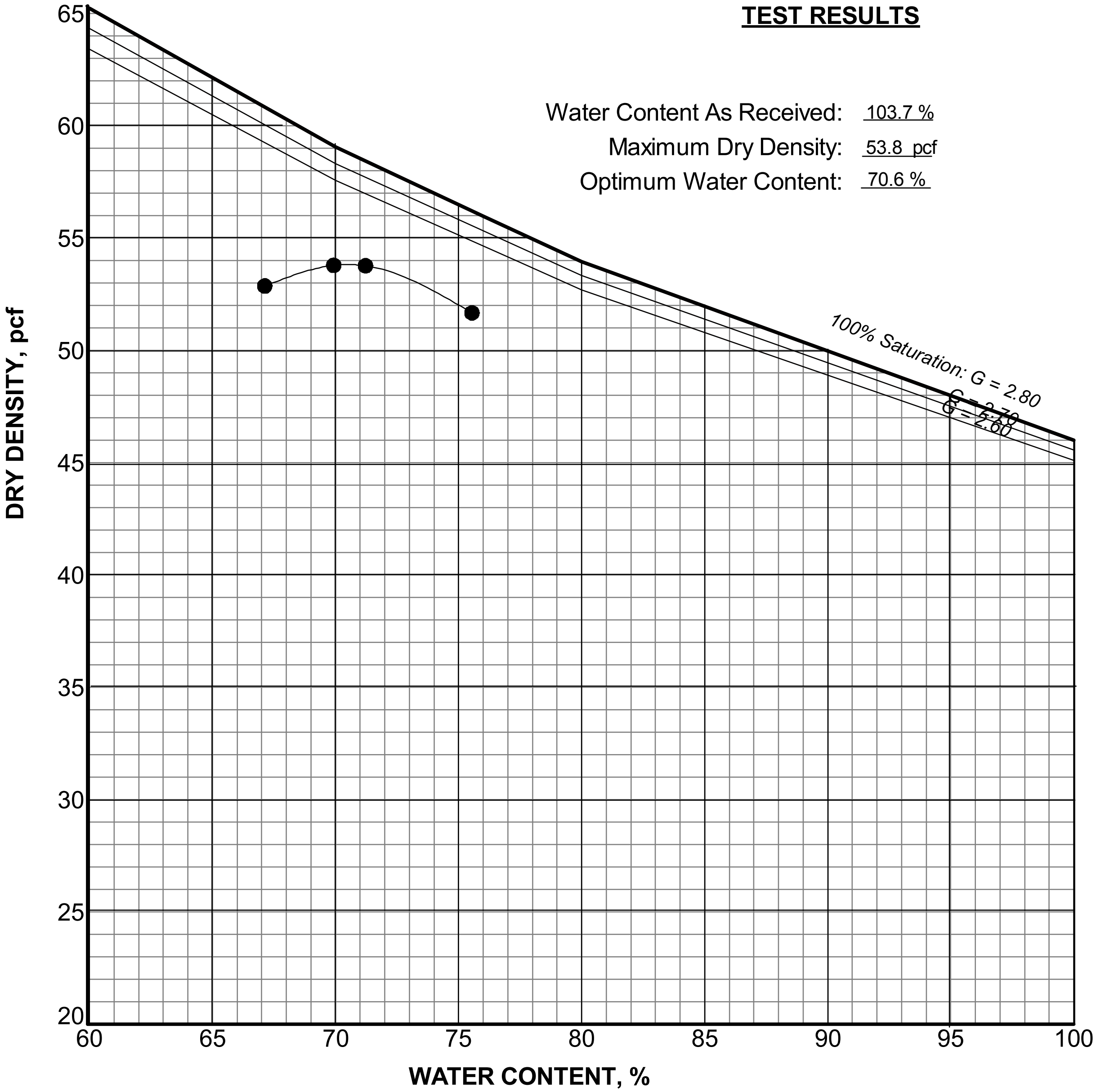
Checked By:

TEST RESULTS

Water Content As Received: 103.7 %

Maximum Dry Density: 53.8 pcf

Optimum Water Content: 70.6 %



OTHER TEST RESULTS

GRAIN SIZE ANALYSES: % Gravel: 0.0

% Sand: 23.2

% Fines: 76.8

ATTERBERG LIMITS: Liquid Limit: NP

Plastic Limit: NP

Plasticity Index: NP

AECI NMPP - LINED POND
Marston, Missouri

MOISTURE-DENSITY TEST

July 2017 41-1-37431-008

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FIG.

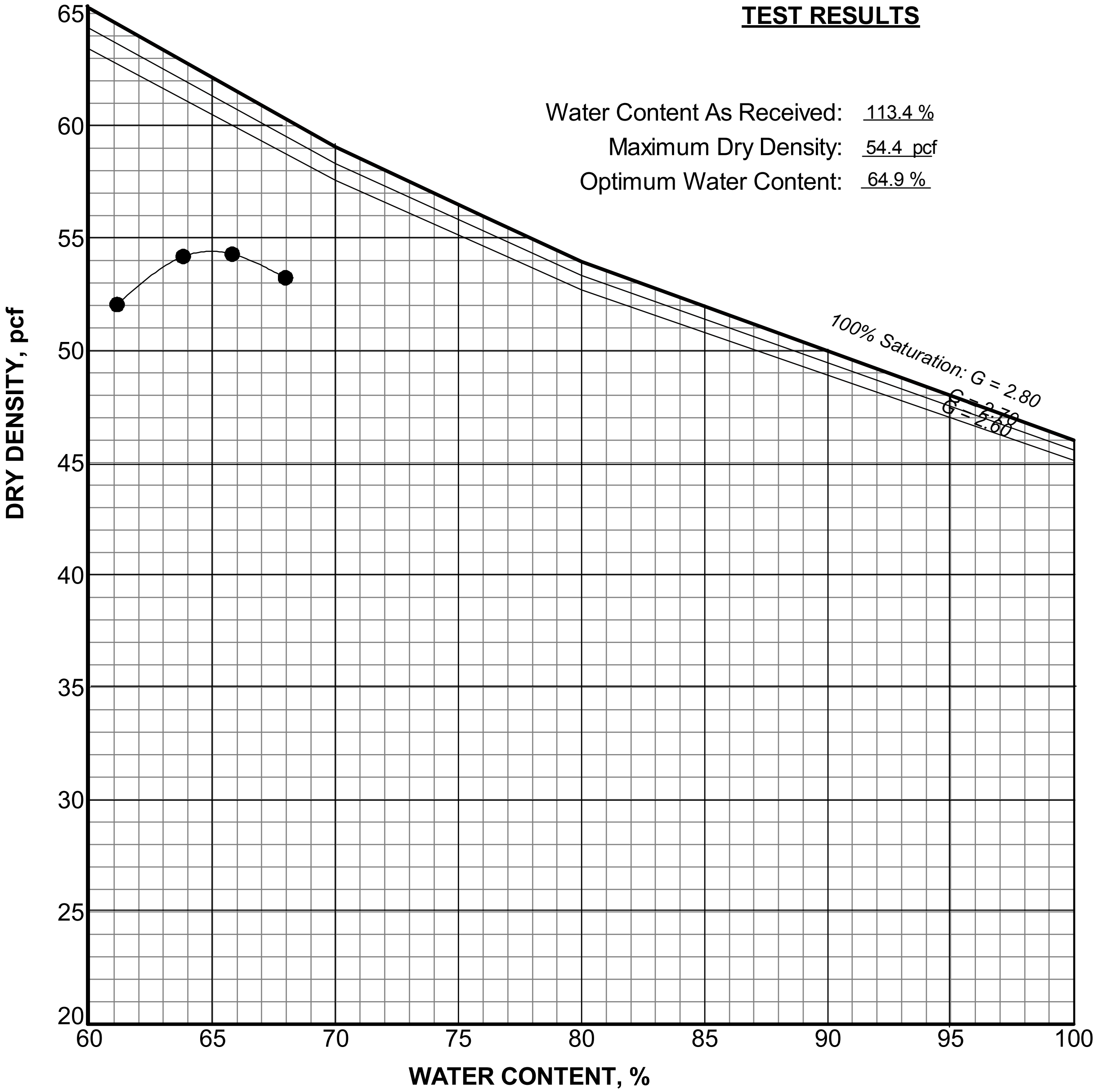
Sample Identification: TP3-4, Bulk, 0.0 - 9.0 feet.

Description of Material: Tan, Sandy Silt. (ML)

Compaction Test Method: ASTM D698 Method A
Rammer Type: Mechanical
Checked By:

TEST RESULTS

Water Content As Received: 113.4 %
Maximum Dry Density: 54.4 pcf
Optimum Water Content: 64.9 %



OTHER TEST RESULTS

GRAIN SIZE ANALYSES:	% Gravel:	0.0
	% Sand:	48.2
	% Fines:	51.8
ATTERBERG LIMITS:	Liquid Limit:	NP
	Plastic Limit:	NP
	Plasticity Index:	NP

AECI NMPP - LINED POND
Marston, Missouri

MOISTURE-DENSITY TEST

July 2017
41-1-37431-008

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FIG.

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Boring	HA-B9	Tested by / Date	JAS	07/21/17
Sample	U3	Calculated by / Date	CMB	07/24/17
Depth (ft)	14.4	Checked by / Date	CMB	07/24/17
Description	Stiff, brown, Silt (ML).			

Specimen Data

Height	5.985	inches
Diameter	2.854	inches
H/D ratio	2.097	
Volume	627.4	cc
Wet wt.	1184.26	grams
Bulk Density	117.8	pcf
Dry Density	94.4	pcf
M.C.	24.7%	percent
Saturation	85.2%	percent
Void ratio	0.784	
Gs	2.7	assumed

Instrument Constants

Deformation	0.001	inches/div
Load	1	lb/div.
Confinment	10	psi

Peak values

p	1.837	tsf
q	1.117	tsf
strain	15.0%	%
strain rate	0.040	in. per min.

Deformation div.	Load div.	Strain %	Load lb	Stress tsf	p tsf	q tsf
0.000	0.0	0.0%	0.0	0.000	0.720	0.000
0.005	3.6	0.1%	3.6	0.040	0.740	0.020
0.010	16.3	0.2%	16.3	0.183	0.812	0.092
0.015	23.3	0.3%	23.3	0.262	0.851	0.131
0.020	30.4	0.3%	30.4	0.341	0.891	0.171
0.030	44.5	0.5%	44.5	0.498	0.969	0.249
0.050	68.9	0.8%	68.9	0.769	1.105	0.385
0.075	95.6	1.3%	95.6	1.063	1.251	0.531
0.100	118.0	1.7%	118.0	1.306	1.373	0.653
0.125	133.1	2.1%	133.1	1.467	1.454	0.734
0.150	145.0	2.5%	145.0	1.592	1.516	0.796
0.175	153.8	2.9%	153.8	1.682	1.561	0.841
0.200	160.1	3.3%	160.1	1.744	1.592	0.872
0.225	167.1	3.8%	167.1	1.813	1.626	0.906
0.250	171.3	4.2%	171.3	1.851	1.645	0.925
0.300	179.7	5.0%	179.7	1.926	1.683	0.963
0.350	186.2	5.8%	186.2	1.980	1.710	0.990
0.400	192.8	6.7%	192.8	2.034	1.737	1.017
0.450	196.2	7.5%	196.2	2.054	1.747	1.027
0.500	200.5	8.4%	200.5	2.083	1.761	1.041
0.550	205.4	9.2%	205.4	2.117	1.779	1.059
0.600	209.2	10.0%	209.2	2.140	1.790	1.070
0.650	213.7	10.9%	213.7	2.170	1.805	1.085
0.700	215.9	11.7%	215.9	2.175	1.808	1.088
0.750	219.2	12.5%	219.2	2.192	1.816	1.096
0.800	223.1	13.4%	223.1	2.215	1.827	1.107
0.850	225.8	14.2%	225.8	2.225	1.833	1.113
0.900	228.4	15.0%	228.4	2.235	1.837	1.117

AECI NMPP - Lined Pond
Marston, Missouri

UNCONSOLIDATED, UNDRAINED STRENGTH
IN TRIAXIAL COMPRESSION
BORING - HA-B9 : SAMPLE - U3

July 2017 41-1-37431-008

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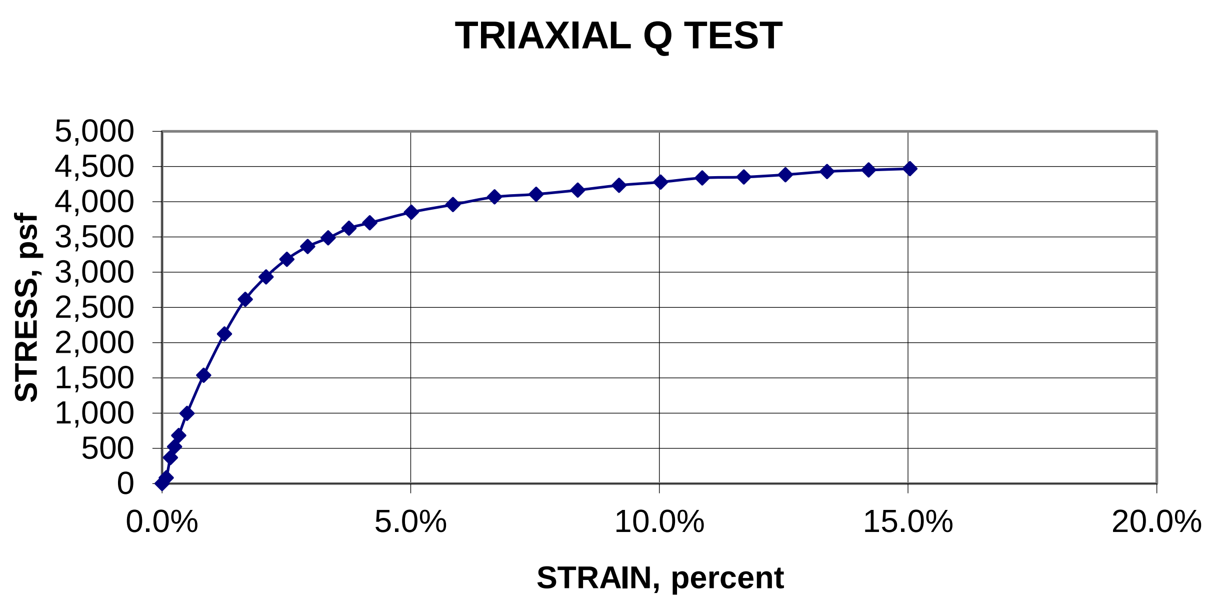
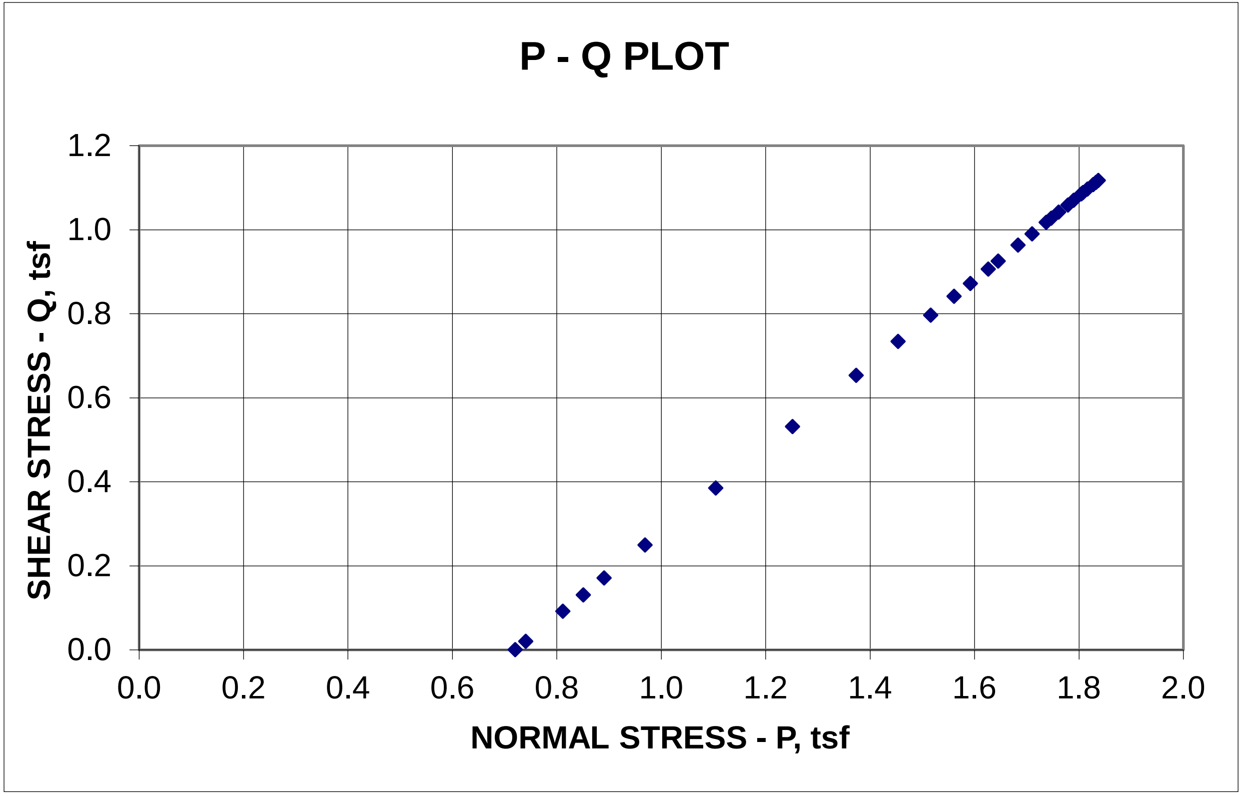
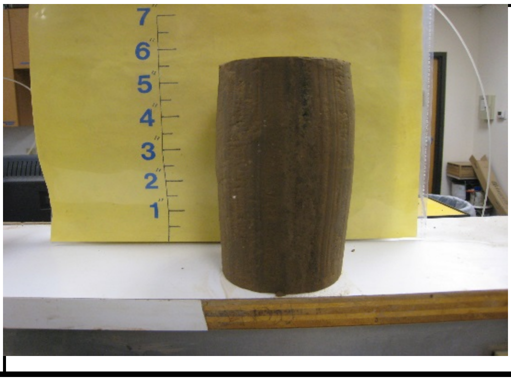
FIG.

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION
PLOT OF TEST DATA







Photograph
of
Failure

AECI NMPP - Lined Pond
Marston, Missouri

UNCONSOLIDATED, UNDRAINED STRENGTH
IN TRIAXIAL COMPRESSION
BORING - HA-B9 : SAMPLE - U3

July 2017 41-1-37431-008

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FIG.

P:\41-1 STL\37400s\37431\008 AECI Lined Pond\Lab\41-1-37431-008 HA-B9 U3-2 D2850 7/24/2017

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Boring	HA-B9	Tested by / Date	JAS	07/21/17
Sample	U3	Calculated by / Date	CMB	07/24/17
Depth (ft)	15	Checked by / Date	CMB	07/24/17
Description	Stiff, brown, Silt (ML).			

Specimen Data			Instrument Constants		
Height	5.990	inches	Deformation	0.001	inches/div
Diameter	2.861	inches	Load	1	lb/div.
H/D ratio	2.094		Confinement	16.5	psi
Volume	631.0	cc			
Wet wt.	1227.54	grams	Peak values		
Bulk Density	121.4	pcf	p	2.481	tsf
Dry Density	96.6	pcf	q	1.293	tsf
M.C.	25.7%	percent	strain	15.0%	%
Saturation	93.2%	percent	strain rate	0.040	in. per min.
Void ratio	0.745				
Gs	2.7	assumed			

Deformation	Load	Strain	Load	Stress	p	q
div.	div.	%	lb	tsf	tsf	tsf
0.000	0.0	0.0%	0.0	0.000	1.188	0.000
0.005	3.0	0.1%	3.0	0.034	1.205	0.017
0.010	7.3	0.2%	7.3	0.082	1.229	0.041
0.015	17.2	0.3%	17.2	0.192	1.284	0.096
0.020	27.1	0.3%	27.1	0.303	1.339	0.151
0.030	43.1	0.5%	43.1	0.480	1.428	0.240
0.050	66.7	0.8%	66.7	0.741	1.558	0.370
0.075	90.7	1.3%	90.7	1.003	1.690	0.502
0.100	110.4	1.7%	110.4	1.216	1.796	0.608
0.125	126.6	2.1%	126.6	1.389	1.882	0.694
0.150	139.5	2.5%	139.5	1.524	1.950	0.762
0.175	150.7	2.9%	150.7	1.640	2.008	0.820
0.200	159.2	3.3%	159.2	1.725	2.051	0.863
0.225	175.0	3.8%	175.0	1.889	2.132	0.944
0.250	180.5	4.2%	180.5	1.941	2.158	0.970
0.300	188.5	5.0%	188.5	2.010	2.193	1.005
0.350	198.6	5.8%	198.6	2.101	2.239	1.051
0.400	208.0	6.7%	208.0	2.184	2.280	1.092
0.450	217.3	7.5%	217.3	2.264	2.320	1.132
0.500	225.2	8.3%	225.2	2.328	2.352	1.164
0.550	233.1	9.2%	233.1	2.391	2.384	1.196
0.600	238.5	10.0%	238.5	2.428	2.402	1.214
0.650	244.8	10.9%	244.8	2.473	2.425	1.237
0.700	250.3	11.7%	250.3	2.510	2.443	1.255
0.750	254.1	12.5%	254.1	2.529	2.453	1.265
0.800	260.2	13.4%	260.2	2.571	2.473	1.285
0.850	263.0	14.2%	263.0	2.579	2.478	1.290
0.900	265.6	15.0%	265.6	2.586	2.481	1.293

AECI NMPP - Lined Pond
Marston, Missouri

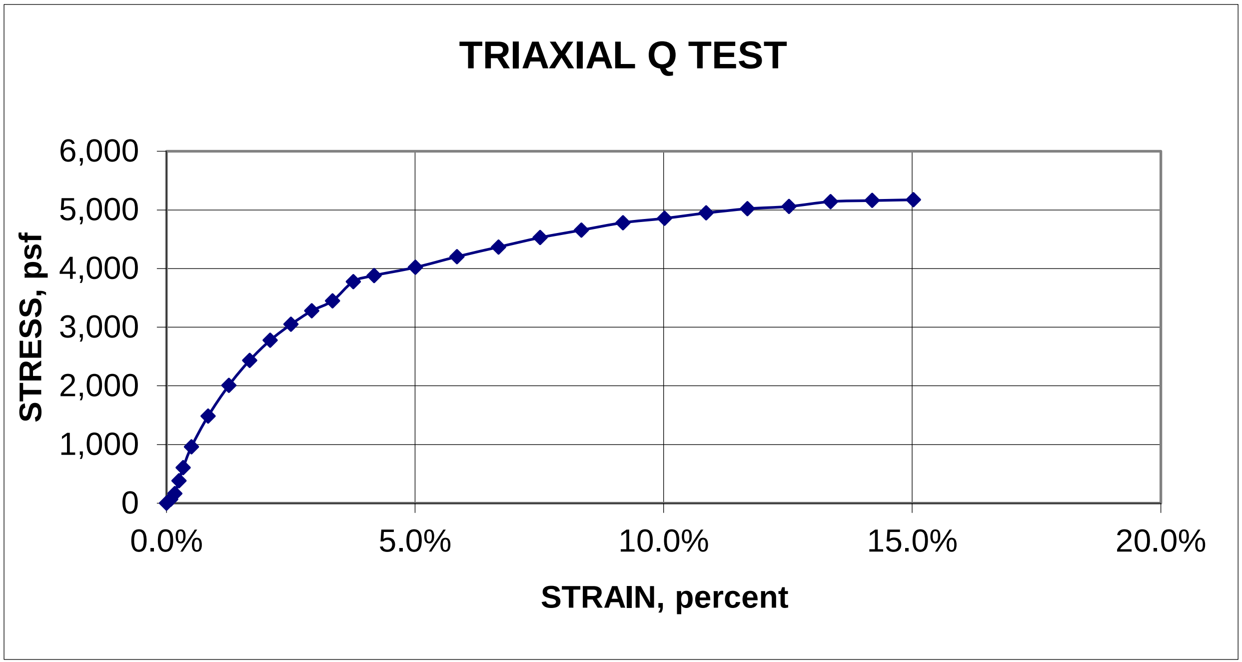
UNCONSOLIDATED, UNDRAINED STRENGTH
IN TRIAXIAL COMPRESSION
BORING - HA-B9 : SAMPLE - U3

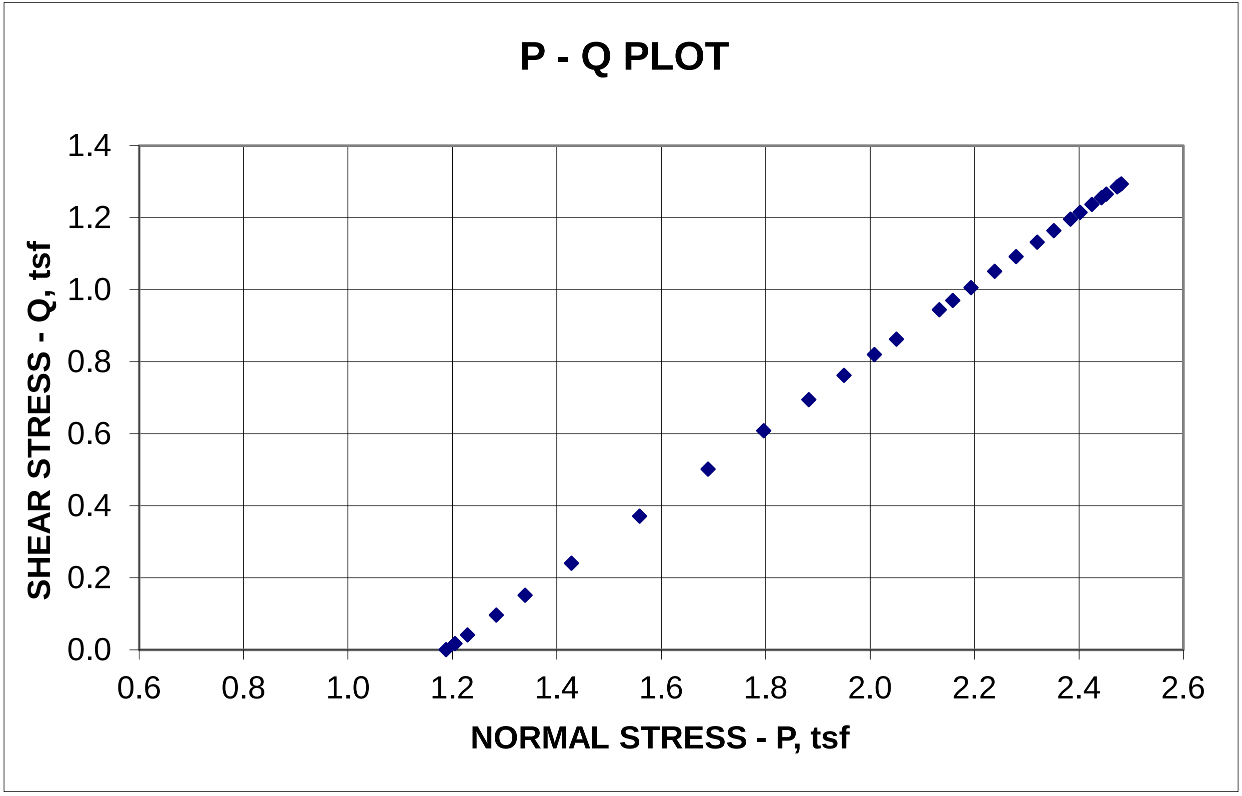
July 2017 41-1-37431-008

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG.

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION
PLOT OF TEST DATA





Photograph
of
Failure

AECI NMPP - Lined Pond
Marston, Missouri

UNCONSOLIDATED, UNDRAINED STRENGTH

IN TRIAXIAL COMPRESSION

BORING - HA-B9 : SAMPLE - U3

July 2017 41-1-37431-008

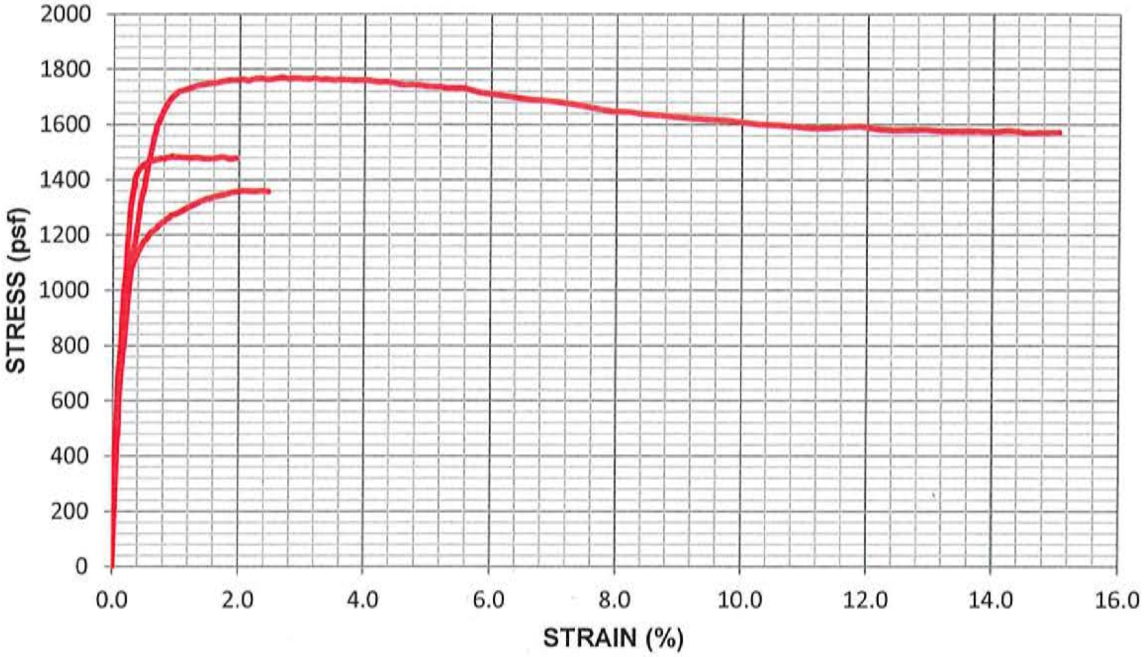
SHANNON & WILSON, INC.

Geotechnical and Environmental
Consultants

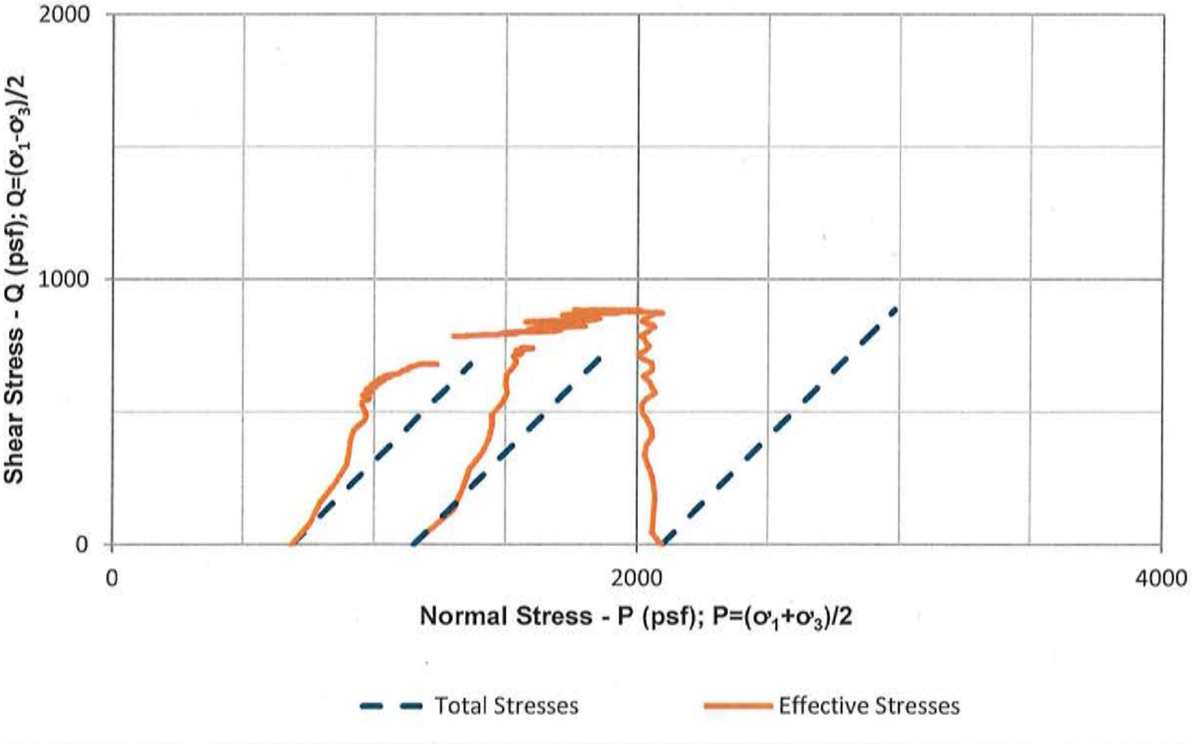
FIG.

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
WITH PORE PRESSURE MEASUREMENT

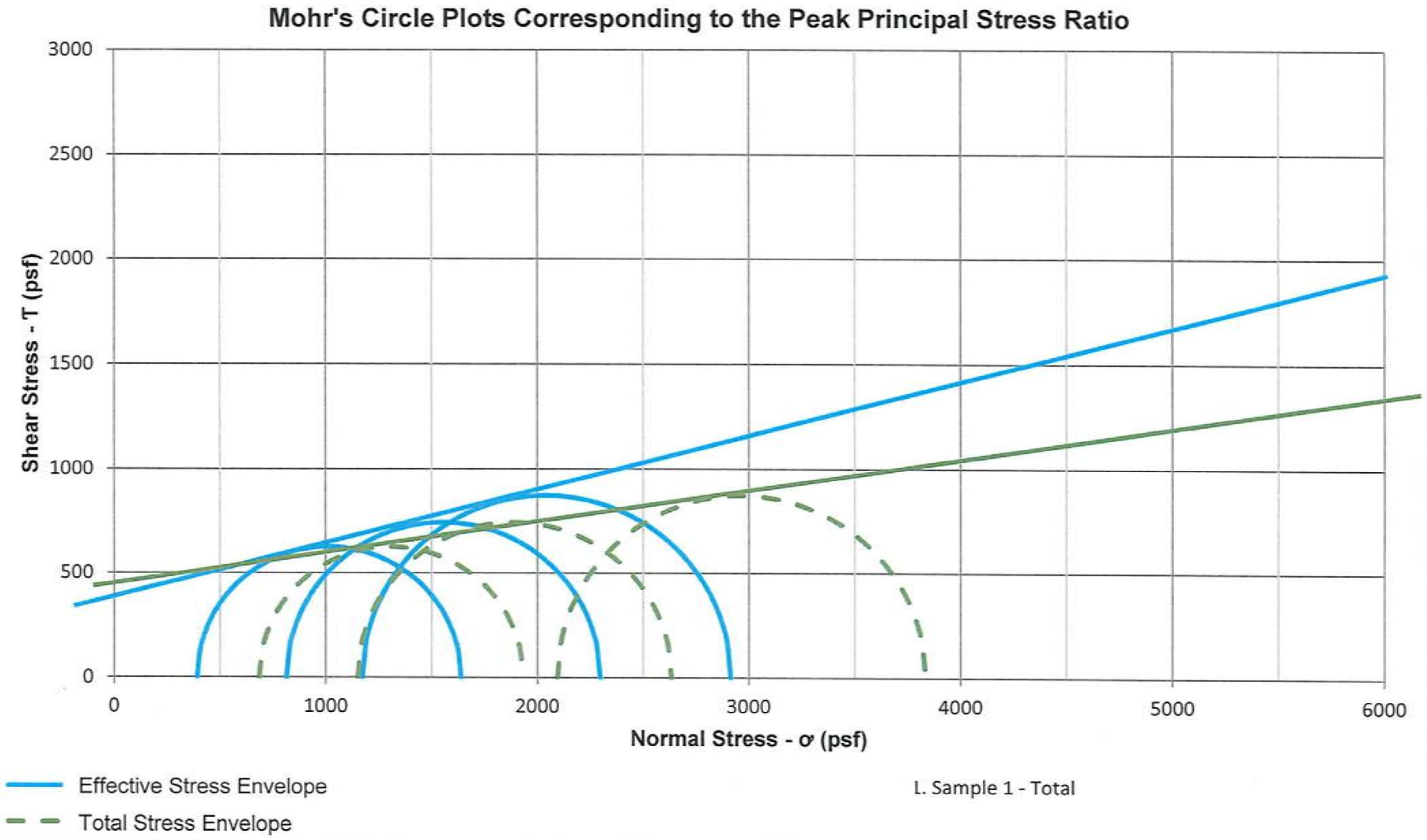
STRESS - STRAIN



P-Q PLOT



SHANNON & WILSON, INC. **2043 WESTPORT CENTER DR.** **SAINT LOUIS, MISSOURI 63146** **41-1-37431-008**	**CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION** **AECI NMPP - Lined Pond** **Marston, Missouri** **HA-B9 / U1 / 6.8**



Sample	Strain (%)
Stage 1	0.8
Stage 2	1.0
Stage 3	1.3

c =	450 psf
ϕ =	8 deg
c' =	380 psf
ϕ' =	14 deg

NOTES:
1. Mohr's circles in this plot are based upon the maximum principal stress difference observed during loading except Stage 3 in which similar strain was chosen.
2. Strength parameters determined by Shannon & Wilson. Engineer-of-Record should evaluate cohesion and friction commensurate with project conditions.

AECI NMPP - Lined Pond
Marston, Missouri

Mohr's Circle Plots
HA-B9 / U1

August 2017 41-1-37431-008

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Figure 1

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - Lined Pond					
Location	Marston, Missouri			Client	Haley & Aldrich	
Job No.	41-1-37431-008			Tested by	CMB	Jul-17
Boring	HA-B9			Calculated by	CMB	Aug-17
Sample	U1	Specimen Number	Stage 3	Checked by	Dpm	8/16/17
Depth (ft)	6.8	Undisturbed/Remold	Undisturbed	File	41-1-37431-008 HA-B9 U1 ASTM D4767	
Description	Mottled gray and brown, Fat Clay (CH).			Procedure	ASTM D4767	
Remarks	On stage 3 strain, sample sheared far enough to touch cell walls.					

Specimen Data	Initial	Post Consol.	Post Shear
Height (in)	5.546	5.521	4.690
Diameter (in)	2.868	2.848	
Volume (in^3)	35.830	35.171	
Height/Diameter ratio	1.934	1.939	
Weight (g)	1098.49	1087.69	1087.69
Water Content (%)	34.67	33.34	33.34
Bulk Unit Weight (pcf)	116.8	117.8	117.8
Dry Unit Weight (pcf)	86.7	88.4	88.4
Cross-Sectional Area* (in^2)	6.461	6.371	
% Saturation - Wet Method	100.09	100.10	100.10
Specific Gravity - Assumed	2.68	2.68	2.68
Void Ratio	0.928	0.893	0.893
			Entire Sample
Tare ID			31
Mass wet soil + tare (g)			1274.71
Mass dry soil + tare (g)			982.14
Mass tare (g)			164.95

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	106.0
Pore Pressure (psi)	91.5
Effective Confining Pressure (psi)	14.6
B-value	0.97

Consolidation Phase

Change in Volume (in^3)	0.659
T_{50} (min)	351.2

Platen Travel Rate (in/min)	0.00007

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	2967.0
Peak P' (psf)	2045.4
Peak Q (psf)	870.7
Strain at Peak (%)	1.3
σ_3' (psf)	1174.7
σ_1' (psf)	2916.0
σ_3 (psf)	2096.3
σ_1 (psf)	3837.7

Picture of Failure

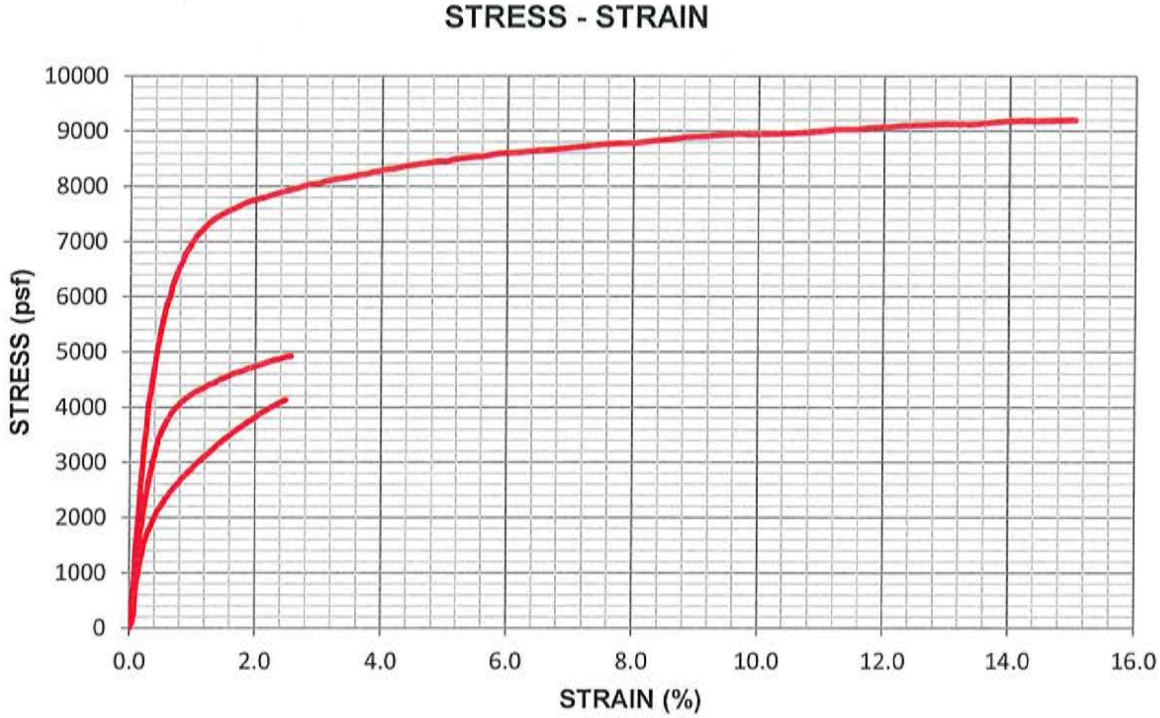
AECI NMPP - Lined Pond
Marston, Missouri

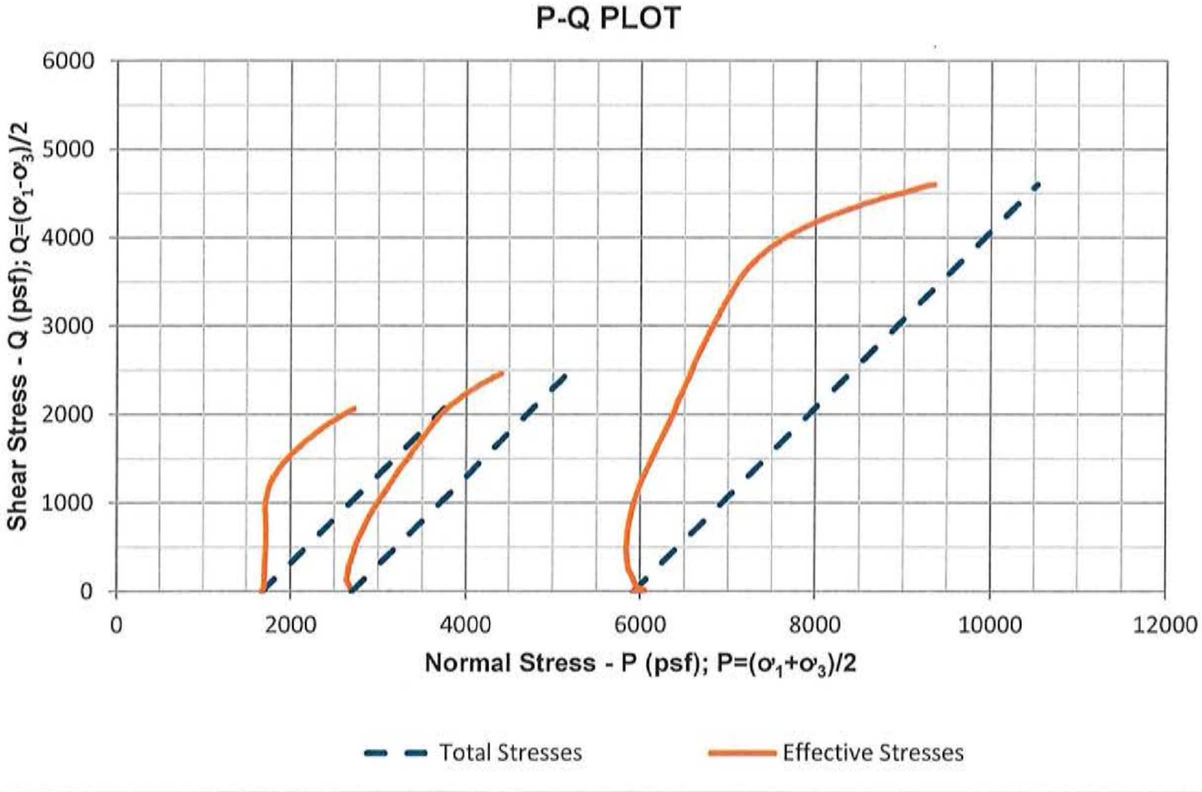
CU TRIAXIAL TEST RESULTS
HA-B9 / U1 / Stage 3

August 2017 41-1-37431-008

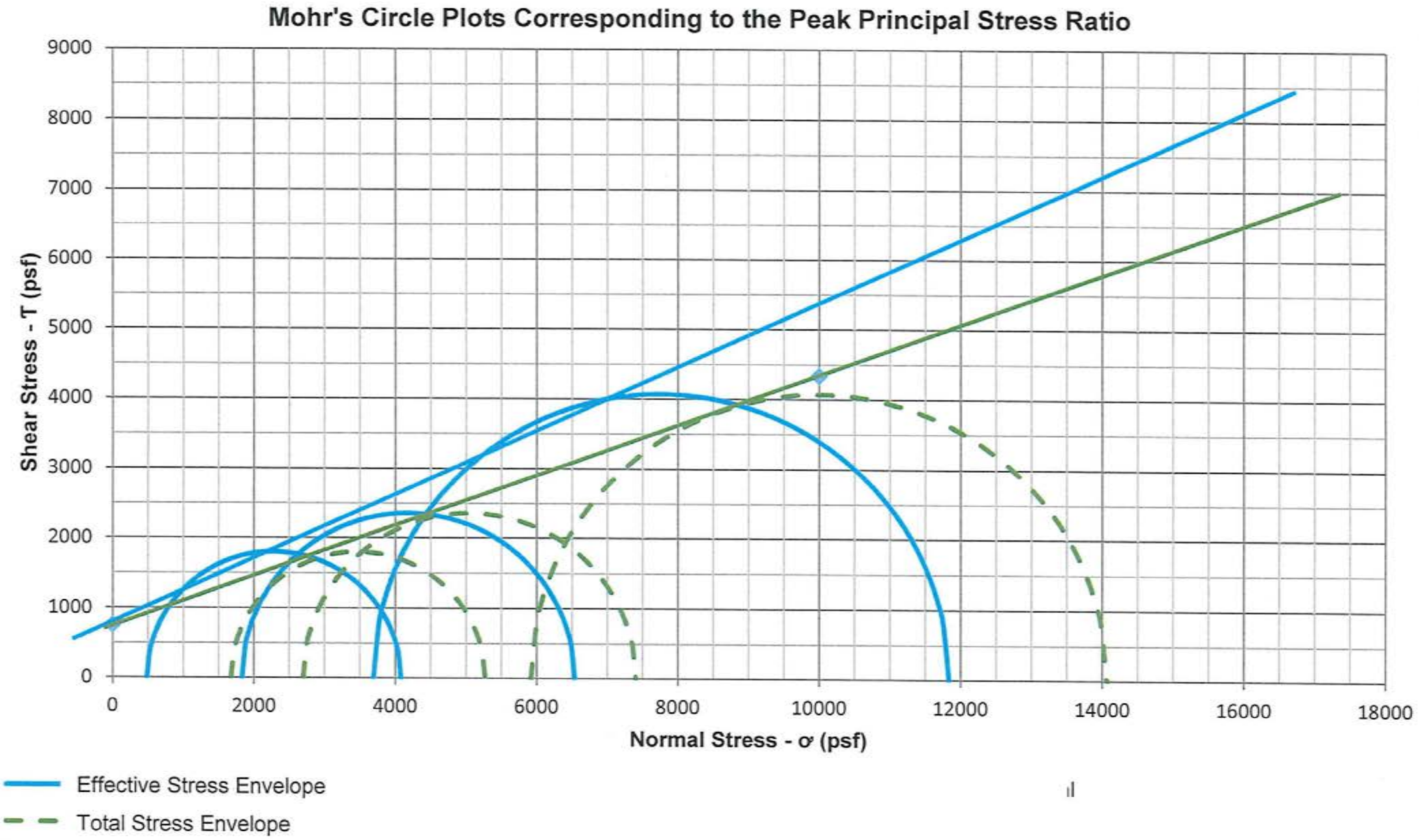
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST WITH PORE PRESSURE MEASUREMENT





SHANNON & WILSON, INC. 2043 WESTPORT CENTER DR. SAINT LOUIS, MISSOURI 63146 41-1-37431-008	CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION AECI NMPP - Lined Pond Marston, Missouri HA-B10OW / U2 / 18.6



Sample	Strain (%)
Stage 1	1.7
Stage 2	1.9
Stage 3	3.3

c =	750 psf
ϕ =	20 deg
c' =	750 psf
ϕ' =	25 deg

NOTES:
1. Mohr's circles in this plot are based upon the maximum principal stress difference observed during loading.
2. Strength parameters determined by Shannon & Wilson. Engineer-of-Record should evaluate cohesion and friction commensurate with project conditions.

AECI NMPP - Lined Pond
Marston, Missouri

Mohr's Circle Plots
HA-B10OW / U2

August 2017 41-1-37431-008

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Figure 1

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - Lined Pond					
Location	Marston, Missouri			Client	Haley & Aldrich	
Job No.	41-1-37431-008			Tested by	CMB	Jul-17
Boring	HA-B10OW			Calculated by	CMB	Aug-17
Sample	U2	Specimen Number	Stage 3	Checked by	DCM	8/2/17
Depth (ft)	18.6	Undisturbed/Remold	Undisturbed	File	41-1-37431-008 HA-B10OW U2 ASTM D4	
Description	Mottled gray and brown, Fat Clay (CH).			Procedure	ASTM D4767	
Remarks						

Specimen Data	Initial	Post Consol.	Post Shear
Height (in)	5.630	5.594	5.475
Diameter (in)	2.934	2.922	
Volume (in^3)	38.071	37.522	
Height/Diameter ratio	1.919	1.914	
Weight (g)	1297.70	1288.70	1288.70
Water Content (%)	20.73	19.89	19.89
Bulk Unit Weight (pcf)	129.9	130.8	130.8
Dry Unit Weight (pcf)	107.6	109.1	109.1
Cross-Sectional Area* (in^2)	6.763	6.708	
% Saturation - Wet Method	100.13	100.13	100.13
Specific Gravity - Assumed	2.68	2.68	2.68
Void Ratio	0.555	0.532	0.532
			Entire Sample
Tare ID			25
Mass wet soil + tare (g)			1441.93
Mass dry soil + tare (g)			1210.08
Mass tare (g)			161.28

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions	
Cell Pressure (psi)	132.4
Pore Pressure (psi)	91.3
Effective Confining Pressure (psi)	41.1
B-value	0.96

Consolidation Phase	
Change in Volume (in^3)	0.549
T_{50} (min)	230.9

Platen Travel Rate (in/min)	0.00010

Additional Testing	
Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results	
Peak P (psf)	9996.3
Peak P' (psf)	7767.1
Peak Q (psf)	4072.3
Strain at Peak (%)	3.3
σ_3' (psf)	3694.8
σ_1' (psf)	11839.3
σ_3 (psf)	5924.0
σ_1 (psf)	14068.5

Picture of Failure

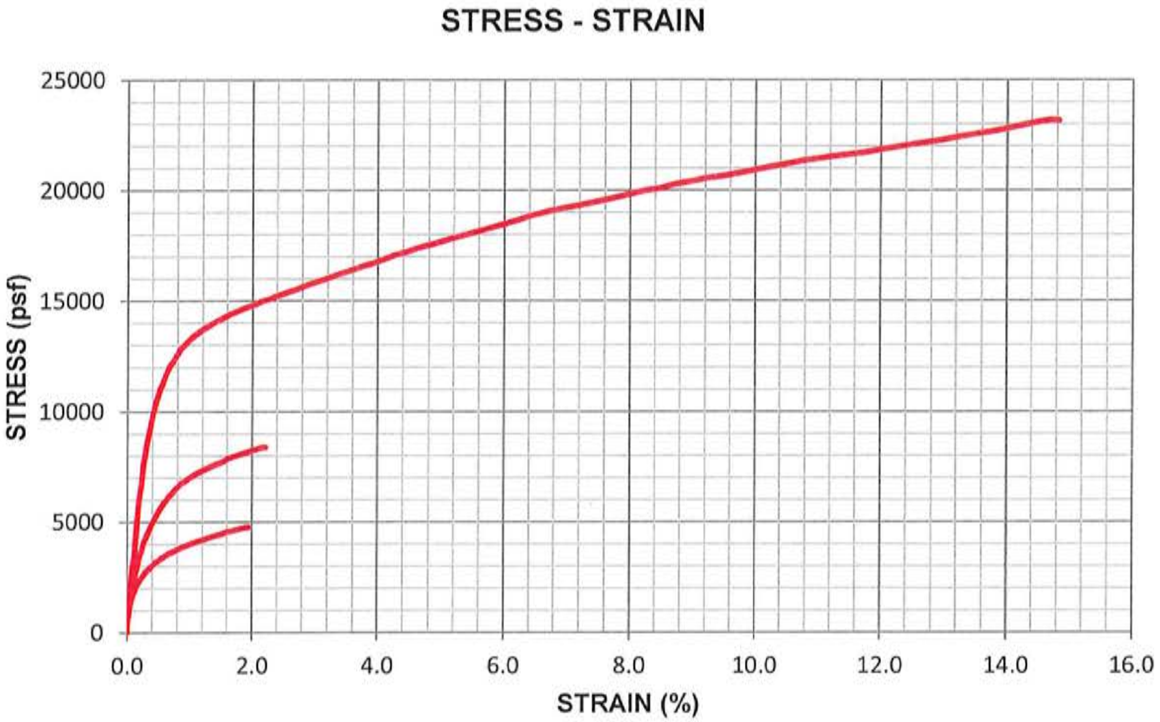
AECI NMPP - Lined Pond
Marston, Missouri

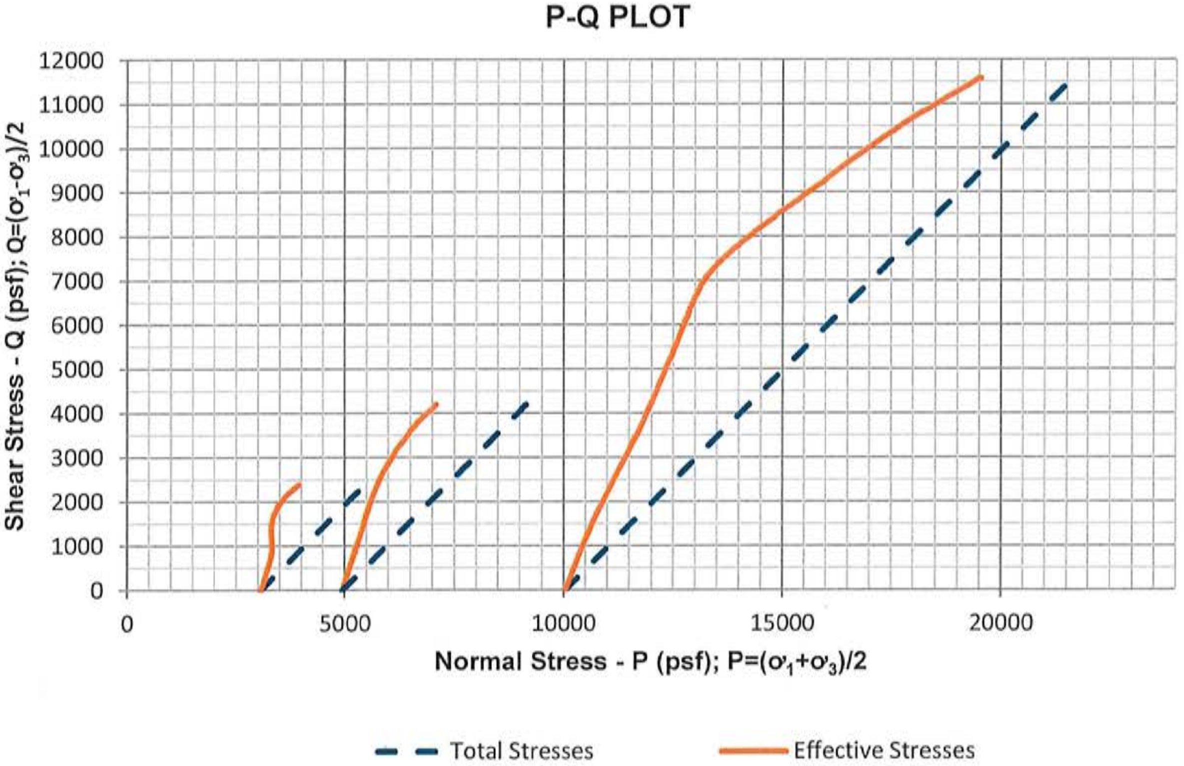
CU TRIAXIAL TEST RESULTS
HA-B10OW / U2 / Stage 3

August 2017 41-1-37431-008

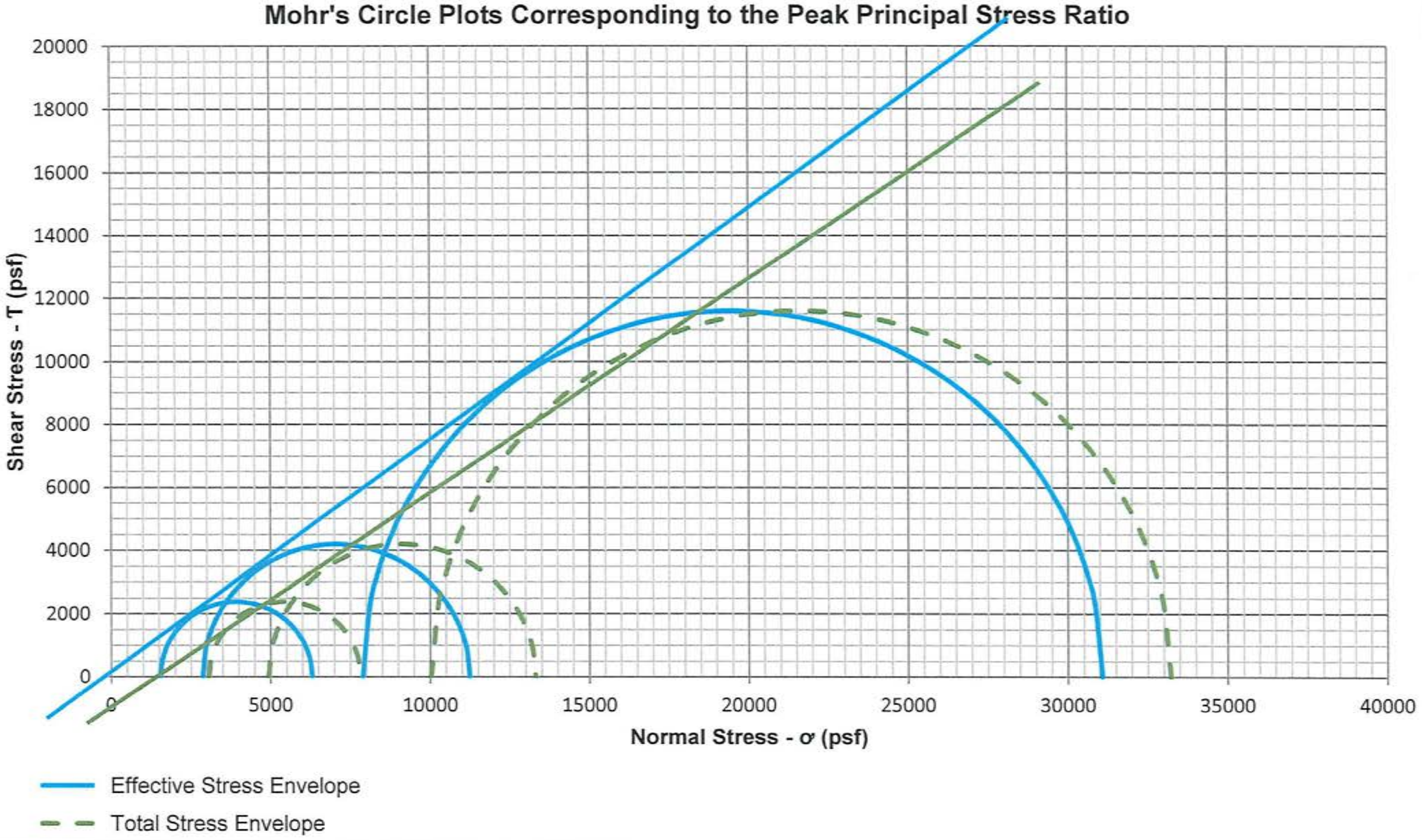
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
WITH PORE PRESSURE MEASUREMENT





SHANNON & WILSON, INC. 2043 WESTPORT CENTER DR. SAINT LOUIS, MISSOURI 63146 41-1-37431-008	CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION AECI NMPP - Lined Pond Marston, Missouri HA-B10OW / U3 / 30.4



Sample	Strain (%)
Stage 1	1.9
Stage 2	2.1
Stage 3	14.7

c =	-1000 psf
ϕ =	34.2 deg
c' =	0 psf
ϕ' =	36.5 deg

NOTES:

1. Mohr's circles in this plot are based upon the maximum principal stress difference observed during loading.
2. Strength parameters determined by Shannon & Wilson. Engineer-of-Record should evaluate cohesion and friction commensurate with project conditions.

