



Stantec

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April 19, 2010

let_029_175569040

Mr. Michael S. Turnbow
Tennessee Valley Authority
1101 Market Street, LP 2G-C
Chattanooga, Tennessee 37402

Re: Issued for Construction
Letter of Recommendations
South Slope of West Pond
Scrubber Sludge Complex
Paradise Fossil Plant
Paradise, Muhlenberg County, Kentucky

Dear Mr. Snider:

Stantec Consulting Services Inc. (Stantec) has completed the geotechnical exploration along the south slope of West Pond and would like to issue the following letter of recommendations for review. This letter presents a brief description of the project, results of engineering analysis and pertinent recommendations.

1. Background

Stantec Consulting Services Inc. (Stantec) has been assisting TVA since early 2009 with geotechnical evaluation of the Scrubber Sludge Complex located at Paradise Fossil Plant. On November 10, 2009, Stantec's engineering technician noted six (6) separate wet areas along the south slope of the West Pond (see Figures 1, 2 and subsequent photos from November 10, 2009). Based on the field observations at that time it appeared that the wet areas were being created due to possible seepage occurring through the initial dike. Subsequently, Stantec recommended that a subsurface exploration be performed along the south slope of the West Pond to characterize the initial dike and install additional piezometers.

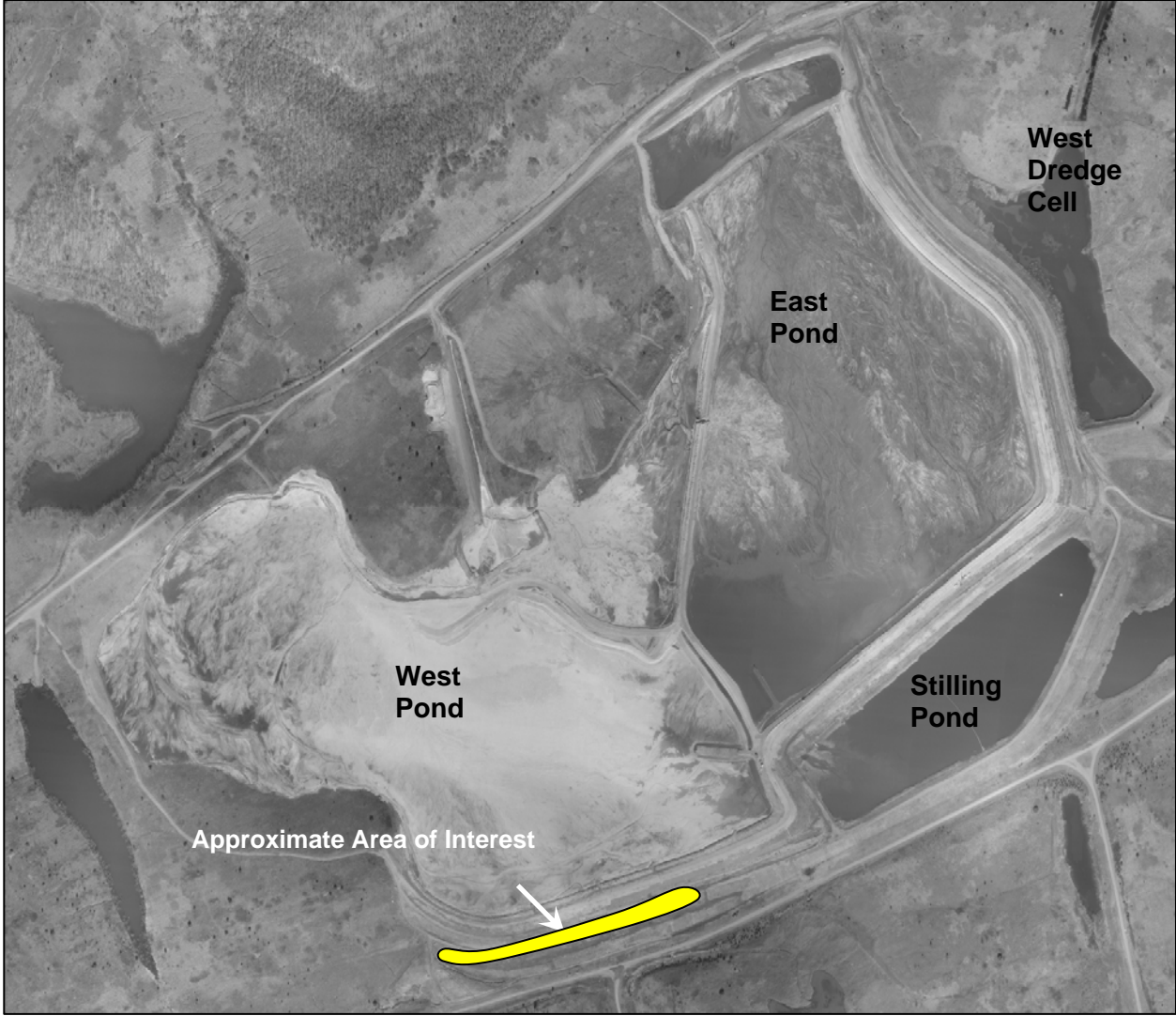


Figure 1: Approximate Area of Interest

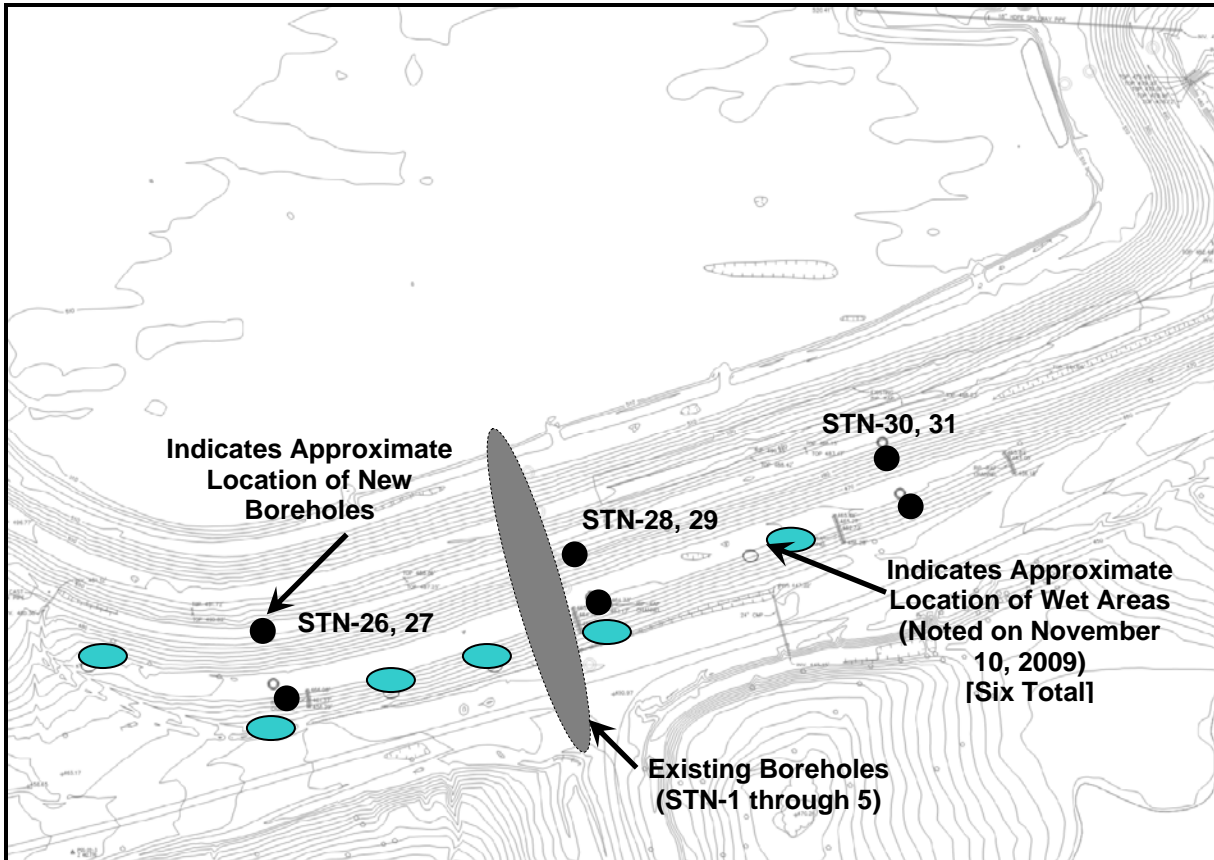


Figure 2: Approximate Location of Wet Areas





2. Subsurface Exploration

2.1. General

Stantec's scope of work consisted of subsurface exploration, laboratory testing and engineering analysis. Fieldwork for the subsurface exploration was performed during the months of December, 2009 and January, 2010. The field work consisted of advancing a total of twelve (12) borings at the project site. Boring locations were chosen, staked and surveyed by Stantec. The locations of the borings and their corresponding elevations are given on the boring layout drawing presented in Attachment A. The subsurface exploration was performed using 3¼ inch (ID) hollow stem augers following a carbide tipped tooth bit.

Standard Penetration Testing (SPT) was performed in selected borings at continuous depth intervals within the initial dike and at selected depth intervals within the underlying mine spoil. A standard penetration test consists of dropping a 140-pound hammer to drive a split-barrel sampler 18 inches. The consistency or relative density of the soil material is estimated by the number of blows it takes to drive the split spoon sampler the last 12 inches. This method is typically used to obtain soil samples, estimate the consistency or relative density of the soil and also to estimate the vertical limits of the subsurface soil horizons. The results of SPT testing are presented on the boring logs included in Attachment B.

Undisturbed Shelby tube samples of mine spoil were obtained from various borings at selected depth intervals. All Shelby tube samples were sealed with caps in the field and transported to Stantec's laboratory for testing. A list of recovered samples, including sample depths and recovery is presented on the boring logs in Attachment B.

Upon completion of the drilling and sampling procedures, the boreholes were tremie-grouted or backfilled with well materials (cement, sand and/or bentonite) if piezometer was installed in the borehole. An engineering technician was present on-site throughout the drilling and sampling operations. The engineering technician directed the drill crew, logged the subsurface materials encountered during the exploration and collected soil samples. Particular attention was given to the material's color, texture, moisture content and consistency or relative density. Following the field exploration, the SPT samples and Shelby tubes were transported to our laboratory for subsequent testing. The samples will be available for review up to thirty (30) days following the submittal of final version of this letter, at which time the samples will be discarded unless prior arrangements for storage have been made.

2.2. Summary of Borings

Layout of borings is presented on a drawing included in Attachment A. Typed boring logs are presented in Attachment B. Summary of boring information is presented in Table 1, where all measurements are expressed in feet.

Table 1. Summary of Borings

Boring No.	Top of Hole (Elevation)	Bottom of Hole (Elevation)	Bottom of Hole (Feet)
STN-26	471.6	428.6	43.0
STN-26A	471.4	451.5	19.9
STN-27	491.9	428.9	63.0
STN-27A	492.2	465.2	27.0
STN-28	470.4	428.9	41.5
STN-28A	470.2	450.4	19.8
STN-29	488.8	429.3	59.5
STN-29A	489.1	467.1	22.0
STN-30	470.7	431.2	39.5
STN-30A	470.5	452.5	18.0
STN-31	486.6	428.6	58.0
STN-31A	487.0	465.0	22.0

2.3. Instrumentation

Stantec's scope of work for geotechnical exploration also included installing piezometers in selected borings. Standpipe piezometers, installed in a borehole, consisted of a casagrande filter tip joined to a 1-inch diameter riser pipe. The filter tip was placed in a sand pack and a bentonite seal was placed above the sand to isolate the target pore water pressure reading area. The annular space between the riser pipe and the borehole was backfilled to the surface with bentonite grout to prevent vertical migration of water. The riser pipe was terminated 2 to 3 feet above ground level and protected with a lockable metal cover. Instrumentation schematics and water level readings of piezometers are presented in Attachment C. A summary of instrumentation is presented in Table 2.

Table 2. Summary of Instrumentation

Boring No.	Instrument	Instrument ID
STN-2	PZ	PZ-2*
STN-2	PZ	PZ-2A*
STN-4	PZ	PZ-4*
STN-5	PZ	PZ-5*
STN-26A	PZ	PZ-26A
STN-27A	PZ	PZ-27A
STN-28A	PZ	PZ-28A
STN-29A	PZ	PZ-29A
STN-30A	PZ	PZ-30A
STN-31A	PZ	PZ-31A

* - installed early 2009 during Phase 2 exploration

2.4. Subsurface Soil Conditions

The subsurface conditions encountered in different borings consisted of mine spoils. Mine spoil can be visually described as lean to fat clay with intermediate sand lenses, gray to dark gray, moist to wet, soft to very stiff and with heterogeneous mixture of coal, shale, sandstone and siltstone fragments. USCS (Unified Soil Classification System) classification tests performed on mine spoil classified the material as SC (Clayey sand with gravel). One of the borings (STN-31) drilled at the crest of the initial dike confirmed the presence of a 24 feet thick sand chimney drain (installed in 1986 during the construction of the initial dike). One of the twelve (12) borings (STN-27) located near the west end of south slope noted a 7.5 feet thick layer of gypsum-fly ash material associated with the ponding phase (1986 to 1996).

2.5. Laboratory Testing

Stantec performed laboratory testing of mine spoil samples to estimate its engineering properties. The laboratory tests were performed in general accordance with ASTM standard testing procedures. Detailed results of laboratory testing are presented in Attachment D.

3. Engineering Analysis

3.1. General

Stantec's scope of work included performing seepage analysis for existing conditions and proposed conditions. The analysis procedure and the results of the analysis are presented in the following paragraphs. Outputs from the engineering analysis are presented as Attachment E to this letter.

3.2 Cross Section

Analysis was performed for the following existing ground cross section.

- 1) AA' (cross section through borings STN-1 through STN-5)

3.3 Seepage Analysis

3.3.1 Background

The objective of seepage analysis was to understand the total head (and pore water pressure) distribution within a given cross section of the dike. Seepage analysis was performed using SEEP/W, a numerical software tool developed by Geo-Slope International Inc. SEEP/W is a finite element software product for analyzing groundwater seepage and pore-water pressure distribution problems within porous materials such as soil and rock. The first step in the seepage analysis was to develop a cross section of the dike. Stantec utilized boring logs, historic drawings and survey information to estimate the dimensions of the cross section. SEEP/W uses the concept of regions and points to define the geometry of a problem and to facilitate discretization (or meshing) of the problem. Upon defining the

geometry of the model, material properties were assigned for the *Saturated/Unsaturated Model* offered in SEEP/W. The next step in the process was to define boundary conditions. All boundary conditions were applied to region points and region lines. Upon defining the boundary conditions, the model was analyzed using *Steady State* seepage analysis option available in SEEP/W based on the assumption that the boundary conditions are constant over time. Specific details regarding the analysis procedure are presented in the following sections.

3.3.2 Material Properties

The material properties used for seepage analysis are presented in Table 3. Material properties are consistent with those used in Phase 2 report (dated August 25, 2009).

Table 3. Material Properties used for Seepage Analysis

Material	K _v (cm/sec)	K _v /K _h	K _h /K _v	e	w-sat (%)	w-res (%)
Gypsum – Fly Ash	2E-5	0.02	50	0.65	41	3
Gypsum	2E-5	0.02	50	0.70	39	3
Compacted Mine Spoil	5E-5	0.33	3	0.60	37	2
Mine Spoil	5E-5	0.33	3	0.60	37	2

Where,

- k_v is the vertical hydraulic conductivity
- k_h is the horizontal hydraulic conductivity
- e is the void ratio
- w_{sat} is the saturated volumetric water content, and
- w_{res} is the residual water content

3.3.3 Under-drains

To evaluate the effect of under-drain functionality on piping factors of safety (near the toe of initial dike) the current seepage analysis was performed for two (2) cases. These include one without under-drains and one with under-drains. The cases are designated as follows.

- X) No Under-drains (assumes no under-drains to be present) [See Figure 3]
- Y) With Under-drains (assumes under-drains to be present) [See Figure 4]

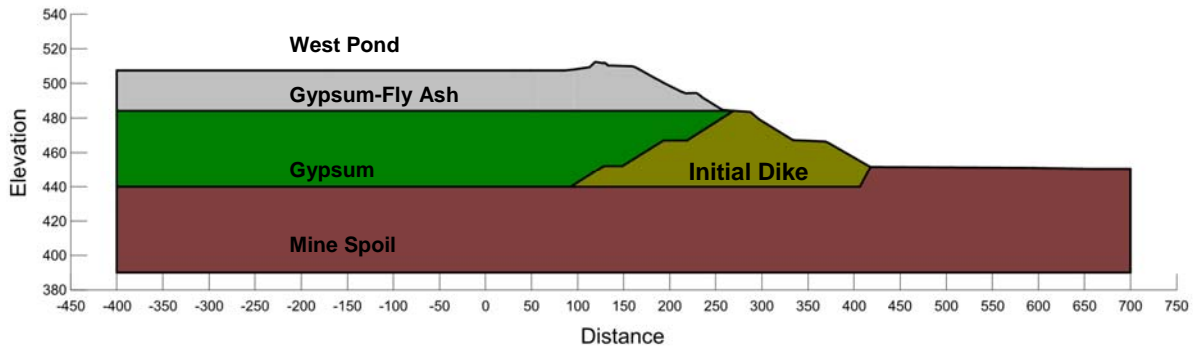


Figure 3. Cross Section A-A' without under-drains

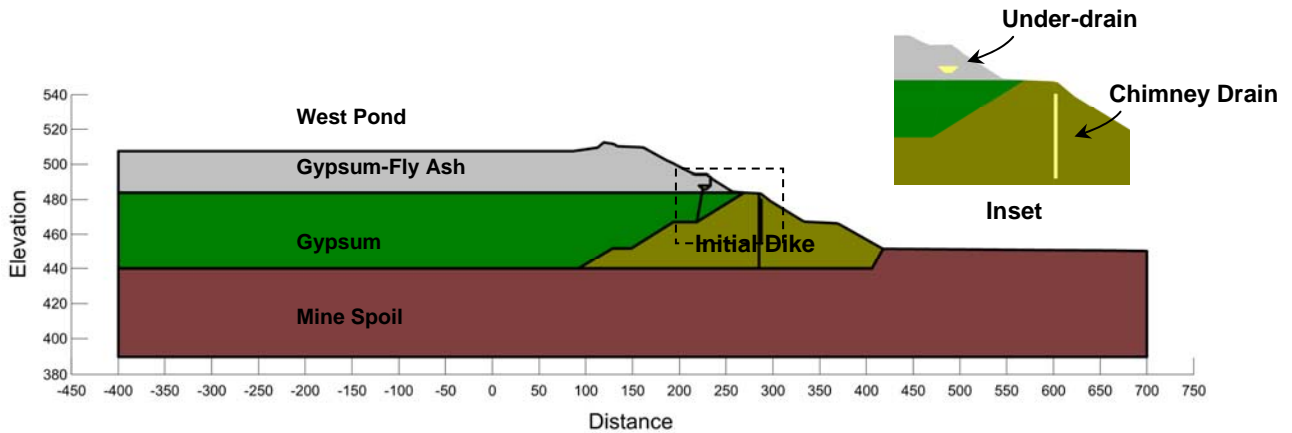


Figure 4. Cross Section A-A' with under-drains

3.3.4 Results

Detailed results of seepage analysis are presented in Attachment E and briefly summarized in Table 5.

Table 5. Summary of Computed Exit Gradients and Factors of Safety against Piping*

Case	Vertical Gradient (i_v) at Critical Exit Point*	Critical Gradient (i_{crit})	FS_{piping}
No Under drains	0.24	1.06	4.5
With Under drains	0.24	1.06	4.5

*-near toe of the initial dike

The results of seepage analysis indicate that the piping factors of safety (near the toe of the initial dike) are equal in both cases (without under drains or with under drains). This can be attributed to the minimal effect sand chimney drain has on controlling the total head and phreatic surface near the toe of the initial dike (See Figure 5 below and SEEPW outputs in Attachment E).

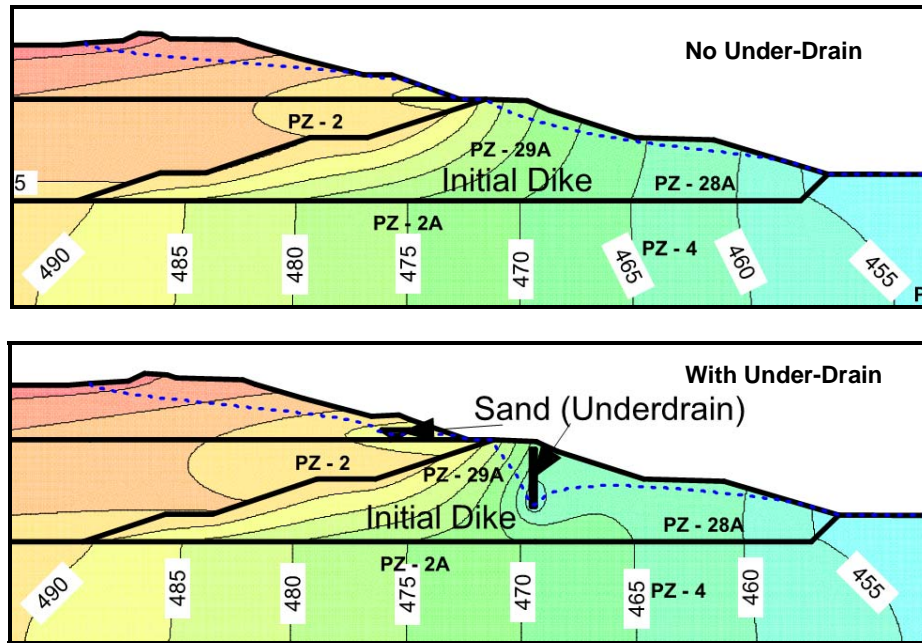


Figure 5: Total Head and Phreatic Surface Comparison between two cases

3.4. Stability Analysis

Stantec's scope of work for the current work plan did not include re-visiting the stability analysis due to the following. Based on the results of Phase 2 evaluation of the scrubber sludge complex, the minimum factor of safety against sliding for cross section A-A' (south slope of the West Pond) is 1.5. For detailed information regarding stability analysis for cross section A-A', please refer to the draft report of geotechnical exploration submitted on August 25, 2009.

4. Conclusions and Recommendations

4.1. **Subsurface Exploration:** The subsurface conditions noted in the boreholes are consistent with the history of the structure. Mine spoil material (used for constructing the initial dike) was encountered in all of the borings. One of the borings (STN-31) drilled at the crest of the initial dike confirmed the presence of a 24 feet thick sand chimney drain (installed in 1986 during the construction of the initial dike). The results of SPT testing did not indicate any unusually soft or very soft conditions within the initial dike. One of the twelve (12) borings (STN-27) located near the west end of south slope noted a 7.5 feet thick layer of gypsum-fly ash material associated with the ponding phase (1986 to 1996).

4.2. **Seepage Analysis:** Based on the results of seepage analysis, the piping factor of safety at the toe of the initial dike is equal to 4.5. However, it is to be noted that the seepage profile will be somewhat irregular and vary from location to location along the south slope.

This can be attributed to, among other things, variation in the functionality of the under-drains and heterogeneous nature of the mine spoil material.

4.3. Field Observations: Stantec's on-site engineering technician continued to periodically observe the wet areas since November 10, 2009 (when they were initially noted). Since then, the wet areas have not shown any visible signs of seepage beyond what was initially observed. Some of the areas are no longer wet at the time of this writing and no new wet areas have developed.

4.3. Repairs: Based on the results of the subsurface exploration and seepage analysis and field observations, Stantec does not recommend any construction repairs (such as armoring or buttressing) at this time. However, future monitoring (as discussed in the next paragraph) is required. If conditions change, repair measures may be warranted.

4.4. Future Monitoring: It is recommended that the south slope of the West Pond be monitored in the future for seepage and stability related issues. This includes taking frequent water level readings, annual inspections and periodic observations of the slopes for signs of seepage and instability. Stantec agrees with AECOM's recommendation of installing additional slope inclinometers along the south slope of the west pond (see Page 3 of Attachment F). Stantec is taking weekly water level measurements of all piezometers at this time and will continue to do so until June, 2010. Subsequently TVA will assume the monitoring activities.

5. Closure

The analysis and conclusions presented here are based on information gathered from the borings, several assumptions and calculations performed using that degree of care and skill ordinarily exercised under similar circumstances by competent members of the engineering profession. No warranties can be made regarding the continuity of conditions between and beyond borings. The objective of this letter is to provide the results of geotechnical exploration performed along the south slope of the West Pond and pertinent recommendations for future monitoring.

Sincerely,

STANTEC CONSULTING SERVICES INC.



