HISTORY OF CONSTRUCTION

CFR 257.73(c)(1)

Bottom Ash Storage Pond

Welsh Plant
Pittsburg, Texas

October, 2016

Prepared for: AEP/SWEPCO - Welsh Plant

Pirkey, Texas

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

GERS – 16 – 130

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1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CCR 257.73(c)(1) with an evaluation of the facility.

2.0 DESCRIPTION OF CCR THE IMPOUNDMENT

The AEP J. Robert Welsh Plant is located in southern Titus County, approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The facility operates two surface impoundments for storing CCR materials called the Primary Bottom Ash Pond and the Bottom Ash Storage pond. The Bottom Ash Storage Pond CCR unit is located at the south end of the Plant and approximately 1,000 feet west of the Welsh Reservoir.

The Bottom Ash Storage Pond embankments are approximately 20 feet in height and are constructed on a 3:1 slope (3 feet horizontal, 1 foot vertical). The elevation at the base of the embankment is approximately 340 feet above msl, and the elevation at the top of the embankment around the perimeter of the Bottom Ash Storage Pond is approximately 360 feet above msl. Presently a combination of economizer ash, bottom ash and some fly ash is sluiced to the bottom ash storage pond from the primary bottom ash pond.

3.0 SUMMARY OF OWNERSHIP 275.73(c)(1)(i)

[The name and address of the person(s) owning or operating the CCR unit: the name associated with the CCR unit: and the identification number of the CCR unit if one has been assigned by the state.]

The AEP J. Robert Welsh Plant is located at 1187 County Road 4865, Pittsburg, TX, 75686, in southern Titus County. The plant is approximately 8 miles northeast of Pittsburg, Texas, and approximately two miles northwest of Cason, Texas. The Bottom Ash Storage Pond CCR unit is located at the south end of the Plant and approximately 1,000 feet west of the Welsh Reservoir. It is owned and operated by Southwestern Electric Power Company (SWEPCO). The facilities Ash Pond Complex operates two surface impoundments for storing CCR and a clear water pond for decant water.

4.0 LOCATION OF THE CCR UNIT 275.73 (c)(1)(ii)

[The location of the CCR unit identified on the most recent U.S. Geological Survey (USGS) 7 ½ minute or 15 minute topographic quadrangle map, or a topographic map of equivalent scale if a USGS map is not available.]

A location map is included in Attachment A.

5.0 STATEMENT OF PURPOSE 275.73 (c)(1)(iii)

[A statement of the purpose for which the CCR unit is being used.]

The Bottom Ash Storage Pond is a surface impoundment for storing CCR. Presently, economizer ash and occasionally bottom ash and fly ash from the primary bottom ash pond is dredged and sluiced to the bottom ash storage pond. The Bottom Ash Storage Pond area also receives storm water run-off from a

small water shed area of the plant property and an adjacent ash storage area. All of the decant water from the Bottom Ash Storage Pond flows back into the primary bottom ash pond.

6.0 NAME AND SIZE OF WATERSHED THE CCR UNIT IS LOCATED 275.73 (c)(1)(iv)

[The name and size in acres of the watershed within which the CCR unit is located.]

The Welsh Bottom Ash Pond is comprised of a diked embankments constructed of compacted earth materials. The Bottom Ash Storage Pond is bounded by natural ground surface (topographically higher areas) to the north and embankment dikes to the south, east and west. Therefore, there are areas surrounding the impoundment that contributes to the run-off. The watershed for the ponds is equal to approximately 42 acres.

The Bottom Ash Storage Pond is located within the Region 11 – Arkansas –White –Red Region Watershed and are part of the sub group HUC = 11140305 Lake O' the Pines watershed area. The area is approximately 571,731.2 acres.

7.0 DESCRIPTION OF THE FOUNDATION AND ABUTMENT MATERIALS 275.73(c)(1)(v)

[A description of the physical and engineering properties of the foundation and abutment materials on which the CCR unit is located.]

Native coarse grained (or sandy) material underlying the Bottom Ash Pond generally Consist of medium dense to very dense silty sand (SM), clayey sand (SC) and silt (ML) and Fine grained (or clayey) material consist of medium stiff to hard lean clay and fat clay (CL and CH) soils. The engineering properties of foundation soils had a cohesion that ranged between 0 psf and 300 psf and a friction angle that ranged between 22 degrees and 36 degrees. Additioanl details on the engineering properties of the foundaiton soils is in the design reports presented in Attachment B.

8.0 DESCRIPTION OF EACH CONSTRUCTED ZONE OR STAGE OF THE CCR UNIT 275.73 (c)(1)(vi)

[A statement of the type, size, range, and physical and engineering properties of the materials used in constructing each zone or stage of the CCR unit; and the approximate dates of construction of each successive stage of construction of the CCR unit.]

The Bottom Ash Storage Pond embankment was constructed in 2000 and is constructed of compacted earth fill. The source and type of soils used for earth fill is unknown. However, AEP contracted with Auckland Consulting, Inc. of Tyler, Texas to perform a Geotechnical Investigation of Existing Bottom Ash Storage Pond Embankments in 2016 (copy provided in Attachment B). The evaluation of the existing earthen embankments consisted of slope stability and seepage analyses for the embankments. The evaluation was performed using information obtained from soil borings located on the crest and outside toe of the embankments. The embankments for the Bottom Ash Storage were investigated. The subsurface exploration of the embankment consisted of advancing a total of seven (7) borings located in potentially critical areas of the embankment. Four (4) borings (Boring Nos. 2 through 5) were completed along the embankment crest with termination depths ranging from approximately 40 to 50 feet. Three

(3) borings (Boring Nos. 6 through 8) were completed along the embankment toe and were advanced to termination depths of approximately 40 feet.

Based on soil borings and field testing information, the existing soil embankment consist of lean clay (CL) with existing side slopes (both up- and downstream) of approximately 3:1 (H:V), Maximum embankment height of approximately 34 feet (downstream) and top of dam elevation of 360.0 feet MSL. The engineering properties of embankment soils had a cohesion of 150 psf and a friction angle of 32 degrees. Additioanl details on the engineering properties of the foundaiton soils is in the design reports presented in Attachment C. The downstream slope of the embankment is constructed with an intermediate 12-foot wide bench that supports a 30-inch HDPE decant pipe. To account for the potential loading of the decant pipe, a surcharge load of 150 psf was applied to the bench. The crest width of the embankment is approximately 12 feet. The impoundment's storage area (side slopes and bottom) is lined with a 60 mil HDPE liner.

9.0 ENGINEERING STRUCTURES AND APPURTENANCES, 275.73 (c)(1)(vii)

[At a scale that details engineering structures and appurtenances relevant to the design, construction, operation, and maintenance of the CCR unit, detailed dimensional drawings of the CCR unit, including a plan view and cross sections of the length and width of the CCR unit, showing all zones, foundation improvements, drainage provisions, spillways, diversion ditches, outlets, instrument locations, and slope protection…]

Ash materials are dredged from the Primary bottom Ash Pond and sluiced to the Bottom Ash Storage Pond, where the ash materials are then managed. The southeast corner of the Bottom Ash Storage Pond has an interior dike which separates the main body of the pond from a small sump area. This interior dike has a 40-foot wide interior spillway section with a crest elevation of 355.0 feet, however this spillway does not act as the hydraulic control for the Bottom Ash Storage Pond. Discharges from the Bottom Ash Storage Pond are initially controlled by an 18-inch HDPE pipe with an invert elevation of 350.5 feet penetrating the 40 foot wide interior spillway, and then by a 30-inch HDPE pipe with an invert elevation of 350.0 feet located in the sump area; flows through this pipe are directed back to Primary Pond. The Bottom Ash Storage Pond has an 8-foot wide emergency spillway with a crest elevation of 358.0 feet. The emergency spillway channel is lined with riprap and discharges into an unnamed tributary of Swauano Creek just upstream of the south end of the Welsh Reservoir emergency spillway. The design drawings are presented in Attachment C.

10.0 SUMMARY OF POOL SURFACE ELEVATIONS, AND MAXIMUM DEPTH OF CCR, 275.73 (c)(1)(vii)

[…in addition to the normal operating pool surface elevation and the maximum pool elevation following peak discharge from the inflow design flood, the expected maximum depth of CCR within the CCR surface impoundment.]

The table below describes the normal pool elevations and maximum pool elevations as well as maximum depth of CCR within the impoundment. The Inflow Design Flood is the 100-year storm event.

	Primary Bottom Ash Pond
Normal Pool Elevation	350.5
Maximum Pool Elevation following peak discharge from inflow design flood	355.046
Expected Maximum depth of CCR within impoundment	20 ft

11.0 FEATURES THAT COULD ADVERSELY AFFECT OPERATION DUE TO MALFUNCTION OR MIS-OPERATION (275.73 (c)(1)(vii))

[…and any identifiable natural or manmade features that could adversely affect operations of the CCR unit due to malfunction or mis-operation]

In the event of malfunction or mis-operation of any of the pond's appurtenances the ponds operations could be adversely affected. These structures include weir structures, low water discharge gated structures, effluent return piping and pump structures and influent sluicing piping and structures. See design drawings in Attachment C for location and details of all appurtenances.

12.0 DESCRIPTION OF THE TYPE, PURPOSE AND LOCATION OF EXISTING INSTRUMENTATION 275.73 (c)(1)(viii)

[A description of the type, purpose, and location of existing instrumentation.]

This is no instrumentation for this facility.

13.0 AREA – CAPACITY CURVES FOR THE CCR UNIT 275.73 (c)(1)(ix)

[Area-capacity curves for the CCR unit.]

The area capacity curves for the Primary Bottom Ash Pond is included in the Hydrology and Hydraulic Analysis Report by Freese and Nichols, Inc., dated 2010 in Attachment D.

14.0 275.73 (c)(1)(x) DESCRIPTION OF EACH SPILLWAY AND DIVERSION

[A description of each spillway and diversion design features and capacities and calculations used in their determination.]

Complete details of each spillway structure are included with the design drawings in Attachment C. Hydrology and Hydraulic Analysis which include calculations for each spillway structure are included in Inflow Design Flood Control Plan.

The principal spillway for the Bottom Ash Pond is a 40-foot long broad-crested weir with 6:1 side slopes and crest at elevation 355.0 ft-msl. However, this spillway does not act as the hydraulic control for the Bottom Ash Storage Pond. Discharges from the Bottom Ash Storage Pond are initially controlled by an

18-inch HDPE pipe with an invert elevation of 350.5 feet penetrating the 40 foot wide interior spillway, and then by a 30-inch HDPE pipe with an invert elevation of 350.0 feet located in the sump area; flows through this pipe are directed back to Primary Pond. The Bottom Ash Storage Pond has an 8-foot wide emergency spillway with a crest elevation of 358.0 feet. The emergency spillway channel is lined with rock riprap and discharges into an unnamed tributary of Swauano Creek just upstream of the south end of the Welsh Reservoir emergency spillway.

15.0 SUMMARY CONSTRUCTION SPECIFICATIONS AND PROVISIONS FOR SURVEILLANCE, MAINTENANCE AND REPAIR 275.73 (c)(1)(xi)

[The construction specifications and provisions for surveillance, maintenance, and repair of the CCR unit.]

Readily available portions of the original construction specifications are included in Appendix B.

As required by the CCR rules the Primary Ash Pond is inspected at least every 7 days by a qualified person. Instrumentation data is collected at least every 30 days and reviewed by AEP Engineering Services. Also as a requirement of the CCR rules the impoundment is also inspected annual by a professional engineer.

If repairs are found to be necessary during any inspection they will be completed as needed.

16.0 RECORD OR KNOWLEDGE OF STRUCTURAL INSTABILITY 275.73 (c)(1)(xii)

[Any record or knowledge of the structural instability of the CCR unit.]

To date there has been no known record of knowledge of the structural instability of the CCR unit.

ATTACHMENT A

LOCATION MAP

1 0.5 0 KILOMETERS 1 2

1000 500 0 METERS 1000 2000

1 0.5 0 1

MILES

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

FEET

N

W E

THIS DRAWING IS CLASSIFIED AS:

AEP PUBLIC

REFERENCE AEP's CORPORATE INFORMATION SECURITY POLICY

SOUTHWESTERN ELECTRIC POWER COMPANY

WELSH PLANT

CASON TEXAS

UNIT:	DRAWING NUMBER:	REV:
13	LOCATION MAP	1
SCALE: 1"=2000'	CIVIL ENGINEERING	
DR:		
CH:		
SUP:		
ENG:		
DATE: 10/4/16		

BOTTOM ASH STORAGE POND

USGS TOPO MAP

7.5-MINUTE SERIES

AEP AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

ATTACHMENT B

DESIGN REPORTS

Initial Safety Factor Assessment – Bottom Ash Pond

Welsh Power Plant
Pittsburg, Texas

Auckland Project No. 2016-007
August 30, 2016

Prepared For:

American Electric Power Company
1 Riverside Plaza
Columbus, Ohio 43215

Prepared By:

Auckland Consulting, LLC
Jacksonville, Texas

TBPE Firm Registration No. F-16721
Expires 2/29/2017

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Appendix

1.0 Introduction and Embankment Information

1.1 Introduction

The following report and evaluation provides the Initial Safety Factor Assessment of the Bottom Ash Pond, an existing CCR impoundment (as defined by 40 CFR §257.2) located at the Welsh Power Plant near Pittsburg, Texas. In accordance with 40 CFR §257.73(e)(1)(i) through (iv) this initial assessment provides field and laboratory data, model outputs (detailing multiple stability conditions) and summary of safety factors for the Bottom Ash Pond. In accordance with 40 CFR §257.73(e)(2) this report provides the Initial Safety Factor Assessment certification for the Bottom Ash Pond.

1.2 Referenced Information and Data

The impoundment pool elevation data cited herein were provided in a separate hydrology and hydraulic (H&H) analysis report completed by Freese and Nichols titled *Hydraulic Analysis of Welsh Power Plant Ash Ponds* dated December 29, 2010 (not included herein). The referenced report generally meets the demonstration requirements of 40 CFR §257.82(a).

Embankment profile dimensions and elevations were determined by using existing information provided by the client. This information is included in the Appendix of this report.

1.3 Embankment Evaluation Criteria

Based on information provided and collected, the existing embankment is primarily lean clay (CL) with existing side slopes (both up- and downstream) of approximately 3:1 (H:V), maximum embankment height of approximately 34 feet (downstream) and top of dam elevation of 360.0 feet MSL. The downstream slope of the embankment is constructed with a 12-foot wide bench (vertical position on the slope varies along the embankment) that supports a 30-inch HDPE decant pipe. To account for the potential loading of the decant pipe, a surcharge load of 150 psf was applied to the bench. The crest width of the embankment is approximately 12 feet. The impoundment's storage area (side slopes and bottom) is lined with a 60-mil HDPE liner. The critical section for the embankment was determined to occur in the vicinity of Boring No. 4, as depicted on the Plan of Borings.

It is our understanding that the maximum storage elevation of impounded CCR material is 355.0 feet (MSL); however, the facility is managed to maintain an ash level less than this maximum level. The downstream toe of the Bottom Ash Pond is not adjacent to other water bodies that may inundate the downstream slope (or toe) and therefore not subject to 40 CFR §257.73(d)(1)(A)(3)(vii).

In accordance with 40 CFR §257.73(e)(1)(i) and (ii), the maximum storage pool elevation for the Bottom Ash Pond as determined by the 25-year, 24-hour storm event is 355.62 feet (MSL). For the purposes of this evaluation, the maximum storage pool elevation of 356.0 feet (MSL) was utilized. Likewise, the maximum (or flood) surcharge loading elevation as determined by the 100-year, 24-hour event is 355.76 feet (MSL), for this evaluation a maximum surcharge loading elevation of 356.0 feet (MSL) was utilized. Storage pool elevations were determined in accordance with 40 CFR §257.82(a).

2.0 Field and Laboratory Testing

2.1 Field Activities

The subsurface exploration of the embankment consisted of advancing a total of seven (7) borings located in potentially critical areas of the embankment. Four (4) borings (Boring Nos. 2 through 5) were completed along the embankment crest with termination depths ranging from approximately 40 to 50 feet. Three (3) borings (Boring Nos. 6 through 8) were completed along the embankment toe and were advanced to termination depths of approximately 40 feet. Boring No. 1 was not accessible by drilling equipment and therefore not completed. Borings were located in the field as shown on the Plan of Borings included in the Appendix of this report.

Drilling Methods. Field operations were performed in general accordance with ASTM procedures or similar accepted practices. Soil borings were drilled using a track mounted Geoprobe drilling rig equipped with a rotary head and continuous augers. The use of mud rotary or rotary wash was not necessary.

Soil Sampling. Sample intervals were semi-continuous in the upper 10 feet of each boring and five (5) foot intervals thereafter, unless otherwise directed by the onsite engineer. Split-spoon (Standard Penetration Test, SPT) or disturbed samples were collected in general accordance with ASTM Standard Method D 1586. Relatively undisturbed soil samples were collected in general accordance with ASTM D 1587 and extruded in the field and sealed in plastic to protect against moisture loss. Soil shear strengths were determined by using a calibrated hand penetrometer on undisturbed samples.

The collected samples were subsequently examined and selected for laboratory testing by a geotechnical engineer.

Boring Logs. The general subsurface soil and groundwater conditions encountered during field activities are presented on boring logs attached in the Appendix of this report. Information on the boring logs includes groundwater levels, laboratory test data, penetration resistance and soil classifications based on the Unified Soil Classification System (USCS).

Groundwater Level Measurements. Groundwater level observations completed during field activities are noted on the boring logs attached in the Appendix of this report.

2.2 Laboratory Testing Program

Laboratory testing was conducted on selected samples to assist in the classification of the soils encountered and to evaluate the physical and engineering properties of subsurface soils. Laboratory test results are presented on the boring logs included in the Appendix. Laboratory tests were performed in general accordance with ASTM procedures cited in the table below.

Laboratory Test	Test Designation
Atterberg Liquid Limit and Plastic Limit Determination	ASTM D 4318
Percentage Soil Passing No. 200 Sieve	ASTM D 1140
Moisture Content Determination	ASTM D 2216
Particle Size Analysis of Soils	ASTM D 422
Unconsolidated Undrained (UU) Triaxial Compression	ASTM D 2850
Hydraulic Conductivity	ASTM D 5084
Consolidated Undrained (CU) Triaxial Compression	ASTM D 4767
Direct Shear of Soils Under Consolidated Drain Conditions	ASTM D 3080

Soil samples not utilized in laboratory testing will be retained for approximately 30 days from the report issuance date and then disposed, unless specifically requested in writing from the client.

3.0 Slope Stability Analyses

3.1 General

Soil parameters used for stability analyses of the existing embankment are based on findings of the completed laboratory and field testing programs and previous assessments completed as the Welsh Power Plant. The probable failure planes were analyzed using the analytical slope stability software, SLIDE by Rocscience, Inc. Methods of evaluation used in SLIDE are considered to be limited equilibrium methods of analysis, where each individual shear plane is evaluated to determine the resulting shear stress at the point of failure. For the purposes of this evaluation the Bishop Method of analysis, which analyzes circular failure planes through the slope was utilized.

Per 40 CFR §257.73(e)(1)(i) through (iii), three (3) modeled scenarios (presented below) were utilized to evaluate the stability of the existing embankment: steady state seepage (long term) condition under maximum storage pool, steady state seepage (long term) condition under maximum surcharge pool, and steady state seepage condition with seismic loading under maximum storage pool conditions. The following minimum factors of safety (FS) and soil stress parameters were utilized in modeling. Minimum factors of safety are based on demonstration requirements provided in 40 CFR §257.73(e)(1).

Summary of Embankment Condition and Factor of Safety		
Embankment Condition	**Soil Parameters**	**Minimum Factor of Safety**
Steady State Seepage – Maximum Pool	Effective Stress	1.50
Steady State Seepage – Surcharge Pool	Effective Stress	1.40
Steady State Seepage (Seismic) – Maximum Pool	Total Stress	1.00
NOTE: Minimum factors of safety based on demonstration requirements provided in 40 CFR §257.82 (e)(1).		

For evaluation of steady state seepage (long term) conditions with seismic, peak ground acceleration for this location was obtained from the USGS National Seismic Hazard Mapping Project (http://earthquake.usgs.gov/hazards). Based on the seismic survey data, the anticipated site specific peak ground acceleration (PGA) of 0.06g (acceleration at rock sites) for two (2) percent probability of exceedance in 50 years (40 CFR Part 257, Preamble page 21384). Correcting for acceleration at soft soil sites (Seismic Site Classification D) yields an estimated PGA of 0.13g. The seismic coefficient (k) used for pseudo static analysis is determined by reducing the estimated PGA by 50% yielding a seismic coefficient of 0.065g.

3.2 Liquefaction Assessment

Liquefaction of soils occurs when horizontal shearing stresses exceed the strength of existing loose, saturated sand. This sudden loss of shear strength and subsequent soil structure is typically associated with earthquake-induced horizontal movement. Recent engineering publications[1] provide criteria to assess liquefaction potential of sands (little to no fines) and clayey soils of low plasticity (e.g. clayey sands, silts). These criteria indicate that water content of fine-grained or cohesive soils needs to be high (≥ 0.85 *Liquid Limit [LL]), a clay fine content (defined as grains smaller than 0.002 mm) of less than 10 percent (< 10%), and relatively low soil density (assessed in terms of SPT blow counts). In addition, the accepted minimum seismic threshold acceleration to cause liquefaction in loose sands is 0.10g, the anticipated site specific PGA for this site is 0.06g.

Native coarse grained (or sandy) material underlying the Bottom Ash Pond generally consist of medium dense to very dense silty sand (SM), clayey sand (SC) and silt (ML) and fine grained (or clayey) material consist of medium stiff to hard lean clay and fat clay (CL and CH) soils. Based on these soil characteristics and that the Bottom Ash Pond is located in

[1] Seed, R.B., et al, Recent Advances in Soil Liquefaction Engineering: A Unified and Consistent Framework, 26th Annual ASCE Los Angeles Spring Seminar, April 2003

a zone of low peak ground acceleration (PGA), the risk of either embankment or underlying soils liquefying are negligible [40 CFR §257.73(e)(1)(iv)].

3.3 Embankment and Foundation Stratigraphy

The models developed for this evaluation are based on the existing embankment geometry, results of field and laboratory testing and hydrologic site information provided by the client. Selection of the critical slope section was based on both height and subsurface sensitivity to loading. The following tables provide a summary of soil parameters used for these analyses. Specific soil parameters used for each model are presented in the Appendix.

Summary of Long Term, Total Stress Soil Parameters:			
Material Type	**Unit Weight (pcf)**	**Consolidated-Undrained Cohesion (psf)**	**Consolidated-Undrained Angle of Internal Friction (degrees)**
Embankment Fill	125	250	28
Silty, Clayey Sand (SM_SC)	120	225	20
Silty Sand (SM)	120	0	30
Native Fat and Lean Clay (CH_CL)	125	450	14
Ash	100	0	30
NOTE: Properties used for Steady State Seepage with Seismic analyses.			

Summary of Long Term, Effective Stress Soil Parameters			
Material Type	**Unit Weight (pcf)**	**Consolidated-Drained Cohesion (psf)**	**Consolidated-Drained Angle of Internal Friction (degrees)**
Embankment Fill	125	150	32
Silty, Clayey Sand (SM_SC)	120	0	34
Silty Sand (SM)	120	0	36
Native Fat and Lean Clay (CH_CL)	125	300	22
Ash	100	0	30
NOTE: Properties used for Steady State Seepage analyses. Consolidated-drained conditions determined based on pore pressure measurements made during Consolidated-Undrained (CU) triaxial testing.			

The HDPE liner was modeled at the interface of the slope and the ash pond, a nominal strength of 50 psf was assumed for the liner material.

3.4 Seepage Analysis Parameters

The observed groundwater levels while drilling through the embankment (approximate groundwater elevation of 30 to 34 feet, below the crest) correspond with those groundwater elevations encountered while drilling adjacent to the embankment toe (approximately groundwater elevation six [6] feet, below existing grade). No elevated groundwater seepage or groundwater levels were observed in boreholes completed in the embankment that would indicate a prolific and defined phreatic surface in the embankment.

Therefore, based on the available information it appears that the existing impermeable liner has precluded the development of a phreatic surface (internal groundwater elevation) within the embankment. Though the probability of a phreatic surface developing in the embankment is considered low, it is however possible, and therefore was modeled as part of the structural assessment.

The analysis of embankment seepage is based on laboratory results and estimated values for permeability for various embankment and native foundation soils. These soil parameters were utilized in the models to establish a long term steady state condition and corresponding phreatic surface in the embankment. Hydraulic conductivity test results are provided in the Appendix. Hydraulic conductivity properties utilized in the seepage analysis are provided in the below table.

Hydraulic Conductivity of Embankment Soils	
Material Type	**Permeability (ft/sec)**
Embankment Fill	1×10^{-8}
Silty, Clayey Sand (SM_SC)	1×10^{-5}
Silty Sand (SM)	1×10^{-5}
Native Fat and Lean Clay (CH_CL)	1×10^{-8}
Ash	1×10^{-4}

The HDPE liner is assumed to be impermeable; therefore a very low permeability value of $1x10^{-20}$ ft/sec was utilized.

3.5 Stability Analysis Results

The following table provides the results of the stability analysis for each of the conditions cited herein, as required by 40 CFR §257.73(e)(1)(i) through (iii). The graphical representations of each analysis are included in the Appendix.