AECI NMPP - Lined Pond
Marston, Missouri

Mohr's Circle Plots
HA-B10OW / U3

July 2017 41-1-37431-008

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Figure 1

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - Lined Pond					
Location	Marston, Missouri			Client	Haley & Aldrich	
Job No.	41-1-37431-008			Tested by	CMB	Jul-17
Boring	HA-B10OW			Calculated by	CMB	Jul-17
Sample	U3	Specimen Number	Stage 3	Checked by	DPm	7/21/17
Depth (ft)	30.4	Undisturbed/Remold	Undisturbed	File	41-1-37431-008 HA-B10OW U3 ASTM D4	
Description	Brown, Silt (ML).			Procedure	ASTM D4767	
Remarks						

Specimen Data	Initial	Post Consol.	Post Shear
Height (in)	5.669	5.646	4.808
Diameter (in)	2.752	2.726	
Volume (in^3)	33.728	32.953	
Height/Diameter ratio	2.060	2.071	
Weight (g)	1082.17	1069.47	1069.47
Water Content (%)	28.13	26.62	26.62
Bulk Unit Weight (pcf)	122.2	123.6	123.6
Dry Unit Weight (pcf)	95.4	97.6	97.6
Cross-Sectional Area* (in^2)	5.950	5.837	
% Saturation - Wet Method	100.10	100.11	100.11
Specific Gravity - Assumed	2.68	2.68	2.68
Void Ratio	0.753	0.713	0.713
			Entire Sample
Tare ID			8
Mass wet soil + tare (g)			1183.42
Mass dry soil + tare (g)			958.52
Mass tare (g)			100.00

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions	
Cell Pressure (psi)	160.9
Pore Pressure (psi)	91.1
Effective Confining Pressure (psi)	69.7
B-value	0.96

Consolidation Phase	
Change in Volume (in^3)	0.775
T_{50} (min)	0.9

Platen Travel Rate (in/min)	0.02538

Additional Testing	
Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results	
Peak P (psf)	21637.2
Peak P' (psf)	19493.6
Peak Q (psf)	11596.5
Strain at Peak (%)	14.7
σ_3' (psf)	7897.1
σ_1' (psf)	31090.1
σ_3 (psf)	10040.7
σ_1 (psf)	33233.7

Picture of Failure

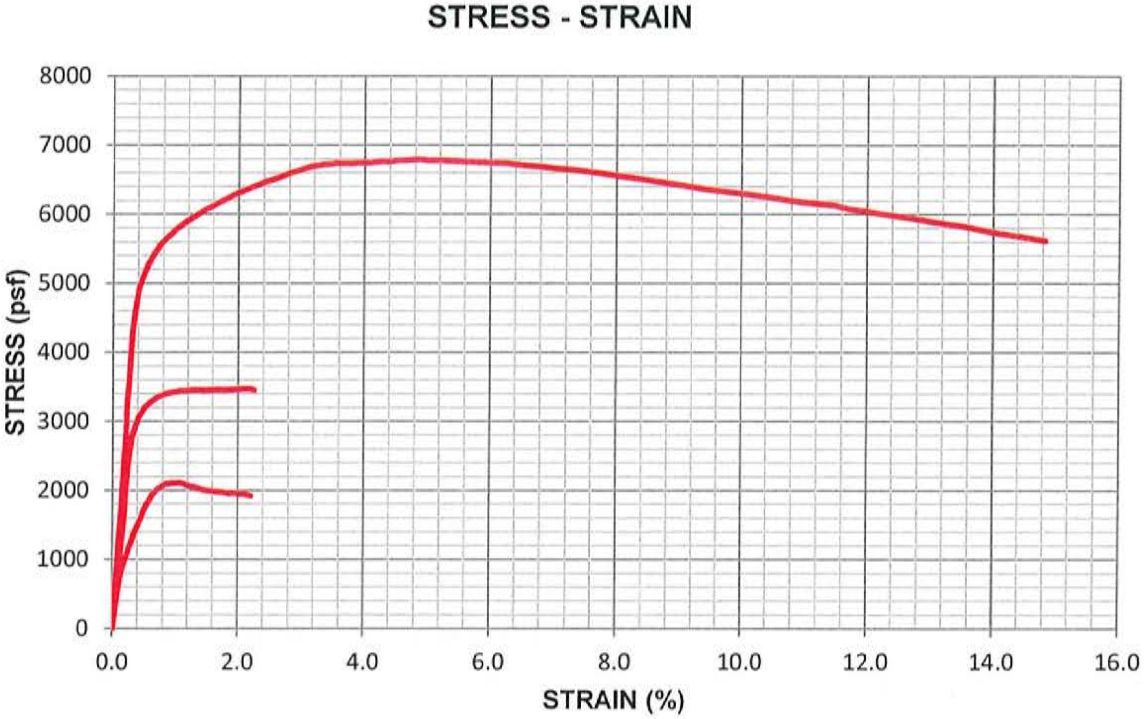
AECI NMPP - Lined Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-B10OW / U3 / Stage 3

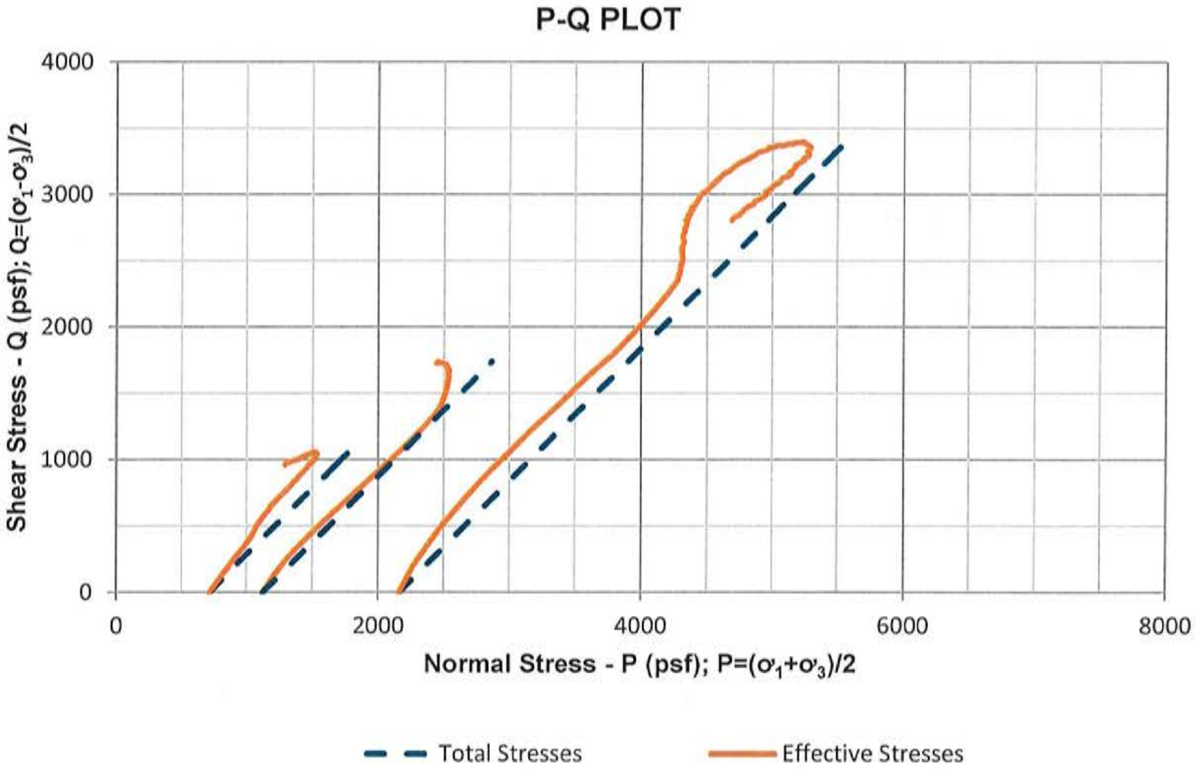
July 2017 41-1-37431-008

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST WITH PORE PRESSURE MEASUREMENT



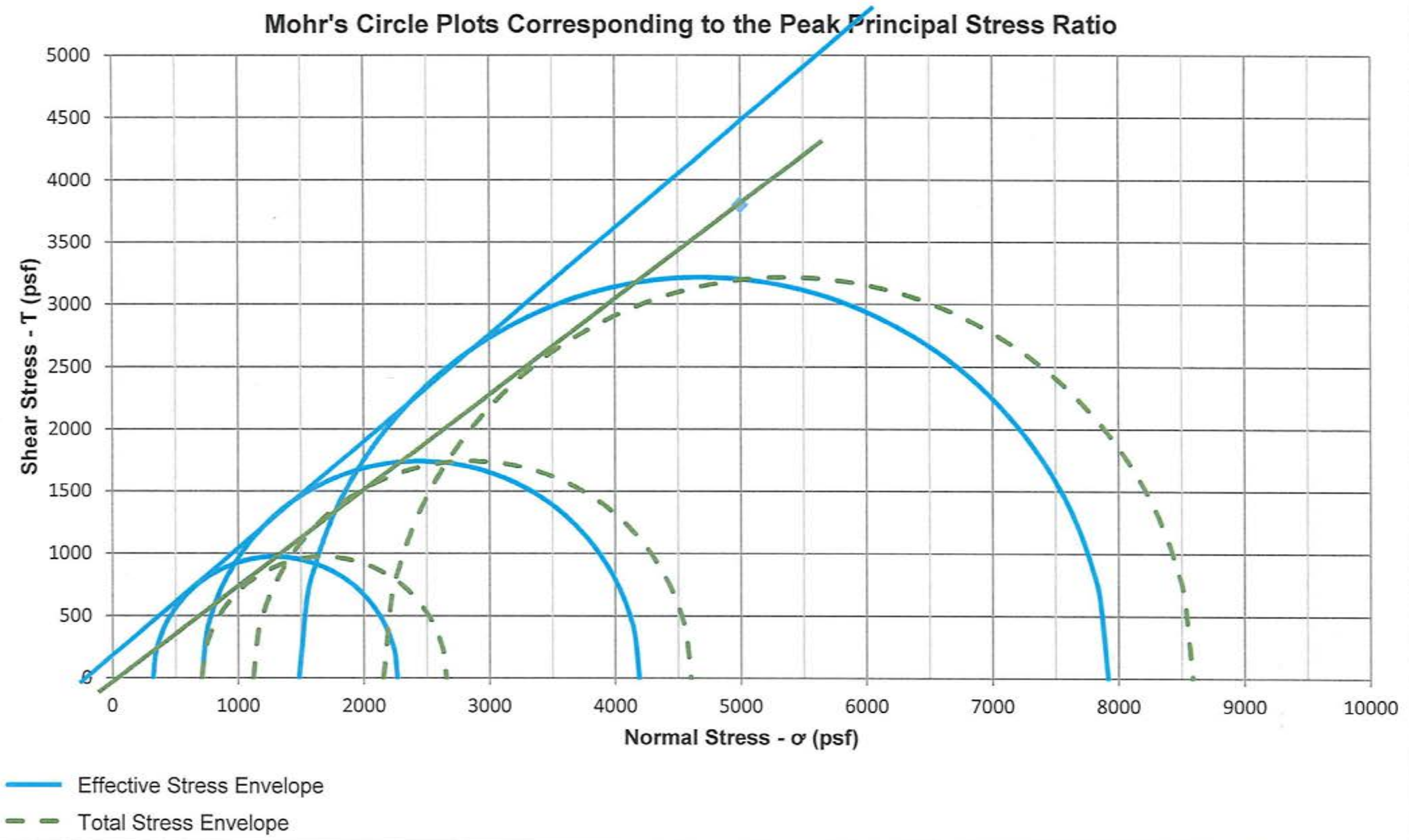
STRESS - STRAIN



P-Q PLOT

SHANNON & WILSON, INC.
2043 WESTPORT CENTER DR.
SAINT LOUIS, MISSOURI 63146
41-1-37431-008

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
AECI NMPP - Lined Pond
Marston, Missouri
TP3-2 #1 / Bulk / 0 - 11.0



Sample	Strain (%)
Stage 1	2.1
Stage 2	2.2
Stage 3	2.3

c =	-50 psf
ϕ =	38 deg
c' =	180 psf
ϕ' =	41 deg

NOTES:
1. Mohr's circles in this plot are based upon the maximum principal stress difference observed during loading.
2. Strength parameters determined by Shannon & Wilson. Engineer-of-Record should evaluate cohesion and friction commensurate with project conditions.

AECI NMPP - Lined Pond
Marston, Missouri

Mohr's Circle Plots
TP3-2 #1 / Bulk

August 2017
41-1-37431-008

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Figure 1

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - Lined Pond					
Location	Marston, Missouri			Client	Haley & Aldrich	
Job No.	41-1-37431-008			Tested by	CMB	Aug-17
Boring	TP3-2 #1			Calculated by	CMB	Aug-17
Sample	Bulk	Specimen Number	Stage 3	Checked by	DPm	8/29/17
Depth (ft)	0 - 11.0	Undisturbed/Remold	Remold	File	41-1-37431-008 TP3-2 #1 Bulk ASTM D47	
Description	Gray, Silt with Sand (ML) (Ash).			Procedure	ASTM D4767	
Remarks						

Specimen Data

	Initial	Post Consol.	Post Shear
Height (in)	5.703	5.709	5.582
Diameter (in)	3.000	2.984	
Volume (in^3)	40.310	39.932	
Height/Diameter ratio	1.901	1.913	
Weight (g)	1001.52	995.32	995.32
Water Content (%)	84.14	83.00	83.00
Bulk Unit Weight (pcf)	94.7	95.0	95.0
Dry Unit Weight (pcf)	51.4	51.9	51.9
Cross-Sectional Area* (in^2)	7.068	6.994	
% Saturation - Wet Method	100.06	100.06	100.06
Specific Gravity - Assumed	2.68	2.68	2.68
Void Ratio	2.253	2.223	2.223
			Entire Sample
Tare ID			8
Mass wet soil + tare (g)			1077.42
Mass dry soil + tare (g)			636.69
Mass tare (g)			100.14

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	107.6
Pore Pressure (psi)	92.6
Effective Confining Pressure (psi)	15.0
B-value	0.98

Consolidation Phase

Change in Volume (in^3)	0.378
T_{50} (min)	0.5
Platen Travel Rate (in/min)	0.01969

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	5374.2
Peak P' (psf)	4702.4
Peak Q (psf)	3216.7
Strain at Peak (%)	2.3
σ_3' (psf)	1485.8
σ_1' (psf)	7919.1
σ_3 (psf)	2157.6
σ_1 (psf)	8590.9

Picture of Failure

AECI NMPP - Lined Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
TP3-2 #1 / Bulk / Stage 3

August 2017 41-1-37431-008

SHANNON & WILSON, INC.
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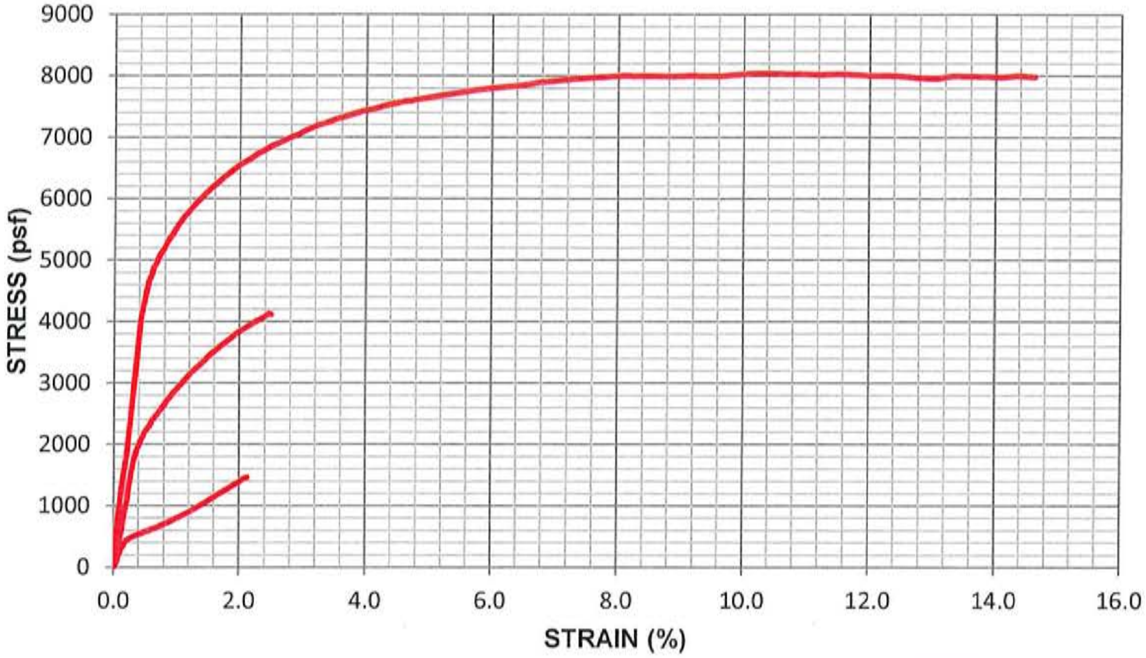
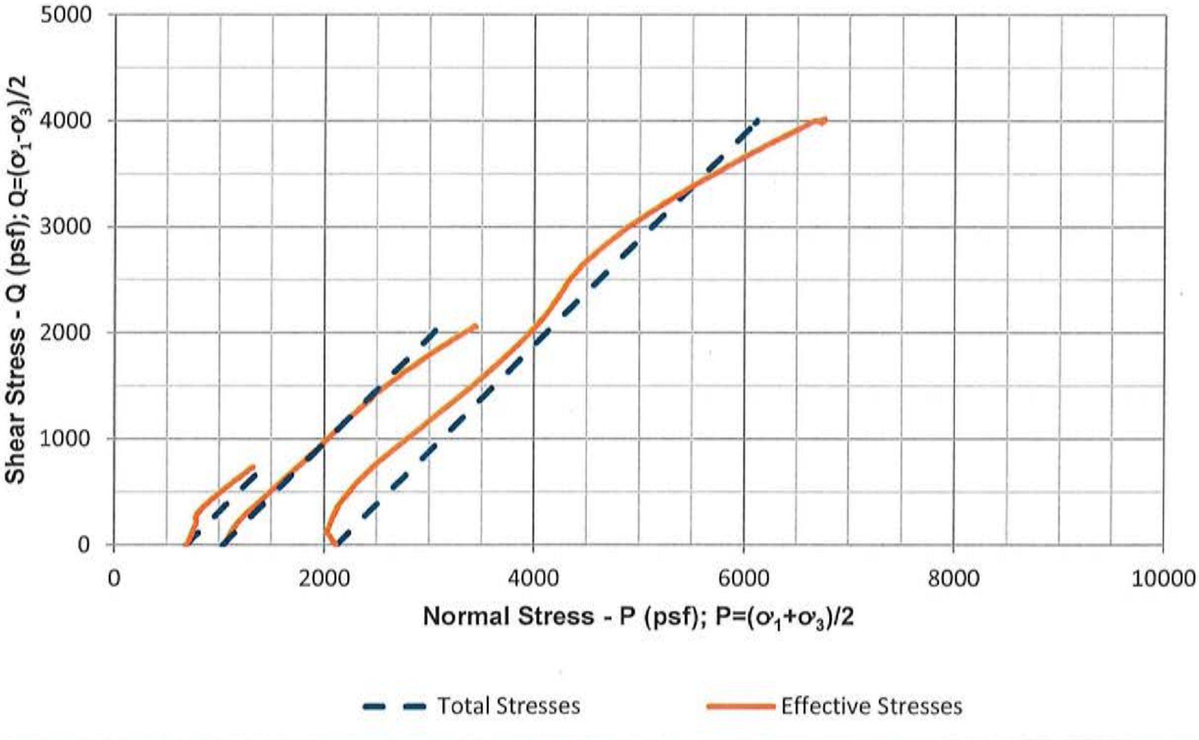
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
WITH PORE PRESSURE MEASUREMENT

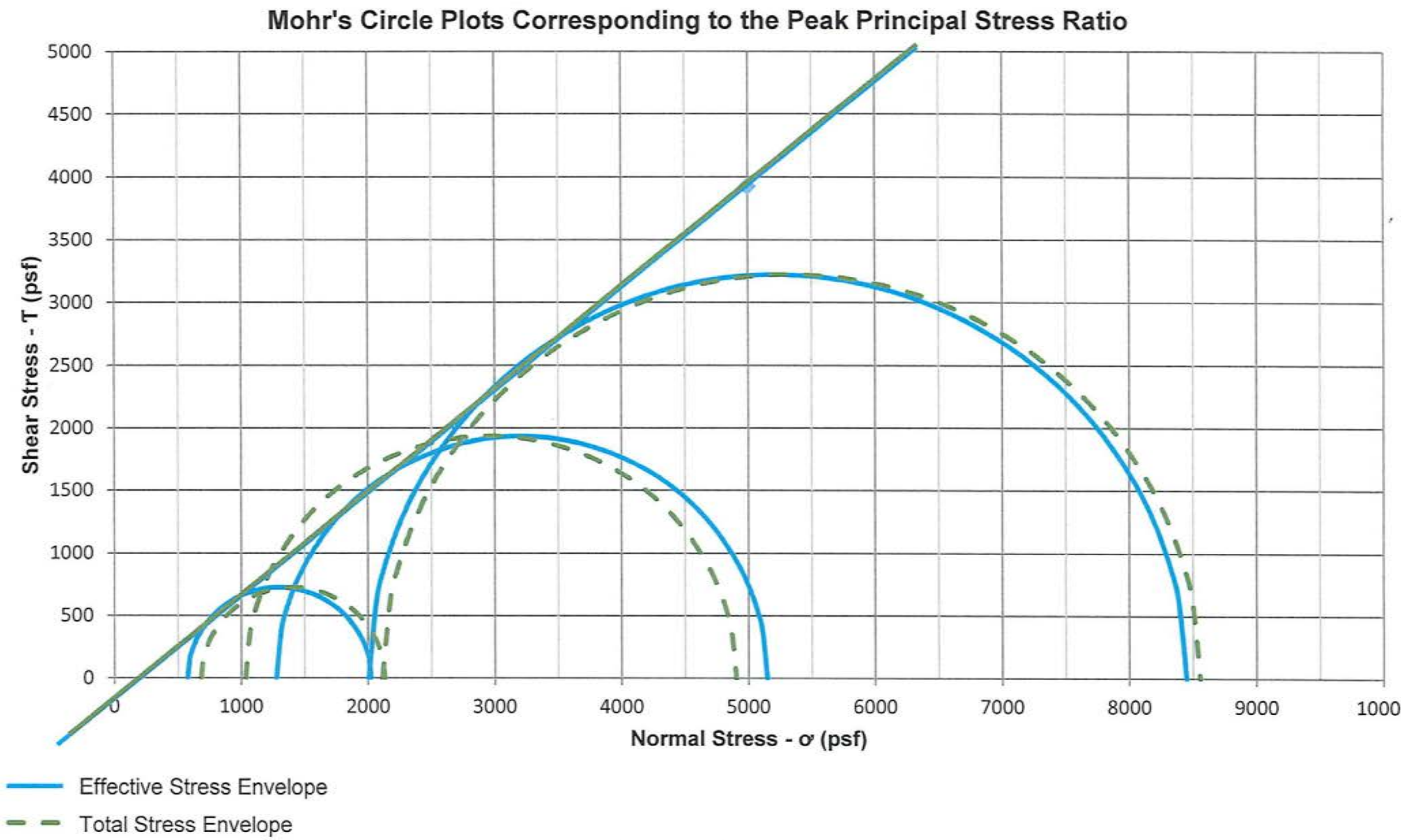
STRESS - STRAIN



P-Q PLOT



SHANNON & WILSON, INC. **2043 WESTPORT CENTER DR.** **SAINT LOUIS, MISSOURI 63146** **41-1-37431-008**	**CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION** **AECI NMPP - Lined Pond** **Marston, Missouri** **TP3-2 #2 / Bulk / 0 - 11.0**



Sample	Strain (%)
Stage 1	2.1
Stage 2	2.0
Stage 3	1.9

c =	-180 psf
ϕ =	39 deg
c' =	-180 psf
ϕ' =	39 deg

NOTES:

1. Mohr's circles in this plot are based upon the maximum principal stress difference observed during loading.
2. Strength parameters determined by Shannon & Wilson. Engineer-of-Record should evaluate cohesion and friction commensurate with project conditions.

AECI NMPP - Lined Pond
Marston, Missouri

Mohr's Circle Plots
TP3-2 #2 / Bulk

August 2017
41-1-37431-008

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Figure 1

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - Lined Pond					
Location	Marston, Missouri			Client	Haley & Aldrich	
Job No.	41-1-37431-008			Tested by	CMB	Aug-17
Boring	TP3-2 #2			Calculated by	CMB	Aug-17
Sample	Bulk	Specimen Number	Stage 3	Checked by	DPm	8/29/17
Depth (ft)	0 - 11.0	Undisturbed/Remold	Remold	File	41-1-37431-008 TP3-2 #2 Bulk ASTM D47	
Description	Gray, Silt with Sand (ML) (Ash).			Procedure	ASTM D4767	
Remarks						

Specimen Data	Initial	Post Consol.	Post Shear
Height (in)	5.742	5.759	5.640
Diameter (in)	3.007	2.966	
Volume (in^3)	40.770	39.794	
Height/Diameter ratio	1.910	1.942	
Weight (g)	967.97	951.97	951.97
Water Content (%)	102.35	99.01	99.01
Bulk Unit Weight (pcf)	90.4	91.1	91.1
Dry Unit Weight (pcf)	44.7	45.8	45.8
Cross-Sectional Area* (in^2)	7.100	6.909	
% Saturation - Wet Method	100.06	100.06	100.06
Specific Gravity - Assumed	2.68	2.68	2.68
Void Ratio	2.741	2.652	2.652
			Entire Sample
Tare ID			31
Mass wet soil + tare (g)			1040.63
Mass dry soil + tare (g)			658.42
Mass tare (g)			164.96

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	104.7
Pore Pressure (psi)	90.0
Effective Confining Pressure (psi)	14.7
B-value	0.98

Consolidation Phase

Change in Volume (in^3)	0.976
T_{50} (min)	48.9

Platen Travel Rate (in/min)	0.00049

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	5337.7
Peak P' (psf)	5229.5
Peak Q (psf)	3222.4
Strain at Peak (%)	1.9
σ_3' (psf)	2007.1
σ_1' (psf)	8451.9
σ_3 (psf)	2115.3
σ_1 (psf)	8560.1

Picture of Failure

AECI NMPP - Lined Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
TP3-2 #2 / Bulk / Stage 3

August 2017 41-1-37431-008

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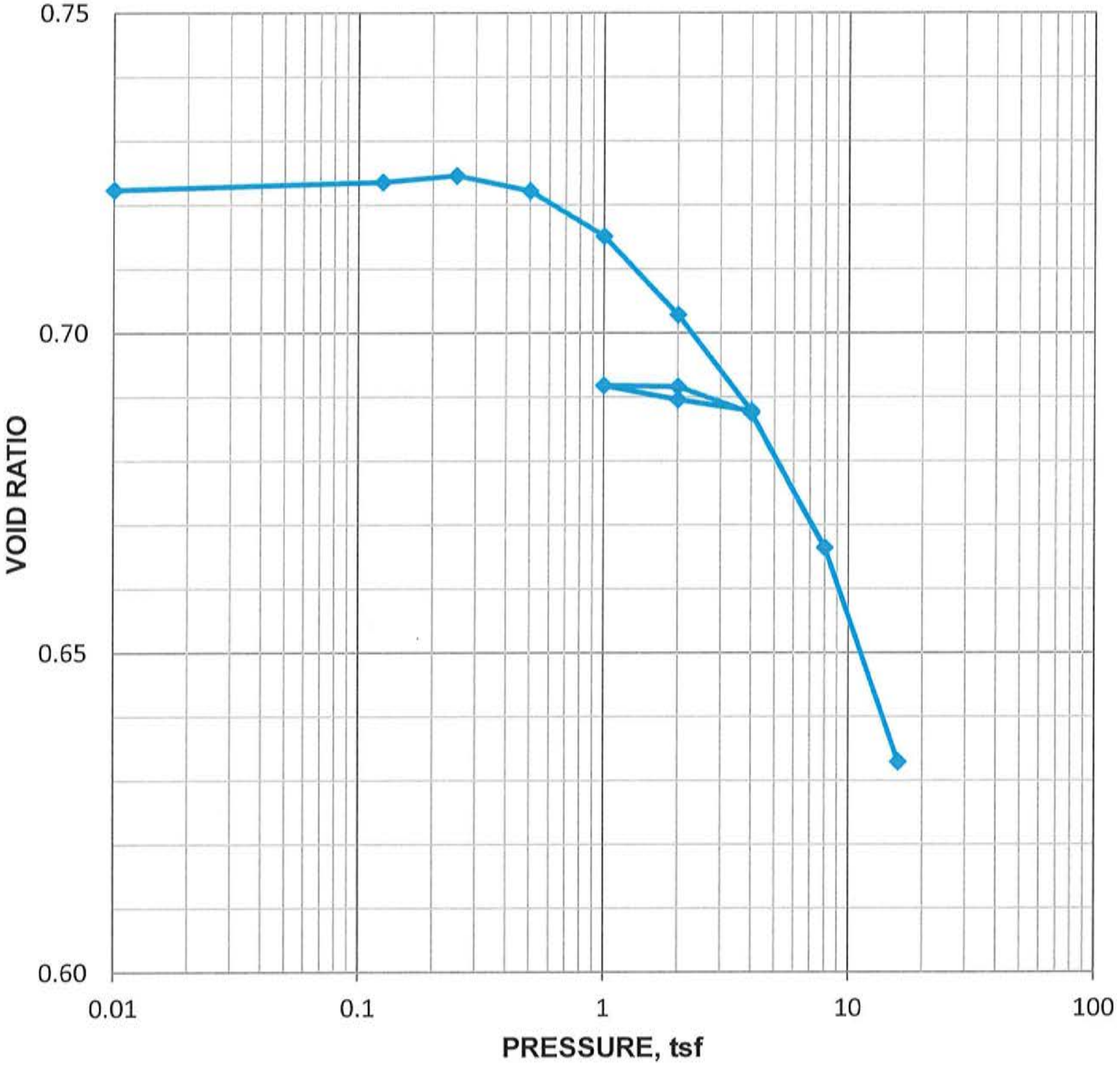
CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm²/second	Load, tsf	Coefficient of Consolidation, mm²/second
0.125	5.3E+00	1.0	NA
0.25	3.3E+00	2.0	NA
0.5	3.3E+00	4.0	NA
1.0	2.6E+00	8.0	1.2E+00
2.0	2.0E+00	16.0	9.2E-01
4.0	9.1E-01		
2.0	NA		

AECI NMPP - Lined Pond
Marston, Missouri

VOID RATIO PLOT

HA-B9

U3

July 2017 41-1-37431-008

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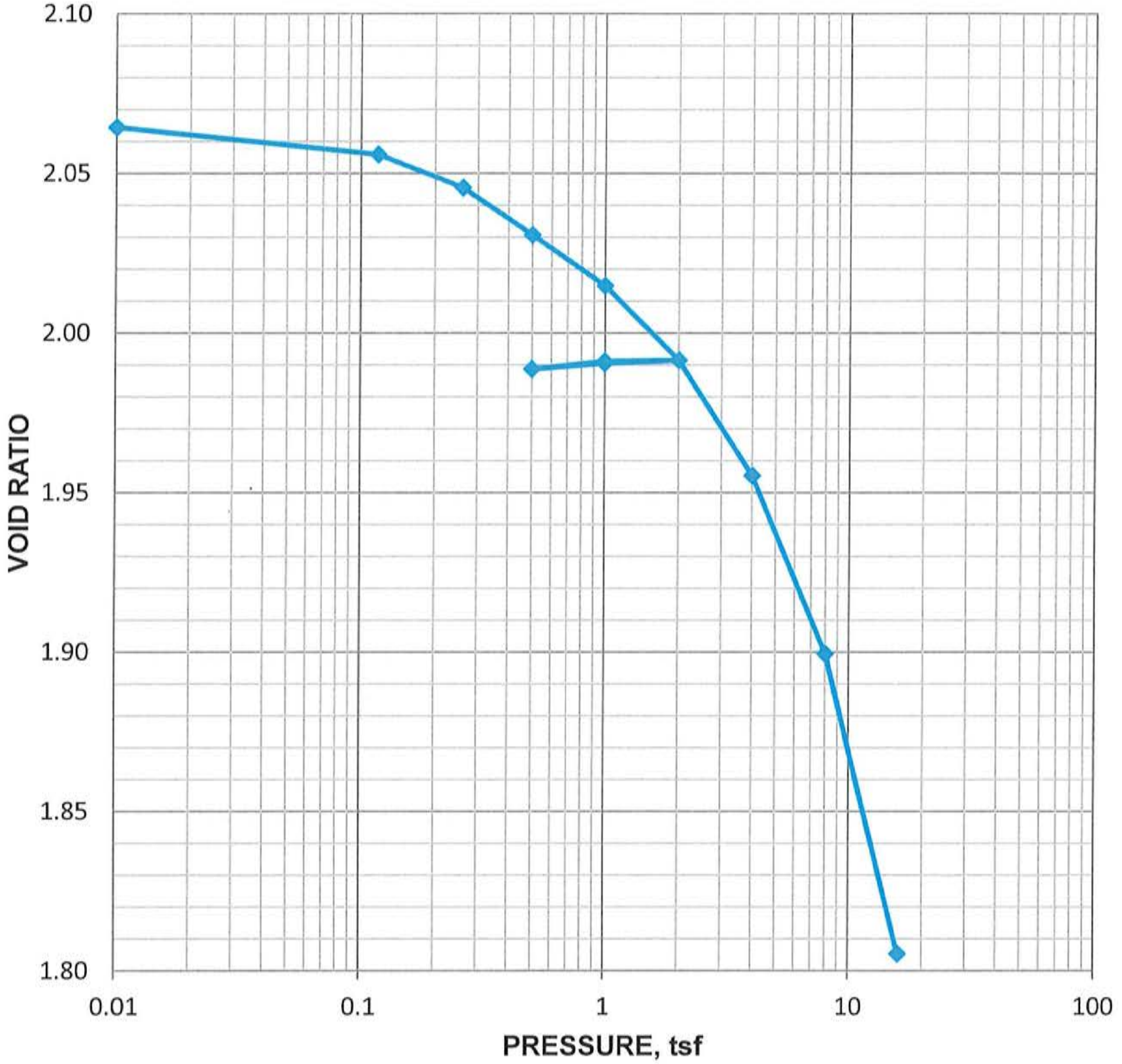
FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.117	5.3E+00	1.0	NA
0.26	3.4E-03	2.0	NA
0.5	2.3E+00	4.0	2.9E-01
1.0	2.0E+00	8.0	1.4E-01
2.0	2.0E+00	16.0	1.6E-01
1.0	NA		
0.5	NA		

AECI NMPP - Lined Pond
Marston, Missouri

VOID RATIO PLOT

TP3-2

Bulk

August 2017 41-1-37431-008

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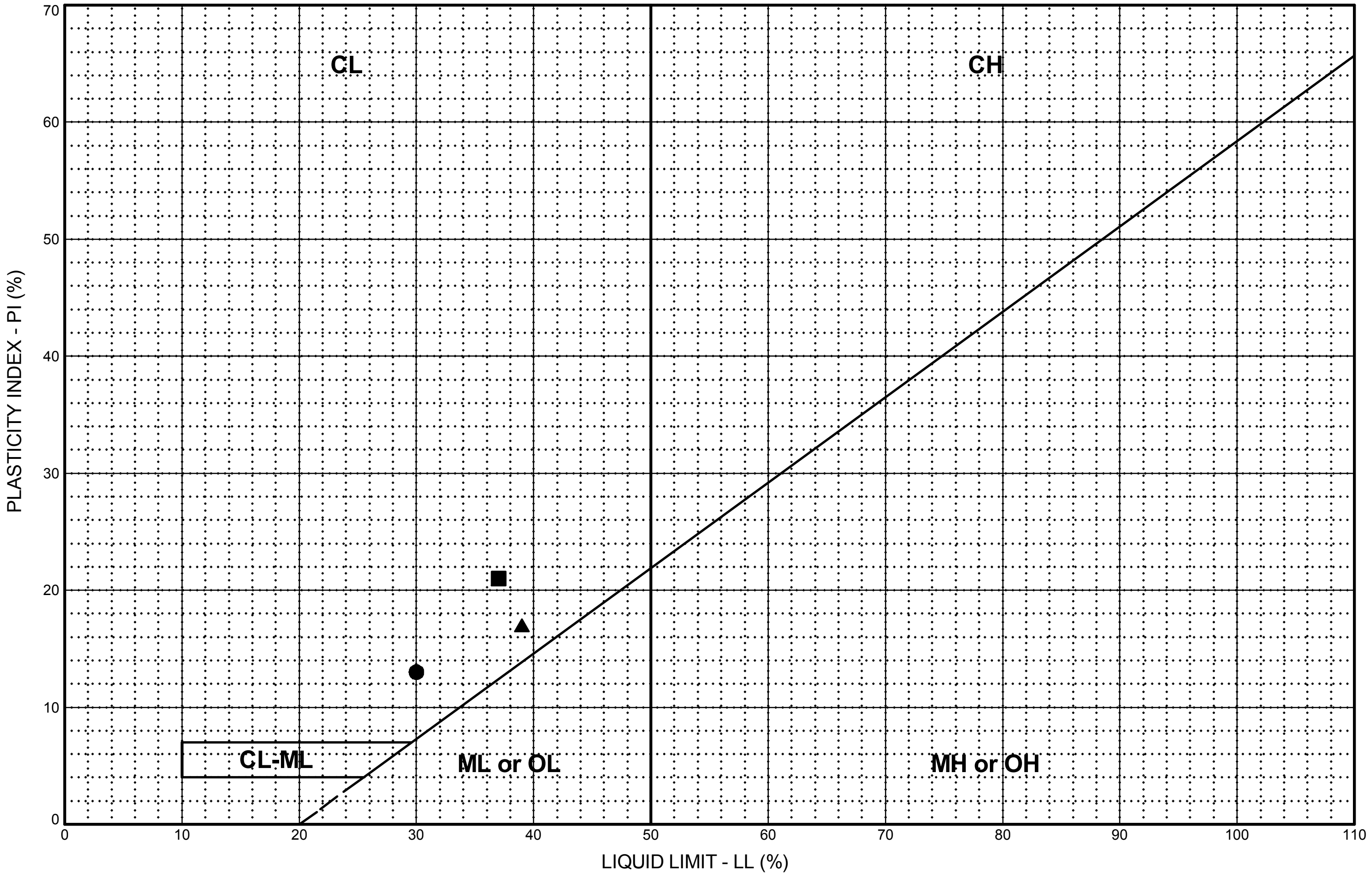
FIG.



LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● HA-B13, S6	10.0 - 12.0	CL	Gray, Sandy Lean Clay.	30	17	13	20.9	67.9
■ HA-B15, S3	4.0 - 6.0	CL	Brown, Sandy Lean Clay.	37	16	21	20.2	65.6
▲ HA-B16, S5	14.0 - 16.0	CL	Gray and brown, Lean Clay.	39	22	17	25.7	93.0

AECI NMPP - POND 004
Marston, Missouri

PLASTICITY CHART

July 2017
41-1-37431-009

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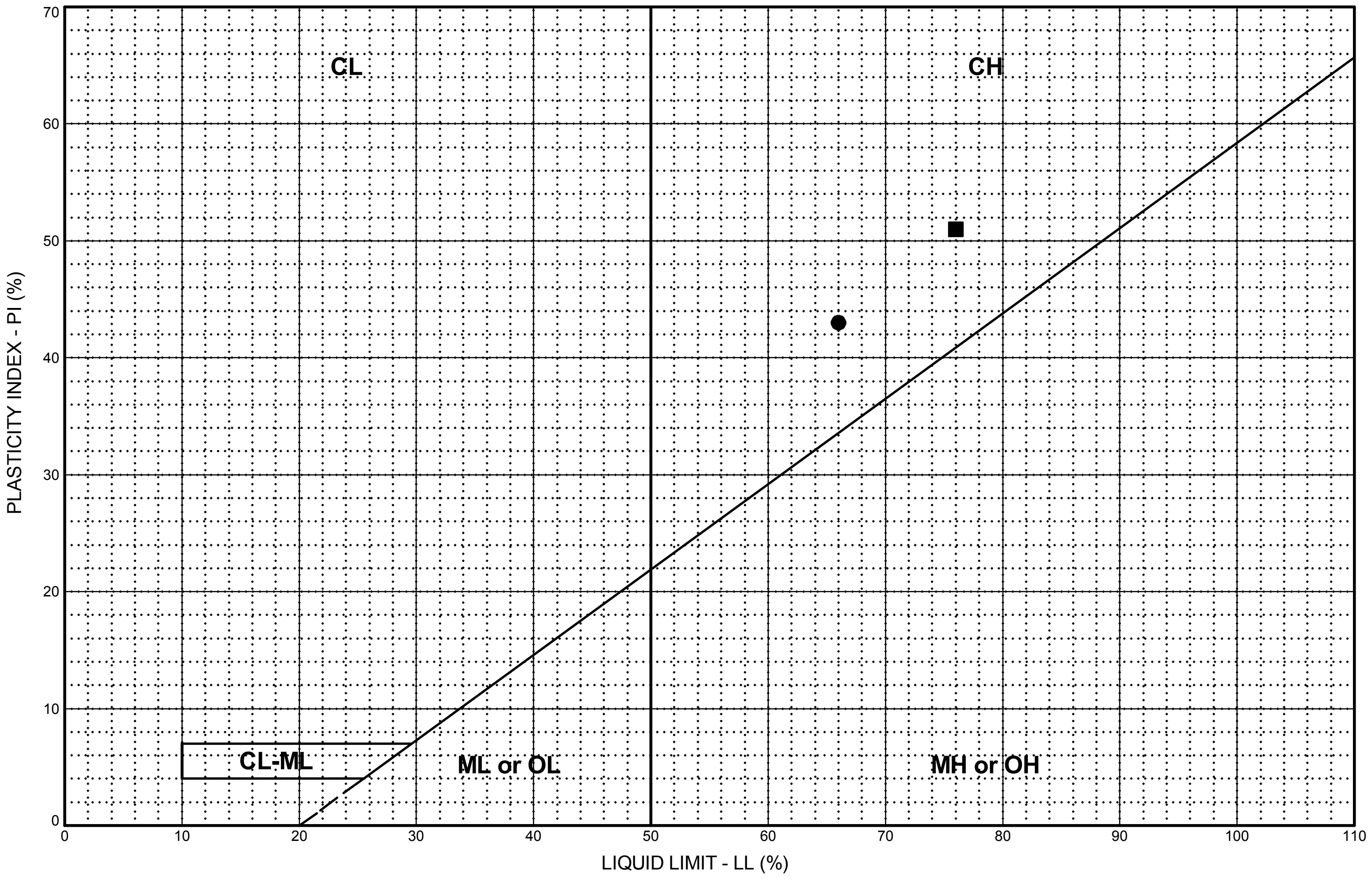
FIG.

ATTERBERG - WITH SAMPLE INTERVALS 41-1-37431-009 LAB DATA.GPJ SHAN_WIL.GDT 7/13/17

FIG.



LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

ATTERBERG - NORMAL 41-1-37431-009 LAB DATA.GPJ SHAN_WIL.GDT 7/26/17

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● HA-B11, U1	13.2	CH	Mottled gray and brown, Fat Clay.	66	23	43	26.0	98.9
■ HA-B12, U1	11.2	CH	Mottled gray and brown, Fat Clay.	76	25	51	30.5	97.8

AECI NMPP - POND 004
Marston, Missouri

PLASTICITY CHART

July 2017 41-1-37431-009

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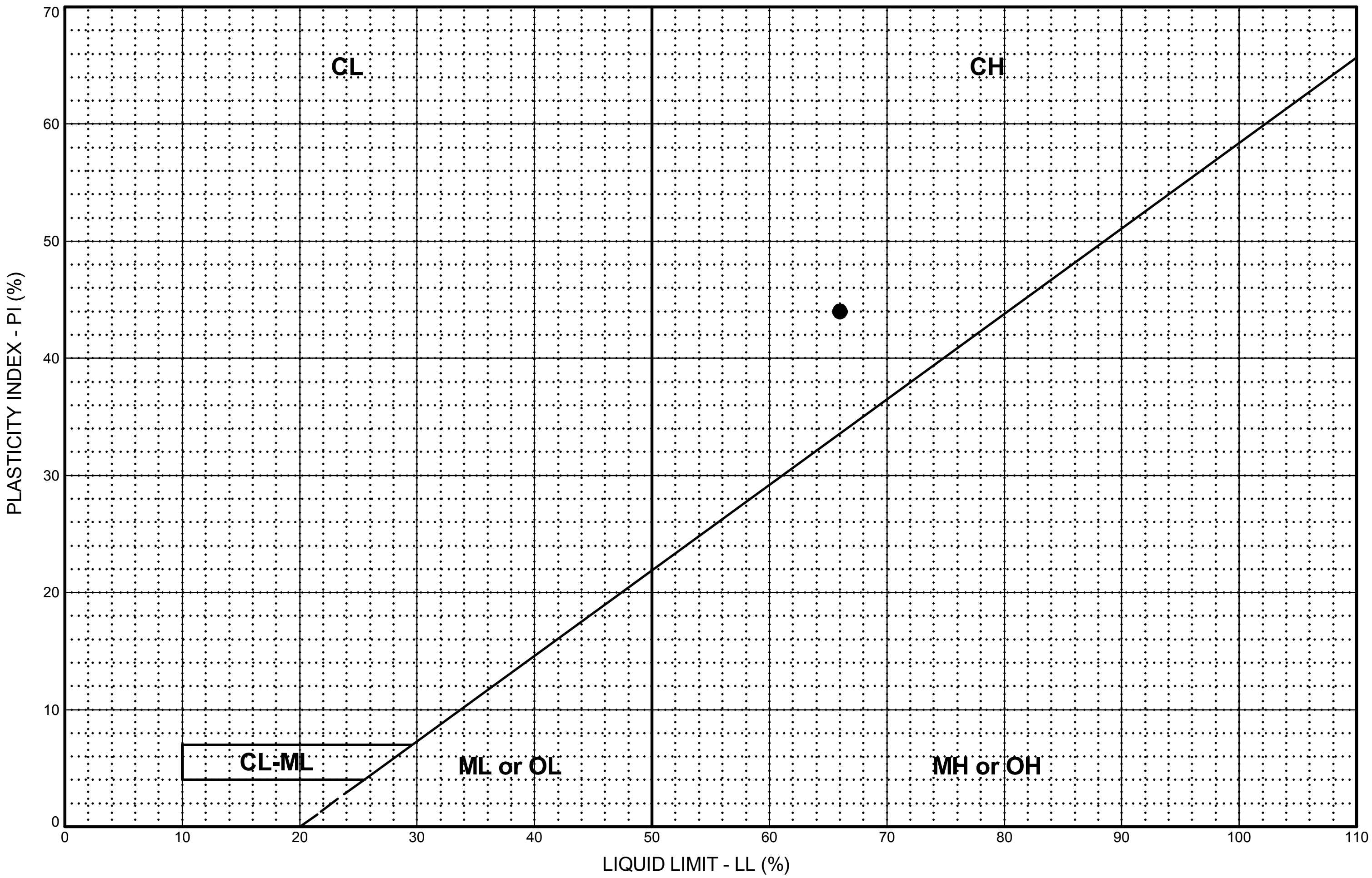
FIG.

FIG.



LEGEND

CL:	Low plasticity inorganic clays; sandy and silty clays
CH:	High plasticity inorganic clays
ML or OL:	Inorganic and organic silts and clayey silts of low plasticity
MH or OH:	Inorganic and organic silts and clayey silts of high plasticity
CL-ML:	Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● HA-B12, U2	14.0 - 16.0	CH	Mottled gray and brown, Fat Clay with Silt lenses.	66	22	44	28.4	97.4

AECI NMPP - POND 004
Marston, Missouri

PLASTICITY CHART

August 2017 41-1-37431-009

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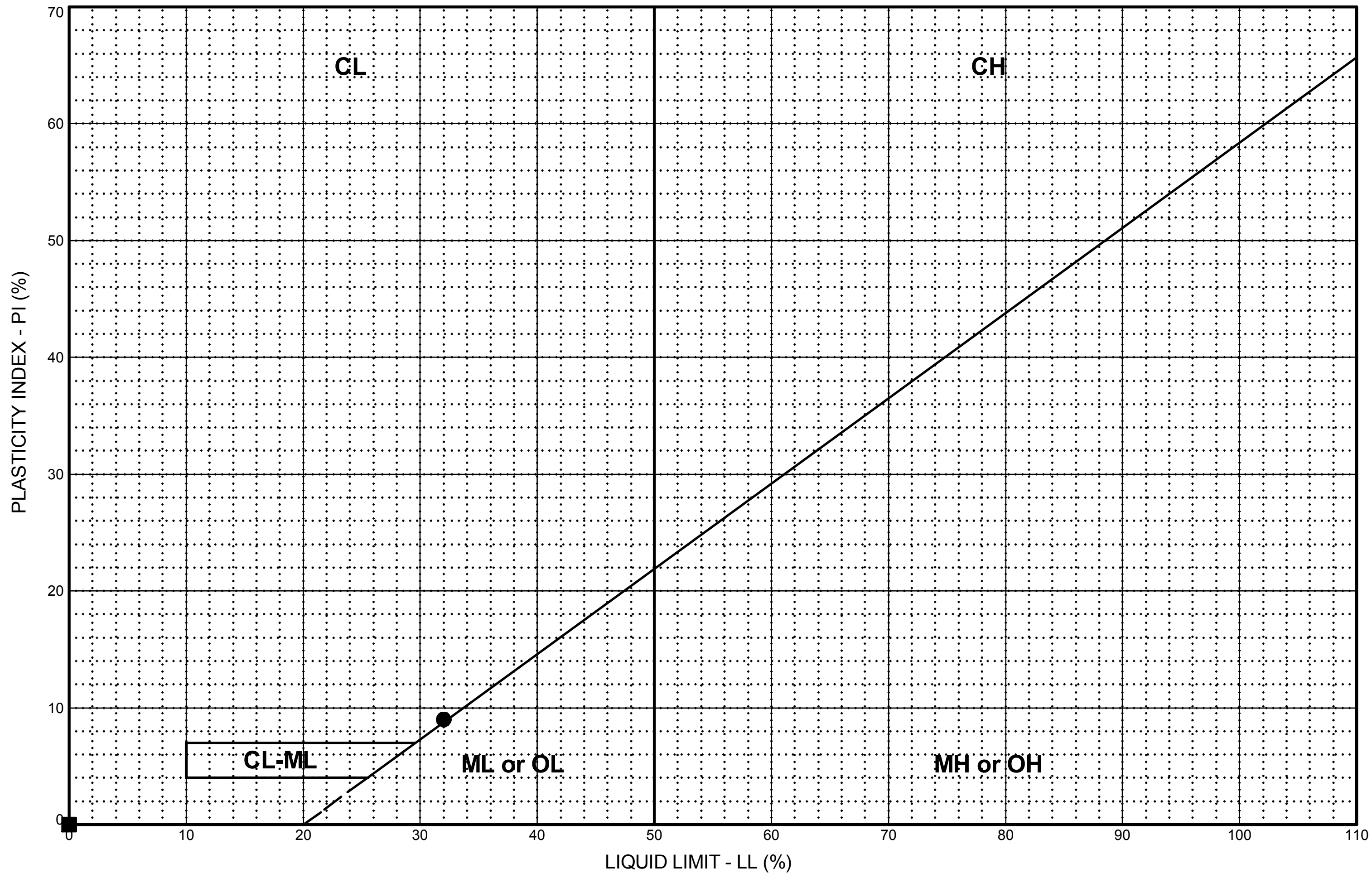
FIG.

FIG.