Sharath C. Vemuri, PE
Senior Project Engineer



Hugo R. Aparicio, PE
Principal

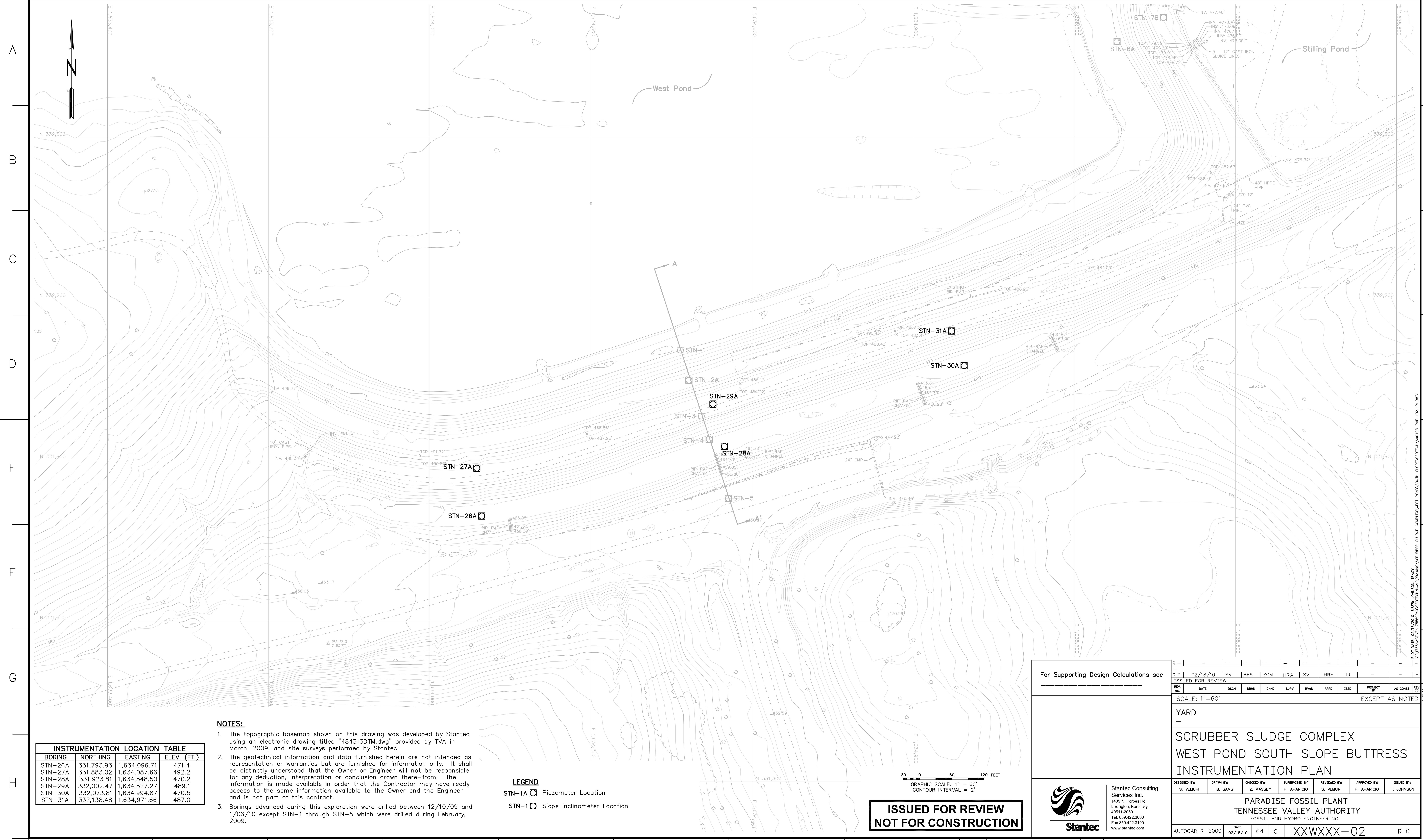
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Enclosures: 1 Attachment A (Boring Layout, Instrumentation Layout, Logs of Borings)
2 Attachment B (Typed Logs)
3 Attachment C (Instrumentation Schematics, Water Level Readings)

- 4 Attachment D (Results of Laboratory Testing)
- 5 Attachment E (Results of Engineering Analysis)
- 6 Attachment F (AECOM Review Letter)

Attachment A

Boring Layout,
Instrumentation Layout,
Logs of Borings



NOTES:

- The topographic basemap shown on this drawing was developed by Stantec using an electronic drawing titled "484313DTM.dwg" provided by TVA in March, 2009, and site surveys performed by Stantec.
- The geotechnical information and data furnished herein are not intended as representation or warranties but are furnished for information only. It shall be distinctly understood that the Owner or Engineer will not be responsible for any deduction, interpretation or conclusion drawn therefrom. The information is made available in order that the Contractor may have ready access to the same information available to the Owner and the Engineer and is not part of this contract.
- Borings advanced during this exploration were drilled between 12/10/09 and 1/06/10 except STN-1 through STN-5 which were drilled during February, 2009.

INSTRUMENTATION LOCATION TABLE			
BORING	NORTHING	EASTING	ELEV. (FT.)
STN-26A	331,793.93	1,634,096.71	471.4
STN-27A	331,883.02	1,634,087.66	492.2
STN-28A	331,923.81	1,634,548.50	470.2
STN-29A	332,002.47	1,634,527.27	489.1
STN-30A	332,073.81	1,634,994.87	470.5
STN-31A	332,138.48	1,634,971.66	487.0

LEGEND
 STN-1A □ Piezometer Location
 STN-1 □ Slope Inclinometer Location

GRAPHIC SCALE: 1" = 60'
 CONTOUR INTERVAL = 2'

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

For Supporting Design Calculations see										R - - - - -	
ISSUED FOR REVIEW										DISCIPLINE INTERFACE	
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVID	APPD	ISSD	PROJECT ID	AS CONST	REV. NO.
SCALE: 1"=60'										EXCEPT AS NOTED	
YARD											
SCRUBBER SLUDGE COMPLEX											
WEST POND SOUTH SLOPE BUTTRESS											
INSTRUMENTATION PLAN											
DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:					
S. VEMURI	B. SAMS	Z. MASSEY	H. APARICIO	S. VEMURI	H. APARICIO	T. JOHNSON					
PARADISE FOSSIL PLANT TENNESSEE VALLEY AUTHORITY FOSSIL AND HYDRO ENGINEERING											
AUTOCAD R 2000	DATE	64	C	XXWXXX-02				R 0			
STANTEC			0			PLOT FACTOR:XX			C.A.D. DRAWING		
TASK COMPLETED BY:			REV. NO.			W_TVA			DO NOT ALTER MANUALLY		

PLOT DATE: 02/18/10 USER: JOHNSON, TRACY
 I:\Projects\2009\484313\Drawings\484313-01-02.dwg

Attachment B

Typed Logs

Project Number	175569040	Location	Drakesboro, KY		
Project Name	Scrubber Sludge Complex	Boring No.	STN-26	Total Depth	43.0 ft
County	Muhlenberg	Surface Elevation	471.6 ft		
Project Type	Geotechnical Exploration	Date Started	1/5/10	Completed	1/6/10
Supervisor	B. Taylor	Driller	Steve Bradford	Depth to Water	Dry
Logged By	B. Taylor	Depth to Water	--	Date/Time	--

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
471.6'	0.0'	Top of Hole							
		Mine spoil, Clayey Sand brown to dark gray, moist to wet, medium stiff to very stiff, with siltstone, sandstone, shale and coal fragments		SPT-1	0.0' - 1.5'	0.7'	5-7-7	18	
			SPT-2	1.5' - 3.0'	1.5'	6-8-6	12		Sandstone observed in SPT
			SPT-3	3.0' - 4.5'	0.7'	32-22-12	6		
			SPT-4	4.5' - 6.0'	1.5'	6-5-6	13		
			SPT-5	6.0' - 7.5'	0.9'	6-8-9	13		
			SPT-6	7.5' - 9.0'	0.8'	10-12-14	9		
			SPT-7	9.0' - 10.5'	0.2'	11-13-16	6		Cobble blocked SPT
			SPT-8	10.5' - 12.0'	0.1'	8-8-8	3		Cobble blocked SPT
			SPT-9	12.0' - 13.5'	1.2'	9-10-10	10		
			SPT-10	13.5' - 15.0'	1.3'	10-12-11	12		
			SPT-11	15.0' - 16.5'	0.3'	7-9-12	7		Cobble blocked SPT
			SPT-12	16.5' - 18.0'	0.5'	16-17-18	11		Rock fragments in SPT
			SPT-13	18.0' - 19.5'	1.5'	15-20-13	9		
			SPT-14	19.5' - 21.0'	1.2'	6-7-8	9		
			SPT-15	21.0' - 22.5'	1.3'	10-10-12	15		
			SPT-16	25.0' - 26.5'	0.2'	2-3-3	--		Cobble blocked SPT at 25.2'
			SPT-17	30.0' - 31.5'	1.5'	12-12-13	14		
			SPT-18	35.0' - 36.5'	1.5'	4-6-7	--		

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SUBSURFACE LOG

Project Number	175569040	Location	Drakesboro, KY	
Project Name	Scrubber Sludge Complex	Boring No.	STN-26	Total Depth 43.0 ft

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
428.6'	43.0'	Mine spoil, Clayey Sand brown to dark gray, moist to wet, medium stiff to very stiff, with siltstone, sandstone, shale and coal fragments <i>(Continued)</i>		SPT-19	40.0' - 41.5'	1.3'	6-5-4	17	SPT sample was saturated
				SPT-20	41.5' - 43.0'	1.5'	3-4-5	--	SPT sample was saturated

No Refusal /
Bottom of Hole

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Project Number	175569040		Location	Drakesboro, KY	
Project Name	Scrubber Sludge Complex		Boring No.	STN-27	Total Depth 63.0 ft
County	Muhlenberg		Surface Elevation	491.9 ft	
Project Type	Geotechnical Exploration		Date Started	12/10/09	Completed 12/11/09
Supervisor	B. Taylor	Driller	Steve Bradford	Depth to Water 5.4 ft	Date/Time 12/11/09
Logged By	B. Taylor		Depth to Water	--	Date/Time --

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
491.9'	0.0'	Top of Hole							
482.9'	9.0'	Mine spoil, Lean Clay brown to dark gray, moist to wet, soft to stiff, with siltstone, sandstone, shale and coal fragments		SPT-1	0.0' - 1.5'	0.6'	2-4-7	--	Gypsum
				SPT-2	1.5' - 3.0'	1.0'	7-9-14	15	
				SPT-3	3.0' - 4.5'	1.2'	14-20-18	13	
				SPT-4	4.5' - 6.0'	1.3'	4-5-7	16	
				SPT-5	6.0' - 7.5'	0.6'	4-4-3	--	
				SPT-6	7.5' - 9.0'	0.8'	9-9-10	16	
475.4'	16.5'	Gypsum-Fly Ash: Dark gray to gray, moist to wet, medium loose to dense		SPT-7	9.0' - 10.5'	1.0'	7-9-10	19	
				SPT-8	10.5' - 12.0'	1.0'	11-14-21	19	
				SPT-9	12.0' - 13.5'	1.0'	21-33-34	15	
				SPT-10	13.5' - 15.0'	1.3'	9-9-12	21	
				SPT-11	15.0' - 16.5'	0.6'	3-4-3	19	
				SPT-12	16.5' - 18.0'	1.0'	3-4-6	18	
		Mine spoil, Clayey Sand brown to dark gray, moist to wet, soft to stiff, with siltstone, sandstone, shale and coal fragments		SPT-13	18.0' - 19.5'	1.0'	6-6-7	23	
				SPT-14	19.5' - 21.0'	1.0'	4-7-9	15	
				SPT-15	21.0' - 22.5'	0.8'	8-8-9	13	
				SPT-16	22.5' - 24.0'	1.1'	5-5-10	24	
				SPT-17	24.0' - 25.5'	1.5'	5-7-11	--	
				SPT-18	25.5' - 27.0'	0.8'	15-15-15	15	
				SPT-19	27.0' - 28.5'	0.6'	15-18-10	--	
				SPT-20	28.5' - 30.0'	1.0'	14-11-11	12	
				SPT-21	30.0' - 31.5'	1.5'	12-14-10	--	
				SPT-22	31.5' - 33.0'	0.9'	13-14-18	16	
				SPT-23	33.0' - 34.5'	0.9'	20-18-14	--	
				SPT-24	34.5' - 36.0'	0.5'	9-11-17	15	

STANTEC/FNSM_LEGACY_171487156.GPJ FNSM_GRAPHIC.LOG.GDT_2/25/10

Project Number		175569040			Location		Drakesboro, KY			
Project Name		Scrubber Sludge Complex			Boring No.		STN-27	Total Depth		63.0 ft
Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks	
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth		
428.9'	63.0'	Mine spoil, Clayey Sand brown to dark gray, moist to wet, soft to stiff, with siltstone, sandstone, shale and coal fragments <i>(Continued)</i>		SPT-25	36.0' - 37.5'	1.1'	14-20-22	--		
				SPT-26	37.5' - 39.0'	0.5'	15-15-17	12		
				SPT-27	39.0' - 40.5'	0.9'	9-12-12	--		
				SPT-28	40.5' - 42.0'	1.0'	9-11-10	16		
				SPT-29	45.0' - 46.5'	0.5'	13-13-12	--		
				SPT-30	50.0' - 51.5'	0.9'	13-10-11	14		
				SPT-31	55.0' - 56.5'	1.0'	10-18-18	--		
				SPT-32	60.0' - 61.5'	1.0'	8-9-10	18		
				SPT-33	61.5' - 63.0'	1.2'	15-21-22	19		
		No Refusal / Bottom of Hole								

Project Number	175569040	Location	Drakesboro, KY		
Project Name	Scrubber Sludge Complex	Boring No.	STN-28	Total Depth	41.5 ft
County	Muhlenberg	Surface Elevation	470.4 ft		
Project Type	Geotechnical Exploration	Date Started	1/4/10	Completed	1/5/10
Supervisor	B. Taylor	Driller	Steve Bradford	Depth to Water	Dry
Logged By	B. Taylor	Depth to Water	--	Date/Time	--

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
470.4'	0.0'	Top of Hole							
		Mine Spoil: Lean to Fat Clay with intermediate sand lenses, brown to dark gray, moist to wet, medium stiff to vey stiff and with heterogeneous mixture of coal, shale, sandstone, and siltstone fragments.		SPT-1	0.0' - 1.5'	1.0'	2-4-4	--	
			SPT-2	1.5' - 3.0'	0.9'	6-6-5	--		
			SPT-3	3.0' - 4.5'	1.5'	10-8-12	--		
			SPT-4	4.5' - 6.0'	1.5'	3-4-5	--		
			SPT-5	6.0' - 7.5'	1.4'	7-8-10	--		
			SPT-6	7.5' - 9.0'	1.2'	11-15-9	--		
			SPT-7	9.0' - 10.5'	1.3'	2-3-3	--		
			SPT-8	10.5' - 12.0'	1.4'	4-11-8	--		
			SPT-9	12.0' - 13.5'	1.0'	11-15-11	--		
			SPT-10	13.5' - 15.0'	1.3'	7-8-11	--		
			SPT-11	15.0' - 16.5'	1.3'	6-13-35	--		
			SPT-12	16.5' - 18.0'	0.8'	11-50+	--		
			SPT-13	18.0' - 19.5'	0.9'	11-15-12	--		
			SPT-14	20.0' - 21.5'	1.5'	16-7-11	--		
			SPT-15	25.0' - 26.5'	0.4'	12-15-13	--	Cobble blocked SPT at 25.4'	
			SPT-16	30.0' - 31.5'	0.2'	11-12-10	--		
			SPT-17	35.0' - 36.5'	1.1'	21-22-21	--		

STANTEC\FNSM_LEGACY_171487156.GPJ FNSM_GRAPHIC.LOG.GDT_2/25/10



SUBSURFACE LOG

Project Number <u>175569040</u>	Location <u>Drakesboro, KY</u>
Project Name <u>Scrubber Sludge Complex</u>	Boring No. <u>STN-28</u> Total Depth <u>41.5 ft</u>

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
428.9'	41.5'			SPT-18	40.0' - 41.5'	0.2'	15-26-36	--	

No Refusal /
Bottom of Hole

STANTEC\FMSM_LEGACY_171487156.GPJ FMSM_GRAPHIC.LOG.GDT 2/25/10

Project Number	175569040	Location	Drakesboro, KY		
Project Name	Scrubber Sludge Complex	Boring No.	STN-29	Total Depth	59.5 ft
County	Muhlenberg	Surface Elevation	488.8 ft		
Project Type	Geotechnical Exploration	Date Started	12/14/09	Completed	12/15/09
Supervisor	B. Taylor	Driller	Steve Bradford	Depth to Water	Dry
Logged By	B. Taylor	Depth to Water	--	Date/Time	--

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
488.8'	0.0'	Top of Hole							
		Mine Spoil: Lean to Fat Clay with intermediate sand lenses, brown to dark gray, moist to wet, medium stiff to very stiff and with heterogeneous mixture of coal, shale, sandstone, and siltstone fragments.		SPT-1	0.0' - 1.5'	0.6'	2-3-4	13	
			SPT-2	1.5' - 3.0'	0.9'	1-2-5	16		
			SPT-3	3.0' - 4.5'	1.5'	5-5-7	16		
			SPT-4	4.5' - 6.0'	1.3'	5-6-7	16		
			SPT-5	6.0' - 7.5'	1.0'	7-12-13	18		
			SPT-6	7.5' - 9.0'	0.9'	14-15-18	13		
			SPT-7	9.0' - 10.5'	1.1'	4-6-7	14		
			SPT-8	10.5' - 12.0'	1.5'	8-9-9	12		
			SPT-9	12.0' - 13.5'	1.1'	14-17-16	11		
			SPT-10	13.5' - 15.0'	1.1'	22-14-17	14		
			SPT-11	15.0' - 16.5'	0.5'	4-4-8	12		Cobble blocked SPT at 15.5'
			SPT-12	16.5' - 18.0'	0.9'	8-8-22	12		
			SPT-13	18.0' - 19.5'	1.0'	32-13-11	15		
			SPT-14	19.5' - 21.0'	1.0'	8-8-12	14		
			SPT-15	21.0' - 22.5'	1.5'	12-11-10	15		
			SPT-16	22.5' - 24.0'	0.3'	8-9-10	--		
			SPT-17	24.0' - 25.5'	1.5'	8-13-17	12		
			SPT-18	25.5' - 27.0'	0.7'	11-15-20	9		Cobble blocked SPT at 25.8'
			SPT-19	27.0' - 28.5'	1.2'	14-15-15	16		
			SPT-20	28.5' - 30.0'	0.6'	9-10-5	14		
			SPT-21	30.0' - 31.5'	1.5'	2-5-5	11		
			SPT-22	31.5' - 33.0'	1.4'	6-6-5	13		
			SPT-23	33.0' - 34.5'	1.5'	3-6-6	19		
			SPT-24	34.5' - 36.0'	0.7'	5-4-5	--		

STANTEC\FNSM_LEGACY_171487156.GPJ_FNSM_GRAPHIC.LOG.GDT_2/25/10

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
429.3'	59.5'	Mine Spoil: Lean to Fat Clay with intermediate sand lenses, brown to dark gray, moist to wet, medium stiff to very stiff and with heterogeneous mixture of coal, shale, sandstone, and siltstone fragments. <i>(Continued)</i>		SPT-25	36.0' - 37.5'	0.7'	5-18-14	13	Cobble blocked SPT at 45.4'
				SPT-26	37.5' - 39.0'	1.3'	14-16-19	12	
				SPT-27	40.0' - 41.5'	1.5'	15-15-17	--	
				SPT-28	45.0' - 46.5'	0.4'	14-23-24	--	
				SPT-29	50.0' - 51.5'	1.1'	16-17-15	12	
				SPT-30	55.0' - 56.5'	1.3'	6-6-9	--	
				SPT-31	56.5' - 58.0'	1.5'	15-15-19	18	
				SPT-32	58.0' - 59.5'	1.4'	11-13-13	--	
		No Refusal / Bottom of Hole							

Project Number	175569040	Location	Drakesboro, KY		
Project Name	Scrubber Sludge Complex	Boring No.	STN-30	Total Depth	39.5 ft
County	Muhlenberg	Surface Elevation	470.7 ft		
Project Type	Geotechnical Exploration	Date Started	12/17/09	Completed	12/18/09
Supervisor	B. Taylor	Driller	Steve Bradford	Depth to Water	Dry
Logged By	B. Taylor	Depth to Water	--	Date/Time	--

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
470.7'	0.0'	Top of Hole							
		Mine Spoil: Lean Clay to Clayey sand with intermediate sand lenses, brown to dark gray, moist to wet, stiff to very stiff and with heterogeneous mixture of coal, shale, sandstone, and siltstone fragments.		SPT-1	0.0' - 1.5'	1.5'	2-2-6	17	Cobble blocked SPT at 7.6'
			SPT-2	1.5' - 3.0'	0.7'	7-6-6	29		
			SPT-3	3.0' - 4.5'	0.1'	5-4-6	--		
			SPT-4	4.5' - 6.0'	1.5'	3-5-5	16		
			SPT-5	6.0' - 7.5'	1.0'	5-7-7	15		
			SPT-6	7.5' - 9.0'	0.1'	6-7-8	--		
			SPT-7	9.0' - 10.5'	1.2'	7-9-9	10		
			SPT-8	10.5' - 12.0'	1.4'	8-10-11	12		
			SPT-9	12.0' - 13.5'	1.3'	11-11-11	12		
			SPT-10	13.5' - 15.0'	1.5'	9-7-11	13		
			SPT-11	15.0' - 16.5'	1.5'	3-6-6	12		
			SPT-12	16.5' - 18.0'	1.5'	7-9-11	13		
			SPT-13	18.0' - 19.5'	1.5'	10-10-11	15		
			SPT-14	25.0' - 26.5'	1.0'	11-11-9	5		
			SPT-15	30.0' - 31.5'	1.2'	11-10-9	9		
			SPT-16	35.0' - 36.5'	1.3'	5-6-9	--		

STANTEC\FNSM_LEGACY_171487156.GPJ FNSM_GRAPHIC.LOG.GDT 2/25/10



SUBSURFACE LOG

Project Number <u>175569040</u>	Location <u>Drakesboro, KY</u>
Project Name <u>Scrubber Sludge Complex</u>	Boring No. <u>STN-30</u> Total Depth <u>39.5 ft</u>

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
431.2'	39.5'			SPT-17	36.5' - 38.0'	1.5'	9-14-13	--	
				SPT-18	38.0' - 39.5'	1.5'	11-12-11	12	

No Refusal /
Bottom of Hole

STANTEC\FMSM_LEGACY_171487156.GPJ FMSM-GRAPHIC LOG.GDT 2/25/10

Project Number	175569040	Location	Drakesboro, KY		
Project Name	Scrubber Sludge Complex	Boring No.	STN-31	Total Depth	58.0 ft
County	Muhlenberg	Surface Elevation	486.6 ft		
Project Type	Geotechnical Exploration	Date Started	12/16/09	Completed	12/16/09
Supervisor	B. Taylor	Driller	Steve Bradford	Depth to Water	Dry
Logged By	B. Taylor	Depth to Water	--	Date/Time	--

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
486.6'	0.0'	Top of Hole							
476.1'	10.5'	Mine Spoil: Lean to Fat Clay with intermediate sand lenses, brown to dark gray, moist to wet, medium stiff to very stiff and with heterogeneous mixture of coal, shale, sandstone, and siltstone fragments.		SPT-1	0.0' - 1.5'	0.8'	2-2-3	--	Cobble blocked SPT at 8.1'
				SPT-2	1.5' - 3.0'	1.5'	3-5-5	14	
				SPT-3	3.0' - 4.5'	1.0'	6-10-9	13	
				SPT-4	4.5' - 6.0'	1.4'	5-6-6	15	
				SPT-5	6.0' - 7.5'	1.3'	6-10-11	12	
				SPT-6	7.5' - 9.0'	0.6'	10-10-11	--	
				SPT-7	9.0' - 10.5'	1.2'	4-6-9	12	
452.1'	34.5'	Sand with intermediate layers of clay and gravel, brown, moist to wet, very loose to dense		SPT-8	10.5' - 12.0'	1.2'	14-12-11	8	
				SPT-9	12.0' - 13.5'	1.0'	8-7-6	8	
				SPT-10	13.5' - 15.0'	1.5'	8-9-6	8	
				SPT-11	15.0' - 16.5'	1.2'	3-2-2	5	
				SPT-12	16.5' - 18.0'	1.5'	1-2-1	5	
				SPT-13	18.0' - 19.5'	1.3'	1-5-16	4	
				SPT-14	19.5' - 21.0'	1.5'	15-19-16	5	
				SPT-15	21.0' - 22.5'	1.4'	11-9-9	4	
				SPT-16	22.5' - 24.0'	1.5'	5-5-5	5	
				SPT-17	24.0' - 25.5'	1.5'	2-3-3	5	
				SPT-18	25.5' - 27.0'	1.4'	2-2-5	7	
				SPT-19	27.0' - 28.5'	1.3'	2-2-3	4	
				SPT-20	28.5' - 30.0'	1.2'	1-2-2	6	
				SPT-21	30.0' - 31.5'	1.3'	2-8-13	7	
				SPT-22	31.5' - 33.0'	1.4'	8-7-6	6	
				SPT-23	33.0' - 34.5'	1.4'	4-6-8	14	
				SPT-24	34.5' - 36.0'	1.0'	4-4-6	19	

STANTEC\FNSM_LEGACY_171487156.GPJ_FNSM_GRAPHIC.LOG.GDT_2/25/10

Project Number	175569040	Location	Drakesboro, KY	
Project Name	Scrubber Sludge Complex	Boring No.	STN-31	Total Depth 58.0 ft