Summary of Stability Analyses – Safety Factors		
Modeled Condition	**Factor of Safety**	
	Actual	**Minimum**
Steady State Seepage – Maximum Pool	2.60	1.50
Steady State Seepage – Surcharge Pool	2.60	1.40
Steady State Seepage with Seismic – Maximum Pool	1.60	1.00

Summary of Stability Analyses– Safety Factors (Potential Phreatic Surface)		
Modeled Condition	**Factor of Safety**	
	Actual	**Minimum**
Steady State Seepage – Maximum Pool	1.78	1.50
Steady State Seepage – Surcharge Pool	1.78	1.40
Steady State Seepage with Seismic – Maximum Pool	1.31	1.00

Based on the findings of this analysis, the evaluated embankment appears to be stable under both modeled conditions (existing conditions and potential phreatic surface) and demonstrate the minimum safety factors, as required by 40 CFR §257.73(e)(1)(i) through (iii).

4.0 Report Limitations

This report has been prepared for the exclusive use of our client for the specific application to the project discussed and has been prepared in accordance with the generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. The analyses contained in the report are based on the data obtained from the soil

borings performed within the project site. This report does not reflect variations that may occur between borings or across the site. Soil borings do not necessarily reflect strata variations that may exist at other locations within the project site.

5.0 Initial Structural Stability Assessment Certification

By means of this certification, (i) I have reviewed the requirements of 40 CFR §257.73(e)(1) – *Periodic Safety Factor Assessments*, (ii) I or my agent has visited and examined the facility, (iii) the referenced data used in this evaluation to the best of my knowledge appears correct and appropriate for use, (iv) and this Initial Safety Factor Assessment for the Bottom Ash Pond (Welsh Power Plant) has been prepared to the best of my knowledge in accordance with §257.73(e)(1).

By: 

Dated: August 30, 2016

TBPE Firm Registration No. F-16721
Expires 2/28/2017

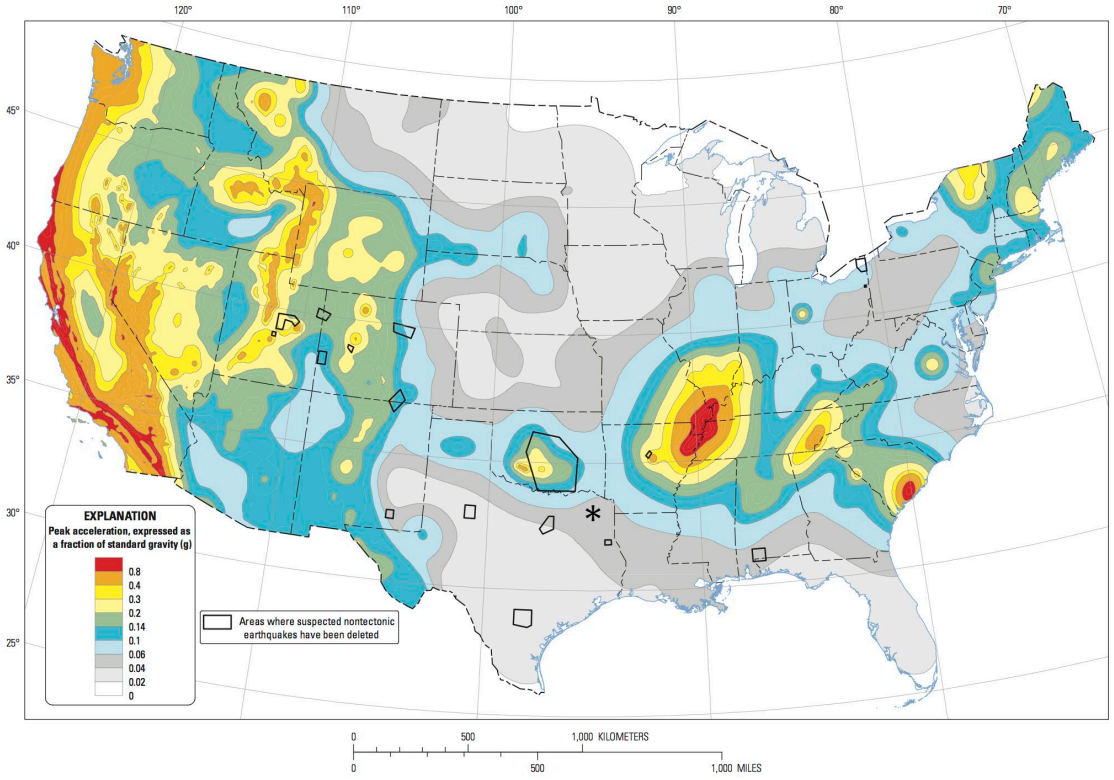
Appendix

Stability Analyses
Reference Data

Aerial image provided by Google Earth.

Soil Boring Location Plan

Scale: N/A	**Welsh Power Plant** **Initial Safety Factor Assessment - Bottom Ash Pond** **Pittsburg, Texas**
Auckland Project No. 2016-007	



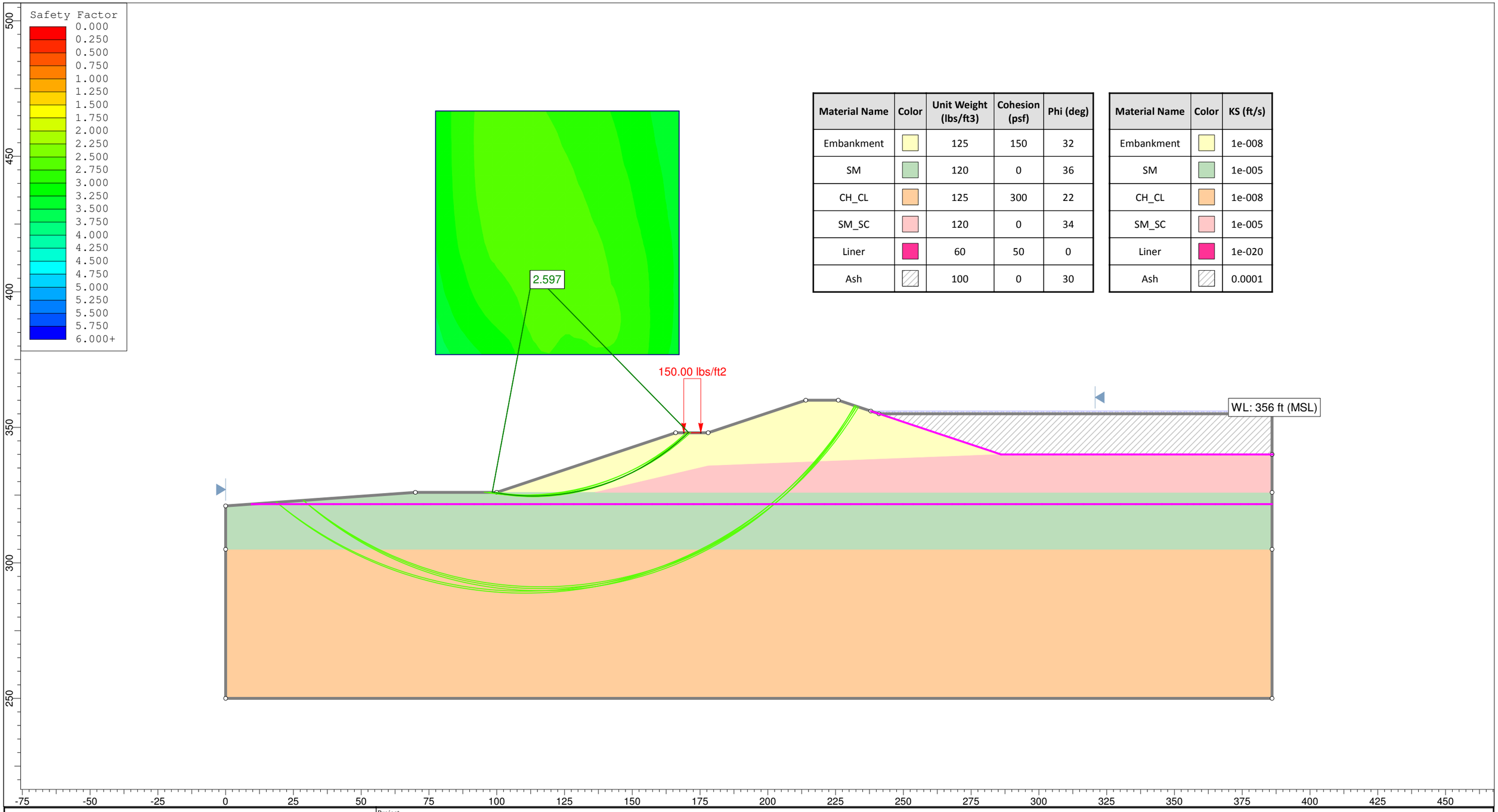
Two-percent probability of exceedance in 50 years map of peak ground acceleration

* Approximate location of Welsh Power Plant

Provided by USGS National Seismic Hazard Mapping Project.

Seismic Probability Map

Scale: N/A	**Welsh Power Plant** **Initial Safety Factor Assessment - Bottom Ash Pond** **Pittsburg, Texas**
Auckland Project No. 2016-007	



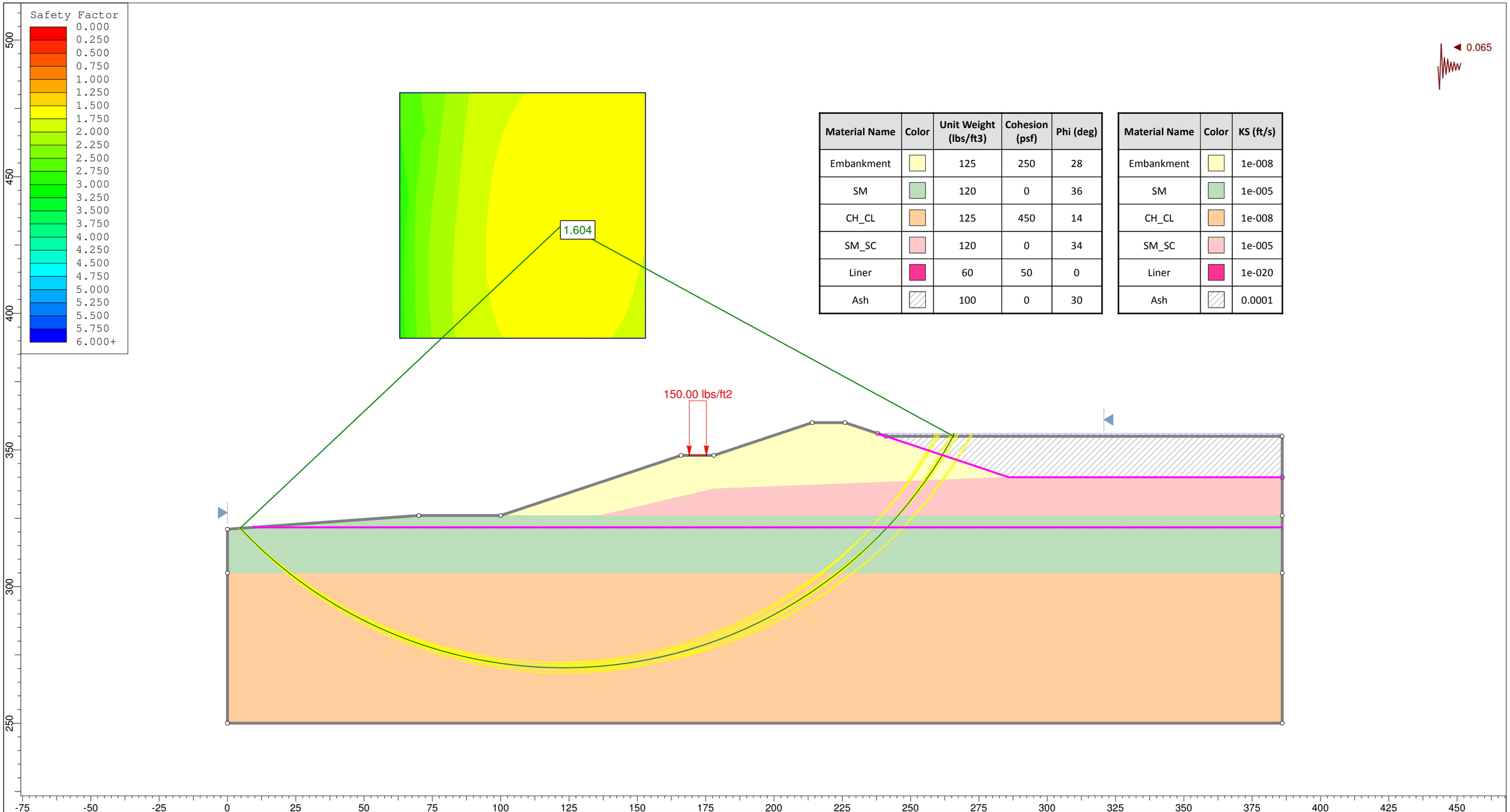
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment		125	150	32
SM		120	0	36
CH_CL		125	300	22
SM_SC		120	0	34
Liner		60	50	0
Ash		100	0	30

Material Name	Color	KS (ft/s)
Embankment		1e-008
SM		1e-005
CH_CL		1e-008
SM_SC		1e-005
Liner		1e-020
Ash		0.0001

Auckland Consulting LLC

SLIDEINTERPRET 6.036

Project	Welsh Power Station - Bottom Ash Pond		
Analysis Description	Steady State Seepage at Maximum and Surcharge Pool		
Drawn By	JJT	*Company*	Auckland
Date	7/11/2016, 3:30:13 PM	*File Name*	Winston_SS.slim



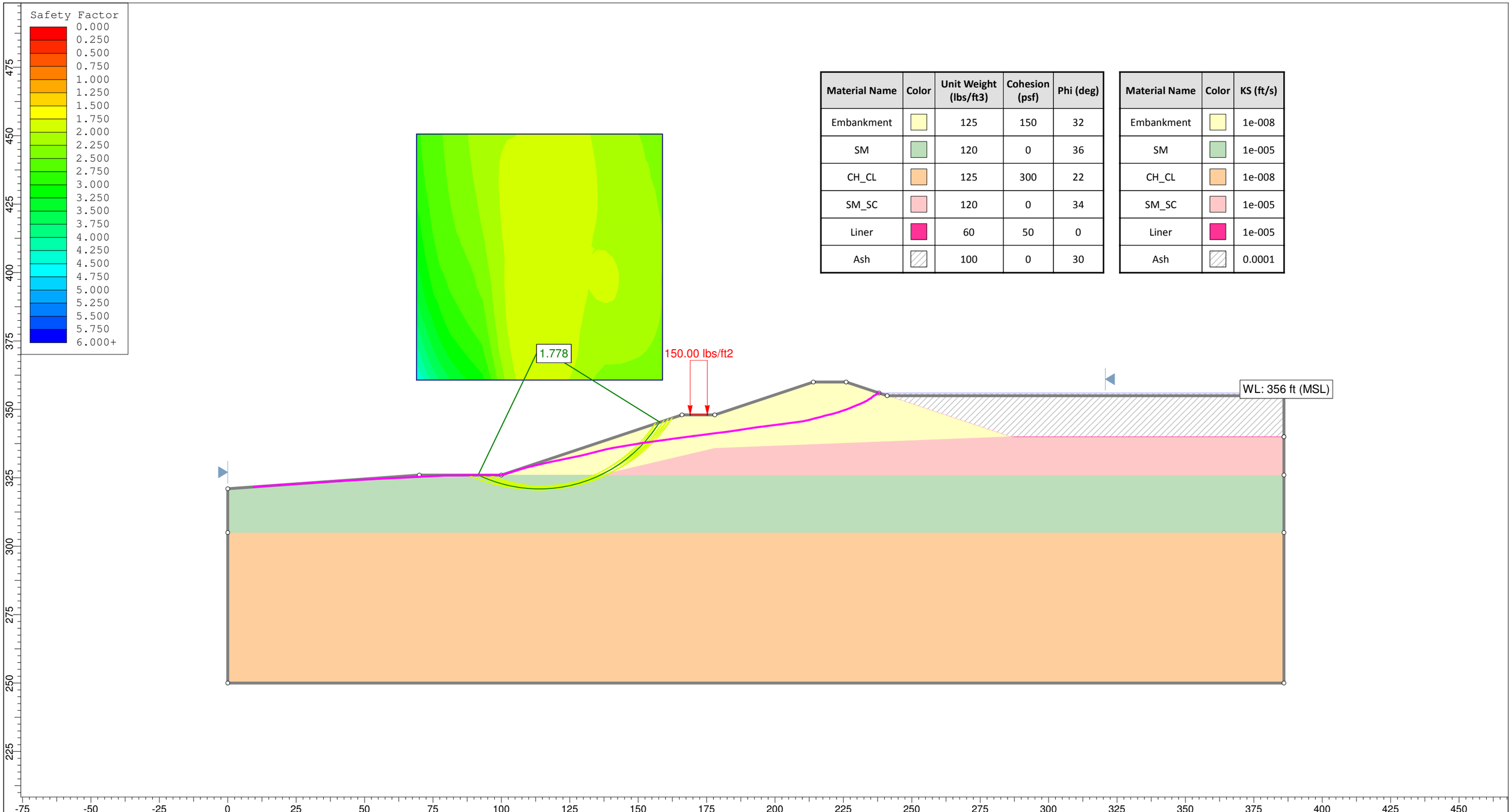
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment		125	250	28
SM		120	0	36
CH_CL		125	450	14
SM_SC		120	0	34
Liner		60	50	0
Ash		100	0	30

Material Name	Color	KS (ft/s)
Embankment		1e-008
SM		1e-005
CH_CL		1e-008
SM_SC		1e-005
Liner		1e-020
Ash		0.0001

Auckland Consulting LLC

SLIDEINTERPRET 6.036

Project	Welsh Power Station - Bottom Ash Pond		
Analysis Description	Steady State Seepage at Maximum and Surcharge Pool, Seismic Analysis		
Drawn By	JJT	*Company*	Auckland
Date	7/11/2016, 3:30:13 PM	*File Name*	Winston_SSS.slim



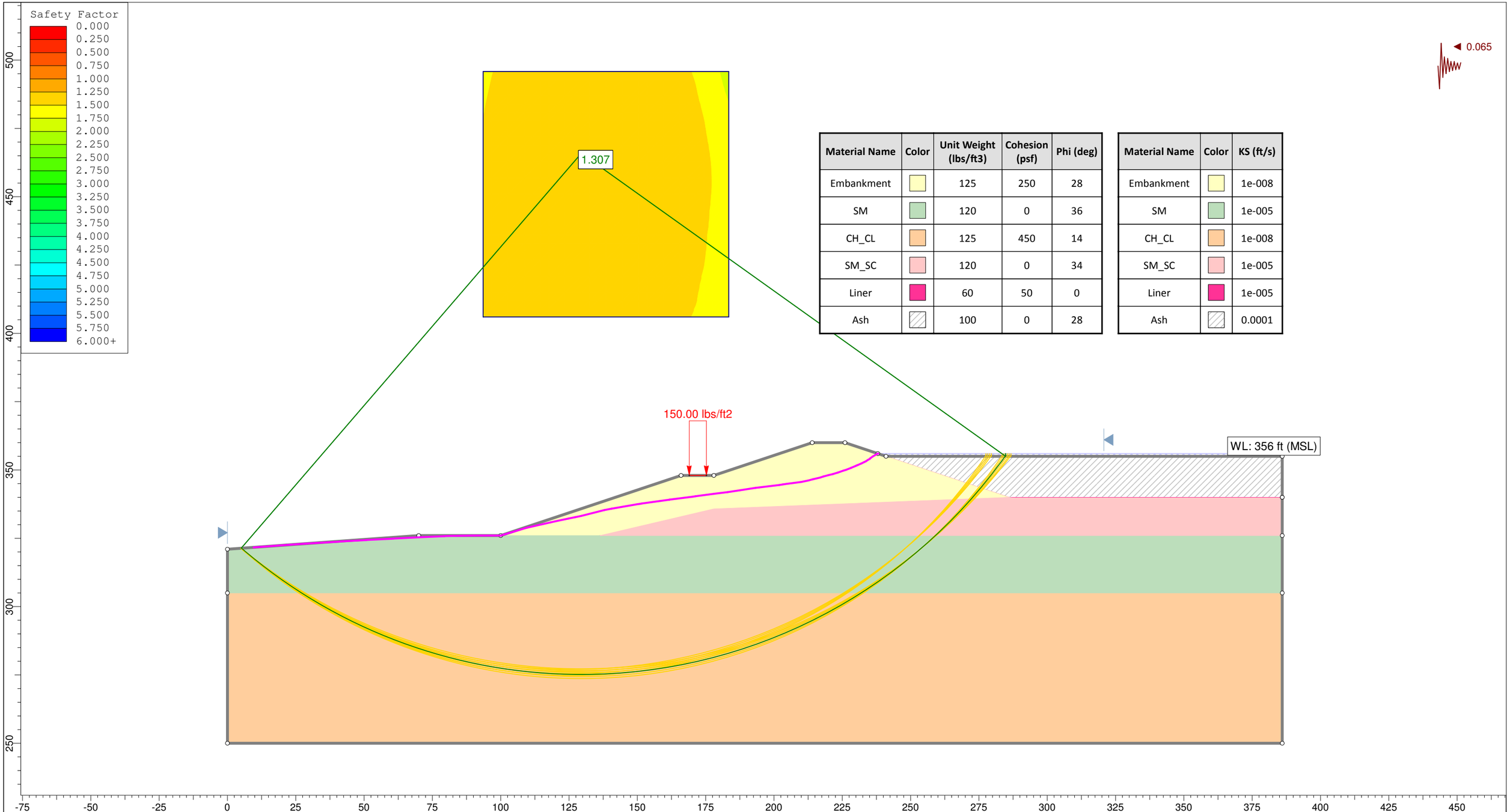
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment		125	150	32
SM		120	0	36
CH_CL		125	300	22
SM_SC		120	0	34
Liner		60	50	0
Ash		100	0	30

Material Name	Color	KS (ft/s)
Embankment		1e-008
SM		1e-005
CH_CL		1e-008
SM_SC		1e-005
Liner		1e-005
Ash		0.0001

Auckland Consulting LLC

SLIDEINTERPRET 6.036

Project	Welsh Power Station - Bottom Ash Pond		
Analysis Description	Steady State Seepage at Maximum and Surcharge Pool (assumed phreatic surface)		
Drawn By	JJT	*Company*	Auckland
Date	7/11/2016, 3:30:13 PM	*File Name*	Winston_SS_L.slim



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Embankment		125	250	28
SM		120	0	36
CH_CL		125	450	14
SM_SC		120	0	34
Liner		60	50	0
Ash		100	0	28

Material Name	Color	KS (ft/s)
Embankment		1e-008
SM		1e-005
CH_CL		1e-008
SM_SC		1e-005
Liner		1e-005
Ash		0.0001

Auckland Consulting LLC

SLIDEINTERPRET 6.036

Project	Welsh Power Station - Bottom Ash Pond		
Analysis Description	Steady State Seepage at Maximum and Surcharge Pool, Seismic Analysis (assumed phreatic surface)		
Drawn By	JJT	*Company*	Auckland
Date	7/11/2016, 3:30:13 PM	*File Name*	Winston_SSS_L.slim

Auckland Consulting LLC

LOG OF BORING B2

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease

Project No.: 2016-007
Drill Date(s): 05/19/2016

GPS Coordinates: N33° 02' 38.1" W94° 50' 42.3"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0			Very Stiff, light gray, red and tan, Sandy Lean Clay (CL), mottled, interbedded sand seams		4.0		57	23	35	18	17	
				- medium stiff, mottled	8								
	5			Stiff, tan with gray and red, Sandy Lean Clay (CL), mottled		N/A							
					14			64	23	34	22	12	
	10			- very stiff, between 11 to 18 ft		3.0	2.5	61	16	36	17	19	114
					15								
	15												
				- hard, between 18 to 20 ft		4.5+							114
	20			- stiff, below 20 ft	15			66	18	38	19	19	
				Medium Dense, light gray with tan, Silt with Sand (ML), with few clay		N/A							
	25			- medium stiff	19			73	17				
▼				Hard, light gray with tan, Lean Clay (CL), interbedded sand seams	40								
	30												
				Very Stiff, light gray with tan, Fat Clay (CH), interbedded sand seams		3.0		98	30	63	31	32	92
	35				18								
				- dark gray, tan and red, with sand inclusions and ferrous partings below 38 ft		3.0							
	40			Boring terminated at 40 feet.									
	45												

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 30 ft during drilling. Water level at 30 feet upon completion. Boring caved to 32 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B3

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease

Project No.: 2016-007
Drill Date(s): 05/18/2016

GPS Coordinates: N33° 02' 39.2" W94° 50' 38.1"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0			Stiff, red, tan and gray, Sandy Lean Clay (CL), mottled	9								
	5			- with interbedded sand seams	13	3.0		59	17	33	16	17	113
	10			- very stiff, tan, gray with red below 10 ft	18	1.5		67	18	39	21	18	111
	15			Very Stiff, red, brown, tan with gray, Lean Clay with Sand (CL), mottled, with interbedded sand seams	16								
	20			- clay with silt and organics (wood debris) at 18 ft	26	4.0	2.2	71	18	42	20	22	109
	25			Medium Dense, gray, Sandy Silt (ML), few organics (wood debris), few clay inclusions	30			61	13				
▽	30			Very Stiff, tan, red and gray, Sandy Lean Clay (CL), mottled with silt	16	N/A		70	19				
▼	35			Medium Dense, light gray and red, Sandy Silt (ML), mottled, few clay inclusions	19			52	12	29	21	8	
	40			Very Stiff, tan, orange and red, Lean Clay (CL), mottled, laminated		N/A		91	29	36	24	12	
	45			Light gray, tan and red, Sandy Silt (ML), mottled, few clay inclusions	35			70	24				
	50			Hard, tan, gray with orange, Sandy Lean Clay (CL) with trace silt, mottled, laminated	34								
	55			Very Stiff, gray, Fat Clay (CH), laminated	29			98	27	53	25	28	
				Boring terminated at 50 feet.									