ATTERBERG - WITH SAMPLE INTERVALS 41-1-37431-009 LAB DATA.GPJ SHAN_WIL.GDT 8/9/17



LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● HA-B16, U1	22.0 - 24.0	CL	Mottled gray and brown, Lean Clay.	32	23	9	26.4	91.9
■ HA-B16, U2	24.0 - 26.0	ML	Mottled gray and brown, Silt.	NP	NP	NP	31.7	91.9

AECI NMPP - POND 004
Marston, Missouri

PLASTICITY CHART

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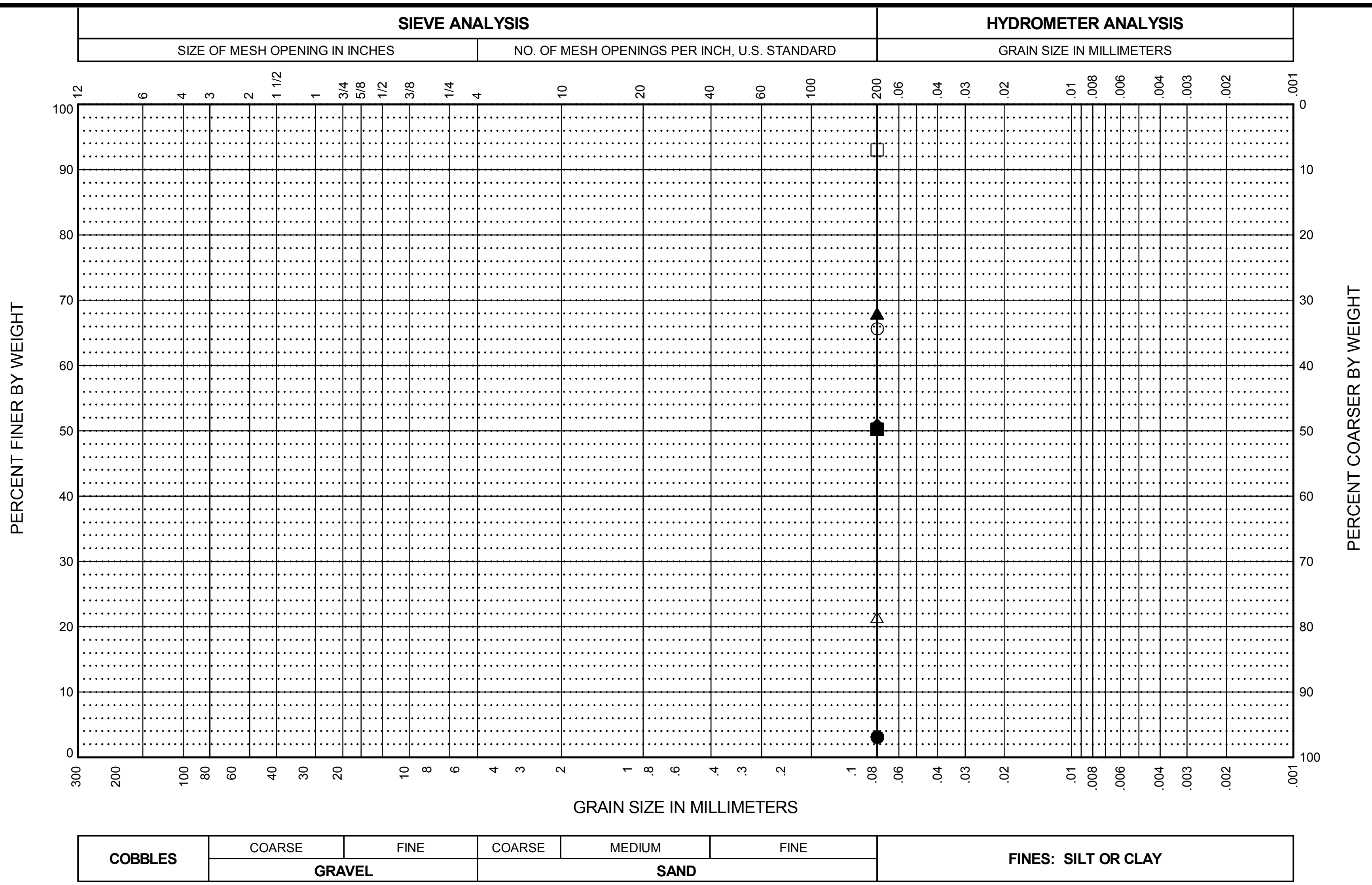
FIG.

FIG.

ATTERBERG - WITH SAMPLE INTERVALS 41-1-37431-009 LAB DATA.GPJ SHAN_WIL.GDT 8/25/17



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B11, S17	63.0 - 65.0	SP	Brown, Poorly Graded Sand.	3.1	15.9			
■ HA-B12, S9	24.0 - 26.0	ML	Brown, Sandy Silt.	50.2	26.6			
▲ HA-B13, S6	10.0 - 12.0	CL	Gray, Sandy Lean Clay.	67.9	20.9	30	13	13
◆ HA-B13, S19	36.0 - 38.0	ML	Brown, Sandy Silt.	50.8	25.1			
○ HA-B15, S3	4.0 - 6.0	CL	Brown, Sandy Lean Clay.	65.6	20.2	37	21	21
□ HA-B16, S5	14.0 - 16.0	CL	Gray and brown, Lean Clay.	93.0	25.7	39	17	18
△ HA-B16, S8	28.0 - 30.0	SM	Brown, Silty Sand.	21.5	25.8			

AECI NMPP - POND 004
Marston, Missouri

GRAIN SIZE DISTRIBUTION

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41-1-37431-009

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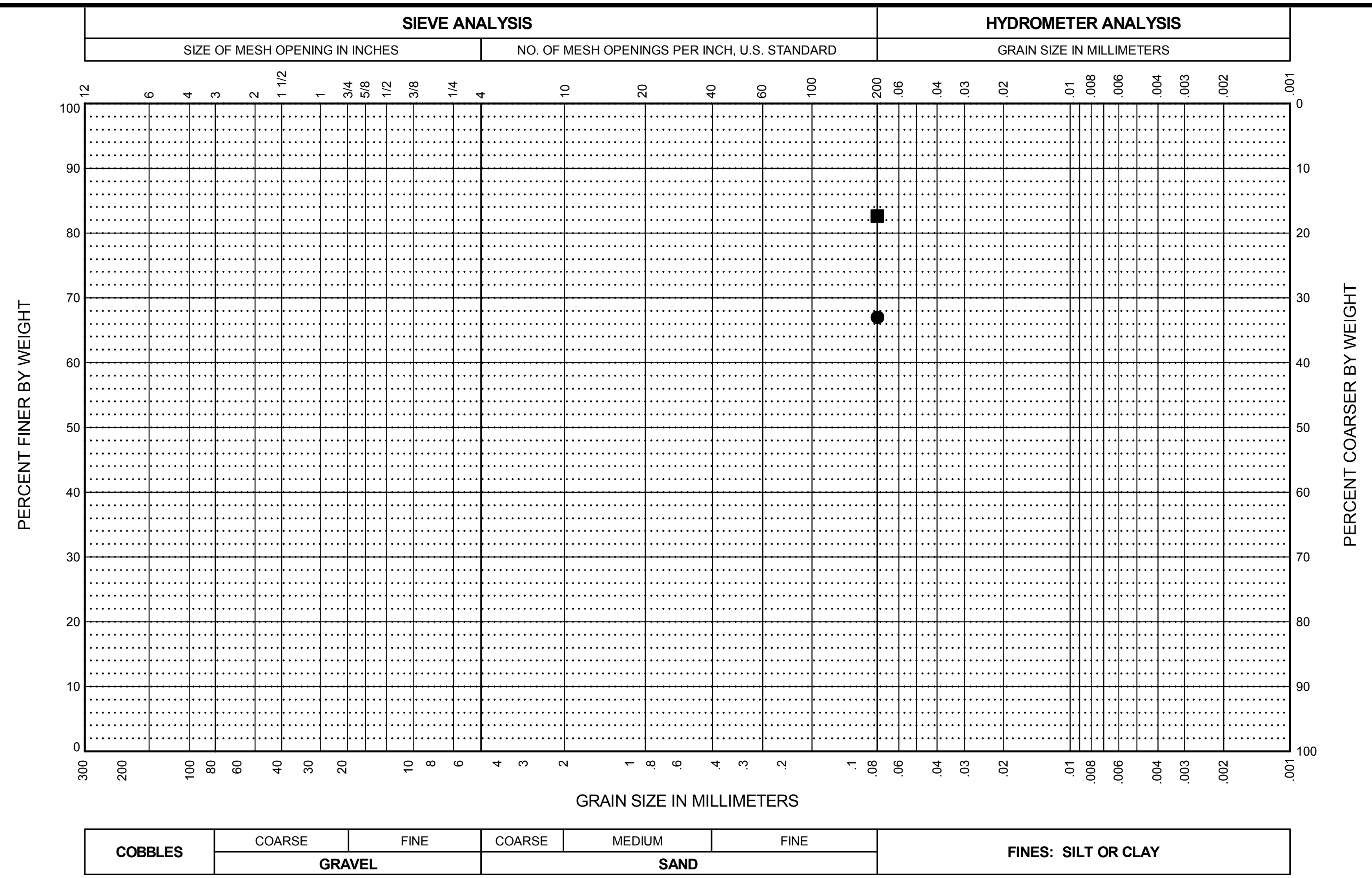
FIG.

GSA- WITH SAMPLE INTERVALS 41-1-37431-009 LAB DATA.GPJ SHAN_WIL.GDT 7/13/17



GSA- WITH SAMPLE INTERVALS 41-1-37431-009 LAB DATA.GPJ SHAN_WIL.GDT 7/13/17

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B18, S12	28.0 - 30.0	ML	Brown, Sandy Silt.	67.0	28.5			
■ HA-B19, S5	10.0 - 12.0	CH	Gray and Brown, Fat Clay with Sand.	82.7	24.2			

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Marston, Missouri

GRAIN SIZE DISTRIBUTION

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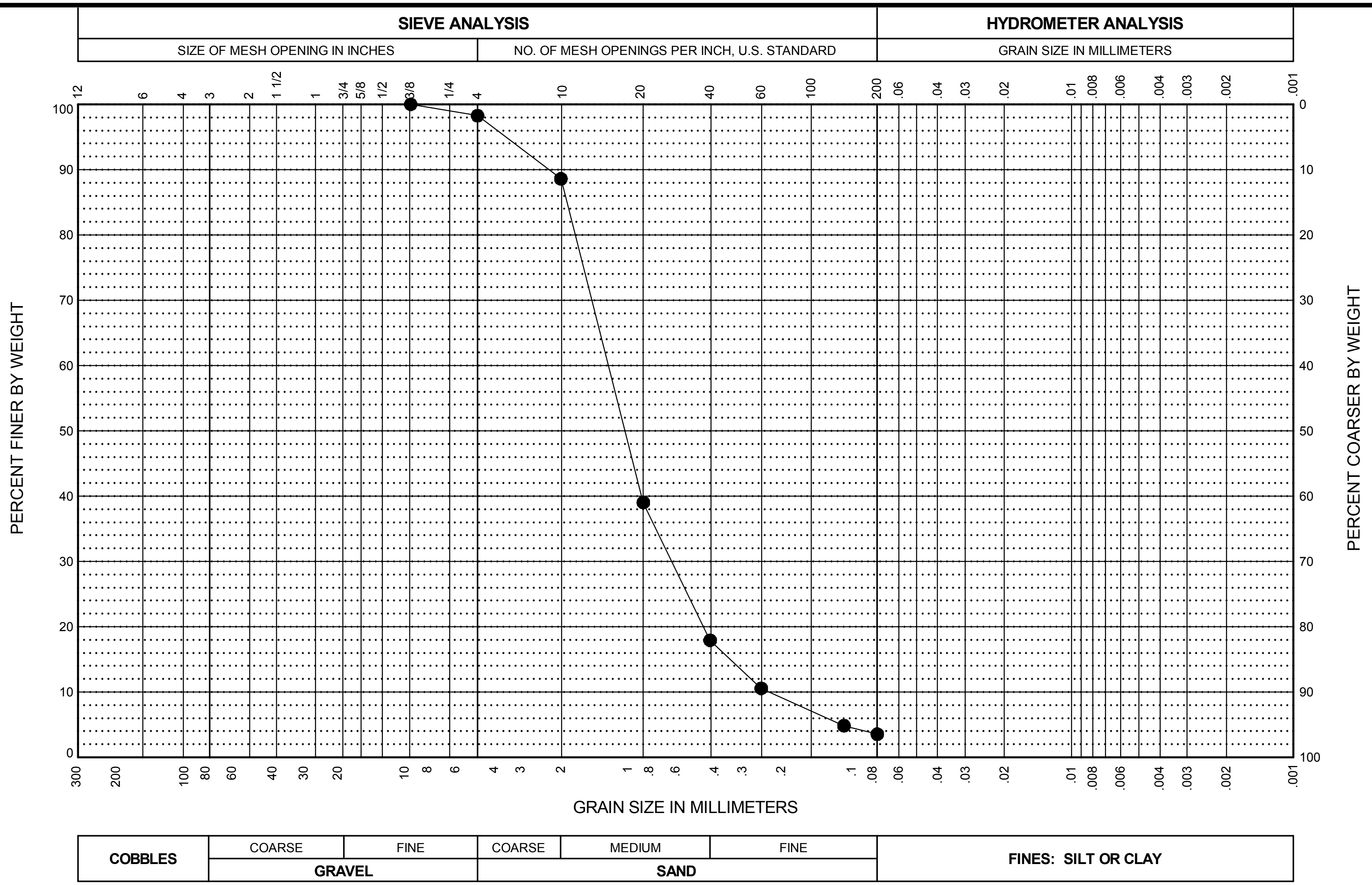
FIG.



GSA- WITH SAMPLE INTERVALS 41-1-37431-009 LAB DATA.GPJ SHAN_WIL.GDT 7/13/17

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B11, S2	2.0 - 4.0	SP	Black, Poorly Graded Sand (Ash).	3.5	4.5			

AECI NMPP - POND 004
Marston, Missouri

GRAIN SIZE DISTRIBUTION

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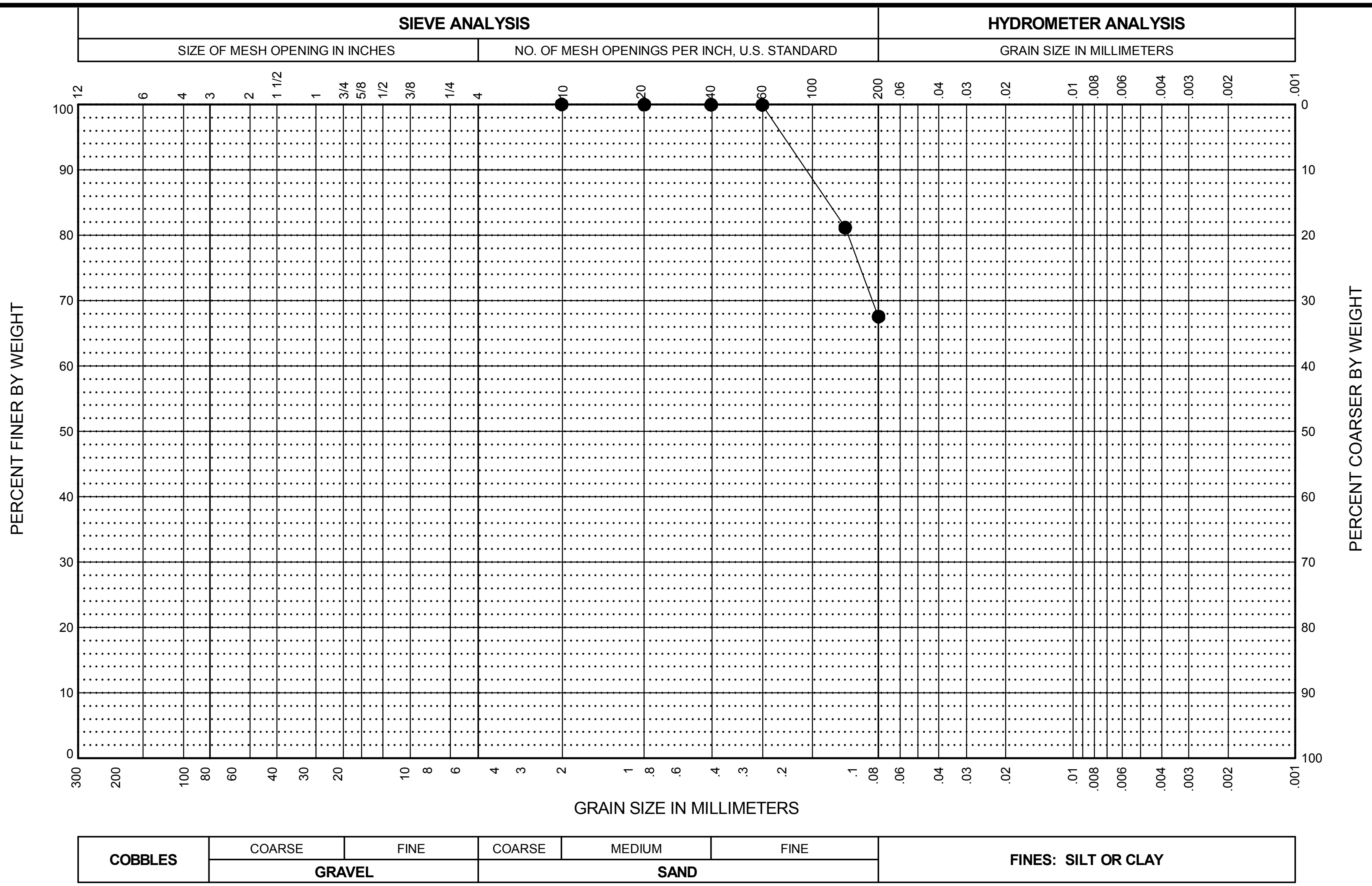
FIG.



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B11, S9	24.0 - 26.0	ML	Brown, Sandy Silt.	67.5	27.2			

AECI NMPP - POND 004
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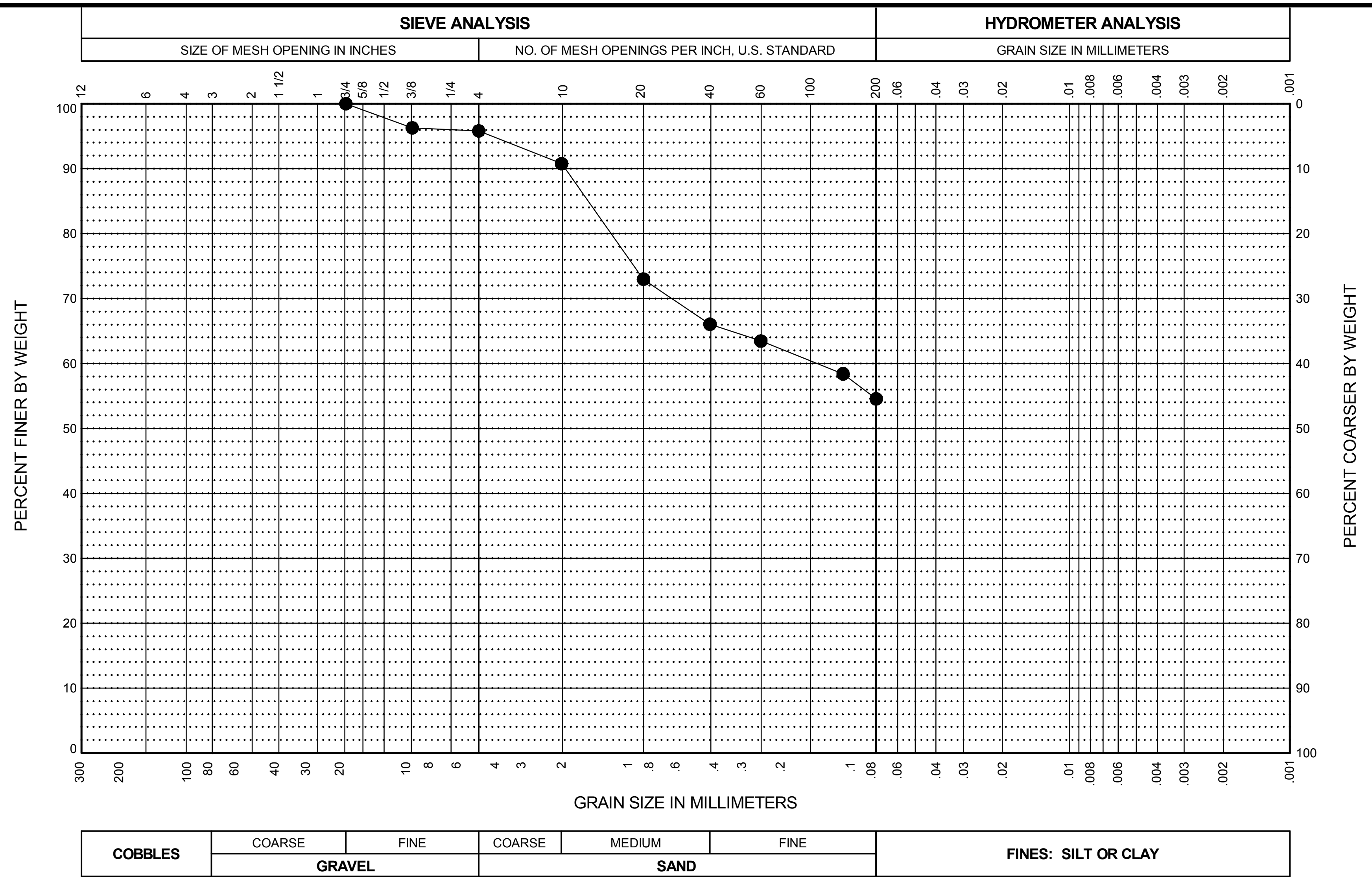
FIG.

GSA- WITH SAMPLE INTERVALS 41-1-37431-009 LAB DATA.GPJ SHAN_WIL.GDT 7/13/17



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B12, S3	4.0 - 6.0	ML	Black, Sandy Silt (Ash).	54.6	21.1			

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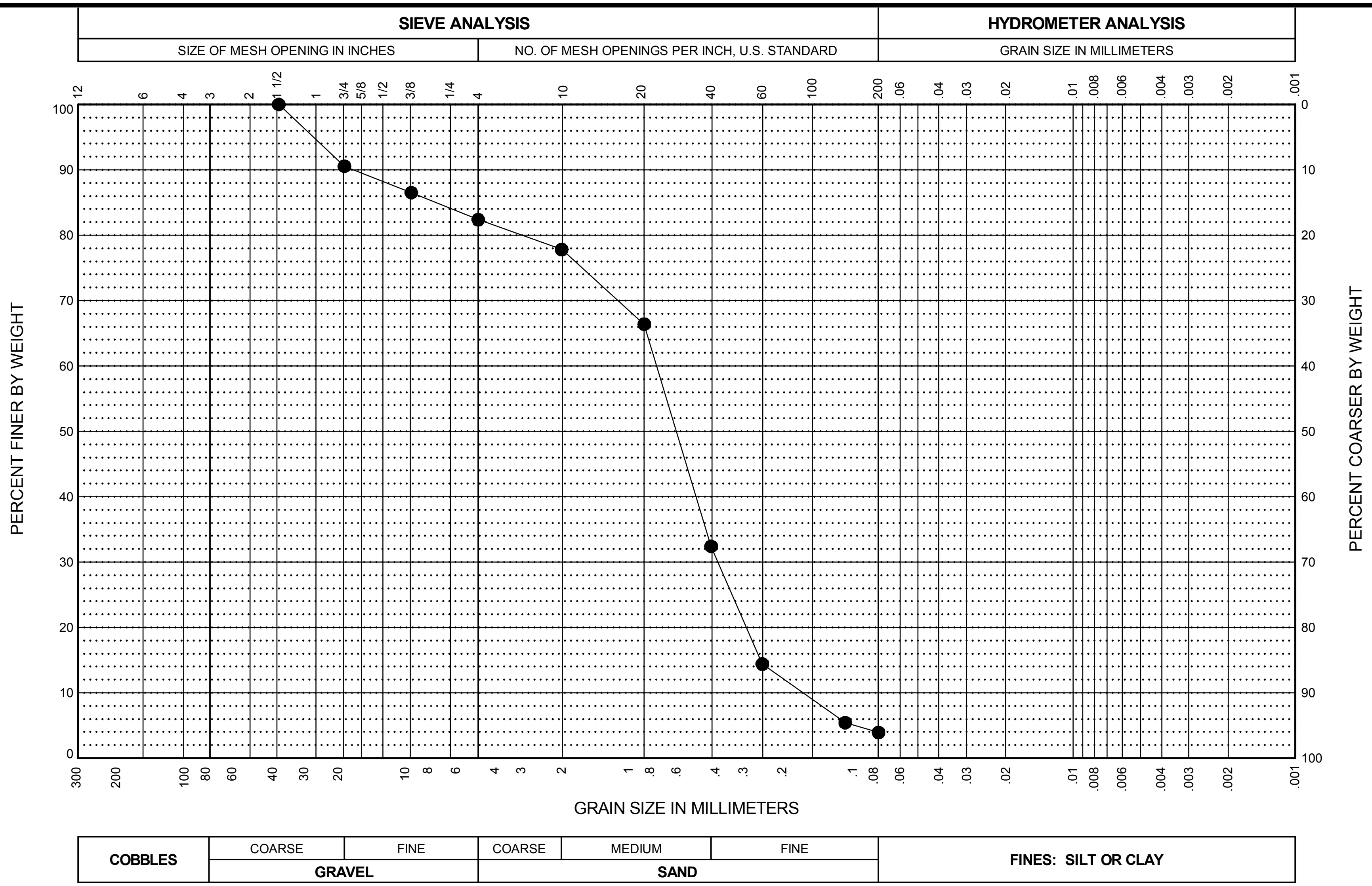
FIG.

GSA- WITH SAMPLE INTERVALS 41-1-37431-009 LAB DATA.GPJ SHAN_WIL.GDT 7/13/17



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B12, S14	53.0 - 55.0	SP	Brown, Poorly Graded Sand with Gravel.	3.9	14.4			

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GRAIN SIZE DISTRIBUTION

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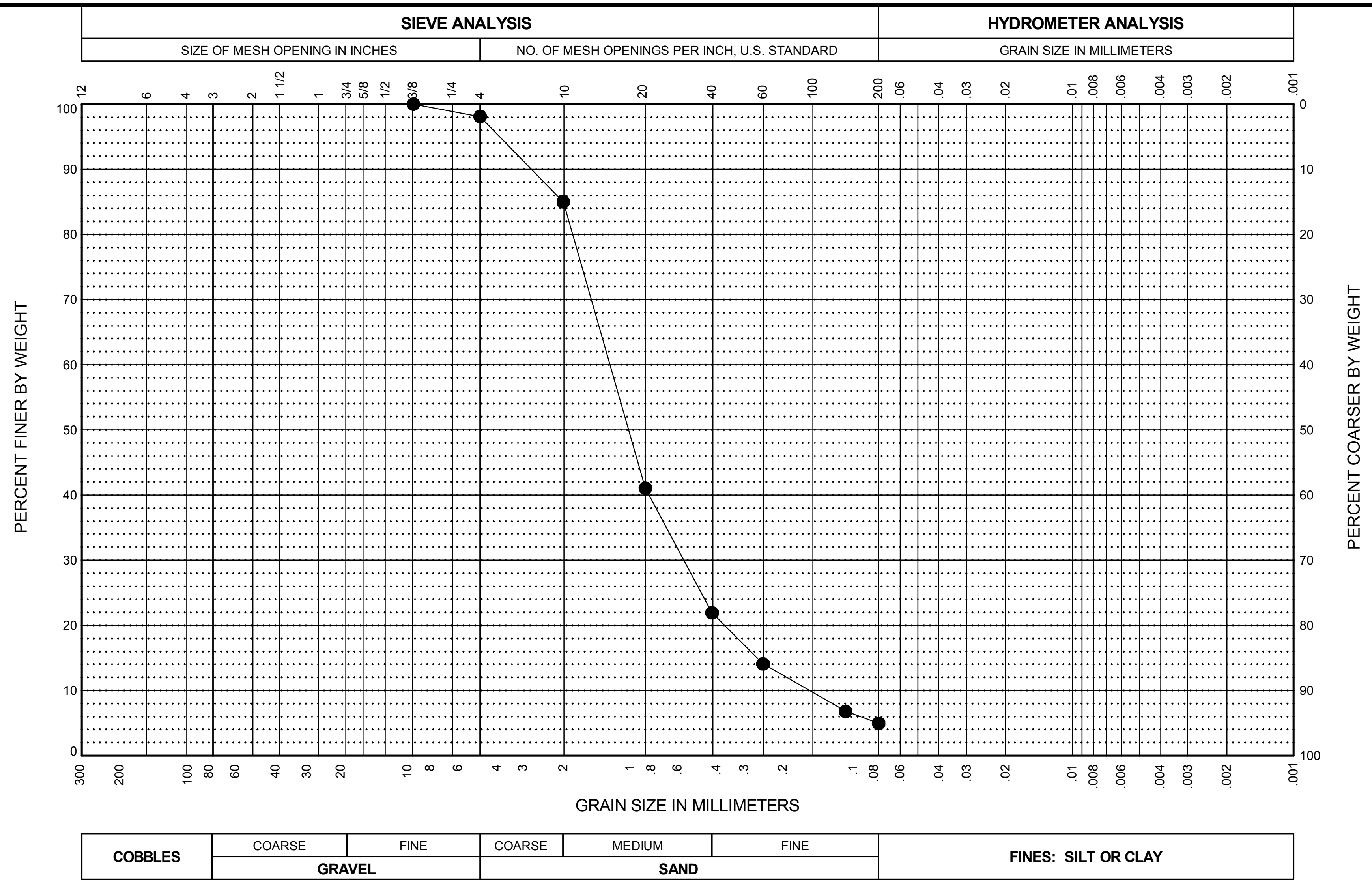
FIG.

GSA- WITH SAMPLE INTERVALS 41-1-37431-009 LAB DATA.GPJ SHAN_WIL.GDT 7/13/17



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B14, S3	6.0 - 8.0	SP	Black, Poorly Graded Sand (Ash).	5.0	20.1			

AECI NMPP - POND 004
Marston, Missouri

GRAIN SIZE DISTRIBUTION

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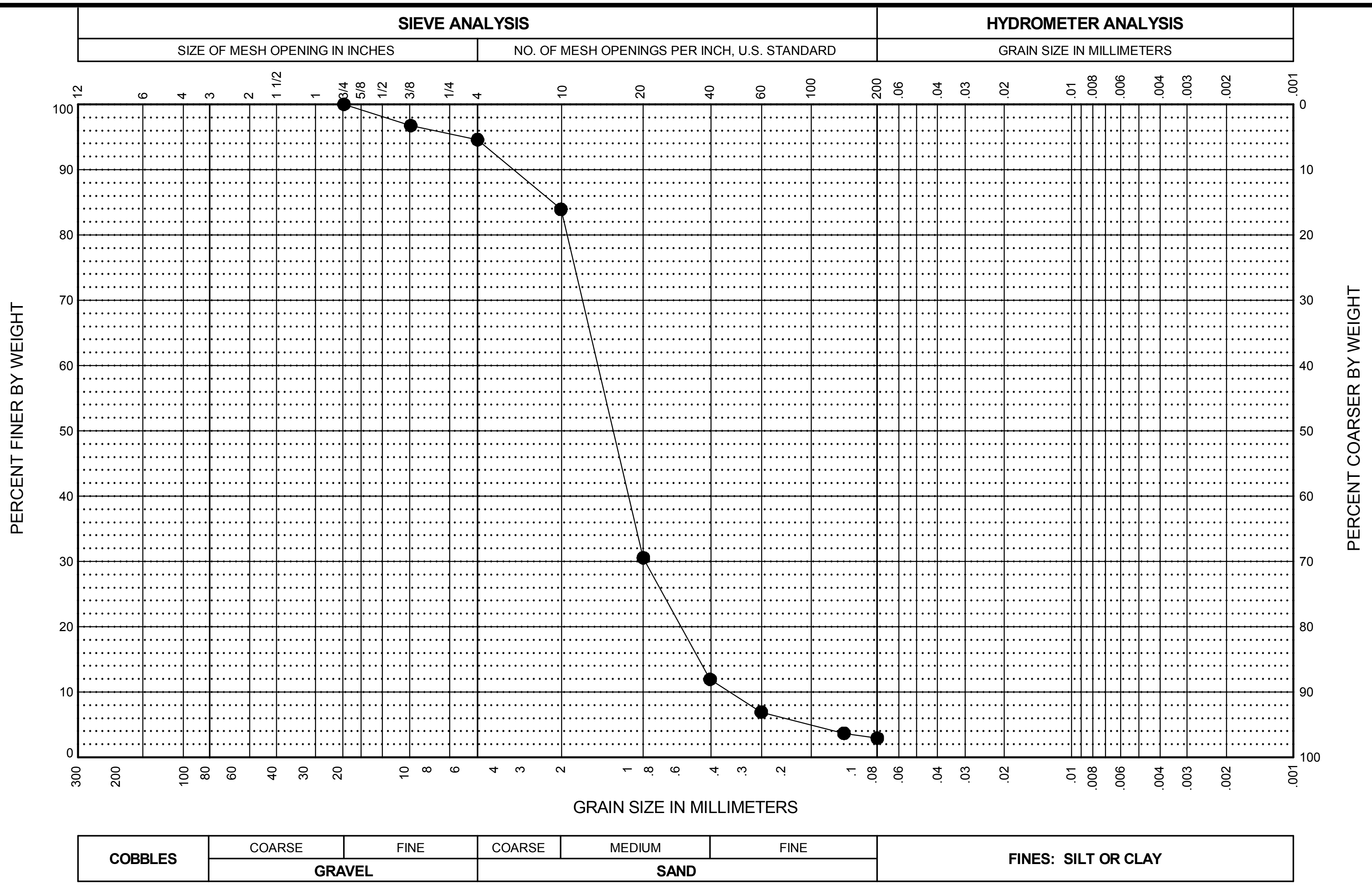
FIG.

GSA- WITH SAMPLE INTERVALS 41-1-37431-009 LAB DATA.GPJ SHAN_WIL.GDT 7/13/17



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● TP4-3, Bulk	0.0 - 10.0	SP	Black, Poorly Graded Sand (Ash).	2.9	4.3			

AECI NMPP - POND 004
Marston, Missouri

GRAIN SIZE DISTRIBUTION

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FIG.

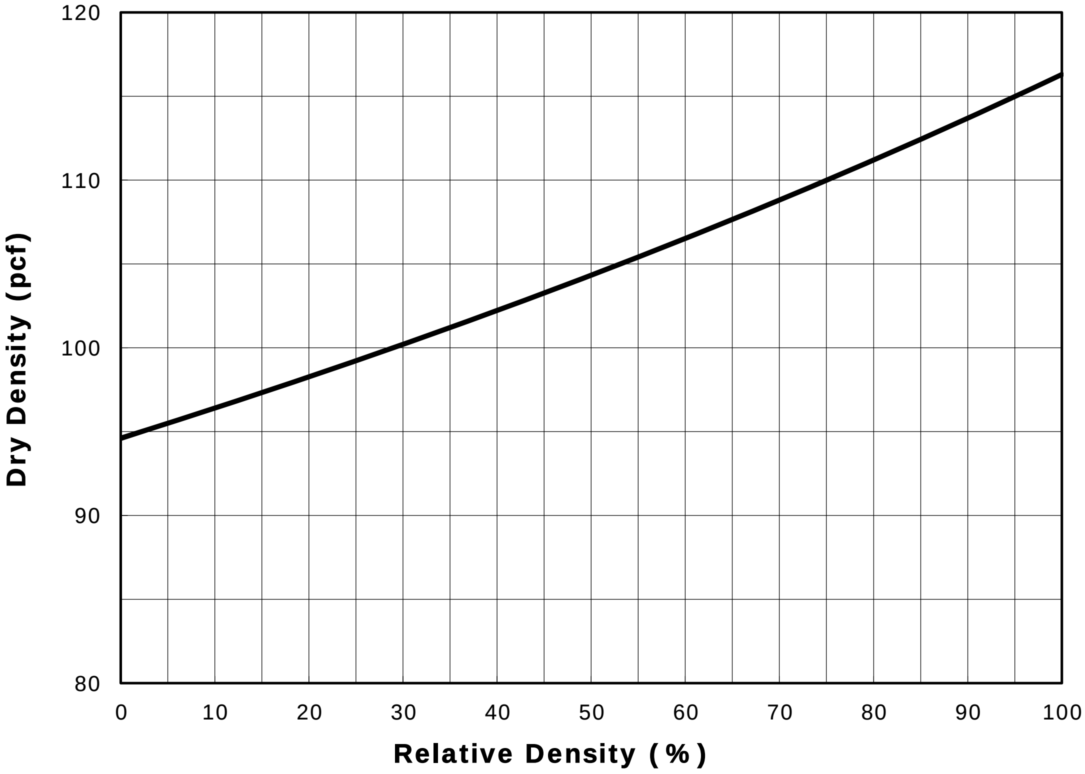
GSA- WITH SAMPLE INTERVALS 41-1-37431-009 LAB DATA.GPJ SHAN_WIL.GDT 7/13/17

GeoTesting EXPRESS

Client:	Shannon & Wilson, Inc.
Project Name:	AECI NMPP- Pond 004
Project Location:	Marston, MO
GTX #:	306726
Test Date:	07/21/17
Tested By:	cwd
Checked By:	emm
Boring ID:	TP4-3
Sample ID:	Bulk
Depth:	0.0-10.0
Description:	Moist, black sand

Relative Density Test by ASTM D 4253 / 4254

Relative Density - Dry Method



Minimum Density		94.6	pcf
Maximum Density	Dry Method	116.3	pcf
	Wet Method	---	pcf

Notes: Only Dry Method performed.

PROJECT AECI NMPP - POND 004
DATE 7/20/17
BORING NO. HA-B11
JOB NO. 41-1-37431-009
SHEET NO. 1
TESTED BY CMB
CLIENT NAME Haley & Aldrich
CHECKED BY CMB

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U1
DEPTH (ft) 12-14
Sampling Method Push
Type of Sample Shelby Tube
Inch 3"
Brass or [✓ Steel]

DEPTH FT.	NAT. W.C.		TYPE OF TEST	CLASSIFICATION
	Strength info.	W.C.		
12.0				17 INCH RECOVERY Sample: Good [✓ Fair] Poor Disturbed
	PP = 1.75	HT-3	MC	Stiff, dark gray and brown, Fat Clay (CH); moist; with sand layers (ash) 12.0 - 12.3 feet, mottled gray and brown below 12.3 feet (no ash); <5% fine sand; 95% high dry strength and plasticity, no dilatancy. (Possible Fill)
12.5			SAVED	
13.0				
	PP = 1.5	HT-4	Atterberg #200 Wash MC, Consol	
13.5				
14.0				

Can/Tare No.	HT-3	HT-2
WET + TARE	78.15	92.08
DRY + TARE	63.56	73.66
TARE	2.53	2.49
% WATER	23.9	25.9

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS:

PROJECT AECI NMPP - POND 004 DATE 7/21/17 BORING NO. HA-B12

JOB NO. 41-1-37431-009 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich CHECKED BY CMB

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U1 DEPTH (ft) 10-12

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C.		TYPE OF TEST	CLASSIFICATION
	Strength info.	W.C.		
				16 INCH RECOVERY Sample: Good Fair [✓ Poor] Disturbed
10.0	PP = N/A	HT-1	MC	Black, Poorly Graded Sand (SP); moist; <5 % non-plastic fines; 95% angular, fine to coarse sand. (Ash) (Fill)
			SAVED	Medium stiff, mottled gray and brown, Fat Clay (CH); moist; <5% fine sand; 95% high dry strength and plasticity, no dilatancy. (Possible Fill)
10.5				
11.0	PP = 1.5	HT-2	Atterberg #200 Wash MC, Consol	
11.5				
12.0				

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

Can/Tare No.	HT-1	HT-2
WET + TARE	53.39	73.06
DRY + TARE	44.23	55.93
TARE	2.55	2.53
% WATER	22.0	32.1

REMARKS:

Shannon & Wilson, Inc.
2043 Westport Center Drive
St. Louis, MO 63146

PROJECT AECI NMPP - POND 004 DATE 7/27/17 BORING NO. HA-B12
JOB NO. 41-1-37431-009 SHEET NO. 1 TESTED BY CMB
CLIENT NAME Haley & Aldrich CHECKED BY CMB

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U2 DEPTH (ft) 14-16
Sampling Method Push
Type of Sample Shelby Tube Inch 3"
Brass or [✓ Steel]

DEPTH FT.	NAT. W.C.		TYPE OF TEST	CLASSIFICATION
	Strength info.	W.C.		
14.0				20 INCH RECOVERY Sample: [✓ Good] Fair Poor Disturbed
	PP = 0.75	HT-1	MC	Medium stiff, mottled gray and brown, Fat Clay with Silt Lenses (CH); moist; <5% fine sand; 95% high dry strength and plasticity, no dilatancy.
			CU	
14.5			Atterberg 200 Wash CU	
15.0			CU	
15.5	PP = 0.5	HT-2	MC	
16.0				

Procedure: ASTM D 2488
NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

Can/Tare No.	HT-1	HT-2
WET + TARE	35.67	43.61
DRY + TARE	28.02	32.19
TARE	2.48	2.50
% WATER	30.0	38.5

REMARKS:

PROJECT AECI NMPP - POND 004 DATE 8/23/17 BORING NO. HA-B16

JOB NO. 41-1-37431-009 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich CHECKED BY CMB

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U1 DEPTH (ft) 22-24

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C.		TYPE OF TEST	CLASSIFICATION
	Strength info.	W.C.		
				21 INCH RECOVERY Sample: [✓ Good] Fair Poor Disturbed
22.0	PP = 0.5	HT-1	MC CONSOLIDATION Atterberg #200 Wash	Medium stiff, mottled gray and brown, Lean Clay (CL); moist; 10% fine sand; 85% medium dry strength and plasticity, no dilatancy. Silt content increasing with depth.
22.5				
23.0			SAVED	
23.5				Light brown, Sandy Silt (ML); dry; 35% fine sand; 65% low dry strength, non-plastic, rapid dilatancy.
	PP = N/A	HT-2	MC	
24.0				

Can/Tare No.	HT-1	HT-2
WET + TARE	62.09	79.31
DRY + TARE	49.37	66.5
TARE	2.54	2.51
% WATER	27.2	20.0

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS: Top 3 inches voidy, possilble fall-in.

PROJECT AECI NMPP - POND 004 DATE 8/23/17 BORING NO. HA-B16

JOB NO. 41-1-37431-009 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich CHECKED BY CMB

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U2 DEPTH (ft) 24-26

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C. Strength info.	NAT. W.C. W.C.	TYPE OF TEST	CLASSIFICATION
				23 INCH RECOVERY Sample: [✓ Good] Fair Poor Disturbed
24.0	PP = N/A	HT-3	MC SAVED	Light brown, Silty Sand (SM); dry; 35% non-plastic fines; 65% fine grained, subangular, sand.
24.5			CONSOLIDATION	Medium stiff, mottled gray and brown, Silt (ML); moist; 10% fine sand; 80% low dry strength, non-plastic, rapid dilatancy.
25.0			CU	
25.5	PP = 0.75	HT-4	Atterberg #200 Wash MC	
26.0				

Can/Tare No.	HT-3	HT-4
WET + TARE	80.08	85.30
DRY + TARE	65.6	68.71
TARE	2.53	2.48
% WATER	23.0	25.0

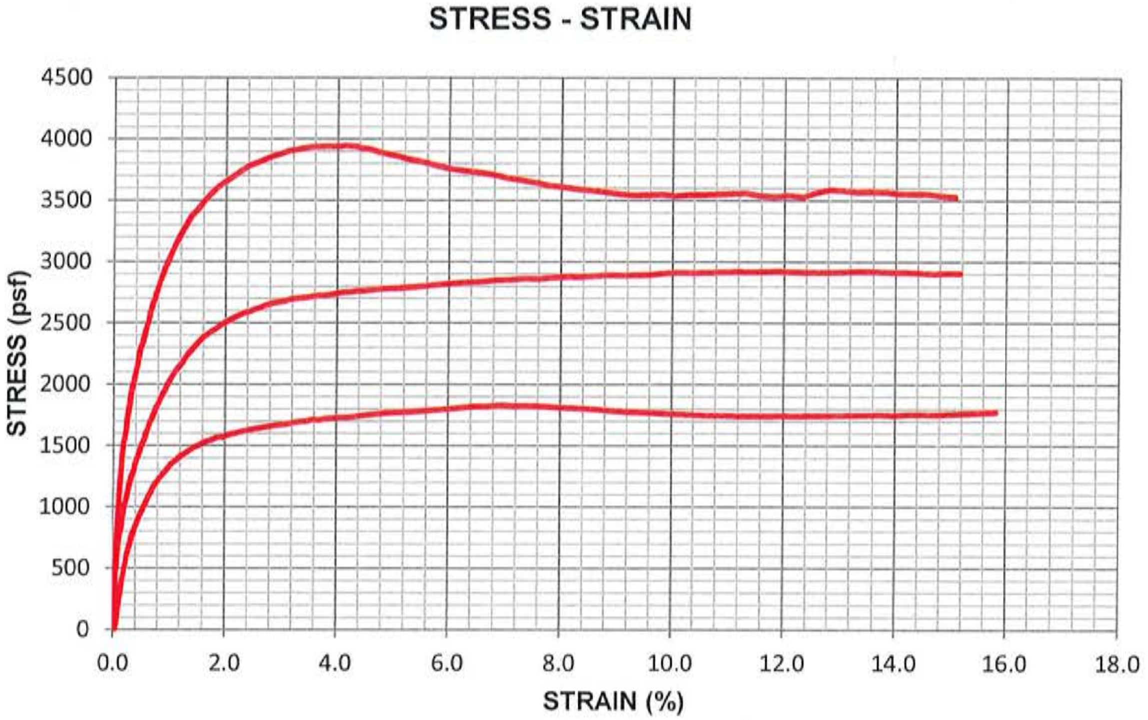
Procedure: ASTM D 2488

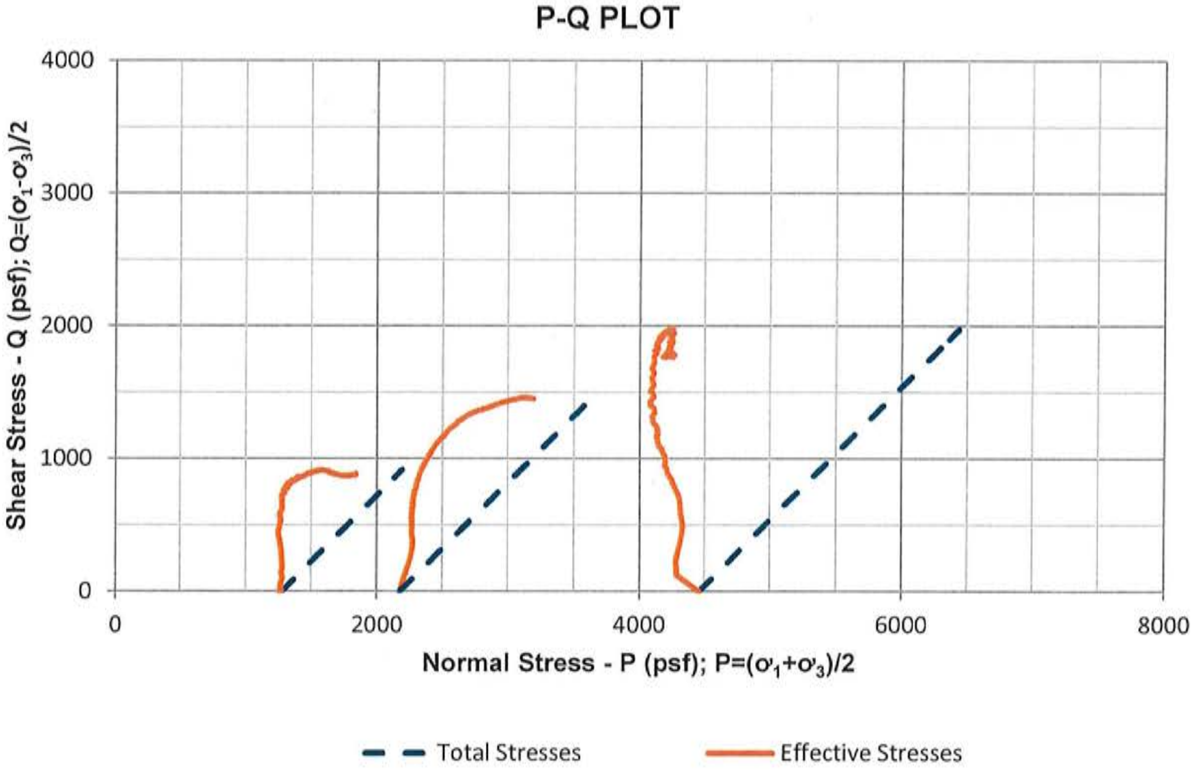
NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS:

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST WITH PORE PRESSURE MEASUREMENT

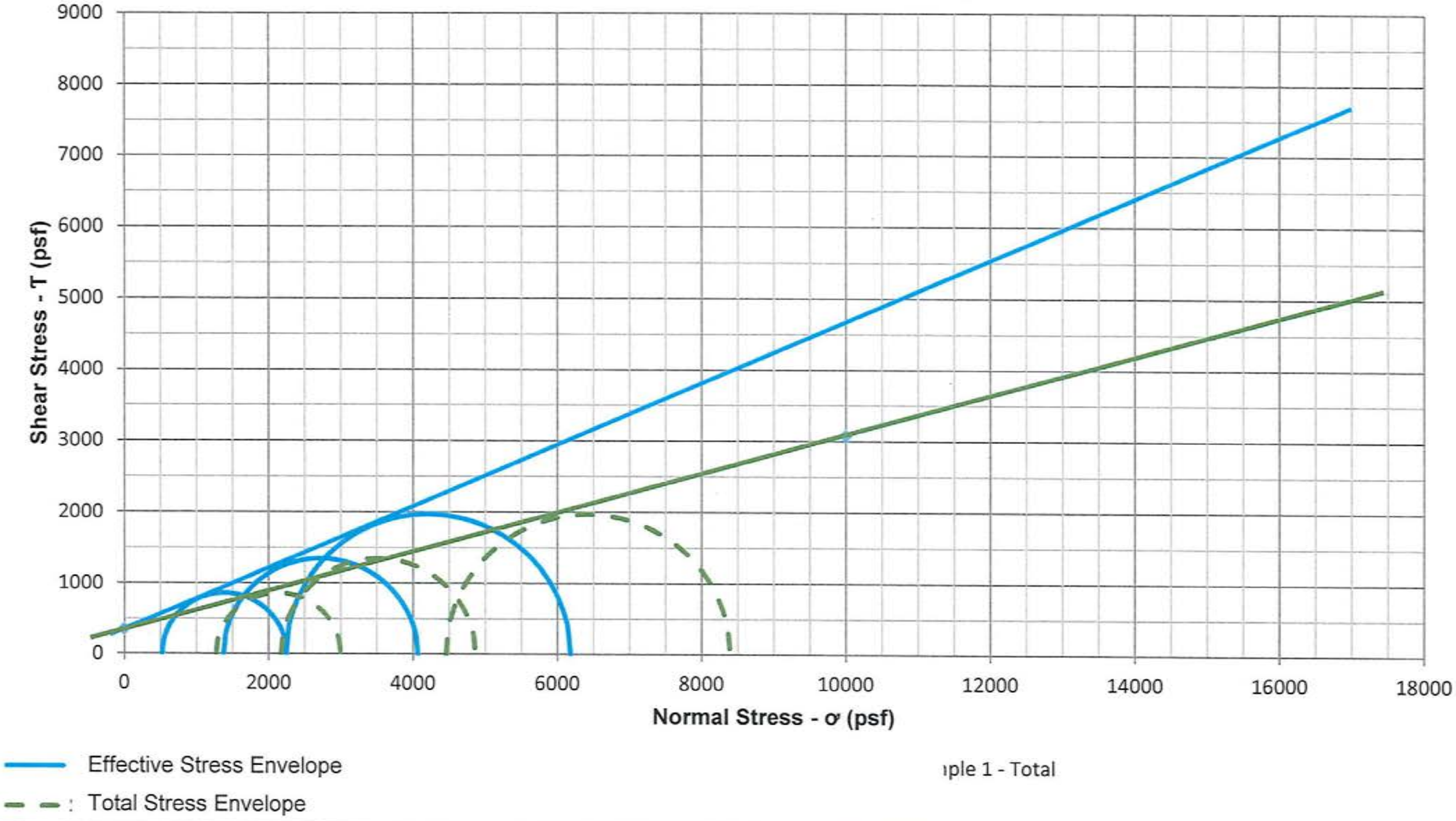

STRESS - STRAIN


P-Q PLOT

SHANNON & WILSON INC.
2043 WESTPORT CENTER DR.
SAINT LOUIS, MISSOURI 63146
41-1-37431-009

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
AECI NMPP - POND 004
Marston, Missouri
HA-B12 / U2 / 14.3

Mohr's Circle Plots Corresponding to the Peak Principal Stress Ratio



Sample	Strain (%)
Sample 1	3.9
Sample 2	3.1
Sample 3	3.8

c =	350 psf
ϕ =	15.3 deg
c' =	350 psf
ϕ' =	23.3 deg

NOTES:
1. Mohr's circles in this plot are based upon the maximum principal stress difference observed during loading.
2. Strength parameters determined by Shannon & Wilson. Engineer-of-Record should evaluate cohesion and friction commensurate with project conditions.