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
		Mine Spoil: Lean to Fat Clay with intermediate sand lenses, brown to dark gray, moist to wet, stiff to very stiff and with heterogeneous mixture of coal, shale, sandstone, and siltstone fragments. <i>(Continued)</i>		SPT-25	36.0' - 37.5'	0.9'	8-9-11	17	
				SPT-26	40.0' - 41.5'	1.1'	3-9-9	15	
				SPT-27	45.0' - 46.5'	1.0'	5-5-5	--	
				SPT-28	50.0' - 51.5'	0.7'	9-10-12	10	
				SPT-29	55.0' - 56.5'	1.4'	7-7-8	15	
428.6'	58.0'			SPT-30	56.5' - 58.0'	1.5'	9-10-12	--	

No Refusal /
Bottom of Hole



SUBSURFACE LOG

Project Number	175569040	Location	Drakesboro, KY		
Project Name	Scrubber Sludge Complex	Boring No.	STN-26A	Total Depth	19.9 ft
County	Muhlenberg	Surface Elevation	471.4 ft		
Project Type	Geotechnical Exploration	Date Started	1/6/10	Completed	1/6/10
Supervisor	B. Taylor	Driller	Steve Bradford	Depth to Water	Dry
Logged By	B. Taylor	Depth to Water	--	Date/Time	--

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
471.4'	0.0'	Top of Hole							
		Mine spoil, brown to dark gray, moist to wet, medium stiff to very stiff, with siltstone, sandstone, shale and coal fragments							
				ST-1	5.0' - 7.0'	1.5'		13	
				ST-2	10.0' - 12.0'	1.4'		15	
451.5'	19.9'								

No Refusal /
Bottom of Hole

STANTEC\FNSM_LEGACY_171487156.GPJ FNSM_GRAPHIC.LOG.GDT 2/25/10



SUBSURFACE LOG

Project Number	175569040	Location	Drakesboro, KY		
Project Name	Scrubber Sludge Complex	Boring No.	STN-27A	Total Depth	27.0 ft
County	Muhlenberg	Surface Elevation	492.2 ft		
Project Type	Geotechnical Exploration	Date Started	12/10/09	Completed	12/10/09
Supervisor	B. Taylor	Driller	Steve Bradford	Depth to Water	6.3 ft
Logged By	B. Taylor	Depth to Water	--	Date/Time	--

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
492.2'	0.0'	Top of Hole							
		Mine spoil, brown to dark gray, moist to wet, soft to stiff, with siltstone, sandstone, shale and coal fragments		ST-1	5.0' - 7.0'	1.3'		15	
				ST-2	10.0' - 12.0'	0.6'		--	
				ST-3	15.0' - 17.0'	1.2'		25	
				ST-4	20.0' - 22.0'	0.0'		--	
				ST-5	25.0' - 27.0'	0.2'		--	
465.2'	27.0'	No Refusal / Bottom of Hole							

STANTEC\FNSM_LEGACY_171487156.GPJ_FNSM_GRAPHIC.LOG.GDT_2/25/10



SUBSURFACE LOG

Project Number	175569040	Location	Drakesboro, KY		
Project Name	Scrubber Sludge Complex	Boring No.	STN-28A	Total Depth	19.8 ft
County	Muhlenberg	Surface Elevation	470.2 ft		
Project Type	Geotechnical Exploration	Date Started	1/5/10	Completed	1/5/10
Supervisor	B. Taylor	Driller	Steve Bradford	Depth to Water	Dry
Logged By	B. Taylor	Depth to Water	--	Date/Time	--

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
470.2'	0.0'	Top of Hole							
		Mine Spoil: Lean to Fat Clay with intermediate sand lenses, brown to dark gray, moist to wet, medium stiff to vey stiff and with heterogeneous mixture of coal, shale, sandstone, and siltstone fragments.		ST-1	5.0' - 7.0'	1.3'		--	
				ST-2	10.0' - 12.0'	1.1'		--	
450.4'	19.8'								

No Refusal / Bottom of Hole

STANTEC\FNSM_LEGACY_171487156.GPJ FNSM-GRAPHIC LOG.GDT 2/25/10



SUBSURFACE LOG

Project Number	175569040	Location	Drakesboro, KY		
Project Name	Scrubber Sludge Complex	Boring No.	STN-29A	Total Depth	22.0 ft
County	Muhlenberg	Surface Elevation	489.1 ft		
Project Type	Geotechnical Exploration	Date Started	12/15/09	Completed	12/16/09
Supervisor	B. Taylor	Driller	Steve Bradford	Depth to Water	Dry
Logged By	B. Taylor	Depth to Water	--	Date/Time	--

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
489.1'	0.0'	Top of Hole							
		Mine Spoil: Lean to Fat Clay with intermediate sand lenses, brown to dark gray, moist to wet, medium stiff to vey stiff and with heterogeneous mixture of coal, shale, sandstone, and siltstone fragments.		ST-1	5.0' - 7.0'	1.1'		17	
				ST-2	10.0' - 12.0'	1.1'		20	
				ST-3	15.0' - 17.0'	0.3'		--	
				ST-4	20.0' - 22.0'	0.8'		--	

No Refusal /
Bottom of Hole

STANTEC\FNSM_LEGACY_171487156.GPJ FNSM_GRAPHIC.LOG.GDT 2/25/10



SUBSURFACE LOG

Project Number	175569040	Location	Drakesboro, KY	
Project Name	Scrubber Sludge Complex	Boring No.	STN-30A	Total Depth 18.0 ft
County	Muhlenberg	Surface Elevation	470.5 ft	
Project Type	Geotechnical Exploration	Date Started	1/4/10	Completed 1/4/10
Supervisor	B. Taylor	Driller	Steve Bradford	Depth to Water Dry Date/Time 1/4/10
Logged By	B. Taylor	Depth to Water	--	Date/Time --

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
470.5'	0.0'	Top of Hole							
		Mine Spoil: Lean to Fat Clay with intermediate sand lenses, brown to dark gray, moist to wet, stiff to very stiff and with heterogeneous mixture of coal, shale, sandstone, and siltstone fragments.		ST-1	5.0' - 7.0'	1.4'		--	
				ST-2	10.0' - 12.0'	1.4'		--	
452.5'	18.0'								

No Refusal / Bottom of Hole

STANTEC\FNSM_LEGACY_171487156.GPJ FNSM_GRAPHIC.LOG.GDT 2/25/10



SUBSURFACE LOG

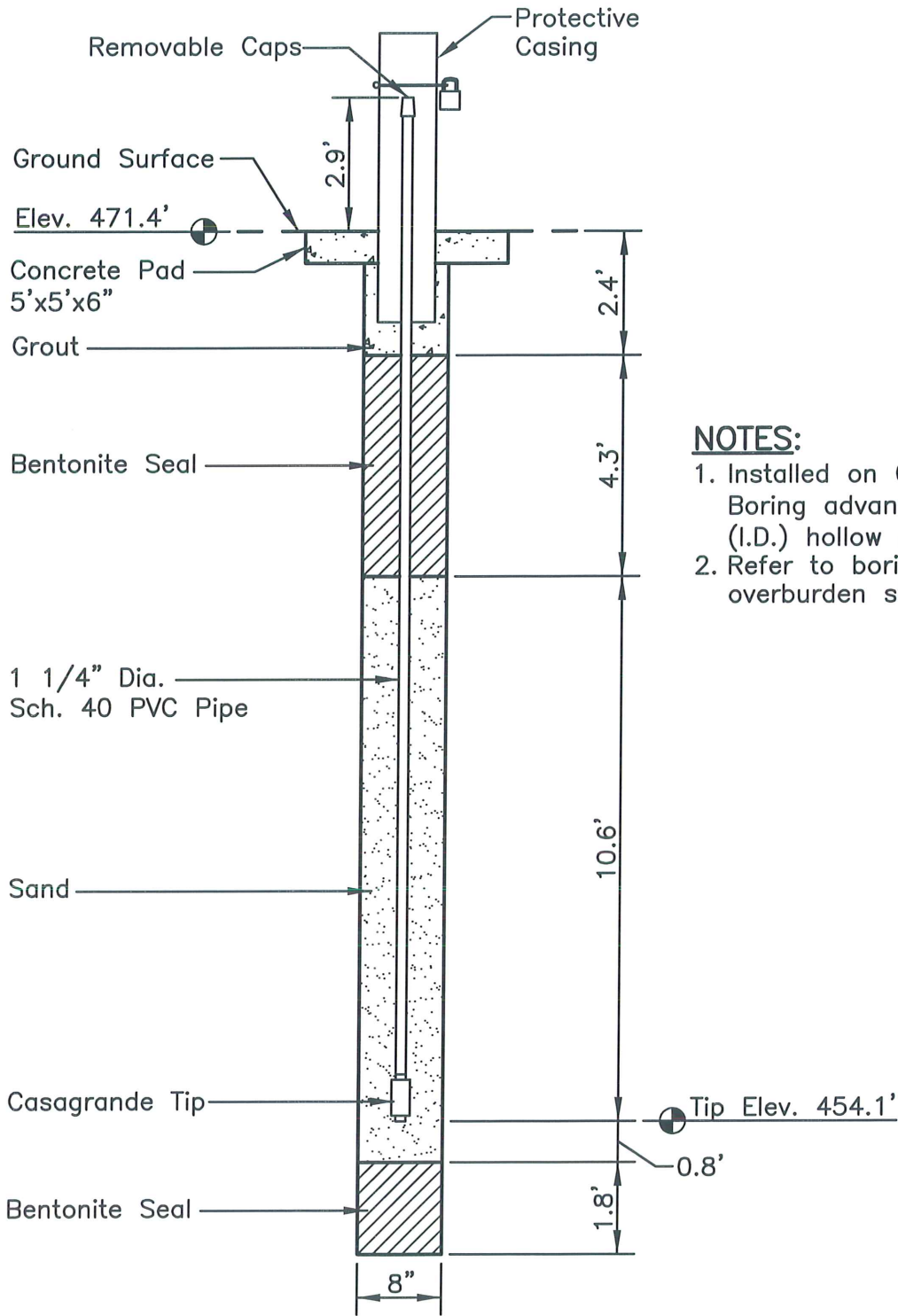
Project Number	175569040	Location	Drakesboro, KY		
Project Name	Scrubber Sludge Complex	Boring No.	STN-31A	Total Depth	22.0 ft
County	Muhlenberg	Surface Elevation	487.0 ft		
Project Type	Geotechnical Exploration	Date Started	12/17/09	Completed	12/17/09
Supervisor	B. Taylor	Driller	Steve Bradford	Depth to Water	Dry
Logged By	B. Taylor	Depth to Water	--	Date/Time	--

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
487.0'	0.0'	Top of Hole							
		Mine Spoil: Lean to Fat Clay with intermediate sand lenses, brown to dark gray, moist to wet, soft to very stiff and with heterogeneous mixture of coal, shale, sandstone, and siltstone fragments.		ST-1	5.0' - 7.0'	1.4'		9	
				ST-2	10.0' - 12.0'	1.2'		17	
				ST-3	15.0' - 17.0'	0.9'		12	
467.0'	20.0'			ST-4	20.0' - 22.0'	1.6'		8	
465.0'	22.0'	Sand with intermediate layers of clay and gravel, brown, moist to wet, medium dense to dense							
		No Refusal / Bottom of Hole							

STANTEC\FNSM_LEGACY_171487156.GPJ FNSM-GRAPHIC LOG.GDT 2/25/10

Attachment C

Instrumentation
Schematics, Water Level
Readings



NOTES:

1. Installed on 01/06/2010. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 01/19/2010 USER: ELLISON, DOC V:\1755\ACTIVE\175569040\GEOTECHNICAL\DRAWING\SCRUBBER_SLUDGE_COMPLEX\INSTRUMENTATION\69040C-PAF-101-FZ26A.DWG

LOCATION:

Northing: 331,796.20
 Easting: 1,634,106.29
 Ground Elevation: 471.4 feet

Locations provided by TVA,
 Power Systems Operations,
 Surveying and Project
 Services.

Horizontal Datum: NAD 27
 Vertical Datum: NGVD29

PIEZOMETER STN-26A
GEOTECHNICAL EXPLORATION
SCRUBBER SLUDGE COMPLEX

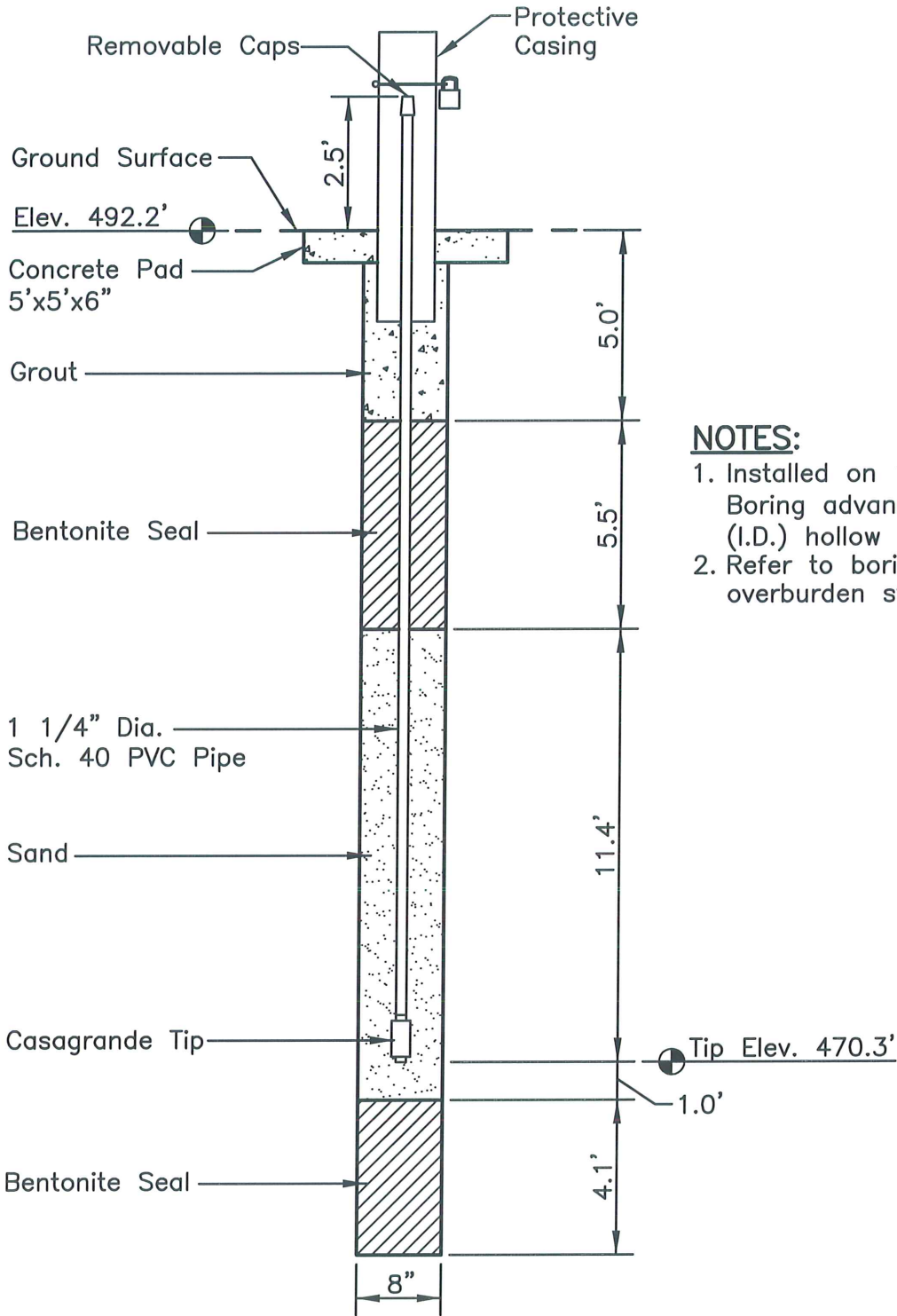


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DRAWN BY	ACC	DATE	JAN., 2010	REVISED	
CHECKED BY	ZM	PROJ. NO.	175569040	1.	3.
CHECKED BY	SV	SCALE	NTS	2.	4.

SHEET
1 OF 1



NOTES:

1. Installed on 12/11/2009. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 01/19/2010 USER: ELLISON, DOC V:\1755\ACTIVE\175569040\GEO\TECHNICAL\DRAWING\SCRUBBER_SLUDGE_COMPLEX\INSTRUMENTATION\69040C-PAF-101-PZ27A.DWG

LOCATION:

Northing: 331,884.74
 Easting: 1,634,097.38
 Ground Elevation: 492.2 feet

Locations provided by TVA, Power Systems Operations, Surveying and Project Services.

Horizontal Datum: NAD 27
 Vertical Datum: NGVD29

**PIEZOMETER STN-27A
 GEOTECHNICAL EXPLORATION
 SCRUBBER SLUDGE COMPLEX**

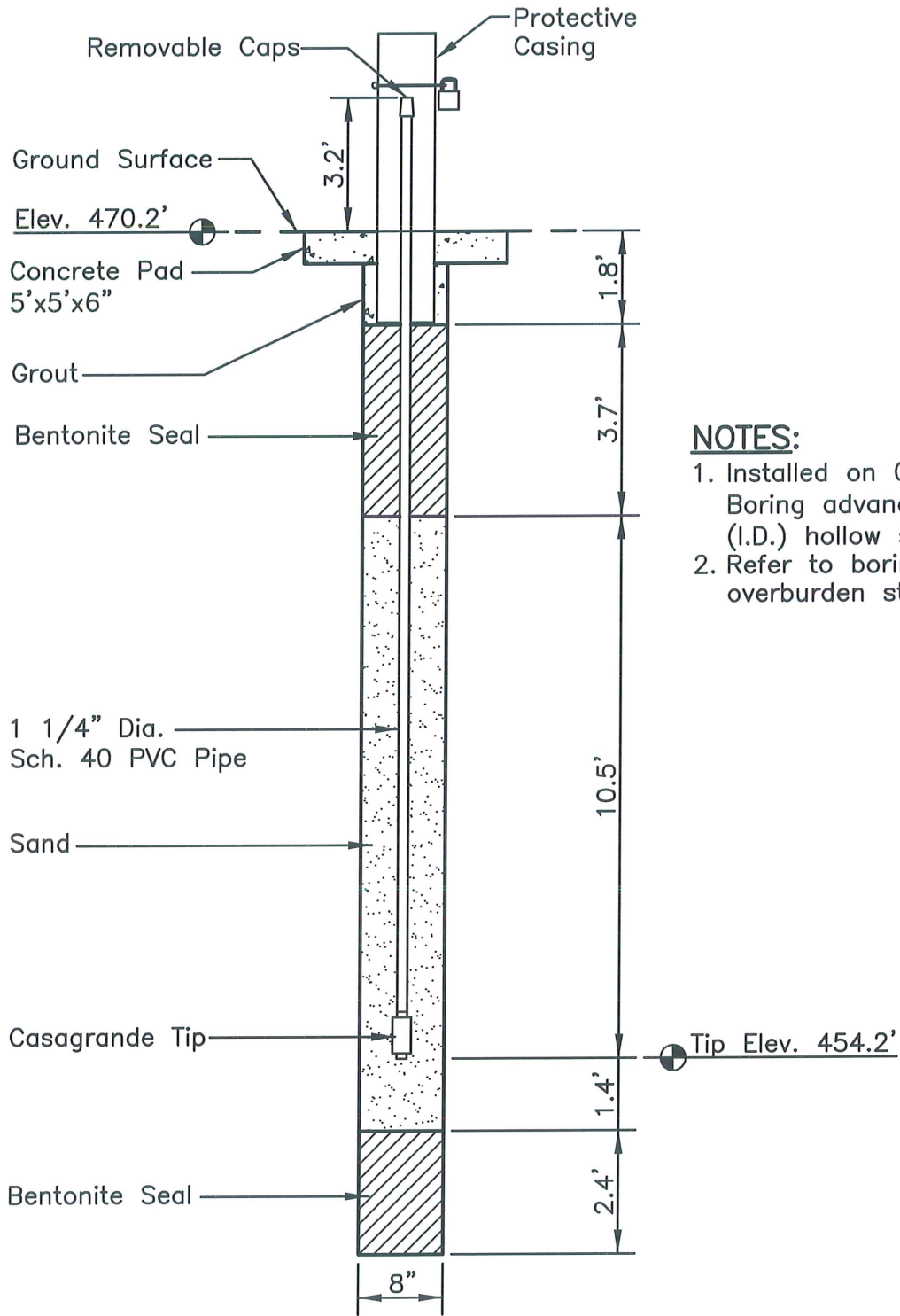


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DRAWN BY	ACC	DATE	JAN., 2010	REVISED	
CHECKED BY	ZM	PROJ. NO.	175569040	1.	3.
CHECKED BY	SV	SCALE	NTS	2.	4.

SHEET
1 OF 1



NOTES:

1. Installed on 01/05/2010. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 01/08/2010 USER: ELLISON, DOC V:\1755\ACTIVE\175566040\GEOTECHNICAL\DRAWING\SCRUBBER_SLUDGE_COMPLEX\INSTRUMENTATION\89040C-PAF-101-PZ28A.DWG

LOCATION:

Northing: 331,927.41
 Easting: 1,634,557.82
 Ground Elevation: 470.2 feet

Locations provided by TVA, Power Systems Operations, Surveying and Project Services.

Horizontal Datum: NAD 27
 Vertical Datum: NGVD29

**PIEZOMETER STN-28A
 GEOTECHNICAL EXPLORATION
 SCRUBBER SLUDGE COMPLEX**

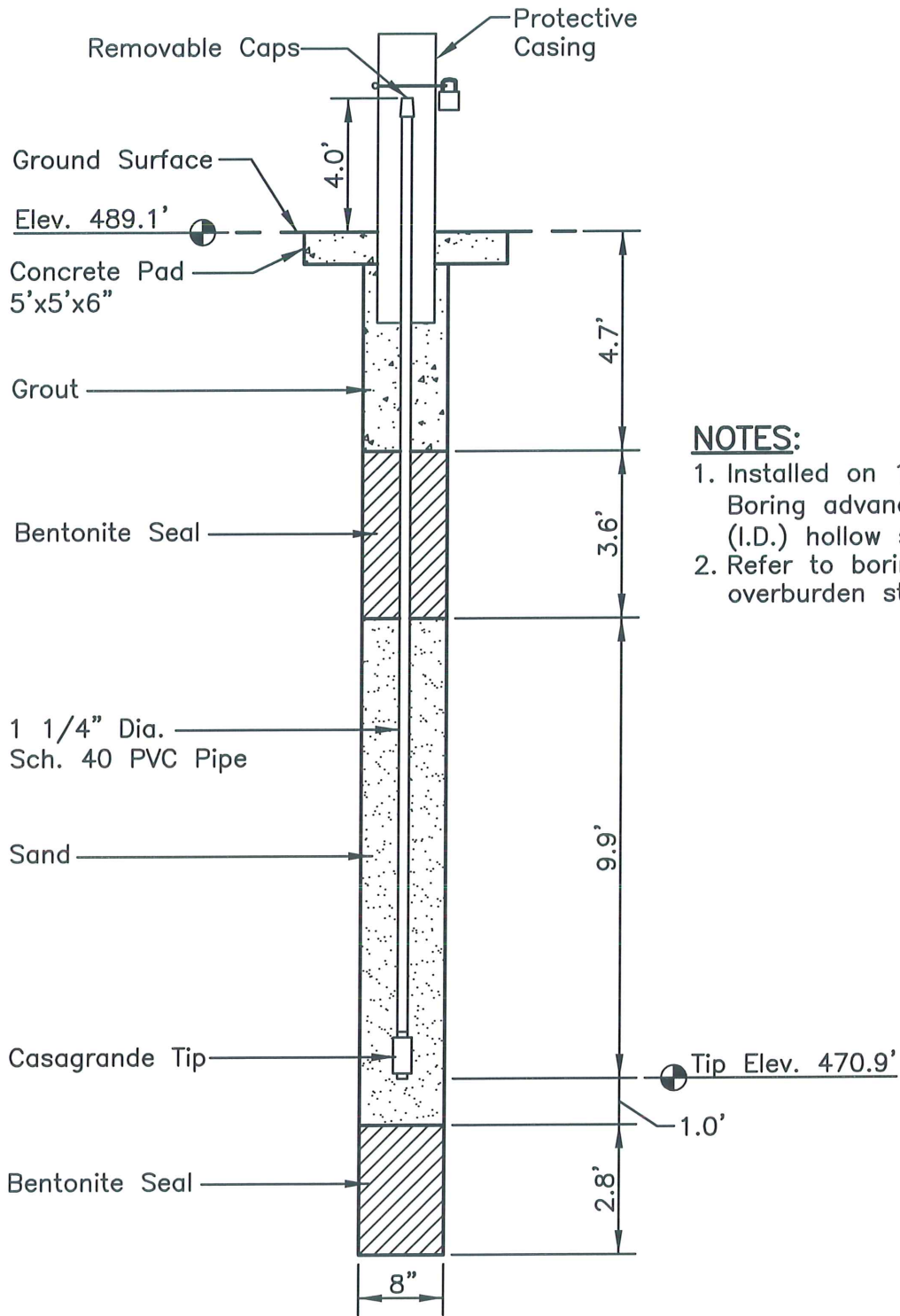


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DRAWN BY	ACC	DATE	JAN., 2010	REVISED		SHEET
CHECKED BY	ZM	PROJ. NO.	175569040	1.	3.	
CHECKED BY	SV	SCALE	NTS	2.	4.	