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 30 ft during drilling. Water level at 33 feet upon completion. Boring caved to 40 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B4

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease

Project No.: 2016-007
Drill Date(s): 06/08/2016

GPS Coordinates: N33° 02' 43.1" W94° 50' 37.1"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0			Stiff, red, brown with gray, Sandy Lean Clay (CL), mottled	9			63	14	38	18	20	
						3.5		44	19	42	25	17	109
	5			Medium Dense, light gray, red and brown, Clayey Sand (SC), mottled, laminated	15								
				Very Stiff, light gray, tan and brown, Sandy Lean Clay (CL), mottled, slickensided		3.5		66	16	33	20	13	
	10				12								
				- stiff, light gray, red and tan, with silt and sand seams below 10 ft	13			62	18				
	15			Medium Dense, light gray and brown, Sandy Silt (ML), mottled, few clay inclusions									
						3.0		55	17	38	20	18	
	20			Very Stiff, brown, gray and red, Sandy Lean Clay (CL), mottled	18								
					10								
	25			- stiff below 23 ft									
				Dense, brown, light gray and red, Silty Sand (SM)		N/A		43	16	NP	NP	NP	
▼	30				37								
				- brown with red, some clay between 30 to 33 ft	46			30	30	NP	NP	NP	
	35			- very dense, light gray with tan below 33 ft									
						N/A							116
	40				48								
					48								
	45												
						N/A		26	19	NP	NP	NP	
	50			Boring terminated at 50 feet.									
	55												

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 32 ft during drilling. Water level at 32 feet upon completion. Boring caved to 40 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B5

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease

Project No.: 2016-007
Drill Date(s): 06/08/2016

GPS Coordinates: N33° 02' 45.0" W94° 50' 33.4"
Surface Elevation: 360 ft, MSL
Drilling Method: Dry Auger

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0			Stiff, red, gray and brown, Sandy Lean Clay (CL), mottled	11	2.0		54	20	40	18	22	
	5			- very stiff with sand lenses below 5 ft		2.5		60	17	44	20	24	119
	10			Very Stiff, light gray and brown, Lean Clay with Sand (CL), mottled	16								
	15			- stiff with sand and organics (root and wood debris) below 13 ft	23	2.0		79	18	35	17	18	110
				Very Stiff, light brown with gray, Sandy Lean Clay (CL), with few organics (root debris)				62	12	30	16	14	
	20			- medium stiff, silt with sand below 18 ft	6								
	25			Medium Dense, light brown, tan with gray, Silty Clayey Sand (SC-SM), mottled, with organics (root debris) between 23 to 25 ft	26	N/A		47	10	31	23	8	
	30			- very dense below 28 ft	34			44	20				
▼	35			Very Dense, light gray with tan, Silt (ML)		N/A		91	27	NP	NP	NP	96
				- sandy silt below 35 ft	68								
	40			Very Dense, light gray with tan, Silty Sand (SM)	96			21	28				
				Boring terminated at 40 feet.									
	45												

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 33 ft during drilling. Water level at 33 feet upon completion. Boring caved to 38 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B6

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease

Project No.: 2016-007
Drill Date(s): 05/17/2016

GPS Coordinates: N33° 02' 43.0" W94° 50' 34.1"
Surface Elevation: 332 ft, MSL (approx)
Drilling Method: Dry Auger

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0			Medium Dense, red, tan and brown, Silt with Sand (ML), mottled	16								
				- with gray	23			73	19	NP	NP	NP	
▼	5			Medium Dense, tan, gray and brown, Silty Sand (SM), mottled		N/A							
▽				- tan and gray below 8 ft	24			45	26	NP	NP	NP	
	10			- very dense between 13 and 30 ft	57								
	15												
					51			47	27				
	20												
				- few clay inclusions below 23 ft	73								
	25												
						N/A		36	29	NP	NP	NP	122
	30			- dense with few clay inclusions between 30 and 33 ft	34								
				- very dense below 33 ft	79								
	35												
				Medium Dense, dark gray, tan and red, Clayey Sand (SC), few silt, trace gypsum	27			39	25	47	21	26	
	40			Boring terminated at 40 feet.									
	45												

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 8 ft during drilling. Water level at 6 feet upon completion. Boring caved to 15 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B7

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease

Project No.: 2016-007
Drill Date(s): 05/17/2016

GPS Coordinates: N33° 02' 40.8" W94° 50' 36.5"
Surface Elevation: 328 ft, MSL (approx)
Drilling Method: Dry Auger

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0			Loose, red, brown and tan, Clayey Sand (SC), few organics	8								
				- medium dense, gray and tan below 3 ft	26			40	22				
▼	5			Dense, tan, gray and red, Silty Sand (SM)	32			31	24	NP	NP	NP	
					47								
	10												
				- light gray with tan, with few clay inclusions between 13 and 18 ft		N/A		31	26	NP	NP	NP	100
	15												
				- medium dense below 18 ft	30								
	20												
				Medium Stiff, tan, orange and brown, Fat Clay (CH), laminated with gypsum	5			92	31	55	22	33	
	25					N/A							
	30			- very stiff below 30 ft	29								
				Hard, dark gray and gray, Lean Clay with Sand (CL), laminated with gypsum	57			73	23	33	18	15	
	35												
					36								
	40			Boring terminated at 40 feet.									
	45												

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 7 ft during drilling. Water level at 6 feet upon completion. Boring caved to 35 feet. N/A: Not Attempted

Auckland Consulting LLC

LOG OF BORING B8

Project Name: Winston Pond Stability Assessment
Project Location: Pittsburg, Texas
Drilling Contractor: C&S Lease

Project No.: 2016-007
Drill Date(s): 05/18/2016

GPS Coordinates: N33° 02' 37.8" W94° 50' 38.0"
Surface Elevation: 338 ft, MSL (approx)
Drilling Method: Dry Auger

Groundwater Elevation (ft)	Depth (feet)	Sample Type	Graphic Log	Material Description	N-Value (Blows/ft)	Pocket Penetrometer (tsf)	Unconfined Strength (tsf)	Passing #200 Sieve (%)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Unit Dry Weight (pcf)
	0			Stiff, gray, red and tan, Sandy Lean Clay (CL), mottled	12	4.5+	1.8	51	18	33	18	15	115
	5			- very stiff between 5 and 8 ft	22								
▽	10			- stiff, gray and light brown, mottled with interbedded sand seams below 8 ft	11			57	23				
	15			Stiff, light brown and gray, Fat Clay (CH), laminated, few ferrous partings	13								
▼	20			- very stiff, dark gray with brown, gypsum below 18 ft	28			60	25	58	32	26	
	25			- laminated with gypsum, interbedded sand seams below 23 ft	22	2.5							
	30				30			88	19	63	32	31	
	35			- hard below 33 ft	38								
	40				34			85	29				
	45			Boring terminated at 40 feet.									

Additional Information/Comments:

Logger: R. Pierson

Notes/Comments: Seepage encountered at 8 ft during drilling. Water level at 16 feet upon completion. Boring caved to 26 feet. N/A: Not Attempted

Auckland Consulting LLC

Boring Log Terms and Symbols

Symbols and Sampler Types

 Thin-walled Tube (Shelby Tube)

 Standard Penetration Test (SPT)

 Auger Sample

 Texas Cone Penetration Test (TCP)

 Observed Static-Water Level

 Observed Free Water (Seepage)

Soil Consistency and Structure

Strength of Fine Grained Soils		
Consistency	**SPT (Blows/ft)**	**UCS (tsf)**
Very Soft	< 2	< 0.25
Soft	2 – 4	0.25 – 0.5
Medium Stiff	4 – 8	0.5 – 1.0
Stiff	8 – 15	1.0 – 2.0
Very Stiff	15 – 30	2.0 – 4.0
Hard	> 30	> 4.0

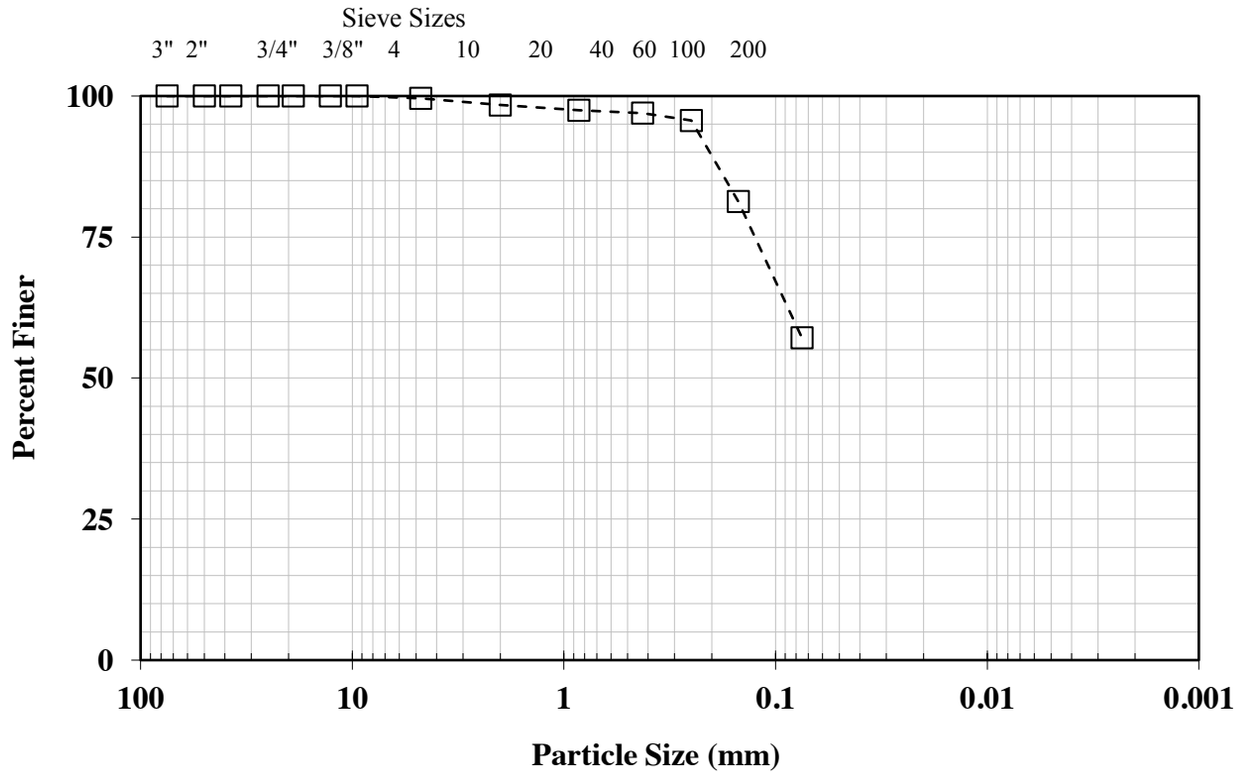
Density of Coarse Grained Soils		
Consistency	**SPT (Blows/ft)**	**TCP (Blows/ft)**
Very Loose	0 – 4	< 8
Loose	5 – 10	9 – 20
Medium Dense	11 – 30	21 – 60
Dense	31 – 50	61 -100
Very Dense	> 50	> 100

Soil Structure - Description	
Description	**Explanation**
Laminated	Alternating layers of varying material or color.
Slickensided	Fractured polished planes, little resistance to fracturing
Blocky	Cohesive soil that can be broken into small angular pieces.
Lensed	Inclusion of small pockets of different soils
Homogeneous	Same appearance and color throughout

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B2 1-3

TRI Log#: 20888.1
Test Method: ASTM D422



Sieve Analysis	
Sieve Size	Percent Passing
3 in. (76.2 mm)	100.0
2 in. (50.8 mm)	100.0
1.5 in. (38.1 mm)	100.0
1 in. (25.4 mm)	100.0
3/4 in. (19.0 mm)	100.0
1/2 in. (12.7 mm)	100.0
3/8 in. (9.51 mm)	100.0
No. 4 (4.76 mm)	99.6
No. 10 (2.00 mm)	98.4
No. 20 (0.841 mm)	97.5
No. 40 (0.420 mm)	97.0
No. 60 (0.250 mm)	95.6
No. 100 (0.149 mm)	81.3
No. 200 (0.074 mm)	57.1
Hydrometer Analysis	
Particle Size	Percent Passing
0.005 mm	- -
0.002 mm	- -

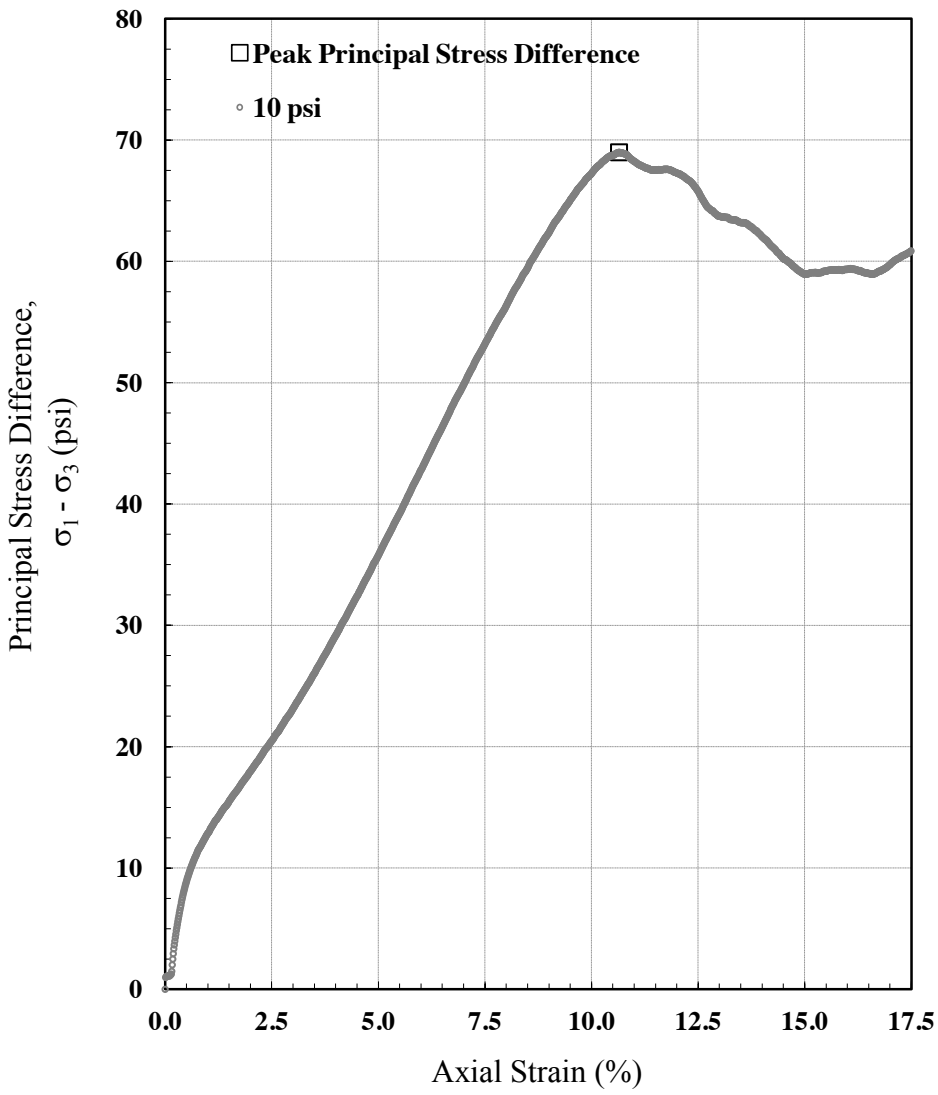
USCS Classification (ASTM D2487)	Sandy lean clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	23.0
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	35
	Plastic Limit	18
	Plastic Index	17
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Unconsolidated-Undrained (Q) Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B2: 11-13

TRI Log #: 20888
Test Method: ASTM D2850



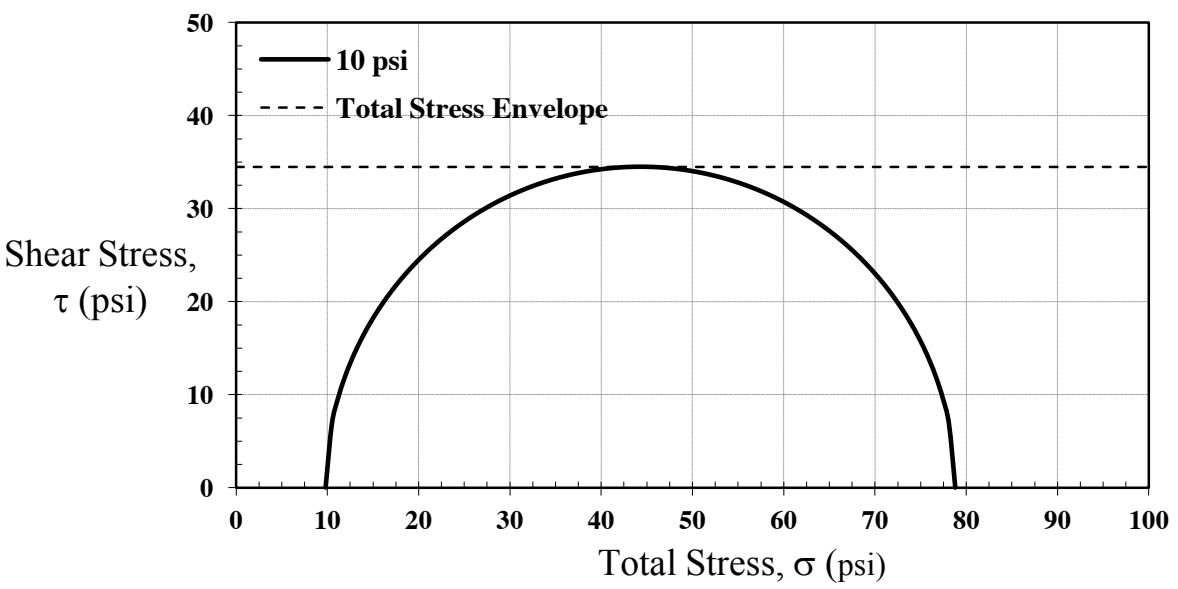
Test Parameters	
Minor Principal Stress (psi)	10.0
Rate of Strain (%/hr)	60

Initial Properties	
Avg. Diameter (in)	2.84
Avg. Height (in)	5.61
Avg. Water Content (%)	15.5
Bulk Density (pcf)	132.1
Dry Density (pcf)	114.4
Saturation (%)	92.0
Void Ratio	0.45
Specific Gravity (Assumed)	2.65

At Failure - Maximum Deviator Stress	
Axial Strain at Failure (%)	10.6
Minor Total Stress (psi)	10.0
Major Total Stress (psi)	79.0
Principal Stress Diff. (psi)	69.0

Total Stress Envelope	
Friction Angle (deg)	0
Undrained Shear Strength, S_u (psi)	34.5
S_u / σ_3	3.4

Note: The Mohr failure envelope was taken as a horizontal straight line. It should, however, be noted that the specimen was partially saturated.



Jeffrey A. Kuhn , Ph.D., P.E., 6/30/2016
Analysis & Quality Review/Date

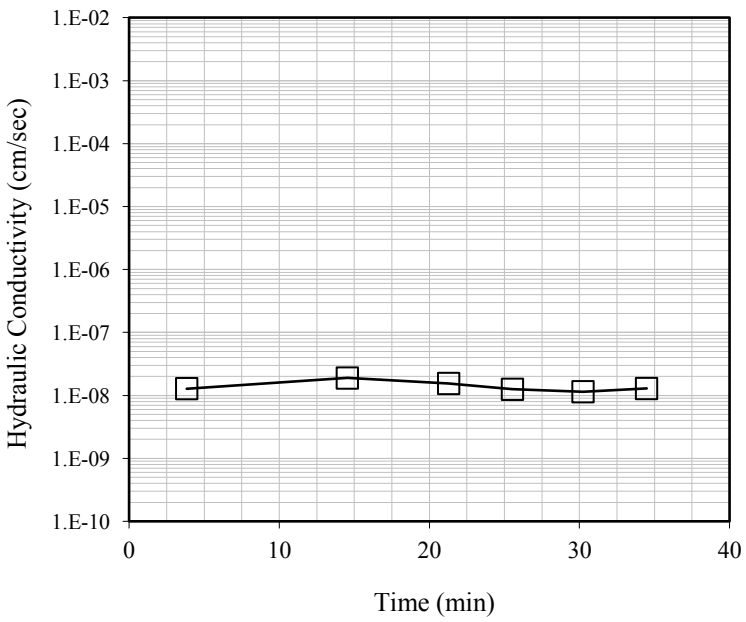
Laboratory Staff: LC

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Hydraulic Conductivity

Client: Auckland Consulting LLC
Project: Winston Pond
Sample ID: B2: 18-20

TRI Log #: 20888
Test Method: ASTM D5084 Method F



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.82
Height (in)	1.81
Initial Mass (g)	389.6
Sample Area (in^2)	6.25
Water Content (%)	15.5
Total Unit Weight (pcf)	131.4
Dry Unit Weight (pcf)	113.8
Specific Gravity (Assumed)	2.65
Degree of Saturation	90.4
Void Ratio	0.45
Porosity	0.31
1 Pore Volume (cc)	57.7
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.96

Specimen Image

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
21.3	1.5E-08
25.5	1.3E-08
30.2	1.1E-08
34.5	1.3E-08
Average, Last 2 Readings	**1.2E-08**

Note: Permeation measurements were made with a mercury U-tube.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Analysis & Quality Review/Date
Testing Performed By: SOC & LC

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B2: 33-35

TRI Log #: 20888
Test Method: ASTM D4767 Mod

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	14.2	28.3	42.5
Initial Specimen Properties			
Avg. Diameter (in)	2.05	2.05	2.05
Avg. Height (in)	4.33	4.33	4.33
Avg. Water Content (%)	30.8	-	-
Bulk Density (pcf)	119.7	119.7	119.7
Dry Density (pcf)	91.5	-	-
Saturation (%)	98.8	-	-
Void Ratio, n	0.84	0.84	0.84
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	79.7	80.0	80.2
B-Value, End of Saturation	0.96	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.82	0.82	0.82
Area (in^2)	3.28	3.28	3.28

Shear / Post-Shear			
Avg. Water Content (%)	-	-	29.7
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	1.0	1.5	1.9
Minor Effective Stress (psi), $\sigma_3'_f$	-	-	-	5.6	11.9	20.5
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	15.8	25.5	34.0
Pore Water Pressure, Δu_f (psi)	-	-	-	9.8	17.2	22.6
Major Effective Stress (psi), $\sigma_1'_f$	-	-	-	21.4	37.4	54.5
Effective Friction Angle (degrees)	-			22.1		
Effective Cohesion (psi)	-			3.3		

R-Envelope, "Total" Stress		
Friction Angle (deg)	-	14.3
Cohesion (psi)	-	2.3

Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

Jeffrey A. Kuhn , Ph.D., P.E., 7/12/2016
Analysis & Quality Review/Date
Laboratory Staff: SOC & LC

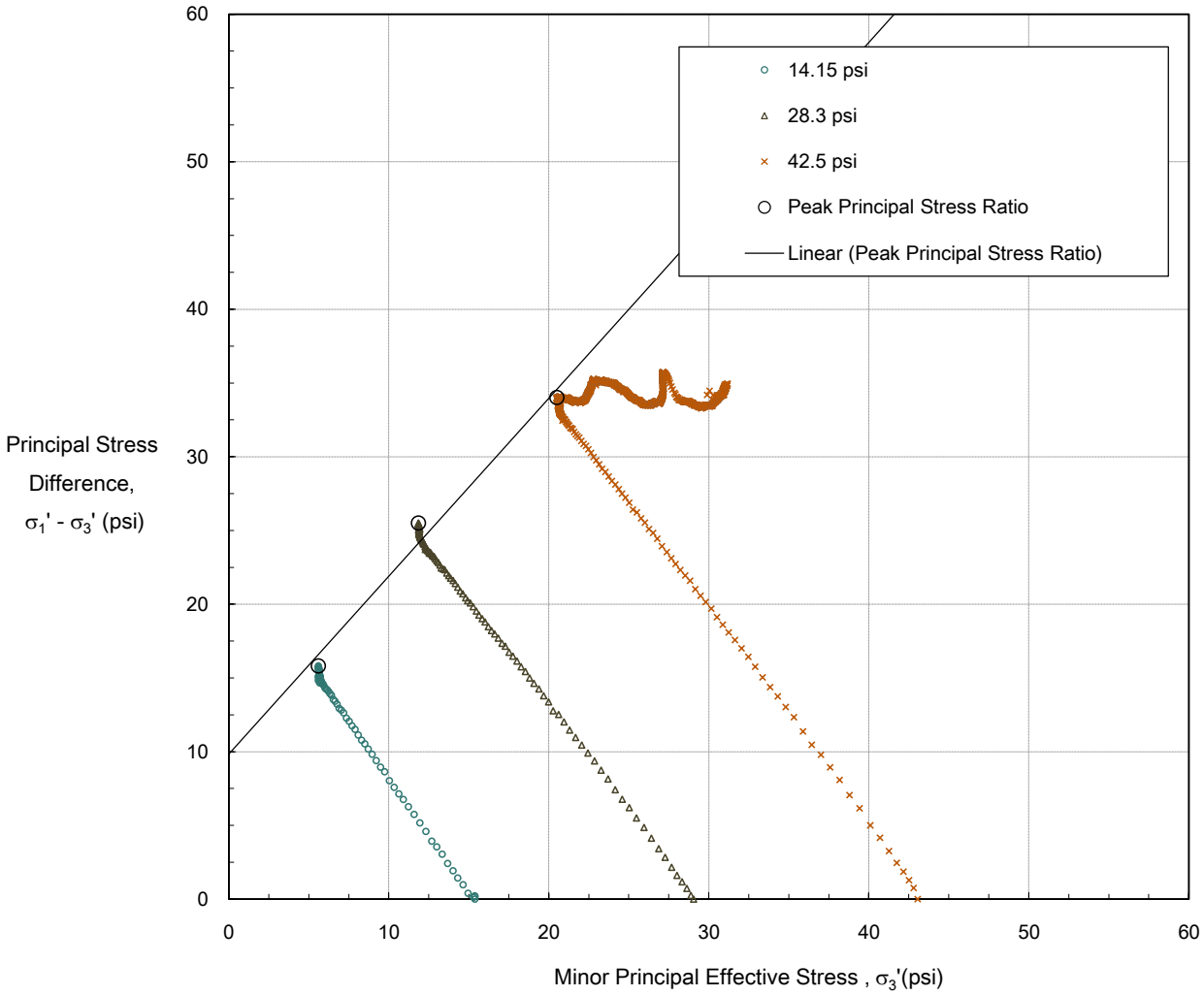
TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B2: 33-35