AECI NMPP - POND 004
Marston, Missouri

Mohr's Circle Plots
HA-B12 / U2

August 2017 41-1-37431-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Figure 1

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - POND 004					
Location	Marston, Missouri			Client	Haley & Aldrich, Inc.	
Job No.	41-1-37431-009			Tested by	CMB	Aug-17
Boring	HA-B12			Calculated by	CMB	Aug-17
Sample	U2	Specimen Number	Sample 1	Checked by	DPM	8/22/17
Depth (ft)	14.3	Undisturbed/Remold	Undisturbed	File	41-1-37431-009 HA-B12 U2 ASTM D4767	
Description	Mottled gray and brown, Fat Clay with Silt Lenses (CH).			Procedure	ASTM D4767	
Remarks						

Specimen Data	Initial	Post Consol.	Post Shear
Height (in)	5.984	5.926	4.988
Diameter (in)	2.887	2.867	
Volume (in^3)	39.172	38.789	
Height/Diameter ratio	2.073	2.067	
Weight (g)	1223.59	1229.45	1229.45
Water Content (%)	29.95	30.58	30.58
Bulk Unit Weight (pcf)	119.0	120.7	120.7
Dry Unit Weight (pcf)	91.6	92.5	92.5
Cross-Sectional Area* (in^2)	6.546	6.454	
% Saturation - Wet Method	96.29	100.44	100.44
Specific Gravity - Assumed	2.7	2.7	2.7
Void Ratio	0.840	0.822	0.822
	Trimmings		Entire Sample
Tare ID	HT-1		31
Mass wet soil + tare (g)	35.67		1396.01
Mass dry soil + tare (g)	28.02		1107.75
Mass tare (g)	2.48		164.96

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	99.3
Pore Pressure (psi)	90.5
Effective Confining Pressure (psi)	8.9
B-value	0.99

Consolidation Phase

Change in Volume (in^3)	0.929
T_{50} (min)	38.3

Platen Travel Rate (in/min)	0.00066

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	2137.7
Peak P' (psf)	1389.4
Peak Q (psf)	863.0
Strain at Peak (%)	3.9
σ_3' (psf)	526.5
σ_1' (psf)	2252.4
σ_3 (psf)	1274.8
σ_1 (psf)	3000.7

Picture of Failure

AECI NMPP - POND 004
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-B12 / U2 / Sample 1

August 2017 41-1-37431-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - POND 004					
Location	Marston, Missouri			Client	Haley & Aldrich, Inc.	
Job No.	41-1-37431-009			Tested by	CMB	Aug-17
Boring	HA-B12			Calculated by	CMB	Aug-17
Sample	U2	Specimen Number	Sample 2	Checked by	DPM	8/22/17
Depth (ft)	14.8	Undisturbed/Remold	Undisturbed	File	41-1-37431-009 HA-B12 U2 ASTM D4767	
Description	Mottled gray and brown, Fat Clay with Silt Lenses (CH).			Procedure	ASTM D4767	
Remarks						

Specimen Data	Initial	Post Consol.	Post Shear
Height (in)	5.992	5.933	5.033
Diameter (in)	2.867	2.871	
Volume (in^3)	38.683	38.302	
Height/Diameter ratio	2.090	2.067	
Weight (g)	1215.43	1226.67	1226.67
Water Content (%)	28.44	29.63	29.63
Bulk Unit Weight (pcf)	119.7	122.0	122.0
Dry Unit Weight (pcf)	93.2	94.1	94.1
Cross-Sectional Area* (in^2)	6.456	6.474	
% Saturation - Wet Method	95.05	101.26	101.26
Specific Gravity - Assumed	2.7	2.7	2.7
Void Ratio	0.808	0.790	0.790
	Trimmings		Entire Sample
Tare ID	116		8
Mass wet soil + tare (g)	247.92		1320.27
Mass dry soil + tare (g)	211.40		1041.40
Mass tare (g)	82.99		100.17

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	110.0
Pore Pressure (psi)	94.9
Effective Confining Pressure (psi)	15.1
B-value	0.98

Consolidation Phase

Change in Volume (in^3)	0.275
T_{50} (min)	11.2

Platen Travel Rate (in/min)	0.00214

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	3522.7
Peak P' (psf)	2723.6
Peak Q (psf)	1346.5
Strain at Peak (%)	3.1
σ_3' (psf)	1377.1
σ_1' (psf)	4070.2
σ_3 (psf)	2176.2
σ_1 (psf)	4869.3

Picture of Failure

AECI NMPP - POND 004
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-B12 / U2 / Sample 2

August 2017 41-1-37431-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Page 1

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - POND 004					
Location	Marston, Missouri			Client	Haley & Aldrich, Inc.	
Job No.	41-1-37431-009			Tested by	CMB	Aug-17
Boring	HA-B12			Calculated by	CMB	Aug-17
Sample	U2	Specimen Number	Sample 3	Checked by	DPM	8/22/17
Depth (ft)	15.3	Undisturbed/Remold	Undisturbed	File	41-1-37431-009 HA-B12 U2 ASTM D4767	
Description	Mottled gray and brown, Fat Clay with Silt Lenses (CH).			Procedure	ASTM D4767	
Remarks						

Specimen Data

	Initial	Post Consol.	Post Shear
Height (in)	5.989	5.920	5.028
Diameter (in)	2.882	2.850	
Volume (in^3)	39.069	38.619	
Height/Diameter ratio	2.078	2.077	
Weight (g)	1236.39	1131.59	1131.59
Water Content (%)	38.46	26.73	26.73
Bulk Unit Weight (pcf)	120.6	111.6	111.6
Dry Unit Weight (pcf)	87.1	88.1	88.1
Cross-Sectional Area* (in^2)	6.523	6.381	
% Saturation - Wet Method	111.07	79.06	79.06
Specific Gravity - Assumed	2.7	2.7	2.7
Void Ratio	0.935	0.913	0.913
	Trimmings		Entire Sample
Tare ID	HT-2		8
Mass wet soil + tare (g)	43.61		1328.46
Mass dry soil + tare (g)	32.19		1069.41
Mass tare (g)	2.50		100.17

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	120.4
Pore Pressure (psi)	89.4
Effective Confining Pressure (psi)	31.0
B-value	0.97

Consolidation Phase

Change in Volume (in^3)	1.294
T_{50} (min)	43.9

Platen Travel Rate (in/min)	0.00055

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	6430.6
Peak P' (psf)	4215.1
Peak Q (psf)	1970.6
Strain at Peak (%)	3.8
σ_3' (psf)	2244.5
σ_1' (psf)	6185.6
σ_3 (psf)	4460.1
σ_1 (psf)	8401.2

Picture of Failure

AECI NMPP - POND 004
Marston, Missouri

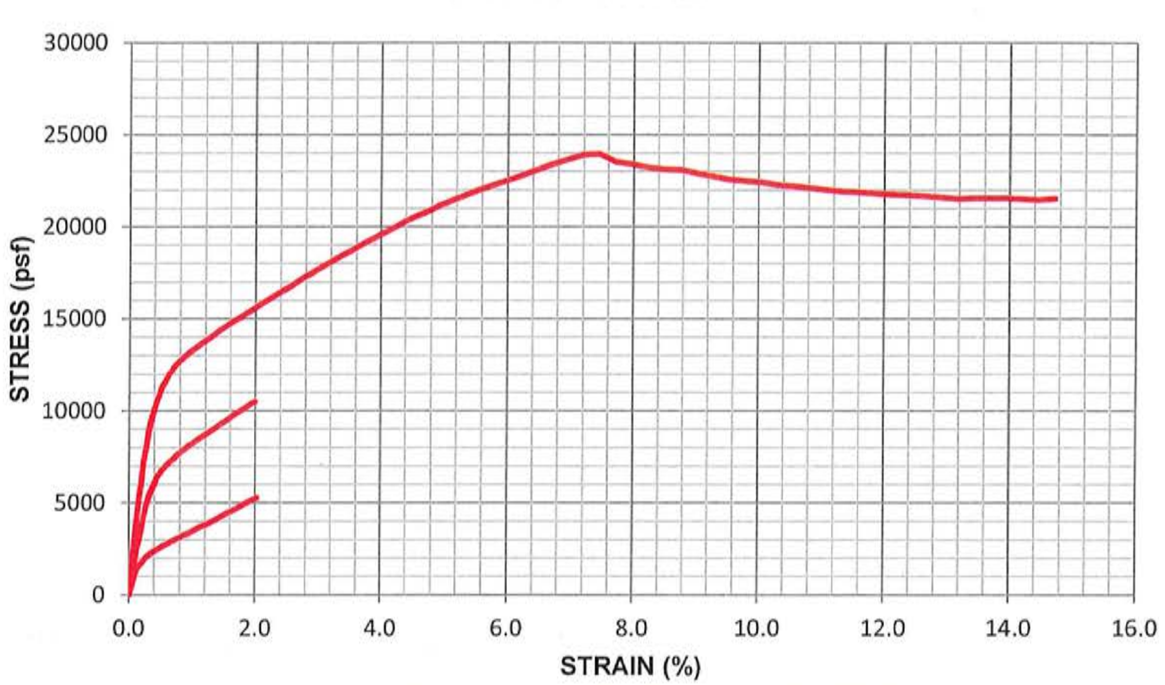
CU TRIAXIAL TEST RESULTS
HA-B12 / U2 / Sample 3

August 2017 41-1-37431-009

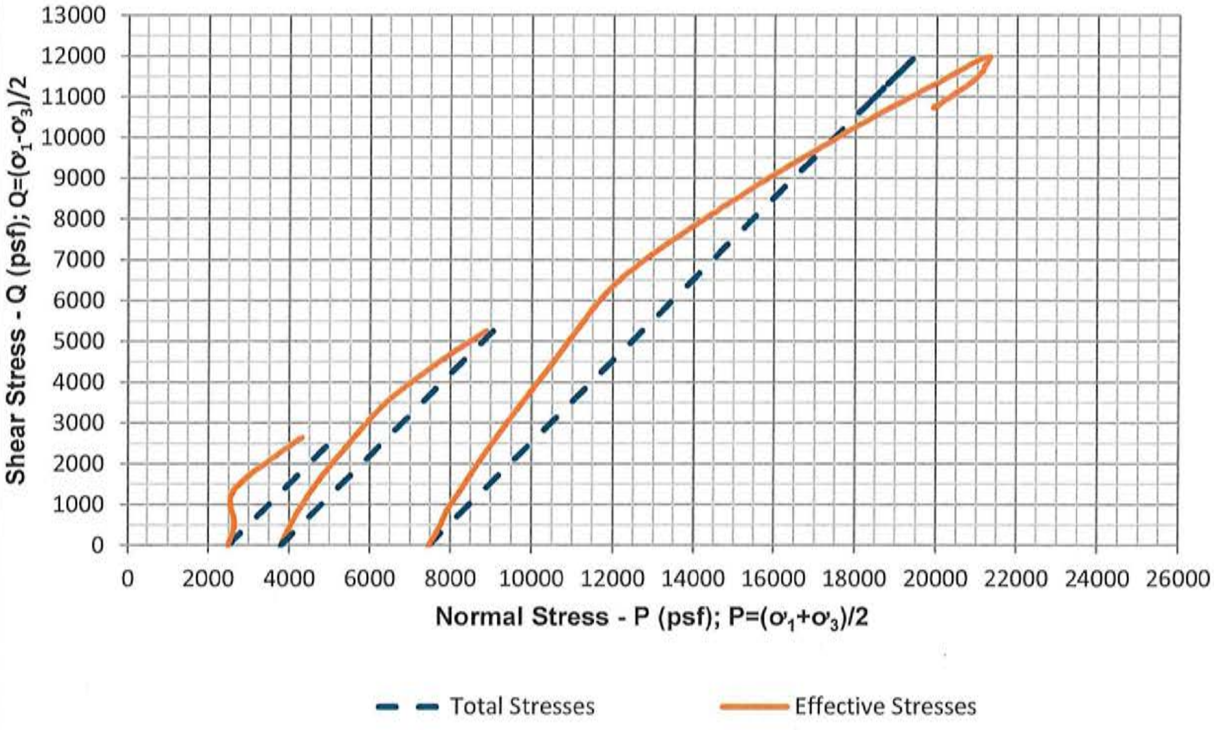
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST WITH PORE PRESSURE MEASUREMENT

STRESS - STRAIN



P-Q PLOT



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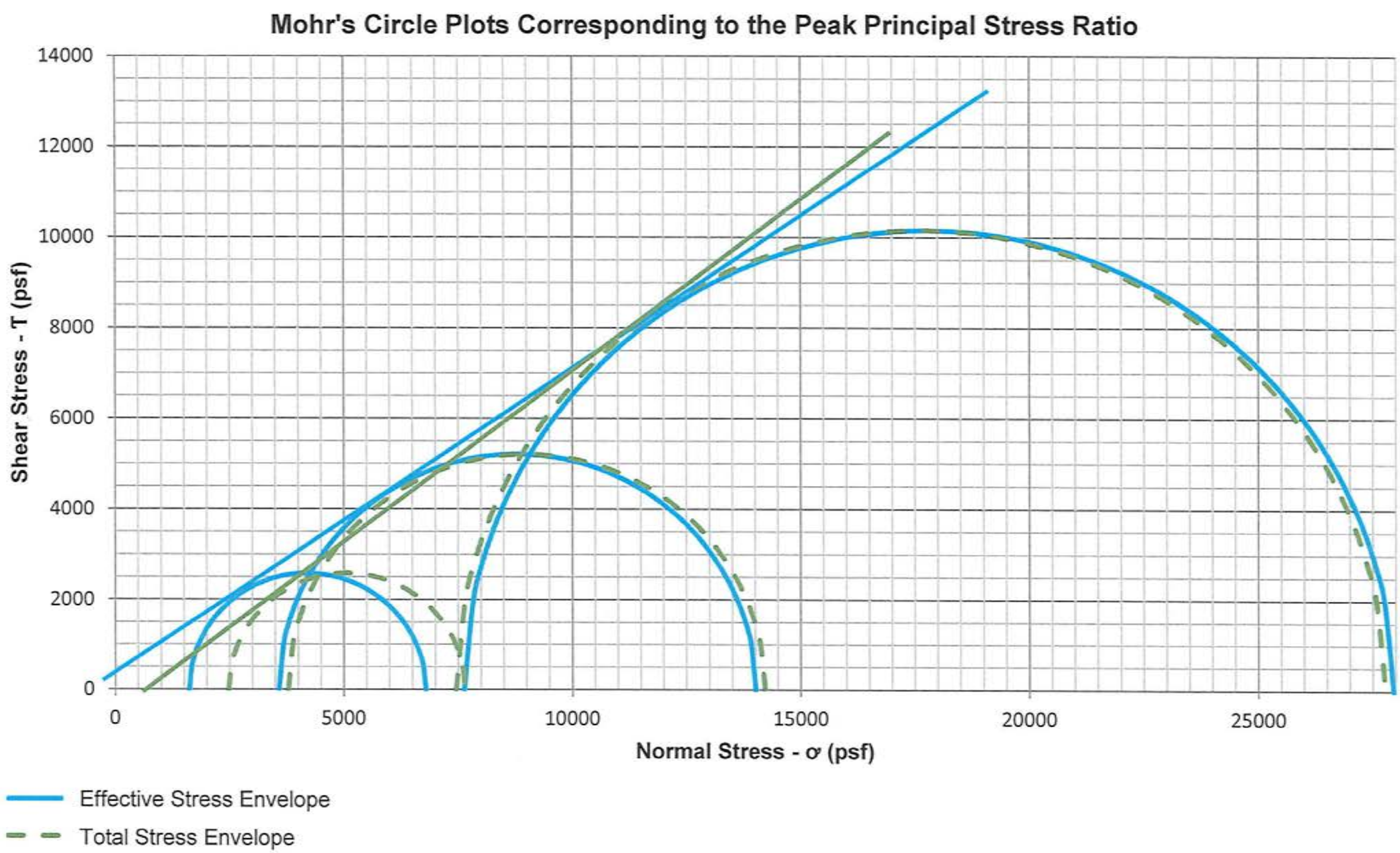
41-1-37431-009

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
AECI NMPP - Pond 004
Marston, Missouri
HA-B16 / U2 / 25.0 - 25.5



Sample	Strain (%)
Stage 1	1.9
Stage 2	1.9
Stage 3	4.4

c = -500 psf
ϕ = 37 deg
c' = 360 psf
ϕ' = 34 deg

NOTES:

1. Mohr's circles in this plot are based upon the maximum principal stress difference observed during loading.
2. Strength parameters determined by Shannon & Wilson. Engineer-of-Record should evaluate cohesion and friction commensurate with project conditions.

AECI NMPP - Pond 004
Marston, Missouri

Mohr's Circle Plots
HA-B16 / U2

September 2017
41-1-37431-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Figure 1

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - Pond 004					
Location	Marston, Missouri			Client	Haley & Aldrich	
Job No.	41-1-37431-009			Tested by	CMB	Aug-17
Boring	HA-B16			Calculated by	CMB	Sep-17
Sample	U2	Specimen Number	Stage 3	Checked by	DPM	9/6/17
Depth (ft)	25.0 - 25.5	Undisturbed/Remold	Undisturbed	File	41-1-37431-009 HA-B16 U2 ASTM D4767	
Description	Mottled gray and brown, Silt (ML).			Procedure	ASTM D4767	
Remarks						

Specimen Data	Initial	Post Consol.	Post Shear
Height (in)	5.760	5.767	5.643
Diameter (in)	2.919	2.908	
Volume (in^3)	38.532	38.306	
Height/Diameter ratio	1.974	1.983	
Weight (g)	1215.26	1211.56	1211.56
Water Content (%)	30.48	30.09	30.09
Bulk Unit Weight (pcf)	120.2	120.5	120.5
Dry Unit Weight (pcf)	92.1	92.6	92.6
Cross-Sectional Area* (in^2)	6.690	6.643	
% Saturation - Wet Method	100.10	100.10	100.10
Specific Gravity - Assumed	2.68	2.68	2.68
Void Ratio	0.816	0.806	0.806
			Entire Sample
Tare ID			29
Mass wet soil + tare (g)			1363.74
Mass dry soil + tare (g)			1105.55
Mass tare (g)			165.60

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	143.0
Pore Pressure (psi)	91.2
Effective Confining Pressure (psi)	51.8
B-value	0.97

Consolidation Phase

Change in Volume (in^3)	0.226
T_{50} (min)	0.1
Platen Travel Rate (in/min)	0.01974

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	17625.4
Peak P' (psf)	17802.7
Peak Q (psf)	10162.6
Strain at Peak (%)	4.4
σ_3' (psf)	7640.1
σ_1' (psf)	27965.2
σ_3 (psf)	7462.8
σ_1 (psf)	27787.9

Picture of Failure

AECI NMPP - Pond 004
Marston, Missouri

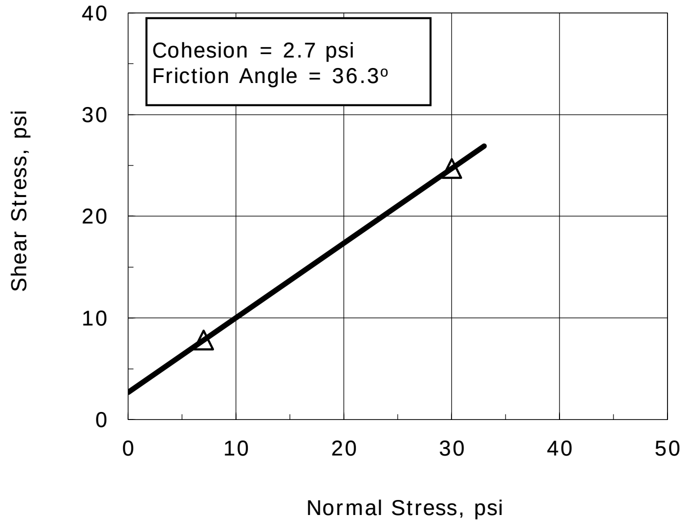
CU TRIAXIAL TEST RESULTS
HA-B16 / U2 / Stage 3

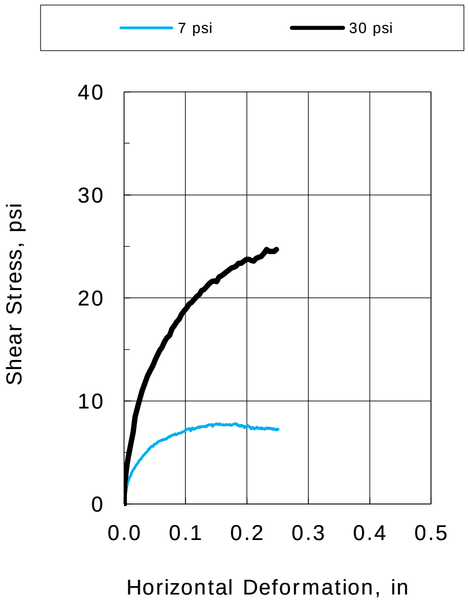
September 2017 41-1-37431-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Client:	Shannon & Wilson, Inc.
Project Name:	AECI NMPP- Pond 004
Project Location:	Marston, MO
GTX #:	300261
Test Date:	8/7/2017
Tested By:	md
Checked By:	jdt
Boring ID:	TP4-3
Sample ID:	Bulk
Depth, ft:	0-10
Visual Description:	Moist, black sand

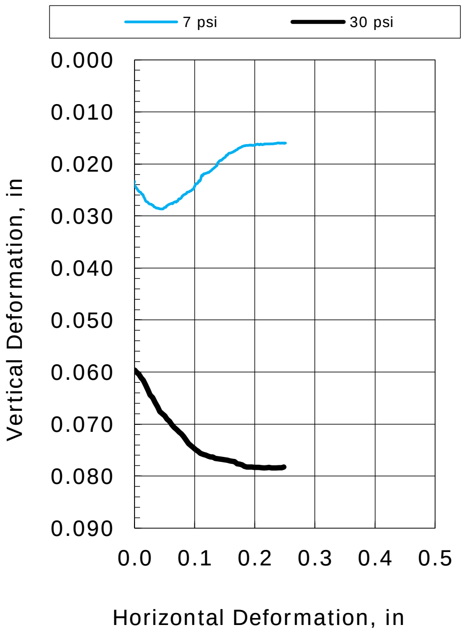
Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D3080





Test No.:	DS-3	DS-4	
Initial Diameter, in:	2.5	2.5	
Initial Height, in:	1.0	1.0	
Initial Mass, grams:	138.9	138.9	
Initial Dry Density, pcf:	98.0	96.8	
Initial Moisture Content, %:	10.0	11.4	
Initial Bulk Density, pcf:	98.0	96.8	
Initial Degree of Saturation:	37.6	41.4	
Initial Void Ratio:	0.72	0.74	
Final Dry Density, pcf:	99.6	105.0	
Final Moisture Content, %:	20.0	21.2	
Final Bulk Density, pcf:	119.4	127.3	
Normal Stress, psi:	7.0	30.0	
Maximum Shear Stress, psi:	7.8	24.7	
Shear Rate, in/min:	0.002	0.002	

Sample Type:	remolded
Estimated Specific Gravity:	2.70
Liquid Limit:	---
Plastic Limit:	---
Plasticity Index:	---
% Passing #200 sieve:	---
Soil Classification:	---
Group Symbol:	---



Notes:

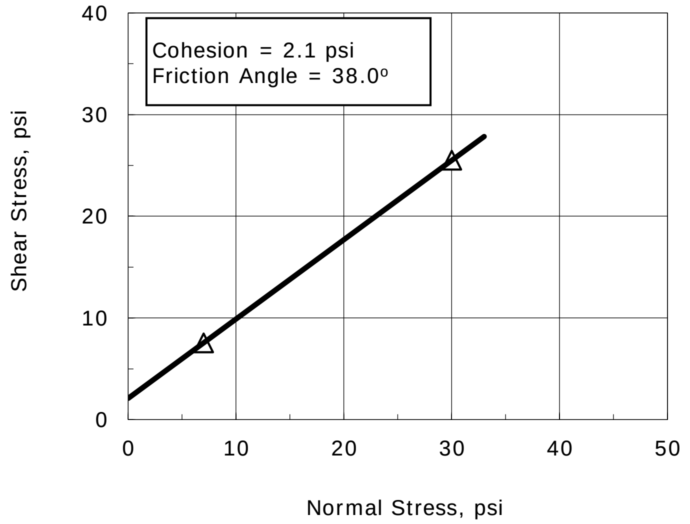
Material greater than #5 sieve screened out of sample prior to testing
Moisture content obtained before shear from sample trimmings.
Moisture Content determined by ASTM D2216

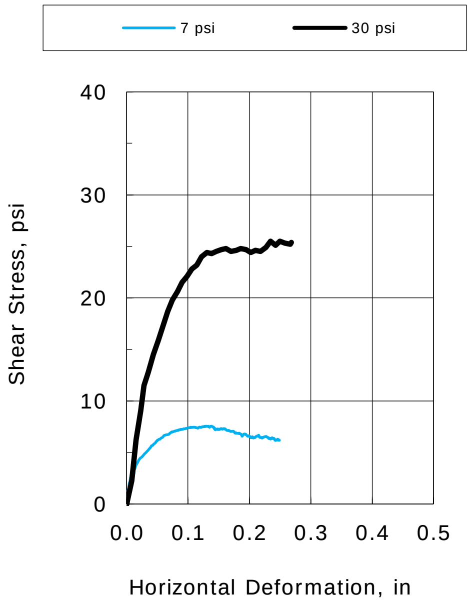
Target Compaction: 98 pcf at 10% moisture content (values specified by client).
Values for cohesion and friction angle determined from best-fit straight line to the data for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site-specific conditions.

"---" indicates testing required to determine these values was not requested.

Client:	Shannon & Wilson, Inc.
Project Name:	AECI NMPP- Pond 004
Project Location:	Marston, MO
GTX #:	300261
Test Date:	8/7/2017
Tested By:	md
Checked By:	jdt
Boring ID:	TP4-3
Sample ID:	Bulk
Depth, ft:	0-10
Visual Description:	Moist, black sand

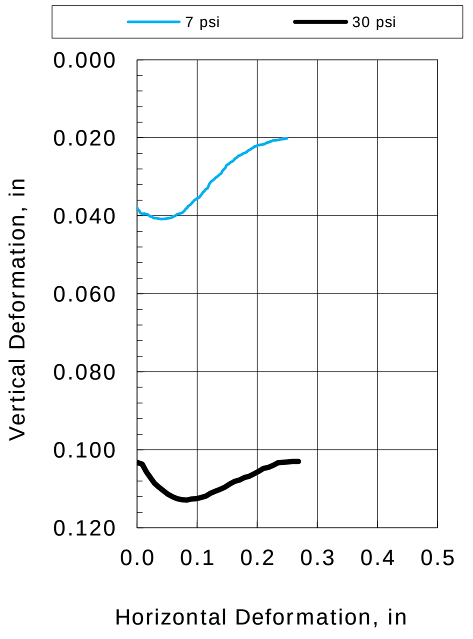
Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D3080





Test No.:	DS-1	DS-2	
Initial Diameter, in:	2.5	2.5	
Initial Height, in:	1.0	1.0	
Initial Mass, grams:	148.8	148.8	
Initial Dry Density, pcf:	105.1	105.1	
Initial Moisture Content, %:	9.9	9.9	
Initial Bulk Density, pcf:	115.5	115.5	
Initial Degree of Saturation:	44.3	44.3	
Initial Void Ratio:	0.60	0.60	
Final Dry Density, pcf:	107.3	117.2	
Final Moisture Content, %:	20.4	19.7	
Final Bulk Density, pcf:	129.1	140.3	
Normal Stress, psi:	7.0	30.0	
Maximum Shear Stress, psi:	7.6	25.5	
Shear Rate, in/min:	0.002	0.002	

Sample Type:	remolded
Estimated Specific Gravity:	2.70
Liquid Limit:	---
Plastic Limit:	---
Plasticity Index:	---
% Passing #200 sieve:	---
Soil Classification:	---
Group Symbol:	---



Notes:

Material greater than #5 sieve screened out of sample prior to testing
Moisture content obtained before shear from sample trimmings.

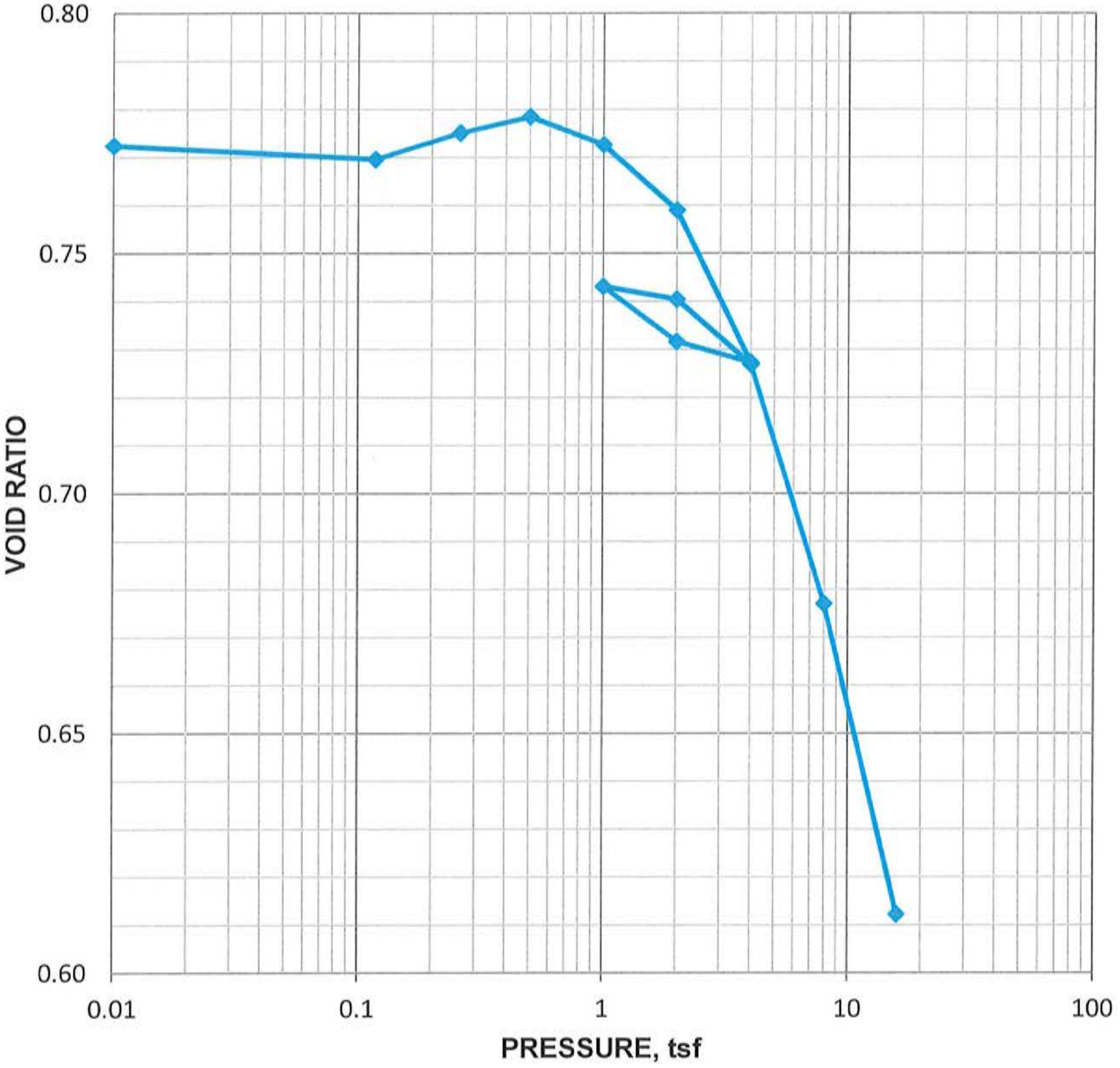
Moisture Content determined by ASTM D2216

Target Compaction: 105 pcf at 10% moisture content (values specified by client).

Values for cohesion and friction angle determined from best-fit straight line to the data for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site-specific conditions.

"---" indicates testing required to determine these values was not requested.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm²/second	Load, tsf	Coefficient of Consolidation, mm²/second
0.117	NA	1.0	NA
0.26	2.1E+00	2.0	NA
0.5	1.1E+00	4.0	NA
1.0	1.5E-01	8.0	1.6E-02
2.0	6.8E-02	16.0	1.3E-02
4.0	3.0E-02		
2.0	NA		

AECI NMPP - Pond 004
Marston, Missouri

VOID RATIO PLOT

HA-B11

U1

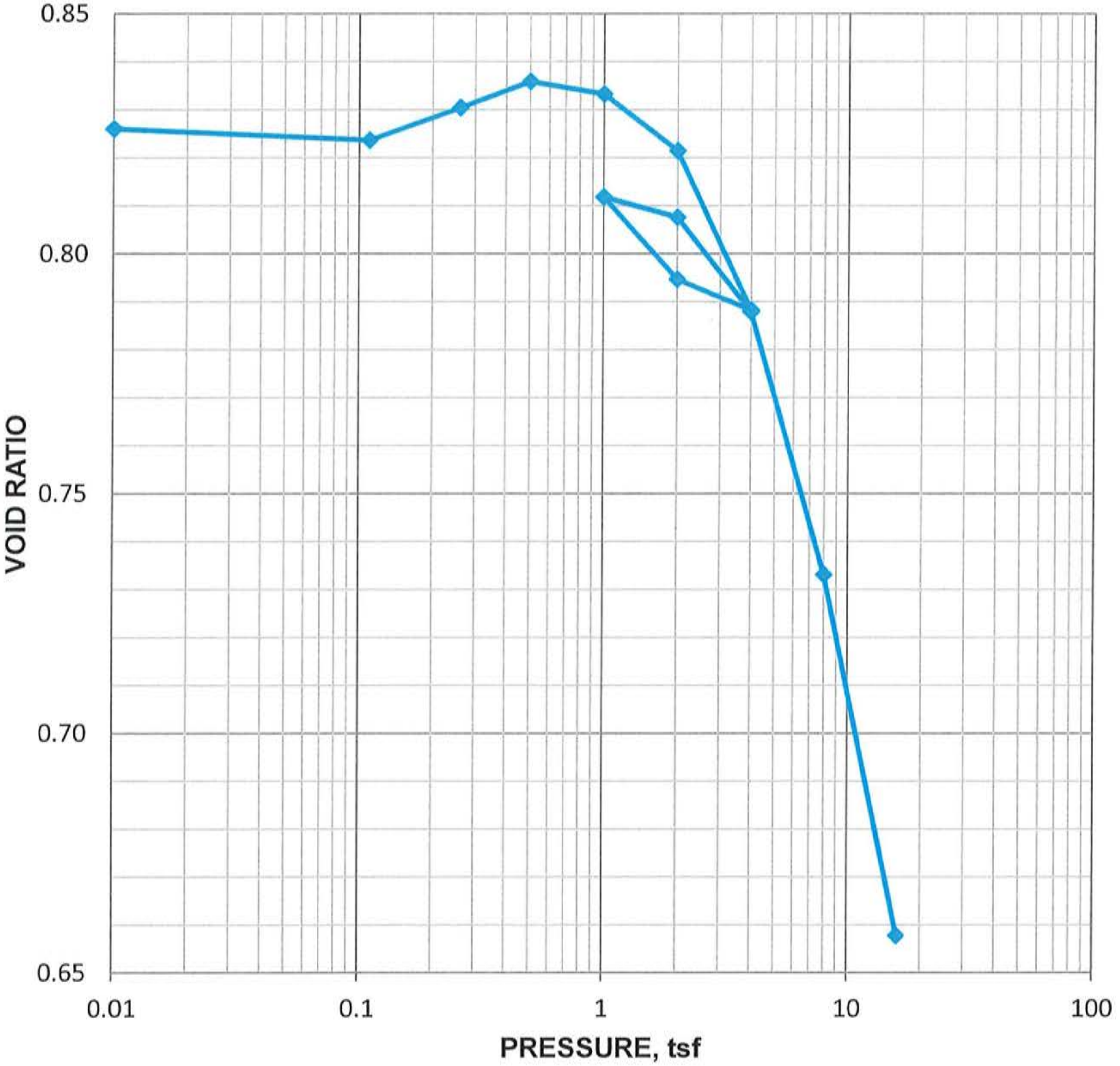
July 2017 41-1-37431-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG.

P:\41-1 STL\37400s\37431\009 AECI Pond 00\Lab\41-1-37431-009 HA-B12 U1 D2435 8/2/2017

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.11	2.1E+00	1.0	NA
0.26	6.6E-02	2.0	NA
0.5	2.1E+00	4.0	NA
1.0	8.8E-02	8.0	6.8E-03
2.0	2.3E-02	16.0	5.4E-03
4.0	1.2E-02		
2.0	NA		

AECI NMPP - Pond 004
Marston, Missouri

VOID RATIO PLOT

HA-B12

U1

July 2017 41-1-37431-009

SHANNON & WILSON, INC.
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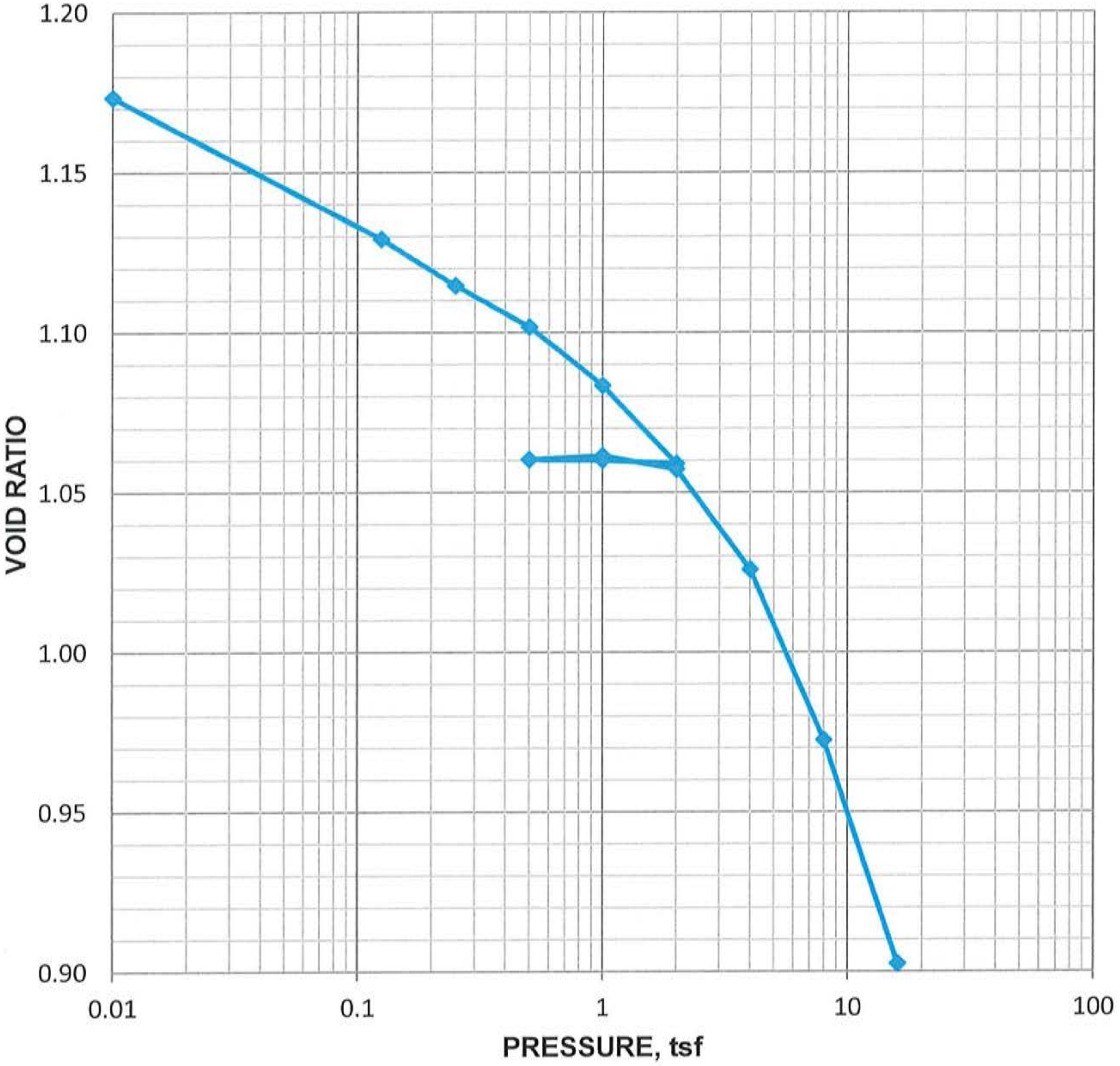
FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.125	1.8E-01	1.0	NA
0.25	2.1E+00	2.0	NA
0.5	2.6E+00	4.0	1.9E+00
1.0	2.3E+00	8.0	1.2E+00
2.0	2.3E+00	16.0	1.0E+00
1.0	NA		
0.5	NA		

AECI NMPP - Pond 004
Marston, Missouri

VOID RATIO PLOT

HA-B16

U1

September 2017 41-1-37431-009

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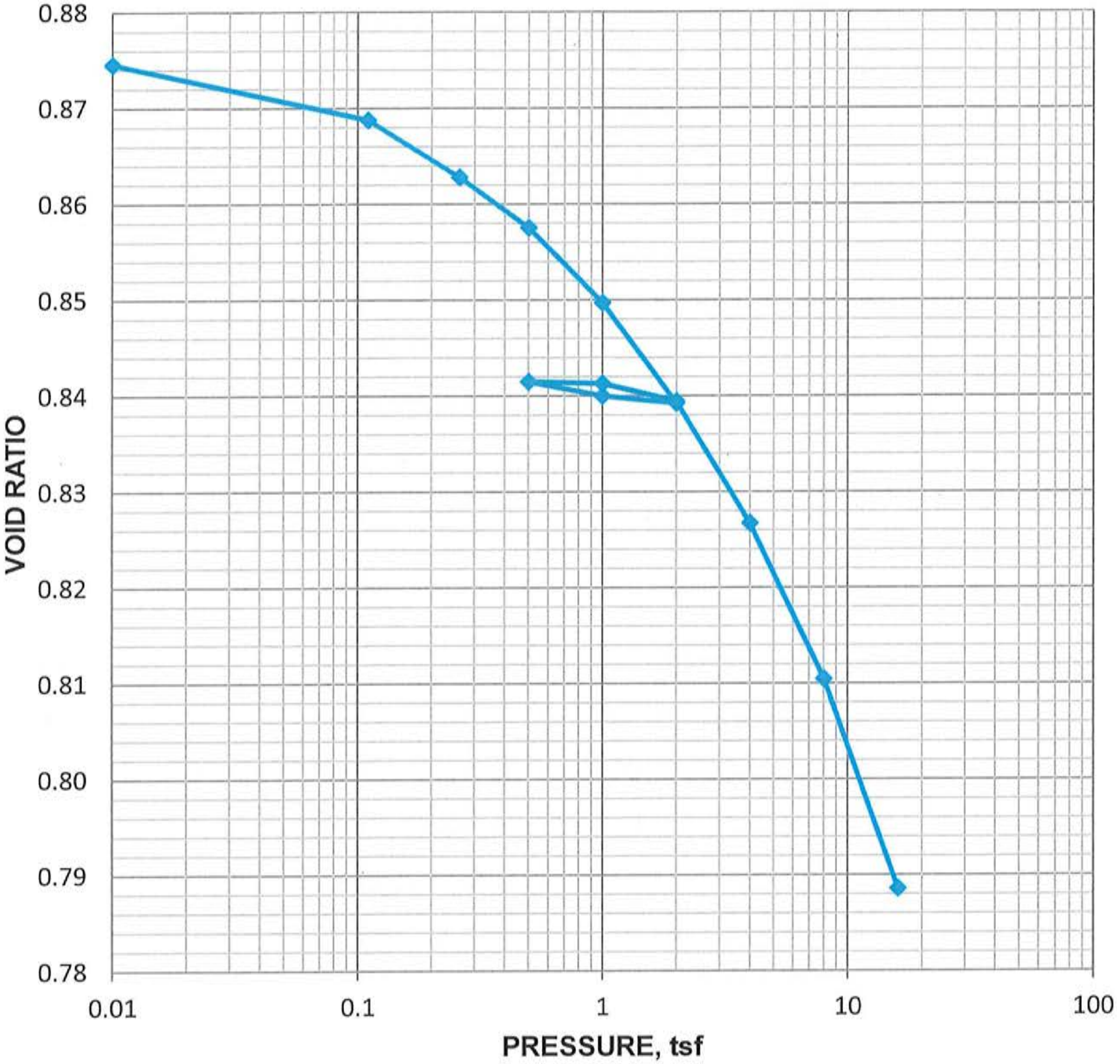
FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.11	1.5E+00	1.0	NA
0.26	2.1E+00	2.0	NA
0.5	2.6E+00	4.0	8.3E-01
1.0	2.0E+00	8.0	6.1E-01
2.0	1.2E+00	16.0	6.6E-01
1.0	NA		
0.5	NA		

AECI NMPP - Pond 004
Marston, Missouri

VOID RATIO PLOT

HA-B16

U2

August 2017 41-1-37431-009

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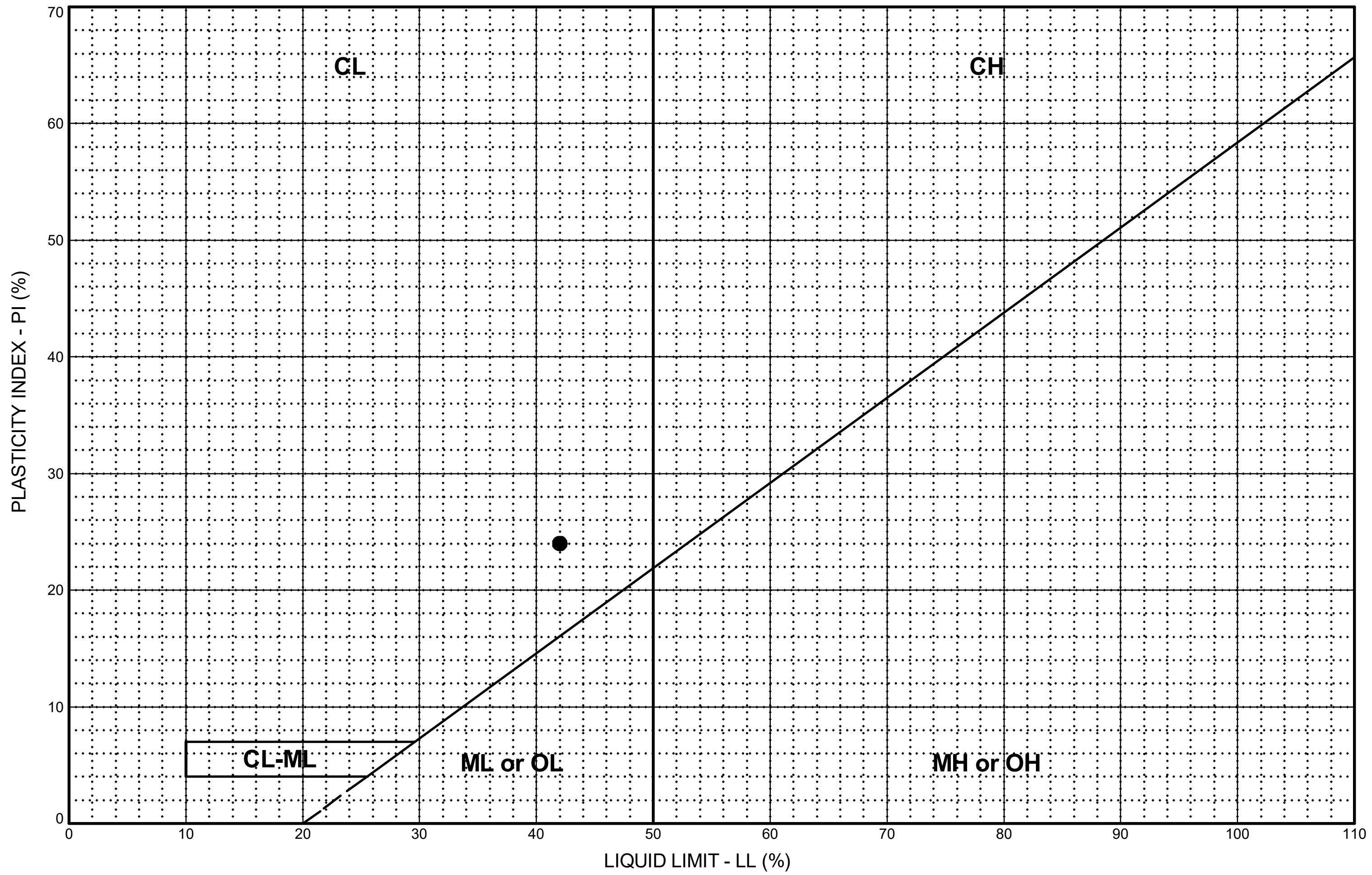
FIG.



LEGEND

CL:	Low plasticity inorganic clays; sandy and silty clays
CH:	High plasticity inorganic clays
ML or OL:	Inorganic and organic silts and clayey silts of low plasticity
MH or OH:	Inorganic and organic silts and clayey silts of high plasticity
CL-ML:	Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● HA-RWP-01OW, U1	10.0 - 12.0	CL	Mottled gray and brown, Lean Clay with Sand.	42	18	24	19.4	83.9

AECI NMPP - Raw Water Pond
Marston, Missouri

PLASTICITY CHART

May 2021 107095-002 / 129342-039

SHANNON & WILSON, INC.
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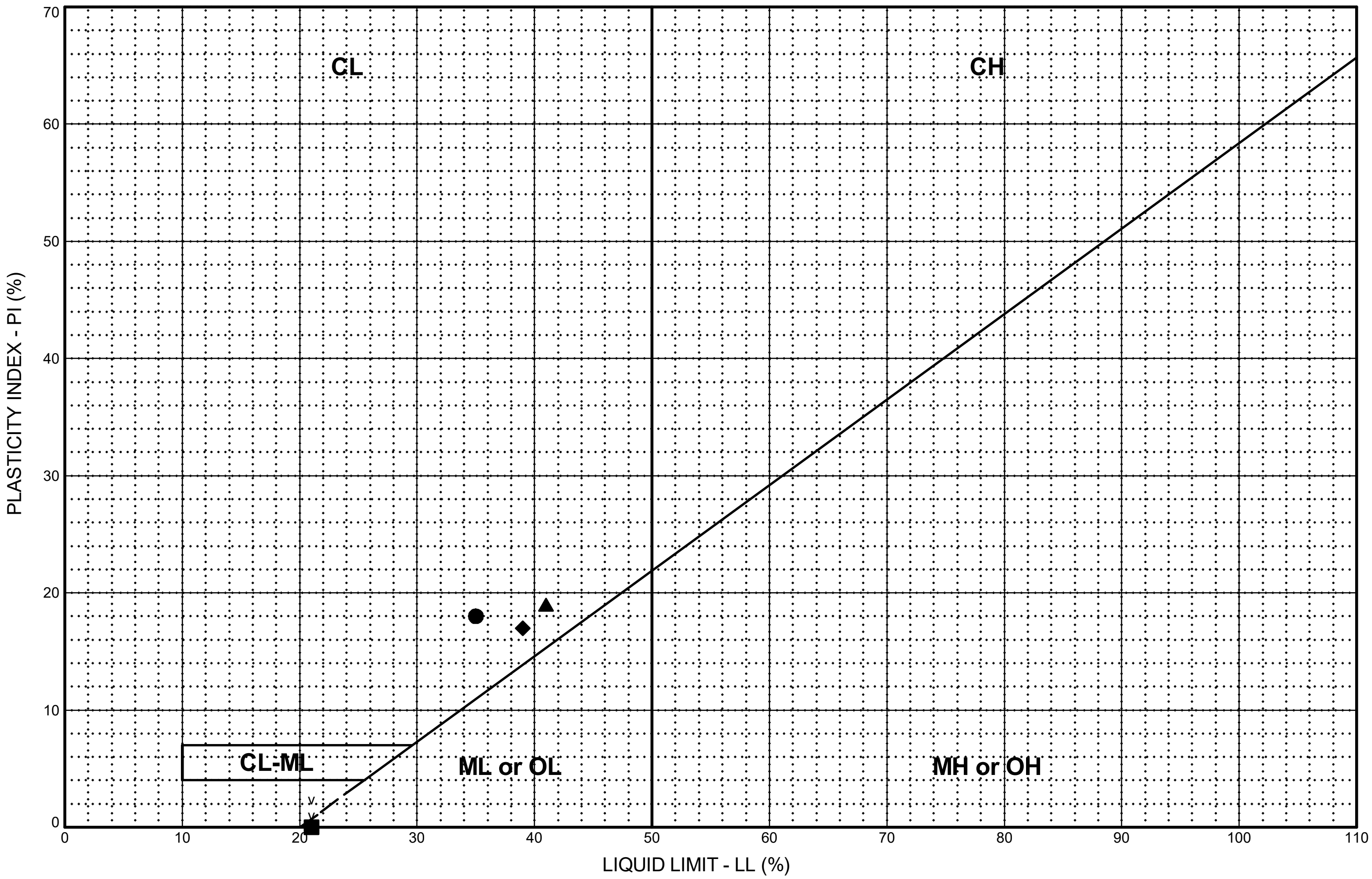
FIG.

FIG.



LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● HA-RWP-02OW, U1	6.0 - 8.0	CL	Dark brown, Sandy Lean Clay.	35	17	18	19.6	64.2
■ HA-RWP-02OW, U2	18.0 - 20.0	ML	Gray, Sandy Silt.	21	22	NP	20.8	60.5
▲ HA-RWP-03, U1	30.0 - 32.0	CL	Mottled dark gray and brown, Lean Clay.	41	22	19	29.5	99.9
◆ HA-RWP-05, U1	12.0 - 14.0	CL	Mottled gray and brown, Lean Clay with Sand.	39	22	17	16.7	82.2

AECI NMPP - Raw Water Pond
Marston, Missouri

PLASTICITY CHART

May 2021
107095-002 / 129342-039

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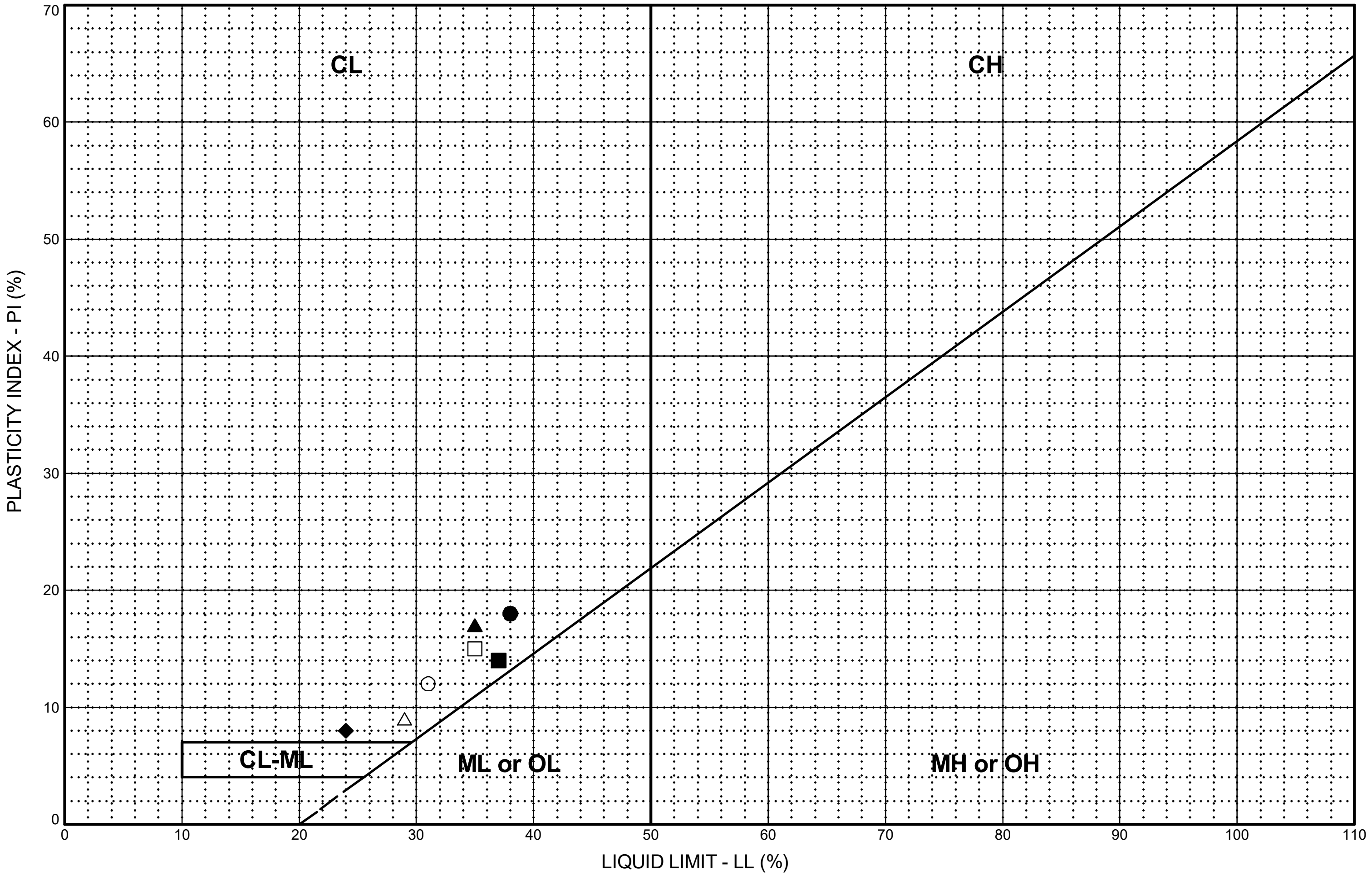
FIG.

FIG.



LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

ATTERBERG - WITH SAMPLE INTERVALS 107095-002 AECI LAB DATA.GPJ SHAN_WIL.GDT 5/7/21

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● GS-1, Bulk	0.0 - 2.0	CL	Dark brown, Lean Clay with Sand.	38	20	18	22.2	73.5
■ GS-2, Bulk	0.0 - 2.0	CL	Dark brown, Lean Clay with Sand.	37	23	14	22.2	82.0
▲ GS-3, Bulk	0.0 - 2.0	CL	Dark brown, Lean Clay with Sand.	35	18	17	20.1	76.5
◆ GS-4, Bulk	0.0 - 2.0	CL	Dark brown, Sandy Lean Clay.	24	16	8	18.4	62.7
○ GS-5, Bulk	0.0 - 2.0	CL	Dark brown, Sandy Lean Clay.	31	19	12	18.4	61.8
□ GS-6, Bulk	0.0 - 2.0	CL	Dark brown, Lean Clay.	35	20	15	22.9	89.4
△ HA-RWP-01OW, U2	22.0 - 24.0	CL	Dark brown, Sandy Lean Clay.	29	20	9	25.3	65.4

AECI NMPP - Raw Water Pond
Marston, Missouri

PLASTICITY CHART

May 2021 107095-002 / 129342-039

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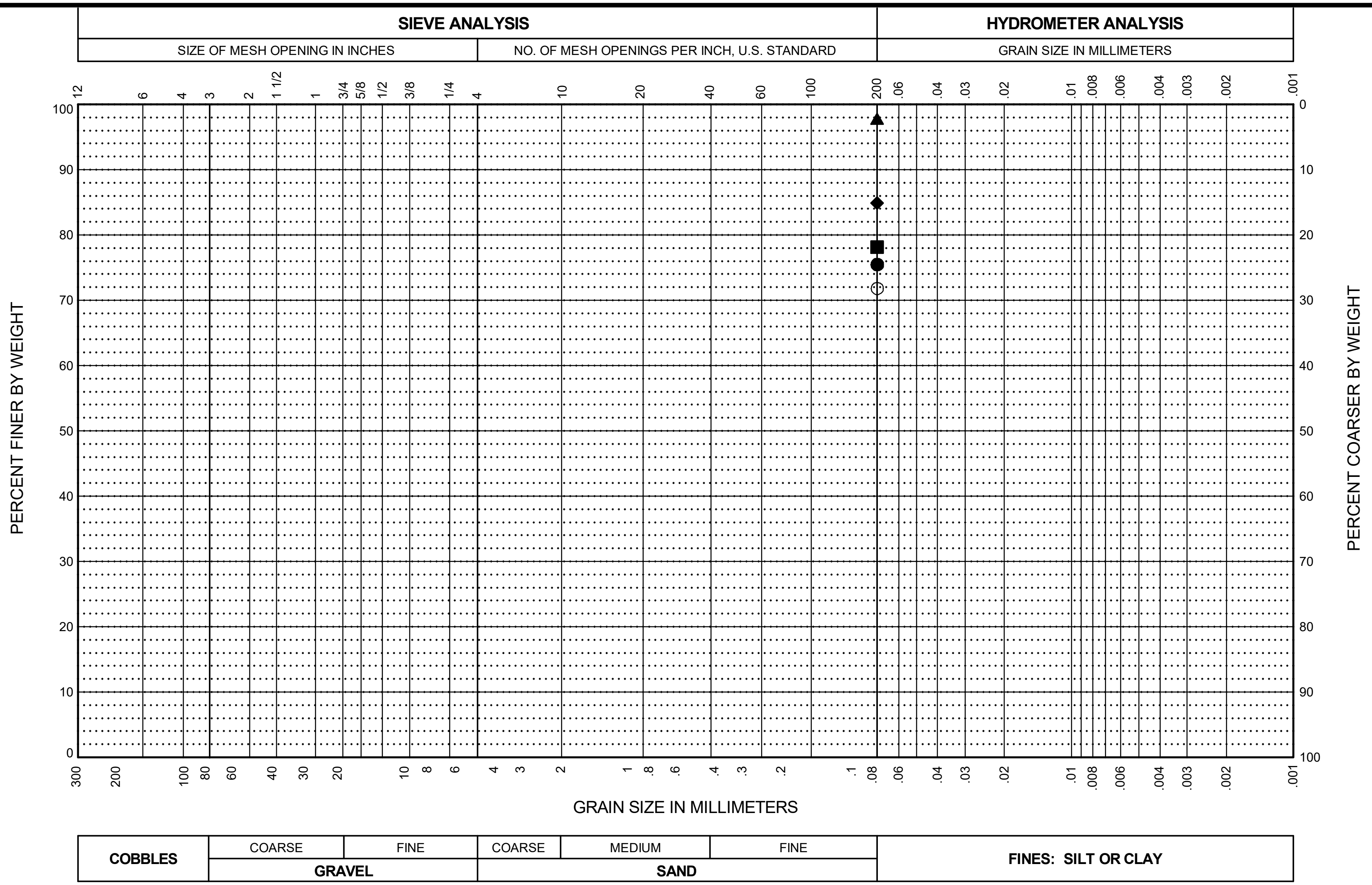
FIG.

FIG.