1 OF 1



NOTES:

1. Installed on 12/16/2009. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 01/11/2010 USER: ELLISON, DOC V:\1755\ACTIVE\175569040\GEO TECHNICAL DRAWING\SCRUBBER_SLUDGE_COMPLEX\INSTRUMENTATION\69040C-PAF-101-PZ29A.DWG

LOCATION:

Northing: 332,004.37
 Easting: 1,634,537.00
 Ground Elevation: 489.1 feet

Locations provided by TVA, Power Systems Operations, Surveying and Project Services.

Horizontal Datum: NAD 27
 Vertical Datum: NGVD29

**PIEZOMETER STN-29A
 GEOTECHNICAL EXPLORATION
 SCRUBBER SLUDGE COMPLEX**

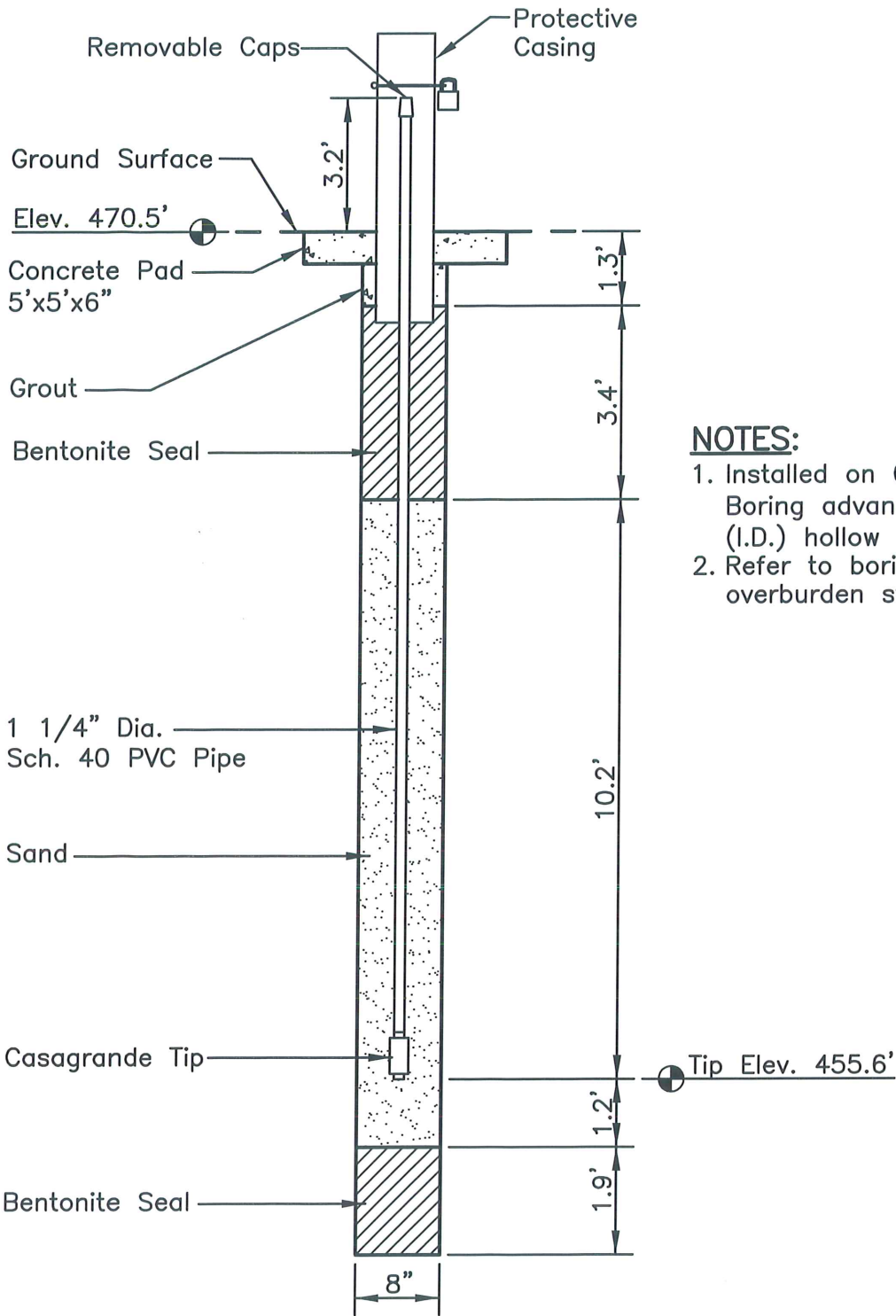


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DRAWN BY	ACC	DATE	JAN., 2010	REVISED	
CHECKED BY	ZM	PROJ. NO.	175569040	1.	3.
CHECKED BY	SV	SCALE	NTS	2.	4.

SHEET
1 OF 1



NOTES:

1. Installed on 01/04/2010. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 01/11/2010 USER: ELLISON, DOC V:\1755\ACTIVE\175569040\GEO\TECHNICAL\DRAWING\SCRUBBER_SLUDGE_COMPLEX\INSTRUMENTATION\69040C-PAF-101-PZ30A.DWG

LOCATION:

Northing: 332,077.28
 Easting: 1,635,004.16
 Ground Elevation: 470.5 feet

Locations provided by TVA, Power Systems Operations, Surveying and Project Services.

Horizontal Datum: NAD 27
 Vertical Datum: NGVD29

PIEZOMETER STN-30A
GEOTECHNICAL EXPLORATION
SCRUBBER SLUDGE COMPLEX

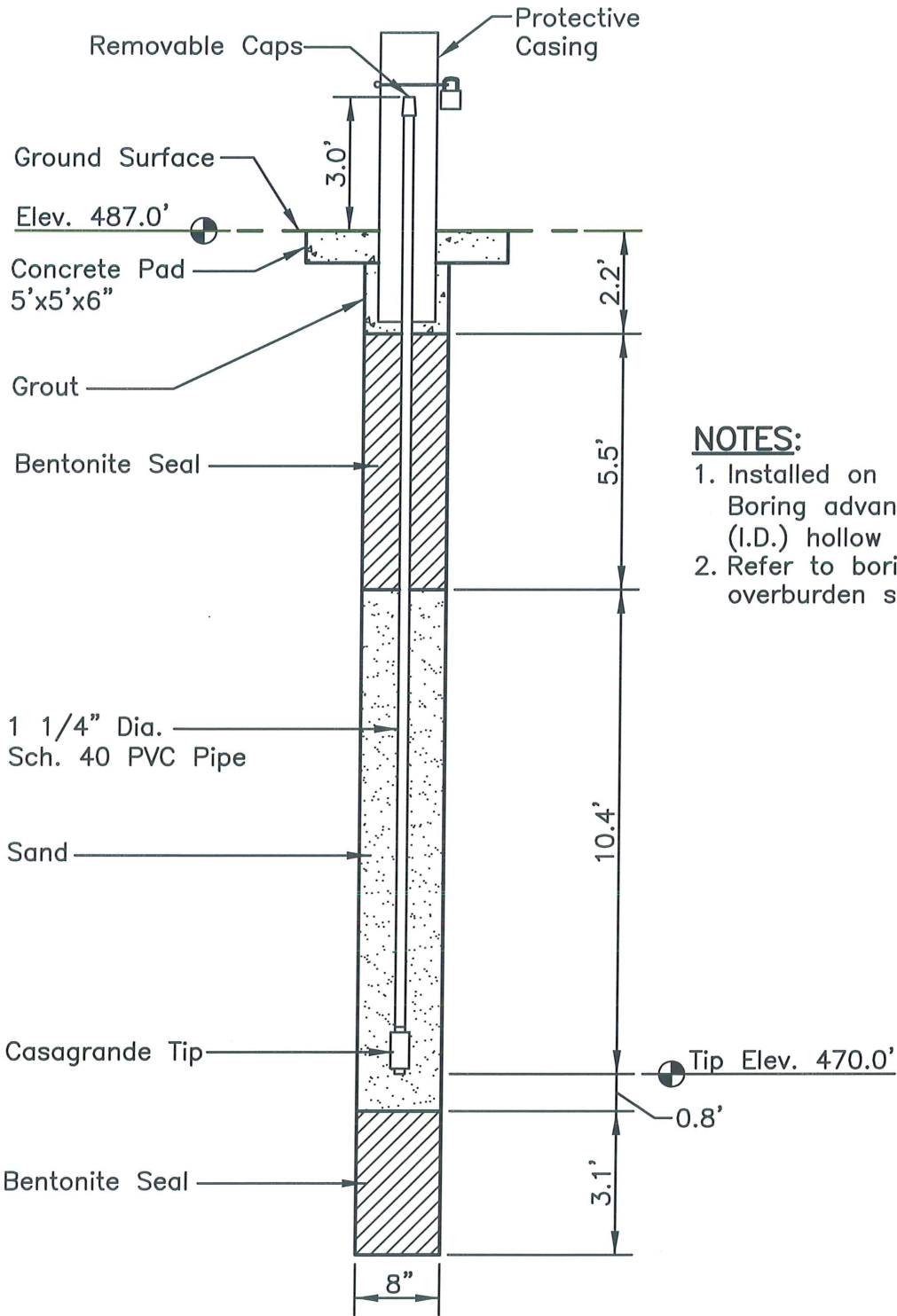


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DRAWN BY	ACC	DATE	JAN., 2010	REVISED	
CHECKED BY	ZM	PROJ. NO.	175569040	1.	3.
CHECKED BY	SV	SCALE	NTS	2.	4.

SHEET
1 OF 1



NOTES:

1. Installed on 12/17/2009. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 01/11/2010 USER: ELLISON, DOC V:\1755\ACTIVE\175569040\GEOTECHNICAL\DRAWING\SCRUBBER_SLUDGE_COMPLEX\INSTRUMENTATION\69040C-PAF-101-PZ31A.DWG

LOCATION:

Northing: 332,141.29
 Easting: 1,634,981.22
 Ground Elevation: 487.0 feet

Locations provided by TVA, Power Systems Operations, Surveying and Project Services.

Horizontal Datum: NAD 27
 Vertical Datum: NGVD29

**PIEZOMETER STN-31A
 GEOTECHNICAL EXPLORATION
 SCRUBBER SLUDGE COMPLEX**



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DRAWN BY	ACC	DATE	JAN., 2010	REVISED	
CHECKED BY	ZM	PROJ. NO.	175569040	1.	3.
CHECKED BY	SV	SCALE	NTS	2.	4.

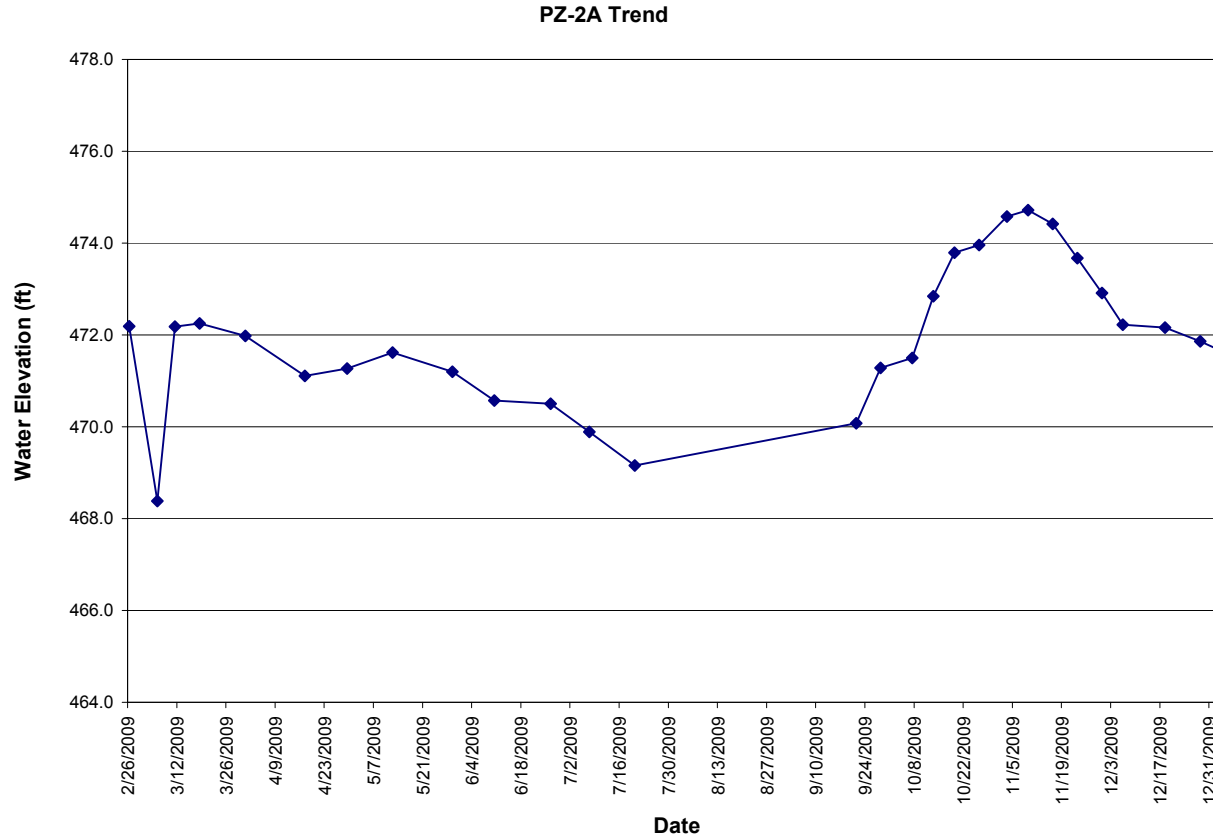
SHEET
1 OF 1

**PIEZOMETER READINGS
PARADISE FOSSIL PLANT**

Piezometer No. PZ-2A
 Piezometer Installation Date 2/2/2009
 Surface Elevation (ft) 494.2

Project No. 175569040
 Tip Elevation (ft) 437.1
 Location West Pond South Slope

Date	Water Elevation (ft)
2/26/2009	472.2
3/6/2009	468.4
3/11/2009	472.2
3/18/2009	472.3
3/31/2009	472.0
4/17/2009	471.1
4/29/2009	471.3
5/12/2009	471.6
5/29/2009	471.2
6/10/2009	470.6
6/26/2009	470.5
7/7/2009	469.9
7/20/2009	469.2
9/21/2009	470.1
9/28/2009	471.3
10/7/2009	471.5
10/13/2009	472.8
10/19/2009	473.8
10/26/2009	474.0
11/3/2009	474.6
11/9/2009	474.7
11/16/2009	474.4
11/23/2009	473.7
11/30/2009	472.9
12/6/2009	472.2
12/18/2009	472.2
12/28/2009	471.9
1/4/2010	471.6
1/12/2010	471.1
1/18/2010	471.0
1/25/2010	471.5
2/1/2010	471.5
2/8/2010	471.8
2/15/2010	472.2

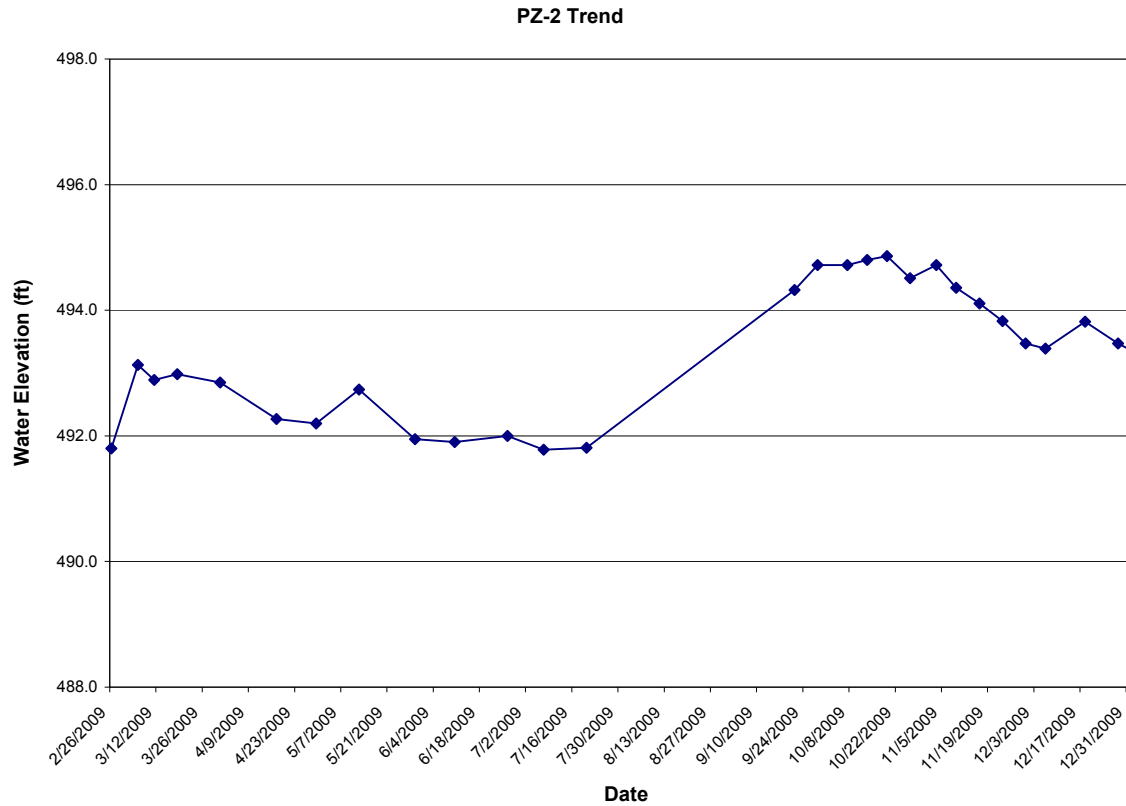


**PIEZOMETER READINGS
PARADISE FOSSIL PLANT**

Piezometer No. PZ-2
 Piezometer Installation Date 2/2/2009
 Surface Elevation (ft) 494.2

Project No. 175569040
 Tip Elevation (ft) 468.4
 Location West Pond South Slope

Date	Water Elevation (ft)
2/26/2009	491.8
3/6/2009	493.1
3/11/2009	492.9
3/18/2009	493.0
3/31/2009	492.9
4/17/2009	492.3
4/29/2009	492.2
5/12/2009	492.7
5/29/2009	492.0
6/10/2009	491.9
6/26/2009	492.0
7/7/2009	491.8
7/20/2009	491.8
9/21/2009	494.3
9/28/2009	494.7
10/7/2009	494.7
10/13/2009	494.8
10/19/2009	494.9
10/26/2009	494.5
11/3/2009	494.7
11/9/2009	494.4
11/16/2009	494.1
11/23/2009	493.8
11/30/2009	493.5
12/6/2009	493.4
12/18/2009	493.8
12/28/2009	493.5
1/4/2010	493.3
1/12/2010	492.9
1/18/2010	493.1
1/25/2010	494.1
2/1/2010	494.2
2/8/2010	494.6
2/15/2010	494.7

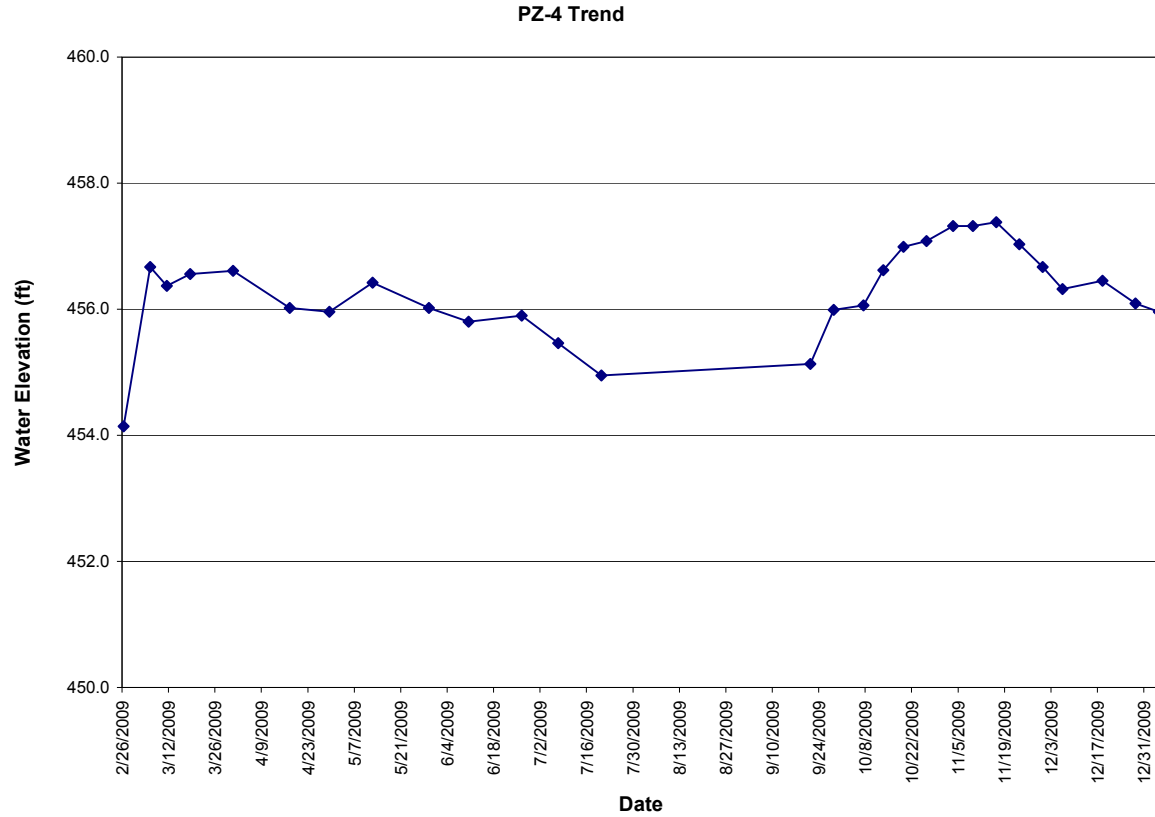


**PIEZOMETER READINGS
PARADISE FOSSIL PLANT**

Piezometer No. PZ-4
 Piezometer Installation Date 2/17/2009
 Surface Elevation (ft) 467.5

Project No. 175569040
 Tip Elevation (ft) 420.7
 Location West Pond South Slope

Date	Water Elevation (ft)
2/26/2009	454.1
3/6/2009	456.7
3/11/2009	456.4
3/18/2009	456.6
3/31/2009	456.6
4/17/2009	456.0
4/29/2009	456.0
5/12/2009	456.4
5/29/2009	456.0
6/10/2009	455.8
6/26/2009	455.9
7/7/2009	455.5
7/20/2009	455.0
9/21/2009	455.1
9/28/2009	456.0
10/7/2009	456.1
10/13/2009	456.6
10/19/2009	457.0
10/26/2009	457.1
11/3/2009	457.3
11/9/2009	457.3
11/16/2009	457.4
11/23/2009	457.0
11/30/2009	456.7
12/6/2009	456.3
12/18/2009	456.5
12/28/2009	456.1
1/4/2010	456.0
1/12/2010	455.6
1/18/2010	455.6
1/25/2010	456.2
2/1/2010	455.9
2/8/2010	456.1
2/15/2010	456.3

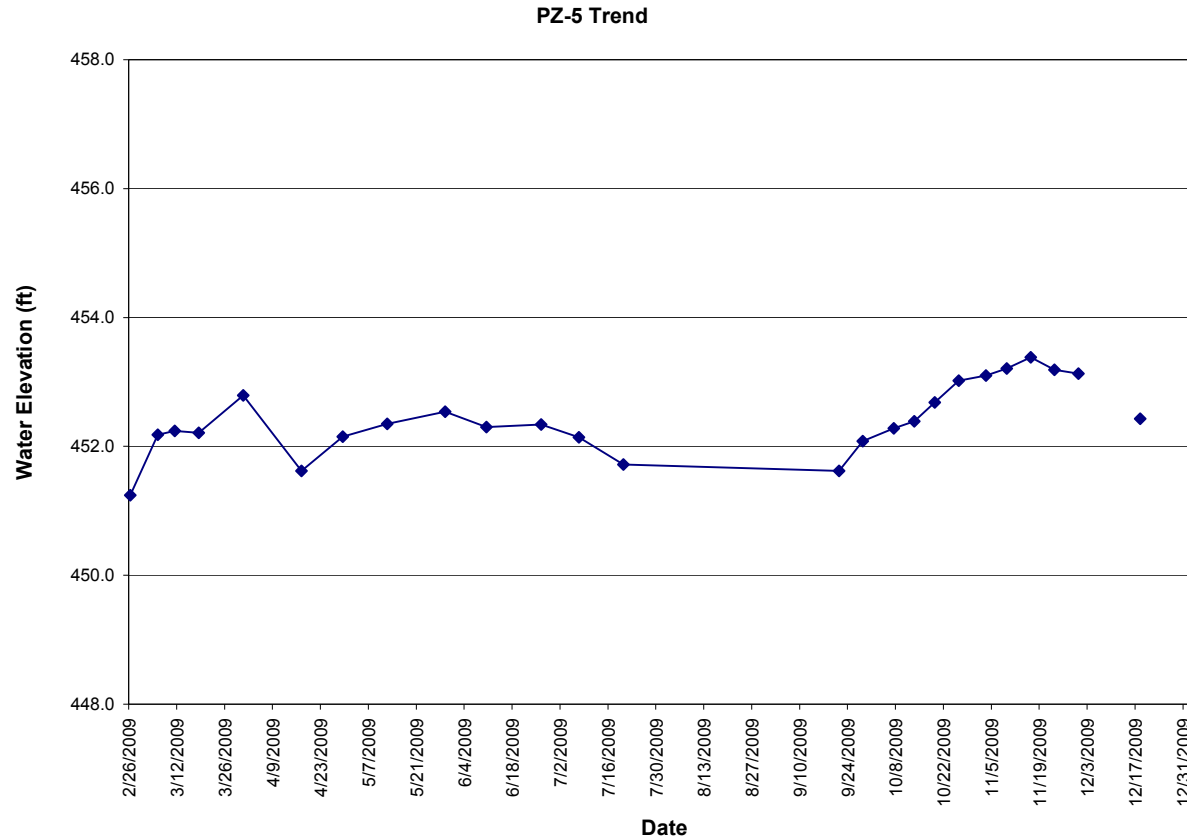


**PIEZOMETER READINGS
PARADISE FOSSIL PLANT**

Piezometer No. PZ-5
 Piezometer Installation Date 2/9/2009
 Surface Elevation (ft) 451.9