TRI Log #: 20888
Test Method: ASTM D4767 Mod

Modified Mohr-Coulomb



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	22.1
Effective Cohesion (psi)	-	3.3

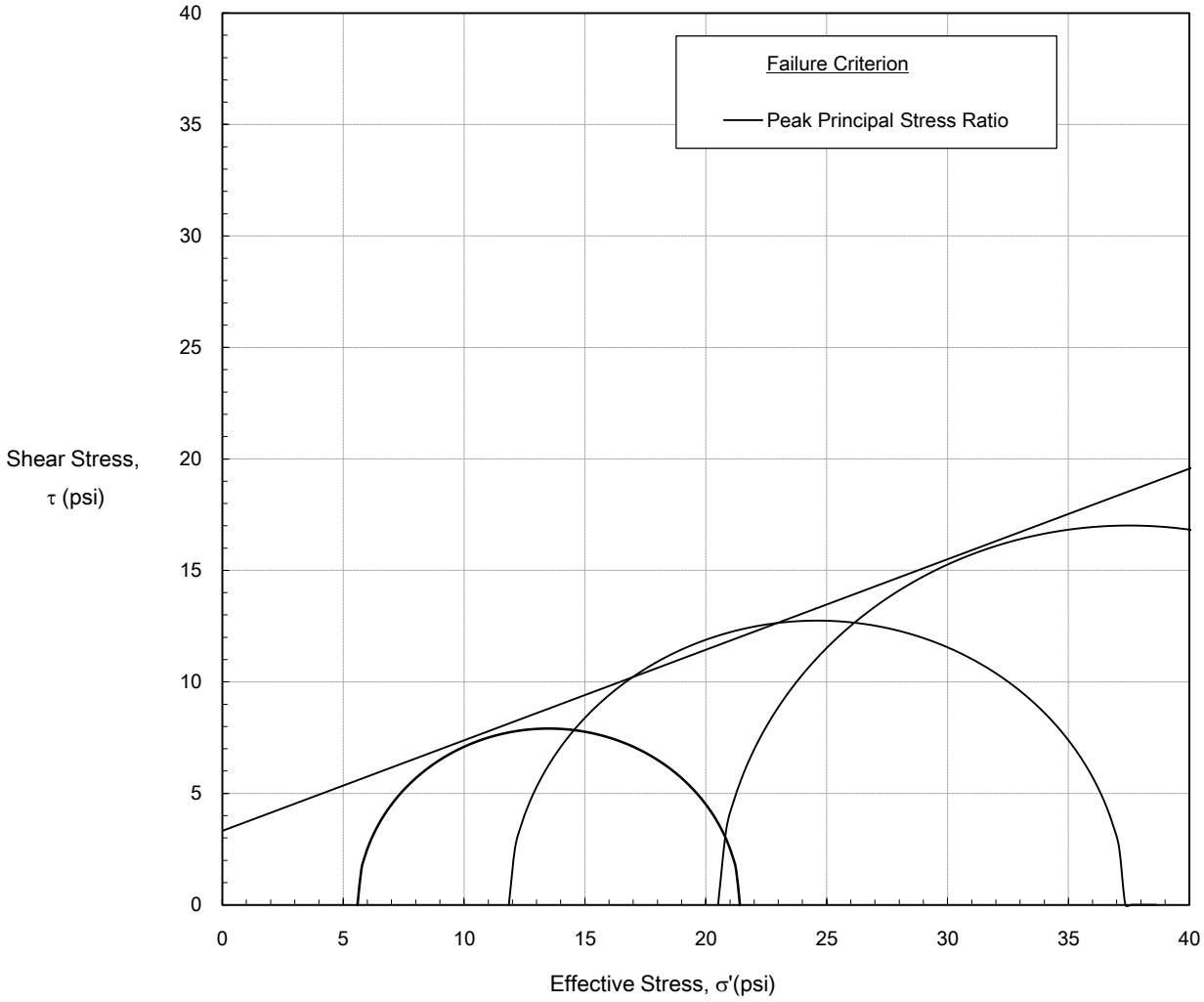
TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B2: 33-35

TRI Log #: 20888
Test Method: ASTM D4767 Mod

Mohr-Coulomb



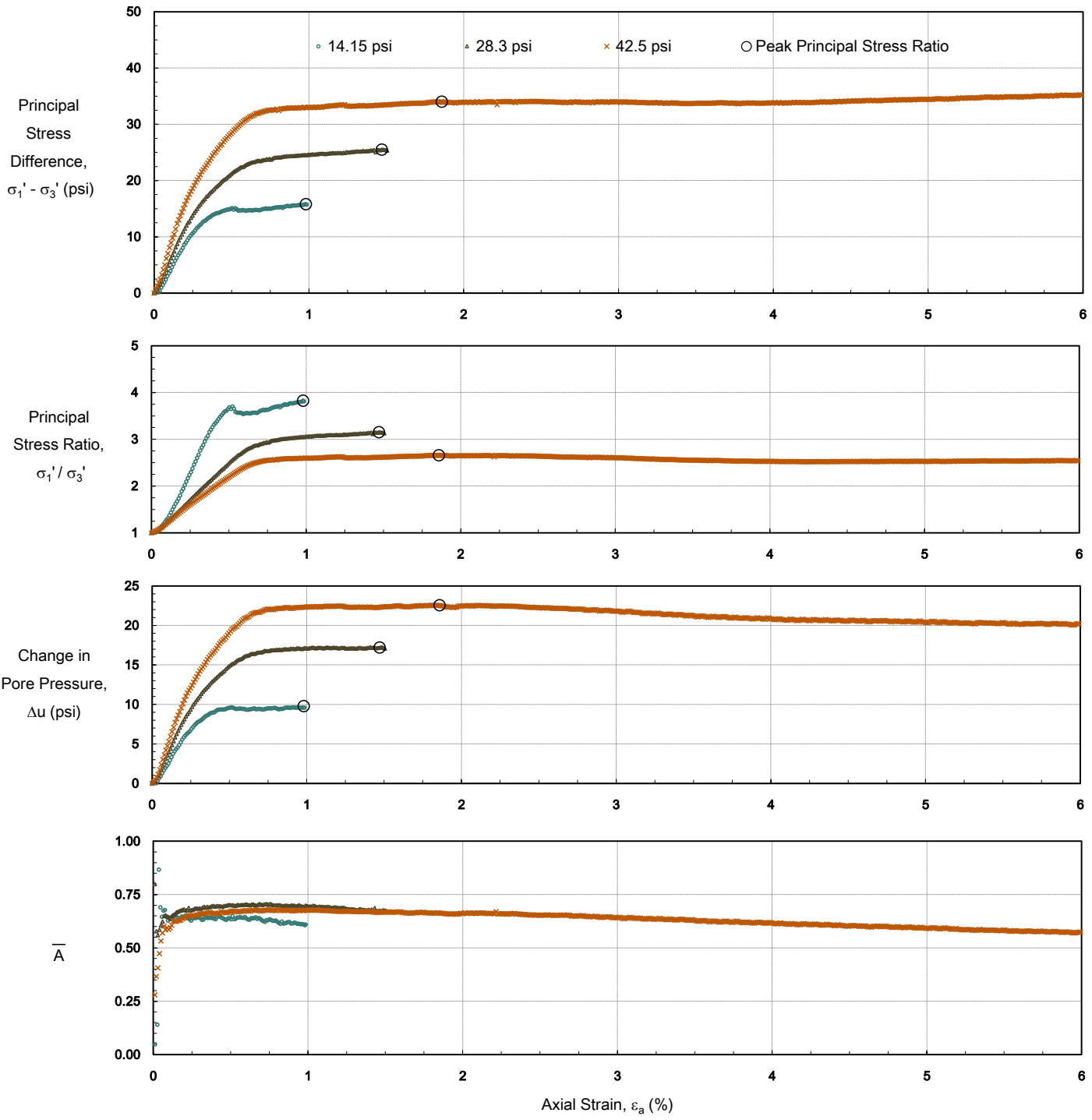
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	22.1
Effective Cohesion (psi)	-	3.3

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B2: 33-35

TRI Log #: 20888
Test Method: ASTM D4767 Mod



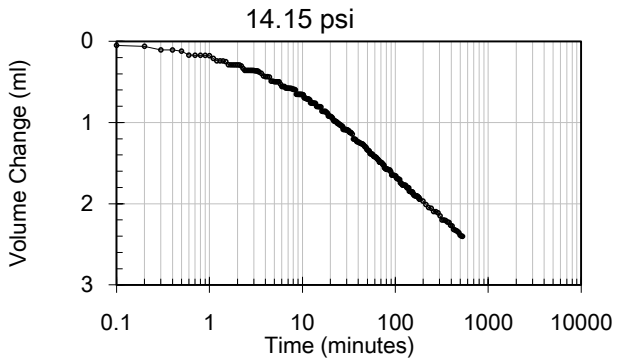
TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

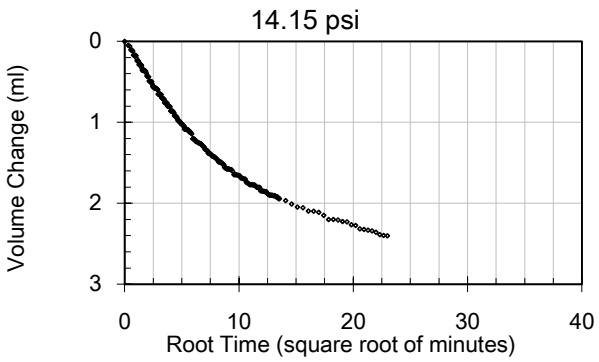
Multi-Stage Consolidated-Undrained Triaxial Compression

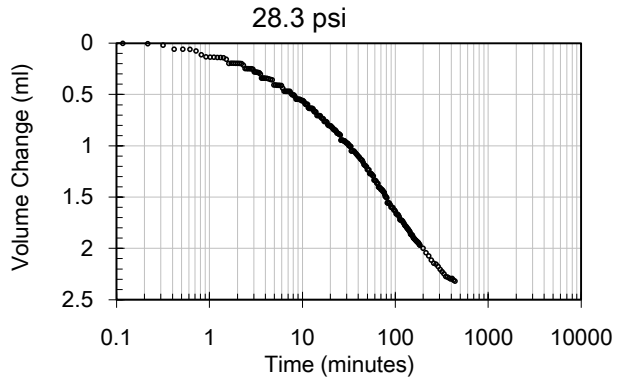
Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B2: 33-35

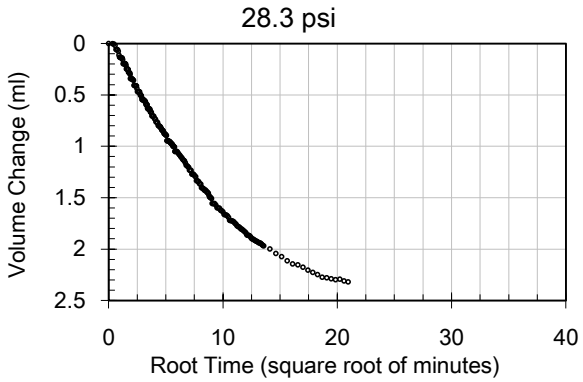
TRI Log #: 20888
Test Method: ASTM D4767 Mod

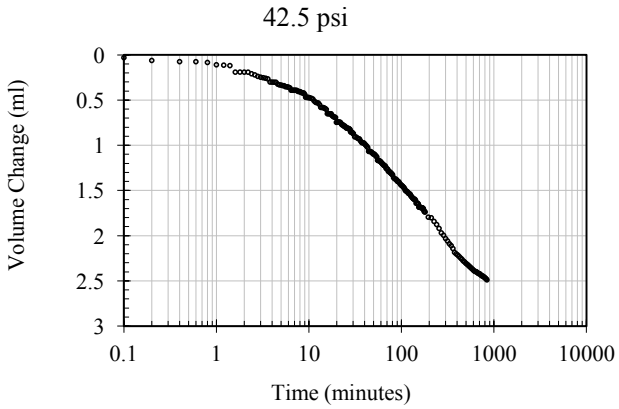
Consolidation

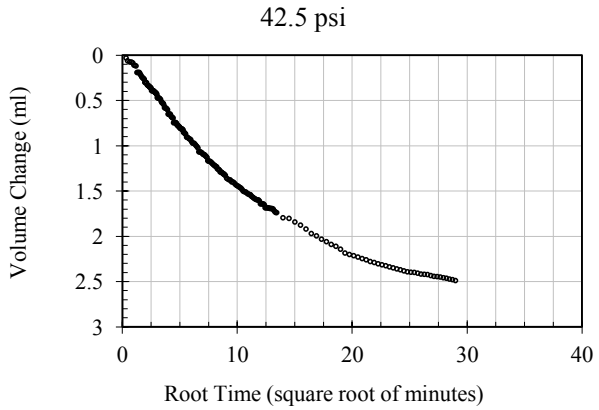










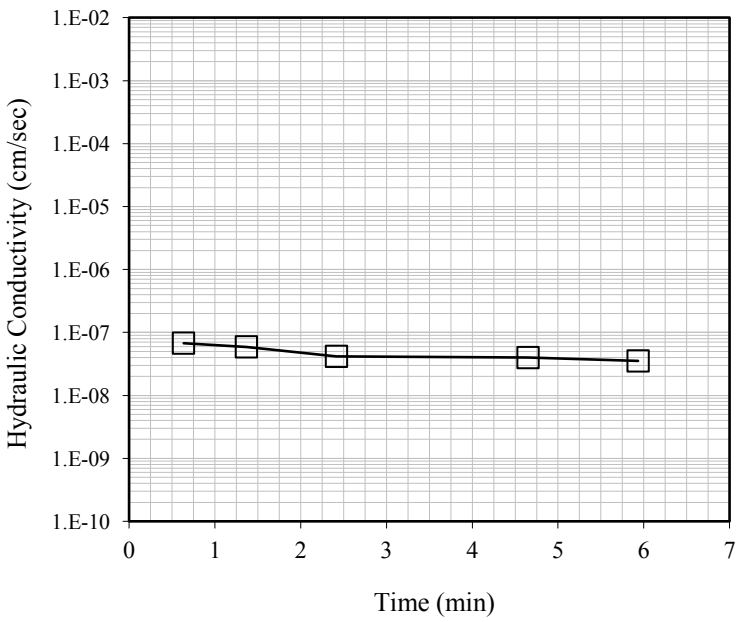


TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Hydraulic Conductivity

Client: Auckland Consulting LLC
Project: Winston Pond
Sample ID: B3: 3-5

TRI Log #: 20888
Test Method: ASTM D5084 Method F



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.83
Height (in)	1.59
Initial Mass (g)	341.8
Sample Area (in^2)	6.28
Water Content (%)	15.9
Total Unit Weight (pcf)	130.4
Dry Unit Weight (pcf)	112.6
Specific Gravity (Assumed)	2.65
Degree of Saturation	89.6
Void Ratio	0.47
Porosity	0.32
1 Pore Volume (cc)	52.2
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.96

Specimen Image

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
1.4	5.9E-08
2.4	4.2E-08
4.6	4.0E-08
5.9	3.5E-08
Average, Last 2 Readings	**3.8E-08**

Note: Permeation measurements were made with a mercury U-tube.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Analysis & Quality Review/Date
Testing Performed By: SOC & LC

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

TRI Log #: 20888
Test Method: ASTM D4767 Mod

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	3.8	7.5	15.0
Initial Specimen Properties			
Avg. Diameter (in)	2.05	2.05	2.05
Avg. Height (in)	4.46	4.46	4.46
Avg. Water Content (%)	17.8	-	-
Bulk Density (pcf)	130.1	130.1	130.1
Dry Density (pcf)	110.5	-	-
Saturation (%)	91.3	-	-
Void Ratio, n	0.53	0.53	0.53
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	81.1	81.1	81.1
B-Value, End of Saturation	1.00	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.51	0.51	0.51
Area (in^2)	3.27	3.27	3.26

Shear / Post-Shear			
Avg. Water Content (%)	-	-	19.9
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	1.0	0.8	2.7
Minor Effective Stress (psi), $\sigma_3'_f$	-	-	-	2.2	4.4	10.1
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	7.0	11.6	28.5
Pore Water Pressure, Δu_f (psi)	-	-	-	1.6	3.1	4.9
Major Effective Stress (psi), $\sigma_1'_f$	-	-	-	9.2	16.0	38.6
Effective Friction Angle (degrees)	-			35.1		
Effective Cohesion (psi)	-			0.1		

R-Envelope, "Total" Stress		
Friction Angle (deg)	-	28.5
Cohesion (psi)	-	0 (Forced)

Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

Jeffrey A. Kuhn , Ph.D., P.E., 7/13/2016
Analysis & Quality Review/Date
Laboratory Staff: SOC & LC

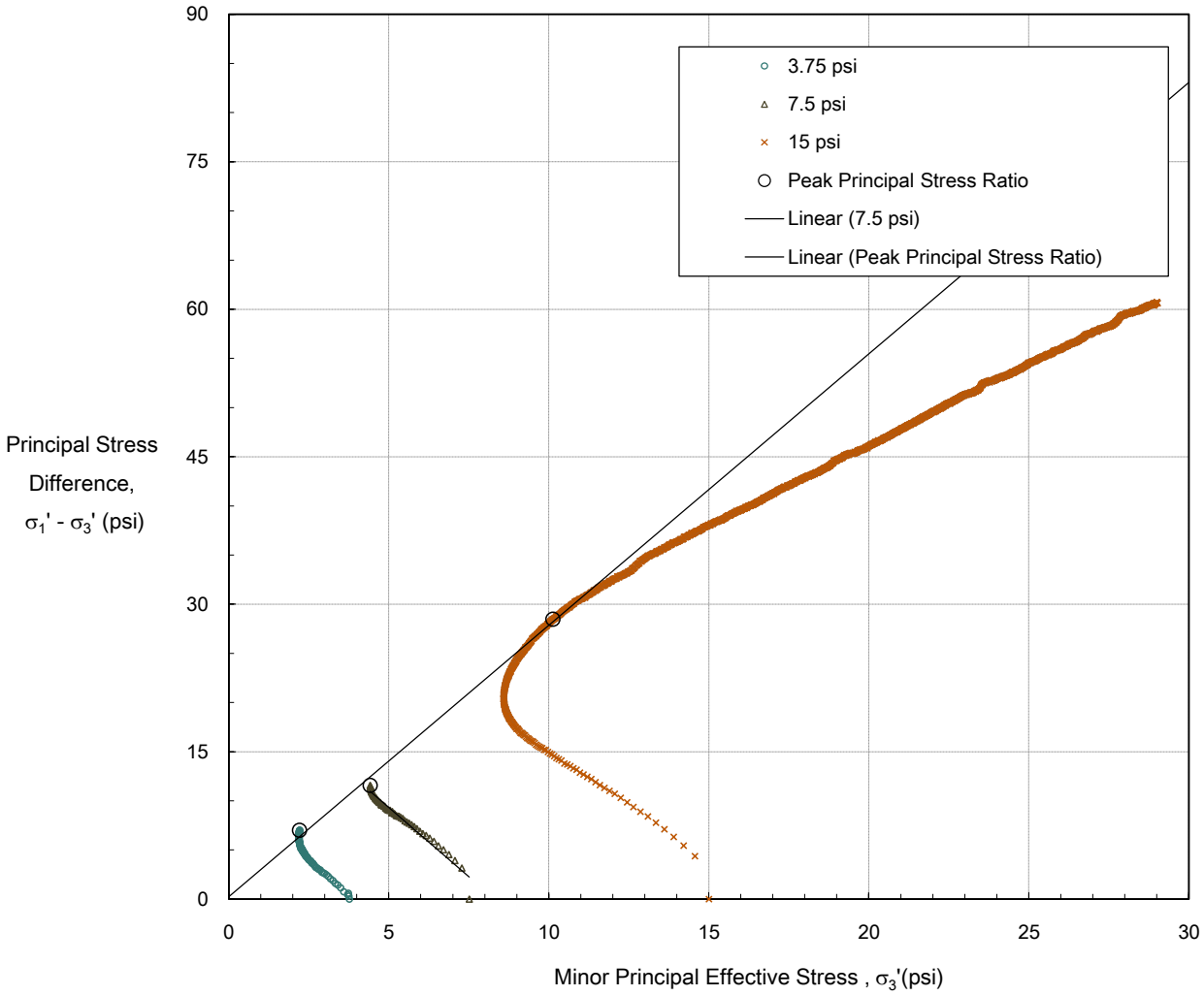
TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

TRI Log #: 20888
Test Method: ASTM D4767 Mod

Modified Mohr-Coulomb



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	35.1
Effective Cohesion (psi)	-	0.1

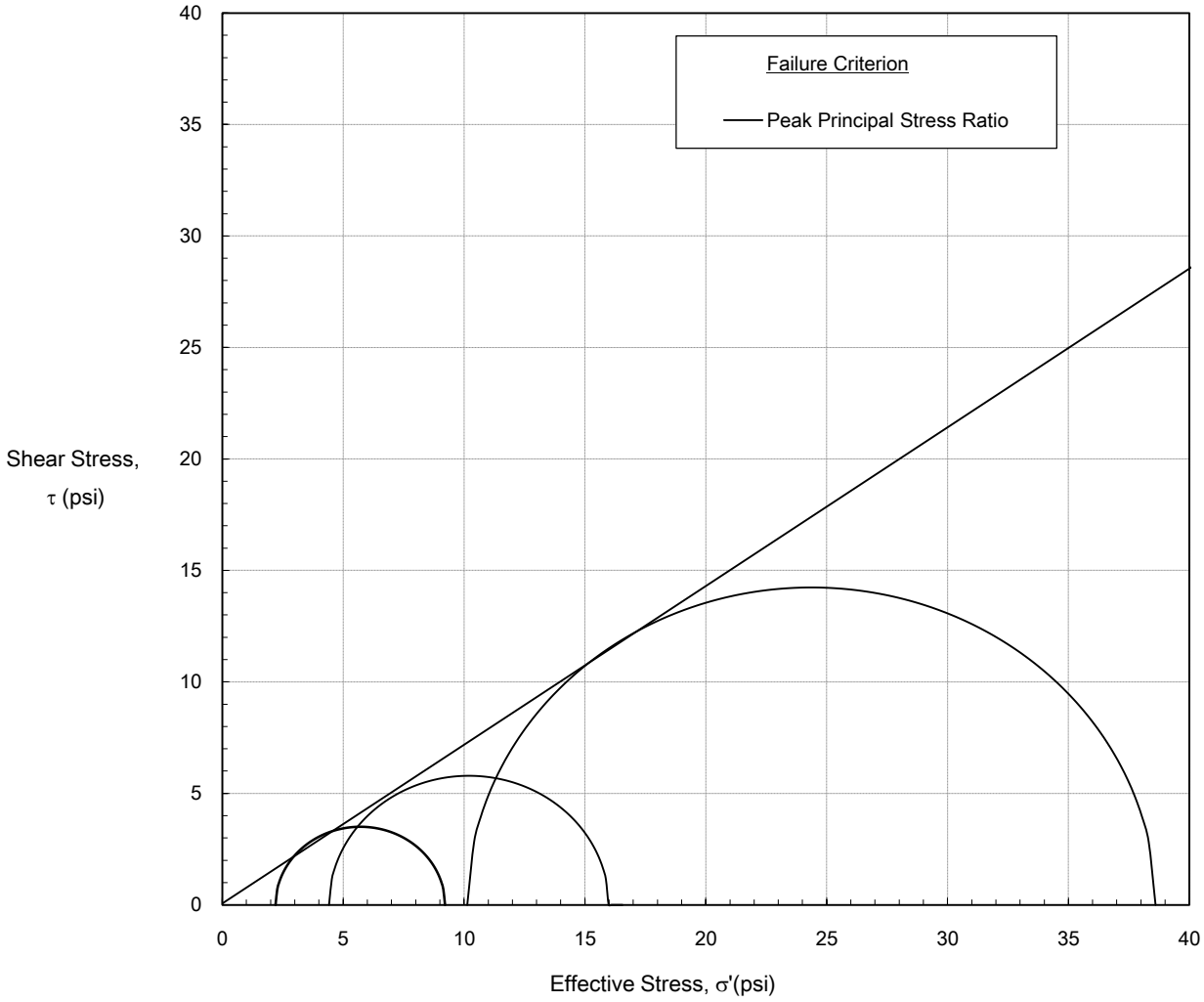
TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