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-RWP-03, S-5	8.0 - 10.0	CL	Dark gray, Lean Clay with Sand.	75.5	20.4			
■ HA-RWP-04, S-4	6.0 - 8.0	CL	Mottled gray and brown, Lean Clay with Sand.	78.2	20.1			
▲ HA-RWP-06OW, S-5	8.0 - 10.0	CL	Dark brown, Lean Clay.	97.8	21.8			
◆ HA-RWP-06OW, S-13	28.0 - 30.0	CL	Olive-brown, Lean Clay with Sand.	84.9	29.4			
○ HA-RWP-08, S-4	6.0 - 8.0	CL	Olive-brown, Lean Clay with Sand.	71.8	18.6			

AECI NMPP - Raw Water Pond
Marston, Missouri

GRAIN SIZE DISTRIBUTION

May 2021 107095-002 / 129342-039

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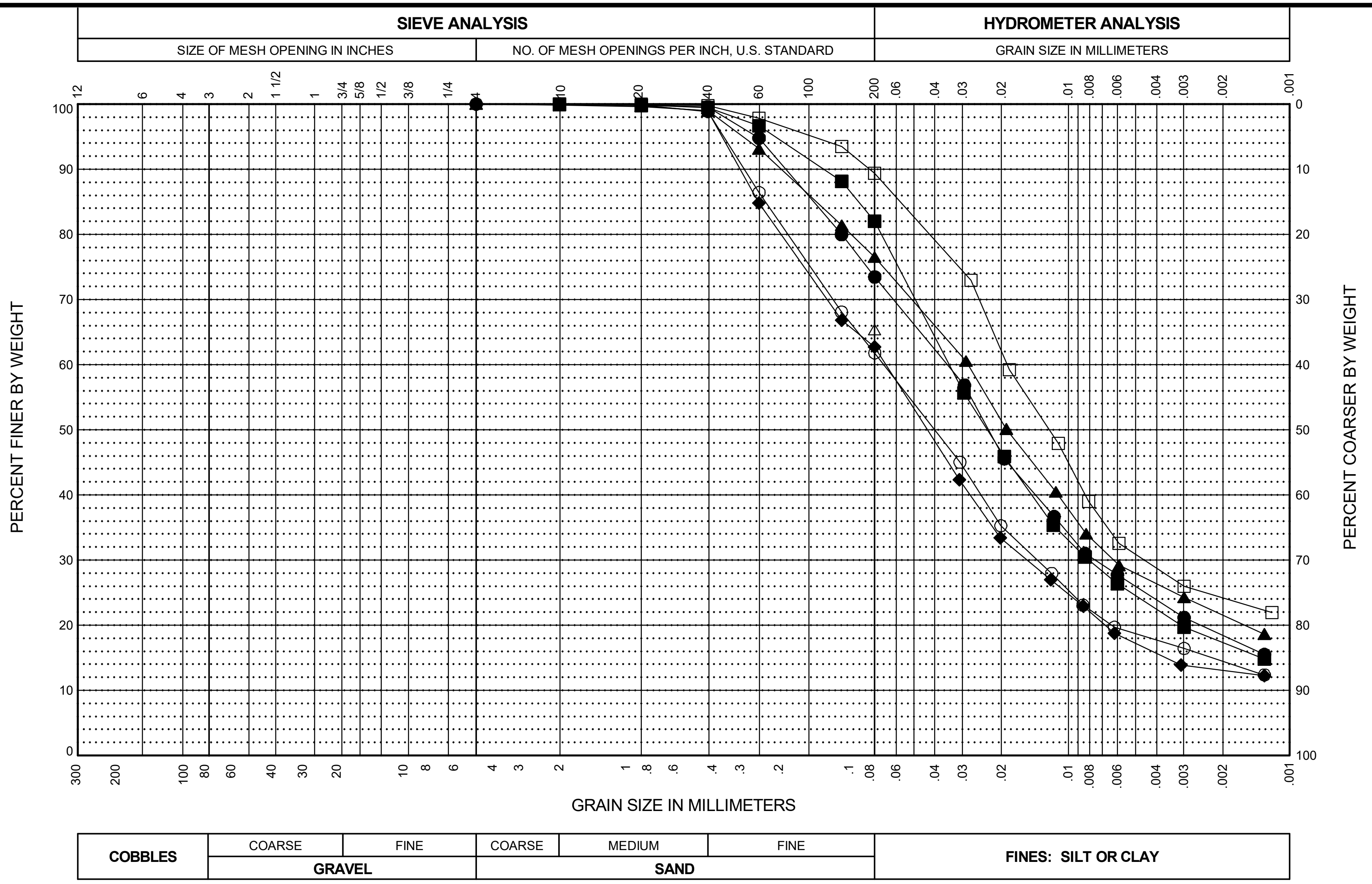
FIG.

GSA- WITH SAMPLE INTERVALS 107095-002 AECI LAB DATA.GPJ SHAN_WIL.GDT 5/27/21



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● GS-1, Bulk	0.0 - 2.0	CL	Dark brown, Lean Clay with Sand.	73.5	22.2	38	20	18
■ GS-2, Bulk	0.0 - 2.0	CL	Dark brown, Lean Clay with Sand.	82.0	22.2	37	23	14
▲ GS-3, Bulk	0.0 - 2.0	CL	Dark brown, Lean Clay with Sand.	76.5	20.1	35	18	17
◆ GS-4, Bulk	0.0 - 2.0	CL	Dark brown, Sandy Lean Clay.	62.7	18.4	24	16	8
○ GS-5, Bulk	0.0 - 2.0	CL	Dark brown, Sandy Lean Clay.	61.8	18.4	31	19	12
□ GS-6, Bulk	0.0 - 2.0	CL	Dark brown, Lean Clay.	89.4	22.9	35	20	15
△ HA-RWP-01OW, U2	22.0 - 24.0	CL	Dark brown, Sandy Lean Clay.	65.4	25.3	29	20	9

AECI NMPP - Raw Water Pond
Marston, Missouri

GRAIN SIZE DISTRIBUTION

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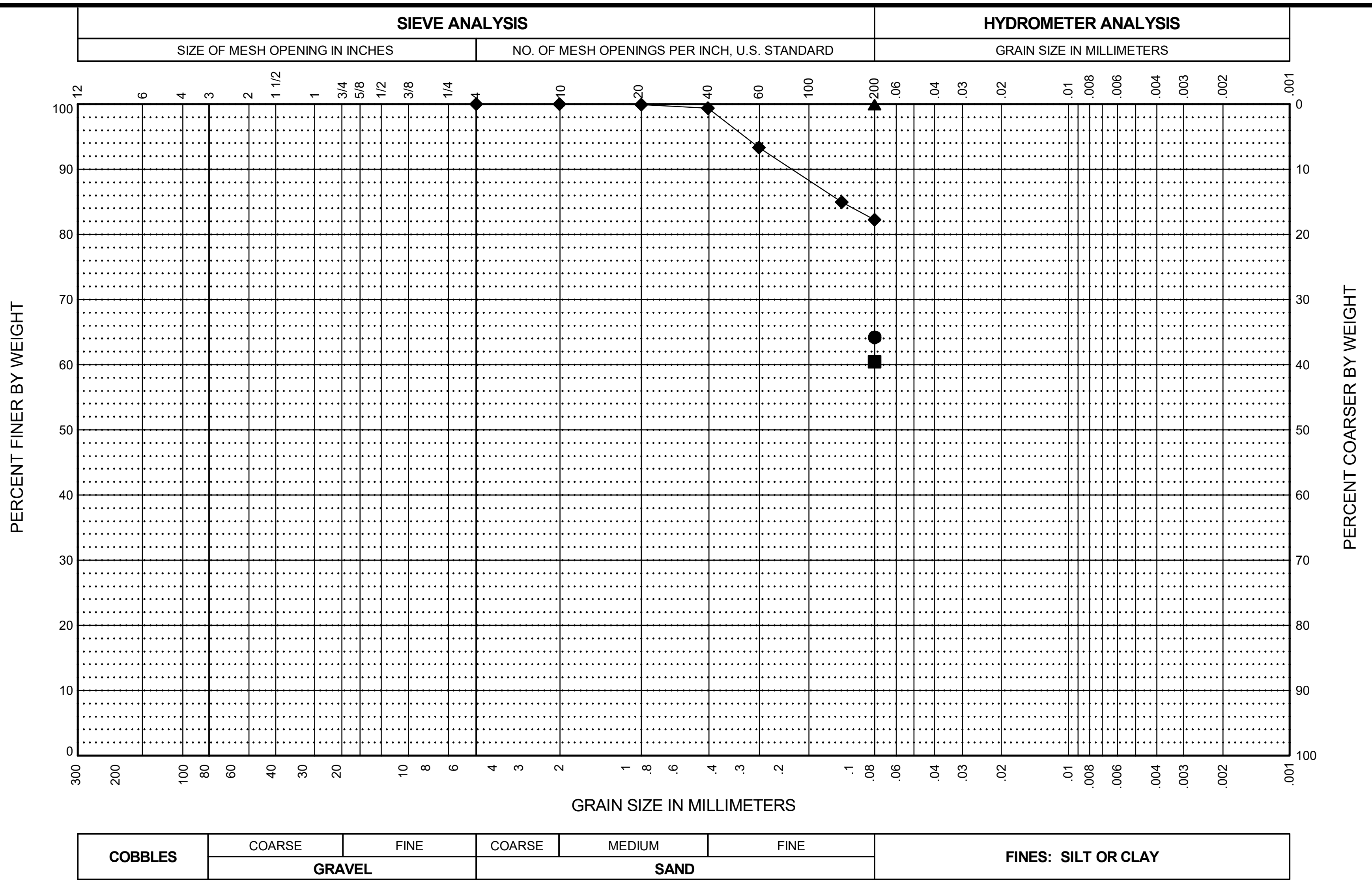
FIG.

GSA- WITH SAMPLE INTERVALS 107095-002 AECI LAB DATA.GPJ SHAN_WIL.GDT 5/7/21



GSA- WITH SAMPLE INTERVALS 107095-002 AECI LAB DATA.GPJ SHAN_WIL.GDT 5/7/21

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-RWP-02OW, U1	6.0 - 8.0	CL	Dark brown, Sandy Lean Clay.	64.2	19.6	35	17	18
■ HA-RWP-02OW, U2	18.0 - 20.0	ML	Gray, Sandy Silt.	60.5	20.8	21	22	NP
▲ HA-RWP-03, U1	30.0 - 32.0	CL	Mottled dark gray and brown, Lean Clay.	99.9	29.5	41	22	19
◆ HA-RWP-05, U1	12.0 - 14.0	CL	Mottled gray and brown, Lean Clay with Sand.	82.2	16.7	39	22	17

AECI NMPP - Raw Water Pond
Marston, Missouri

GRAIN SIZE DISTRIBUTION

May 2021 107095-002 / 129342-039

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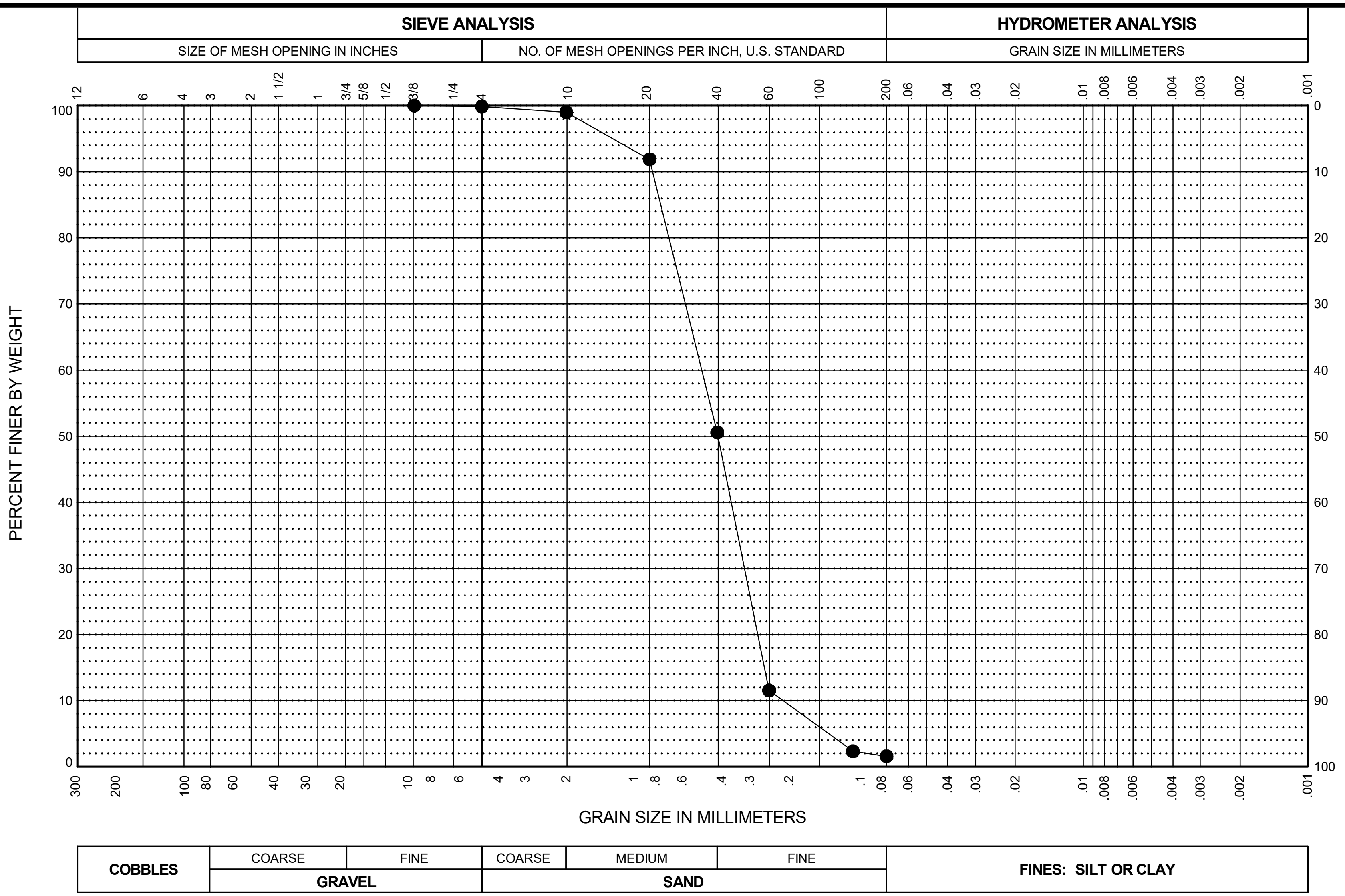
FIG.



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-RWP-02OW, S-12	38.0 - 40.0	SP	Yellow-brown, Poorly Graded Sand.	1.6	19.6			

AECI NMPP - Raw Water Pond
Marston, Missouri

GRAIN SIZE DISTRIBUTION

May 2021 107095-002 / 129342-039

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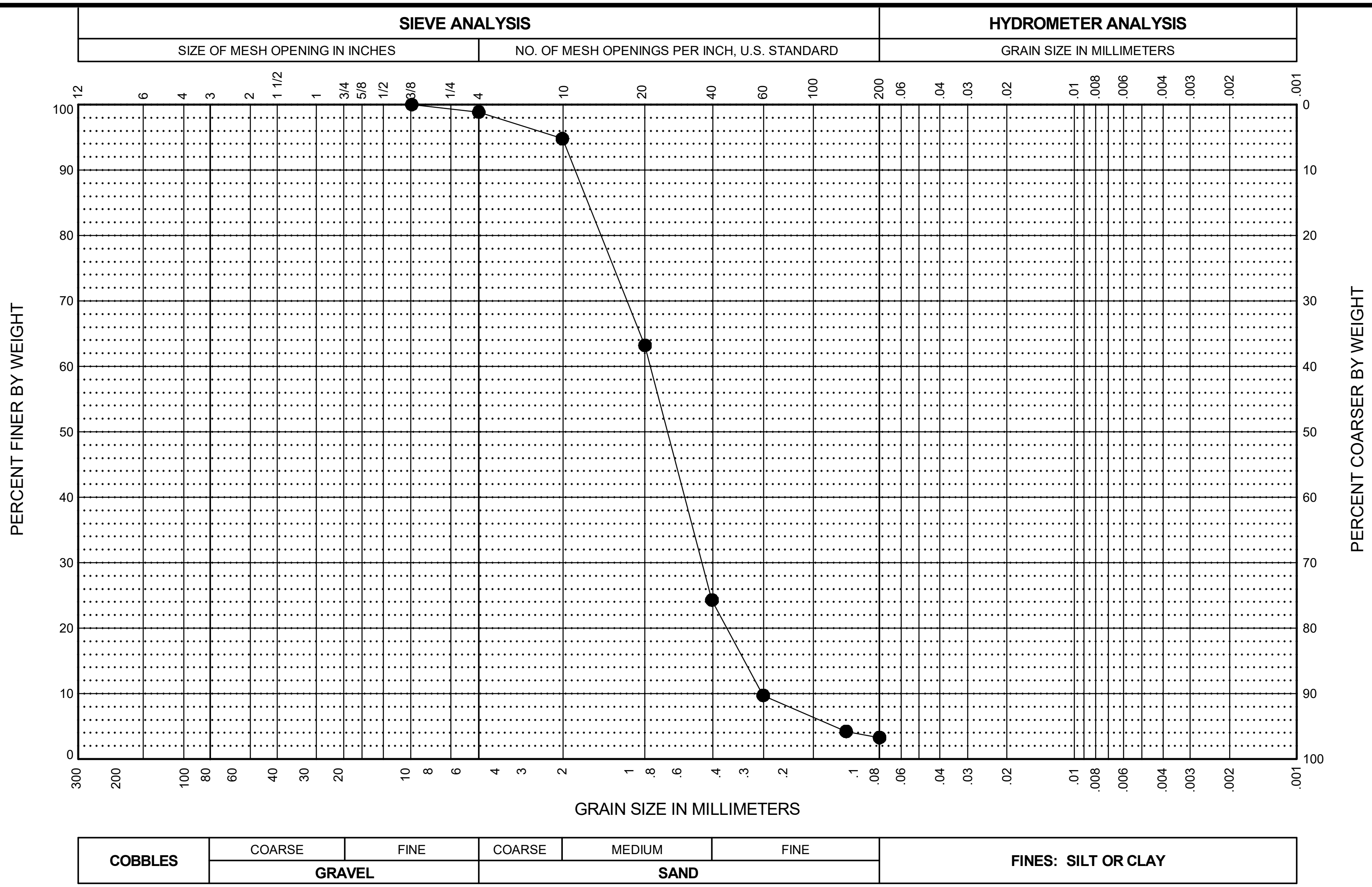
FIG.

GSA- WITH SAMPLE INTERVALS 107095-002 AECI LAB DATA.GPJ SHAN_WIL.GDT 5/27/21



GSA- WITH SAMPLE INTERVALS 107095-002 AECI LAB DATA.GPJ SHAN_WIL.GDT 5/27/21

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-RWP-03, S-20	63.0 - 65.0	SP	Yellow-brown, Poorly Graded Sand.	3.3	15.7			

AECI NMPP - Raw Water Pond
Marston, Missouri

GRAIN SIZE DISTRIBUTION

May 2021 107095-002 / 129342-039

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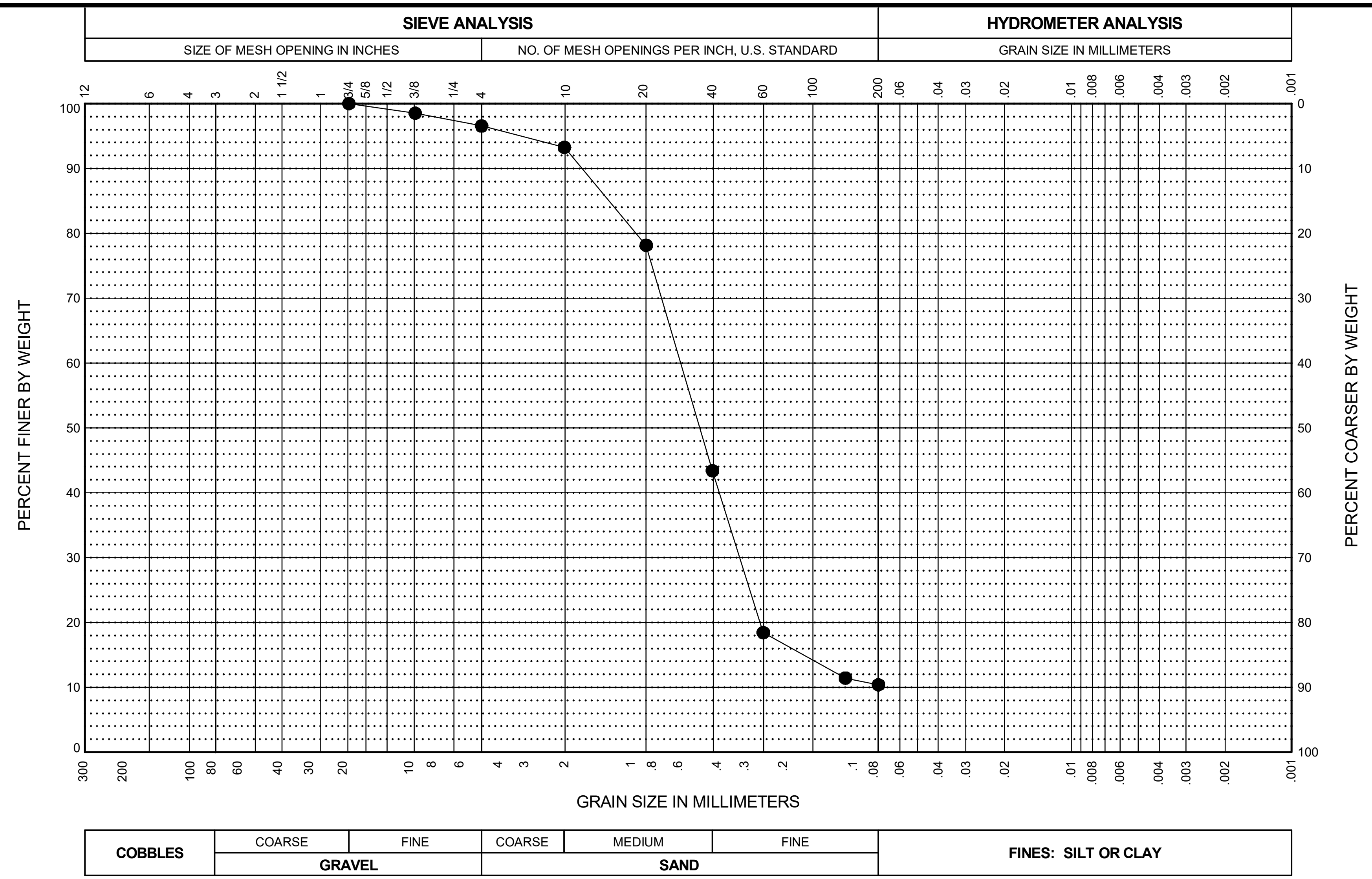
FIG.



GSA- WITH SAMPLE INTERVALS 107095-002 AECI LAB DATA.GPJ SHAN_WIL.GDT 5/27/21

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-RWP-04, S-15	43.0 - 45.0	SP-SM	Yellow-brown, Poorly Graded Sand with Silt.	10.4	15.2			

AECI NMPP - Raw Water Pond
Marston, Missouri

GRAIN SIZE DISTRIBUTION

May 2021 107095-002 / 129342-039

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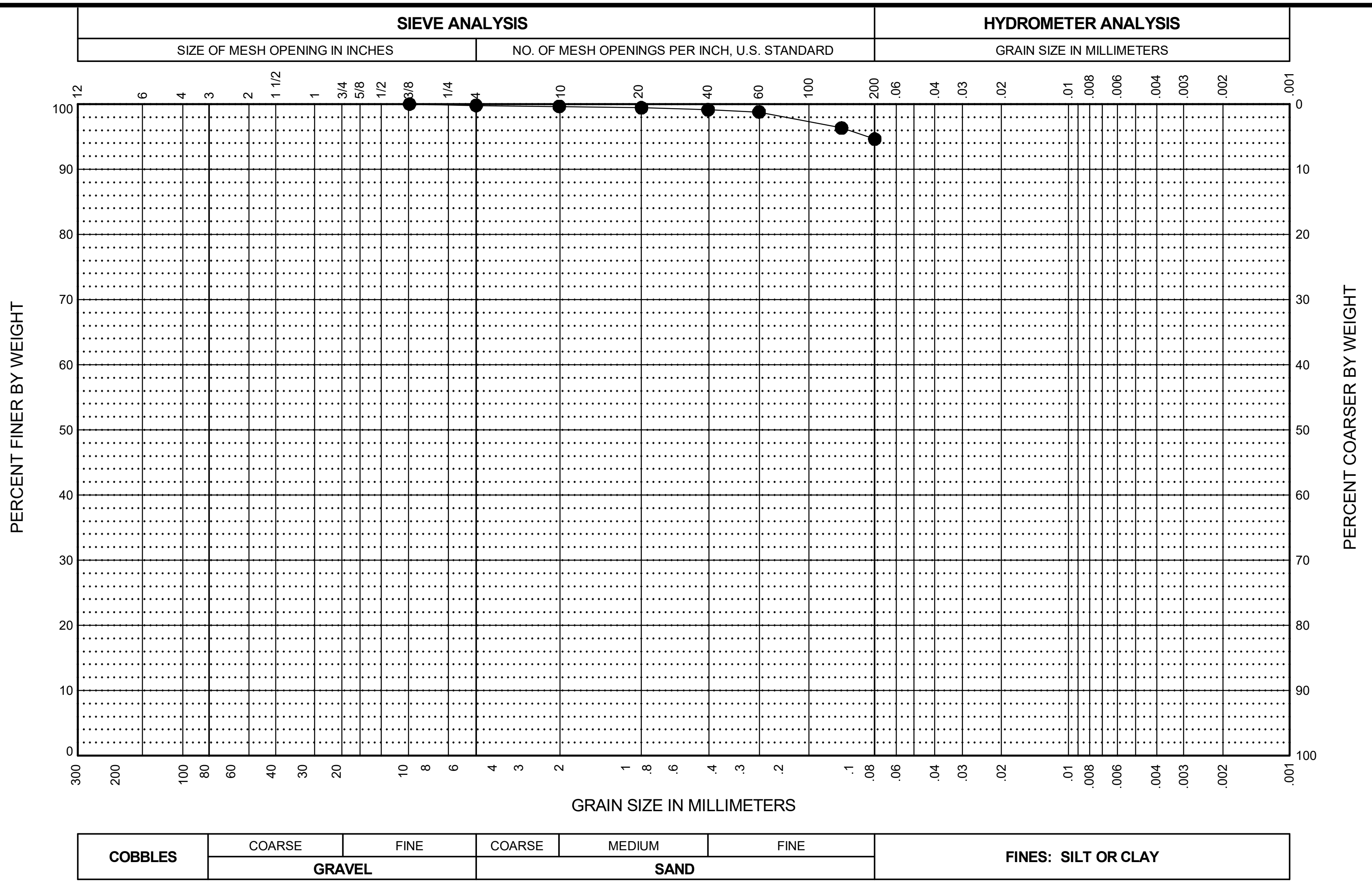
FIG.



GSA- WITH SAMPLE INTERVALS 107095-002 AECI LAB DATA.GPJ SHAN_WIL.GDT 5/27/21

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-RWP-07, S-4	8.0 - 10.0	CL	Mottled gray and brown, Lean Clay.	94.6	29.6			

AECI NMPP - Raw Water Pond
Marston, Missouri

GRAIN SIZE DISTRIBUTION

May 2021 107095-002 / 129342-039

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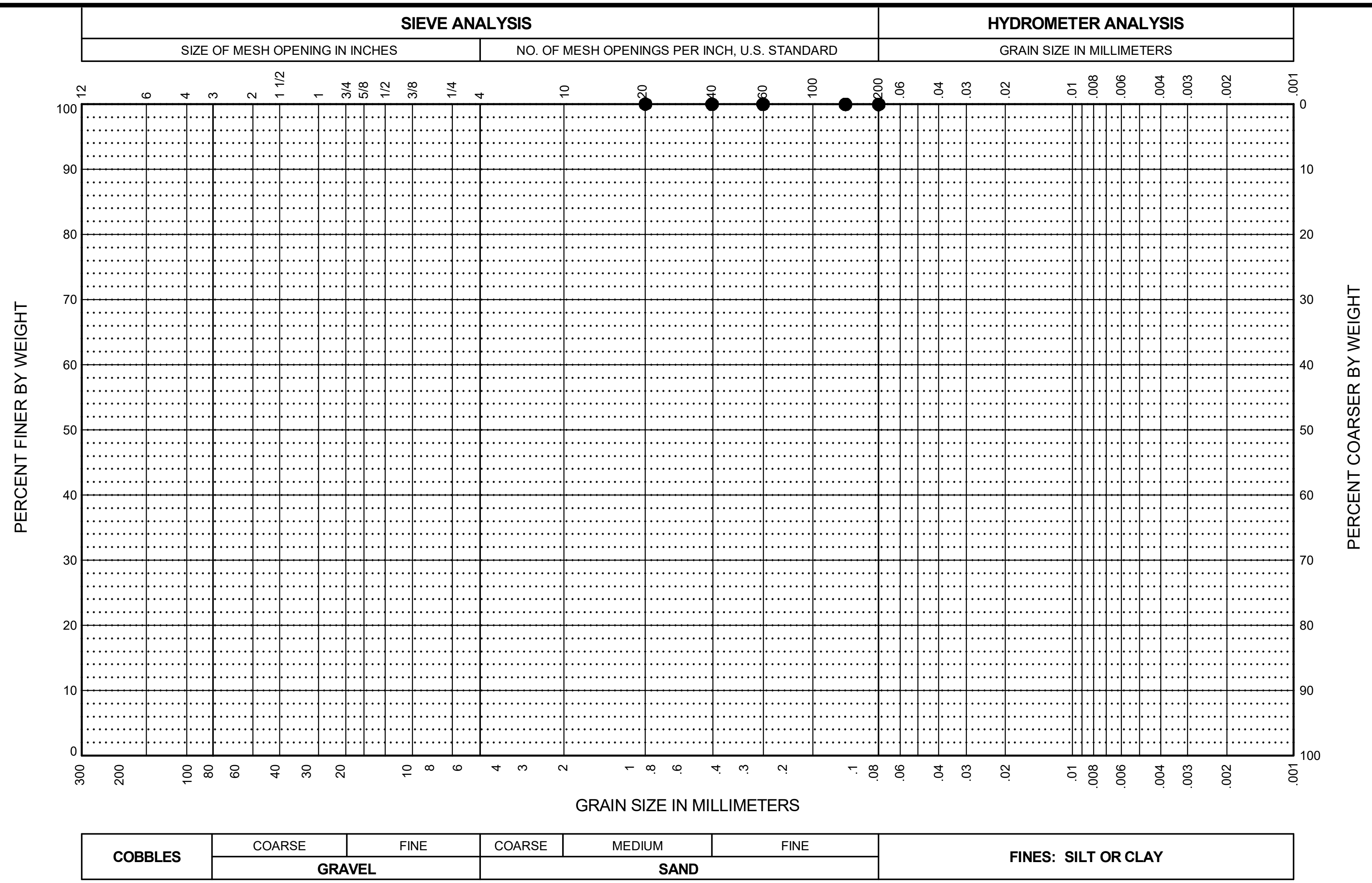
FIG.



GSA- WITH SAMPLE INTERVALS 107095-002 AECI LAB DATA.GPJ SHAN_WIL.GDT 5/27/21

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-RWP-07, S-11	33.0 - 35.0	CL	Brown, Lean Clay.	99.9	34.3			

AECI NMPP - Raw Water Pond
Marston, Missouri

GRAIN SIZE DISTRIBUTION

May 2021 107095-002 / 129342-039

SHANNON & WILSON, INC.
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FIG.

DRY DENSITY
ASTM D7263

Project	AECI NMPP - Raw Water Pond	Client	Haley & Aldrich, Inc.	
Location	Marston, Missouri	Tested By / Date	CMB	4/27-28/21
Job No.	107095-002	Calculated By / Date	CMB	04/29/21
File	107095-002 D7263	Checked By / Date	CMB	04/29/21

Sample Boring	HA-RWP-01OW	HA-RWP-03	HA-RWP-05	HA-RWP-02OW
Sample Number	U2	U1	U1	U1
Sample Depth	23.3	30.7	13.1	7.0
Height (in)	5.986	5.981	5.992	5.999
Diameter (in)	2.876	2.833	2.877	2.881
Weight (gms)	1210.48	1190.59	1306.08	1322.03
Tare ID	108	113	28	103
Tare weight (gms)	81.07	82.49	159.67	81.42
Wet Weight (gms)	346.30	244.70	482.99	249.15
Dry Weight (gms)	292.81	207.78	436.62	221.67
Moisture %	25.3	29.5	16.7	19.6
Area (in^2)	6.50	6.30	6.50	6.52
Volume (in)	38.89	37.70	38.95	39.11
Volume (ft)	0.02	0.02	0.02	0.02
Volume (cm)	637.25	617.82	638.33	640.85
Wet Density (pcf)	118.6	120.3	127.7	128.8
Dry Density (pcf)	94.7	92.9	109.4	107.7

Sample Boring	HA-RWP-02OW			
Sample Number	U2			
Sample Depth	18.8			
Height (in)	5.997			
Diameter (in)	2.856			
Weight (gms)	1205.53			
Tare ID	94			
Tare weight (gms)	83.21			
Wet Weight (gms)	255.40			
Dry Weight (gms)	225.75			
Moisture %	20.8			
Area squared	6.41			
Volume (in)	38.42			
Volume (ft)	0.02			
Volume (cm)	629.57			
Wet Density (pcf)	119.54			
Dry Density (pcf)	99.0			

DRY DENSITY
ASTM D7263

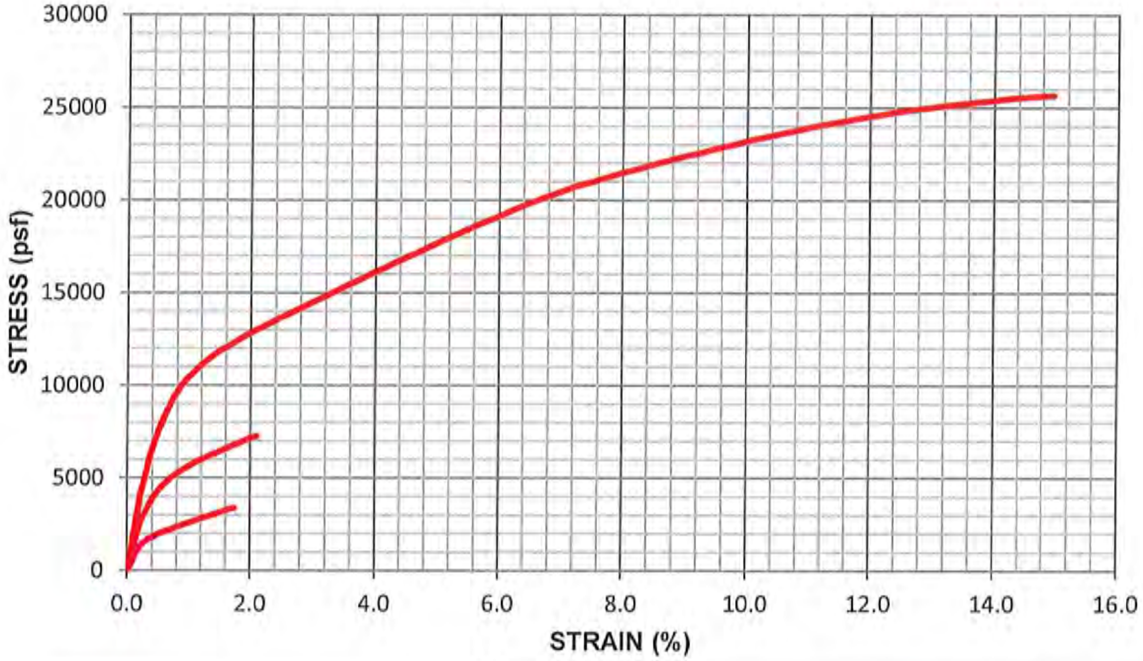
Project	AECI NMPP - Raw Water Pond	Client	Haley & Aldrich, Inc.	
Location	Marston, Missouri	Tested By / Date	CMB	05/25/21
Job No.	107095-002	Calculated By / Date	CMB	05/26/21
File	107095-002 D7263	Checked By / Date	CMB	05/26/21

Sample Boring	HA-RWP-01OW			
Sample Number	U1			
Sample Depth	11.3			
Height (in)	6.004			
Diameter (in)	2.871			
Weight (gms)	1302.05			
Tare ID	TJ			
Tare weight (gms)	83.27			
Wet Weight (gms)	201.50			
Dry Weight (gms)	182.29			
Moisture %	19.4			
Area (in^2)	6.47	0.00	0.00	0.00
Volume (in)	38.87	0.00	0.00	0.00
Volume (ft)	0.02	0.00	0.00	0.00
Volume (cm)	636.94	0.00	0.00	0.00
Wet Density (pcf)	127.6	#DIV/0!	#DIV/0!	#DIV/0!
Dry Density (pcf)	106.9	#DIV/0!	#DIV/0!	#DIV/0!

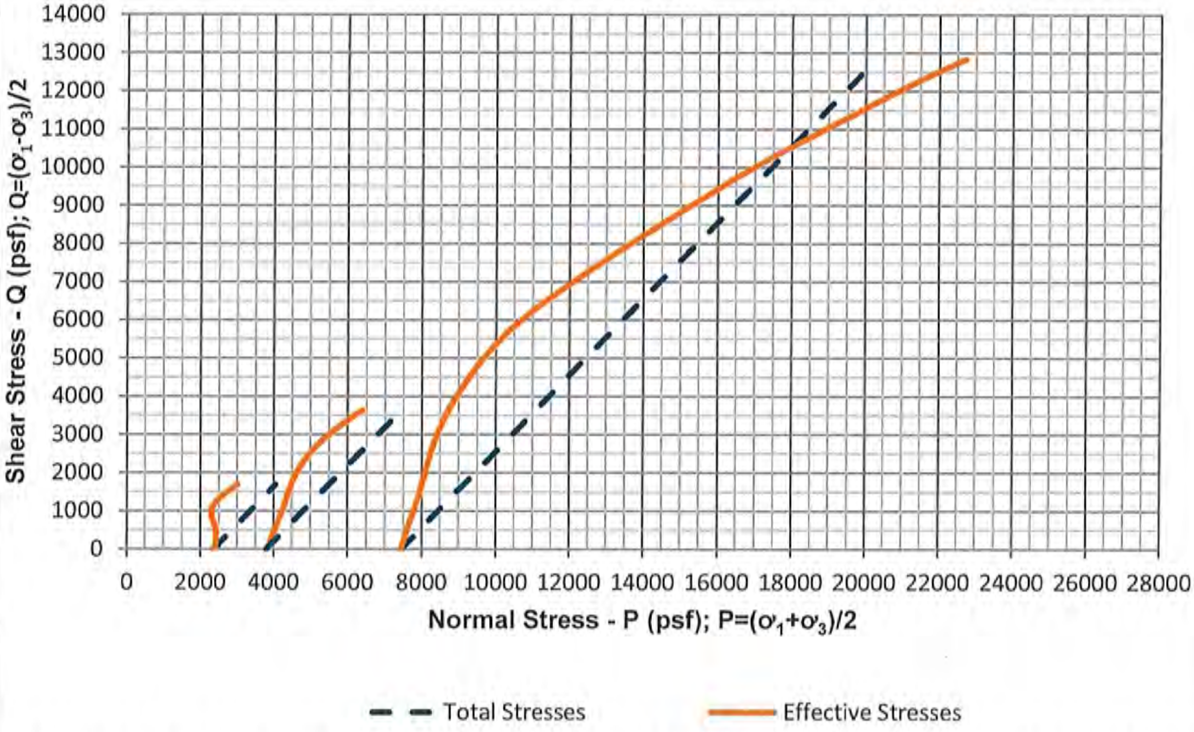
Sample Boring				
Sample Number				
Sample Depth				
Height (in)				
Diameter (in)				
Weight (gms)				
Tare ID				
Tare weight (gms)				
Wet Weight (gms)				
Dry Weight (gms)				
Moisture %				
Area squared	0.00			
Volume (in)	0.00			
Volume (ft)	0.00			
Volume (cm)	0.00			
Wet Density (pcf)	#DIV/0!			
Dry Density (pcf)	#DIV/0!			

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST WITH PORE PRESSURE MEASUREMENT

STRESS - STRAIN



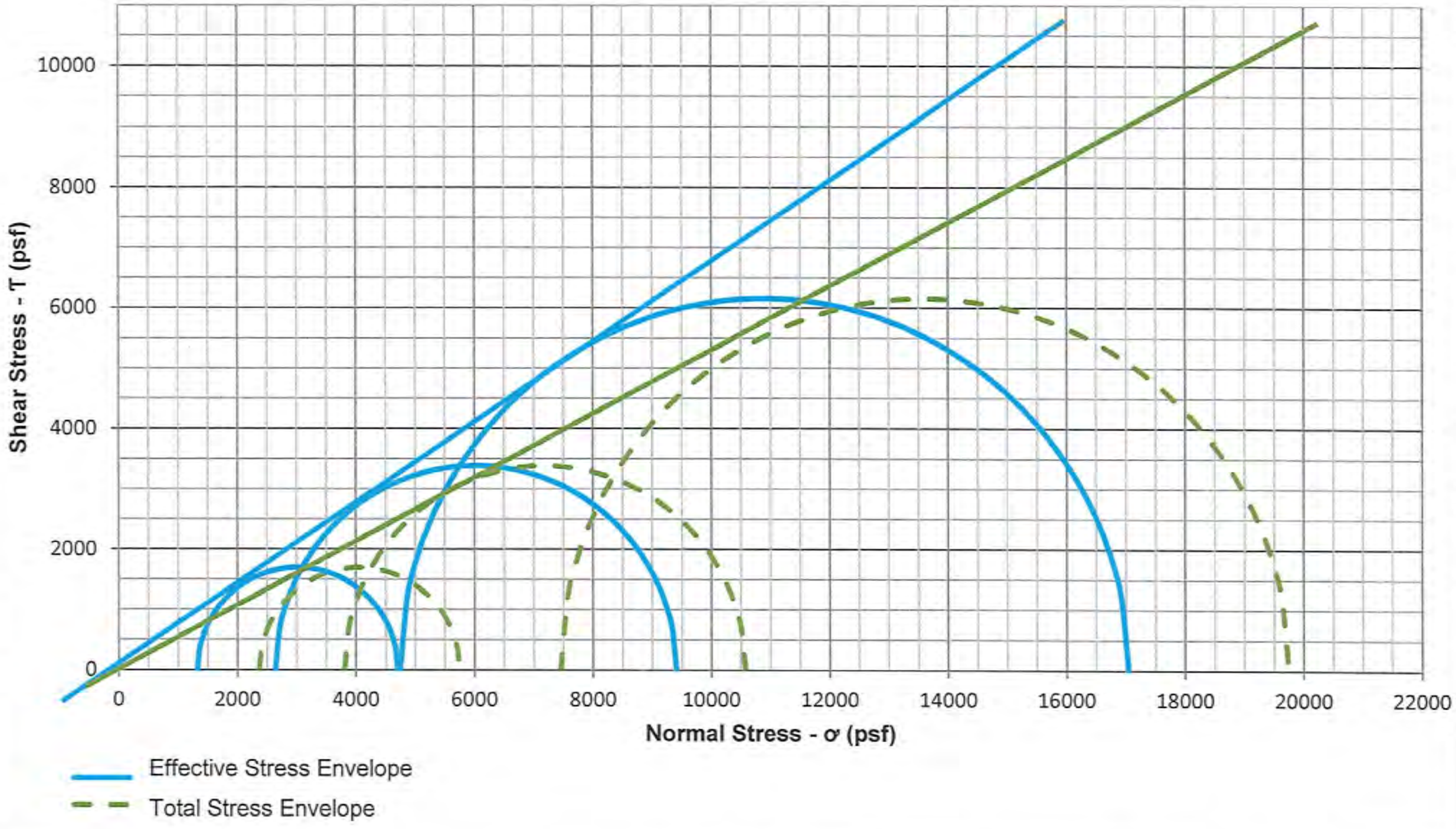
P-Q PLOT



SHANNON & WILSON, INC.
2043 WESTPORT CENTER DR.
SAINT LOUIS, MISSOURI 63146
107095-002

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
AECI NMPP - Raw Water Pond
Marston, Missouri
HA-RWP-01 / U2 / 23.3

Mohr's Circle Plots Corresponding to the Peak Principal Stress Ratio



Sample	Strain (%)
Stage 1	1.7
Stage 2	1.7
Stage 3	1.7

c =	0 psf
ϕ =	28.0 deg
c' =	0 psf
ϕ' =	34.0 deg

NOTES:

1. Mohr's circles in this plot are based upon the principal stress difference at the same strain during loading.
2. Strength parameters determined by Shannon & Wilson. Engineer-of-Record should evaluate cohesion and friction commensurate with project conditions.

AECI NMPP - Raw Water Pond
Marston, Missouri

Mohr's Circle Plots
HA-RWP-01 / U2

May 2021
107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Figure 1

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - Raw Water Pond					
Location	Marston, Missouri			Client	Haley & Aldrich, Inc.	
Job No.	107095-002			Tested by	CMB	May-21
Boring	HA-RWP-01			Calculated by	CMB	May-21
Sample	U2	Specimen Number	Stage 1	Checked by	DPm	5/28/2021
Depth (ft)	23.3	Undisturbed/Remold	Undisturbed	File	107095-002 HA-RWP-01 U2 ASTM D4767	
Description	Dark brown, Sandy Silt (ML).			Procedure	ASTM D4767	
Remarks						

Specimen Data

	Initial	Post Consol.	Post Shear
Height (in)	5.986	5.967	5.863
Diameter (in)	2.876	2.861	
Volume (in^3)	38.887	38.354	
Height/Diameter ratio	2.081	2.086	
Weight (g)	1210.48	1234.28	1234.28
Water Content (%)	25.26	27.72	27.72
Bulk Unit Weight (pcf)	118.6	120.9	122.6
Dry Unit Weight (pcf)	94.7	94.7	96.0
Cross-Sectional Area* (in^2)	6.496	6.428	
% Saturation - Wet Method	88.33	100.11	100.11
Specific Gravity - Assumed	2.68	2.68	2.68
Void Ratio	0.766	0.742	0.742
	Trimmings		
Tare ID	108		
Mass wet soil + tare (g)	346.30		
Mass dry soil + tare (g)	292.81		
Mass tare (g)	81.07		

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	105.7
Pore Pressure (psi)	89.3
Effective Confining Pressure (psi)	16.4
B-value	100.00

Consolidation Phase

Change in Volume (in^3)	0.533
T_{50} (min)	0.2
Platen Travel Rate (in/min)	0.00951

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	4056.3
Peak P' (psf)	3014.3
Peak Q (psf)	1689.9
Strain at Peak (%)	1.7
σ_3' (psf)	1324.5
σ_1' (psf)	4704.2
σ_3 (psf)	2366.5
σ_1 (psf)	5746.2

Picture of Failure

See Stage 3

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-01 / U2 / Stage 1

May 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf) P	P'	Q
0.00	0.0	0.0	2366.5	2366.5	1.00	2366.5	2366.5	0.0
0.03	96.2	-5.8	2468.5	2372.3	1.04	2414.6	2420.4	48.1
0.05	213.0	48.3	2531.2	2318.2	1.09	2473.0	2424.7	106.5
0.07	312.4	90.1	2588.8	2276.4	1.14	2522.7	2432.6	156.2
0.09	407.6	133.9	2640.2	2232.6	1.18	2570.3	2436.4	203.8
0.10	550.6	197.1	2720.0	2169.4	1.25	2641.8	2444.7	275.3
0.12	744.8	291.2	2820.1	2075.3	1.36	2738.9	2447.7	372.4
0.14	925.6	387.2	2904.9	1979.3	1.47	2829.3	2442.1	462.8
0.17	1073.7	477.3	2962.8	1889.2	1.57	2903.3	2426.0	536.8
0.20	1202.2	557.8	3010.9	1808.7	1.66	2967.6	2409.8	601.1
0.21	1309.7	630.4	3045.8	1736.1	1.75	3021.3	2390.9	654.8
0.24	1404.0	693.2	3077.3	1673.3	1.84	3068.5	2375.3	702.0
0.27	1486.7	749.9	3103.3	1616.6	1.92	3109.9	2360.0	743.4
0.29	1554.3	797.8	3122.9	1568.7	1.99	3143.6	2345.8	777.1
0.32	1618.7	841.9	3143.3	1524.6	2.06	3175.9	2334.0	809.4
0.34	1677.5	881.5	3162.4	1485.0	2.13	3205.2	2323.7	838.7
0.37	1729.8	916.8	3179.5	1449.7	2.19	3231.4	2314.6	864.9
0.40	1781.2	947.8	3199.9	1418.7	2.26	3257.1	2309.3	890.6
0.42	1826.4	974.1	3218.8	1392.4	2.31	3279.7	2305.6	913.2
0.44	1864.0	997.5	3233.0	1369.0	2.36	3298.5	2301.0	932.0
0.47	1901.7	1018.3	3249.9	1348.2	2.41	3317.3	2299.0	950.8
0.49	1942.0	1036.5	3272.0	1329.9	2.46	3337.5	2300.9	971.0
0.51	1980.4	1054.2	3292.7	1312.3	2.51	3356.7	2302.5	990.2
0.54	2014.8	1069.6	3311.7	1296.9	2.55	3373.9	2304.3	1007.4
0.57	2050.0	1083.0	3333.5	1283.5	2.60	3391.5	2308.5	1025.0
0.60	2079.6	1094.8	3351.3	1271.7	2.64	3406.3	2311.5	1039.8
0.62	2112.8	1105.0	3374.3	1261.5	2.67	3422.9	2317.9	1056.4
0.64	2145.4	1114.6	3397.2	1251.9	2.71	3439.2	2324.6	1072.7
0.67	2176.7	1122.3	3420.9	1244.2	2.75	3454.9	2332.6	1088.4
0.69	2211.5	1129.0	3449.0	1237.5	2.79	3472.2	2343.3	1105.8
0.79	2327.7	1148.4	3545.8	1218.1	2.91	3530.4	2382.0	1163.9
0.88	2444.4	1157.6	3653.3	1208.9	3.02	3588.7	2431.1	1222.2
1.00	2556.8	1158.9	3764.4	1207.6	3.12	3644.9	2486.0	1278.4
1.09	2664.5	1154.3	3876.6	1212.2	3.20	3698.7	2544.4	1332.2
1.18	2780.3	1146.1	4000.7	1220.4	3.28	3756.7	2610.6	1390.2
1.28	2890.6	1134.2	4122.9	1232.3	3.35	3811.8	2677.6	1445.3
1.38	3007.4	1117.0	4256.9	1249.5	3.41	3870.2	2753.2	1503.7
1.48	3111.5	1100.1	4377.9	1266.4	3.46	3922.2	2822.1	1555.7
1.58	3220.5	1082.0	4505.0	1284.5	3.51	3976.7	2894.8	1610.2
1.68	3325.6	1059.3	4632.7	1307.2	3.54	4029.3	2970.0	1662.8
1.74	3379.7	1042.0	4704.2	1324.5	3.55	4056.3	3014.3	1689.9

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-01 / U2 / Stage 1

May 2021
107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - Raw Water Pond					
Location	Marston, Missouri			Client	Haley & Aldrich, Inc.	
Job No.	107095-002			Tested by	CMB	May-21
Boring	HA-RWP-01			Calculated by	CMB	May-21
Sample	U2	Specimen Number	Stage 2	Checked by	DPM	5/28/2021
Depth (ft)	23.3	Undisturbed/Remold	Undisturbed	File	107095-002 HA-RWP-01 U2 ASTM D4767	
Description	Dark brown, Sandy Silt (ML).			Procedure	ASTM D4767	
Remarks						

Specimen Data	Initial	Post Consol.	Post Shear
Height (in)	5.863	5.859	5.736
Diameter (in)	2.886	2.880	
Volume (in^3)	38.354	38.177	
Height/Diameter ratio	2.031	2.034	
Weight (g)	1234.28	1231.38	1231.38
Water Content (%)	27.72	27.42	27.42
Bulk Unit Weight (pcf)	122.6	122.9	122.9
Dry Unit Weight (pcf)	96.0	96.4	96.4
Cross-Sectional Area* (in^2)	6.542	6.516	
% Saturation - Wet Method	100.11	100.11	100.11
Specific Gravity - Assumed	2.68	2.68	2.68
Void Ratio	0.742	0.734	0.734
Tare ID			
Mass wet soil + tare (g)			
Mass dry soil + tare (g)			
Mass tare (g)			

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	116.6
Pore Pressure (psi)	90.1
Effective Confining Pressure (psi)	26.4
B-value	100.00

Consolidation Phase

Change in Volume (in^3)	0.177
T_{50} (min)	0.1
Platen Travel Rate (in/min)	0.00971

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	7189.4
Peak P' (psf)	6024.2
Peak Q (psf)	3381.8
Strain at Peak (%)	1.7
σ_3' (psf)	2642.4
σ_1' (psf)	9406.1
σ_3 (psf)	3807.6
σ_1 (psf)	10571.2

Picture of Failure

See Stage 3

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-01 / U2 / Stage 2

May 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf)		
						P	P'	Q
0.00	0.0	0.0	3807.6	3807.6	1.00	3807.6	3807.6	0.0
0.02	143.3	1.0	3949.8	3806.5	1.04	3879.2	3878.2	71.6
0.04	320.1	56.4	4071.2	3751.1	1.09	3967.6	3911.2	160.0
0.06	550.0	131.3	4226.2	3676.2	1.15	4082.5	3951.2	275.0
0.09	899.1	242.7	4463.9	3564.9	1.25	4257.1	4014.4	449.5
0.11	1283.9	353.7	4737.8	3453.9	1.37	4449.5	4095.8	641.9
0.14	1650.4	458.9	4999.1	3348.7	1.49	4632.8	4173.9	825.2
0.16	1995.5	558.6	5244.6	3249.0	1.61	4805.3	4246.8	997.8
0.19	2272.8	645.9	5434.5	3161.7	1.72	4944.0	4298.1	1136.4
0.21	2522.8	729.1	5601.3	3078.5	1.82	5069.0	4339.9	1261.4
0.23	2742.3	805.7	5744.2	3001.9	1.91	5178.7	4373.1	1371.2
0.26	2944.6	874.1	5878.0	2933.4	2.00	5279.9	4405.7	1472.3
0.29	3135.2	934.9	6007.8	2872.6	2.09	5375.1	4440.2	1567.6
0.32	3310.4	988.4	6129.5	2819.2	2.17	5462.7	4474.4	1655.2
0.35	3477.3	1037.0	6247.9	2770.6	2.26	5546.2	4509.2	1738.6
0.37	3630.5	1079.4	6358.7	2728.2	2.33	5622.8	4543.4	1815.3
0.40	3770.7	1116.6	6461.7	2691.0	2.40	5692.9	4576.3	1885.4
0.41	3905.3	1147.8	6565.0	2659.8	2.47	5760.2	4612.4	1952.6
0.44	4032.6	1175.0	6665.1	2632.5	2.53	5823.8	4648.8	2016.3
0.47	4151.7	1199.8	6759.5	2607.8	2.59	5883.4	4683.6	2075.8
0.49	4262.3	1220.9	6849.0	2586.7	2.65	5938.7	4717.8	2131.1
0.52	4366.7	1241.0	6933.3	2566.6	2.70	5990.9	4749.9	2183.4
0.54	4465.6	1255.5	7017.7	2552.1	2.75	6040.4	4784.9	2232.8
0.57	4559.3	1269.7	7097.1	2537.9	2.80	6087.2	4817.5	2279.6
0.60	4645.7	1283.2	7170.0	2524.3	2.84	6130.4	4847.2	2322.8
0.62	4734.3	1292.9	7248.9	2514.6	2.88	6174.7	4881.8	2367.1
0.65	4815.9	1304.5	7319.0	2503.1	2.92	6215.5	4911.0	2407.9
0.67	4888.9	1311.8	7384.7	2495.8	2.96	6252.0	4940.2	2444.4
0.70	4963.4	1317.9	7453.1	2489.7	2.99	6289.3	4971.4	2481.7
0.72	5033.7	1323.8	7517.5	2483.7	3.03	6324.4	5000.6	2516.9
0.75	5100.3	1328.9	7579.0	2478.7	3.06	6357.7	5028.9	2550.2
0.78	5162.0	1331.3	7638.2	2476.3	3.08	6388.5	5057.2	2581.0
0.80	5222.0	1333.9	7695.7	2473.7	3.11	6418.6	5084.7	2611.0
0.83	5280.3	1335.4	7752.5	2472.1	3.14	6447.7	5112.3	2640.2
0.86	5339.6	1337.1	7810.0	2470.5	3.16	6477.4	5140.3	2669.8
0.88	5394.0	1336.4	7865.2	2471.2	3.18	6504.6	5168.2	2697.0
0.91	5447.9	1336.6	7918.9	2470.9	3.20	6531.5	5194.9	2724.0
0.93	5505.9	1335.7	7977.8	2471.9	3.23	6560.5	5224.9	2753.0
0.96	5557.1	1335.1	8029.7	2472.5	3.25	6586.1	5251.1	2778.6
0.99	5604.9	1332.0	8080.4	2475.5	3.26	6610.0	5278.0	2802.4
1.01	5654.8	1330.1	8132.2	2477.4	3.28	6635.0	5304.8	2827.4
1.11	5837.1	1316.4	8328.2	2491.1	3.34	6726.1	5409.7	2918.5
1.21	6004.8	1299.1	8513.4	2508.5	3.39	6810.0	5510.9	3002.4
1.32	6171.9	1275.6	8703.8	2532.0	3.44	6893.5	5617.9	3085.9
1.43	6323.3	1251.4	8879.5	2556.2	3.47	6969.2	5717.8	3161.7
1.52	6469.6	1223.9	9053.3	2583.7	3.50	7042.3	5818.5	3234.8
1.63	6617.3	1196.5	9228.4	2611.1	3.53	7116.2	5919.7	3308.6
1.72	6763.7	1165.2	9406.1	2642.4	3.56	7189.4	6024.2	3381.8
1.83	6901.8	1132.4	9576.9	2675.1	3.58	7258.4	6126.0	3450.9
1.93	7044.4	1100.4	9751.6	2707.2	3.60	7329.8	6229.4	3522.2
2.04	7194.7	1065.1	9937.2	2742.5	3.62	7404.9	6339.8	3597.4

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-01 / U2 / Stage 2

May 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf)		
						P	P'	Q
2.10	7264.4	1035.2	10036.8	2772.4	3.62	7439.8	6404.6	3632.2