Project No. 175569040
 Tip Elevation (ft) 399.3
 Location West Pond South Slope

Date	Water Elevation (ft)
2/26/2009	451.2
3/6/2009	452.2
3/11/2009	452.2
3/18/2009	452.2
3/31/2009	452.8
4/17/2009	451.6
4/29/2009	452.2
5/12/2009	452.4
5/29/2009	452.5
6/10/2009	452.3
6/26/2009	452.3
7/7/2009	452.1
7/20/2009	451.7
9/21/2009	451.6
9/28/2009	452.1
10/7/2009	452.3
10/13/2009	452.4
10/19/2009	452.7
10/26/2009	453.0
11/3/2009	453.1
11/9/2009	453.2
11/16/2009	453.4
11/23/2009	453.2
11/30/2009	453.1
12/6/2009	(frozen)
12/18/2009	452.4
12/28/2009	(frozen)
1/4/2010	(frozen)
1/12/2010	- (frozen)
1/18/2010	- (frozen)
1/25/2010	452.5
2/1/2010	- (frozen)
2/8/2010	- (frozen)
2/15/2010	- (frozen)





PIEZOMETER

Paradise Fossil Plant
 13246 State Route 176
 175569040

Location	Piezometer	1/18/2010				1/25/2010				2/1/2010			
		Surface Elevation (ft)	Stickup (ft)	Depth Measurement (ft)	Water Elevation (ft)	Surface Elevation (ft)	Stickup (ft)	Depth Measurement (ft)	Water Elevation (ft)	Surface Elevation (ft)	Stickup (ft)	Depth Measurement (ft)	Water Elevation (ft)
STN-26A	STN-26A	471.4	2.9	20.1	454.2	471.4	2.9	20.2	454.2	471.4	2.9	20.2	454.2
STN-27A	STN-27A	492.2	2.6	6.9	487.8	492.2	2.6	6.6	488.1	492.2	2.6	6.7	488.0
STN-28A	STN-28A	470.2	3.2	NA**	NA	470.2	3.2	18.7	454.8	470.2	3.2	18.6	454.8
STN-29A	STN-29A	489.1	4.0	17.8	475.4	489.1	4.0	17.9	475.2	489.1	4.0	18.2	475.0
STN-30A	STN-30A	470.5	3.2	18.2	455.5	470.5	3.2	18.2	455.5	470.5	3.2	18.2	455.5
STN-31A	STN-31A	487.0	3.0	20.3	469.7	487.0	3.0	20.3	469.7	487.0	3.0	20.3	469.7



PIEZOMETER

Paradise Fossil Plant
13246 State Route 176
175569040

		2/8/2010				2/15/2010			
Location	Piezometer	Surface Elevation (ft)	Stickup (ft)	Depth Measurement (ft)	Water Elevation (ft)	Surface Elevation (ft)	Stickup (ft)	Depth Measurement (ft)	Water Elevation (ft)
STN-26A	STN-26A	471.4	2.9	20.2	454.2	471.4	2.9	20.2	454.2
STN-27A	STN-27A	492.2	2.6	6.6	488.1	492.2	2.6	6.5	488.3
STN-28A	STN-28A	470.2	3.2	18.6	454.8	470.2	3.2	18.6	454.8
STN-29A	STN-29A	489.1	4.0	18.0	475.1	489.1	4.0	17.8	475.4
STN-30A	STN-30A	470.5	3.2	18.2	455.5	470.5	3.2	18.2	455.5
STN-31A	STN-31A	487.0	3.0	20.3	469.7	487.0	3.0	20.3	469.7

Attachment D

Results of Laboratory
Testing



Summary of Soil Tests

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope Project Number 175569040
 Source STN-26, 4.5'-6.0', 7.5'-9.0', 13.5'-15.0', 18.0'-19.5' Lab ID 262
 County Muhlenberg Date Received 1-8-10
 Sample Type SPT Comp Date Reported 1-22-10

Test Results

Natural Moisture Content

Test Not Performed
 Moisture Content (%): N/A

Atterberg Limits

Test Method: ASTM D 4318 Method A
 Prepared: Dry
 Liquid Limit: 34
 Plastic Limit: 18
 Plasticity Index: 16
 Activity Index: 1.23

Particle Size Analysis

Preparation Method: ASTM D 421
 Gradation Method: ASTM D 422
 Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	
		Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	89.6
No. 4	4.75	77.6
No. 10	2	55.7
No. 40	0.425	47.7
No. 200	0.075	40.5
	0.02	31.0
	0.005	20.3
	0.002	13.2
estimated	0.001	9.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	22.4	44.3
Coarse Sand	21.9	8.0
Medium Sand	8.0	---
Fine Sand	7.2	7.2
Silt	20.2	27.3
Clay	20.3	13.2

Moisture-Density Relationship

Test Not Performed
 Maximum Dry Density (lb/ft³): N/A
 Maximum Dry Density (kg/m³): N/A
 Optimum Moisture Content (%): N/A
 Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
 Bearing Ratio (%): N/A
 Compacted Dry Density (lb/ft³): N/A
 Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
 Prepared: Dry
 Particle Size: No. 10
 Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: SC
 Group Name: Clayey sand with gravel
 AASHTO Classification: A-6 (2)

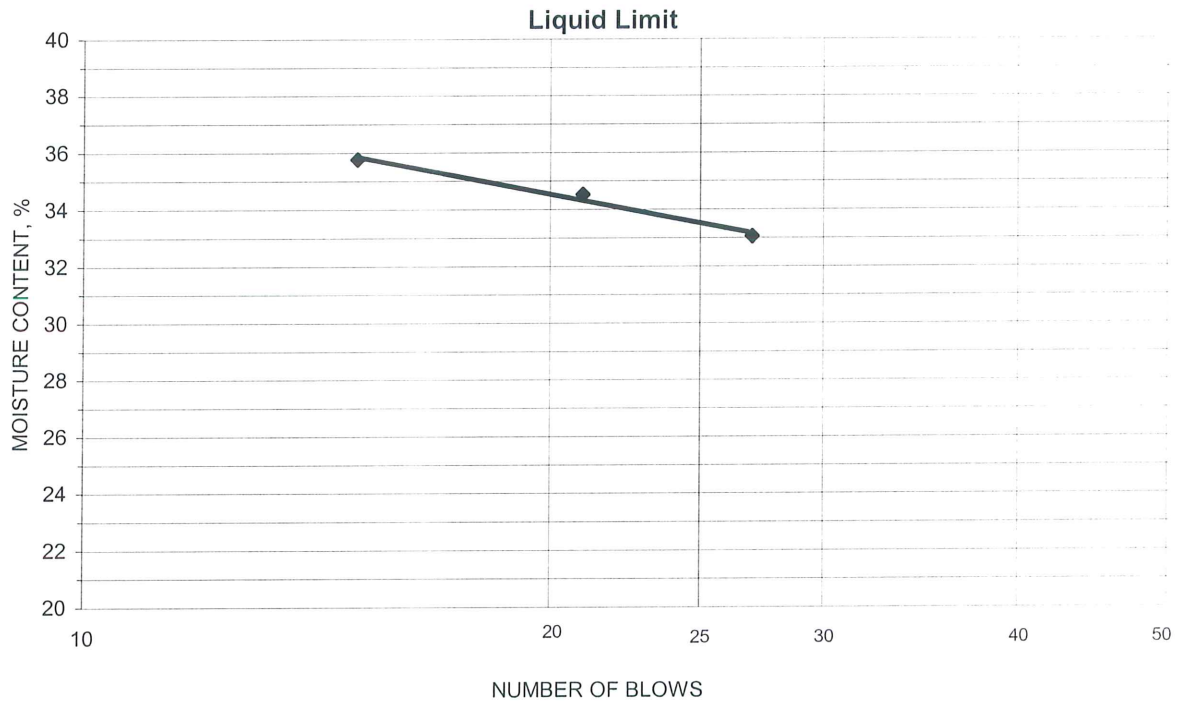
Comments: _____

Reviewed by:

Project PAF-Scrubber Sludge Complex, W Pond S Slope
 Source STN-26, 4.5'-6.0', 7.5'-9.0', 13.5'-15.0', 18.0'-19.5'
 Tested By MC Test Method ASTM D 4318 Method A
 Test Date 01-20-2010 Prepared Dry

Project No. 175569040
 Lab ID 262
 % + No. 40 52
 Date Received 01-08-2010

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.85	17.61	10.83	27	33.0	34
19.39	17.16	10.70	21	34.5	
20.15	17.84	11.38	15	35.8	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
18.54	17.44	11.28	17.9	18	16
18.81	17.70	11.50	17.9		

Remarks: _____
 _____ Reviewed By TLK

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope
 Source STN-26, 4.5'-6.0', 7.5'-9.0', 13.5'-15.0', 18.0'-19.5'

Project Number 175569040
 Lab ID 262

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
 Prepared using: ASTM D 421
 Particle Shape: Angular
 Particle Hardness: Hard and Durable
 Tested By: JF
 Test Date: 01-14-2010
 Date Received: 01-08-2010

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	89.6
No. 4	77.6
No. 10	55.7

Maximum Particle size: 3/4" Sieve

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

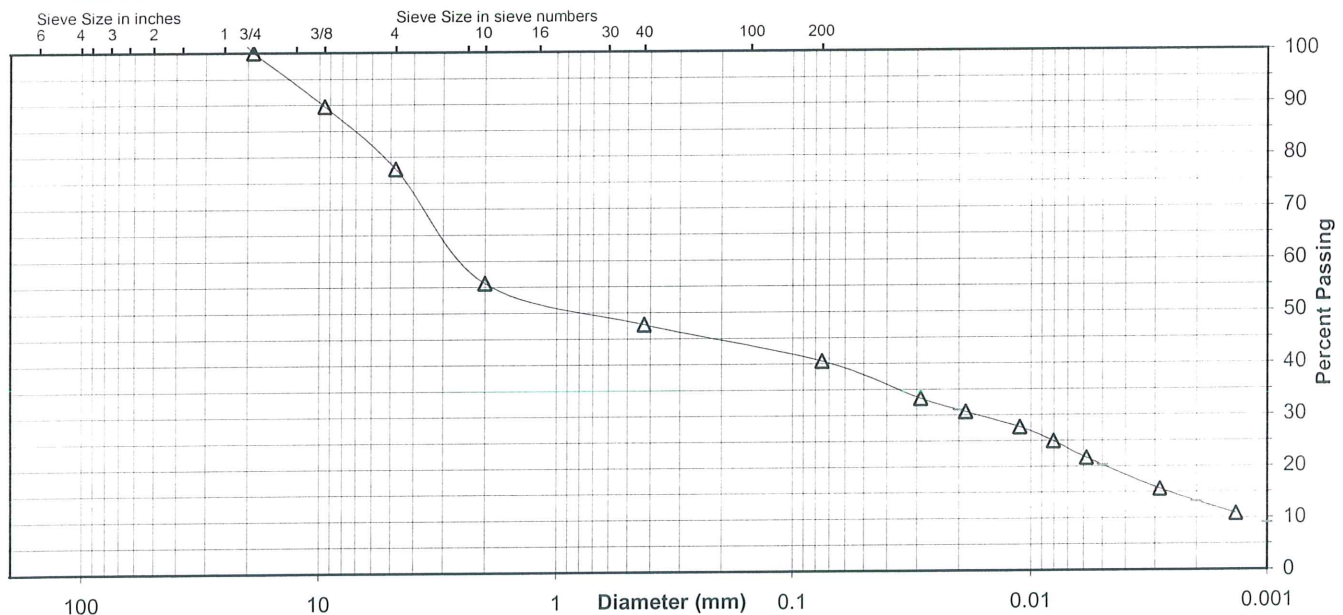
Specific Gravity 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	47.7
No. 200	40.5
0.02 mm	31.0
0.005 mm	20.3
0.002 mm	13.2
0.001 mm	9.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	22.4	21.9	8.0	7.2	20.2	20.3
AASHTO	Gravel		Coarse Sand	Fine Sand	Silt		Clay
	44.3		8.0	7.2	27.3		13.2



Comments _____

Reviewed By 



Summary of Soil Tests

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope Project Number 175569040
 Source STN-27, 22.5'-24.0', 25.5'-27.0', 28.5'-30.0', 31.5'-33.0' Lab ID 292
 County Muhlenberg Date Received 1-8-10
 Sample Type SPT Comp Date Reported 1-22-10

Test Results

Natural Moisture Content

Test Not Performed
 Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
 Gradation Method: ASTM D 422
 Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	
		Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	100.0
3/4"	19	95.2
3/8"	9.5	88.8
No. 4	4.75	81.3
No. 10	2	66.9
No. 40	0.425	55.7
No. 200	0.075	45.5
	0.02	36.9
	0.005	24.6
	0.002	17.0
estimated	0.001	13.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	18.7	33.1
Coarse Sand	14.4	11.2
Medium Sand	11.2	---
Fine Sand	10.2	10.2
Silt	20.9	28.5
Clay	24.6	17.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
 Prepared: Dry
 Liquid Limit: 36
 Plastic Limit: 19
 Plasticity Index: 17
 Activity Index: 1.00

Moisture-Density Relationship

Test Not Performed
 Maximum Dry Density (lb/ft³): N/A
 Maximum Dry Density (kg/m³): N/A
 Optimum Moisture Content (%): N/A
 Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
 Bearing Ratio (%): N/A
 Compacted Dry Density (lb/ft³): N/A
 Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
 Prepared: Dry
 Particle Size: No. 10
 Specific Gravity at 20° Celsius: 2.68

Classification

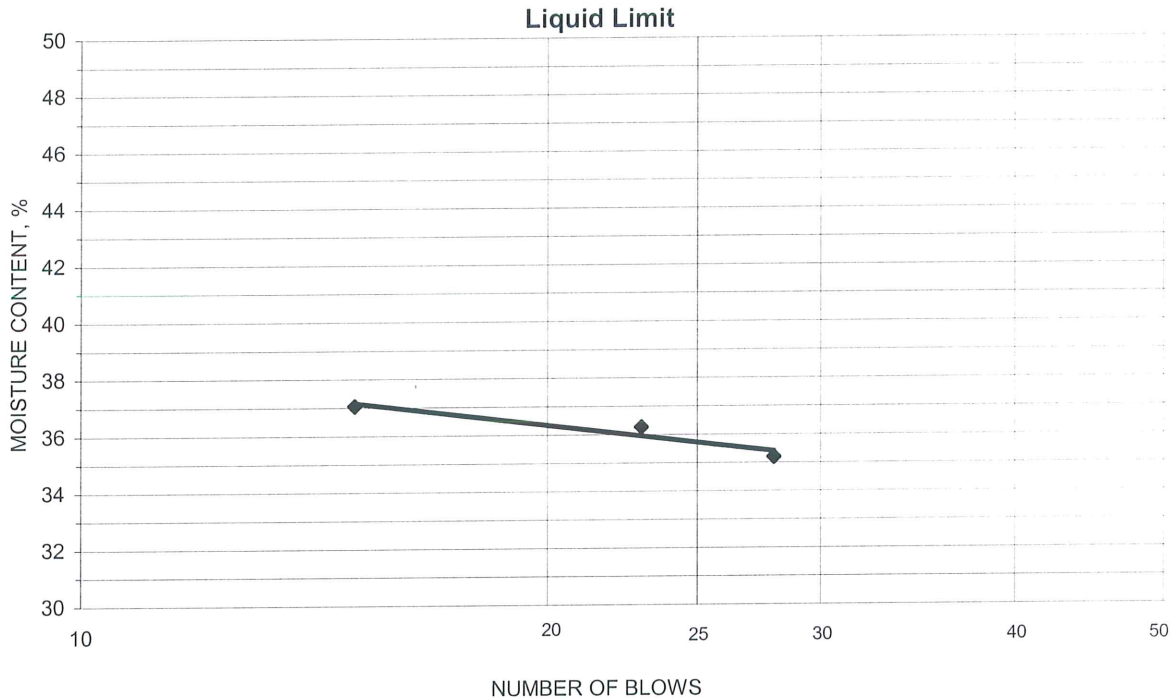
Unified Group Symbol: SC
 Group Name: Clayey sand with gravel
 AASHTO Classification: A-6 (4)

Comments: _____
 Reviewed by:

Project PAF-Scrubber Sludge Complex, W Pond S Slope
 Source STN-27, 22.5'-24.0', 25.5'-27.0', 28.5'-30.0', 31.5'-33.0'
 Tested By MC Test Method ASTM D 4318 Method A
 Test Date 01-20-2010 Prepared Dry

Project No. 175569040
 Lab ID 292
 % + No. 40
 Date Received 01-08-2010


Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.04	17.01	11.24	28	35.2	36
19.55	17.36	11.32	23	36.3	
19.27	17.11	11.28	15	37.0	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
18.75	17.59	11.34	18.6	19	17
18.52	17.31	10.86	18.8		

Remarks: _____

Reviewed By 

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope
 Source STN-27, 22.5'-24.0', 25.5'-27.0', 28.5'-30.0', 31.5'-33.0'

Project Number 175569040
 Lab ID 292

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
 Prepared using: ASTM D 421
 Particle Shape: Angular
 Particle Hardness: Hard and Durable
 Tested By: JF
 Test Date: 01-14-2010
 Date Received: 01-08-2010

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	100.0
3/4"	95.2
3/8"	88.8
No. 4	81.3
No. 10	66.9

Maximum Particle size: 1" Sieve

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

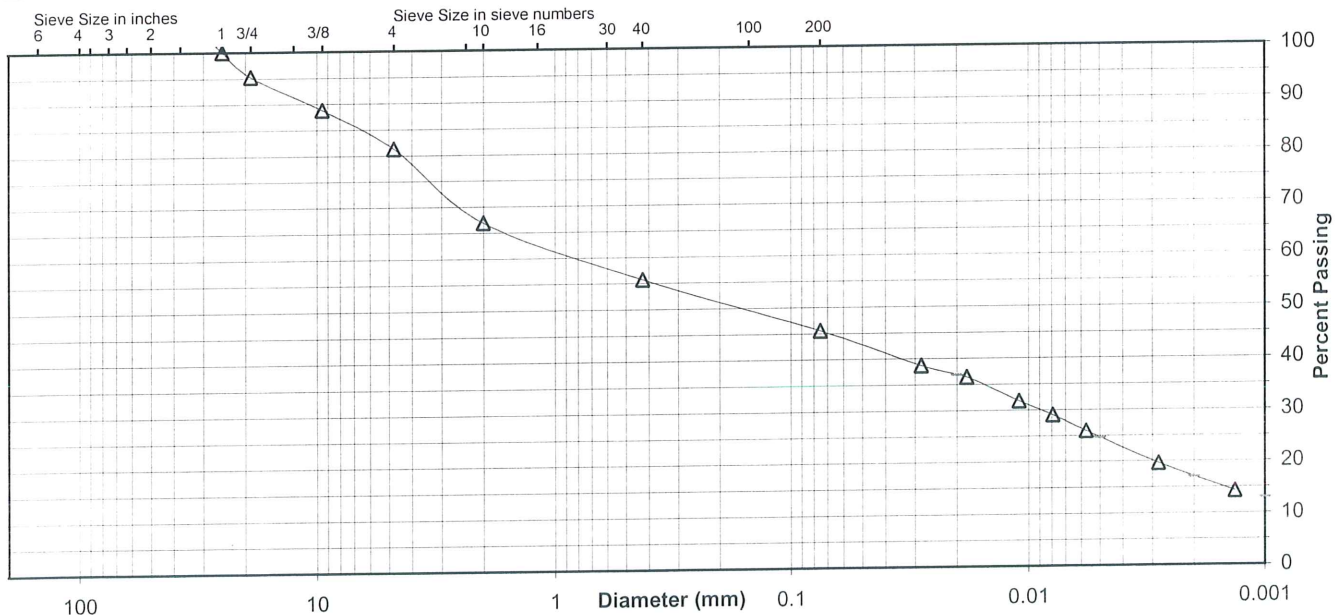
Specific Gravity 2.68

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	55.7
No. 200	45.5
0.02 mm	36.9
0.005 mm	24.6
0.002 mm	17.0
0.001 mm	13.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	4.8	13.9	14.4	11.2	10.2	20.9	24.6
AASHTO	Gravel		Coarse Sand		Fine Sand	Silt	Clay
	33.1		11.2		10.2	28.5	17.0



Comments _____

Reviewed By 

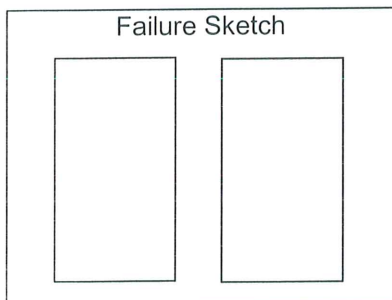
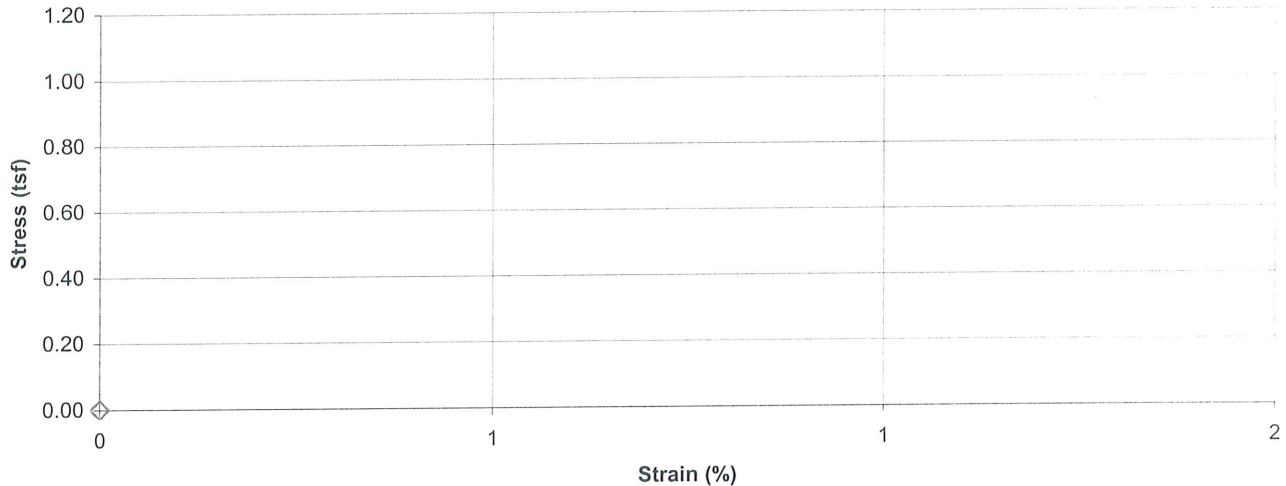


**Unconfined Compressive Strength
of Cohesive Soil**
ASTM D 2166

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope Project Number 175569040
 Source STN-26A, 5.0'-7.0' Lab ID 277
 Visual Description Gravelly Lean Clay (CL), brown, moist, firm, mine spoil
 Recovered 1.2'
 Test Interval 5.6' - 6.1'

Specimen Type: <u>Undisturbed</u>	LL <u>N/A</u>	PL <u>N/A</u>	Date Extruded <u>01/11/2010</u>
		PI <u>N/A</u>	Date Tested <u>N/A</u>
Initial Wet Density (pcf) <u>135.1</u>	Initial MC Taken <u>Before Test, From Trimmings</u>		
Initial Moisture Content (%) <u>13.2</u>			
Initial Dry Density (pcf) <u>119.3</u>	At Test MC Taken <u>N/A</u>		
At Test Moisture Content (%) <u>N/A</u>			
At Test Dry Density (pcf) <u>N/A</u>			
Specific Gravity <u>N/A</u>			
Degree of Saturation (%) <u>N/A</u>	Unconfined Compressive Strength (tsf) <u>N/A</u>		
Average Height (in) <u>6.141</u>	Undrained Shear Strength (tsf) <u>N/A</u>		
Average Diameter (in) <u>2.892</u>	Strain at Maximum Stress (%) <u>N/A</u>		
Height to Diameter Ratio <u>2.1</u>	Strain rate to failure (% / min.) <u>N/A</u>		

Stress vs. Strain



Pocket Penetrometer Reading (tsf) N/A
 Torvane Reading (kg/cm²) N/A

Comments
Fracture at 5.6'. Gouge at 5.3'.