TRI Log #: 20888
Test Method: ASTM D4767 Mod

Mohr-Coulomb



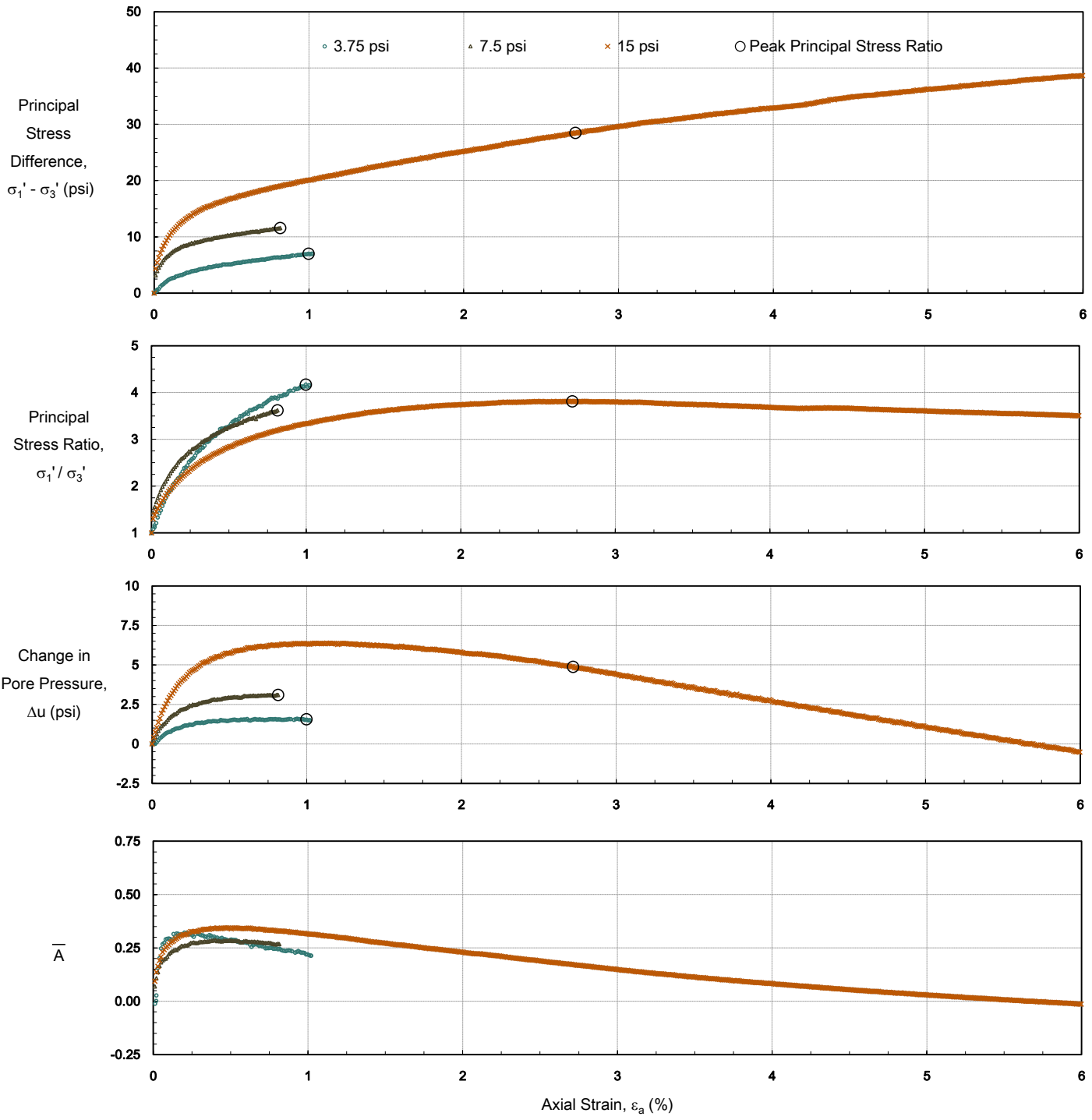
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	35.1
Effective Cohesion (psi)	-	0.1

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

TRI Log #: 20888
Test Method: ASTM D4767 Mod



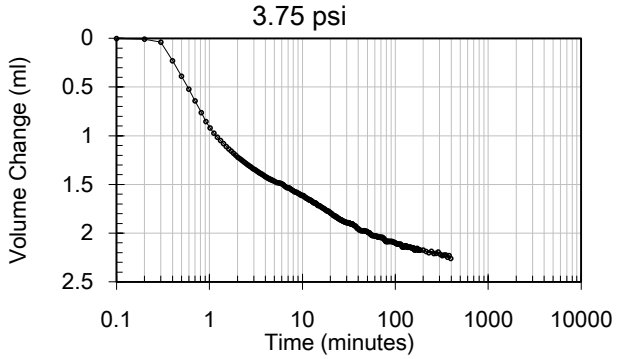
TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

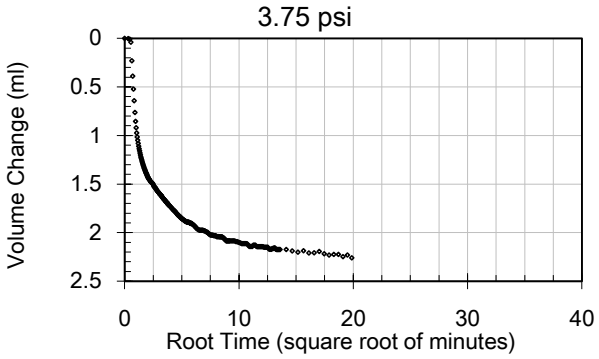
Multi-Stage Consolidated-Undrained Triaxial Compression

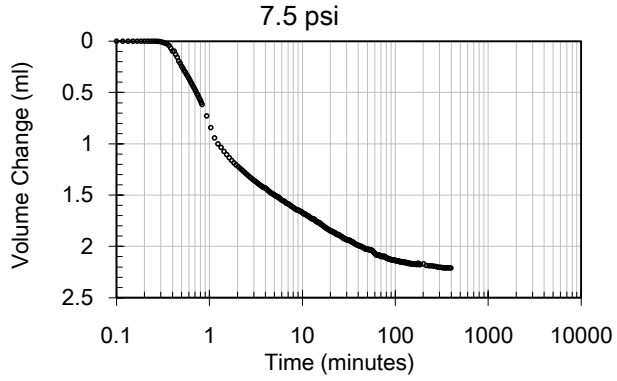
Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 8-10

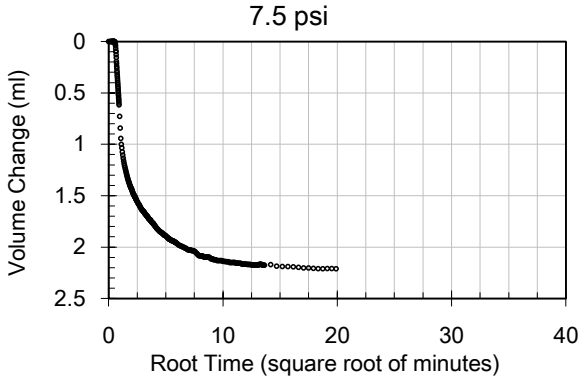
TRI Log #: 20888
Test Method: ASTM D4767 Mod

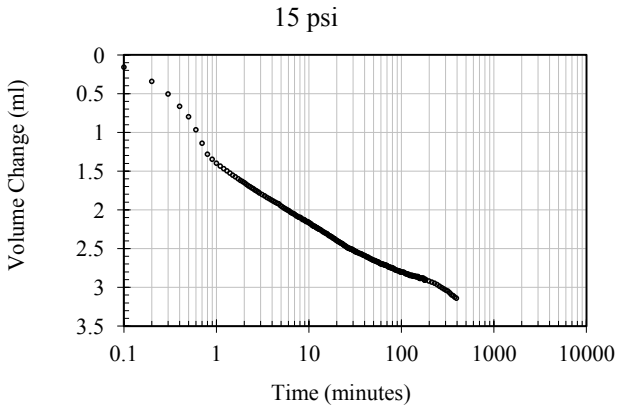
Consolidation

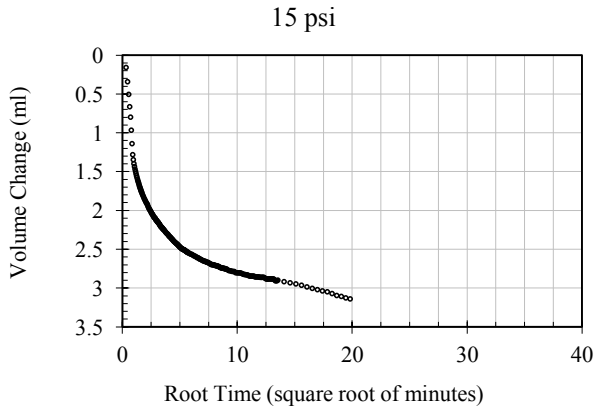










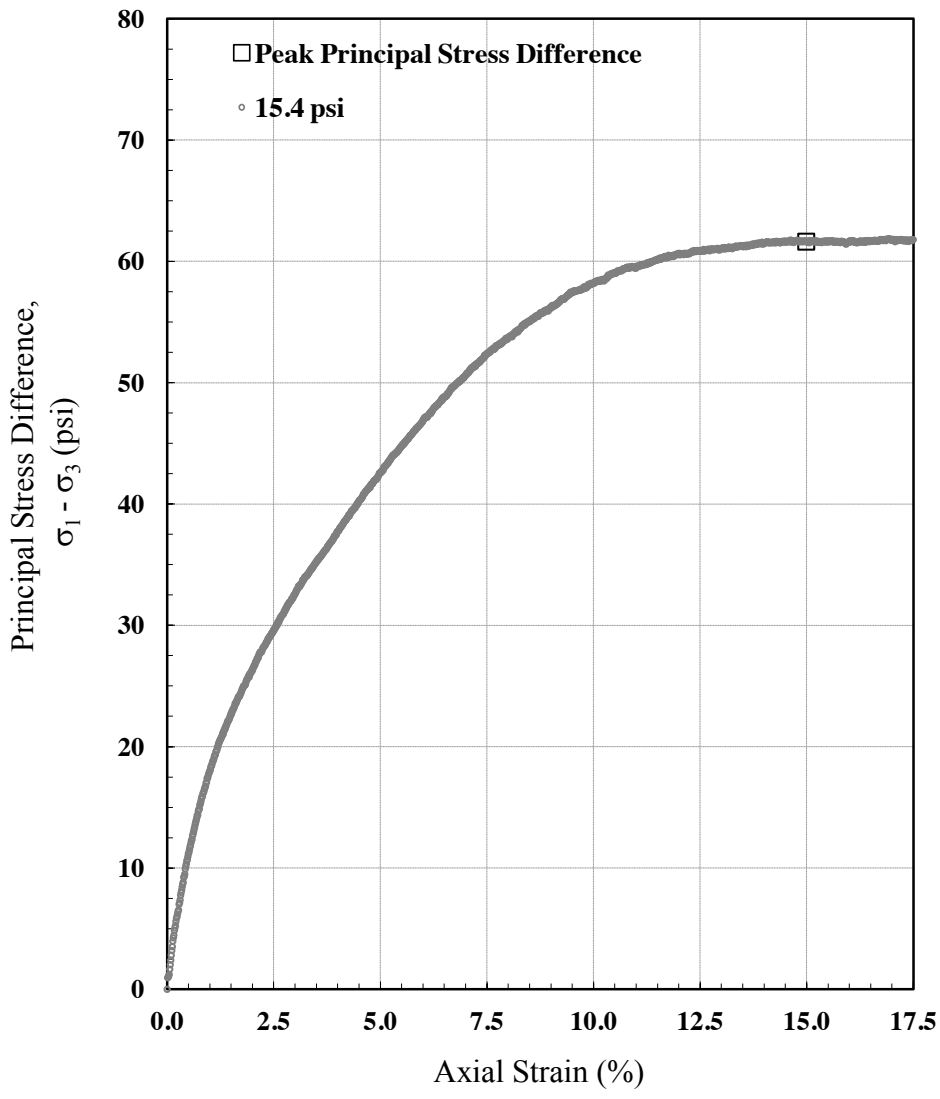


TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Unconsolidated-Undrained (Q) Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3: 18-19

TRI Log #: 20888
Test Method: ASTM D2850



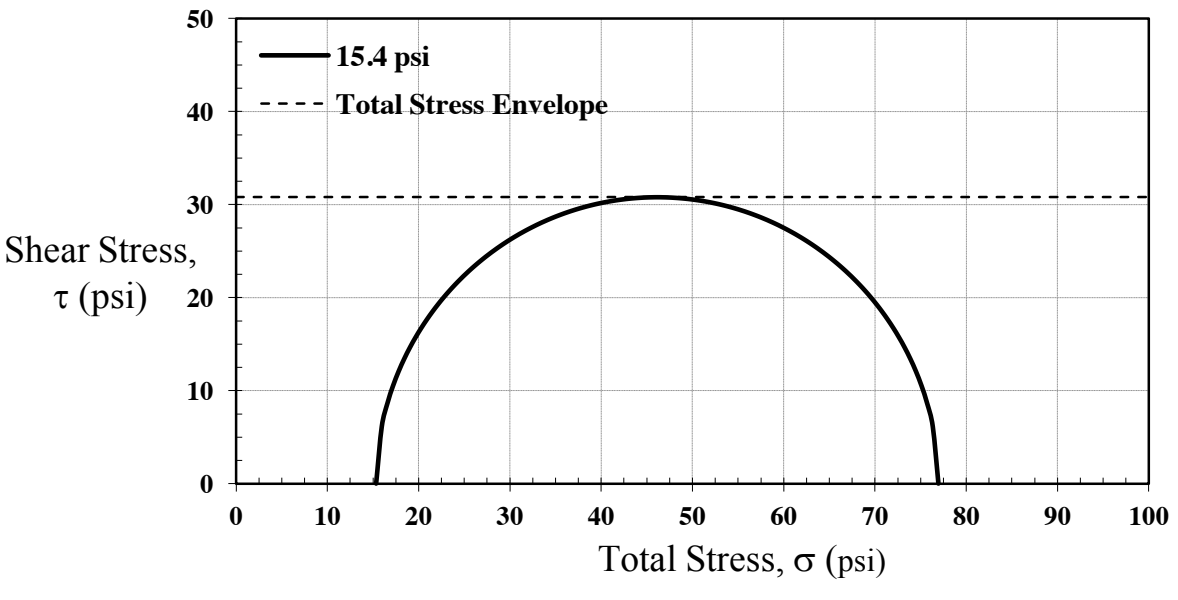
Test Parameters	
Minor Principal Stress (psi)	15.4
Rate of Strain (%/hr)	60

Initial Properties	
Avg. Diameter (in)	1.31
Avg. Height (in)	2.55
Avg. Water Content (%)	18.6
Bulk Density (pcf)	129.6
Dry Density (pcf)	109.2
Saturation (%)	95.9
Void Ratio	0.51
Specific Gravity (Assumed)	2.65

At Failure - Maximum Deviator Stress	
Axial Strain at Failure (%)	15.0
Minor Total Stress (psi)	15.4
Major Total Stress (psi)	77.0
Principal Stress Diff. (psi)	61.6

Total Stress Envelope	
Friction Angle (deg)	0
Undrained Shear Strength, S_u (psi)	30.8
S_u / σ_3	2.0

Note: The Mohr failure envelope was taken as a horizontal straight line. It should, however, be noted that the specimen was partially saturated.



Jeffrey A. Kuhn , Ph.D., P.E., 6/30/2016
Analysis & Quality Review/Date

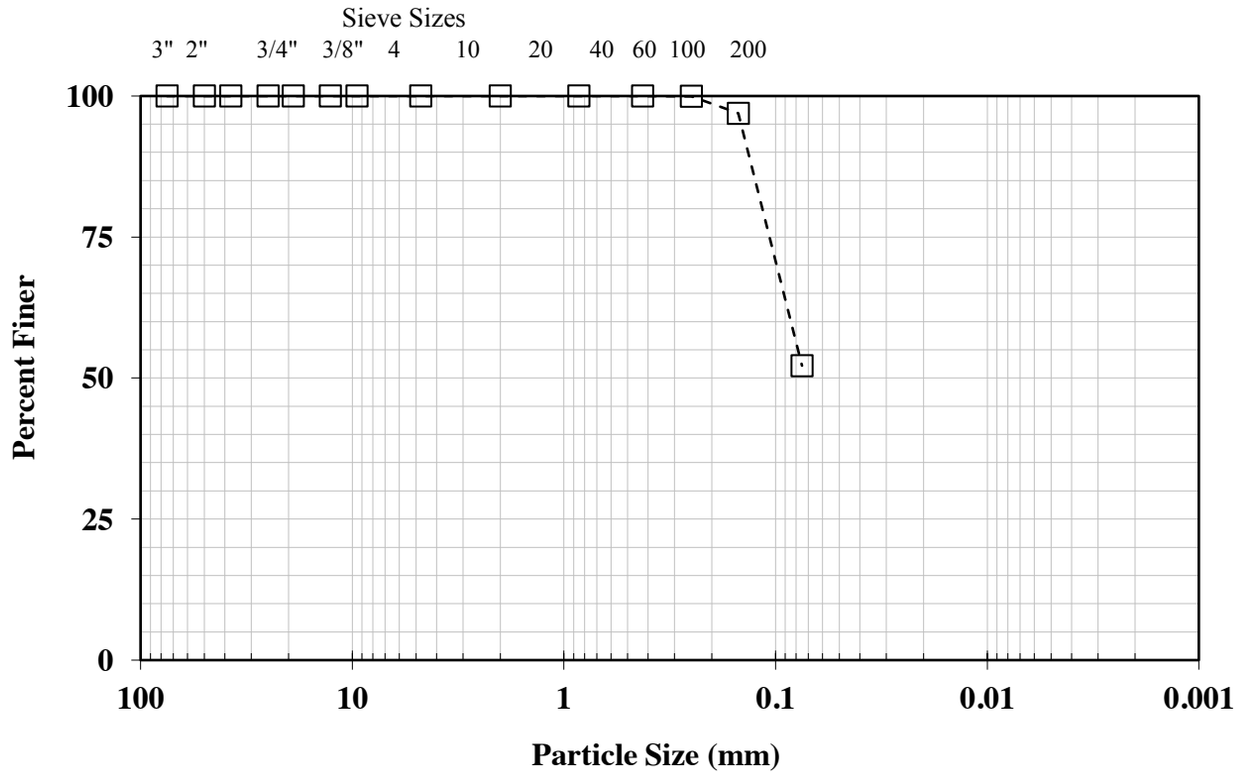
Laboratory Staff: LC

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B3 28-30

TRI Log#: 20888.13
Test Method: ASTM D422



Sieve Analysis		
Sieve Size		Percent Passing
3 in.	(76.2 mm)	100.0
2 in.	(50.8 mm)	100.0
1.5 in.	(38.1 mm)	100.0
1 in.	(25.4 mm)	100.0
3/4 in.	(19.0 mm)	100.0
1/2 in.	(12.7 mm)	100.0
3/8 in.	(9.51 mm)	100.0
No. 4	(4.76 mm)	100.0
No. 10	(2.00 mm)	100.0
No. 20	(0.841 mm)	100.0
No. 40	(0.420 mm)	100.0
No. 60	(0.250 mm)	99.9
No. 100	(0.149 mm)	96.9
No. 200	(0.074 mm)	52.2
Hydrometer Analysis		
Particle Size		Percent Passing
0.005 mm		- -
0.002 mm		- -

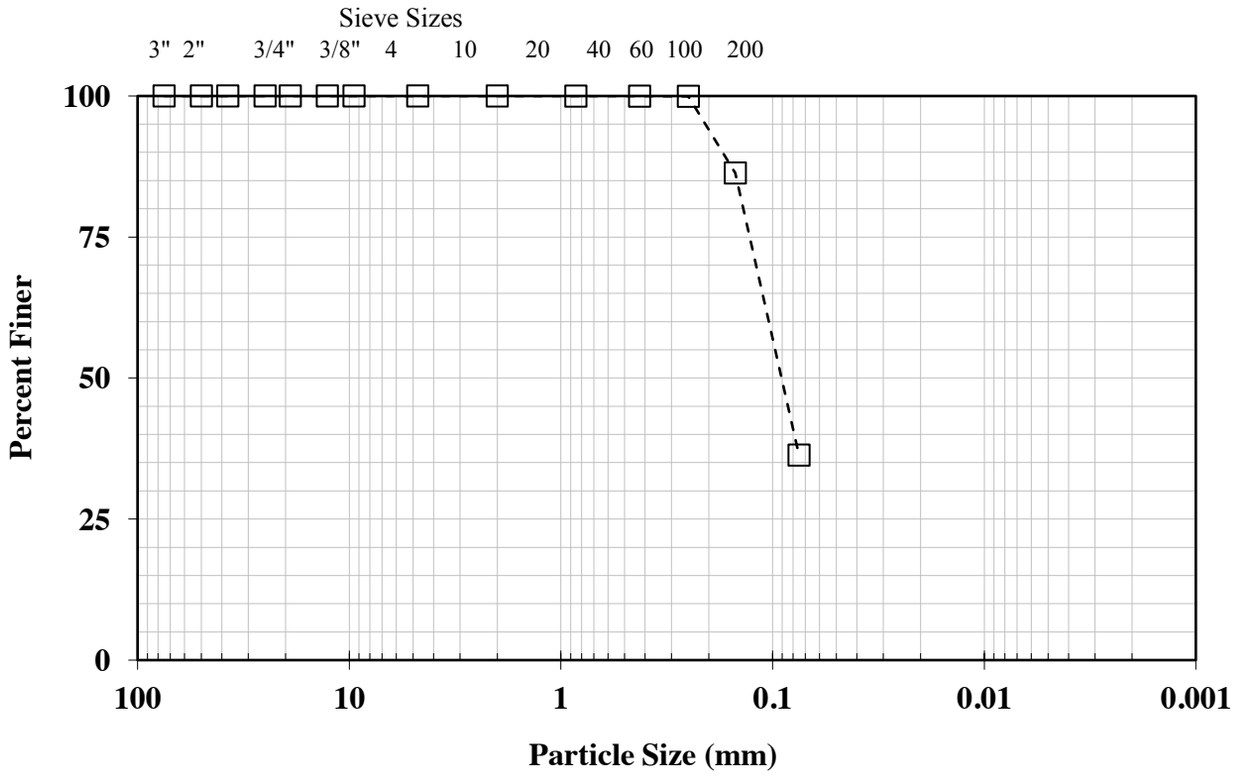
USCS Classification (ASTM D2487)	Sandy lean clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	11.9
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	29
	Plastic Limit	21
	Plastic Index	8
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B6: 28-30

TRI Log#: 20888.20
Test Method: ASTM D422



Sieve Analysis		
Sieve Size		Percent Passing
3 in.	(76.2 mm)	100.0
2 in.	(50.8 mm)	100.0
1.5 in.	(38.1 mm)	100.0
1 in.	(25.4 mm)	100.0
3/4 in.	(19.0 mm)	100.0
1/2 in.	(12.7 mm)	100.0
3/8 in.	(9.51 mm)	100.0
No. 4	(4.76 mm)	100.0
No. 10	(2.00 mm)	100.0
No. 20	(0.841 mm)	100.0
No. 40	(0.420 mm)	100.0
No. 60	(0.250 mm)	99.9
No. 100	(0.149 mm)	86.3
No. 200	(0.074 mm)	36.3
Hydrometer Analysis		
Particle Size		Percent Passing
0.005 mm		- -
0.002 mm		- -

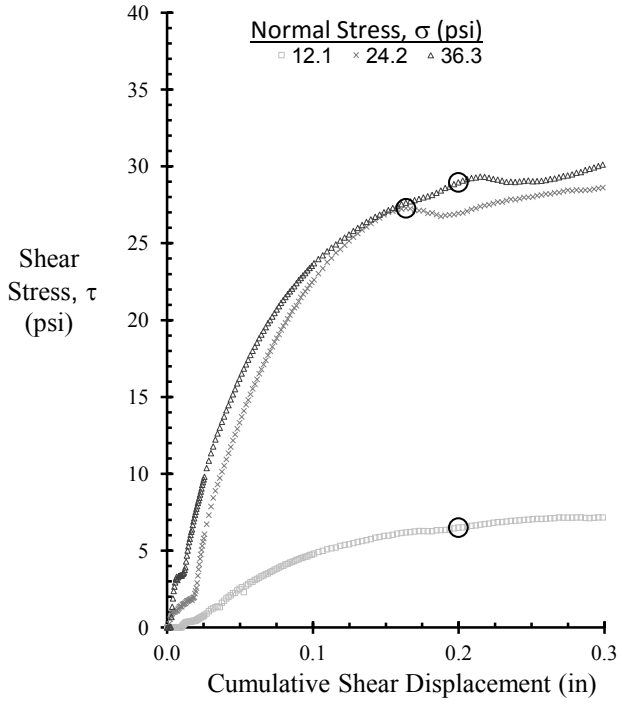
USCS Classification (ASTM D2487)	Silty sand (SM)	
As-Received Moisture Content (%)	(ASTM D2216)	28.9
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	25
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

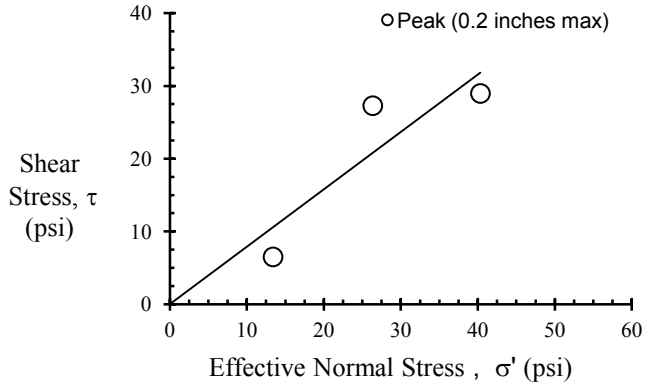
Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Direct Shear of Soil Under Consolidated-Drained Conditions