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-01 / U2 / Stage 2

May 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - Raw Water Pond					
Location	Marston, Missouri			Client	Haley & Aldrich, Inc.	
Job No.	107095-002			Tested by	CMB	May-21
Boring	HA-RWP-01			Calculated by	CMB	May-21
Sample	U2	Specimen Number	Stage 3	Checked by	DPm	5/28/2021
Depth (ft)	23.3	Undisturbed/Remold	Undisturbed	File	107095-002 HA-RWP-01 U2 ASTM D4767	
Description	Dark brown, Sandy Silt (ML).			Procedure	ASTM D4767	
Remarks						

Specimen Data	Initial	Post Consol.	Post Shear
Height (in)	5.736	5.770	4.906
Diameter (in)	2.911	2.893	
Volume (in^3)	38.177	37.914	
Height/Diameter ratio	1.970	1.995	
Weight (g)	1231.38	1227.08	1227.08
Water Content (%)	27.42	26.98	26.98
Bulk Unit Weight (pcf)	122.9	123.3	123.3
Dry Unit Weight (pcf)	96.4	97.1	97.1
Cross-Sectional Area* (in^2)	6.656	6.571	
% Saturation - Wet Method	100.11	100.11	100.11
Specific Gravity - Assumed	2.68	2.68	2.68
Void Ratio	0.734	0.722	0.722
			Entire Sample
Tare ID			25
Mass wet soil + tare (g)			1349.86
Mass dry soil + tare (g)			1106.36
Mass tare (g)			161.37

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	141.3
Pore Pressure (psi)	89.6
Effective Confining Pressure (psi)	51.7
B-value	100.00

Consolidation Phase

Change in Volume (in^3)	0.262
T_{50} (min)	0.2

Platen Travel Rate (in/min)	0.00986

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	13598.4
Peak P' (psf)	10892.7
Peak Q (psf)	6148.8
Strain at Peak (%)	1.7
σ_3' (psf)	4744.0
σ_1' (psf)	17041.5
σ_3 (psf)	7449.6
σ_1 (psf)	19747.2

Picture of Failure

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-01 / U2 / Stage 3

May 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf)		
						P	P'	Q
0.00	0.0	0.0	7449.6	7449.6	1.00	7449.6	7449.6	0.0
0.02	256.4	87.5	7618.6	7362.1	1.03	7577.9	7490.3	128.2
0.05	579.8	193.7	7835.7	7255.9	1.08	7739.5	7545.8	289.9
0.07	1038.1	349.5	8138.3	7100.2	1.15	7968.7	7619.2	519.1
0.09	1528.9	514.1	8464.5	6935.5	1.22	8214.1	7700.0	764.5
0.11	2030.7	674.4	8805.9	6775.2	1.30	8465.0	7790.5	1015.3
0.14	2529.5	832.7	9146.4	6616.9	1.38	8714.4	7881.7	1264.7
0.17	3006.0	989.1	9466.6	6460.5	1.47	8952.7	7963.6	1503.0
0.19	3444.2	1145.5	9748.3	6304.1	1.55	9171.7	8026.2	1722.1
0.21	3863.9	1296.5	10017.1	6153.2	1.63	9381.6	8085.1	1932.0
0.23	4263.9	1440.4	10273.1	6009.2	1.71	9581.6	8141.2	2132.0
0.26	4640.9	1574.0	10516.6	5875.6	1.79	9770.1	8196.1	2320.5
0.29	5007.9	1698.6	10759.0	5751.1	1.87	9953.6	8255.0	2504.0
0.31	5349.9	1811.7	10987.8	5637.9	1.95	10124.6	8312.9	2675.0
0.34	5674.7	1913.6	11210.7	5536.0	2.03	10287.0	8373.3	2837.3
0.36	5994.6	2008.4	11435.8	5441.3	2.10	10446.9	8438.6	2997.3
0.38	6288.3	2095.1	11642.9	5354.6	2.17	10593.8	8498.7	3144.2
0.41	6576.5	2171.9	11854.3	5277.7	2.25	10737.9	8566.0	3288.3
0.44	6855.9	2243.9	12061.6	5205.7	2.32	10877.6	8633.7	3428.0
0.46	7117.0	2307.8	12258.9	5141.9	2.38	11008.2	8700.4	3558.5
0.49	7366.0	2364.3	12451.3	5085.3	2.45	11132.6	8768.3	3683.0
0.51	7603.1	2414.9	12637.8	5034.7	2.51	11251.2	8836.3	3801.6
0.54	7827.3	2460.9	12816.1	4988.7	2.57	11363.3	8902.4	3913.7
0.57	8046.1	2502.2	12993.6	4947.5	2.63	11472.7	8970.5	4023.1
0.60	8259.1	2540.6	13168.2	4909.0	2.68	11579.2	9038.6	4129.6
0.63	8456.4	2572.9	13333.1	4876.7	2.73	11677.8	9104.9	4228.2
0.65	8643.5	2604.2	13488.9	4845.4	2.78	11771.4	9167.2	4321.8
0.68	8820.6	2631.3	13638.9	4818.4	2.83	11859.9	9228.7	4410.3
0.70	8993.0	2655.6	13787.1	4794.1	2.88	11946.1	9290.6	4496.5
0.73	9155.5	2677.6	13927.5	4772.1	2.92	12027.4	9349.8	4577.7
0.75	9313.2	2696.4	14066.5	4753.3	2.96	12106.3	9409.9	4656.6
0.78	9460.4	2713.7	14196.3	4735.9	3.00	12179.8	9466.1	4730.2
0.80	9601.7	2729.7	14321.7	4720.0	3.03	12250.5	9520.8	4800.9
0.83	9738.3	2743.5	14444.5	4706.2	3.07	12318.8	9575.3	4869.2
0.86	9865.4	2755.9	14559.2	4693.8	3.10	12382.4	9626.5	4932.7
0.88	9990.3	2764.8	14675.2	4684.9	3.13	12444.8	9680.0	4995.2
0.91	10105.0	2774.6	14780.0	4675.0	3.16	12502.1	9727.5	5052.5
0.94	10215.1	2782.5	14882.2	4667.1	3.19	12557.2	9774.7	5107.6
0.96	10320.8	2789.7	14980.7	4659.9	3.21	12610.1	9820.3	5160.4
0.99	10417.2	2796.2	15070.6	4653.4	3.24	12658.2	9862.0	5208.6
1.02	10513.4	2799.8	15163.2	4649.8	3.26	12706.3	9906.5	5256.7
1.12	10856.9	2810.3	15496.2	4639.3	3.34	12878.1	10067.8	5428.4
1.22	11152.2	2809.9	15792.0	4639.7	3.40	13025.8	10215.9	5576.1
1.32	11420.7	2800.7	16069.6	4648.9	3.46	13160.0	10359.3	5710.4
1.42	11667.9	2782.3	16335.3	4667.4	3.50	13283.6	10501.3	5833.9
1.52	11897.6	2760.5	16586.8	4689.2	3.54	13398.4	10638.0	5948.8
1.64	12102.5	2734.3	16817.8	4715.3	3.57	13500.9	10766.6	6051.3
1.74	12297.5	2705.7	17041.5	4744.0	3.59	13598.4	10892.7	6148.8
1.83	12501.3	2671.2	17279.7	4778.4	3.62	13700.3	11029.0	6250.6
1.94	12695.8	2636.2	17509.3	4813.5	3.64	13797.6	11161.4	6347.9
2.04	12886.1	2598.9	17736.9	4850.7	3.66	13892.7	11293.8	6443.1

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-01 / U2 / Stage 3

May 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf)		
						P	P'	Q
2.15	13075.4	2559.5	17965.5	4890.1	3.67	13987.3	11427.8	6537.7
2.26	13263.9	2514.2	18199.3	4935.4	3.69	14081.6	11567.3	6631.9
2.37	13438.1	2475.9	18411.8	4973.7	3.70	14168.7	11692.7	6719.0
2.47	13618.6	2434.3	18634.0	5015.4	3.72	14259.0	11824.7	6809.3
2.58	13791.5	2391.1	18850.1	5058.6	3.73	14345.4	11954.3	6895.8
2.68	13957.8	2349.6	19057.9	5100.0	3.74	14428.6	12079.0	6978.9
2.78	14126.0	2303.4	19272.3	5146.3	3.74	14512.6	12209.3	7063.0
2.89	14295.0	2260.1	19484.6	5189.6	3.75	14597.1	12337.1	7147.5
2.99	14472.0	2215.1	19706.5	5234.6	3.76	14685.6	12470.5	7236.0
3.09	14642.0	2169.7	19921.9	5279.9	3.77	14770.6	12600.9	7321.0
3.20	14805.4	2124.3	20130.7	5325.3	3.78	14852.4	12728.0	7402.7
3.30	14980.6	2075.4	20354.9	5374.2	3.79	14940.0	12864.6	7490.3
3.41	15152.9	2028.6	20573.9	5421.0	3.80	15026.1	12997.5	7576.5
3.51	15320.8	1979.6	20790.8	5470.1	3.80	15110.0	13130.5	7660.4
3.62	15494.4	1929.8	21014.2	5519.8	3.81	15196.8	13267.0	7747.2
3.72	15655.4	1881.3	21223.8	5568.4	3.81	15277.4	13396.1	7827.7
3.83	15832.0	1832.0	21449.6	5617.6	3.82	15365.6	13533.6	7916.0
3.93	16000.7	1781.3	21669.0	5668.3	3.82	15450.0	13668.7	8000.3
4.04	16162.1	1732.6	21879.2	5717.1	3.83	15530.7	13798.1	8081.1
4.15	16318.6	1685.6	22082.6	5764.0	3.83	15609.0	13923.3	8159.3
4.24	16475.4	1636.3	22288.8	5813.4	3.83	15687.3	14051.1	8237.7
4.34	16638.3	1585.9	22502.0	5863.7	3.84	15768.8	14182.9	8319.1
4.45	16796.0	1536.7	22709.0	5912.9	3.84	15847.7	14311.0	8398.0
4.55	16960.2	1485.7	22924.1	5963.9	3.84	15929.7	14444.0	8480.1
4.66	17119.3	1435.0	23134.0	6014.7	3.85	16009.3	14574.3	8559.6
4.75	17269.4	1387.8	23331.2	6061.8	3.85	16084.3	14696.5	8634.7
4.86	17432.2	1336.9	23544.9	6112.7	3.85	16165.7	14828.8	8716.1
4.95	17603.0	1287.8	23764.8	6161.9	3.86	16251.1	14963.4	8801.5
5.06	17760.8	1236.7	23973.7	6212.9	3.86	16330.0	15093.3	8880.4
5.17	17909.9	1184.6	24175.0	6265.1	3.86	16404.6	15220.0	8955.0
5.42	18298.5	1051.9	24696.3	6397.8	3.86	16598.9	15547.0	9149.3
5.68	18673.9	925.6	25197.9	6524.0	3.86	16786.6	15861.0	9337.0
5.94	19024.0	807.2	25666.5	6642.5	3.86	16961.7	16154.5	9512.0
6.19	19399.0	681.1	26167.5	6768.6	3.87	17149.1	16468.1	9699.5
6.44	19745.2	550.8	26644.0	6898.8	3.86	17322.2	16771.4	9872.6
6.70	20083.3	420.8	27112.1	7028.9	3.86	17491.3	17070.5	10041.6
6.97	20402.1	288.8	27562.9	7160.8	3.85	17650.7	17361.9	10201.0
7.22	20716.7	157.2	28009.1	7292.4	3.84	17808.0	17650.8	10358.3
7.49	20965.2	31.8	28383.0	7417.8	3.83	17932.2	17900.4	10482.6
7.73	21217.1	-90.3	28757.0	7540.0	3.81	18058.2	18148.5	10608.5
7.98	21454.4	-206.4	29110.5	7656.0	3.80	18176.9	18383.2	10727.2
8.25	21694.4	-322.1	29466.1	7771.8	3.79	18296.8	18619.0	10847.2
8.50	21915.2	-437.1	29801.9	7886.7	3.78	18407.2	18844.3	10957.6
8.76	22152.8	-551.5	30154.0	8001.2	3.77	18526.1	19077.6	11076.4
9.01	22372.6	-654.3	30476.5	8103.9	3.76	18635.9	19290.2	11186.3
9.28	22577.3	-758.3	30785.3	8207.9	3.75	18738.3	19496.6	11288.7
9.52	22802.9	-865.1	31117.7	8314.8	3.74	18851.1	19716.2	11401.4
9.79	23004.4	-965.2	31419.3	8414.9	3.73	18951.8	19917.1	11502.2
10.05	23226.8	-1068.0	31744.4	8517.6	3.73	19063.0	20131.0	11613.4
10.32	23414.4	-1163.5	32027.5	8613.1	3.72	19156.8	20320.3	11707.2
10.57	23597.2	-1259.3	32306.2	8709.0	3.71	19248.2	20507.6	11798.6

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-01 / U2 / Stage 3

May 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf)		
						P	P'	Q
10.83	23793.6	-1351.4	32594.6	8801.0	3.70	19346.4	20697.8	11896.8
11.09	23977.4	-1445.1	32872.2	8894.8	3.70	19438.4	20883.5	11988.7
11.35	24140.8	-1529.6	33120.0	8979.2	3.69	19520.0	21049.6	12070.4
11.62	24290.1	-1612.4	33352.1	9062.0	3.68	19594.7	21207.0	12145.0
11.87	24442.9	-1692.5	33585.1	9142.1	3.67	19671.1	21363.6	12221.5
12.13	24593.4	-1773.3	33816.3	9222.9	3.67	19746.3	21519.6	12296.7
12.38	24732.1	-1854.2	34036.0	9303.9	3.66	19815.7	21669.9	12366.1
12.64	24855.1	-1927.2	34231.9	9376.8	3.65	19877.2	21804.4	12427.5
12.90	24972.6	-1996.3	34418.6	9445.9	3.64	19936.0	21932.2	12486.3
13.16	25079.7	-2065.3	34594.6	9515.0	3.64	19989.5	22054.8	12539.8
13.41	25186.5	-2129.9	34766.0	9579.5	3.63	20042.9	22172.7	12593.2
13.67	25270.9	-2188.6	34909.1	9638.2	3.62	20085.1	22273.7	12635.4
13.93	25363.7	-2249.2	35062.5	9698.8	3.62	20131.5	22380.7	12681.8
14.18	25473.9	-2302.3	35225.9	9752.0	3.61	20186.6	22488.9	12737.0
14.45	25551.1	-2355.5	35356.2	9805.2	3.61	20225.2	22580.7	12775.5
14.69	25603.1	-2403.6	35456.3	9853.2	3.60	20251.2	22654.8	12801.5
14.96	25663.2	-2446.0	35558.9	9895.7	3.59	20281.3	22727.3	12831.6

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-01 / U2 / Stage 3

May 2021 107095-002

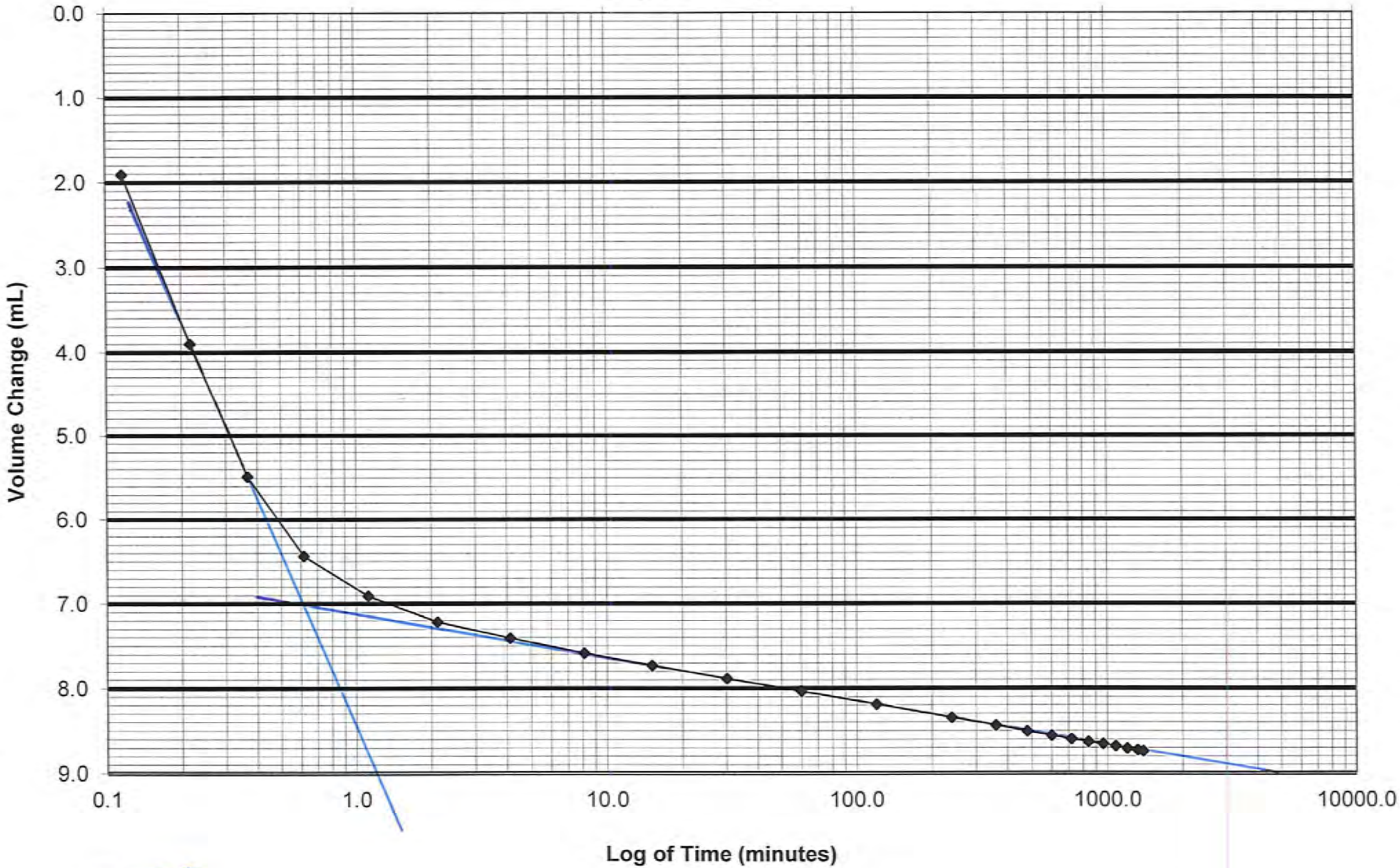
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

AECI NMPP - Raw Water Pond

107095-002

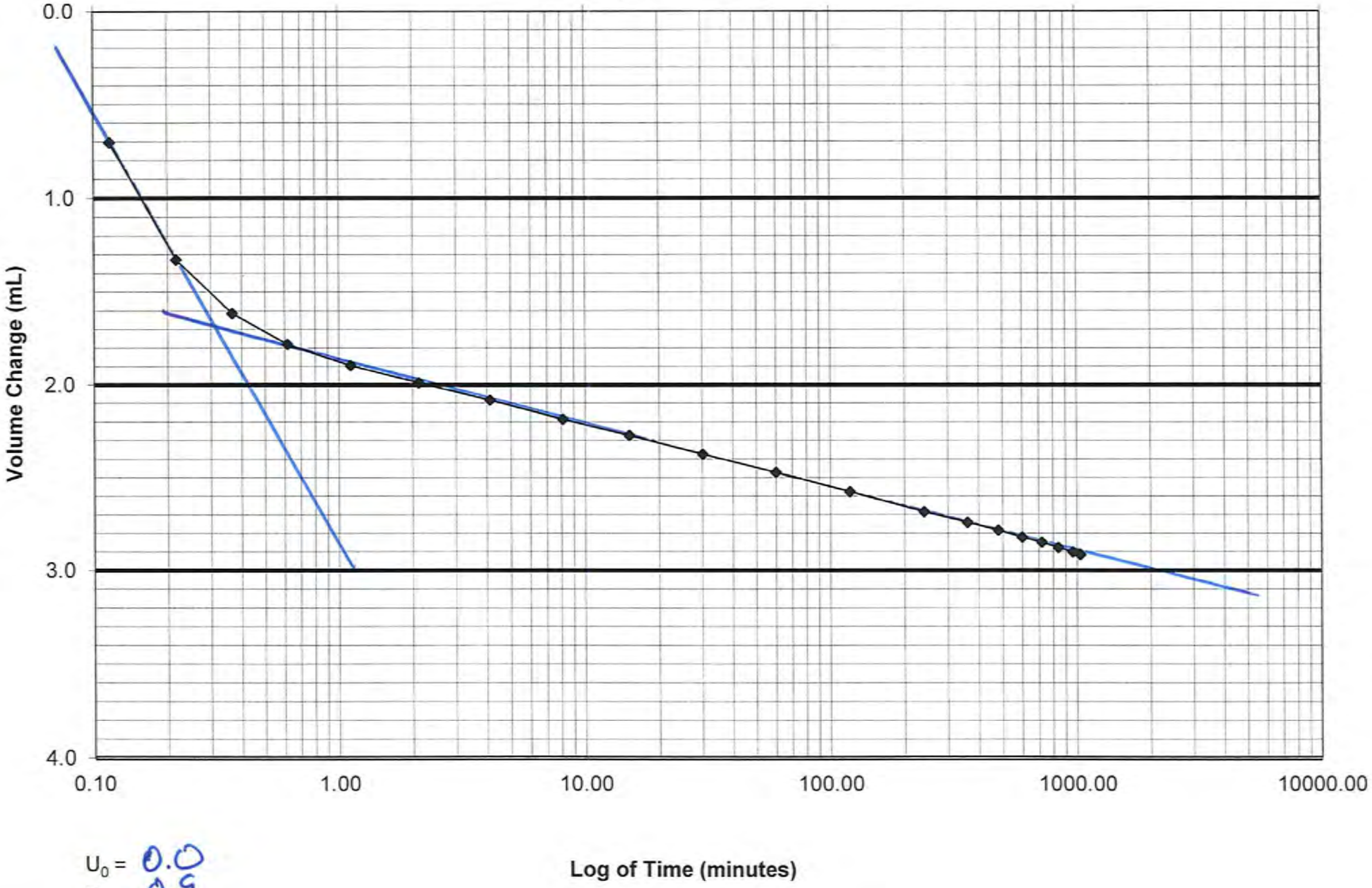
HA-RWP-01 U2

Stage 1 16.0 psi



U_0 = 0.0
U_{50} = 3.5
U_{100} = 7.0
t_{50} = 0.19

90/hr = 125.45


AECI NMPP - Raw Water Pond
107095-002
HA-RWP-01 U2
Stage 2 25.5 psi

U_0 = 0.0
U_{50} = 0.9
U_{100} = 1.7
t_{50} = 0.13

90/hr = 172.95

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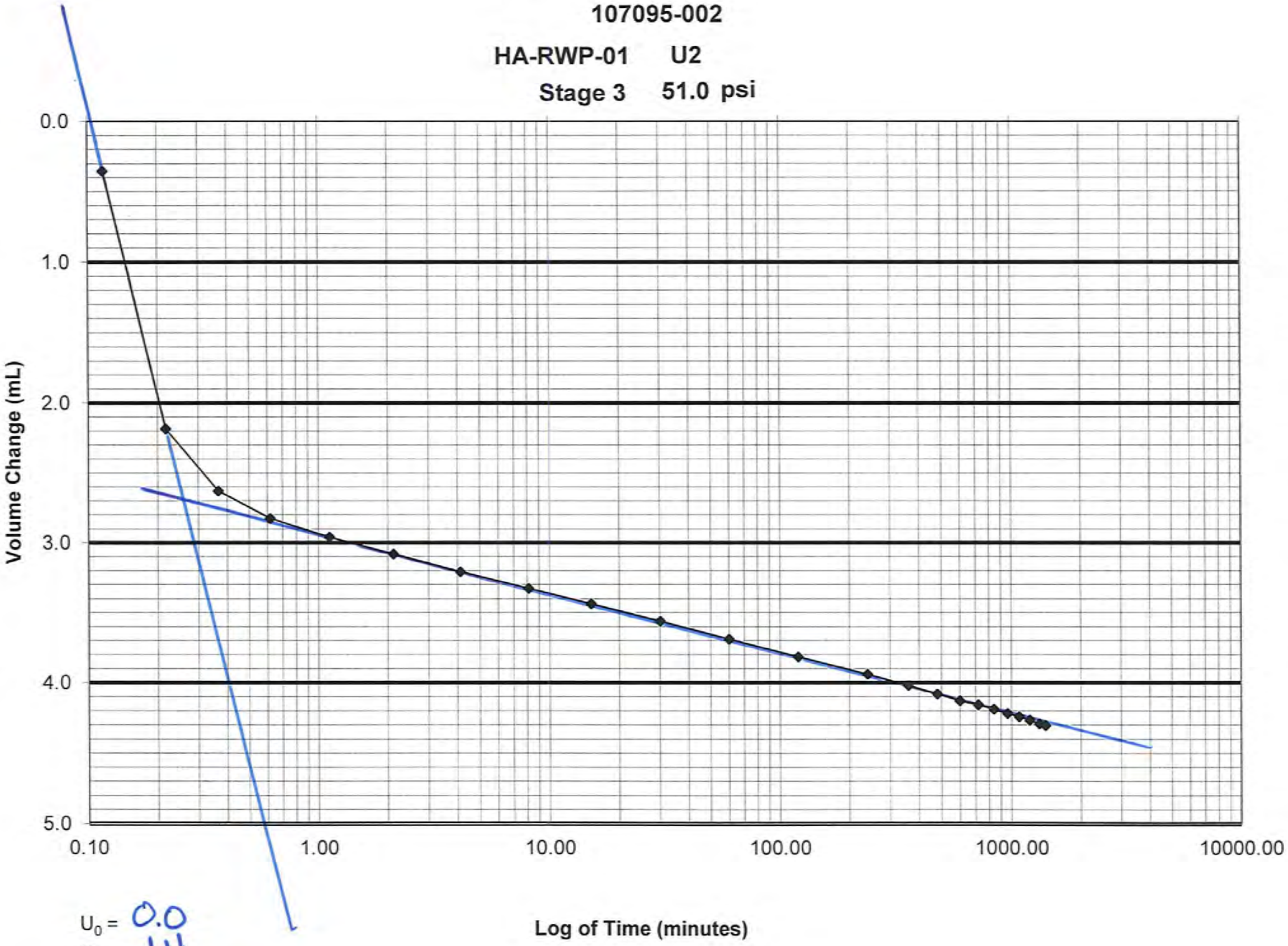
AECI NMPP - Raw Water Pond

107095-002

HA-RWP-01 U2

Stage 3 51.0 psi



U_0 = 0.0
U_{50} = 1.4
U_{100} = 2.7
t_{50} = 0.16

9o/hr=146.83

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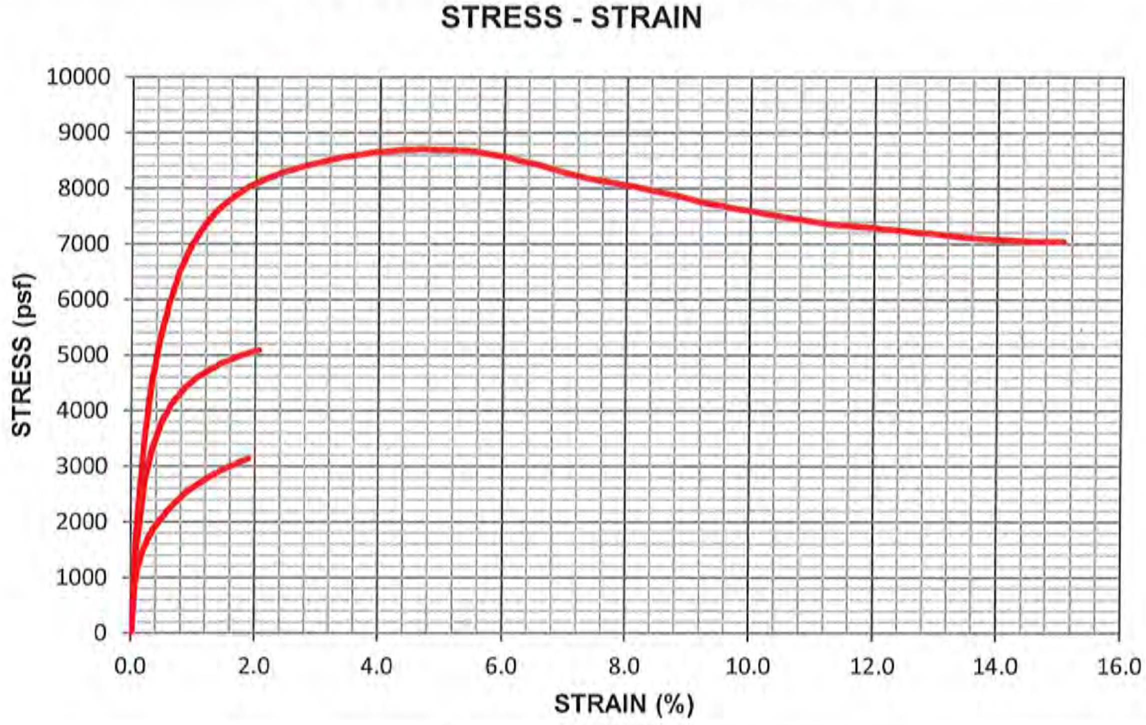
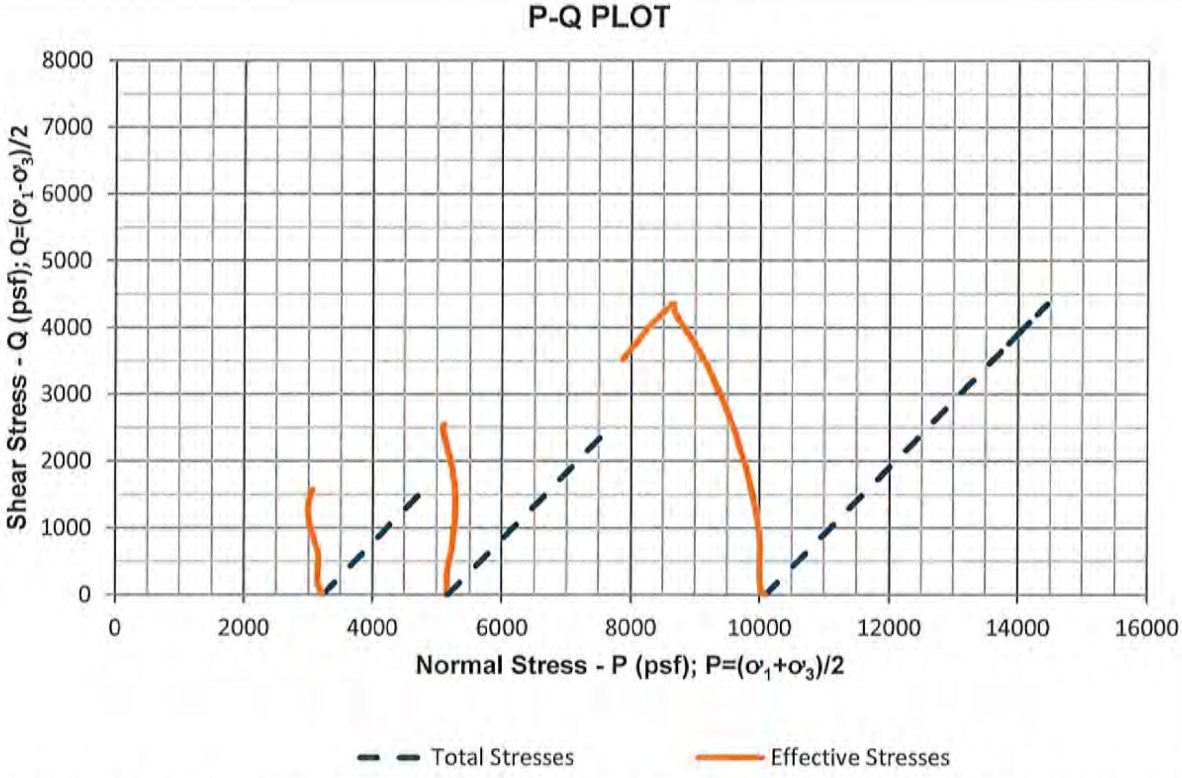
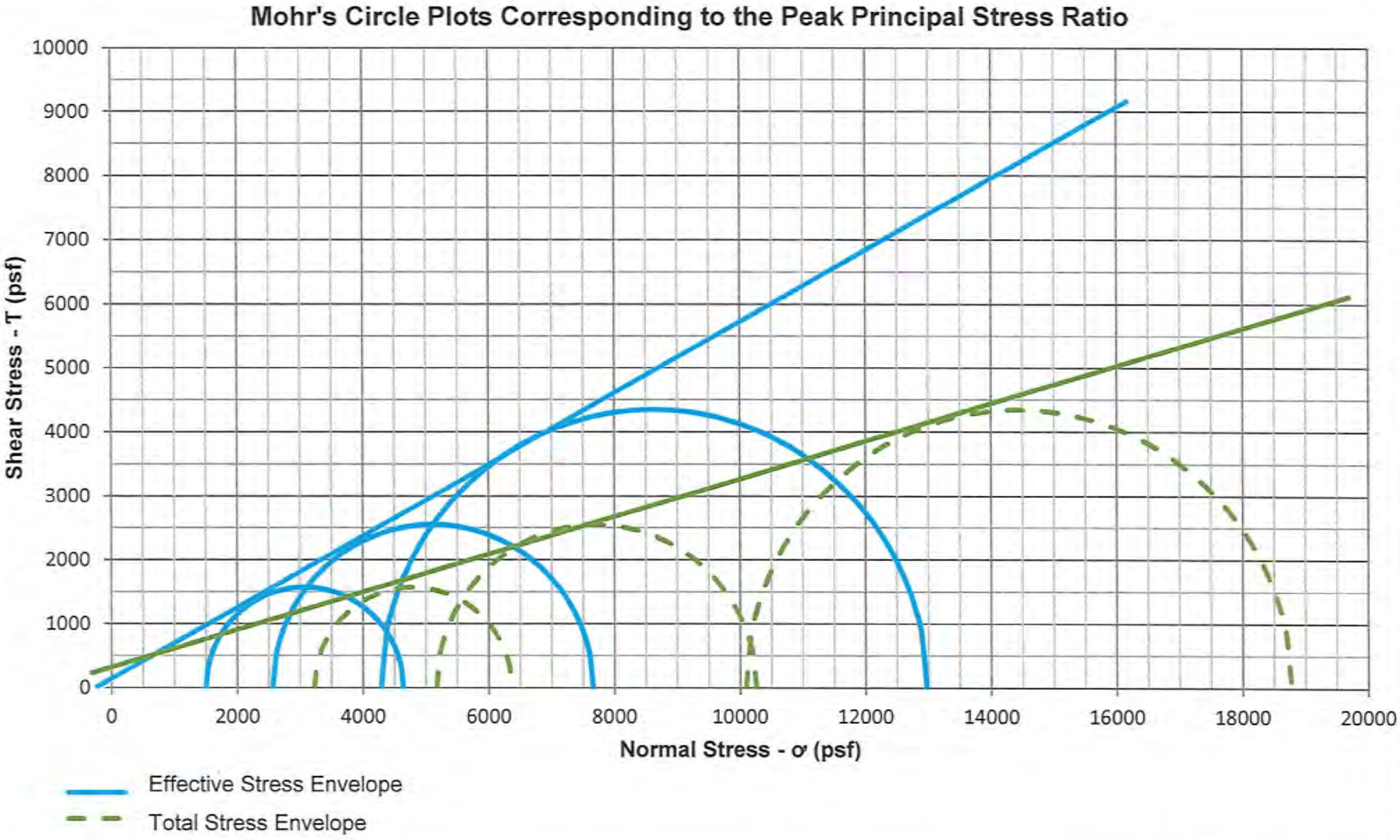
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST WITH PORE PRESSURE MEASUREMENT





SHANNON & WILSON, INC. 2043 WESTPORT CENTER DR. SAINT LOUIS, MISSOURI 63146 107095-002	CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION **AECI NMPP - Raw Water Pond** **Marston, Missouri** HA-RWP-03 / U1 / 30.7



Sample	Strain (%)
Stage 1	1.9
Stage 2	2.1
Stage 3	5.2

c =	310 psf
ϕ =	16.5 deg
c' =	120 psf
ϕ' =	29.2 deg

NOTES:
1. Mohr's circles in this plot are based upon the maximum principal stress difference observed during loading.
2. Strength parameters determined by Shannon & Wilson. Engineer-of-Record should evaluate cohesion and friction commensurate with project conditions.

AECI NMPP - Raw Water Pond
Marston, Missouri

Mohr's Circle Plots
HA-RWP-03 / U1

May 2021
107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Figure 1

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - Raw Water Pond					
Location	Marston, Missouri			Client	Haley & Aldrich, Inc.	
Job No.	107095-002			Tested by	CMB	May-21
Boring	HA-RWP-03			Calculated by	CMB	May-21
Sample	U1	Specimen Number	Stage 1	Checked by	Dm	5/28/2021
Depth (ft)	30.7	Undisturbed/Remold	Undisturbed	File	107095-002 HA-RWP-03 U1 ASTM D4767	
Description	Mottled dark gray and brown, Lean Clay (CL).			Procedure	ASTM D4767	
Remarks						

Specimen Data	Initial	Post Consol.	Post Shear
Height (in)	5.981	5.926	5.813
Diameter (in)	2.833	2.797	
Volume (in^3)	37.701	36.415	
Height/Diameter ratio	2.111	2.119	
Weight (g)	1190.59	1173.20	1173.20
Water Content (%)	29.47	27.58	27.58
Bulk Unit Weight (pcf)	120.3	118.5	122.7
Dry Unit Weight (pcf)	92.9	92.9	96.2
Cross-Sectional Area* (in^2)	6.304	6.145	
% Saturation - Wet Method	98.76	100.11	100.11
Specific Gravity - Assumed	2.68	2.68	2.68
Void Ratio	0.800	0.738	0.738
	Trimmings		
Tare ID	113		
Mass wet soil + tare (g)	244.70		
Mass dry soil + tare (g)	207.78		
Mass tare (g)	82.49		

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	111.8
Pore Pressure (psi)	89.3
Effective Confining Pressure (psi)	22.4
B-value	98.00

Consolidation Phase

Change in Volume (in^3)	1.286
T_{50} (min)	33.0

Platen Travel Rate (in/min)	0.00068

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	4794.7
Peak P' (psf)	3070.1
Peak Q (psf)	1567.8
Strain at Peak (%)	1.9
σ_3' (psf)	1502.3
σ_1' (psf)	4638.0
σ_3 (psf)	3226.9
σ_1 (psf)	6362.6

Picture of Failure

See Stage 3

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-03 / U1 / Stage 1

May 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf) P	P'	Q
0.00	0.0	0.0	3226.9	3226.9	1.00	3226.9	3226.9	0.0
0.02	311.3	233.2	3305.0	2993.7	1.10	3382.5	3149.4	155.7
0.05	575.8	369.2	3433.5	2857.7	1.20	3514.8	3145.6	287.9
0.07	791.5	470.5	3547.9	2756.4	1.29	3622.6	3152.2	395.8
0.10	980.8	560.0	3647.7	2666.9	1.37	3717.3	3157.3	490.4
0.11	1129.4	632.1	3724.2	2594.8	1.44	3791.6	3159.5	564.7
0.14	1243.9	693.4	3777.4	2533.5	1.49	3848.8	3155.4	621.9
0.16	1338.5	748.1	3817.3	2478.8	1.54	3896.1	3148.0	669.2
0.18	1418.7	803.9	3841.6	2422.9	1.59	3936.2	3132.3	709.3
0.21	1487.3	854.3	3859.9	2372.6	1.63	3970.5	3116.3	743.6
0.23	1547.3	891.6	3882.6	2335.3	1.66	4000.5	3108.9	773.6
0.26	1611.2	930.5	3907.6	2296.4	1.70	4032.5	3102.0	805.6
0.28	1669.2	964.0	3932.0	2262.9	1.74	4061.5	3097.5	834.6
0.30	1728.1	1004.2	3950.8	2222.6	1.78	4090.9	3086.7	864.1
0.33	1780.5	1039.4	3968.0	2187.5	1.81	4117.1	3077.8	890.3
0.35	1822.4	1072.7	3976.6	2154.2	1.85	4138.1	3065.4	911.2
0.36	1870.5	1099.9	3997.4	2126.9	1.88	4162.1	3062.2	935.2
0.39	1907.4	1128.9	4005.4	2098.0	1.91	4180.6	3051.7	953.7
0.42	1949.5	1155.2	4021.2	2071.6	1.94	4201.6	3046.4	974.8
0.45	1984.4	1178.6	4032.6	2048.2	1.97	4219.1	3040.4	992.2
0.46	2025.0	1202.7	4049.2	2024.2	2.00	4239.4	3036.7	1012.5
0.50	2054.9	1228.6	4053.2	1998.3	2.03	4254.3	3025.8	1027.5
0.52	2093.1	1248.4	4071.5	1978.5	2.06	4273.4	3025.0	1046.5
0.54	2124.8	1268.0	4083.7	1958.8	2.08	4289.3	3021.2	1062.4
0.57	2163.3	1288.0	4102.2	1938.9	2.12	4308.5	3020.6	1081.6
0.59	2185.9	1309.7	4103.1	1917.2	2.14	4319.8	3010.1	1093.0
0.61	2209.5	1317.2	4119.2	1909.7	2.16	4331.6	3014.4	1104.8
0.64	2249.4	1341.0	4135.2	1885.9	2.19	4351.6	3010.6	1124.7
0.66	2279.3	1357.6	4148.6	1869.3	2.22	4366.5	3009.0	1139.7
0.69	2309.7	1373.4	4163.2	1853.5	2.25	4381.7	3008.4	1154.9
0.71	2336.6	1391.0	4172.5	1835.9	2.27	4395.2	3004.2	1168.3
0.73	2359.4	1402.9	4183.4	1824.0	2.29	4406.6	3003.7	1179.7
0.76	2381.8	1416.0	4192.7	1810.9	2.32	4417.8	3001.8	1190.9
0.78	2412.7	1430.5	4209.0	1796.3	2.34	4433.2	3002.7	1206.3
0.81	2432.7	1442.8	4216.8	1784.1	2.36	4443.2	3000.4	1216.4
0.82	2452.5	1455.5	4224.0	1771.4	2.38	4453.1	2997.7	1226.3
0.85	2478.0	1466.7	4238.2	1760.2	2.41	4465.9	2999.2	1239.0
0.87	2498.7	1476.3	4249.2	1750.5	2.43	4476.2	2999.9	1249.3
0.89	2528.1	1490.5	4264.5	1736.4	2.46	4490.9	3000.4	1264.1
0.91	2539.1	1496.9	4269.1	1730.0	2.47	4496.4	2999.6	1269.6
0.94	2561.5	1507.6	4280.8	1719.3	2.49	4507.6	3000.0	1280.8
0.97	2586.6	1523.6	4289.8	1703.2	2.52	4520.2	2996.5	1293.3
1.07	2660.0	1555.3	4331.5	1671.6	2.59	4556.9	3001.6	1330.0
1.16	2727.6	1586.0	4368.5	1640.8	2.66	4590.7	3004.7	1363.8
1.25	2800.1	1612.6	4414.4	1614.3	2.73	4626.9	3014.4	1400.1
1.35	2858.4	1637.6	4447.7	1589.3	2.80	4656.1	3018.5	1429.2
1.45	2910.3	1655.8	4481.4	1571.0	2.85	4682.0	3026.2	1455.2
1.54	2968.9	1676.7	4519.1	1550.2	2.92	4711.3	3034.6	1484.5
1.64	3013.2	1688.9	4551.2	1538.0	2.96	4733.5	3044.6	1506.6
1.74	3059.3	1703.4	4582.7	1523.5	3.01	4756.5	3053.1	1529.6
1.83	3104.2	1715.0	4616.0	1511.9	3.05	4779.0	3063.9	1552.1

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-03 / U1 / Stage 1

May 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf)		
						P	P'	Q
1.90	3135.7	1724.6	4638.0	1502.3	3.09	4794.7	3070.1	1567.8

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-03 / U1 / Stage 1

May 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - Raw Water Pond					
Location	Marston, Missouri			Client	Haley & Aldrich, Inc.	
Job No.	107095-002			Tested by	CMB	May-21
Boring	HA-RWP-03			Calculated by	CMB	May-21
Sample	U1	Specimen Number	Stage 2	Checked by	DPM	5/28/2021
Depth (ft)	30.7	Undisturbed/Remold	Undisturbed	File	107095-002 HA-RWP-03 U1 ASTM D4767	
Description	Mottled dark gray and brown, Lean Clay (CL).			Procedure	ASTM D4767	
Remarks						

Specimen Data	Initial	Post Consol.	Post Shear
Height (in)	5.813	5.814	5.694
Diameter (in)	2.824	2.792	
Volume (in^3)	36.415	35.591	
Height/Diameter ratio	2.058	2.083	
Weight (g)	1173.20	1159.70	1159.70
Water Content (%)	27.58	26.11	26.11
Bulk Unit Weight (pcf)	122.7	124.1	124.1
Dry Unit Weight (pcf)	96.2	98.4	98.4
Cross-Sectional Area* (in^2)	6.264	6.121	
% Saturation - Wet Method	100.11	100.11	100.11
Specific Gravity - Assumed	2.68	2.68	2.68
Void Ratio	0.738	0.699	0.699
Tare ID			
Mass wet soil + tare (g)			
Mass dry soil + tare (g)			
Mass tare (g)			

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	125.1
Pore Pressure (psi)	89.2
Effective Confining Pressure (psi)	35.9
B-value	98.00

Consolidation Phase

Change in Volume (in^3)	0.824
T_{50} (min)	51.4
Platen Travel Rate (in/min)	0.00046

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	7713.4
Peak P' (psf)	5112.1
Peak Q (psf)	2544.8
Strain at Peak (%)	2.1
σ_3' (psf)	2567.3
σ_1' (psf)	7656.9
σ_3 (psf)	5168.6
σ_1 (psf)	10258.2

Picture of Failure

See Stage 3

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-03 / U1 / Stage 2

May 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf)		
						P	P'	Q
0.00	0.0	0.0	5168.6	5168.6	1.00	5168.6	5168.6	0.0
0.03	50.6	39.0	5180.3	5129.6	1.01	5193.9	5155.0	25.3
0.06	492.5	260.3	5400.8	4908.3	1.10	5414.9	5154.5	246.2
0.07	968.6	462.3	5674.9	4706.3	1.21	5652.9	5190.6	484.3
0.09	1389.6	628.7	5929.5	4539.9	1.31	5863.4	5234.7	694.8
0.12	1723.8	778.4	6114.0	4390.2	1.39	6030.5	5252.1	861.9
0.15	2018.4	910.2	6276.8	4258.5	1.47	6177.8	5267.6	1009.2
0.17	2265.2	1020.8	6413.0	4147.8	1.55	6301.2	5280.4	1132.6
0.21	2484.2	1123.3	6529.5	4045.3	1.61	6410.7	5287.4	1242.1
0.22	2664.3	1217.7	6615.2	3950.9	1.67	6500.8	5283.1	1332.1
0.24	2828.6	1300.9	6696.3	3867.7	1.73	6582.9	5282.0	1414.3
0.28	2976.3	1371.4	6773.4	3797.2	1.78	6656.7	5285.3	1488.1
0.30	3103.1	1434.9	6836.8	3733.7	1.83	6720.2	5285.3	1551.6
0.32	3218.8	1498.8	6888.7	3669.8	1.88	6778.0	5279.2	1609.4
0.35	3326.9	1556.4	6939.1	3612.2	1.92	6832.1	5275.6	1663.4
0.38	3422.5	1612.1	6979.0	3556.5	1.96	6879.9	5267.7	1711.2
0.41	3500.8	1657.2	7012.2	3511.4	2.00	6919.0	5261.8	1750.4
0.43	3576.2	1708.1	7036.8	3460.6	2.03	6956.7	5248.7	1788.1
0.45	3655.5	1757.0	7067.2	3411.7	2.07	6996.4	5239.4	1827.7
0.48	3728.6	1786.7	7110.5	3381.9	2.10	7032.9	5246.2	1864.3
0.49	3797.7	1824.8	7141.5	3343.8	2.14	7067.4	5242.7	1898.8
0.52	3849.9	1865.0	7153.5	3303.6	2.17	7093.6	5228.6	1925.0
0.55	3913.4	1897.4	7184.6	3271.2	2.20	7125.3	5227.9	1956.7
0.57	3957.2	1929.1	7196.7	3239.5	2.22	7147.2	5218.1	1978.6
0.61	4015.4	1967.4	7216.6	3201.2	2.25	7176.3	5208.9	2007.7
0.62	4056.9	1994.1	7231.4	3174.5	2.28	7197.1	5203.0	2028.5
0.64	4110.9	2010.0	7269.5	3158.6	2.30	7224.1	5214.1	2055.4
0.68	4148.8	2041.8	7275.6	3126.8	2.33	7243.0	5201.2	2074.4
0.71	4187.8	2065.7	7290.7	3102.9	2.35	7262.5	5196.8	2093.9
0.73	4224.7	2090.3	7303.0	3078.3	2.37	7280.9	5190.6	2112.3
0.76	4261.3	2116.2	7313.7	3052.4	2.40	7299.3	5183.0	2130.6
0.79	4286.7	2146.1	7309.2	3022.5	2.42	7312.0	5165.9	2143.4
0.81	4328.9	2163.0	7334.6	3005.6	2.44	7333.1	5170.1	2164.5
0.83	4353.8	2173.4	7349.1	2995.2	2.45	7345.5	5172.2	2176.9
0.86	4387.5	2189.7	7366.5	2978.9	2.47	7362.4	5172.7	2193.8
0.88	4419.8	2210.4	7378.0	2958.2	2.49	7378.5	5168.1	2209.9
0.91	4441.9	2232.2	7378.3	2936.4	2.51	7389.6	5157.4	2221.0
0.94	4472.5	2251.7	7389.5	2917.0	2.53	7404.9	5153.2	2236.3
0.96	4492.3	2274.2	7386.7	2894.4	2.55	7414.8	5140.6	2246.2
1.05	4591.7	2315.6	7444.7	2853.0	2.61	7464.4	5148.8	2295.8
1.16	4656.9	2374.7	7450.8	2793.9	2.67	7497.1	5122.4	2328.5
1.27	4737.5	2409.6	7496.5	2759.0	2.72	7537.4	5127.8	2368.7
1.36	4787.6	2453.5	7502.8	2715.1	2.76	7562.4	5108.9	2393.8
1.47	4856.8	2488.4	7537.0	2680.2	2.81	7597.0	5108.6	2428.4
1.58	4900.2	2515.4	7553.4	2653.2	2.85	7618.7	5103.3	2450.1
1.68	4952.9	2543.4	7578.1	2625.2	2.89	7645.1	5101.6	2476.4
1.79	4994.3	2565.2	7597.7	2603.4	2.92	7665.8	5100.6	2497.1
1.89	5031.5	2572.2	7628.0	2596.4	2.94	7684.4	5112.2	2515.8
1.99	5068.2	2603.9	7632.9	2564.7	2.98	7702.7	5098.8	2534.1
2.07	5089.6	2601.4	7656.9	2567.3	2.98	7713.4	5112.1	2544.8

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-03 / U1 / Stage 2

May 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - Raw Water Pond					
Location	Marston, Missouri			Client	Haley & Aldrich, Inc.	
Job No.	107095-002			Tested by	CMB	May-21
Boring	HA-RWP-03			Calculated by	CMB	May-21
Sample	U1	Specimen Number	Stage 3	Checked by	DPM	5/28/2021
Depth (ft)	30.7	Undisturbed/Remold	Undisturbed	File	107095-002 HA-RWP-03 U1 ASTM D4767	
Description	Mottled dark gray and brown, Lean Clay (CL).			Procedure	ASTM D4767	
Remarks						

Specimen Data

Specimen Data	Initial	Post Consol.	Post Shear
Height (in)	5.694	5.683	4.827
Diameter (in)	2.821	2.781	
Volume (in^3)	35.591	34.511	
Height/Diameter ratio	2.018	2.044	
Weight (g)	1159.70	1142.00	1142.00
Water Content (%)	26.11	24.18	24.18
Bulk Unit Weight (pcf)	124.1	126.1	126.1
Dry Unit Weight (pcf)	98.4	101.5	101.5
Cross-Sectional Area* (in^2)	6.251	6.073	
% Saturation - Wet Method	100.11	100.11	100.11
Specific Gravity - Assumed	2.68	2.68	2.68
Void Ratio	0.699	0.647	0.647
			Entire Sample
Tare ID			28
Mass wet soil + tare (g)			1301.73
Mass dry soil + tare (g)			1067.72
Mass tare (g)			159.71

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	160.0
Pore Pressure (psi)	89.9
Effective Confining Pressure (psi)	70.1
B-value	98.00

Consolidation Phase

Change in Volume (in^3)	1.080
T_{50} (min)	59.1
Platen Travel Rate (in/min)	0.00041

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	14437.7
Peak P' (psf)	8629.8
Peak Q (psf)	4342.6
Strain at Peak (%)	5.2
σ_3' (psf)	4287.2
σ_1' (psf)	12972.5
σ_3 (psf)	10095.1
σ_1 (psf)	18780.4

Picture of Failure

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-03 / U1 / Stage 3

May 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf)		
						P	P'	Q
0.00	0.0	0.0	10095.1	10095.1	1.00	10095.1	10095.1	0.0
0.02	92.8	106.6	10081.3	9988.5	1.01	10141.5	10034.9	46.4
0.05	582.1	375.9	10301.2	9719.1	1.06	10386.1	10010.2	291.0
0.06	1101.8	628.6	10568.2	9466.5	1.12	10646.0	10017.3	550.9
0.09	1587.0	870.4	10811.7	9224.7	1.17	10888.6	10018.2	793.5
0.11	1999.0	1100.1	10993.9	8995.0	1.22	11094.5	9994.4	999.5
0.14	2365.1	1314.6	11145.5	8780.4	1.27	11277.6	9963.0	1182.5
0.16	2698.2	1507.6	11285.7	8587.4	1.31	11444.2	9936.5	1349.1
0.19	3005.6	1702.6	11398.0	8392.5	1.36	11597.9	9895.2	1502.8
0.21	3295.9	1880.4	11510.5	8214.7	1.40	11743.0	9862.6	1647.9
0.23	3572.9	2052.0	11616.0	8043.1	1.44	11881.5	9829.6	1786.4
0.26	3821.7	2206.6	11710.2	7888.4	1.48	12005.9	9799.3	1910.9
0.28	4038.5	2355.8	11777.8	7739.3	1.52	12114.3	9758.5	2019.3
0.30	4237.1	2490.1	11842.1	7605.0	1.56	12213.6	9723.6	2118.6
0.33	4441.3	2621.6	11914.8	7473.4	1.59	12315.7	9694.1	2220.7
0.35	4626.7	2744.1	11977.7	7351.0	1.63	12408.4	9664.3	2313.3
0.39	4802.8	2863.0	12034.9	7232.1	1.66	12496.5	9633.5	2401.4
0.41	4970.2	2975.6	12089.7	7119.5	1.70	12580.2	9604.6	2485.1
0.44	5120.3	3080.5	12134.8	7014.6	1.73	12655.2	9574.7	2560.1
0.46	5255.4	3184.6	12165.9	6910.5	1.76	12722.8	9538.2	2627.7
0.49	5387.4	3268.7	12213.8	6826.3	1.79	12788.8	9520.1	2693.7
0.52	5513.0	3357.3	12250.7	6737.7	1.82	12851.6	9494.2	2756.5
0.54	5635.5	3442.6	12288.0	6652.5	1.85	12912.8	9470.2	2817.7
0.57	5757.9	3523.3	12329.6	6571.8	1.88	12974.0	9450.7	2878.9
0.59	5864.3	3602.7	12356.6	6492.3	1.90	13027.2	9424.5	2932.1
0.62	5969.3	3679.9	12384.4	6415.2	1.93	13079.7	9399.8	2984.6
0.65	6068.7	3748.7	12415.1	6346.4	1.96	13129.4	9380.7	3034.3
0.68	6155.2	3814.3	12436.1	6280.8	1.98	13172.7	9358.4	3077.6
0.70	6241.4	3880.9	12455.5	6214.1	2.00	13215.8	9334.8	3120.7
0.73	6324.3	3953.1	12466.3	6141.9	2.03	13257.2	9304.1	3162.2
0.75	6410.0	4005.5	12499.6	6089.6	2.05	13300.1	9294.6	3205.0
0.77	6493.3	4059.6	12528.8	6035.5	2.08	13341.7	9282.1	3246.7
0.80	6562.8	4111.7	12546.1	5983.3	2.10	13376.5	9264.7	3281.4
0.83	6630.2	4166.4	12558.9	5928.6	2.12	13410.2	9243.8	3315.1
0.86	6695.3	4215.5	12574.9	5879.6	2.14	13442.7	9227.2	3347.6
0.88	6760.6	4264.2	12591.5	5830.9	2.16	13475.4	9211.2	3380.3
0.91	6824.8	4313.6	12606.3	5781.5	2.18	13507.4	9193.9	3412.4
0.93	6893.3	4352.3	12636.1	5742.7	2.20	13541.7	9189.4	3446.7
0.96	6946.4	4403.1	12638.3	5692.0	2.22	13568.3	9165.1	3473.2
0.99	6999.0	4444.2	12649.9	5650.9	2.24	13594.6	9150.4	3499.5
1.01	7038.5	4490.3	12643.3	5604.8	2.26	13614.3	9124.0	3519.3
1.03	7090.1	4521.2	12664.0	5573.9	2.27	13640.1	9118.9	3545.1
1.14	7278.4	4668.3	12705.1	5426.8	2.34	13734.3	9066.0	3639.2
1.24	7425.6	4791.3	12729.3	5303.7	2.40	13807.9	9016.5	3712.8
1.35	7567.0	4901.5	12760.6	5193.6	2.46	13878.6	8977.1	3783.5
1.46	7678.1	4991.6	12781.5	5103.4	2.50	13934.1	8942.5	3839.0
1.56	7770.1	5071.3	12793.8	5023.7	2.55	13980.1	8908.8	3885.0
1.67	7865.4	5153.5	12807.0	4941.5	2.59	14027.8	8874.3	3932.7
1.77	7939.8	5218.3	12816.5	4876.7	2.63	14065.0	8846.6	3969.9
1.88	8025.6	5279.5	12841.2	4815.6	2.67	14107.9	8828.4	4012.8
1.98	8074.4	5337.3	12832.2	4757.8	2.70	14132.3	8795.0	4037.2