Reviewed By



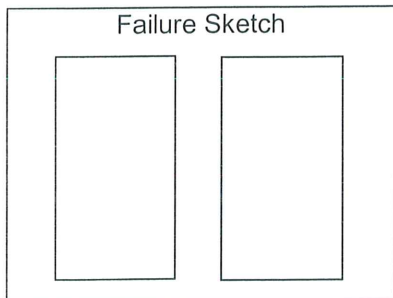
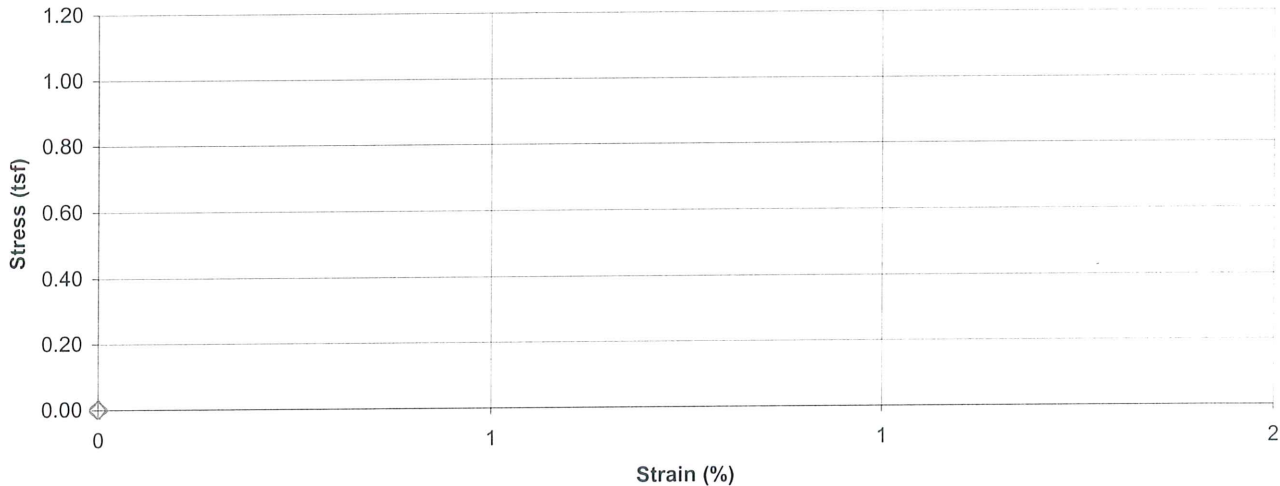
**Unconfined Compressive Strength
of Cohesive Soil**
ASTM D 2166

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope Project Number 175569040
 Source STN-26A, 10.0'-12.0' Lab ID 278
 Visual Description Lean Clay with Gravel (CL), brown, moist, firm, mine spoil

Recovered 0.9'
 Test Interval 10.3' - 10.8'

Specimen Type: <u>Undisturbed</u>	LL <u>N/A</u>	PL <u>N/A</u>	Date Extruded <u>01/11/2010</u>
		PI <u>N/A</u>	Date Tested <u>N/A</u>
Initial Wet Density (pcf) <u>133.7</u>	Initial MC Taken <u>Before Test, From Trimmings</u>		
Initial Moisture Content (%) <u>15.4</u>			
Initial Dry Density (pcf) <u>115.9</u>			
At Test Moisture Content (%) <u>N/A</u>	At Test MC Taken <u>N/A</u>		
At Test Dry Density (pcf) <u>N/A</u>			
Specific Gravity <u>N/A</u>			
Degree of Saturation (%) <u>N/A</u>	Unconfined Compressive Strength (tsf) <u>N/A</u>		
Average Height (in) <u>6.100</u>	Undrained Shear Strength (tsf) <u>N/A</u>		
Average Diameter (in) <u>2.881</u>	Strain at Maximum Stress (%) <u>N/A</u>		
Height to Diameter Ratio <u>2.1</u>	Strain rate to failure (% / min.) <u>N/A</u>		

Stress vs. Strain



Pocket Penetrometer Reading (tsf) N/A
 Torvane Reading (kg/cm²) N/A

Comments

Reviewed By



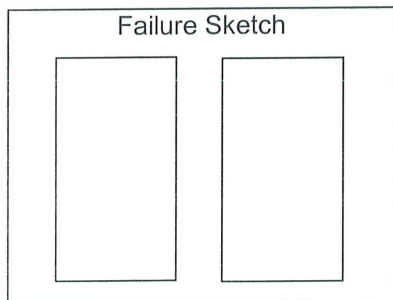
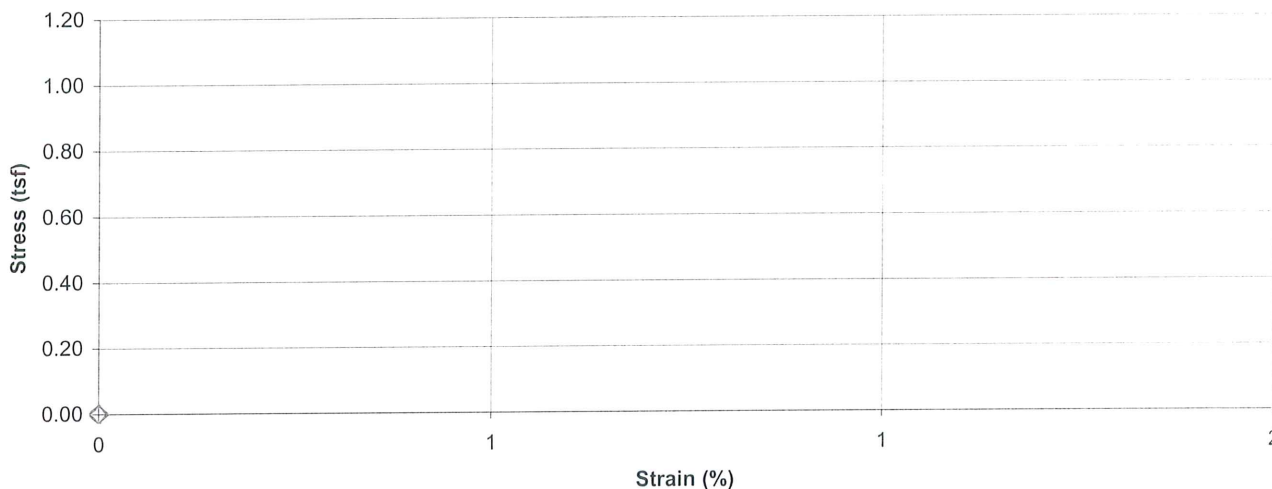
**Unconfined Compressive Strength
of Cohesive Soil**
ASTM D 2166

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope Project Number 175569040
 Source STN-27A, 5.0'-7.0' Lab ID 303
 Visual Description Lean Clay with Gravel (CL), brown, moist, firm, mine spoil

Recovered 0.8'
 Test Interval 5.3' - 5.8'

Specimen Type: <u>Undisturbed</u>	LL <u>N/A</u>	PL <u>N/A</u>	Date Extruded <u>01/11/2010</u>
		PI <u>N/A</u>	Date Tested <u>N/A</u>
Initial Wet Density (pcf) <u>118.4</u>		Initial MC Taken <u>Before Test, From Trimmings</u>	
Initial Moisture Content (%) <u>14.7</u>			
Initial Dry Density (pcf) <u>103.1</u>			
At Test Moisture Content (%) <u>N/A</u>		At Test MC Taken <u>N/A</u>	
At Test Dry Density (pcf) <u>N/A</u>			
Specific Gravity <u>N/A</u>			
Degree of Saturation (%) <u>N/A</u>		Unconfined Compressive Strength (tsf) <u>N/A</u>	
Average Height (in) <u>6.004</u>		Undrained Shear Strength (tsf) <u>N/A</u>	
Average Diameter (in) <u>2.886</u>		Strain at Maximum Stress (%) <u>N/A</u>	
Height to Diameter Ratio <u>2.1</u>		Strain rate to failure (% / min.) <u>N/A</u>	

Stress vs. Strain



Pocket Penetrometer Reading (tsf) N/A
 Torvane Reading (kg/cm²) N/A

Comments

Reviewed By



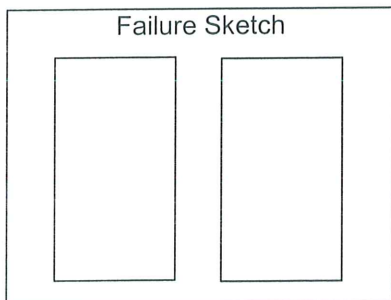
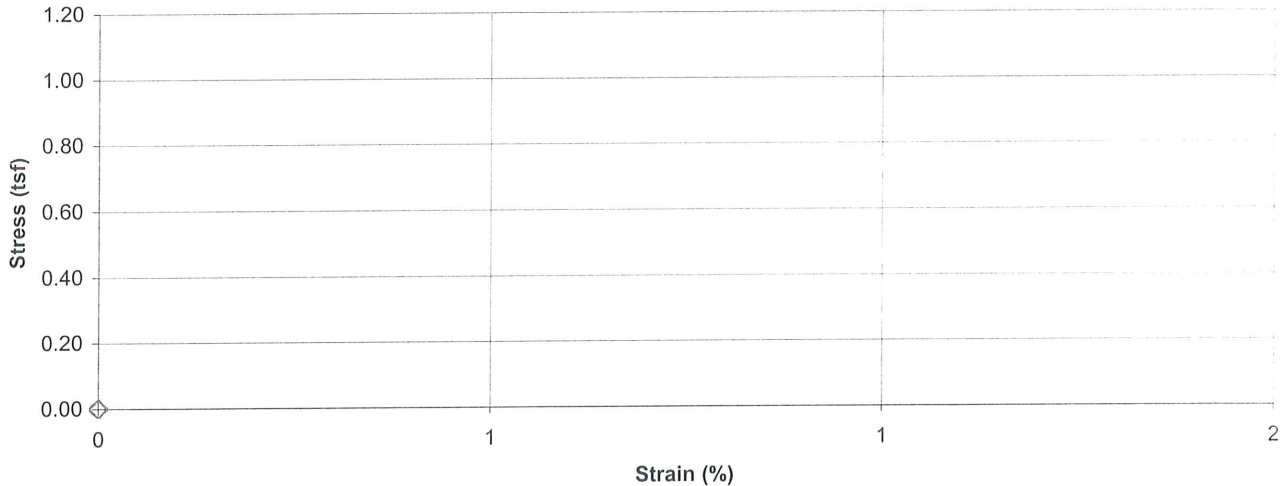
**Unconfined Compressive Strength
of Cohesive Soil**
ASTM D 2166

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope Project Number 175569040
 Source STN-27A, 15.0'-17.0' Lab ID 304
 Visual Description Silt (ML), gray brown, wet, very soft, organics, flyash, gypsum

Recovered 0.8'
 Test Interval 15.0' - 15.8'

Specimen Type: <u>Undisturbed</u>	LL <u>N/A</u>	PL <u>N/A</u>	Date Extruded <u>01/11/2010</u>
		PI <u>N/A</u>	Date Tested <u>N/A</u>
Initial Wet Density (pcf) <u>N/A</u>	Initial MC Taken <u>Before Test, From Center of Specimen</u>		
Initial Moisture Content (%) <u>25.0</u>			
Initial Dry Density (pcf) <u>N/A</u>	At Test MC Taken <u>N/A</u>		
At Test Moisture Content (%) <u>N/A</u>			
At Test Dry Density (pcf) <u>N/A</u>			
Specific Gravity <u>N/A</u>			
Degree of Saturation (%) <u>N/A</u>	Unconfined Compressive Strength (tsf) <u>N/A</u>		
Average Height (in) <u>N/A</u>	Undrained Shear Strength (tsf) <u>N/A</u>		
Average Diameter (in) <u>N/A</u>	Strain at Maximum Stress (%) <u>N/A</u>		
Height to Diameter Ratio <u>N/A</u>	Strain rate to failure (% / min.) <u>N/A</u>		

Stress vs. Strain



Pocket Penetrometer Reading (tsf) N/A
 Torvane Reading (kg/cm²) N/A

Comments
No 6" specimen due to high moisture content
MC determined using 40° C oven
Saved in bag

Reviewed By



Project Name PAF-Scrubber Sludge Complex, W Pond S Slope

Moisture Content of Soil
ASTM D 2216

Project Number 175569040

Tested By Ford

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Straatified, Laminated, Lensed, Homogeneous

Test Method ASTM

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & Can Weight (g)	Moisture Content (%)
STN-26, 0.0'-1.5'	259	1/12/09	Hom	No. 4		No	47.02	189.93	167.94	18.2
STN-26, 1.5'-3.0'	260	1/12/09	Hom	3/4"		No	44.18	242.80	221.42	12.1
STN-26, 3.0'-4.5'	261	1/12/09		3/4"		No	46.85	171.42	164.71	5.7
STN-26, 4.5'-6.0'	263	1/12/09	Hom	3/4"		No	44.66	231.72	210.67	12.7
STN-26, 6.0'-7.5'	264	1/12/09	Hom	3/4"		No	44.77	168.03	154.32	12.5
STN-26, 7.5'-9.0'	265	1/12/09	Hom	3/4"		No	50.77	241.61	226.26	8.7
STN-26, 9.0'-10.5'	266	1/12/09	Hom	3/4"		No	46.69	145.95	140.27	6.1
STN-26, 10.5'-12.0'	267	1/12/09		3/4"		No	46.12	89.40	88.02	3.3
STN-26, 12.0'-13.5'	268	1/12/09	Hom	3/4"		No	45.80	215.75	199.95	10.2
STN-26, 13.5'-15.0'	269	1/12/09	Hom	3/4"		No	40.72	210.13	192.18	11.9
STN-26, 15.0'-16.5'	270	1/12/09		3/4"		No	45.27	140.89	134.46	7.2
STN-26, 16.5'-18.0'	271	1/12/09	Hom	3/4"		No	49.78	181.00	168.36	10.7
STN-26, 18.0'-19.5'	272	1/12/09	Hom	3/4"		No	45.04	194.44	182.37	8.8
STN-26, 19.5'-21.0'	273	1/12/09	Hom	3/4"		No	47.77	261.99	244.33	9.0
STN-26, 21.0'-22.5'	274	1/12/09	Hom	3/4"		No	43.81	247.18	221.15	14.7
STN-26, 30.0'-31.5'	275	1/13/10	Hom	3/4"		No	44.75	261.04	234.21	14.2
STN-26, 40.0'-41.5'	276	1/13/10	Hom	3/4"		No	49.80	247.01	217.86	17.3
STN-27, 1.5'-3.0'	279	1/13/10	Hom	3/8"		No	41.07	210.32	188.35	14.9
STN-27, 3.0'-4.5'	280	1/13/10	Hom	3/4"		No	47.03	249.35	225.72	13.2
STN-27, 4.5'-6.0'	281	1/13/10	Hom	3/8"		No	43.75	214.30	191.40	15.5
STN-27, 7.5'-9.0'	282	1/13/10		3/4"		No	44.43	229.05	203.06	16.4
STN-27, 9.0'-10.5'	283	1/13/10	Hom	3/4"		No	50.29	245.92	214.78	18.9
STN-27, 10.5'-12.0'	284	1/13/10		No. 4		Yes	44.70	225.80	197.04	18.9
STN-27, 12.0'-13.5'	285	1/13/10	Hom	3/4"		No	40.72	221.31	197.39	15.3
STN-27, 13.5'-15.0'	286	1/13/10		3/4"		No	44.05	242.66	208.51	20.8
STN-27, 15.0'-16.5'	287	1/13/10		3/4"		No	44.19	207.14	181.60	18.6
STN-27, 16.5'-18.0'	288	1/13/10		3/4"		No	43.93	270.19	236.06	17.8
STN-27, 18.0'-19.5'	289	1/13/10		3/4"		No	44.04	275.60	232.60	22.8



Project Name **PAF-Scrubber Sludge Complex, W Pond S Slope**

Moisture Content of Soil

ASTM D 2216

Project Number 175569040
Tested By **Ford**

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Test Method **ASTM**

Material Type: Stratified, Laminated, Lensed, Homogeneous

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & Can Weight (g)	Moisture Content (%)
STN-27, 19.5'-21.0'	290	1/13/10	Hom	3/4"			No	40.52	221.74	198.08	15.0
STN-27, 21.0'-22.5'	291	1/13/10	Hom	3/4"			No	43.93	217.97	197.99	13.0
STN-27, 22.5'-24.0'	293	1/13/10		3/8"			No	48.52	249.04	209.65	24.4
STN-27, 25.5'-27.0'	294	1/13/10		3/4"			No	43.83	224.87	201.52	14.8
STN-27, 28.5'-30.0'	295	1/13/10		3/4"			No	44.32	272.48	247.84	12.1
STN-27, 31.5'-33.0'	296	1/13/10	Hom	3/4"			No	45.10	167.49	151.00	15.6
STN-27, 34.5'-36.0'	297	1/13/10		3/4"			No	45.44	290.17	258.54	14.8
STN-27, 37.5'-39.0'	298	1/13/10	Hom	3/4"			No	52.66	208.80	192.05	12.0
STN-27, 40.5'-42.0'	299	1/13/10	Hom	3/4"			No	45.52	196.55	175.26	16.4
STN-27, 50.0'-51.5'	300	1/13/10		3/4"			No	49.85	273.88	246.81	13.7
STN-27, 60.0'-61.5'	301	1/13/10	Hom	3/4"			No	44.28	249.54	218.14	18.1
STN-27, 61.5'-63.0'	302	1/13/10	Hom	3/4"			No	44.89	294.17	258.30	16.8

Handwritten mark



Summary of Soil Tests

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope Project Number 175569040
 Source STN-30, 4.5'-6.0', 9.0'-10.5', 13.5'-15.0', 15.0'-16.5' Lab ID 188
 County Muhlenberg Date Received 1-5-10
 Sample Type SPT Comp Date Reported 1-20-10

Test Results

Natural Moisture Content

Test Not Performed
 Moisture Content (%): N/A

Atterberg Limits

Test Method: ASTM D 4318 Method A
 Prepared: Dry
 Liquid Limit: 35
 Plastic Limit: 16
 Plasticity Index: 19
 Activity Index: 1.19

Particle Size Analysis

Preparation Method: ASTM D 421
 Gradation Method: ASTM D 422
 Hydrometer Method: ASTM D 422

Particle Size		% Passing
Sieve Size	(mm)	
3"	75	
2"	50	
1 1/2"	37.5	100.0
1"	25	96.9
3/4"	19	93.1
3/8"	9.5	86.3
No. 4	4.75	81.0
No. 10	2	68.3
No. 40	0.425	58.8
No. 200	0.075	46.5
	0.02	38.5
	0.005	25.5
	0.002	15.8
estimated	0.001	9.0

Moisture-Density Relationship

Test Not Performed
 Maximum Dry Density (lb/ft³): N/A
 Maximum Dry Density (kg/m³): N/A
 Optimum Moisture Content (%): N/A
 Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
 Bearing Ratio (%): N/A
 Compacted Dry Density (lb/ft³): N/A
 Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
 Prepared: Dry
 Particle Size: No. 10
 Specific Gravity at 20° Celsius: 2.63

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	19.0	31.7
Coarse Sand	12.7	9.5
Medium Sand	9.5	---
Fine Sand	12.3	12.3
Silt	21.0	30.7
Clay	25.5	15.8

Classification

Unified Group Symbol: SC
 Group Name: Clayey sand with gravel
 AASHTO Classification: A-6 (5)

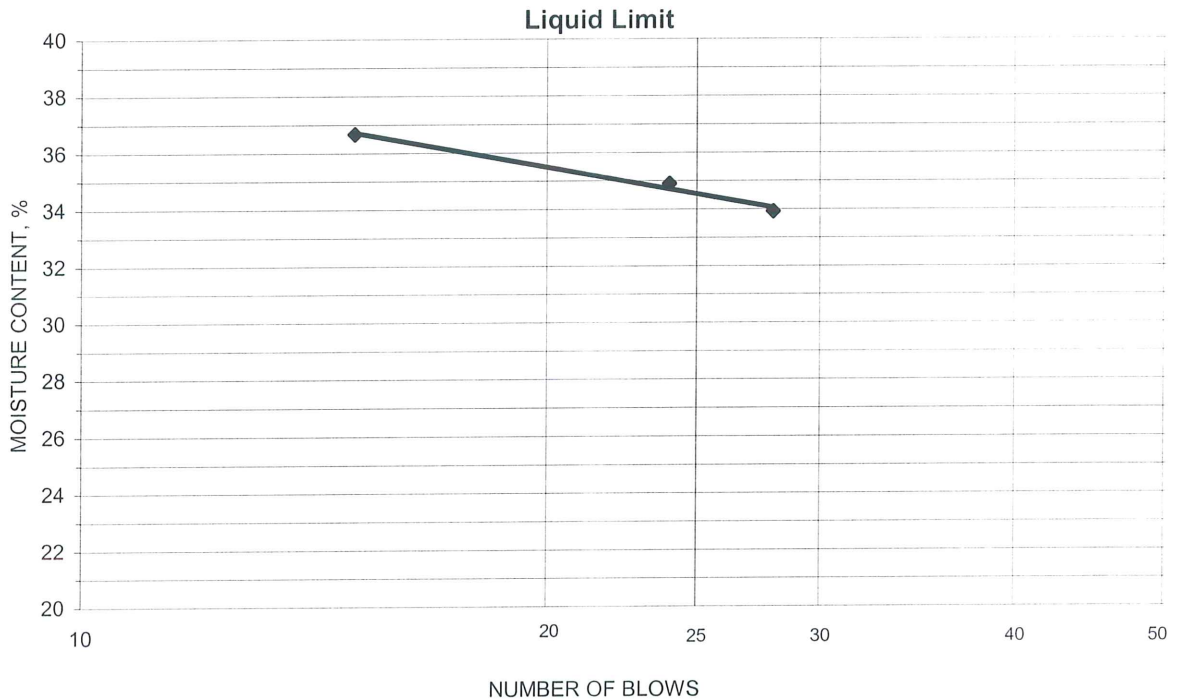
Comments: MC determined using 40°C oven

Reviewed by: [Signature]

Project PAF-Scrubber Sludge Complex, W Pond S Slope
 Source STN-30, 4.5'-6.0', 9.0'-10.5', 13.5'-15.0', 15.0'-16.5'
 Tested By CSM Test Method ASTM D 4318 Method A
 Test Date 01-13-2010 Prepared Dry

Project No. 175569040
 Lab ID 188
 % + No. 40
 Date Received 01-05-2010

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
22.55	19.60	10.90	28	33.9	35
22.90	19.85	11.11	24	34.9	
22.59	19.40	10.70	15	36.7	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
19.51	18.41	11.72	16.4	16	19
18.57	17.50	11.01	16.5		

Remarks: _____
 _____ Reviewed By 



Project Name **PAF-Scrubber Sludge Complex, W Pond S Slope**

Moisture Content of Soil
ASTM D 2216

Project Number 175569040
Tested By For

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous
Test Method ASTM

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & Can Weight (g)	Moisture Content (%)
STN-30, 0.0'-1.5'	186	1/1/1/10	Hom	3/4"			No	22.85	114.87	101.66	16.8
STN-30, 1.5'-3.0'	187	1/1/1/10	Hom	3/4"			No	22.07	92.55	76.73	28.9
STN-30, 4.5'-6.0'	189	1/1/1/10	Hom	3/4"			No	22.60	98.93	88.51	15.8
STN-30, 6.0'-7.5'	190	1/1/1/10	Hom	3/4"			No	21.60	101.69	91.43	14.7
STN-30, 9.0'-10.5'	191	1/1/1/10	Hom	3/4"			No	23.59	99.50	92.42	10.3
STN-30, 10.5'-12.0'	192	1/1/1/10	Hom	3/4"			No	19.73	93.52	85.72	11.8
STN-30, 12.0'-13.5'	193	1/1/1/10	Hom	3/4"			No	21.67	114.59	104.44	12.3
STN-30, 13.5'-15.0'	194	1/1/1/10	Hom	3/4"			No	24.02	110.45	100.35	13.2
STN-30, 15.0'-16.5'	195	1/1/1/10	Hom	3/4"			No	21.51	108.15	98.66	12.3
STN-30, 16.5'-18.0'	196	1/1/1/10	Hom	3/8"			No	19.05	100.04	90.92	12.7
STN-30, 18.0'-19.5'	197	1/1/1/10	Hom	3/4"			No	22.55	96.29	86.85	14.7
STN-30, 25.0'-26.5'	198	1/1/1/10	Hom	3/4"			No	21.00	97.53	93.82	5.1
STN-30, 30.0'-31.5'	199	1/1/1/10	Hom	3/8"			No	22.14	95.22	89.39	8.7
STN-30, 38.0'-39.5'	200	1/1/1/10	Hom	3/4"			No	21.65	106.92	97.51	12.4
STN-31, 1.5'-3.0'	201	1/1/1/10	Hom	3/4"			No	22.62	87.37	79.36	14.1
STN-31, 3.0'-4.5'	202	1/1/1/10	Hom	3/4"			No	23.07	96.02	87.75	12.8
STN-31, 4.5'-6.0'	203	1/1/1/10	Hom	3/8"			No	27.51	126.81	113.96	14.9
STN-31, 6.0'-7.5'	204	1/1/1/10	Hom	3/4"			No	22.37	109.90	100.27	12.4
STN-31, 9.0'-10.5'	205	1/1/1/10	Hom	3/4"			No	29.00	131.36	120.68	11.6
STN-31, 10.5'-12.0'	206	1/1/1/10	Hom	3/8"			No	22.44	106.16	99.81	8.2
STN-31, 12.0'-13.5'	207	1/1/1/10		3/4"			No	22.68	131.40	122.99	8.4
STN-31, 13.5'-15.0'	208	1/1/1/10		No. 4			No	19.11	91.01	85.41	8.4
STN-31, 15.0'-16.5'	209	1/1/1/10		No. 4			No	20.97	92.98	89.63	4.9
STN-31, 16.5'-18.0'	210	1/1/1/10		No. 10			Yes	23.54	100.62	97.66	4.0
STN-31, 18.0'-19.5'	211	1/1/1/10		No. 10			Yes	21.88	91.86	89.06	4.2
STN-31, 19.5'-21.0'	212	1/1/1/10		3/8"			No	21.72	113.99	109.55	5.1
STN-31, 21.0'-22.5'	213	1/1/1/10		No. 4			No	23.38	118.21	114.64	3.9
STN-31, 22.5'-24.0'	214	1/1/1/10		3/8"			No	19.47	98.15	94.44	4.9