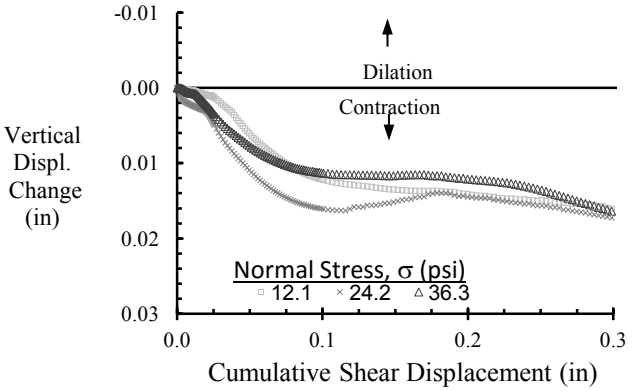
Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B6: 28-30

TRI Log#: 20888
Test Method: ASTM D 3080





Note: Area Correction Has Been Applied



Sample Number		1	2	3
Initial Condition	Diameter, in	2.50	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	29.9	27.7	28.8
	Saturation, %	225.9	223.9	225.0
	Dry Density, pcf	122.4	124.5	123.4
	Void Ratio	0.35	0.33	0.34
Post Consol	Height, in (prior to shear)	0.94	0.96	0.97
	Final Water Content, %	25.5	21.5	21.9
	Dry Density, pcf	130.9	129.3	126.6
	Void Ratio	0.26	0.28	0.31
Displacement rate (in/min)		2.0E-03	2.0E-03	2.0E-03
Peak (0.2 inches)	Normal Stress, σ' (psi)	13.40	26.36	40.34
	Shear Stress, τ (psi)	6.50	27.28	28.96
	Displacement (in)	0.20	0.16	0.20
	ϕ'_d, degrees	38.3		
	c'_d, psi	0 (Forced)		

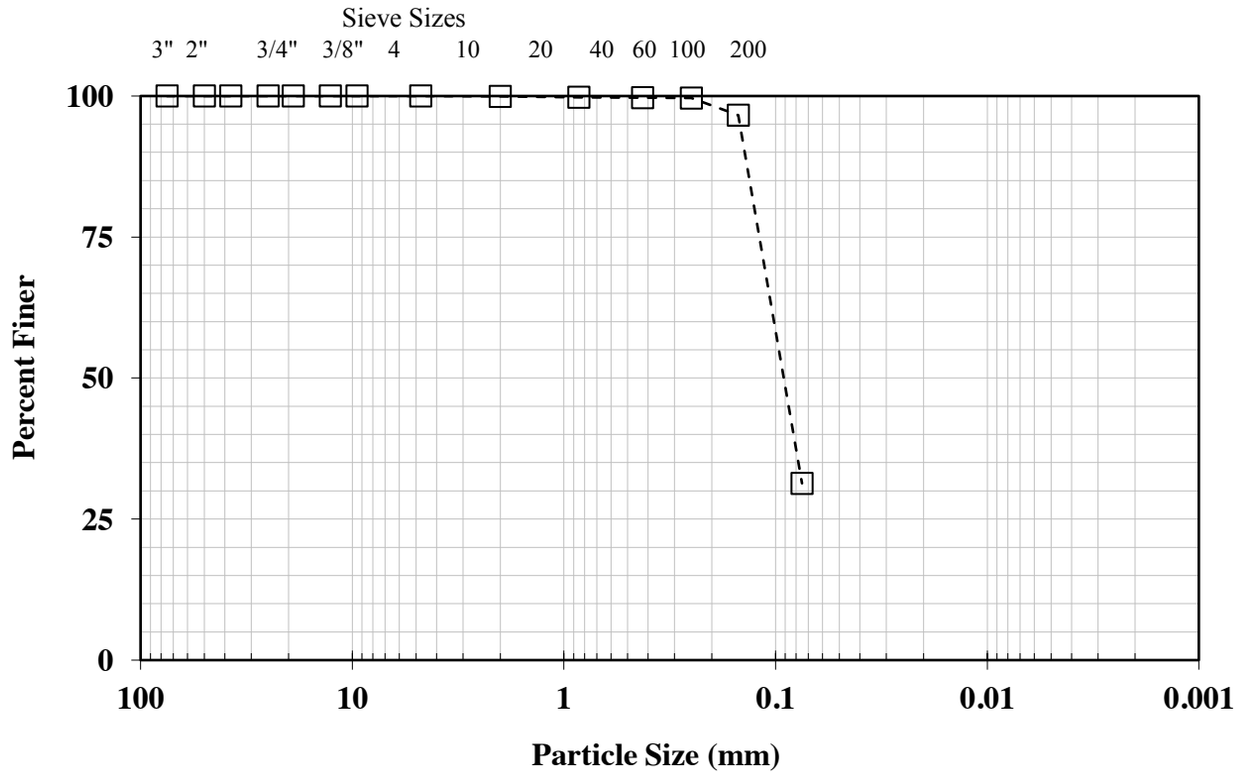
Note: The loose sample was tamped in place. A specific gravity of 2.65 was assumed for weight-volume calculations.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/16
Analysis & Quality Review/Date
Test Performed By: LC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B7 13-15

TRI Log#: 20888.24
Test Method: ASTM D422



Sieve Analysis		
Sieve Size		Percent Passing
3 in.	(76.2 mm)	100.0
2 in.	(50.8 mm)	100.0
1.5 in.	(38.1 mm)	100.0
1 in.	(25.4 mm)	100.0
3/4 in.	(19.0 mm)	100.0
1/2 in.	(12.7 mm)	100.0
3/8 in.	(9.51 mm)	100.0
No. 4	(4.76 mm)	100.0
No. 10	(2.00 mm)	99.9
No. 20	(0.841 mm)	99.8
No. 40	(0.420 mm)	99.7
No. 60	(0.250 mm)	99.6
No. 100	(0.149 mm)	96.6
No. 200	(0.074 mm)	31.3
Hydrometer Analysis		
Particle Size		Percent Passing
0.005 mm		- -
0.002 mm		- -

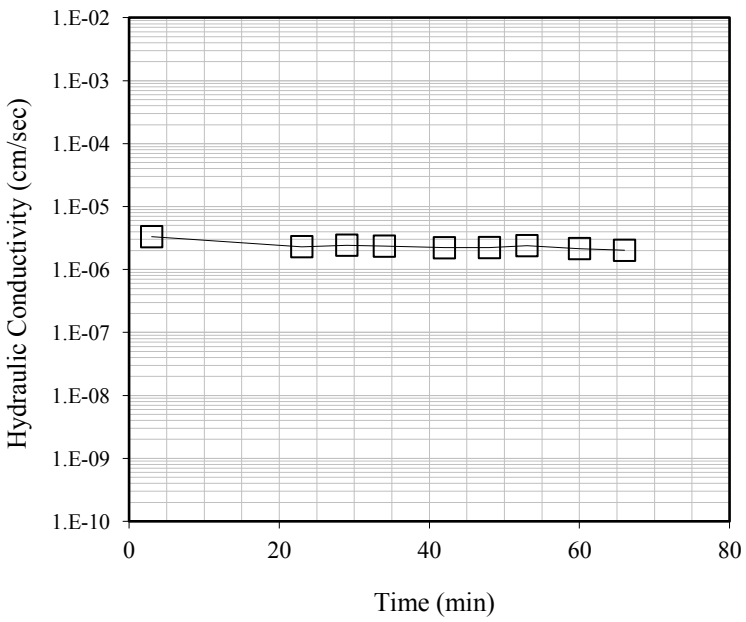
USCS Classification (ASTM D2487)	Silty sand (SM)	
As-Received Moisture Content (%)	(ASTM D2216)	25.6
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	24
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Hydraulic Conductivity

Client: Auckland Consulting LLC
Project: Winston Pond
Sample ID: B7: 13-15

TRI Log #: 20888
Test Method: ASTM D5084 Method C



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.80
Height (in)	2.21
Initial Mass (g)	444.2
Sample Area (in^2)	6.16
Water Content (%)	24.5
Total Unit Weight (pcf)	124.3
Dry Unit Weight (pcf)	99.9
Specific Gravity (Assumed)	2.65
Degree of Saturation	99.0
Void Ratio	0.66
Porosity	0.40
1 Pore Volume (cc)	88.3
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.99

Specimen Image

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
48.0	2.2E-06
53.0	2.4E-06
60.0	2.2E-06
66.0	2.0E-06
Average, Last 4 Readings	**2.2E-06**

Note: Permeation measurements were made with a mercury U-tube.

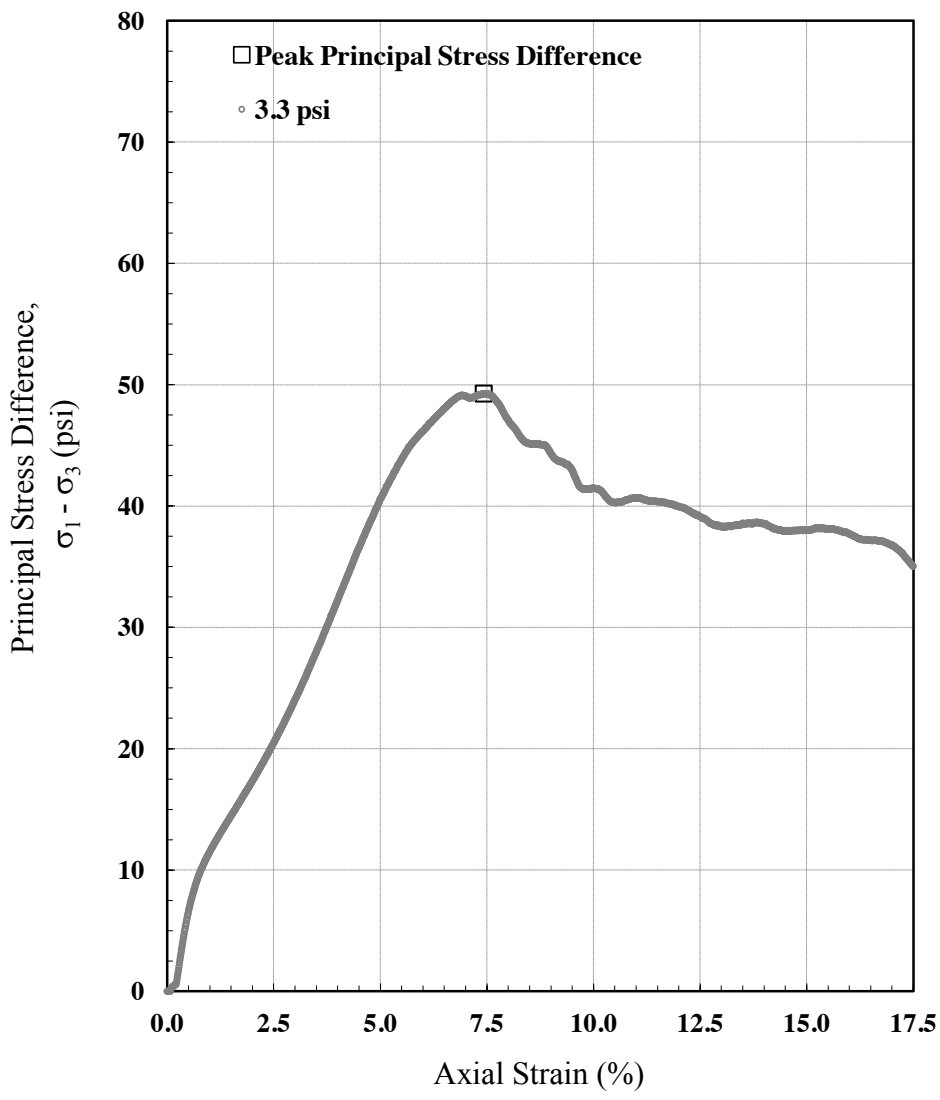
Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Analysis & Quality Review/Date
Testing Performed By: SOC & LC

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Unconsolidated-Undrained (Q) Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B8: 3-5

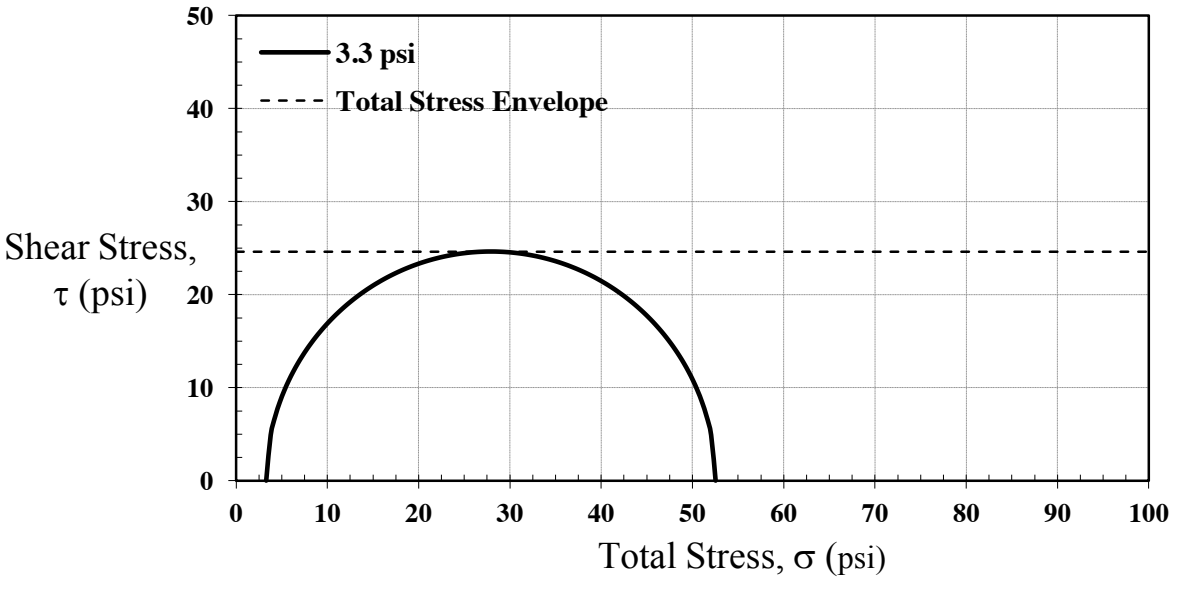
TRI Log #: 20888
Test Method: ASTM D2850



Test Parameters	
Minor Principal Stress (psi)	3.3
Rate of Strain (%/hr)	60

Initial Properties	
Avg. Diameter (in)	2.80
Avg. Height (in)	5.60
Avg. Water Content (%)	15.2
Bulk Density (pcf)	132.9
Dry Density (pcf)	115.4
Saturation (%)	92.8
Void Ratio	0.43
Specific Gravity (Assumed)	2.65

At Failure - Maximum Deviator Stress	
Axial Strain at Failure (%)	7.4
Minor Total Stress (psi)	3.3
Major Total Stress (psi)	52.6
Principal Stress Diff. (psi)	49.3



Total Stress Envelope	
Friction Angle (deg)	0
Undrained Shear Strength, S_u (psi)	24.6
S_u / σ_3	7.5

Note: The Mohr failure envelope was taken as a horizontal straight line. It should, however, be noted that the specimen was partially saturated.

Jeffrey A. Kuhn , Ph.D., P.E., 6/30/2016
Analysis & Quality Review/Date

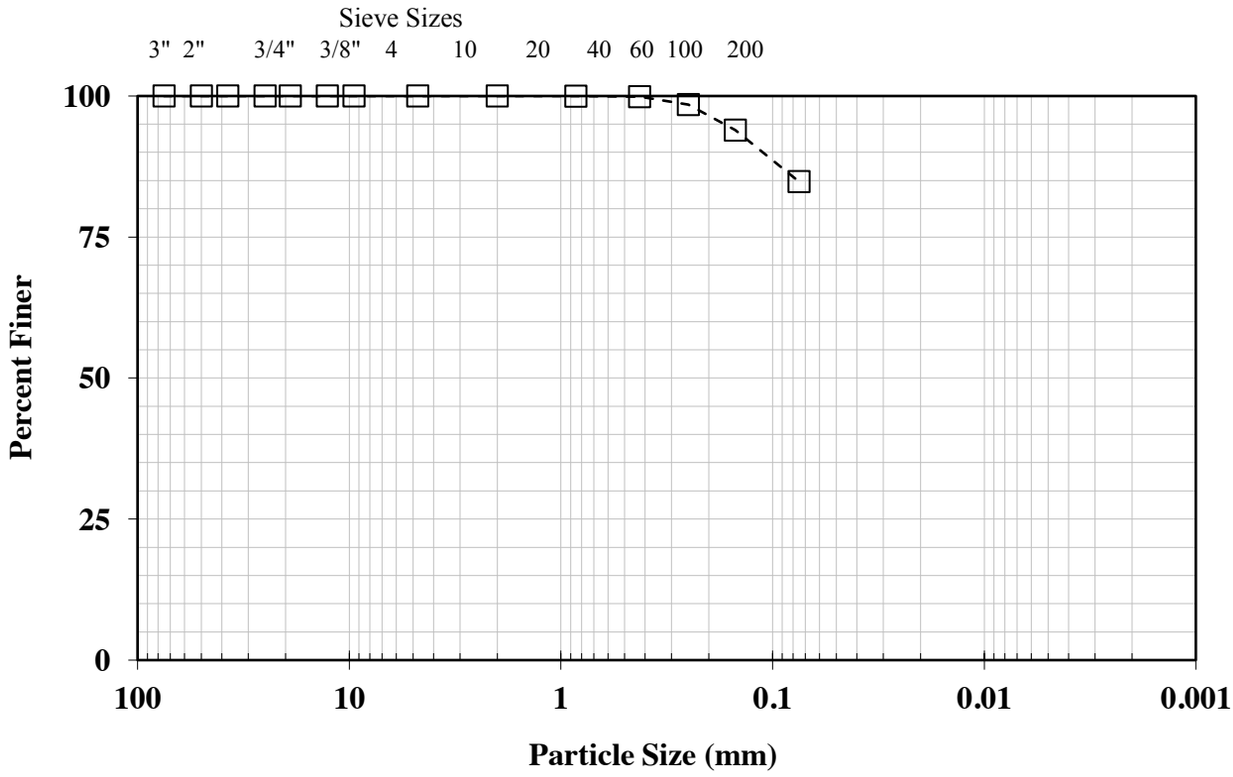
Laboratory Staff: LC

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B8 38-40

TRI Log#: 20888.32
Test Method: ASTM D422



Sieve Analysis		
Sieve Size		Percent Passing
3 in.	(76.2 mm)	100.0
2 in.	(50.8 mm)	100.0
1.5 in.	(38.1 mm)	100.0
1 in.	(25.4 mm)	100.0
3/4 in.	(19.0 mm)	100.0
1/2 in.	(12.7 mm)	100.0
3/8 in.	(9.51 mm)	100.0
No. 4	(4.76 mm)	100.0
No. 10	(2.00 mm)	100.0
No. 20	(0.841 mm)	100.0
No. 40	(0.420 mm)	99.9
No. 60	(0.250 mm)	98.5
No. 100	(0.149 mm)	93.9
No. 200	(0.074 mm)	84.8
Hydrometer Analysis		
Particle Size		Percent Passing
0.005 mm		- -
0.002 mm		- -

USCS Classification (ASTM D2487)	- -	
As-Received Moisture Content (%)	(ASTM D2216)	28.8
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	- -
	Plastic Limit	- -
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (3-5)

TRI Log #: 21381
Test Method: ASTM D4767 Mod

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	5.0	10.0	15.0
Initial Specimen Properties			
Avg. Diameter (in)	1.95	1.96	1.97
Avg. Height (in)	4.39	4.33	4.24
Avg. Water Content (%)	18.1	-	-
Bulk Density (pcf)	128.7	129.5	130.6
Dry Density (pcf)	109.0	-	-
Saturation (%)	89.4	-	-
Void Ratio, n	0.55	0.54	0.52
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	81.0	80.9	80.9
B-Value, End of Saturation	0.97	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.54	0.52	0.51
Area (in^2)	2.98	3.00	3.04

Shear / Post-Shear			
Avg. Water Content (%)	-	-	20.6
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	0.8	1.3	1.6
Minor Effective Stress (psi), $\sigma_3'_f$	-	-	-	2.7	6.1	11.1
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	9.1	16.6	25.8
Pore Water Pressure, Δu_f (psi)	-	-	-	2.5	4.2	4.2
Major Effective Stress (psi), $\sigma_1'_f$	-	-	-	11.8	22.7	36.9
Effective Friction Angle (degrees)	-			29.9		
Effective Cohesion (psi)	-			1.2		

R-Envelope, "Total" Stress		
Friction Angle (deg)	-	26.9
Cohesion (psi)	-	0.1

Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

Jeffrey A. Kuhn , Ph.D., P.E., 7/12/2016
Analysis & Quality Review/Date
Laboratory Staff: SOC & LC

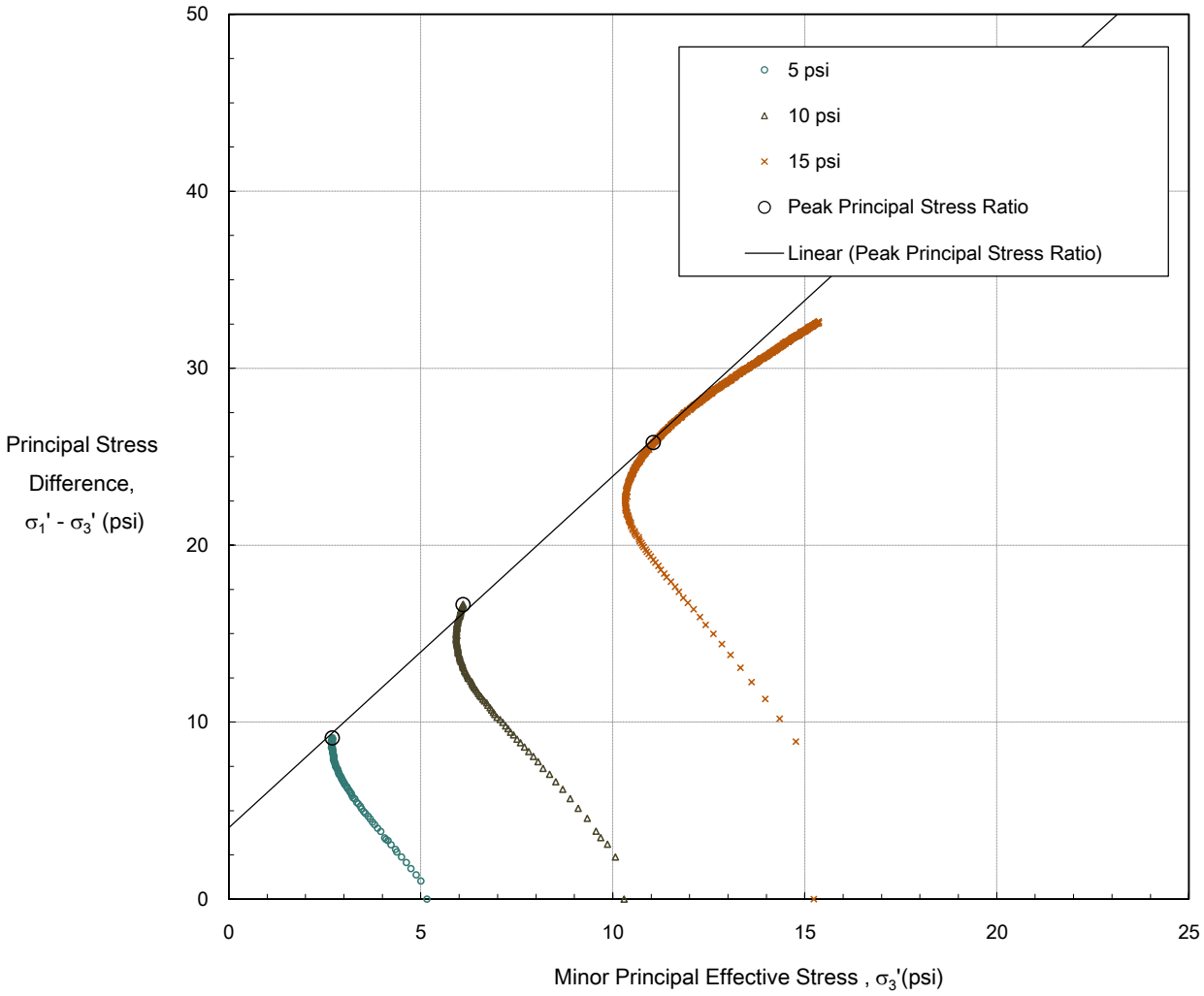
TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (3-5)

TRI Log #: 21381
Test Method: ASTM D4767 Mod

Modified Mohr-Coulomb



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	29.9
Effective Cohesion (psi)	-	1.2