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-03 / U1 / Stage 3

May 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf)		
						P	P'	Q
2.09	8132.3	5377.7	12849.7	4717.4	2.72	14161.2	8783.5	4066.1
2.18	8182.3	5417.6	12859.7	4677.5	2.75	14186.2	8768.6	4091.1
2.30	8224.2	5459.1	12860.2	4636.0	2.77	14207.2	8748.1	4112.1
2.40	8274.4	5493.3	12876.2	4601.8	2.80	14232.3	8739.0	4137.2
2.50	8311.6	5523.8	12882.8	4571.3	2.82	14250.8	8727.1	4155.8
2.62	8348.5	5559.3	12884.2	4535.8	2.84	14269.3	8710.0	4174.2
2.71	8379.6	5581.4	12893.3	4513.7	2.86	14284.9	8703.5	4189.8
2.82	8406.6	5599.4	12902.2	4495.7	2.87	14298.3	8698.9	4203.3
2.94	8440.2	5630.9	12904.3	4464.1	2.89	14315.2	8684.2	4220.1
3.02	8464.0	5647.5	12911.6	4447.6	2.90	14327.0	8679.6	4232.0
3.15	8498.7	5668.7	12925.1	4426.3	2.92	14344.4	8675.7	4249.4
3.25	8516.2	5681.1	12930.2	4414.0	2.93	14353.2	8672.1	4258.1
3.36	8548.7	5697.4	12946.3	4397.6	2.94	14369.4	8672.0	4274.3
3.46	8566.7	5707.4	12954.3	4387.6	2.95	14378.4	8671.0	4283.3
3.57	8584.6	5717.8	12961.9	4377.3	2.96	14387.4	8669.6	4292.3
3.68	8605.8	5737.4	12963.4	4357.6	2.97	14398.0	8660.5	4302.9
3.78	8622.4	5738.0	12979.5	4357.0	2.98	14406.3	8668.3	4311.2
3.89	8647.1	5752.2	12990.0	4342.9	2.99	14418.6	8666.5	4323.6
3.99	8651.9	5759.6	12987.4	4335.5	3.00	14421.0	8661.5	4326.0
4.09	8661.6	5765.6	12991.1	4329.5	3.00	14425.9	8660.3	4330.8
4.21	8673.4	5776.1	12992.5	4319.0	3.01	14431.8	8655.7	4336.7
4.31	8683.0	5775.1	13003.0	4319.9	3.01	14436.6	8661.5	4341.5
4.43	8691.7	5782.1	13004.7	4312.9	3.02	14440.9	8658.8	4345.9
4.52	8688.0	5786.5	12996.5	4308.5	3.02	14439.1	8652.5	4344.0
4.62	8704.1	5782.3	13016.9	4312.7	3.02	14447.1	8664.8	4352.1
4.74	8701.2	5791.0	13005.3	4304.1	3.02	14445.7	8654.7	4350.6
4.85	8690.6	5794.5	12991.1	4300.6	3.02	14440.4	8645.9	4345.3
4.95	8689.7	5796.1	12988.7	4299.0	3.02	14439.9	8643.9	4344.9
5.05	8688.4	5799.1	12984.4	4296.0	3.02	14439.3	8640.2	4344.2
5.16	8685.3	5807.9	12972.5	4287.2	3.03	14437.7	8629.8	4342.6
5.26	8680.2	5799.3	12976.0	4295.8	3.02	14435.2	8635.9	4340.1
5.52	8667.9	5808.7	12954.3	4286.4	3.02	14429.0	8620.4	4334.0
5.79	8613.4	5809.2	12899.3	4285.9	3.01	14401.8	8592.6	4306.7
6.05	8559.4	5811.2	12843.3	4283.9	3.00	14374.8	8563.6	4279.7
6.32	8486.8	5812.5	12769.4	4282.6	2.98	14338.5	8526.0	4243.4
6.58	8416.8	5822.2	12689.7	4272.9	2.97	14303.5	8481.3	4208.4
6.85	8331.1	5820.0	12606.2	4275.1	2.95	14260.6	8440.6	4165.6
7.12	8247.0	5818.9	12523.2	4276.2	2.93	14218.6	8399.7	4123.5
7.38	8178.3	5825.7	12447.7	4269.3	2.92	14184.2	8358.5	4089.2
7.64	8126.7	5828.3	12393.5	4266.8	2.90	14158.4	8330.1	4063.4
7.91	8077.8	5824.5	12348.4	4270.6	2.89	14134.0	8309.5	4038.9
8.17	8021.7	5821.8	12295.0	4273.2	2.88	14105.9	8284.1	4010.9
8.45	7955.9	5816.4	12234.5	4278.7	2.86	14073.0	8256.6	3977.9
8.71	7901.0	5812.6	12183.5	4282.5	2.84	14045.6	8233.0	3950.5
8.97	7825.2	5803.8	12116.4	4291.3	2.82	14007.6	8203.9	3912.6
9.24	7740.4	5805.8	12029.7	4289.3	2.80	13965.3	8159.5	3870.2
9.51	7691.7	5792.2	11994.5	4302.8	2.79	13940.9	8148.7	3845.8
9.77	7633.5	5778.2	11950.3	4316.8	2.77	13911.8	8133.6	3816.7
10.03	7588.1	5784.8	11898.4	4310.3	2.76	13889.1	8104.3	3794.0
10.29	7532.4	5778.3	11849.2	4316.8	2.74	13861.3	8083.0	3766.2
10.56	7485.4	5776.6	11803.9	4318.5	2.73	13837.8	8061.2	3742.7

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-03 / U1 / Stage 3

May 2021
107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf)		
						P	P'	Q
10.82	7437.4	5768.2	11764.3	4326.9	2.72	13813.7	8045.6	3718.7
11.09	7392.5	5768.0	11719.6	4327.1	2.71	13791.3	8023.3	3696.3
11.36	7341.5	5764.9	11671.7	4330.2	2.70	13765.8	8000.9	3670.7
11.61	7322.3	5768.3	11649.1	4326.8	2.69	13756.2	7987.9	3661.1
11.88	7304.6	5764.0	11635.7	4331.1	2.69	13747.4	7983.4	3652.3
12.14	7266.4	5756.5	11605.0	4338.6	2.67	13728.3	7971.8	3633.2
12.40	7244.5	5758.7	11580.9	4336.3	2.67	13717.3	7958.6	3622.3
12.68	7207.6	5762.0	11540.7	4333.1	2.66	13698.9	7936.9	3603.8
12.94	7185.6	5755.4	11525.2	4339.7	2.66	13687.8	7932.5	3592.8
13.21	7151.5	5752.7	11493.8	4342.4	2.65	13670.8	7918.1	3575.7
13.47	7117.4	5748.7	11463.7	4346.3	2.64	13653.8	7905.0	3558.7
13.73	7098.6	5742.9	11450.8	4352.1	2.63	13644.4	7901.4	3549.3
14.00	7078.5	5744.8	11428.7	4350.2	2.63	13634.3	7889.5	3539.2
14.26	7069.7	5740.8	11424.0	4354.3	2.62	13629.9	7889.1	3534.9
14.53	7043.9	5739.4	11399.6	4355.7	2.62	13617.0	7877.6	3522.0
14.79	7036.3	5734.0	11397.4	4361.1	2.61	13613.2	7879.2	3518.2
15.07	7037.9	5741.1	11391.8	4353.9	2.62	13614.0	7872.9	3519.0

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-03 / U1 / Stage 3

May 2021 107095-002

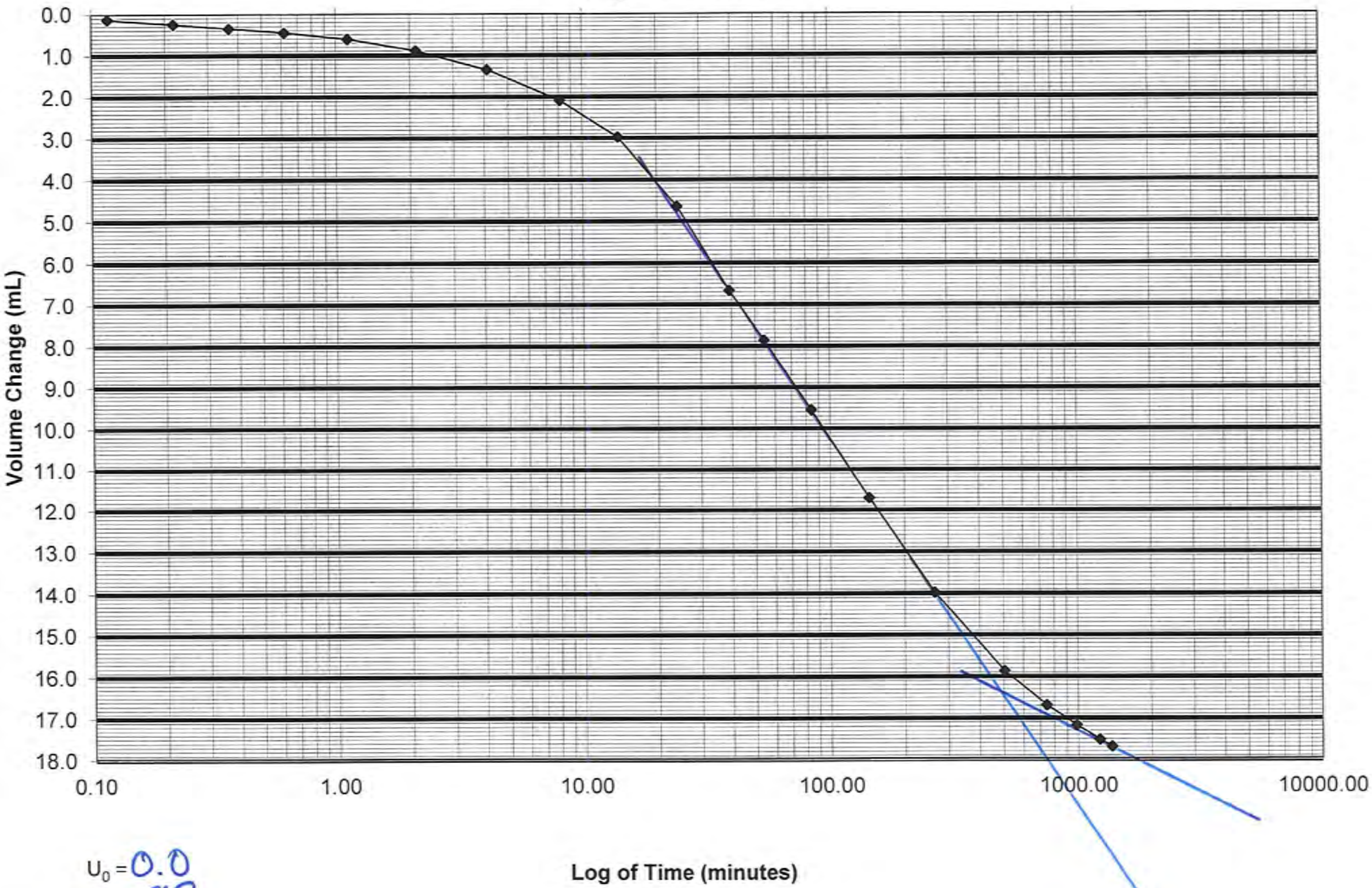
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

AECI NMPP - Raw Water Pond

107095-002

HA-RWP-03 U1

Stage 3 69.0 psi



U_0 = 0.0
U_{50} = 8.2
U_{100} = 16.4
t_{50} = 59.12

%/hr = 0.41

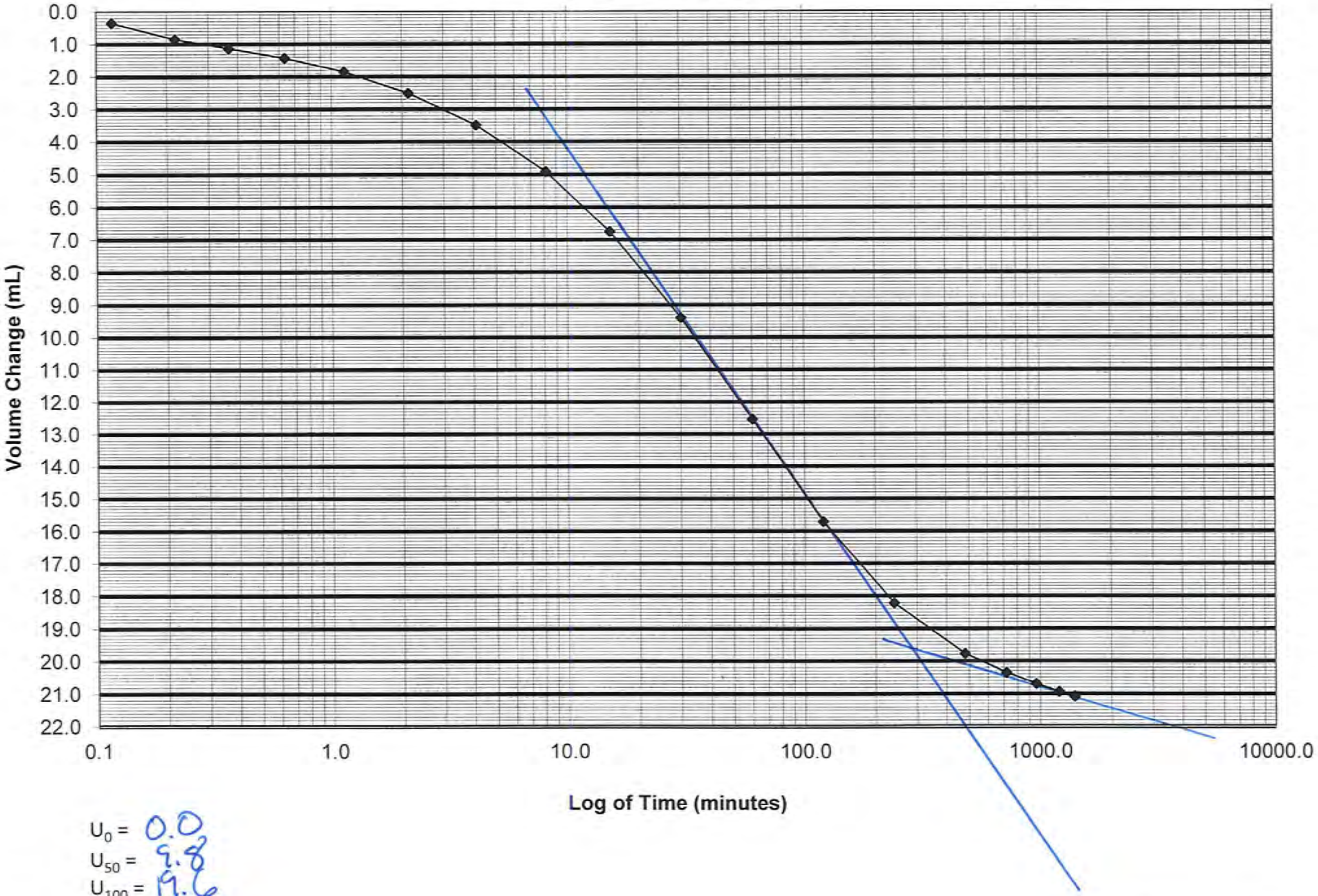
SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

AECI NMPP - Raw Water Pond

107095-002

HA-RWP-03 U1

Stage 1 21.5 psi



U_0 = 0.0
U_{50} = 9.8
U_{100} = 19.6
t_{50} = 32.95

%/HR=0.728

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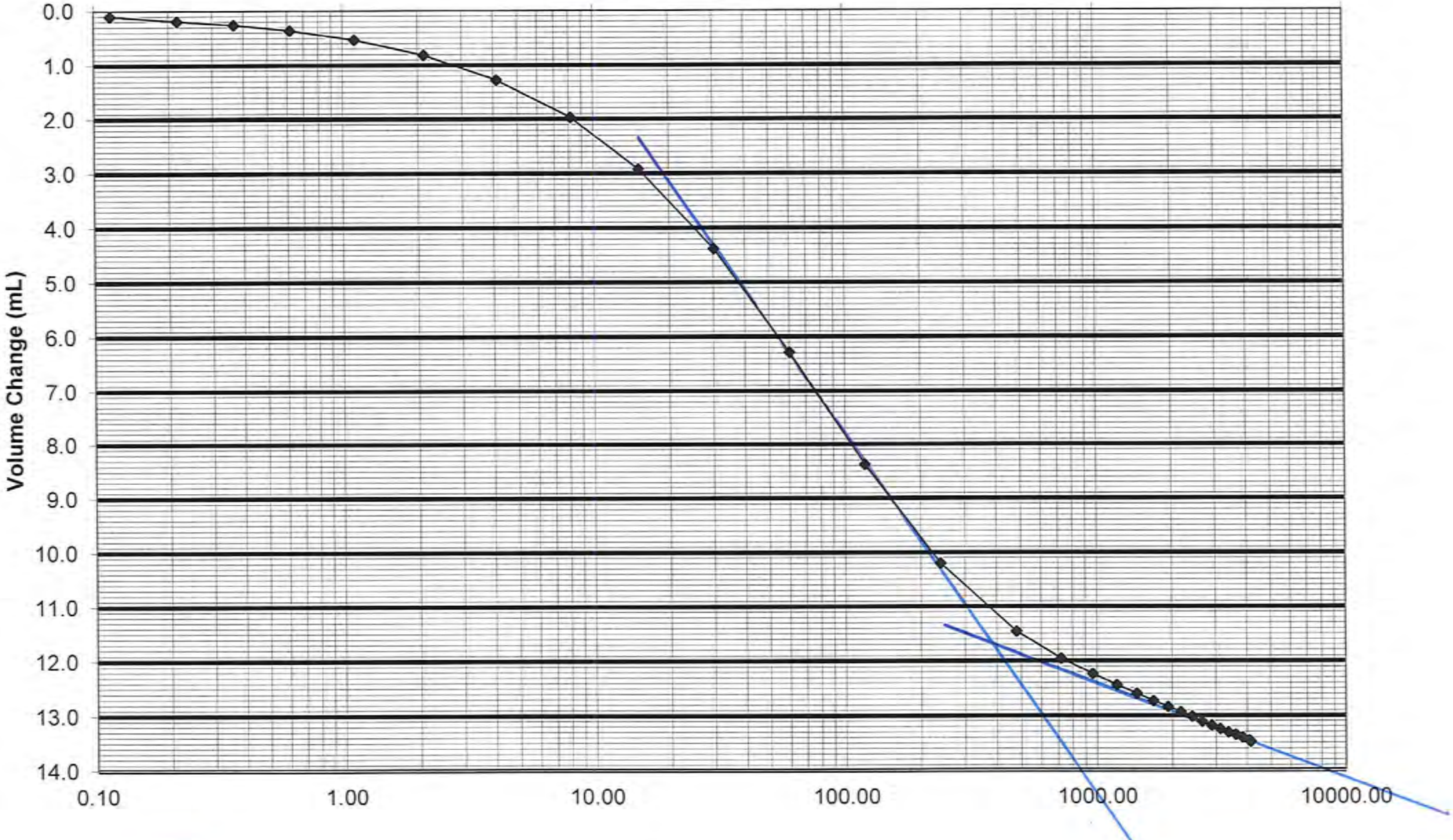
AECI NMPP - Raw Water Pond

107095-002

HA-RWP-03 U1

Stage 2 34.5 psi



U_0 = 0.0

U_{50} = 5.9

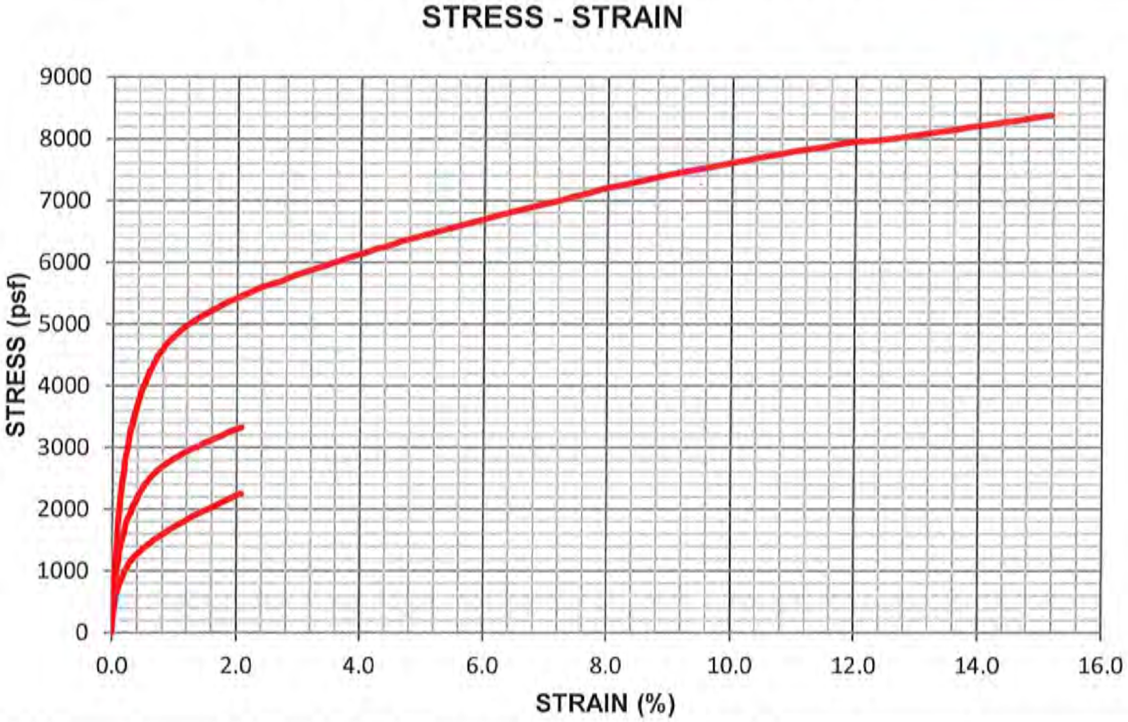
U_{100} = 11.7

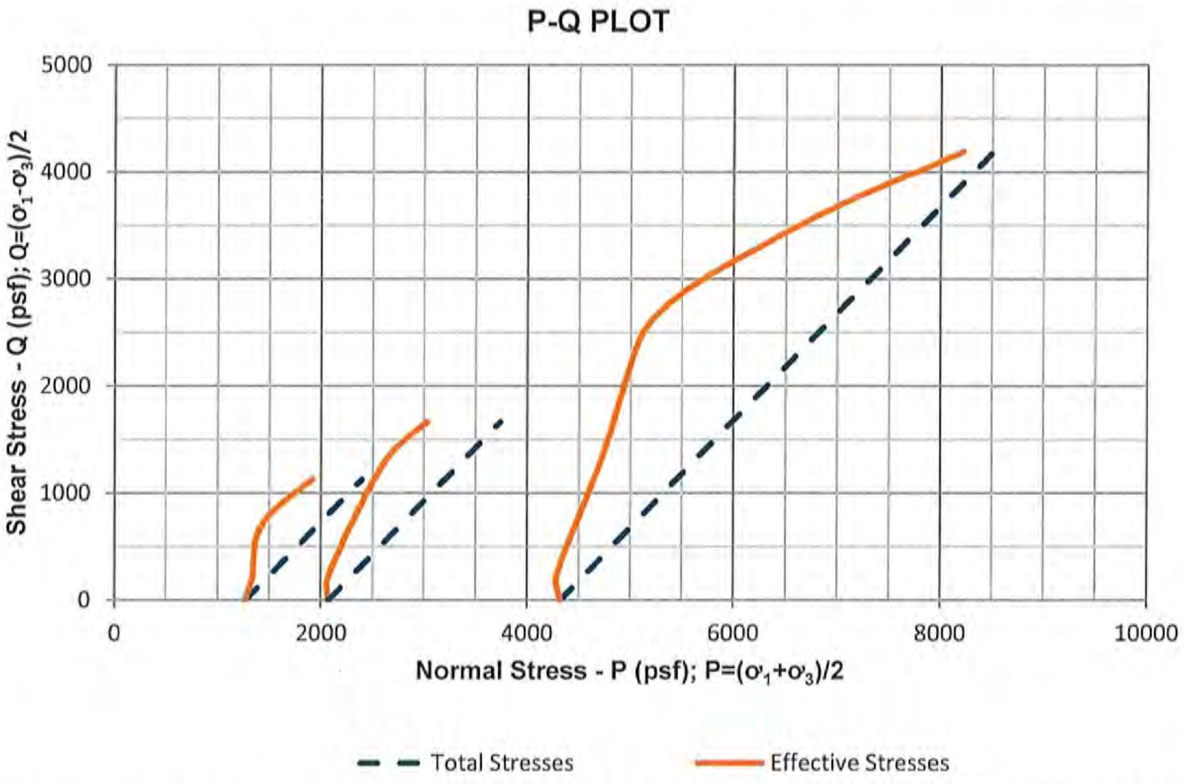
t_{50} = 51.35

%/hr=0.467

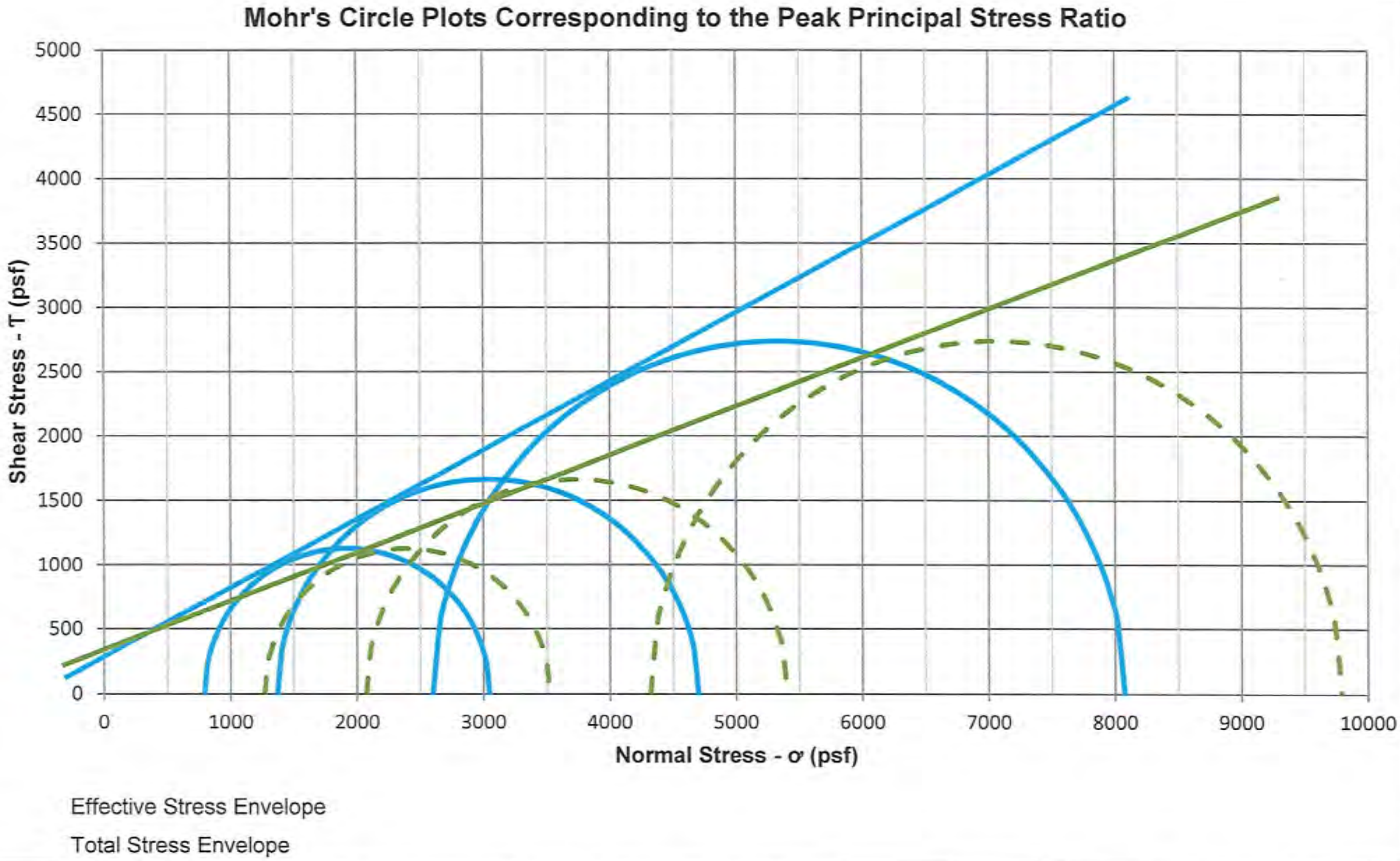
SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
WITH PORE PRESSURE MEASUREMENT





SHANNON & WILSON, INC. 2043 WESTPORT CENTER DR. SAINT LOUIS, MISSOURI 63146 107095-002	CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION AECI NMPP - Raw Water Pond Marston, Missouri HA-RWP-05 / U1 / 13.1



Sample	Strain (%)
Stage 1	2.1
Stage 2	2.1
Stage 3	2.1

c =	340 psf
ϕ =	20.7 deg
c' =	280 psf
ϕ' =	28.2 deg

NOTES:
1. Mohr's circles in this plot are based upon the principal stress difference at the same strain during loading.
2. Strength parameters determined by Shannon & Wilson. Engineer-of-Record should evaluate cohesion and friction commensurate with project conditions.

AECI NMPP - Raw Water Pond
Marston, Missouri

Mohr's Circle Plots
HA-RWP-05 / U1

June 2021
107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Figure 1

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - Raw Water Pond					
Location	Marston, Missouri			Client	Haley & Aldrich, Inc.	
Job No.	107095-002			Tested by	CMB	May-21
Boring	HA-RWP-05			Calculated by	CMB	Jun-21
Sample	U1	Specimen Number	Stage 1	Checked by	DPM	6/2/2021
Depth (ft)	13.1	Undisturbed/Remold	Undisturbed	File	107095-002 HA-RWP-05 U1 ASTM D4767	
Description	Mottled gray-brown, Lean Clay with Sand (CL).			Procedure	ASTM D4767	
Remarks						

Specimen Data

	Initial	Post Consol.	Post Shear
Height (in)	5.992	5.990	5.866
Diameter (in)	2.877	2.865	
Volume (in^3)	38.953	38.610	
Height/Diameter ratio	2.083	2.091	
Weight (g)	1306.08	1334.02	1334.02
Water Content (%)	16.74	19.24	19.24
Bulk Unit Weight (pcf)	127.7	130.5	131.6
Dry Unit Weight (pcf)	109.4	109.4	110.4
Cross-Sectional Area* (in^2)	6.501	6.446	
% Saturation - Wet Method	84.92	100.13	100.13
Specific Gravity - Assumed	2.68	2.68	2.68
Void Ratio	0.528	0.515	0.515
	Trimmings		
Tare ID	28		
Mass wet soil + tare (g)	482.99		
Mass dry soil + tare (g)	436.62		
Mass tare (g)	159.67		

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	98.8
Pore Pressure (psi)	90.0
Effective Confining Pressure (psi)	8.8
B-value	99.00

Consolidation Phase

Change in Volume (in^3)	0.343
T_{50} (min)	47.8
Platen Travel Rate (in/min)	0.00049

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	2397.2
Peak P' (psf)	1919.5
Peak Q (psf)	1126.8
Strain at Peak (%)	2.1
σ_3' (psf)	792.8
σ_1' (psf)	3046.3
σ_3 (psf)	1270.4
σ_1 (psf)	3524.0

Picture of Failure

See Stage 3

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-05 / U1 / Stage 1

June 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf)		
						P	P'	Q
0.00	0.0	0.0	1270.4	1270.4	1.00	1270.4	1270.4	0.0
0.02	227.6	69.7	1428.3	1200.7	1.19	1384.2	1314.5	113.8
0.04	411.5	133.1	1548.8	1137.3	1.36	1476.2	1343.1	205.8
0.05	504.3	175.9	1598.8	1094.5	1.46	1522.6	1346.7	252.2
0.06	584.9	214.6	1640.8	1055.9	1.55	1562.9	1348.3	292.5
0.09	670.1	258.3	1682.3	1012.2	1.66	1605.5	1347.2	335.1
0.12	762.5	301.3	1731.6	969.1	1.79	1651.7	1350.4	381.3
0.14	841.0	334.3	1777.1	936.1	1.90	1690.9	1356.6	420.5
0.17	904.4	367.5	1807.3	903.0	2.00	1722.6	1355.2	452.2
0.19	961.6	392.1	1839.9	878.4	2.09	1751.2	1359.1	480.8
0.21	1006.9	413.5	1863.8	857.0	2.17	1773.9	1360.4	503.4
0.24	1051.0	434.9	1886.5	835.5	2.26	1795.9	1361.0	525.5
0.26	1095.6	449.4	1916.7	821.1	2.33	1818.2	1368.9	547.8
0.28	1133.1	461.9	1941.7	808.6	2.40	1837.0	1375.1	566.5
0.31	1169.0	475.4	1964.0	795.0	2.47	1854.9	1379.5	584.5
0.34	1198.5	486.4	1982.5	784.1	2.53	1869.7	1383.3	599.2
0.37	1227.6	495.5	2002.5	774.9	2.58	1884.3	1388.7	613.8
0.39	1256.8	505.0	2022.2	765.4	2.64	1898.8	1393.8	628.4
0.42	1281.0	513.3	2038.1	757.1	2.69	1910.9	1397.6	640.5
0.44	1307.4	522.0	2055.8	748.4	2.75	1924.1	1402.1	653.7
0.47	1327.6	527.4	2070.6	743.0	2.79	1934.2	1406.8	663.8
0.49	1351.5	530.6	2091.3	739.8	2.83	1946.2	1415.5	675.7
0.51	1376.1	534.6	2111.9	735.8	2.87	1958.5	1423.9	688.1
0.54	1394.7	537.2	2127.9	733.2	2.90	1967.8	1430.6	697.3
0.57	1416.7	542.1	2145.1	728.4	2.95	1978.8	1436.7	708.4
0.58	1434.4	546.7	2158.1	723.7	2.98	1987.6	1440.9	717.2
0.61	1451.6	551.0	2171.0	719.4	3.02	1996.2	1445.2	725.8
0.64	1468.9	552.4	2187.0	718.1	3.05	2004.9	1452.5	734.5
0.65	1491.6	556.5	2205.6	714.0	3.09	2016.2	1459.8	745.8
0.68	1509.8	554.0	2226.2	716.4	3.11	2025.3	1471.3	754.9
0.70	1521.2	556.8	2234.9	713.6	3.13	2031.0	1474.2	760.6
0.73	1539.0	559.7	2249.7	710.7	3.17	2039.9	1480.2	769.5
0.76	1556.8	559.9	2267.3	710.6	3.19	2048.8	1489.0	778.4
0.78	1573.8	559.3	2284.9	711.1	3.21	2057.3	1498.0	786.9
0.81	1591.3	560.4	2301.4	710.1	3.24	2066.1	1505.7	795.7
0.84	1606.9	563.6	2313.6	706.8	3.27	2073.9	1510.2	803.4
0.86	1624.1	561.7	2332.8	708.7	3.29	2082.5	1520.8	812.1
0.89	1642.1	561.7	2350.8	708.7	3.32	2091.5	1529.8	821.1
0.91	1659.5	560.2	2369.7	710.2	3.34	2100.2	1540.0	829.7
0.93	1673.6	562.1	2382.0	708.3	3.36	2107.3	1545.1	836.8
0.97	1688.3	560.9	2397.8	709.5	3.38	2114.6	1553.7	844.2
1.06	1752.5	559.3	2463.7	711.2	3.46	2146.7	1587.4	876.3
1.17	1802.5	553.2	2519.7	717.2	3.51	2171.7	1618.5	901.2
1.26	1863.9	546.9	2587.5	723.6	3.58	2202.4	1655.5	932.0
1.37	1921.8	541.8	2650.4	728.6	3.64	2231.3	1689.5	960.9
1.47	1969.3	532.0	2707.7	738.4	3.67	2255.1	1723.1	984.7
1.57	2014.9	525.4	2759.9	745.0	3.70	2277.9	1752.5	1007.5
1.67	2065.4	515.0	2820.9	755.5	3.73	2303.1	1788.2	1032.7
1.77	2114.0	505.6	2878.8	764.8	3.76	2327.4	1821.8	1057.0
1.87	2163.4	497.0	2936.9	773.4	3.80	2352.2	1855.1	1081.7
1.96	2208.7	483.7	2995.5	786.7	3.81	2374.8	1891.1	1104.4

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-05 / U1 / Stage 1

June 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf)		
						P	P'	Q
2.07	2253.5	477.7	3046.3	792.8	3.84	2397.2	1919.5	1126.8
2.07	2246.9	478.4	3038.9	792.0	3.84	2393.9	1915.4	1123.4

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-05 / U1 / Stage 1

June 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Project	AECI NMPP - Raw Water Pond					
Location	Marston, Missouri			Client	Haley & Aldrich, Inc.	
Job No.	107095-002			Tested by	CMB	May-21
Boring	HA-RWP-05			Calculated by	CMB	Jun-21
Sample	U1	Specimen Number	Stage 2	Checked by	DPm	6/2/2021
Depth (ft)	13.1	Undisturbed/Remold	Undisturbed	File	107095-002 HA-RWP-05 U1 ASTM D4767	
Description	Mottled gray-brown, Lean Clay with Sand (CL).			Procedure	ASTM D4767	
Remarks						

Specimen Data	Initial	Post Consol.	Post Shear
Height (in)	5.866	5.887	5.764
Diameter (in)	2.895	2.877	
Volume (in^3)	38.610	38.281	
Height/Diameter ratio	2.026	2.046	
Weight (g)	1334.02	1328.62	1328.62
Water Content (%)	19.24	18.76	18.76
Bulk Unit Weight (pcf)	131.6	132.2	132.2
Dry Unit Weight (pcf)	110.4	111.3	111.3
Cross-Sectional Area* (in^2)	6.582	6.503	
% Saturation - Wet Method	100.13	100.13	100.13
Specific Gravity - Assumed	2.68	2.68	2.68
Void Ratio	0.515	0.502	0.502
Tare ID			
Mass wet soil + tare (g)			
Mass dry soil + tare (g)			
Mass tare (g)			

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	104.4
Pore Pressure (psi)	90.0
Effective Confining Pressure (psi)	14.4
B-value	99.00

Consolidation Phase

Change in Volume (in^3)	0.330
T_{50} (min)	89.9
Platen Travel Rate (in/min)	0.00026

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	3738.9
Peak P' (psf)	3036.2
Peak Q (psf)	1664.3
Strain at Peak (%)	2.1
σ_3' (psf)	1372.0
σ_1' (psf)	4700.5
σ_3 (psf)	2074.6
σ_1 (psf)	5403.2

Picture of Failure

See Stage 3

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-05 / U1 / Stage 2

June 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf)		
						P	P'	Q
0.00	0.0	0.0	2074.6	2074.6	1.00	2074.6	2074.6	0.0
0.03	316.2	180.3	2210.6	1894.3	1.17	2232.7	2052.4	158.1
0.04	562.7	258.1	2379.2	1816.5	1.31	2356.0	2097.8	281.3
0.06	807.3	324.7	2557.3	1749.9	1.46	2478.3	2153.6	403.7
0.09	1006.8	376.3	2705.2	1698.3	1.59	2578.0	2201.7	503.4
0.11	1175.1	425.8	2823.9	1648.9	1.71	2662.2	2236.4	587.5
0.13	1319.7	462.7	2931.7	1611.9	1.82	2734.5	2271.8	659.9
0.15	1450.0	492.6	3032.0	1582.0	1.92	2799.6	2307.0	725.0
0.18	1561.5	519.8	3116.3	1554.8	2.00	2855.4	2335.5	780.8
0.21	1664.1	548.6	3190.1	1526.0	2.09	2906.7	2358.1	832.1
0.23	1751.4	568.5	3257.5	1506.1	2.16	2950.3	2381.8	875.7
0.25	1829.4	585.2	3318.9	1489.4	2.23	2989.3	2404.1	914.7
0.27	1897.3	604.9	3367.0	1469.7	2.29	3023.3	2418.4	948.7
0.31	1950.6	622.0	3403.2	1452.6	2.34	3049.9	2427.9	975.3
0.32	2020.4	636.4	3458.6	1438.2	2.40	3084.8	2448.4	1010.2
0.35	2080.1	643.4	3511.3	1431.2	2.45	3114.7	2471.3	1040.1
0.38	2130.2	656.6	3548.2	1418.0	2.50	3139.7	2483.1	1065.1
0.40	2182.1	673.6	3583.1	1401.0	2.56	3165.7	2492.1	1091.0
0.43	2233.8	681.6	3626.8	1393.1	2.60	3191.5	2509.9	1116.9
0.45	2275.7	688.4	3661.9	1386.2	2.64	3212.5	2524.1	1137.8
0.48	2319.5	695.8	3698.3	1378.8	2.68	3234.4	2538.6	1159.7
0.50	2359.6	703.8	3730.4	1370.8	2.72	3254.4	2550.6	1179.8
0.52	2394.7	711.7	3757.6	1362.9	2.76	3272.0	2560.3	1197.3
0.55	2430.5	717.6	3787.6	1357.0	2.79	3289.9	2572.3	1215.3
0.58	2459.9	724.3	3810.2	1350.3	2.82	3304.6	2580.2	1229.9
0.60	2490.3	732.0	3832.9	1342.6	2.85	3319.8	2587.8	1245.2
0.62	2525.8	734.6	3865.8	1340.0	2.88	3337.5	2602.9	1262.9
0.64	2547.6	736.1	3886.2	1338.6	2.90	3348.4	2612.4	1273.8
0.68	2574.9	744.1	3905.4	1330.5	2.94	3362.1	2617.9	1287.4
0.70	2596.8	746.9	3924.5	1327.8	2.96	3373.0	2626.1	1298.4
0.72	2620.8	748.0	3947.5	1326.6	2.98	3385.0	2637.0	1310.4
0.75	2643.8	748.8	3969.6	1325.8	2.99	3396.5	2647.7	1321.9
0.78	2661.1	758.8	3977.0	1315.8	3.02	3405.2	2646.4	1330.6
0.80	2685.4	753.6	4006.4	1321.0	3.03	3417.3	2663.7	1342.7
0.82	2703.7	756.7	4021.6	1317.9	3.05	3426.5	2669.8	1351.8
0.86	2723.0	757.4	4040.3	1317.2	3.07	3436.1	2678.7	1361.5
0.88	2739.5	760.6	4053.5	1314.0	3.08	3444.4	2683.8	1369.8
0.90	2753.6	764.2	4064.0	1310.4	3.10	3451.4	2687.2	1376.8
0.92	2774.1	761.1	4087.5	1313.5	3.11	3461.7	2700.5	1387.0
0.95	2788.6	764.0	4099.2	1310.6	3.13	3468.9	2704.9	1394.3
0.98	2807.1	764.2	4117.5	1310.4	3.14	3478.2	2713.9	1403.5
1.08	2863.6	766.1	4172.1	1308.5	3.19	3506.4	2740.3	1431.8
1.17	2924.2	761.5	4237.3	1313.1	3.23	3536.7	2775.2	1462.1
1.27	2971.3	757.9	4288.1	1316.8	3.26	3560.3	2802.4	1485.7
1.38	3019.7	754.0	4340.3	1320.6	3.29	3584.5	2830.4	1509.9
1.48	3070.1	747.2	4397.5	1327.4	3.31	3609.7	2862.5	1535.0
1.58	3114.2	744.7	4444.1	1329.9	3.34	3631.7	2887.0	1557.1
1.68	3159.7	734.0	4500.3	1340.6	3.36	3654.5	2920.5	1579.9
1.78	3202.6	728.1	4549.1	1346.5	3.38	3675.9	2947.8	1601.3
1.87	3244.3	716.1	4602.9	1358.5	3.39	3696.8	2980.7	1622.2
1.97	3288.8	707.7	4655.7	1366.9	3.41	3719.0	3011.3	1644.4

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-05 / U1 / Stage 2

June 2021 107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf) P	P'	Q
2.08	3328.3	702.7	4700.2	1371.9	3.43	3738.8	3036.0	1664.1
2.08	3328.5	702.7	4700.5	1372.0	3.43	3738.9	3036.2	1664.3

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SUMMARY OF TEST DATA

Project	AECI NMPP - Raw Water Pond					
Location	Marston, Missouri			Client	Haley & Aldrich, Inc.	
Job No.	107095-002			Tested by	CMB	May-21
Boring	HA-RWP-05			Calculated by	CMB	Jun-21
Sample	U1	Specimen Number	Stage 3	Checked by	DPm	6/2/2021
Depth (ft)	13.1	Undisturbed/Remold	Undisturbed	File	107095-002 HA-RWP-05 U1 ASTM D4767	
Description	Mottled gray-brown, Lean Clay with Sand (CL).			Procedure	ASTM D4767	
Remarks						

Specimen Data	Initial	Post Consol.	Post Shear
Height (in)	5.764	5.780	4.904
Diameter (in)	2.908	2.881	
Volume (in^3)	38.281	37.689	
Height/Diameter ratio	1.982	2.006	
Weight (g)	1328.62	1318.92	1318.92
Water Content (%)	18.76	17.89	17.89
Bulk Unit Weight (pcf)	132.2	133.3	133.3
Dry Unit Weight (pcf)	111.3	113.1	113.1
Cross-Sectional Area* (in^2)	6.641	6.520	
% Saturation - Wet Method	100.13	100.14	100.14
Specific Gravity - Assumed	2.68	2.68	2.68
Void Ratio	0.502	0.479	0.479
			Entire Sample
Tare ID			20
Mass wet soil + tare (g)			1467.51
Mass dry soil + tare (g)			1239.65
Mass tare (g)			175.19

*Cross-Sectional Area determined using ASTM D4767 Method A

Pressure Conditions

Cell Pressure (psi)	119.9
Pore Pressure (psi)	89.9
Effective Confining Pressure (psi)	30.0
B-value	99.00

Consolidation Phase

Change in Volume (in^3)	0.592
T_{50} (min)	97.7
Platen Travel Rate (in/min)	0.00025

Additional Testing

Liquid Limit (ASTM D4318)	
Plastic Limit (ASTM D4318)	
Particle-Size (ASTM D422)	
Specific Gravity (ASTM D854)	

Summary of Results

Peak P (psf)	7058.0
Peak P' (psf)	5337.5
Peak Q (psf)	2736.6
Strain at Peak (%)	2.1
σ_3' (psf)	2600.9
σ_1' (psf)	8074.1
σ_3 (psf)	4321.4
σ_1 (psf)	9794.7

Picture of Failure

AECI NMPP - Raw Water Pond
Marston, Missouri

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CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf) P	P'	Q
0.00	0.0	0.0	4321.4	4321.4	1.00	4321.4	4321.4	0.0
0.02	368.5	228.3	4461.6	4093.1	1.09	4505.7	4277.3	184.2
0.04	762.9	362.3	4722.0	3959.1	1.19	4702.9	4340.6	381.5
0.06	1112.2	468.4	4965.2	3853.0	1.29	4877.5	4409.1	556.1
0.08	1437.8	564.1	5195.1	3757.3	1.38	5040.3	4476.2	718.9
0.10	1731.5	652.3	5400.7	3669.1	1.47	5187.2	4534.9	865.8
0.13	2000.6	728.1	5593.9	3593.3	1.56	5321.7	4593.6	1000.3
0.15	2242.7	800.4	5763.7	3521.0	1.64	5442.8	4642.4	1121.3
0.17	2461.6	863.4	5919.6	3458.0	1.71	5552.2	4688.8	1230.8
0.20	2653.6	921.1	6054.0	3400.3	1.78	5648.2	4727.1	1326.8
0.22	2829.6	978.6	6172.4	3342.8	1.85	5736.2	4757.6	1414.8
0.25	2987.0	1032.0	6276.4	3289.4	1.91	5814.9	4782.9	1493.5
0.27	3131.3	1077.7	6375.1	3243.7	1.97	5887.1	4809.4	1565.7
0.29	3262.2	1122.6	6461.1	3198.8	2.02	5952.5	4830.0	1631.1
0.33	3372.0	1161.3	6532.1	3160.1	2.07	6007.4	4846.1	1686.0
0.35	3476.2	1199.6	6598.0	3121.8	2.11	6059.5	4859.9	1738.1
0.37	3575.1	1230.1	6666.4	3091.3	2.16	6109.0	4878.9	1787.5
0.40	3665.5	1265.2	6721.7	3056.2	2.20	6154.2	4888.9	1832.7
0.42	3756.5	1297.1	6780.8	3024.3	2.24	6199.7	4902.5	1878.2
0.45	3832.1	1323.5	6830.1	2997.9	2.28	6237.5	4914.0	1916.1
0.47	3913.4	1348.0	6886.8	2973.4	2.32	6278.1	4930.1	1956.7
0.50	3988.3	1373.2	6936.6	2948.2	2.35	6315.6	4942.4	1994.2
0.53	4049.0	1399.5	6971.0	2922.0	2.39	6346.0	4946.5	2024.5
0.55	4114.1	1419.9	7015.7	2901.6	2.42	6378.5	4958.6	2057.1
0.57	4176.6	1437.3	7060.7	2884.1	2.45	6409.7	4972.4	2088.3
0.59	4231.1	1459.0	7093.5	2862.4	2.48	6437.0	4978.0	2115.6
0.63	4282.4	1479.9	7123.9	2841.5	2.51	6462.6	4982.7	2141.2
0.65	4332.0	1489.8	7163.7	2831.6	2.53	6487.4	4997.7	2166.0
0.67	4376.2	1508.3	7189.4	2813.2	2.56	6509.5	5001.3	2188.1
0.69	4421.9	1521.2	7222.2	2800.2	2.58	6532.4	5011.2	2211.0
0.72	4465.8	1536.0	7251.3	2785.5	2.60	6554.3	5018.4	2232.9
0.74	4507.3	1551.3	7277.4	2770.1	2.63	6575.1	5023.8	2253.6
0.77	4542.5	1563.7	7300.3	2757.8	2.65	6592.7	5029.0	2271.3
0.80	4576.6	1574.5	7323.5	2746.9	2.67	6609.7	5035.2	2288.3
0.82	4609.6	1585.1	7346.0	2736.4	2.68	6626.2	5041.2	2304.8
0.84	4648.0	1594.8	7374.6	2726.6	2.70	6645.4	5050.6	2324.0
0.87	4675.7	1606.5	7390.7	2715.0	2.72	6659.3	5052.8	2337.9
0.90	4706.9	1617.8	7410.5	2703.7	2.74	6674.9	5057.1	2353.4
0.92	4737.5	1620.2	7438.8	2701.3	2.75	6690.2	5070.0	2368.8
0.96	4766.2	1631.6	7456.0	2689.9	2.77	6704.5	5072.9	2383.1
0.98	4787.7	1642.8	7466.3	2678.6	2.79	6715.3	5072.5	2393.8
1.08	4884.3	1667.2	7538.5	2654.2	2.84	6763.6	5096.4	2442.2
1.18	4964.0	1688.3	7597.2	2633.1	2.89	6803.4	5115.2	2482.0
1.28	5037.1	1700.5	7658.0	2620.9	2.92	6840.0	5139.4	2518.5
1.39	5100.8	1709.2	7713.0	2612.2	2.95	6871.8	5162.6	2550.4
1.49	5158.5	1718.8	7761.1	2602.6	2.98	6900.7	5181.9	2579.3
1.60	5221.7	1725.1	7818.0	2596.3	3.01	6932.3	5207.1	2610.8
1.70	5272.7	1727.2	7866.9	2594.2	3.03	6957.8	5230.5	2636.3
1.80	5331.3	1726.3	7926.4	2595.1	3.05	6987.1	5260.7	2665.6
1.91	5382.5	1726.7	7977.2	2594.7	3.07	7012.7	5286.0	2691.2
2.01	5424.7	1723.5	8022.7	2598.0	3.09	7033.8	5310.3	2712.4

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-05 / U1 / Stage 3

June 2021
107095-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf)		
						P	P'	Q
2.11	5473.2	1720.5	8074.1	2600.9	3.10	7058.0	5337.5	2736.6
2.22	5515.1	1720.2	8116.3	2601.2	3.12	7079.0	5358.7	2757.5
2.31	5560.6	1714.0	8168.0	2607.4	3.13	7101.7	5387.7	2780.3
2.42	5600.8	1707.6	8214.6	2613.8	3.14	7121.8	5414.2	2800.4
2.52	5639.0	1699.7	8260.8	2621.7	3.15	7141.0	5441.2	2819.5
2.63	5672.1	1698.3	8295.2	2623.2	3.16	7157.5	5459.2	2836.0
2.73	5699.5	1690.6	8330.2	2630.8	3.17	7171.2	5480.5	2849.7
2.84	5750.0	1682.7	8388.8	2638.8	3.18	7196.5	5513.8	2875.0
2.93	5785.9	1675.5	8431.8	2645.9	3.19	7214.4	5538.9	2892.9
3.04	5820.1	1668.5	8473.0	2652.9	3.19	7231.5	5563.0	2910.1
3.14	5858.4	1656.1	8523.7	2665.3	3.20	7250.6	5594.5	2929.2
3.24	5892.1	1651.7	8561.8	2669.7	3.21	7267.5	5615.8	2946.0
3.35	5925.4	1635.5	8611.3	2686.0	3.21	7284.1	5648.6	2962.7
3.46	5951.6	1627.8	8645.3	2693.6	3.21	7297.3	5669.4	2975.8
3.55	5994.1	1618.7	8696.9	2702.8	3.22	7318.5	5699.8	2997.0
3.66	6022.4	1606.7	8737.2	2714.8	3.22	7332.6	5726.0	3011.2
3.76	6060.3	1595.9	8785.8	2725.6	3.22	7351.6	5755.7	3030.1
3.86	6092.0	1585.1	8828.3	2736.3	3.23	7367.5	5782.3	3046.0
3.96	6126.6	1574.0	8874.0	2747.4	3.23	7384.7	5810.7	3063.3
4.06	6149.8	1561.7	8909.5	2759.7	3.23	7396.3	5834.6	3074.9
4.16	6182.6	1548.3	8955.8	2773.2	3.23	7412.7	5864.5	3091.3
4.26	6221.0	1539.0	9003.4	2782.4	3.24	7431.9	5892.9	3110.5
4.38	6246.0	1526.2	9041.2	2795.2	3.23	7444.4	5918.2	3123.0
4.48	6276.9	1512.7	9085.6	2808.7	3.23	7459.9	5947.2	3138.5
4.57	6309.0	1497.9	9132.6	2823.5	3.23	7476.0	5978.0	3154.5
4.68	6347.7	1488.6	9180.5	2832.9	3.24	7495.3	6006.7	3173.8
4.78	6372.3	1475.0	9218.8	2846.5	3.24	7507.6	6032.6	3186.2
4.89	6404.1	1462.2	9263.4	2859.3	3.24	7523.5	6061.3	3202.1
5.00	6431.1	1447.4	9305.1	2874.0	3.24	7537.0	6089.5	3215.5
5.11	6458.5	1437.2	9342.8	2884.3	3.24	7550.7	6113.5	3229.3
5.37	6529.8	1403.3	9447.9	2918.1	3.24	7586.3	6183.0	3264.9
5.62	6599.3	1375.1	9545.6	2946.3	3.24	7621.1	6245.9	3299.6
5.87	6666.5	1342.6	9645.3	2978.8	3.24	7654.7	6312.0	3333.2
6.14	6739.9	1314.6	9746.8	3006.9	3.24	7691.4	6376.8	3369.9
6.40	6806.8	1285.1	9843.2	3036.3	3.24	7724.8	6439.8	3403.4
6.66	6872.0	1255.7	9937.8	3065.8	3.24	7757.4	6501.8	3436.0
6.92	6936.7	1223.1	10035.1	3098.4	3.24	7789.8	6566.8	3468.4
7.19	6996.0	1194.0	10123.5	3127.4	3.24	7819.4	6625.5	3498.0
7.44	7061.7	1163.0	10220.1	3158.4	3.24	7852.3	6689.3	3530.8
7.69	7123.7	1129.7	10315.4	3191.7	3.23	7883.3	6753.6	3561.8
7.94	7198.0	1095.3	10424.1	3226.1	3.23	7920.4	6825.1	3599.0
8.20	7250.3	1064.2	10507.5	3257.2	3.23	7946.6	6882.4	3625.2
8.47	7303.6	1029.1	10595.9	3292.3	3.22	7973.2	6944.1	3651.8
8.72	7363.2	1002.7	10682.0	3318.8	3.22	8003.0	7000.4	3681.6
8.97	7417.9	970.8	10768.5	3350.6	3.21	8030.4	7059.5	3708.9
9.22	7467.3	940.0	10848.7	3381.4	3.21	8055.1	7115.0	3733.6
9.49	7514.0	908.2	10927.2	3413.2	3.20	8078.4	7170.2	3757.0
9.75	7562.5	876.8	11007.1	3444.6	3.20	8102.7	7225.9	3781.2
10.01	7617.5	845.8	11093.1	3475.6	3.19	8130.2	7284.4	3808.8
10.26	7662.1	814.7	11168.9	3506.8	3.18	8152.5	7337.8	3831.0
10.52	7710.4	781.0	11250.8	3540.5	3.18	8176.6	7395.7	3855.2