Project Name **PAF-Scrubber Sludge Complex, W Pond S Slope**

Moisture Content of Soil

ASTM D 2216

Project Number **175569040**

Tested By **Ford**

Test Method **ASTM**

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & Can Weight (g)	Moisture Content (%)
STN-31, 24.0'-25.5'	215	1/11/10		No. 4			No	22.48	112.45	108.40	4.7
STN-31, 25.5'-27.0'	216	1/11/10		No. 4			No	21.65	105.07	99.84	6.7
STN-31, 27.0'-28.5'	217	1/11/10		No. 10			Yes	20.26	94.01	91.06	4.2
STN-31, 28.5'-30.0'	218	1/11/10		No. 4			No	20.13	97.84	93.79	5.5
STN-31, 30.0'-31.5'	219	1/11/10		3/4"			No	21.71	127.68	121.07	6.7
STN-31, 31.5'-33.0'	220	1/11/10		No. 4			No	24.25	98.41	94.33	5.8
STN-31, 33.0'-34.5'	221	1/11/10		No. 4			No	22.98	136.33	122.32	14.1
STN-31, 34.5'-36.0'	222	1/11/10		3/8"			No	21.47	99.29	86.79	19.1
STN-31, 36.0'-37.5'	223	1/11/10	Hom	3/8"			No	22.55	116.90	103.40	16.7
STN-31, 40.0'-41.5'	224	1/11/10	Hom	3/8"			No	19.94	88.88	79.68	15.4
STN-31, 50.0'-51.5'	225	1/11/10	Hom	3/4"			No	21.18	87.55	81.31	10.4
STN-31, 55.0'-56.5'	226	1/11/10	Hom	3/4"			No	19.71	105.24	94.39	14.5
STN-29, 0.0'-1.5'	227	1/11/10	Hom	3/4"			No	19.66	87.36	79.66	12.8
STN-29, 1.5'-3.0'	228	1/11/10	Hom	3/4"			No	21.53	86.70	77.63	16.2
STN-29, 3.0'-4.5'	229	1/11/10	Hom	3/4"			No	22.24	97.60	87.13	16.1
STN-29, 4.5'-6.0'	230	1/11/10	Hom	3/8"			No	22.29	110.15	98.07	15.9
STN-29, 6.0'-7.5'	231	1/11/10	Hom	3/8"			No	22.05	104.85	92.43	17.6
STN-29, 7.5'-9.0'	232	1/11/10	Hom	3/8"			No	23.27	113.10	103.11	12.5
STN-29, 9.0'-10.5'	233	1/11/10	Hom	3/8"			No	22.21	112.08	100.86	14.3
STN-29, 10.5'-12.0'	234	1/11/10	Hom	3/8"			No	22.80	104.58	95.63	12.3
STN-29, 12.0'-13.5'	235	1/11/10	Hom	3/8"			No	20.58	97.28	89.62	11.1
STN-29, 13.5'-15.0'	236	1/12/10	Hom	3/8"			No	21.81	108.24	97.65	14.0
STN-29, 15.0'-16.5'	237	1/12/10	Hom	3/4"			No	21.74	107.46	98.23	12.1
STN-29, 16.5'-18.0'	238	1/12/10	Hom	3/4"			No	22.22	94.80	86.96	12.1
STN-29, 18.0'-19.5'	239	1/12/10	Hom	3/4"			No	18.73	101.71	90.81	15.1
STN-29, 19.5'-21.0'	240	1/12/10	Hom	3/8"			No	21.64	103.70	93.68	13.9
STN-29, 21.0'-22.5'	241	1/12/10	Hom	3/4"			No	21.82	100.14	90.05	14.8
STN-29, 24.0'-25.5'	242	1/12/10	Hom	3/4"			No	20.77	88.86	81.60	11.9
STN-29, 25.5'-27.0'	243	1/12/10	Hom	3/4"			No	21.46	104.79	98.02	8.8
STN-29, 27.0'-28.5'	244	1/12/10	Hom	3/4"			No	18.96	88.57	78.93	16.1
STN-29, 28.5'-30.3'	245	1/12/10	Hom	3/4"			No	21.78	112.55	101.76	13.5



Project Name PAF-Scrubber Sludge Complex, W Pond S Slope

Moisture Content of Soil
ASTM D 2216

Project Number 175569040
Tested By Ford

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Test Method ASTM

Material Type: Stratified, Laminated, Lensed, Homogeneous

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & Can Weight (g)	Moisture Content (%)
STN-29, 30.0'-31.5'	246	1/12/10	Hom	3/4"			No	22.38	89.82	82.93	11.4
STN-29, 31.5'-33.0'	247	1/12/10	Hom	3/4"			No	21.51	98.75	89.85	13.0
STN-29, 33.0'-34.5'	248	1/12/10	Hom	3/8"			No	21.69	104.01	90.77	19.2
STN-29, 36.0'-37.5'	249	1/12/10	Hom	3/4"			No	22.06	122.39	111.04	12.8
STN-29, 37.5'-39.0'	250	1/12/10	Hom	3/8"			No	22.01	107.00	97.88	12.0
STN-29, 50.0'-51.5'	251	1/12/10	Hom	3/4"			No	22.46	106.59	97.47	12.2
STN-29, 56.5'-58.0'	252	1/12/10	Hom	3/8"			No	21.98	125.53	109.62	18.2



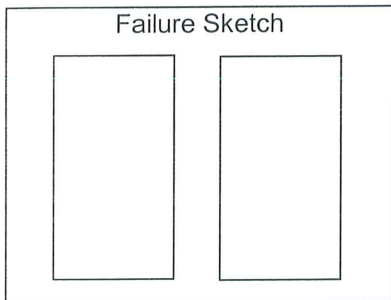
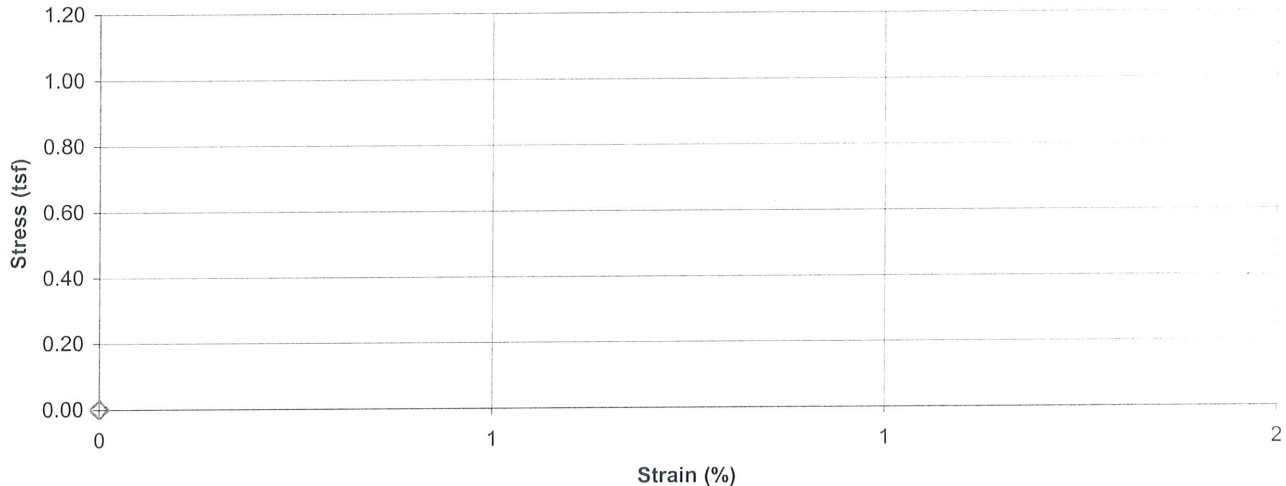
**Unconfined Compressive Strength
of Cohesive Soil**
ASTM D 2166

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope Project Number 175569040
 Source STN-29A, 5.0'-7.0' Lab ID 253
 Visual Description Lean Clay with Gravel (CL), gray brown, moist, firm, mine spoil

Recovered 0.8'
 Test Interval 5.2' - 5.7'

Specimen Type: <u>Undisturbed</u>	LL <u>N/A</u>	PL <u>N/A</u>	Date Extruded <u>01/12/2010</u>
		PI <u>N/A</u>	Date Tested <u>N/A</u>
Initial Wet Density (pcf) <u>132.6</u>		Initial MC Taken <u>Before Test, From Trimmings</u>	
Initial Moisture Content (%) <u>16.9</u>			
Initial Dry Density (pcf) <u>113.4</u>			
At Test Moisture Content (%) <u>N/A</u>		At Test MC Taken <u>N/A</u>	
At Test Dry Density (pcf) <u>N/A</u>			
Specific Gravity <u>N/A</u>			
Degree of Saturation (%) <u>N/A</u>		Unconfined Compressive Strength (tsf) <u>N/A</u>	
Average Height (in) <u>6.035</u>		Undrained Shear Strength (tsf) <u>N/A</u>	
Average Diameter (in) <u>2.884</u>		Strain at Maximum Stress (%) <u>N/A</u>	
Height to Diameter Ratio <u>2.1</u>		Strain rate to failure (% / min.) <u>N/A</u>	

Stress vs. Strain



Pocket Penetrometer Reading (tsf) N/A
 Torvane Reading (kg/cm²) N/A

Comments

Reviewed By



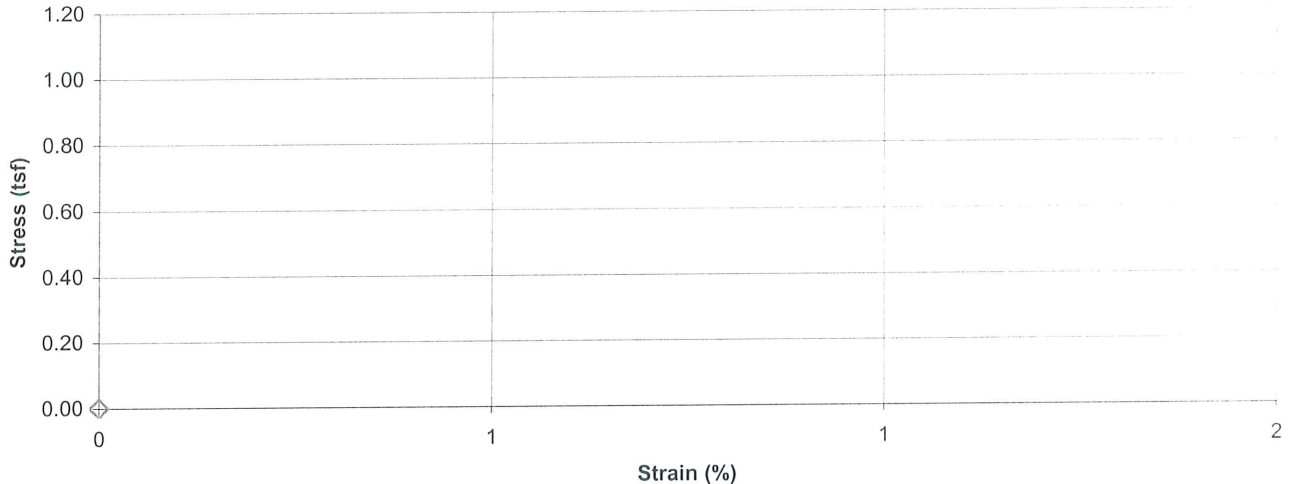
**Unconfined Compressive Strength
of Cohesive Soil**
ASTM D 2166

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope Project Number 175569040
 Source STN-29A, 10.0'-12.0' Lab ID 254
 Visual Description Gravelly Lean Clay (CL), gray brown, moist, firm to soft, mine spoil

Recovered 0.8'
 Test Interval 10.2' - 10.7'

Specimen Type: <u>Undisturbed</u>	LL <u>N/A</u>	PL <u>N/A</u>	Date Extruded <u>01/12/2010</u>
		PI <u>N/A</u>	Date Tested <u>N/A</u>
Initial Wet Density (pcf) <u>136.6</u>	Initial MC Taken <u>Before Test, From Trimmings</u>		
Initial Moisture Content (%) <u>20.0</u>			
Initial Dry Density (pcf) <u>113.8</u>	At Test MC Taken <u>N/A</u>		
At Test Moisture Content (%) <u>N/A</u>			
At Test Dry Density (pcf) <u>N/A</u>			
Specific Gravity <u>N/A</u>			
Degree of Saturation (%) <u>N/A</u>	Unconfined Compressive Strength (tsf) <u>N/A</u>		
Average Height (in) <u>6.137</u>	Undrained Shear Strength (tsf) <u>N/A</u>		
Average Diameter (in) <u>2.890</u>	Strain at Maximum Stress (%) <u>N/A</u>		
Height to Diameter Ratio <u>2.1</u>	Strain rate to failure (% / min.) <u>N/A</u>		

Stress vs. Strain



Failure Sketch

Pocket Penetrometer Reading (tsf) N/A
 Torvane Reading (kg/cm²) N/A

Comments

Reviewed By



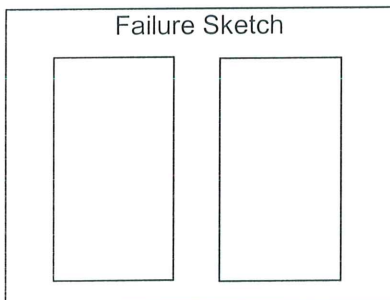
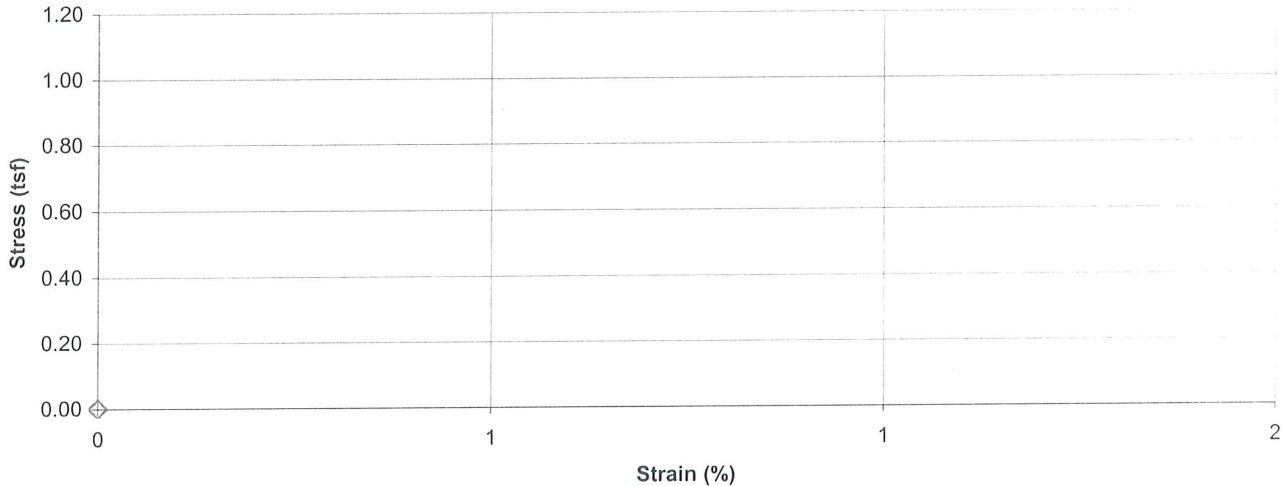
**Unconfined Compressive Strength
of Cohesive Soil**
ASTM D 2166

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope Project Number 175569040
 Source STN-31A, 5.0'-7.0' Lab ID 255
 Visual Description Silty Lean Clay (CL-ML), brown, moist, firm to hard, flyash gypsum

Recovered 0.9'
 Test Interval 5.0' - 5.9'

Specimen Type: <u>Undisturbed</u>	LL <u>N/A</u>	PL <u>N/A</u>	Date Extruded <u>01/13/2010</u>
		PI <u>N/A</u>	Date Tested <u>N/A</u>
Initial Wet Density (pcf) <u>N/A</u>	Initial MC Taken <u>Before Test, From Trimmings</u>		
Initial Moisture Content (%) <u>8.6</u>			
Initial Dry Density (pcf) <u>N/A</u>	At Test MC Taken <u>N/A</u>		
At Test Moisture Content (%) <u>N/A</u>			
At Test Dry Density (pcf) <u>N/A</u>			
Specific Gravity <u>N/A</u>			
Degree of Saturation (%) <u>N/A</u>	Unconfined Compressive Strength (tsf) <u>N/A</u>		
Average Height (in) <u>N/A</u>	Undrained Shear Strength (tsf) <u>N/A</u>		
Average Diameter (in) <u>N/A</u>	Strain at Maximum Stress (%) <u>N/A</u>		
Height to Diameter Ratio <u>N/A</u>	Strain rate to failure (% / min.) <u>N/A</u>		

Stress vs. Strain



Pocket Penetrometer Reading (tsf) N/A
 Torvane Reading (kg/cm²) N/A

Comments
Brittle sample no 6" specimen possible
MC determined using 40° C oven
Saved in bag

Reviewed By



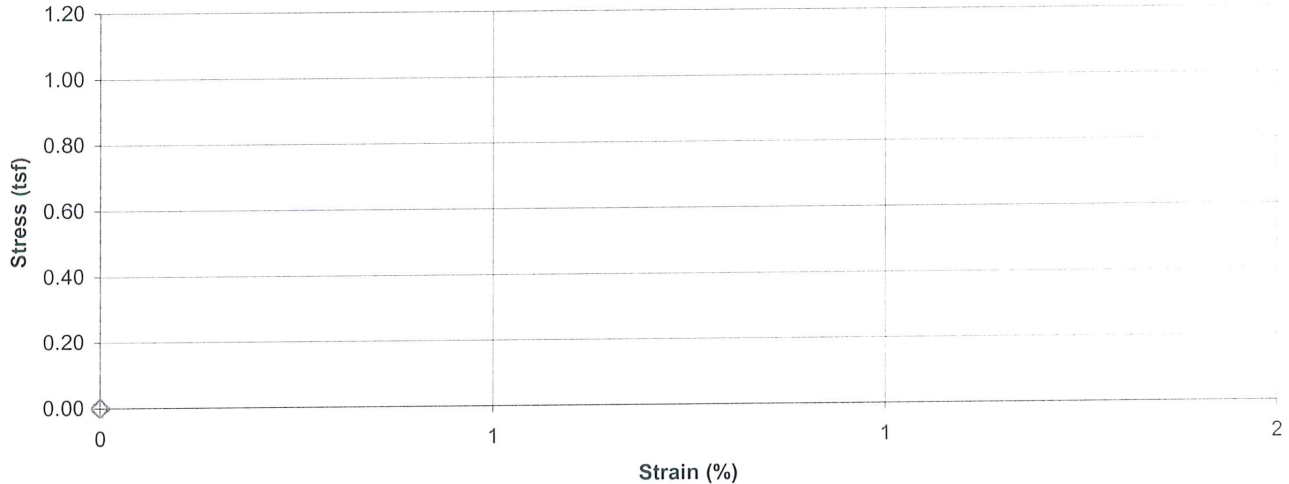
**Unconfined Compressive Strength
of Cohesive Soil**
ASTM D 2166

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope Project Number 175569040
 Source STN-31A, 10.0'-12.0' Lab ID 256
 Visual Description Lean Clay with Gravel (CL), brown, moist, firm, mine spoil

Recovered 0.8'
 Test Interval 10.2' - 10.7'

Specimen Type: <u>Undisturbed</u>	LL <u>N/A</u>	PL <u>N/A</u>	Date Extruded <u>01/13/2010</u>
		PI <u>N/A</u>	Date Tested <u>N/A</u>
Initial Wet Density (pcf) <u>135.6</u>			
Initial Moisture Content (%) <u>17.4</u>	Initial MC Taken <u>Before Test, From Trimmings</u>		
Initial Dry Density (pcf) <u>115.5</u>			
At Test Moisture Content (%) <u>N/A</u>	At Test MC Taken <u>N/A</u>		
At Test Dry Density (pcf) <u>N/A</u>			
Specific Gravity <u>N/A</u>			
Degree of Saturation (%) <u>N/A</u>	Unconfined Compressive Strength (tsf) <u>N/A</u>		
Average Height (in) <u>6.198</u>	Undrained Shear Strength (tsf) <u>N/A</u>		
Average Diameter (in) <u>2.891</u>	Strain at Maximum Stress (%) <u>N/A</u>		
Height to Diameter Ratio <u>2.1</u>	Strain rate to failure (% / min.) <u>N/A</u>		

Stress vs. Strain



Failure Sketch

Pocket Penetrometer Reading (tsf) N/A
 Torvane Reading (kg/cm²) N/A

Comments

Reviewed By

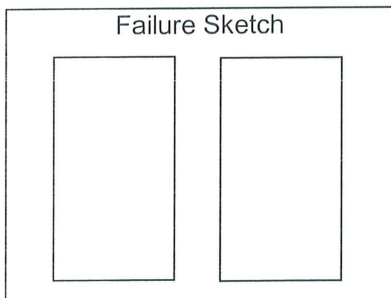
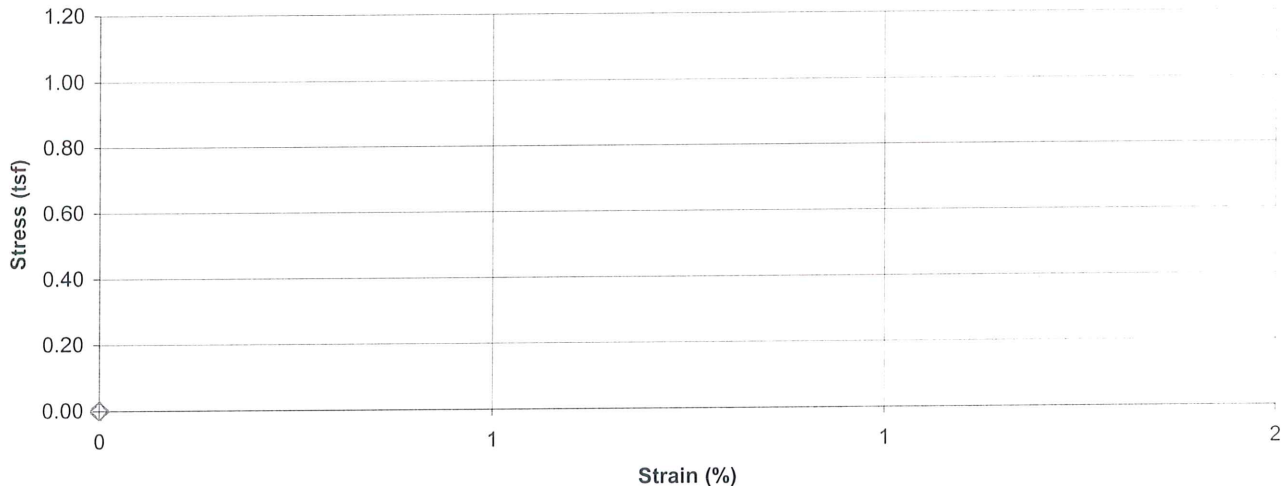


**Unconfined Compressive Strength
of Cohesive Soil**
ASTM D 2166

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope Project Number 175569040
 Source STN-31A, 15.0'-17.0' Lab ID 257
 Visual Description Lean Clay with Gravel (CL), brown, moist, firm, mine spoil
 Recovered 0.7'
 Test Interval 15.2' - 15.7'

Specimen Type: Undisturbed LL N/A PL N/A PI N/A Date Extruded 01/13/2010
 Date Tested N/A
 Initial Wet Density (pcf) 124.1 Initial MC Taken Before Test, From Trimmings
 Initial Moisture Content (%) 12.0
 Initial Dry Density (pcf) 110.8
 At Test Moisture Content (%) N/A At Test MC Taken N/A
 At Test Dry Density (pcf) N/A
 Specific Gravity N/A
 Degree of Saturation (%) N/A Unconfined Compressive Strength (tsf) N/A
 Average Height (in) 5.770 Undrained Shear Strength (tsf) N/A
 Average Diameter (in) 2.868 Strain at Maximum Stress (%) N/A
 Height to Diameter Ratio 2.0 Strain rate to failure (% / min.) N/A