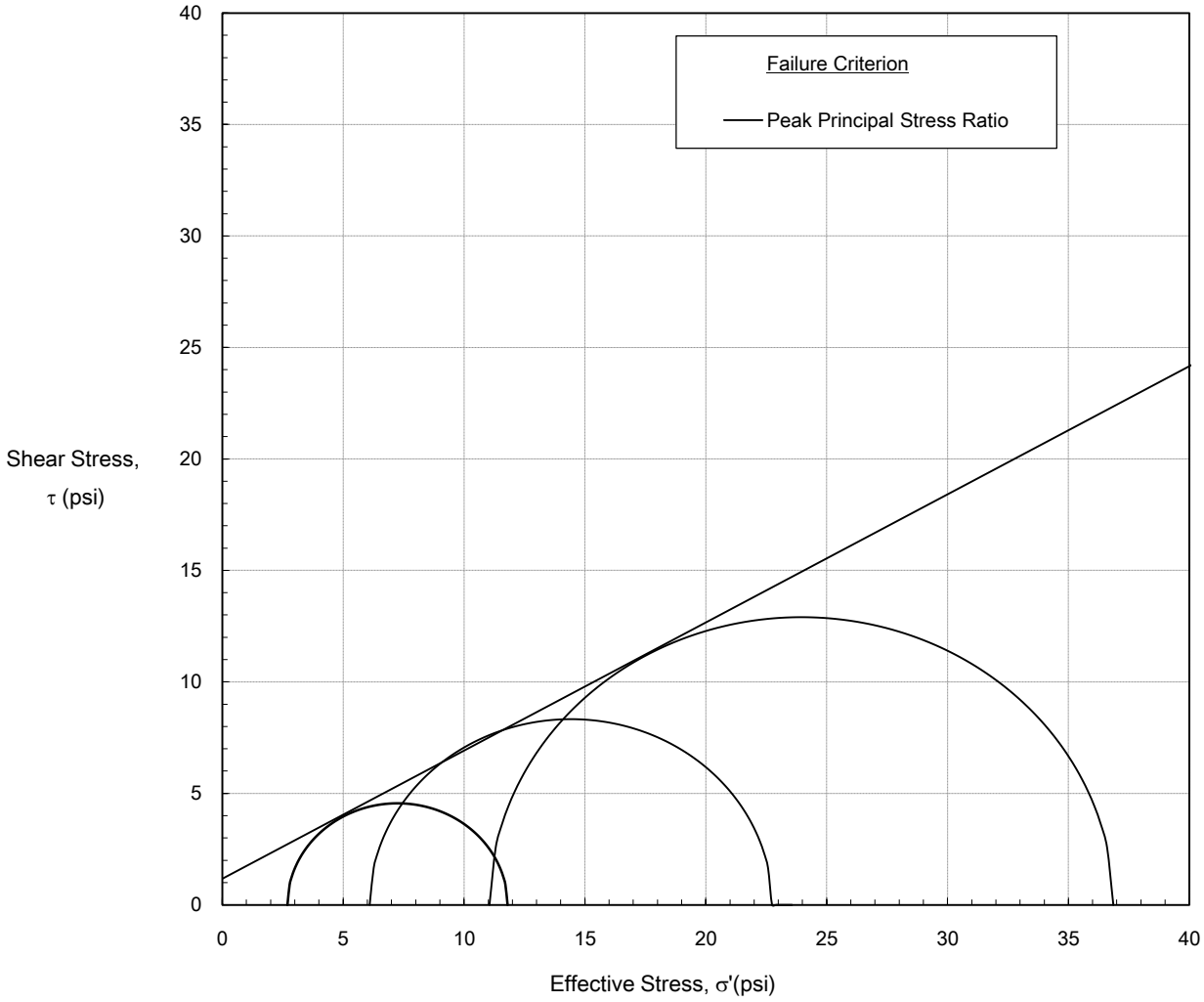
TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (3-5)

TRI Log #: 21381
Test Method: ASTM D4767 Mod

Mohr-Coulomb



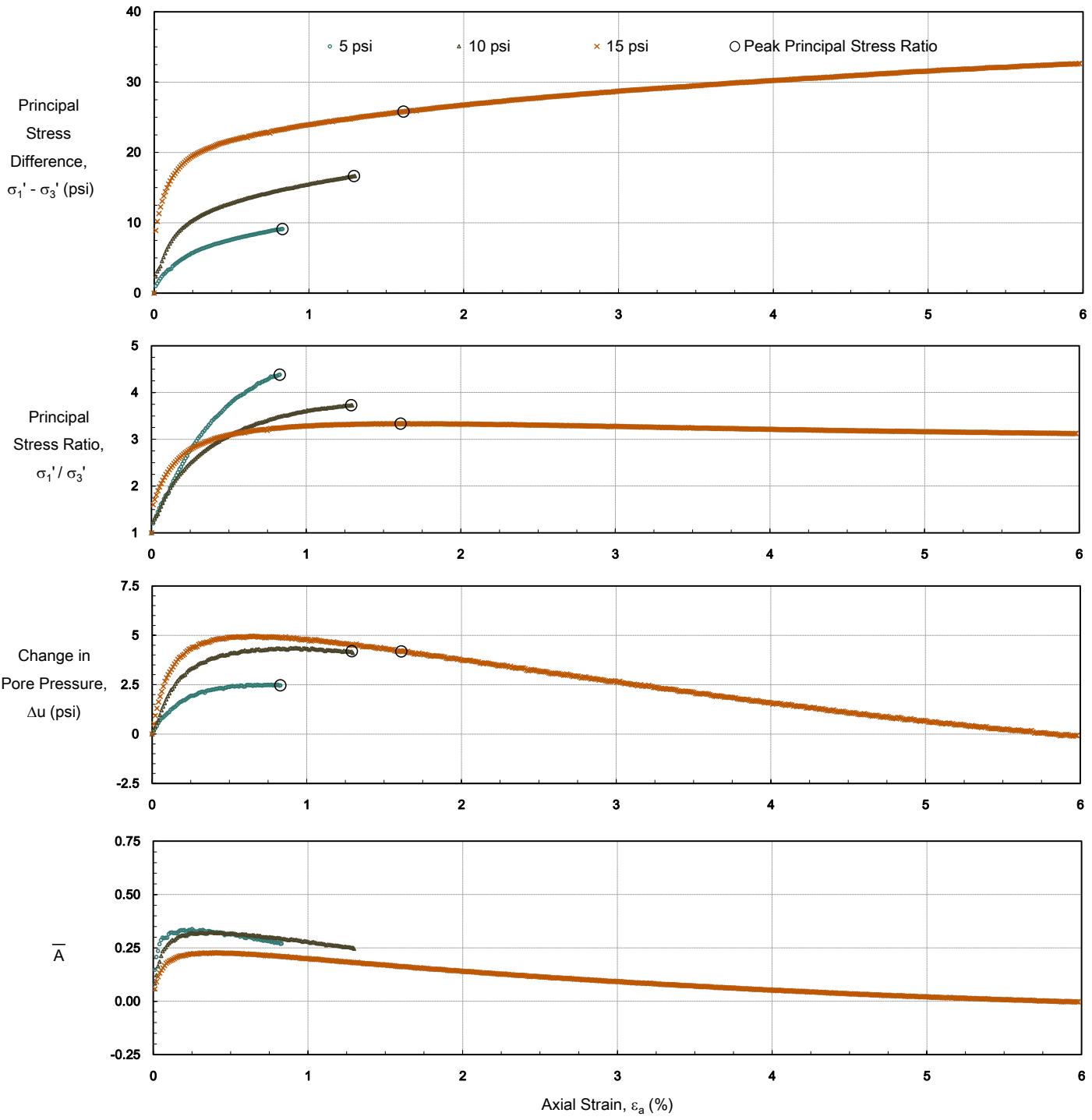
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	29.9
Effective Cohesion (psi)	-	1.2

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (3-5)

TRI Log #: 21381
Test Method: ASTM D4767 Mod



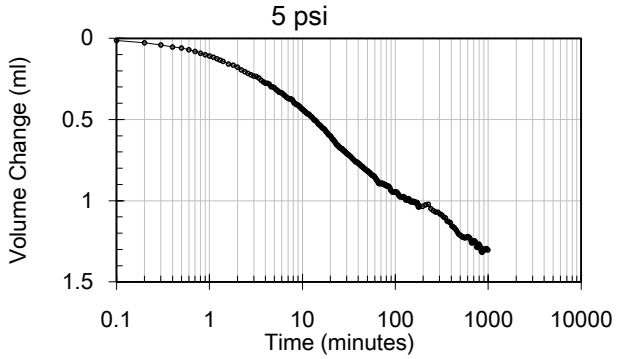
TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

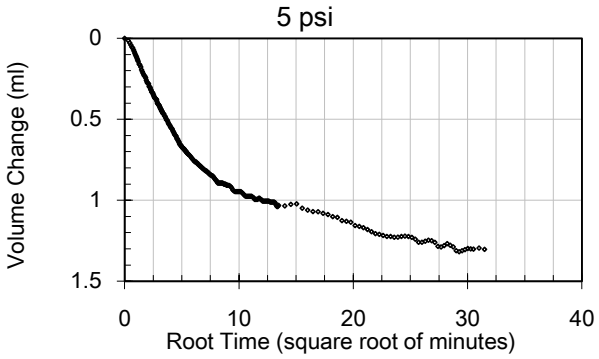
Multi-Stage Consolidated-Undrained Triaxial Compression

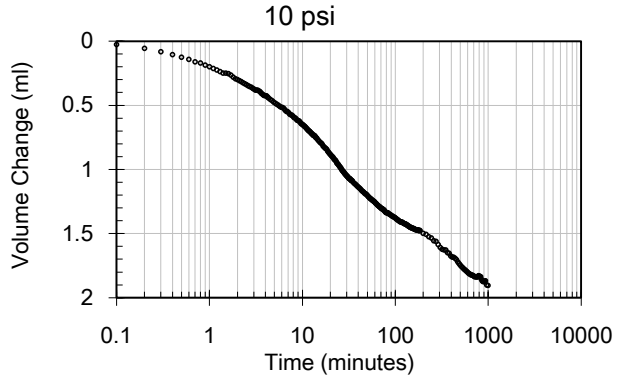
Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (3-5)

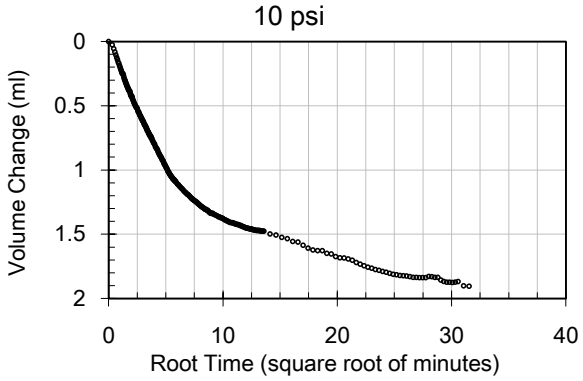
TRI Log #: 21381
Test Method: ASTM D4767 Mod

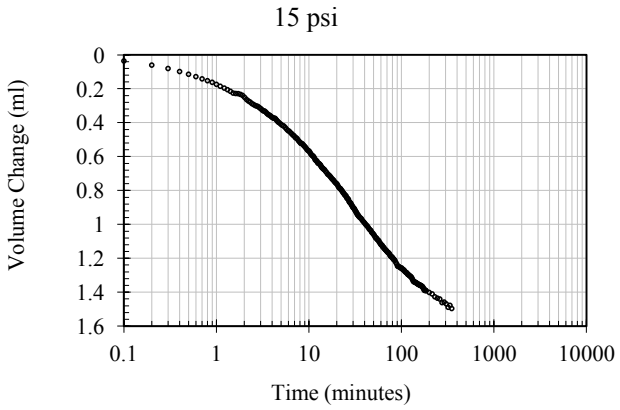
Consolidation

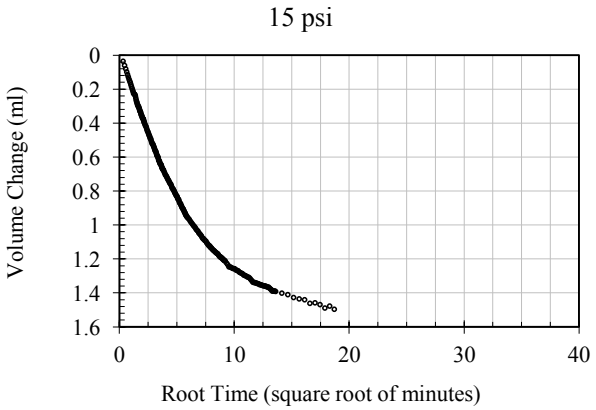










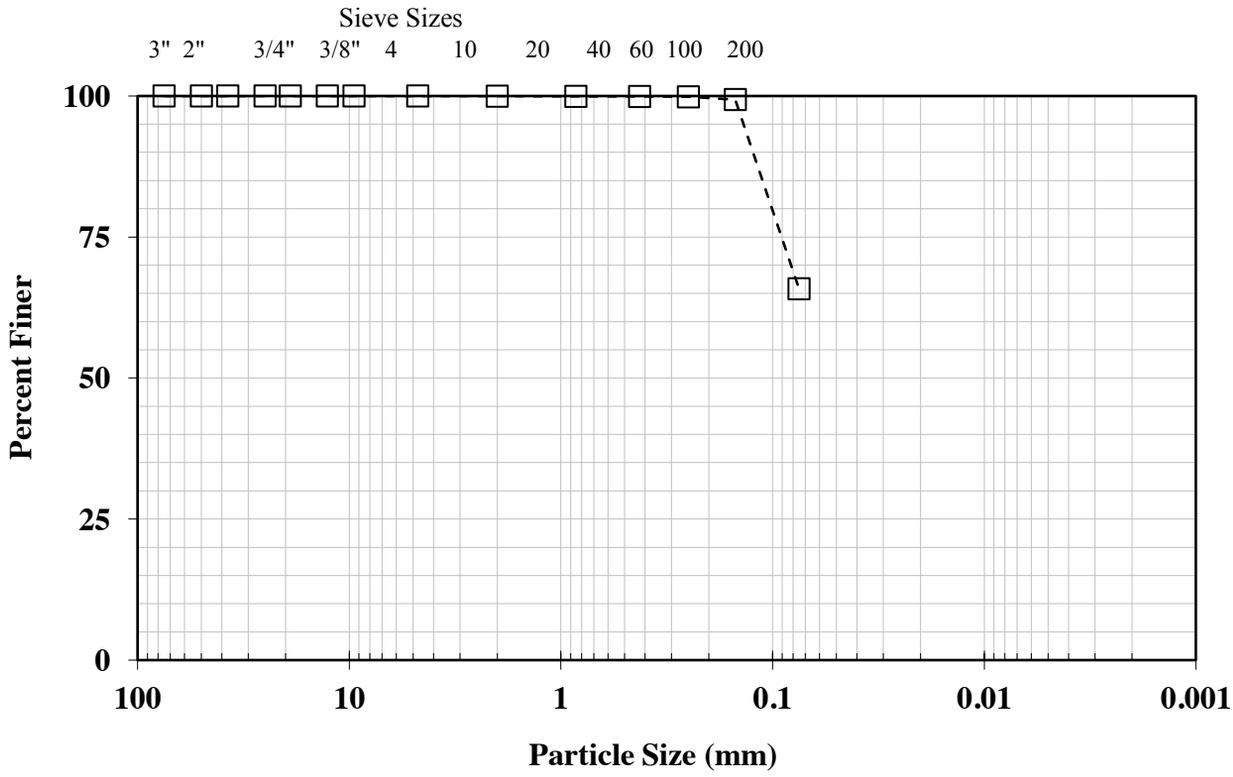


TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (8-10)

TRI Log#: 21381.3
Test Method: ASTM D422



Sieve Analysis		
Sieve Size		Percent Passing
3 in.	(76.2 mm)	100.0
2 in.	(50.8 mm)	100.0
1.5 in.	(38.1 mm)	100.0
1 in.	(25.4 mm)	100.0
3/4 in.	(19.0 mm)	100.0
1/2 in.	(12.7 mm)	100.0
3/8 in.	(9.51 mm)	100.0
No. 4	(4.76 mm)	100.0
No. 10	(2.00 mm)	100.0
No. 20	(0.841 mm)	99.9
No. 40	(0.420 mm)	99.9
No. 60	(0.250 mm)	99.8
No. 100	(0.149 mm)	99.4
No. 200	(0.074 mm)	65.8
Hydrometer Analysis		
Particle Size		Percent Passing
0.005 mm		- -
0.002 mm		- -

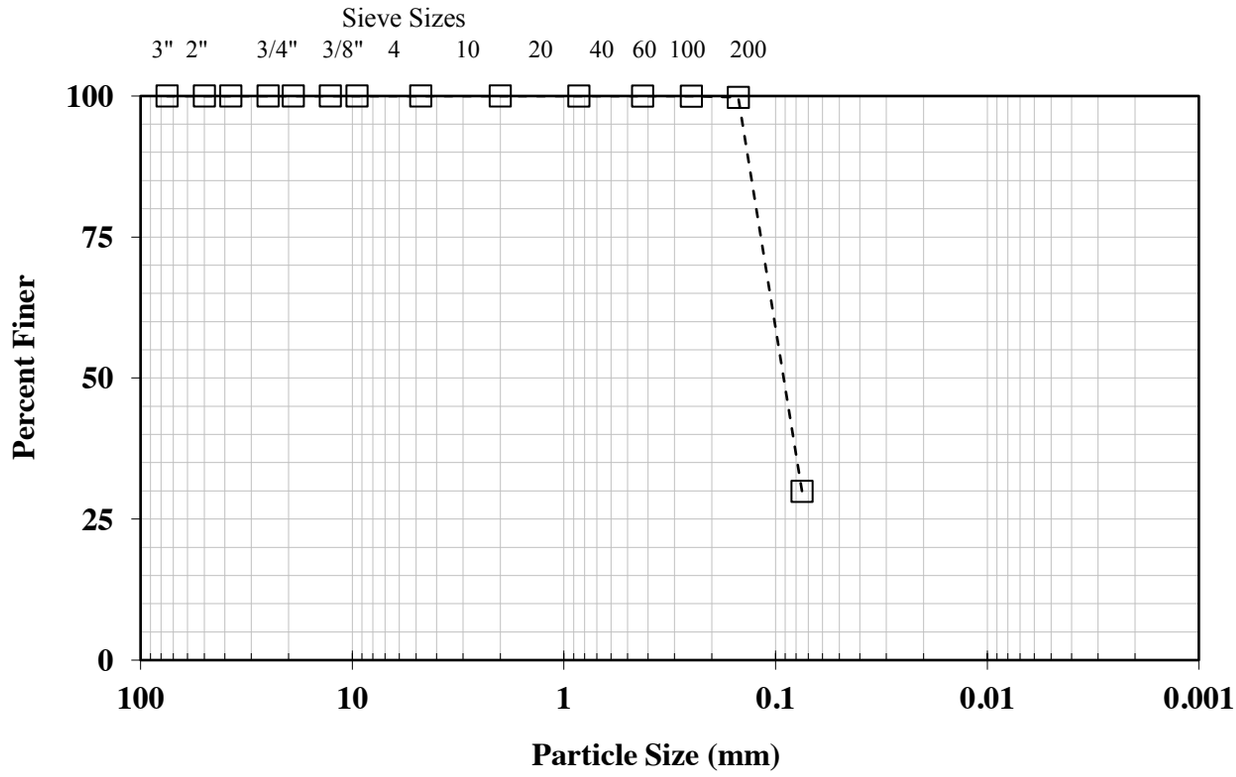
USCS Classification (ASTM D2487)	Sandy lean clay (CL)	
As-Received Moisture Content (%)	(ASTM D2216)	16.3
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	33
	Plastic Limit	20
	Plastic Index	13
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (33-35)

TRI Log#: 21381.7
Test Method: ASTM D422



Sieve Analysis		
Sieve Size		Percent Passing
3 in.	(76.2 mm)	100.0
2 in.	(50.8 mm)	100.0
1.5 in.	(38.1 mm)	100.0
1 in.	(25.4 mm)	100.0
3/4 in.	(19.0 mm)	100.0
1/2 in.	(12.7 mm)	100.0
3/8 in.	(9.51 mm)	100.0
No. 4	(4.76 mm)	100.0
No. 10	(2.00 mm)	100.0
No. 20	(0.841 mm)	100.0
No. 40	(0.420 mm)	100.0
No. 60	(0.250 mm)	100.0
No. 100	(0.149 mm)	99.7
No. 200	(0.074 mm)	29.9
Hydrometer Analysis		
Particle Size		Percent Passing
0.005 mm		- -
0.002 mm		- -

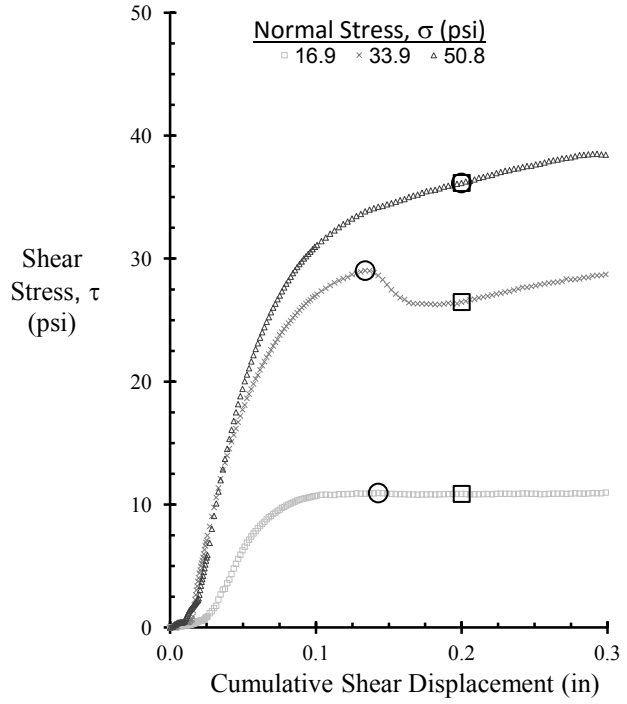
USCS Classification (ASTM D2487)	Silty sand (SM)	
As-Received Moisture Content (%)	(ASTM D2216)	29.6
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	26
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

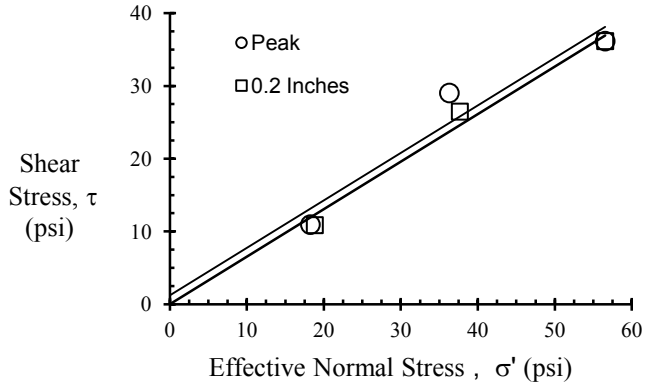
Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Direct Shear of Soil Under Consolidated-Drained Conditions

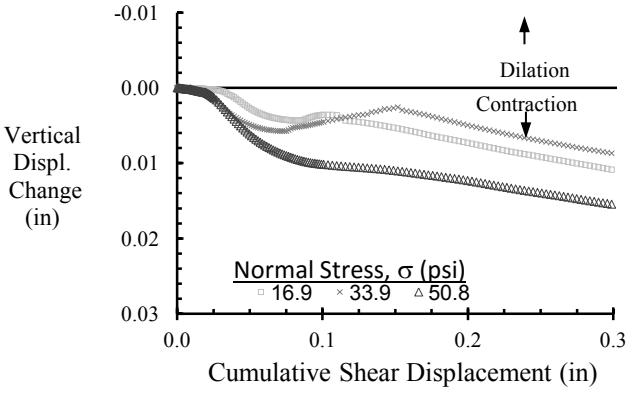
Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-4 (38-40)

TRI Log#: 21381
Test Method: ASTM D 3080





Note: Area Correction Has Been Applied



Sample Number		1	2	3
Initial Condition	Diameter, in	2.50	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	24.7	24.9	24.9
	Saturation, %	155.9	156.2	156.2
	Dry Density, pcf	116.4	116.3	116.3
	Void Ratio	0.42	0.42	0.42
Post Consol	Height, in (prior to shear)	1.00	1.00	0.99
	Final Water Content, %	23.9	25.0	23.6
	Dry Density, pcf	116.9	116.5	117.2
	Void Ratio	0.41	0.42	0.41
Displacement rate (in/min)		2.0E-03	2.0E-03	2.0E-03
Peak	Normal Stress, σ' (psi)	18.26	36.30	56.54
	Shear Stress, τ (psi)	10.94	29.03	36.15
	Displacement (in)	0.14	0.13	0.20
	ϕ'_d, degrees	33.1		
	c'_d, psi	1.2		
Post-Peak	Normal Stress, σ' (psi)	18.83	37.66	56.54
	Shear Stress, τ (psi)	10.87	26.47	36.15
	Displacement (in)	0.20	0.20	0.20
	ϕ'_d, degrees	33.1		
	c'_d, psi	0 (Forced)		

Note: The loose sample was tamped in place. A specific gravity of 2.65 was assumed for weight-volume calculations.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/16
Analysis & Quality Review/Date
Test Performed By: LC

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-5 (5-7)

TRI Log #: 21381
Test Method: ASTM D4767 Mod

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	5.0	10.0	15.0
Initial Specimen Properties			
Avg. Diameter (in)	1.85	1.85	1.87
Avg. Height (in)	4.51	4.44	4.35
Avg. Water Content (%)	17.6	-	-
Bulk Density (pcf)	139.6	141.0	142.1
Dry Density (pcf)	118.7	-	-
Saturation (%)	100.0	-	-
Void Ratio, n	0.42	0.41	0.40
Specific Gravity (Assumed)	2.70		
Total Back-Pressure (psi)	80.7	80.8	81.5
B-Value, End of Saturation	0.94	-	-

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.41	0.40	0.38
Area (in^2)	2.67	2.68	2.72

Shear / Post-Shear			
Avg. Water Content (%)	-	-	19.1
Rate of Strain (%/hr)	0.25	0.25	0.25

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	-	-	-	0.6	1.3	1.4
Minor Effective Stress (psi), $\sigma_3'_f$	-	-	-	4.3	5.6	9.9
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	-	-	-	9.2	11.7	23.4
Pore Water Pressure, Δu_f (psi)	-	-	-	0.7	2.8	3.4
Major Effective Stress (psi), $\sigma_1'_f$	-	-	-	13.5	17.3	33.3
Effective Friction Angle (degrees)	-			32.3		
Effective Cohesion (psi)	-			0 (Forced)		

R-Envelope, "Total" Stress		
Friction Angle (deg)	-	27.1
Cohesion (psi)	-	0 (Forced)

Note: Multi-stage testing was performed for this sample. The first two stages were terminated in accordance with stress path tangency and/or peak principal stress ratio.