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SUMMARY OF TEST DATA

Axial Strain (%)	Deviator Stress (psf)	Excess Pore Pressure (psf)	Effective Major Principal Stress (psf)	Effective Minor Principal Stress (psf)	Effective Principal Stress Ratio	Stress Path Parameters (psf)		
						P	P'	Q
10.77	7753.1	750.3	11324.2	3571.2	3.17	8198.0	7447.7	3876.5
11.03	7804.9	717.5	11408.8	3604.0	3.17	8223.9	7506.4	3902.4
11.29	7839.8	687.9	11473.3	3633.5	3.16	8241.3	7553.4	3919.9
11.54	7880.4	657.1	11544.8	3664.4	3.15	8261.6	7604.6	3940.2
11.79	7928.3	629.9	11619.7	3691.5	3.15	8285.6	7655.6	3964.1
12.06	7958.5	601.2	11678.8	3720.2	3.14	8300.7	7699.5	3979.3
12.32	7975.5	577.4	11719.5	3744.1	3.13	8309.2	7731.8	3987.7
12.58	8001.4	553.6	11769.3	3767.9	3.12	8322.2	7768.6	4000.7
12.83	8038.1	531.8	11827.8	3789.6	3.12	8340.5	7808.7	4019.1
13.09	8077.9	498.9	11900.4	3822.5	3.11	8360.4	7861.5	4038.9
13.35	8115.7	474.1	11963.1	3847.4	3.11	8379.3	7905.2	4057.9
13.61	8154.0	451.3	12024.1	3870.1	3.11	8398.4	7947.1	4077.0
13.87	8196.4	419.6	12098.2	3901.8	3.10	8419.6	8000.0	4098.2
14.14	8233.5	392.3	12162.6	3929.1	3.10	8438.2	8045.8	4116.7
14.38	8272.5	369.5	12224.4	3951.9	3.09	8457.7	8088.2	4136.3
14.64	8300.8	343.8	12278.4	3977.6	3.09	8471.8	8128.0	4150.4
14.91	8346.3	316.5	12351.2	4004.9	3.08	8494.6	8178.1	4173.2
15.16	8382.8	294.7	12409.5	4026.8	3.08	8512.8	8218.2	4191.4

AECI NMPP - Raw Water Pond
Marston, Missouri

CU TRIAXIAL TEST RESULTS
HA-RWP-05 / U1 / Stage 3

June 2021 107095-002

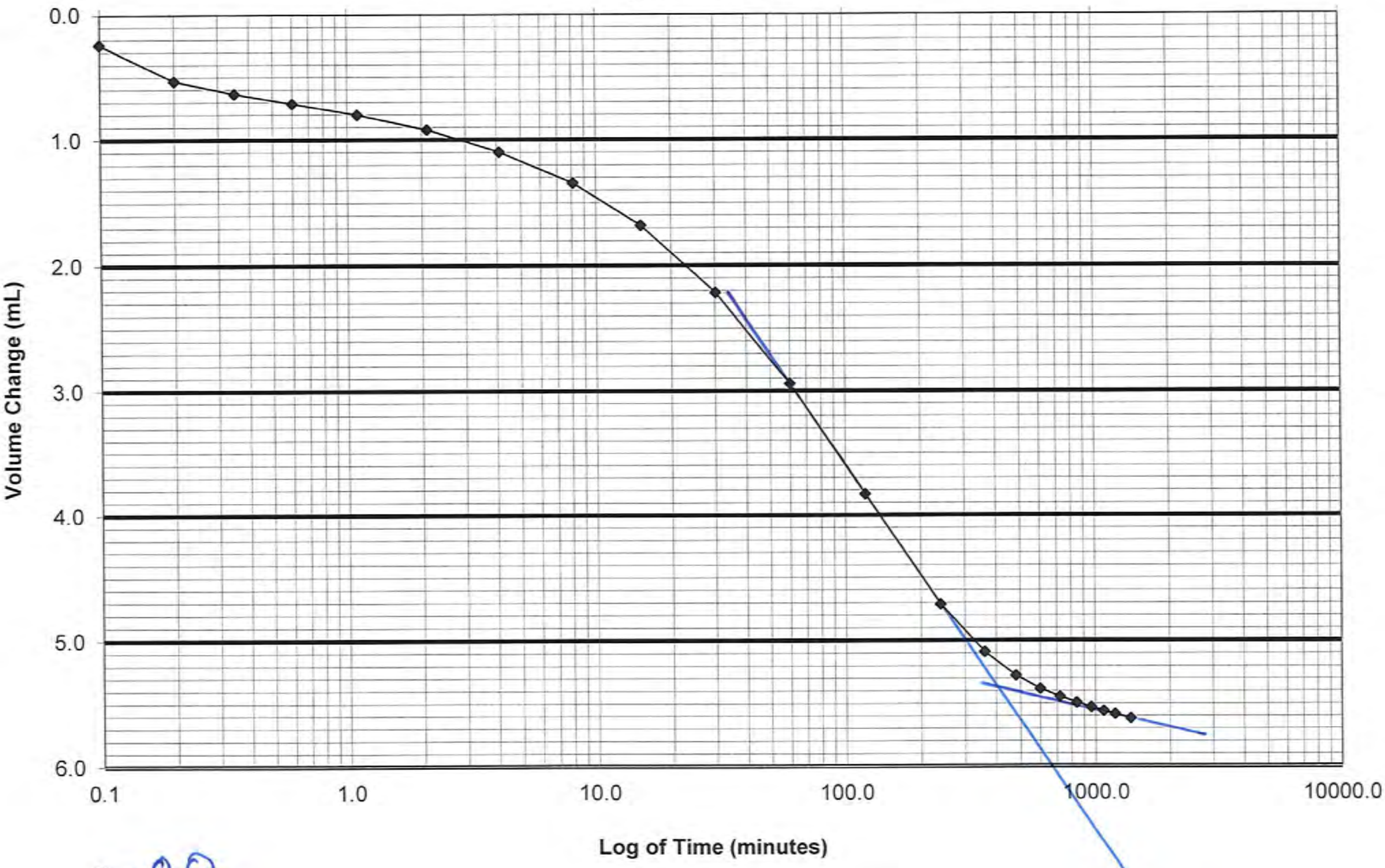
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

AECI NMPP - Raw Water Pond

107095-002

HA-RWP-05 U1

Stage 1 9.0 psi



U_0 = 0.0

U_{50} = 2.7

U_{100} = 5.4

t_{50} = 47.76

%/hr= 0.503

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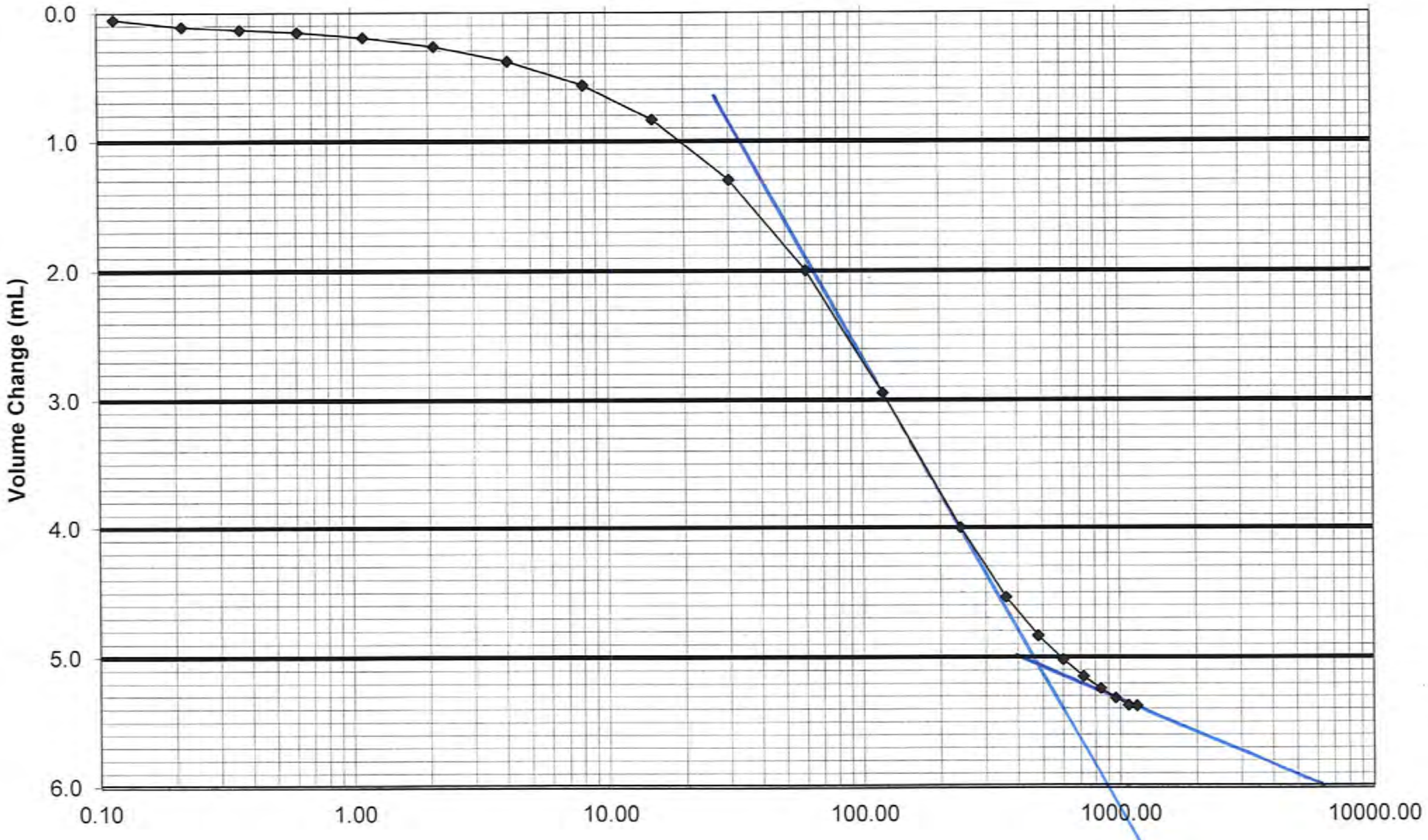
AECI NMPP - Raw Water Pond

107095-002

HA-RWP-05 U1

Stage 2 14.5 psi



U_0 = 0.0
U_{50} = 2.6
U_{100} = 5.1
t_{50} = 89.91

%/hr= 0.267

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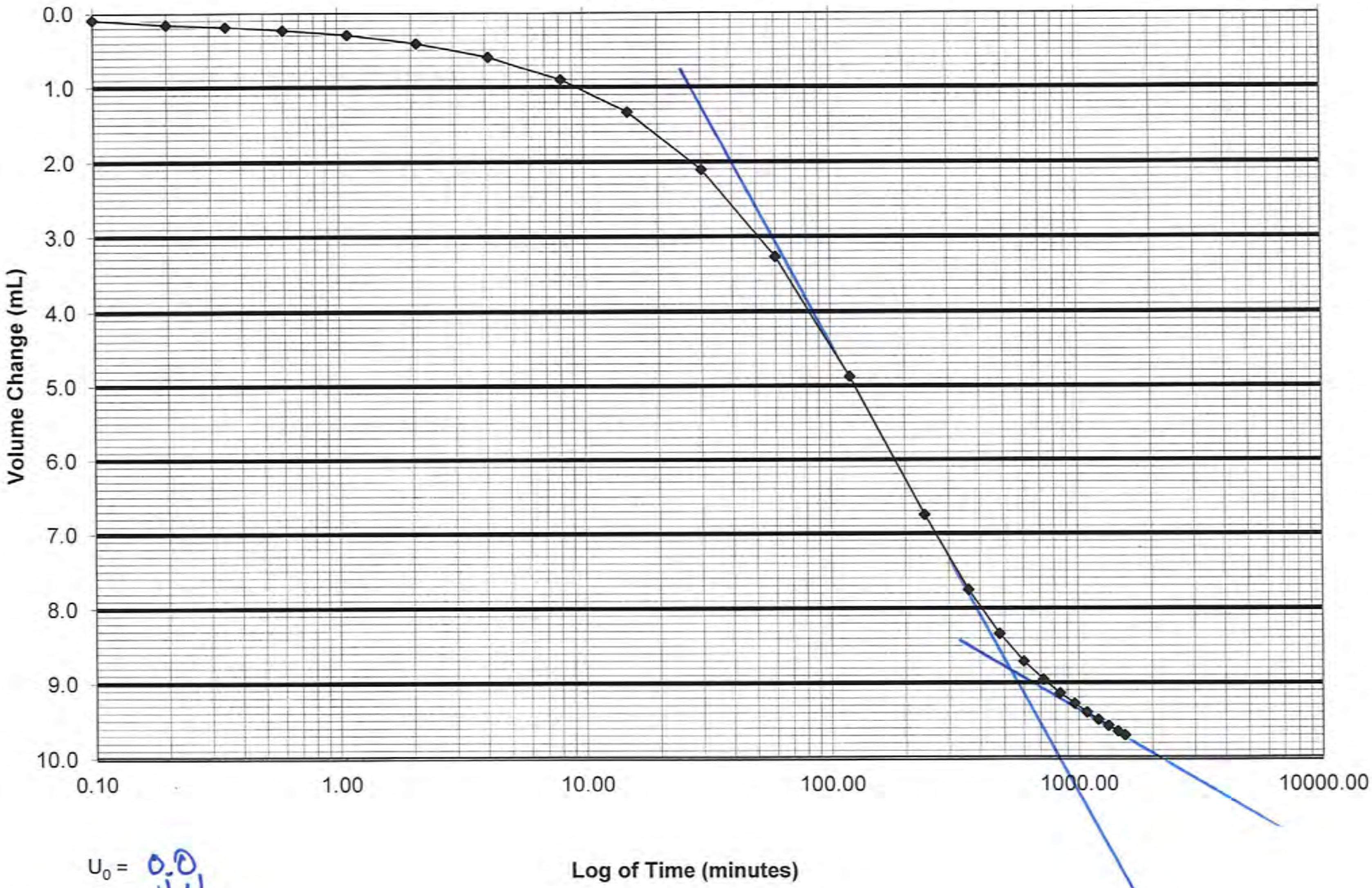
AECI NMPP - Raw Water Pond

107095-002

HA-RWP-05 U1

Stage 3 29.0 psi



U_0 = 0.0
U_{50} = 4.4
U_{100} = 8.8
t_{50} = 97.69

90/hr = 0.246

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

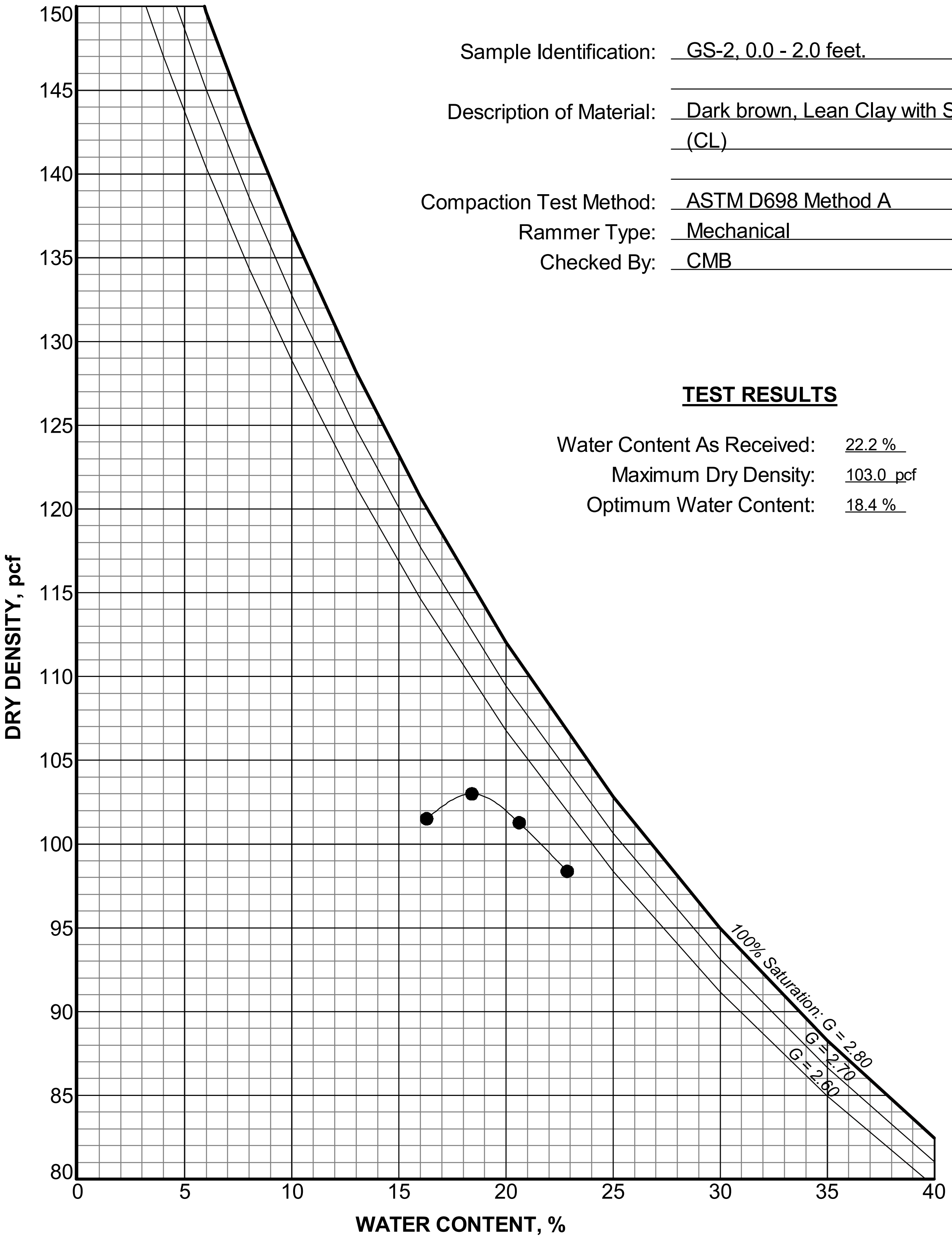
Sample Identification: GS-2, 0.0 - 2.0 feet.

Description of Material: Dark brown, Lean Clay with Sand. (CL)

Compaction Test Method: ASTM D698 Method A

Rammer Type: Mechanical

Checked By: CMB



TEST RESULTS

Water Content As Received: 22.2 %

Maximum Dry Density: 103.0 pcf

Optimum Water Content: 18.4 %

OTHER TEST RESULTS

GRAIN SIZE ANALYSES:	% Gravel:	0.0
	% Sand:	18.0
	% Fines:	82.0
ATTERBERG LIMITS:	Liquid Limit:	37
	Plastic Limit:	23
	Plasticity Index:	14

AECI NMPP - Raw Water Pond
Marston, Missouri

MOISTURE-DENSITY TEST

May 2021 107095-002 / 129342-039

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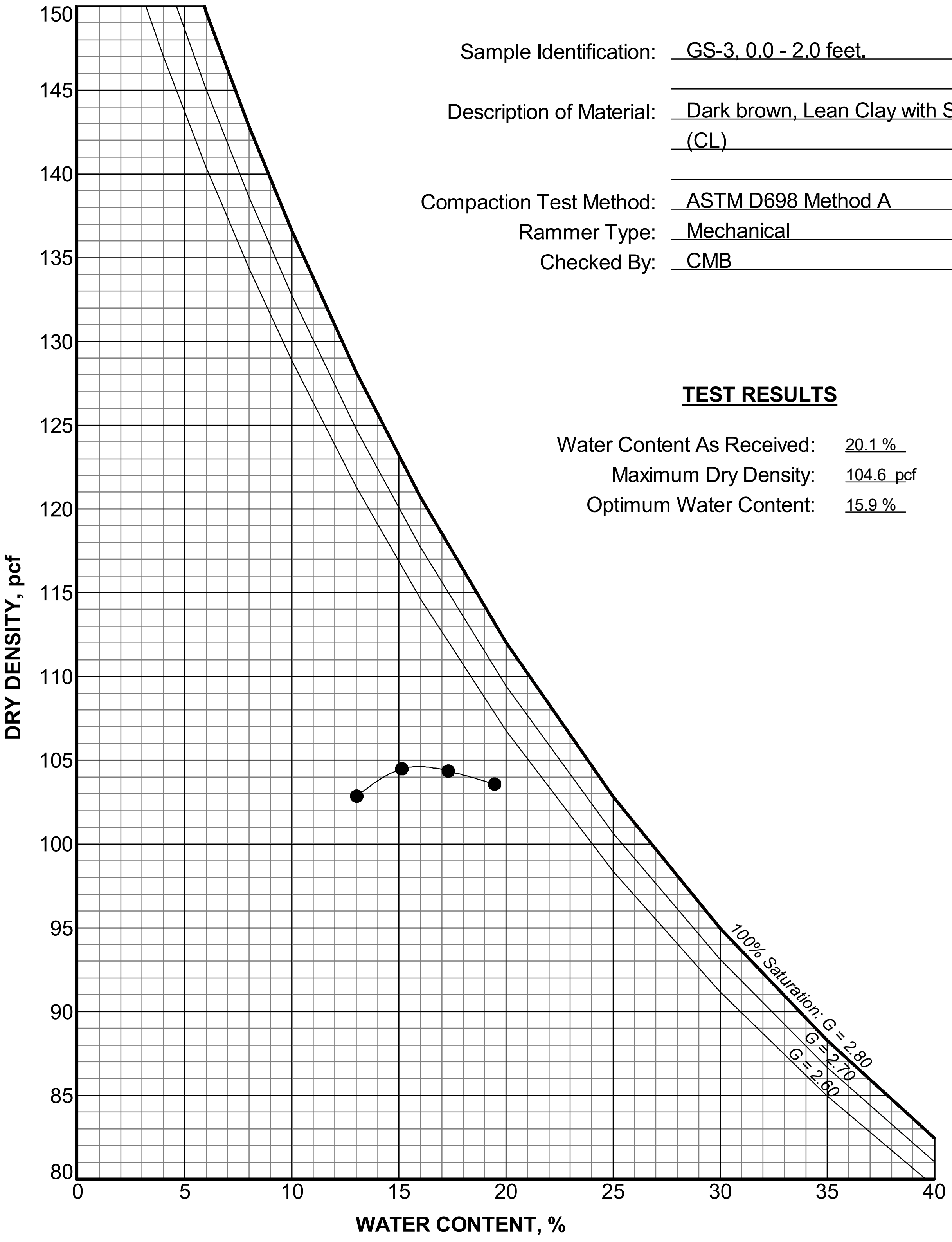
FIG.



Sample Identification: GS-3, 0.0 - 2.0 feet.

Description of Material: Dark brown, Lean Clay with Sand. (CL)

Compaction Test Method: ASTM D698 Method A
Rammer Type: Mechanical
Checked By: CMB

TEST RESULTS

Water Content As Received: 20.1 %
Maximum Dry Density: 104.6 pcf
Optimum Water Content: 15.9 %

OTHER TEST RESULTS

GRAIN SIZE ANALYSES:	% Gravel:	0.0
	% Sand:	23.5
	% Fines:	76.5
ATTERBERG LIMITS:	Liquid Limit:	35
	Plastic Limit:	18
	Plasticity Index:	17

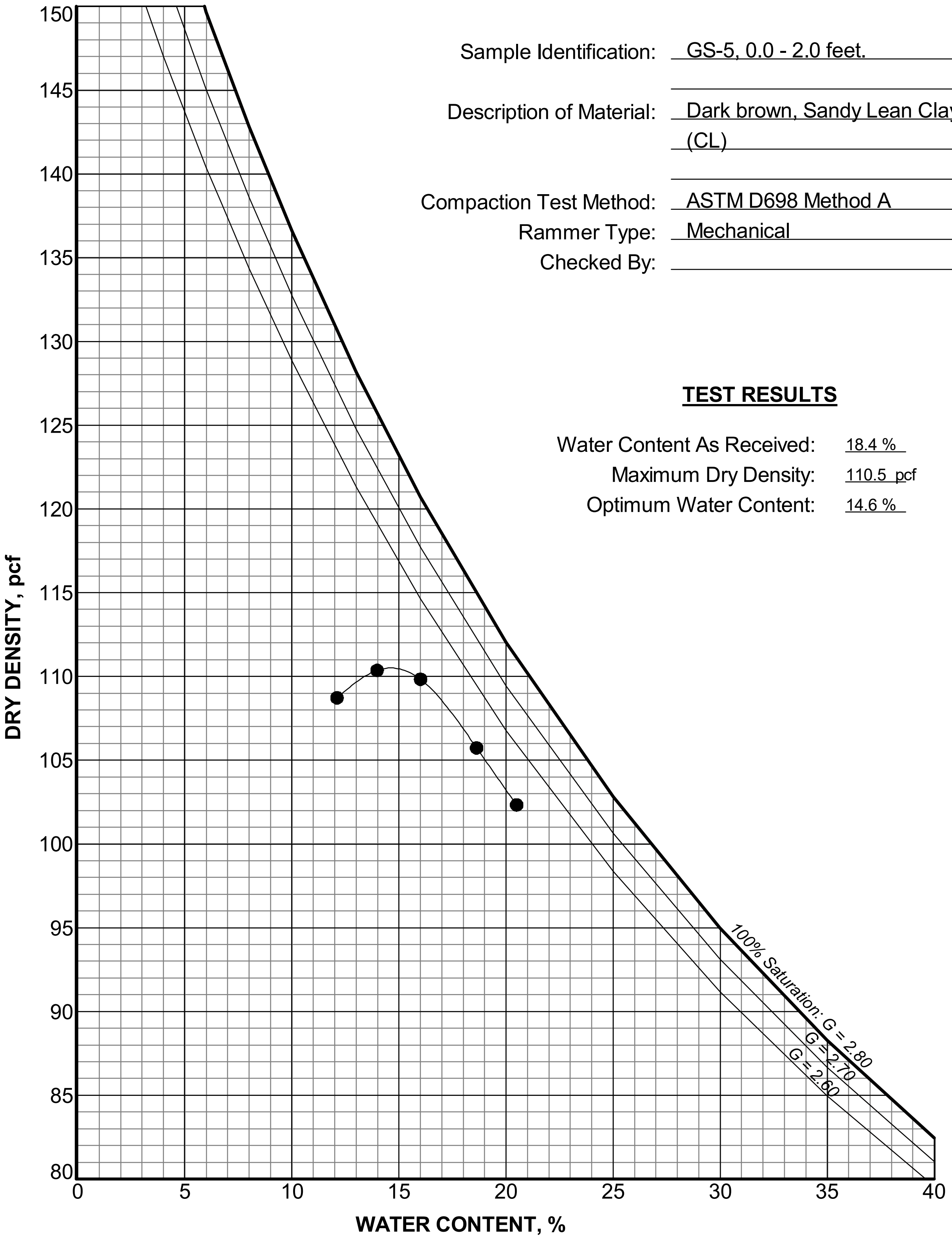
AECI NMPP - Raw Water Pond
Marston, Missouri

MOISTURE-DENSITY TEST

May 2021 107095-002 / 129342-039

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG.



Sample Identification: GS-5, 0.0 - 2.0 feet.

Description of Material: Dark brown, Sandy Lean Clay. (CL)

Compaction Test Method: ASTM D698 Method A

Rammer Type: Mechanical

Checked By:

TEST RESULTS

Water Content As Received: 18.4 %

Maximum Dry Density: 110.5 pcf

Optimum Water Content: 14.6 %

OTHER TEST RESULTS

GRAIN SIZE ANALYSES:	% Gravel:	0.0
	% Sand:	38.2
	% Fines:	61.8
ATTERBERG LIMITS:	Liquid Limit:	31
	Plastic Limit:	19
	Plasticity Index:	12

AECI NMPP - Raw Water Pond
Marston, Missouri

MOISTURE-DENSITY TEST

May 2021 107095-002 / 129342-039

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG.

PROJECT AECI NMPP - Raw Water Pond DATE 5/25/21 BORING NO. HA-RWP-01OW

JOB NO. 107095-002 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich, Inc. CHECKED BY

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U1 DEPTH (ft) 10-12

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C.		TYPE OF TEST	CLASSIFICATION
	Strength info.	W.C.		
10.0				21 INCH RECOVERY Sample [✓ Good] Fair Poor Disturbed
10.5	PP = 2.75 tsf	AT-1	MC	Very stiff to hard, mottled gray and brown, Lean Clay with Sand (CL); moist; 16% fine to medium grained, subangular, sand; 84% medium dry strength, no dilatancy, medium plasticity fines.
11.0			SAVED	
11.5			Dry Density Atterberg #200 Wash	
12.0	PP = 4.5+ tsf	AT-2	SAVED MC	-2-inch Silty Sand layer at 11.6 feet.

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

Can/Tare No.	AT-1	AT-2
WET + TARE	56.49	58.46
DRY + TARE	47.58	51.50
TARE	2.46	2.46
% WATER	19.7	14.2

REMARKS:

PROJECT AECI NMPP - Raw Water Pond DATE 4/27/21 BORING NO. HA-RWP-01OW

JOB NO. 107095-002 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich, Inc. CHECKED BY

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U2 DEPTH (ft) 22-24

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C. Strength info.	NAT. W.C. W.C.	TYPE OF TEST	CLASSIFICATION
				21 INCH RECOVERY Sample [✓ Good] Fair Poor Disturbed
22.0	PP = 0.75 tsf	AT-1	MC	Medium stiff to stiff, dark brown, Sandy Silt (ML); moist; 35% fine to medium grained, subangular, sand; 65% low dry strength, rapid dilatancy, low plasticity fines.
22.5			SAVED	
23.0			Dry Density Atterberg #200 Wash	
23.5			SAVED	
	PP = 1.25 tsf	AT-2	MC	
24.0				

Can/Tare No.	AT-1	AT-2
WET + TARE	65.25	78.48
DRY + TARE	52.82	64.00
TARE	2.50	2.49
% WATER	24.7	23.5

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS:

PROJECT AECI NMPP - Raw Water Pond DATE 4/28/21 BORING NO. HA-RWP-03

JOB NO. 107095-002 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich, Inc. CHECKED BY

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U1 DEPTH (ft) 30-32

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C. Strength info.	NAT. W.C. W.C.	TYPE OF TEST	CLASSIFICATION
30.0				15 INCH RECOVERY Sample: Good [✓ Fair] Poor Disturbed
30.5	PP = 1.25 tsf	AT-1	MC SAVED	Stiff, mottled dark gray and brown, Lean Clay (CL); moist; <1% fine, subangular, sand; >99% medium dry strength, no dilatancy, medium plasticity fines.
31.0			Dry Density Atterberg #200 Wash	
31.5	PP = 1.0 tsf	AT-2	SAVED MC	
32.0				

Can/Tare No.	AT-1	AT-2
WET + TARE	87.67	95.54
DRY + TARE	68.31	73.67
TARE	2.47	2.47
% WATER	29.4	30.7

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS:

PROJECT AECI NMPP - Raw Water Pond DATE 4/28/21 BORING NO. HA-RWP-05

JOB NO. 107095-002 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich, Inc. CHECKED BY

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U1 DEPTH (ft) 12-14

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C.		TYPE OF TEST	CLASSIFICATION
	Strength info.	W.C.		
				18 INCH RECOVERY Sample: [✓ Good] Fair Poor Disturbed
12.0	PP = 3.5 tsf	AT-3	MC	Very stiff to hard, mottled gray and brown, Lean Clay with Sand (CL); moist; 20% fine to medium grained, subangular, sand; 80% medium dry strength, no dilatancy, medium plasticity fines.
			SAVED	
12.5				
13.0			Dry Density Atterberg Sieve	
			SAVED	
13.5	PP = 4.5+ tsf	AT-4	MC	
14.0				

Can/Tare No.	AT-3	AT-4
WET + TARE	85.64	68.88
DRY + TARE	72.01	58.91
TARE	2.45	2.46
% WATER	19.6	17.7

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS:

PROJECT AECI NMPP - Raw Water Pond DATE 4/28/21 BORING NO. HA-RWP-02OW

JOB NO. 107095-002 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich, Inc. CHECKED BY

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U1 DEPTH (ft) 6-8

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C.		TYPE OF TEST	CLASSIFICATION
	Strength info.	W.C.		
				20 INCH RECOVERY Sample [✓ Good] Fair Poor Disturbed
6.0	PP = 2.75 tsf	AT-5	MC	Very stiff to hard, dark brown, Sandy Lean Clay (CL); moist; 36% fine to medium grained, subangular, sand; 64% medium dry strength, no dilatancy, medium plasticity fines.
			SAVED	
6.5				
			Dry Density Atterberg #200 Wash	
7.0				
			SAVED	
7.5	PP = 4.5+ tsf	AT-6	MC	
8.0				

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

Can/Tare No.	AT-5	AT-6
WET + TARE	67.90	97.03
DRY + TARE	59.22	85.24
TARE	2.46	2.45
% WATER	15.3	14.2

REMARKS:

PROJECT AECI NMPP - Raw Water Pond DATE 4/28/21 BORING NO. HA-RWP-02OW

JOB NO. 107095-002 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich, Inc. CHECKED BY

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U2 DEPTH (ft) 18-20

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C. Strength info.	NAT. W.C. W.C.	TYPE OF TEST	CLASSIFICATION
18.0				20 INCH RECOVERY Sample [✓ Good] Fair Poor Disturbed
	PP = 1.75 tsf	AT-7	MC SAVED	Stiff to medium stiff, gray, Sandy Silt (ML); moist; 40% fine to medium grained, subangular, sand; 60% low dry strength, rapid dilatancy, non-plastic fines.
18.5			Dry Density Atterberg Sieve	
19.0			SAVED	
19.5	PP = 0.75 tsf	AT-8	MC	
20.0				

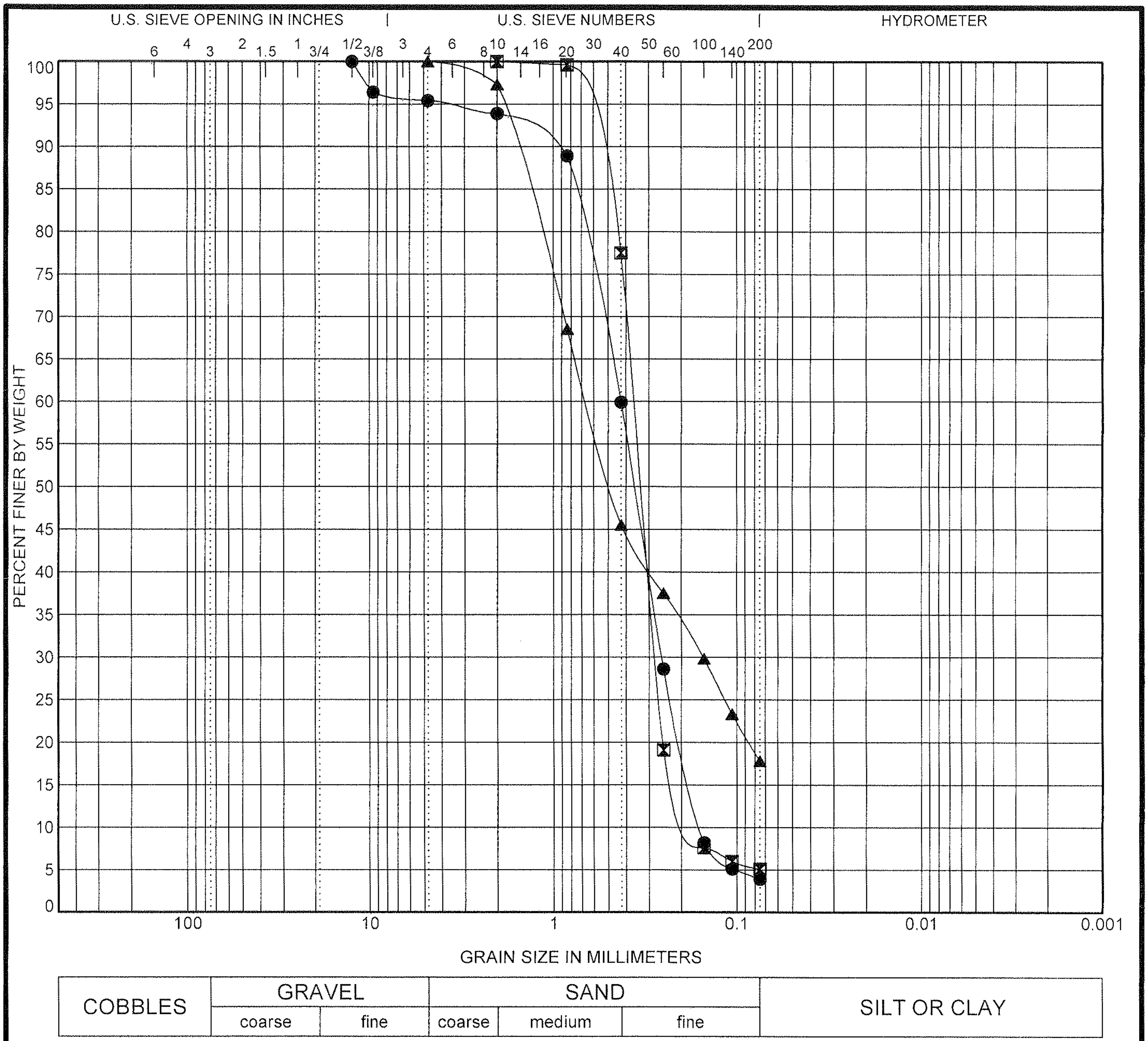
Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

Can/Tare No.	AT-7	AT-8
WET + TARE	66.85	90.29
DRY + TARE	55.66	73.13
TARE	2.45	2.46
% WATER	21.0	24.3

REMARKS:



	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**P-2**	**54.3**	**POORLY GRADED SAND(SP)**				**0.98**	**2.71**
☒	**P-3**	**34.3**	**POORLY GRADED SAND(SP)**				**1.26**	**2.17**
▲	**TP-3**	**2.0**	**SILTY SAND (SLAG)(SM)**					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**P-2**	**54.3**	**12.5**	**0.426**	**0.256**	**0.157**	**4.6**	**91.5**	**3.9**	
☒	**P-3**	**34.3**	**2**	**0.363**	**0.276**	**0.167**	**0.0**	**94.9**	**5.1**	
▲	**TP-3**	**2.0**	**4.75**	**0.653**	**0.152**		**0.0**	**82.2**	**17.8**	

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ENGINEERING AND ENVIRONMENTAL SERVICES
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GRAIN SIZE DISTRIBUTION

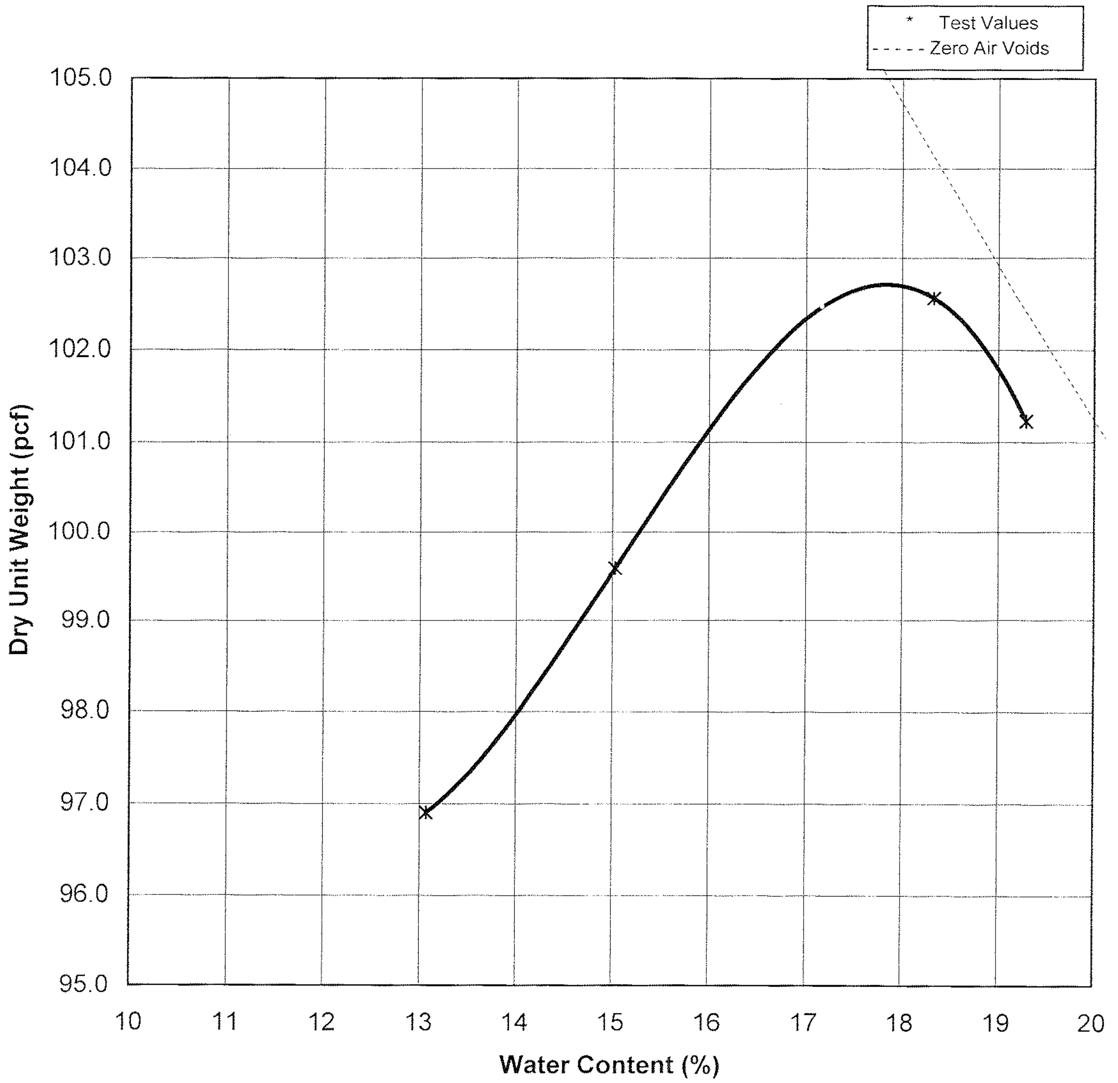
AECI New Madrid
Embankment Stability Evaluation
1011304.91IG

11816 Lackland Road, Suite 150
St. Louis, MO 63146
Ph: 314-997-7740
Fax: 314-997-2067

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES

Project: AECI Ash Pond Evaluation
Client: AECI
Sample Source: Slag Stockpile
Supplier:

LABORATORY COMPACTION TEST



Test Information

Project No.: 1011304.91IG.7310L
Test Date: 03/21/09
Proctor No.: P-5084

Test Method: ASTM D 1557 Method A
Rammer Type: Mechanical
Prep. Method: Dry

Sample Description

Slag

Sample Properties

Moisture Content --
Liquid Limit --
Plastic Limit --
Plasticity Index --
Specific Gravity: 2.400 Estimated
Classification --

Test Results:

Maximum Dry Unit Weight (pcf): 102.7
Optimum Water Content (%): 17.9

Oversize Correction Values:
Maximum Dry Unit Weight (pcf): --
Optimum Water Content (%): --

Tested By: PAR
Date: 03/21/09

Input By: ZRB
Date: 03/23/09

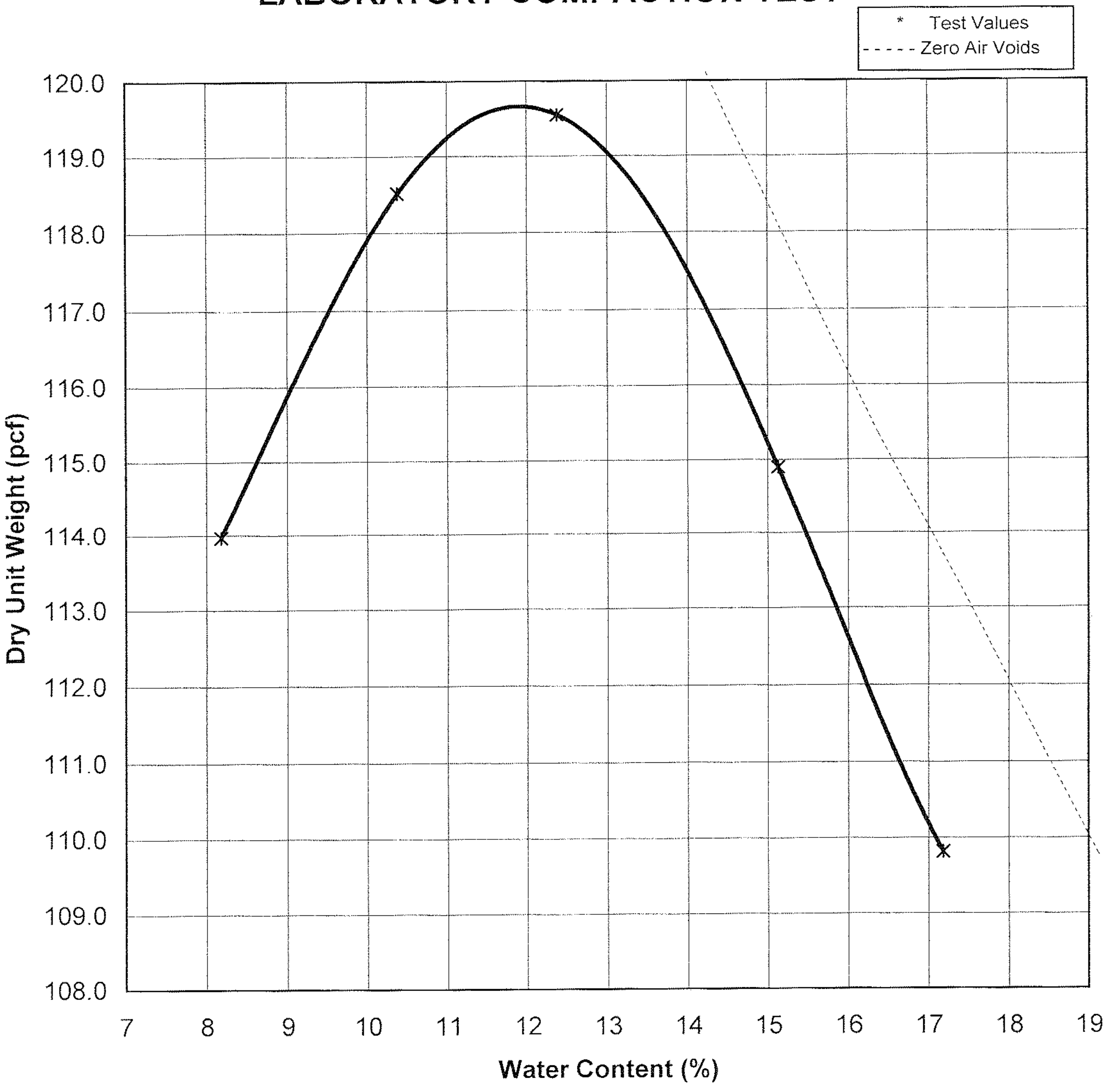
Checked By: ZRB
Date: 03/23/09

11816 Lackland Road, Suite 150
St. Louis, MO 63146
Ph: 314-997-7740
Fax: 314-997-2067

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES

Project: AECI Embankment Stability Evaluation
Client: AECI Consulting Services
Sample Source: P-4 Drilling Spoils
Supplier: N/A

LABORATORY COMPACTION TEST



Test Information

Project No.: 1011304.91IG.7310L
Test Date: 03/24/09
Proctor No.: P-5086

Test Method: ASTM D 1557 Method A
Rammer Type: Mechanical
Prep. Method: Dry

Sample Description

Brown, silty CLAY

Sample Properties

Moisture Content --
Liquid Limit 36
Plastic Limit 19
Plasticity Index 17
Specific Gravity: 2.650 Estimated
Classification CL

Test Results:

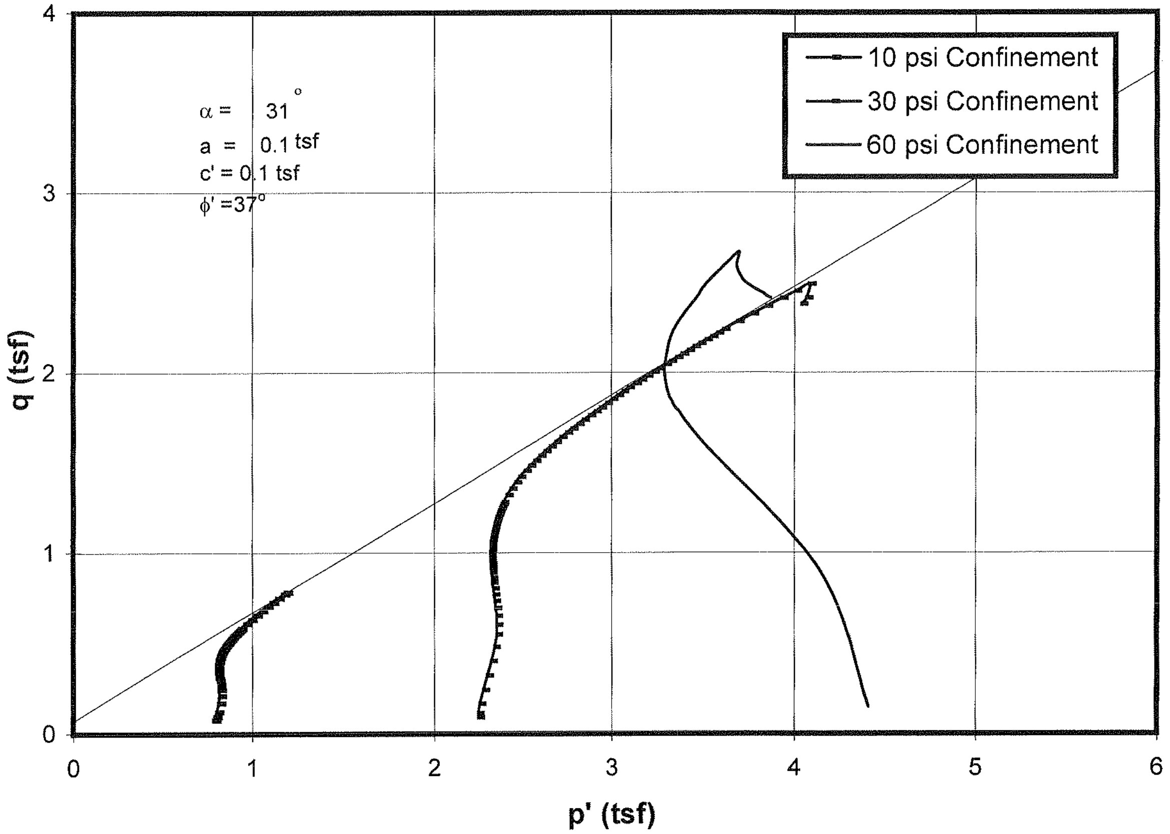
Maximum Dry Unit Weight (pcf): 119.6
Optimum Water Content (%): 11.9

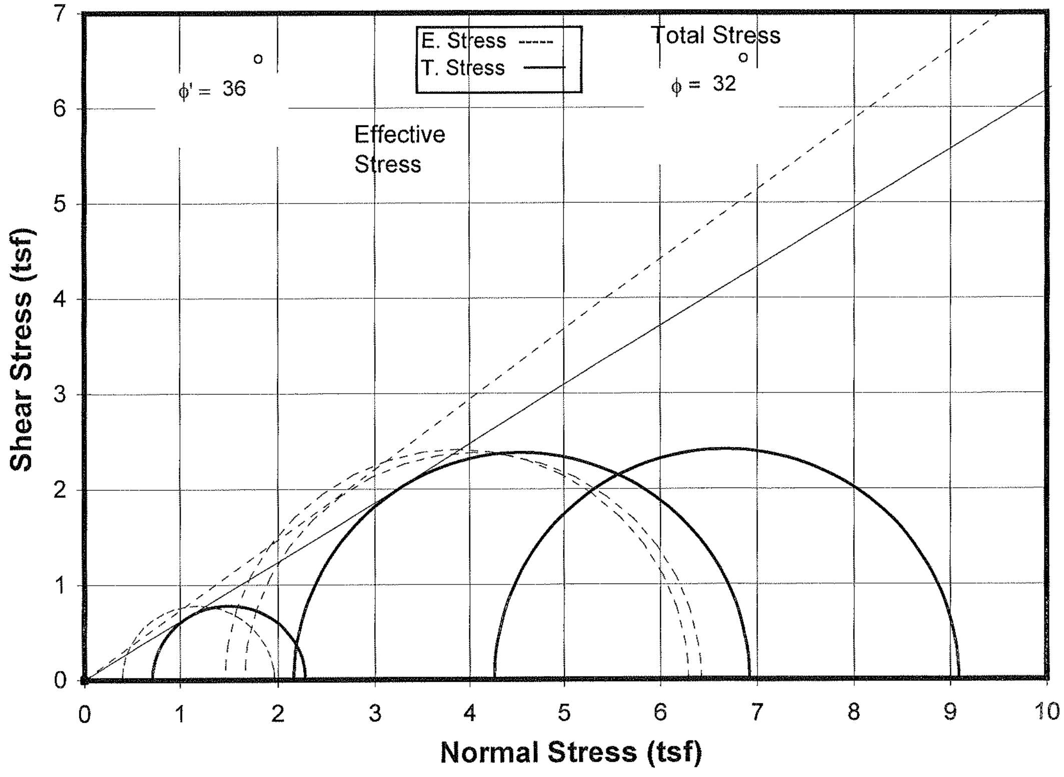
Oversize Correction Values:
Maximum Dry Unit Weight (pcf): --
Optimum Water Content (%): --

Tested By: PAR
Date: 03/24/09

Input By: PAR
Date: 03/25/09

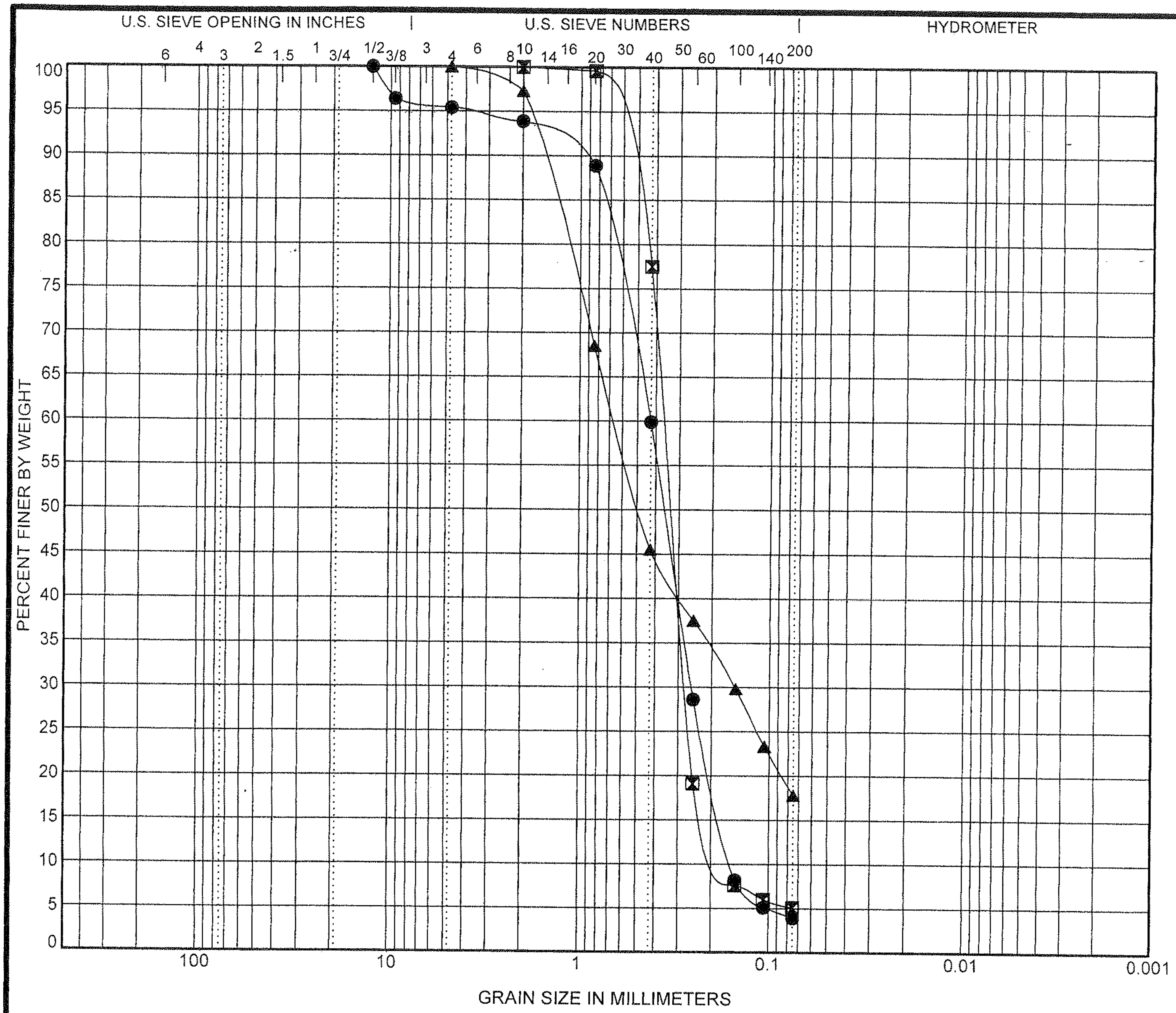
Checked By: ZRB
Date: 03/26/09





CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

ASTM D 4767
Project No.: 1011304
Boring: P-2, P-2, P-2
Sample: 6, 6, 6 - Depth: 14, 14, 14



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	P-2	54.3	POORLY GRADED SAND(SP)				0.98	2.71
☒	P-3	34.3	POORLY GRADED SAND(SP)				1.26	2.17
▲	TP-3	2.0	SILTY SAND (SLAG)(SM)					

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	P-2	54.3	12.5	0.426	0.256	0.157	4.6	91.5	3.9	
☒	P-3	34.3	2	0.363	0.276	0.167	0.0	94.9	5.1	
▲	TP-3	2.0	4.75	0.653	0.152		0.0	82.2	17.8	

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