Stress vs. Strain



Pocket Penetrometer Reading (tsf) N/A
 Torvane Reading (kg/cm²) N/A

Comments

Reviewed By



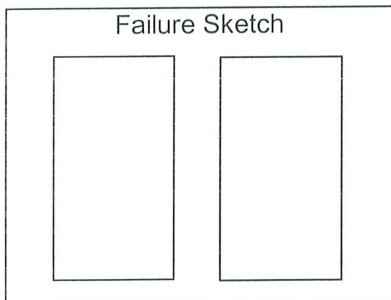
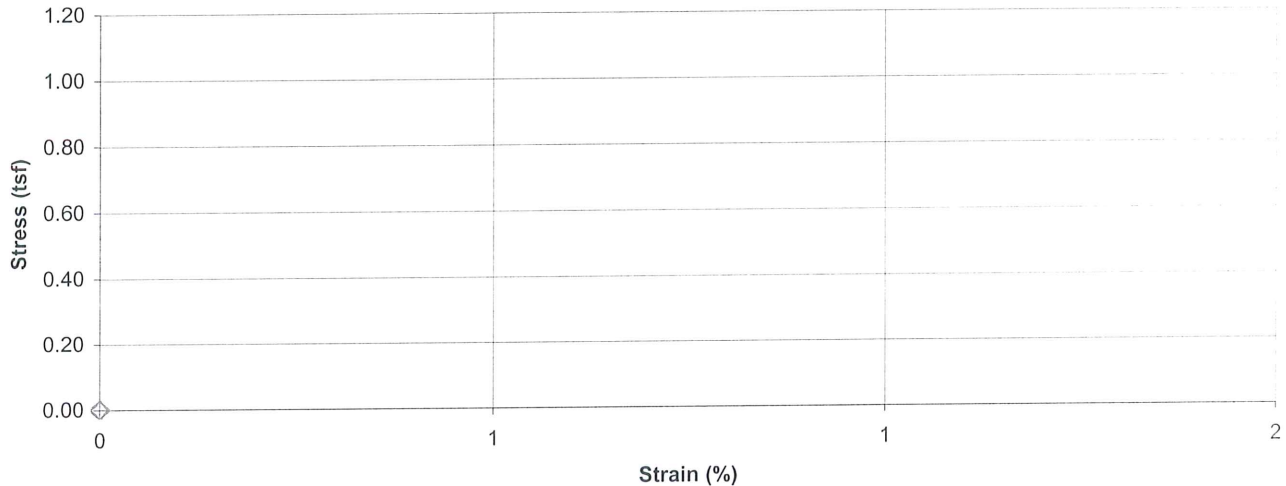
**Unconfined Compressive Strength
of Cohesive Soil**
ASTM D 2166

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope Project Number 175569040
 Source STN-31A, 20.0'-22.0' Lab ID 258A
 Visual Description Lean Clay with Sand (CL), brown, moist, firm

Recovered 1.1'
 Test Interval 20.0' - 20.4'

Specimen Type: <u>Undisturbed</u>	LL <u>N/A</u>	PL <u>N/A</u>	Date Extruded <u>01/13/2010</u>
		PI <u>N/A</u>	Date Tested <u>N/A</u>
Initial Wet Density (pcf) <u>N/A</u>	Initial MC Taken <u>Before Test, From Center of Specimen</u>		
Initial Moisture Content (%) <u>11.8</u>			
Initial Dry Density (pcf) <u>N/A</u>	At Test MC Taken <u>N/A</u>		
At Test Moisture Content (%) <u>N/A</u>			
At Test Dry Density (pcf) <u>N/A</u>			
Specific Gravity <u>N/A</u>			
Degree of Saturation (%) <u>N/A</u>	Unconfined Compressive Strength (tsf) <u>N/A</u>		
Average Height (in) <u>N/A</u>	Undrained Shear Strength (tsf) <u>N/A</u>		
Average Diameter (in) <u>N/A</u>	Strain at Maximum Stress (%) <u>N/A</u>		
Height to Diameter Ratio <u>N/A</u>	Strain rate to failure (% / min.) <u>N/A</u>		

Stress vs. Strain



Pocket Penetrometer Reading (tsf) N/A
 Torvane Reading (kg/cm²) N/A

Comments
Unable to obtain 6" specimen due to soil change at 20.4'.
Saved in bag.

Reviewed By



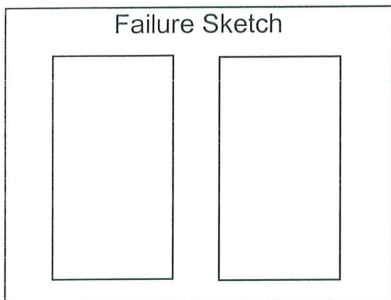
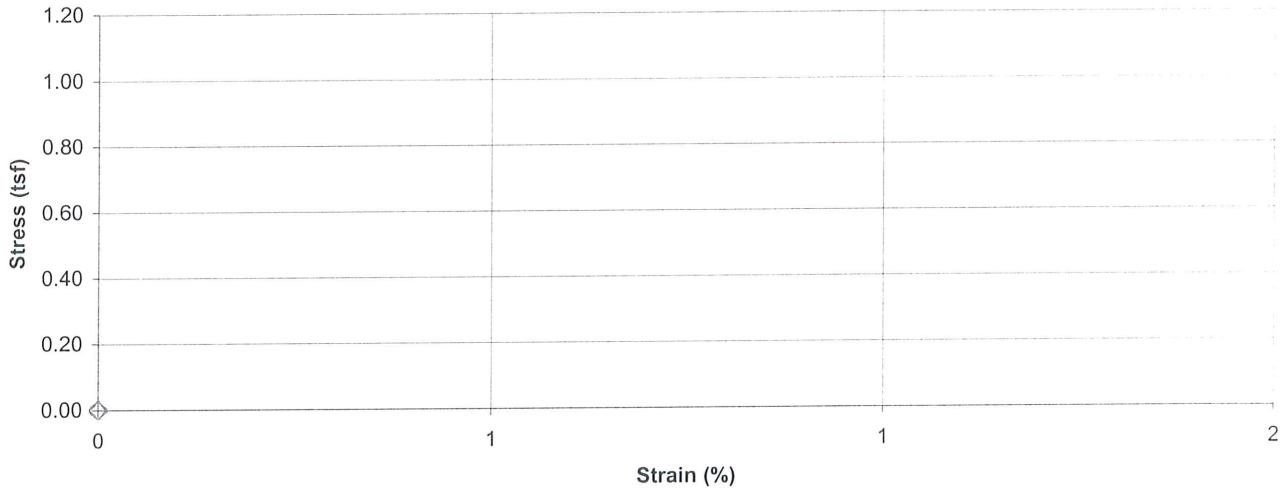
**Unconfined Compressive Strength
of Cohesive Soil**
ASTM D 2166

Project Name PAF-Scrubber Sludge Complex, W Pond S Slope Project Number 175569040
 Source STN-31A, 20.0'-22.0' Lab ID 258B
 Visual Description Poorly Graded Sand (SP), tan, moist, soft

Recovered 1.1'
 Test Interval 20.4' - 21.1'

Specimen Type: Undisturbed LL N/A PL N/A PI N/A Date Extruded 01/13/2010
 Initial Wet Density (pcf) N/A Date Tested N/A
 Initial Moisture Content (%) 3.8 Initial MC Taken Before Test, From Center of Specimen
 Initial Dry Density (pcf) N/A
 At Test Moisture Content (%) N/A At Test MC Taken N/A
 At Test Dry Density (pcf) N/A
 Specific Gravity N/A
 Degree of Saturation (%) N/A Unconfined Compressive Strength (tsf) N/A
 Average Height (in) N/A Undrained Shear Strength (tsf) N/A
 Average Diameter (in) N/A Strain at Maximum Stress (%) N/A
 Height to Diameter Ratio N/A Strain rate to failure (% / min.) N/A

Stress vs. Strain



Pocket Penetrometer Reading (tsf) N/A
 Torvane Reading (kg/cm²) N/A

Comments
Unable to obtain 6" specimen.
Saved in bag.

Reviewed By

Attachment E

Results of Engineering
Analysis

SEEP/W Analysis

South Slope of West Pond Scrubber Sludge Complex

Paradise Fossil Plant Tennessee Valley Authority

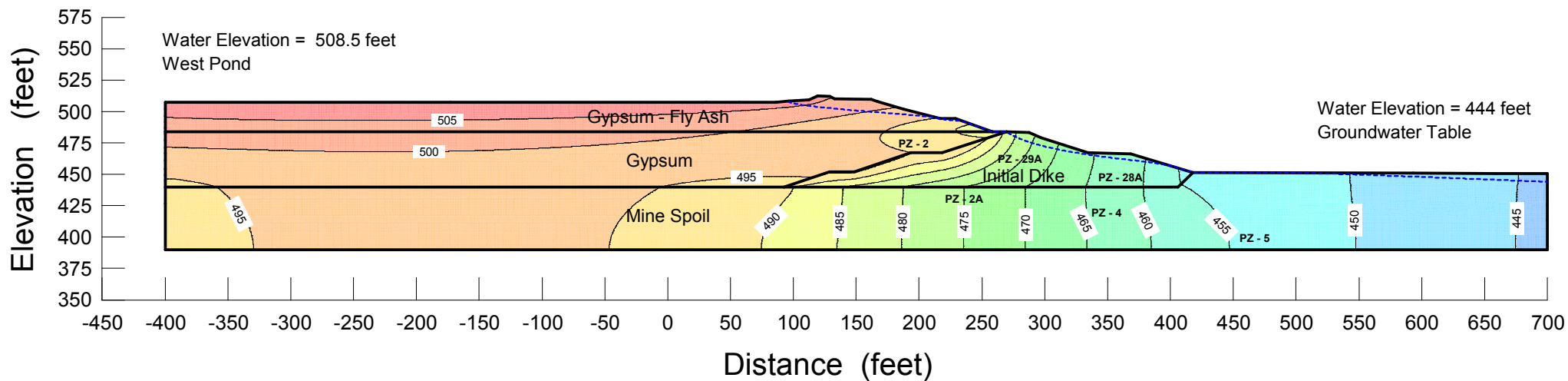
February 2010
 Method: Steady-State Seepage
 File Name: A-A'.gsz

Note:
 The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Piping Potential:
 At Toe of Initial Dike (421.7,451.6)
 Total Head = 451.7 ft
 dH = 1 ft dl = 4.2 ft
 iy = 0.24 icritical = 1.06
 FSpiping = 4.5

Material Type	Khsat (ft/sec)	Kv/Kh	Wsat
Initial Dike	6.56e-009	1	0.34
Gypsum - Fly Ash	3.28e-005	0.02	0.41
Gypsum	3.28e-005	0.02	0.39
Mine Spoil	4.92e-006	0.33	0.37

Existing Condition without Under-Drains



SEEP/W Analysis

South Slope of West Pond Scrubber Sludge Complex

Paradise Fossil Plant Tennessee Valley Authority

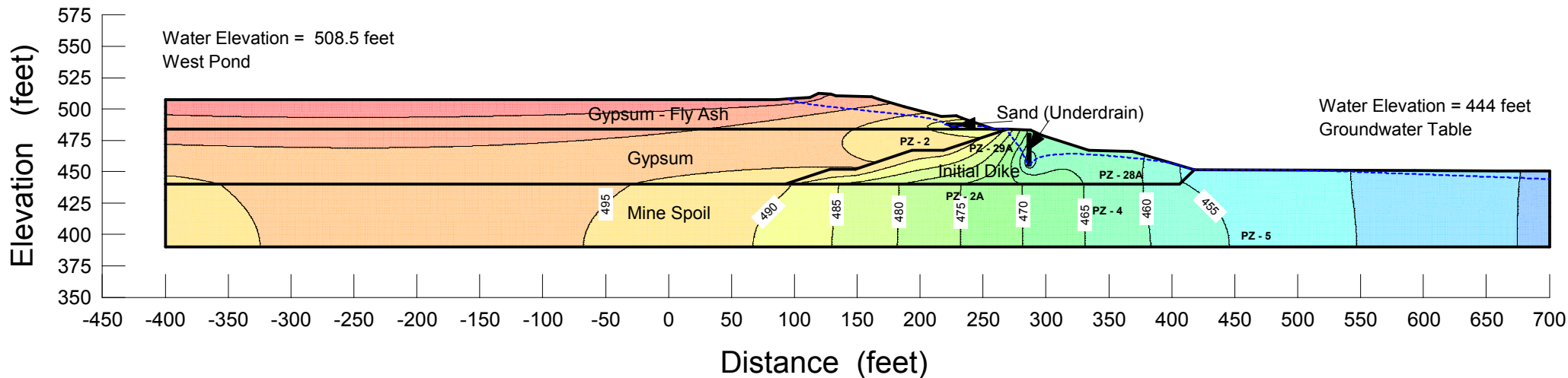
Piping Potential:
 At Toe of Initial Dike (421.7,451.6)
 Total Head = 451.7 ft
 dH = 1 ft dl = 4.2 ft
 iy = 0.24 icritical = 1.06
 FSpiping = 4.5

February 2010
 Method: Steady-State Seepage
 File Name: A-A' with Drains.gsz

Material Type	Khsat (ft/sec)	Kv/Kh	Wsat
Initial Dike	6.56e-009	1	0.34
Gypsum - Fly Ash	3.28e-005	0.02	0.41
Gypsum	3.28e-005	0.02	0.39
Mine Spoil	4.92e-006	0.33	0.37
Sand (Underdrain)	0.000328	1	0.33

Note:
 The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Existing Condition with Under-Drains



Attachment F
AECOM Review Letter

March 24, 2010

Mr. Barry Snider, P.E.
Tennessee Valley Authority
1101 Market Street, LP 5E-C
Chattanooga, Tennessee 37402

Subject: Review of Stantec Letter of Recommendations, South Slope of West Pond, Geotechnical Exploration, Scrubber Sludge Complex, Paradise Fossil Plant, Paradise, Muhlenberg County, Kentucky AECOM Project No. 60140251, Task 200.1

Dear Mr. Snider,

As requested, we have reviewed the following document forwarded to AECOM by TVA on March 5, 2010:

Document Reviewed

AECOM reviewed the following document as requested by the TVA:

1. Stantec Issued for Review Letter of Recommendations, South Slope of West Pond, geotechnical Exploration, Scrubber Sludge Complex, Paradise Fossil Plant, Paradise, Muhlenberg County, Kentucky dated March 1, 2010.

Previously, AECOM reviewed and commented on the following documents for this project:

1. Stantec Report, Issued for Review Proposed Toe Buttress, East Slope of the East Pond, Scrubber Sludge Complex, Paradise Fossil Plant, Paradise, Muhlenberg County, Kentucky, dated January 29, 2010.
2. Filter Design Calculations Proposed Sand Filter, Scrubber Sludge Complex, Paradise Fossil Plant, Muhlenberg, Kentucky, dated December 2, 2009.
3. Stantec Letter Issued for Review, Slope Armoring, South Slope of East Pond, Scrubber Sludge Complex, Paradise Fossil Plant, Paradise, Muhlenberg County, Kentucky, dated October 19, 2009.
4. Stantec Letter Issued for Review, Rock Buttress, South Slope of East Pond, Scrubber Sludge Complex, Paradise Fossil Plant, Paradise, Muhlenberg County, Kentucky, dated October 19, 2009.

AECOM referenced the following document during the review of the March 1, 2010, letter.

1. Stantec Report of Geotechnical Exploration, Scrubber Sludge Complex, Paradise Fossil Plant, Paradise, Muhlenberg County, Kentucky, dated August 24, 2009. (2009 Phase 2 Report)

Report Summary

Stantec has been assisting TVA since early 2009 by conducting geotechnical evaluations of the Scrubber Sludge Complex at the Paradise Fossil Plant in Muhlenberg, Kentucky. On November 10, 2009, six separate wet areas on the south slope of the West Pond were observed. The wet areas are shown on the attached Stantec Figure 1, Approximate Area of Interest. The initial field observations suggest that the wet areas are the result of seepage outbreak through the initial dike. As a result, Stantec performed a subsurface exploration program including soil borings and installing additional piezometers to provide subsurface information for seepage and stability analyses. The results of the explorations and the analysis results were reviewed.

In February and March 2009 Stantec had conducted a subsurface exploration of the Scrubber Sludge Complex. The results of the exploration and analyses were presented in Stantec Report of Geotechnical Exploration dated August 24, 2009 (Phase 2 Report). During the Phase 2 Report exploration four piezometers were reinstalled in borings drilled in this area of the site.

A total of twelve borings were drilled from December 10, 2009 to January 6, 2010. The borehole depths ranged from 18 to 63 feet at six locations shown on Stantec Figure 2 Approximate Location of Wet Areas. The borings were continuously sampled by either performing Standard Penetration Tests or collecting undisturbed samples using 3-inch Shelby tubes. Six additional piezometers were installed to supplement the four piezometer installed earlier in 2009 during the Phase 2 exploration. The piezometers were constructed using a 1-inch diameter riser pipe with a filter tip at the bottom of the riser pipe placed in a sand filter pack. The length of the filter pack ranged from 10.9 to 12.4 feet.

Laboratory testing consisted of performing geotechnical index testing such as Particle-size analysis, Atterberg limits, Specific gravity test, and determination of water content and dry density.

The borings mainly encountered mine spoil used in the construction of the dike fills or which made up the foundation materials. The mine spoils consisted of a low to high plasticity clay with heterogeneous mixture of coal, shale, sandstone, and siltstone fragments. There were also lenses of sand and silt.

A seepage analysis was performed for Section A-A' for the 2009 Phase 2 report, without and with under-drains to determine the effect of the drains on the factor of safety against piping near the toe of the initial dike. The analysis with under-drains also included chimney drain encountered within Boring STN-31. The analysis indicated that the Factor of Safety against a piping failure for without and with under-drains cases was 4.5. The Phase 2 report calculated piping factor of safety as 1.0 for the without under-drains case and 2.1 for the with under-drains case. The stability analysis for this Section A-A' was not updated from the 2009 Phase 2 report since the minimum factor of safety against siding was 1.5.

Stantec recommended no construction related repairs such as armoring or buttressing be performed at this time. The report does recommend that the south slope continue to be monitored for seepage and stability issues. This includes taking frequent piezometer water level readings, performing annual inspections and periodic observations of the slope for signs of seepage or instability.

AECOM Comments on the Report

AECOM's overall opinion is that continued monitoring of the south slope of the West Pond is a good interim plan of action. We have several comments and questions:

- The report does not contain a geological cross-section of Section A-A' which was likely needed for analysis. This figure would be useful depicting piezometer locations, observed water levels and the dike slope seepage outbreak or wet surface areas.
- The report does not state the West Pond water surface elevation on November 10, 2009, and how close the pond was to the dike crest and wet areas on the south slope.
- We do not understand how the Kv/Kh ratio was determined. The August 24, 2009, report does state that Kv was determined from laboratory testing and Kh was assumed. If the Kv/Kh assumption is based on references please cite them in the latest letter report. If they were assumed based on engineering judgment please include a sensitivity study varying the Kv/Kh values for the Gypsum-fly ash and Gypsum materials.
- The results of the piezometer reading for PZ-2 and PZ-5 do indicate that there are some artesian conditions existing below the south facing dike slope. There is no mention of these readings in the text of the report.
- The results of the seepage analysis do not indicate how it compares to the measured piezometers readings in the field and the observed wet areas on the slope.
- If the horizontal hydraulic conductivity Kh was not measured, we suggest in the report the Kh/Kv ratio in gypsum and gypsum/flyash be noted as assumed or that they were back calculated from SEEP/W runs to calibrate the seepage model to match measured water levels.
- The March 1, 2010, seepage analysis results determined that the factor of safety against piping is 4.5 for both with and without under-drain cases. There is no mention of the difference in the calculated Section A-A' Piping Factor of Safeties between the 2009 Phase 2 report and the March 1, 2010, letter report for with and without internal under-drain loading conditions.
- The positive results of the SPT testing indicate that there were no zones of very soft to soft soils within the initial dike. The boring logs do not indicate the separation between dike fill and the mine spoil foundation fill materials.
- Observations of the south slope of the West Pond since November 10, 2009, have not revealed any new wet areas or seepage forming. Reportedly, some of the 2009 wet areas have dried up.

- We agree with the Stantec conclusions that visual, routine monitoring of these areas is all that is required. If new wet areas become evident, open seepage develops and/or instrumentation readings show higher water levels, this could indicate movement or potential instability, then seepage control or slope stabilization measures will need to be considered.
- We also agree with Stantec's recommendation that the monitoring program include weekly readings of the piezometers installed in this area and the slope be observed by trained personnel for new seepage, sloughing, or instability. In addition we would recommend that three inclinometers be installed through the south dike fill into solid foundation soils or bedrock to monitor if any dike slope movements are occurring.

Recommendations

AECOM suggests the following design changes:

- Develop a monitoring program for the south slope of the West Pond that includes piezometer readings (weekly), visual observation of the slope (daily), and inclinometer readings (monthly). Establish trigger warning and action levels based on the seepage and stability analyses. If movements and excessive seepage were to occur, we suggest sluicing gypsum and ash in the West Pond be stopped for an interim period while an engineering review is conducted.
- We recommend that monthly instrumentation reports be issued that summarize the piezometer and inclinometer readings, in addition to a discussion of the visual observations of the slope.
- Install inclinometer casings at three locations where wet areas on the south slope were observed. The inclinometers should be installed near Borings STN-26, STN-28, and STN-30. Readings of the inclinometers should be taken monthly unless there is movement observed of the inclinometer casings.
- Include within the instrumentation monitoring reports the active West Pond water surface elevation and distance between the active pond and the upstream crest edge of the south slope dike.

Summary

AECOM agrees with Stantec's plans to continue to monitor the south dike slope and toe foundation area along the West Pond perimeter. Should instrumentation readings indicate an increase in porewater pressure, movement of the south dike, or if new seepage outbreak or wet areas are observed; then there should be an evaluation of whether or not a seepage filter drain and/or a buttress fill needs to be constructed against the south dike slope to increase the stability of the embankment fill slope.

Thank you for the opportunity to review this submittal. Please call us if you have any questions.

Sincerely,

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Senior Principal Engineer
Vice President

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Attachment:

Figure 1 - Approximate Area of Interest

Figure 2 - Approximate Locations of Wet Areas



Figure 1: Approximate Area of Interest

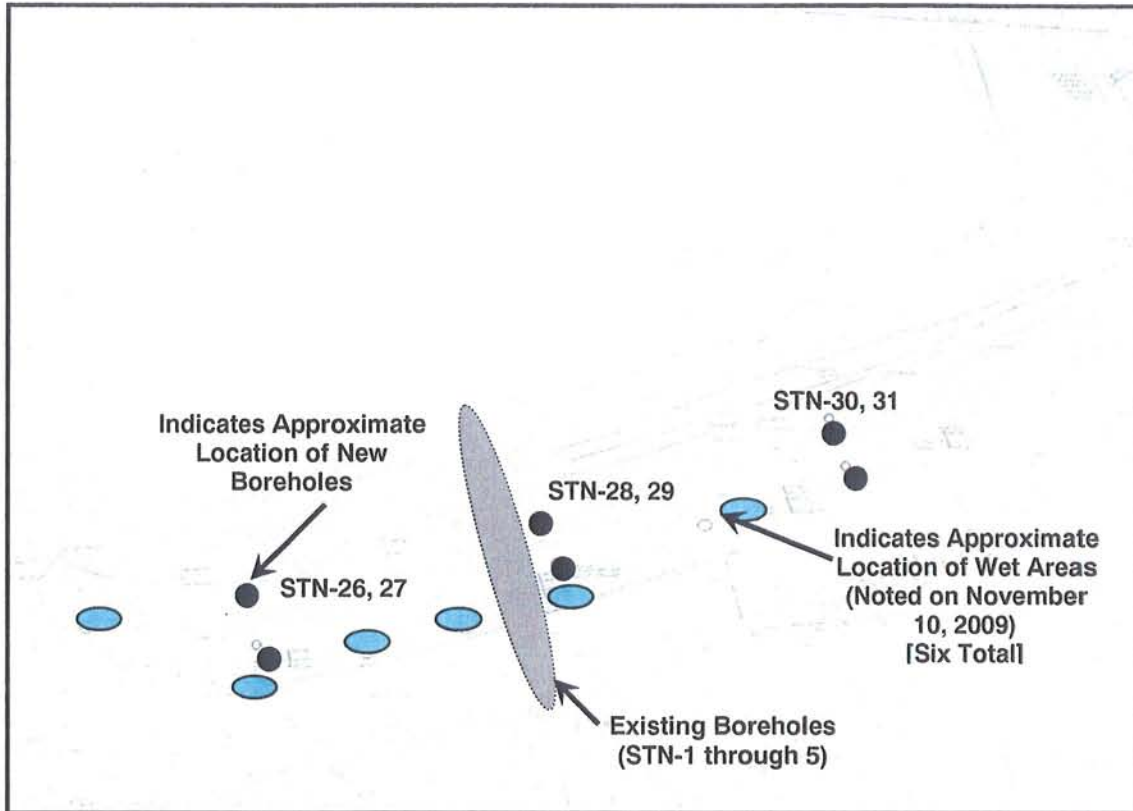


Figure 2: Approximate Location of Wet Areas