Jeffrey A. Kuhn , Ph.D., P.E., 7/12/2016
Analysis & Quality Review/Date
Laboratory Staff: SOC & LC

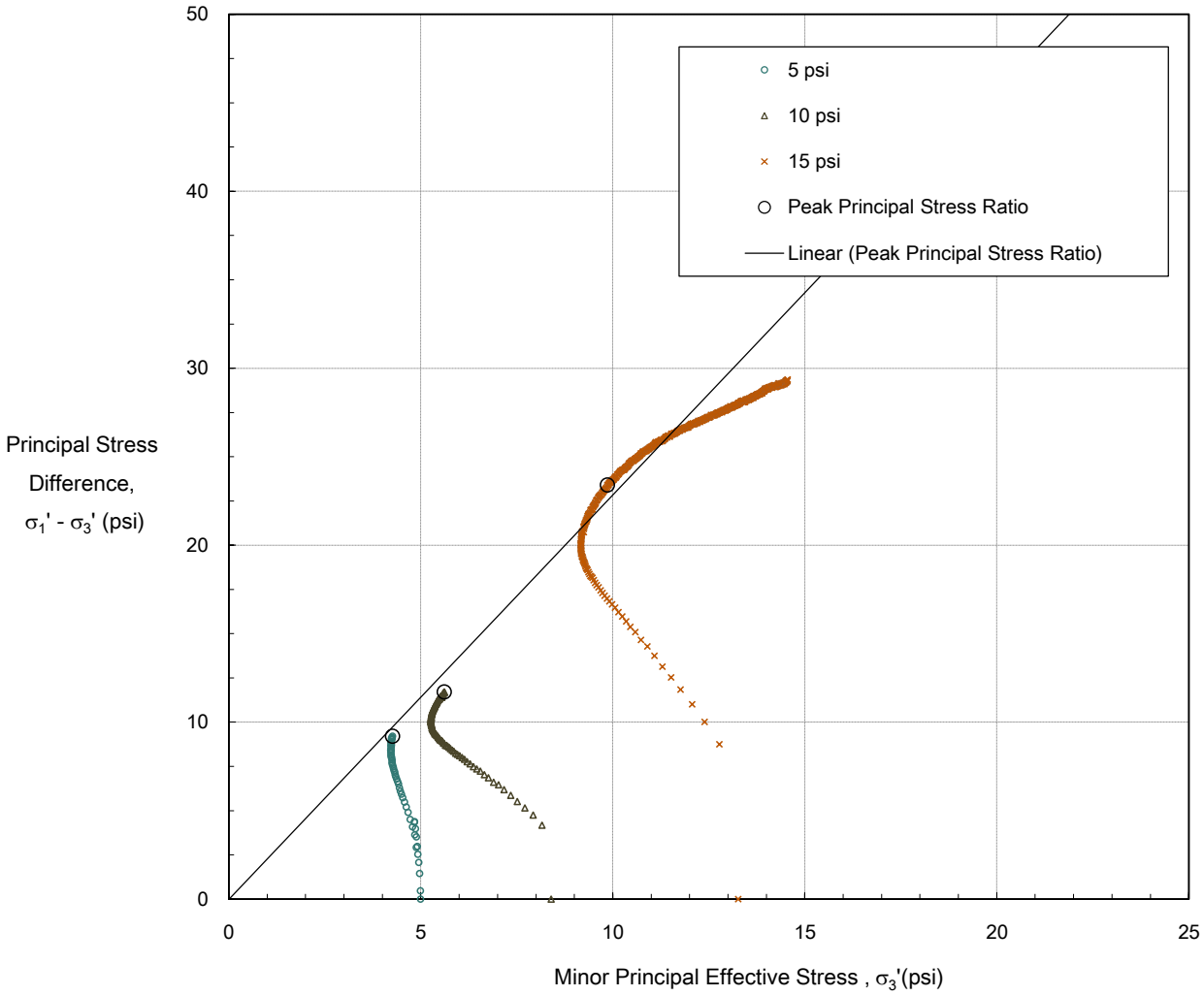
TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-5 (5-7)

TRI Log #: 21381
Test Method: ASTM D4767 Mod

Modified Mohr-Coulomb



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	32.3
Effective Cohesion (psi)	-	0 (Forced)

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-5 (5-7)

TRI Log #: 21381
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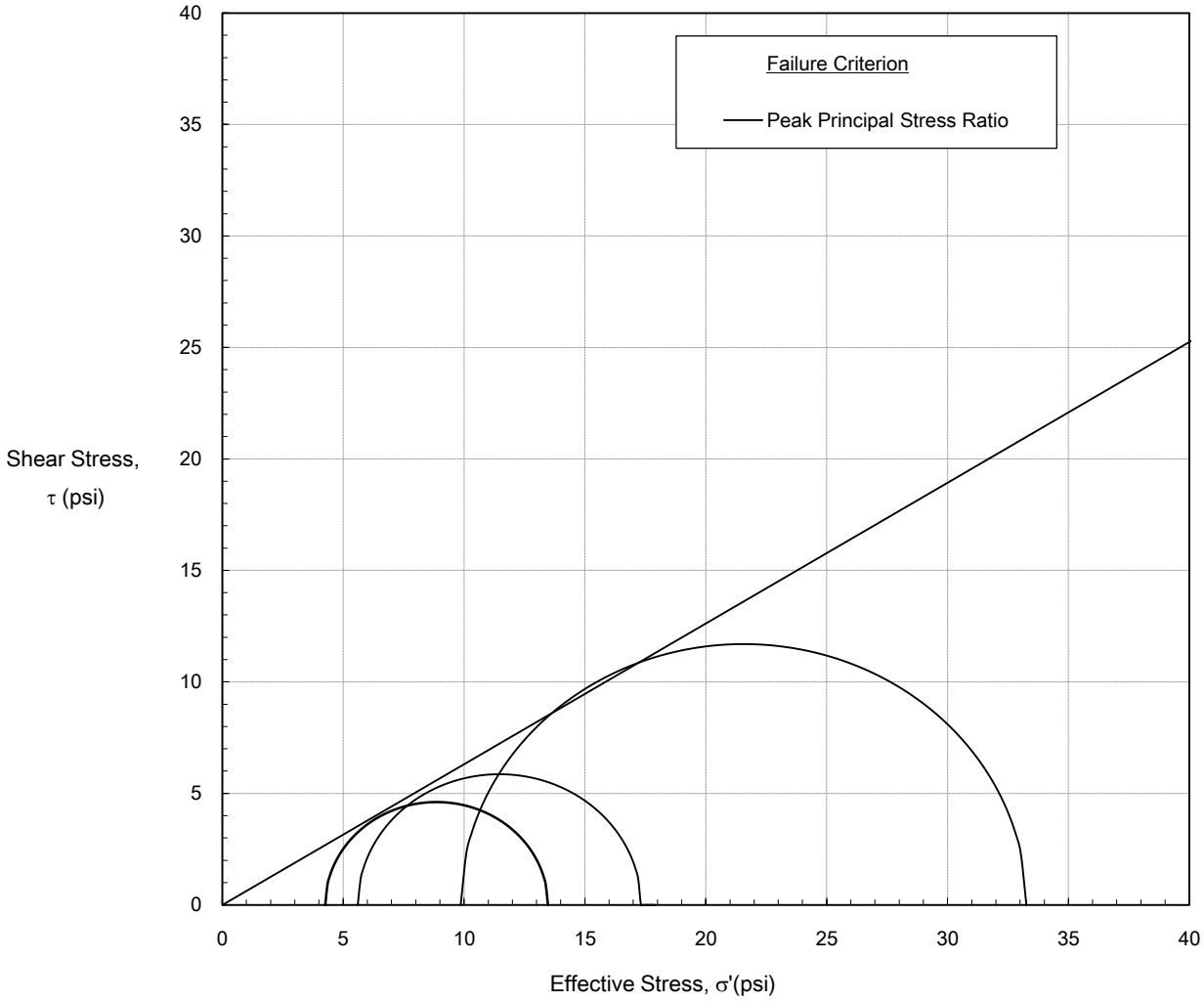
Mohr-Coulomb



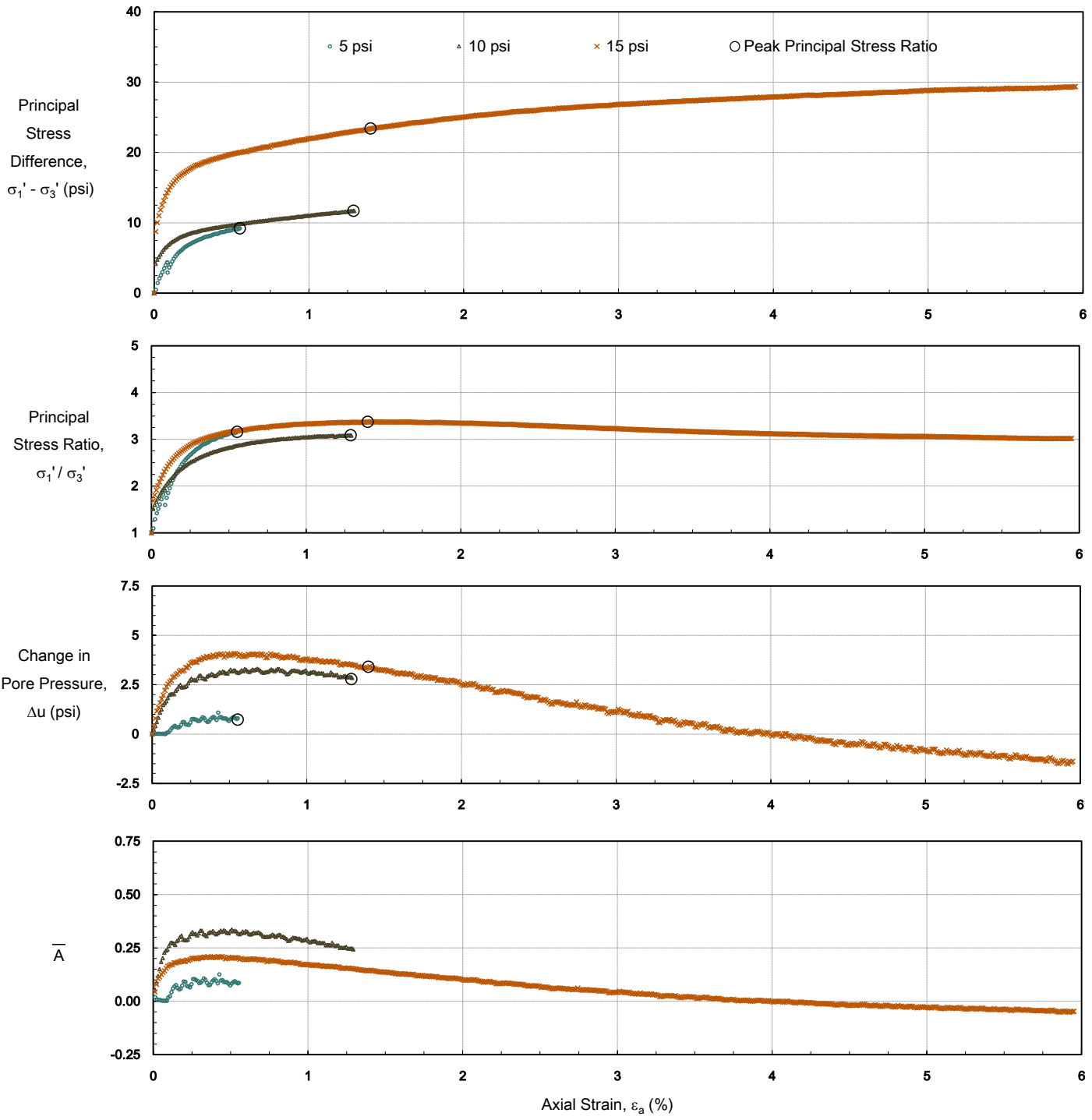
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	-	32.3
Effective Cohesion (psi)	-	0 (Forced)

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Multi-Stage Consolidated-Undrained Triaxial Compression

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-5 (5-7)

TRI Log #: 21381
Test Method: ASTM D4767 Mod



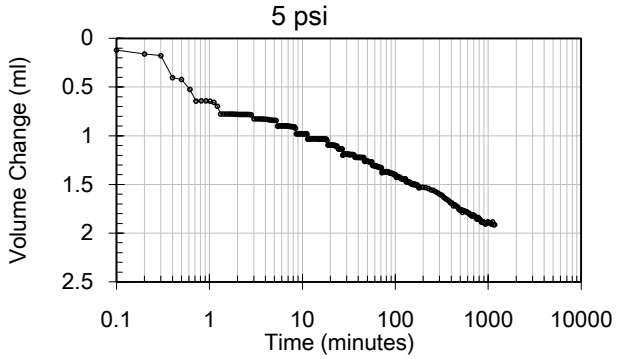
TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

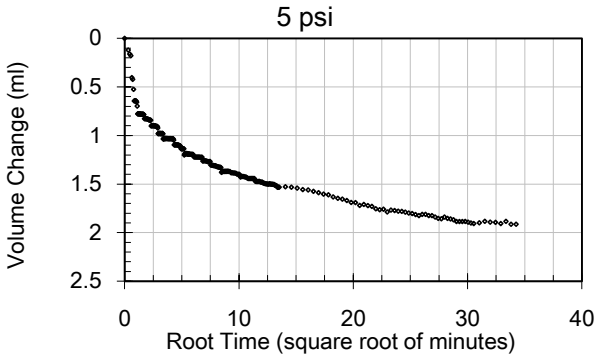
Multi-Stage Consolidated-Undrained Triaxial Compression

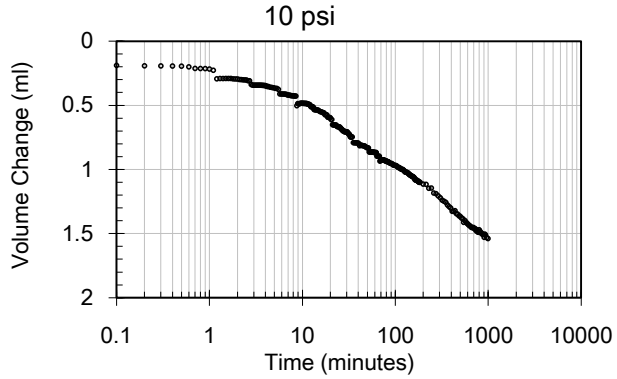
Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-5 (5-7)

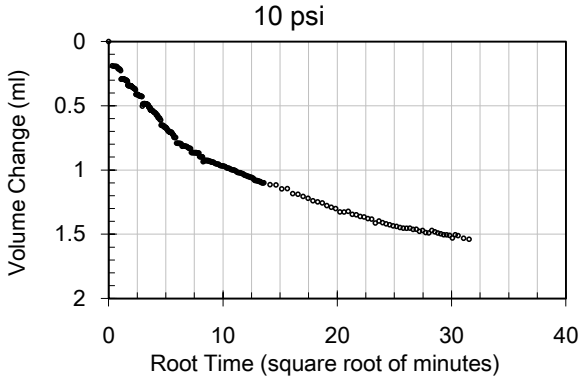
TRI Log #: 21381
Test Method: ASTM D4767 Mod

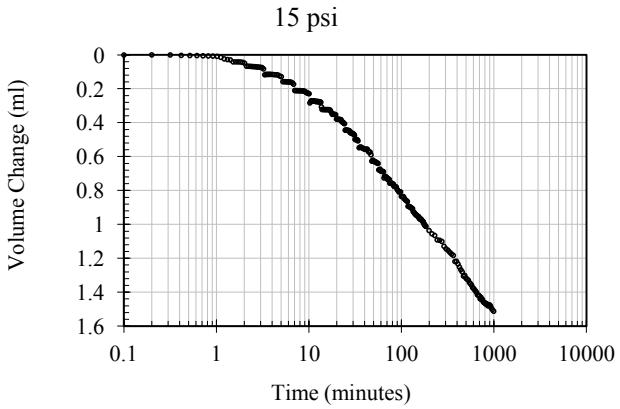
Consolidation

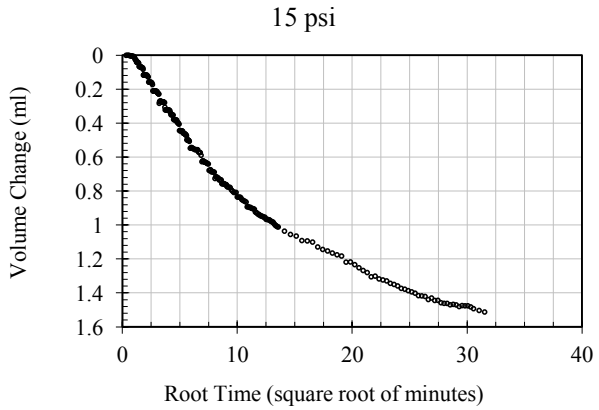










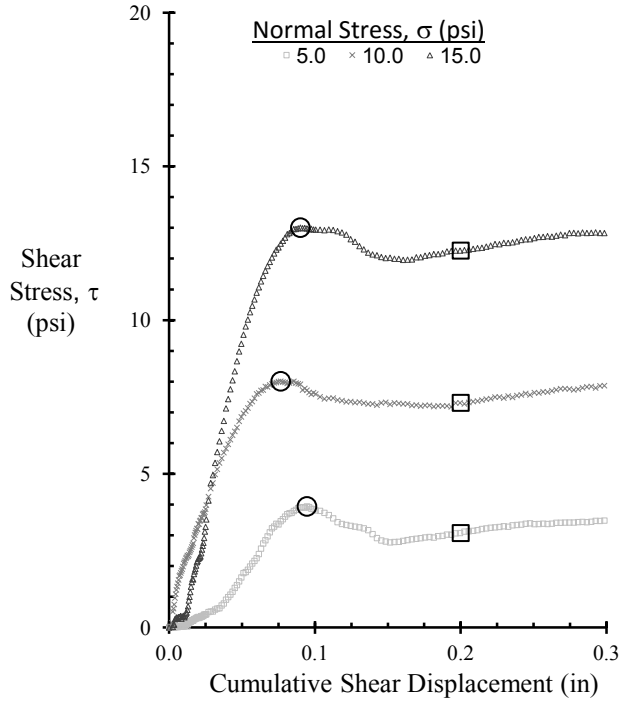


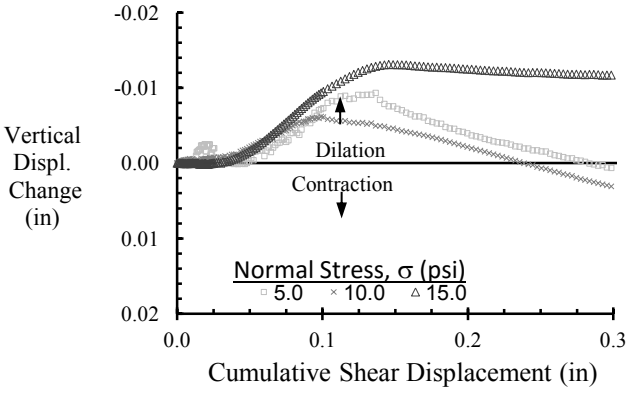
TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

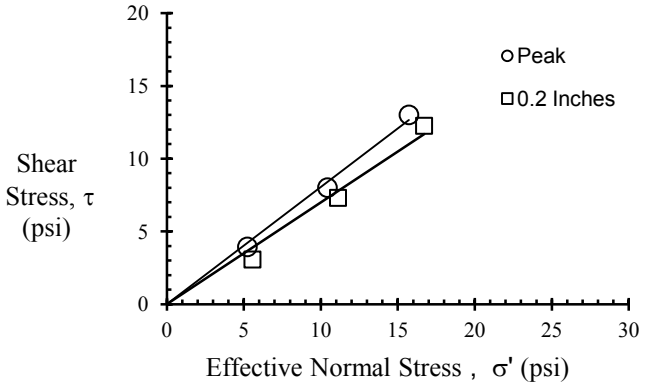
Direct Shear of Soil Under Consolidated-Drained Conditions

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-5 (13-15)

TRI Log#: 21381
Test Method: ASTM D 3080







Note: Area Correction Has Been Applied

Sample Number		1	2	3
Initial Condition	Diameter, in	2.50	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	16.9	16.0	15.6
	Saturation, %	83.9	83.6	89.1
	Dry Density, pcf	107.9	109.7	112.9
	Void Ratio	0.53	0.51	0.46
Post Consol	Height, in (prior to shear)	1.00	1.00	1.00
	Final Water Content, %	21.1	20.9	19.2
	Dry Density, pcf	108.0	109.9	113.3
	Void Ratio	0.53	0.50	0.46
Displacement rate (in/min)		6.0E-04	6.0E-04	6.0E-04
Peak	Normal Stress, σ' (psi)	5.23	10.43	15.72
	Shear Stress, τ (psi)	3.94	8.01	13.01
	Displacement (in)	0.09	0.08	0.09
	ϕ'_d, degrees	38.8		
	c'_d, psi	0 (Forced)		
Post-Peak	Normal Stress, σ' (psi)	5.56	11.12	16.70
	Shear Stress, τ (psi)	3.07	7.31	12.26
	Displacement (in)	0.20	0.20	0.20
	ϕ'_d, degrees	35.0		
	c'_d, psi	0 (Forced)		

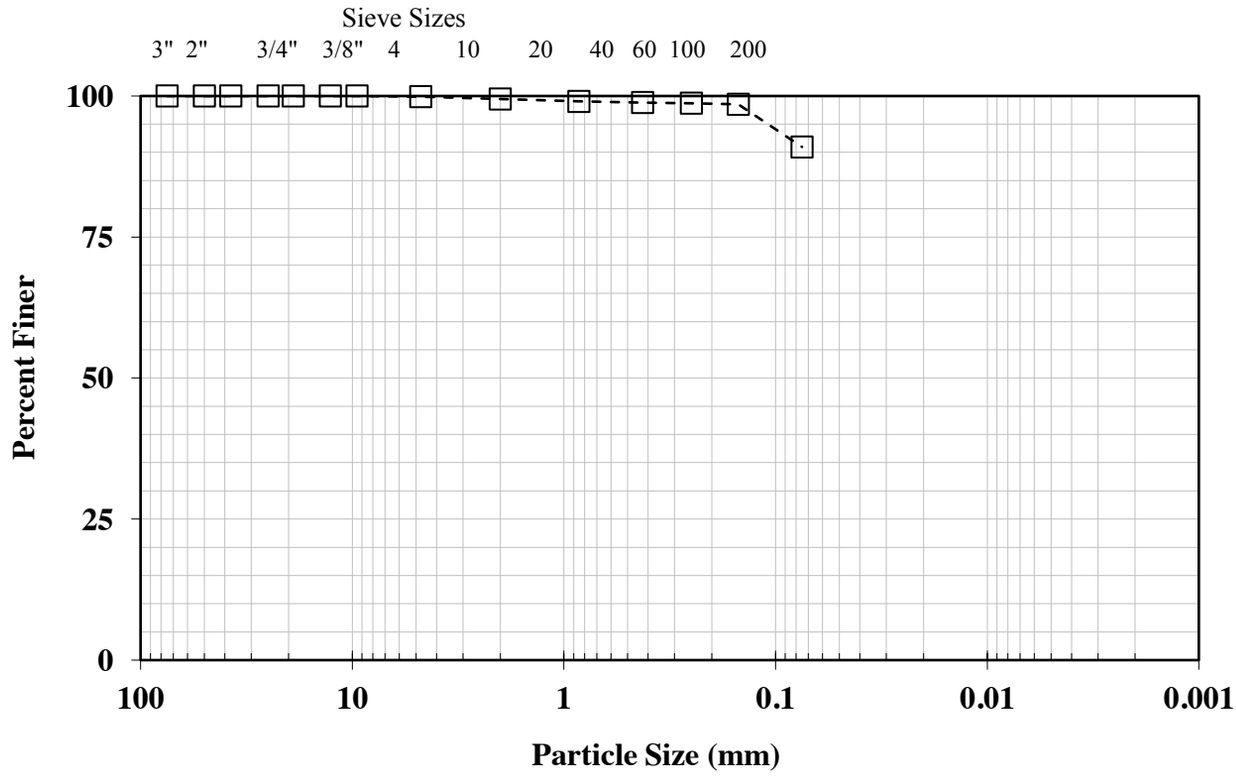
Note: The undisturbed soil samples were extruded and trimmed using a trimming turntable. A specific gravity of 2.65 was assumed for weight-volume calculations.

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/16
Analysis & Quality Review/Date
Test Performed By: LC

Particle Size Analysis for Soils

Client: Auckland Consulting LLC
Project: Winston Pond
Sample: B-5 (33-35)

TRI Log#: 21381.16
Test Method: ASTM D422



Sieve Analysis		
Sieve Size		Percent Passing
3 in.	(76.2 mm)	100.0
2 in.	(50.8 mm)	100.0
1.5 in.	(38.1 mm)	100.0
1 in.	(25.4 mm)	100.0
3/4 in.	(19.0 mm)	100.0
1/2 in.	(12.7 mm)	100.0
3/8 in.	(9.51 mm)	100.0
No. 4	(4.76 mm)	99.9
No. 10	(2.00 mm)	99.5
No. 20	(0.841 mm)	99.0
No. 40	(0.420 mm)	98.8
No. 60	(0.250 mm)	98.7
No. 100	(0.149 mm)	98.5
No. 200	(0.074 mm)	90.9
Hydrometer Analysis		
Particle Size		Percent Passing
0.005 mm		- -
0.002 mm		- -

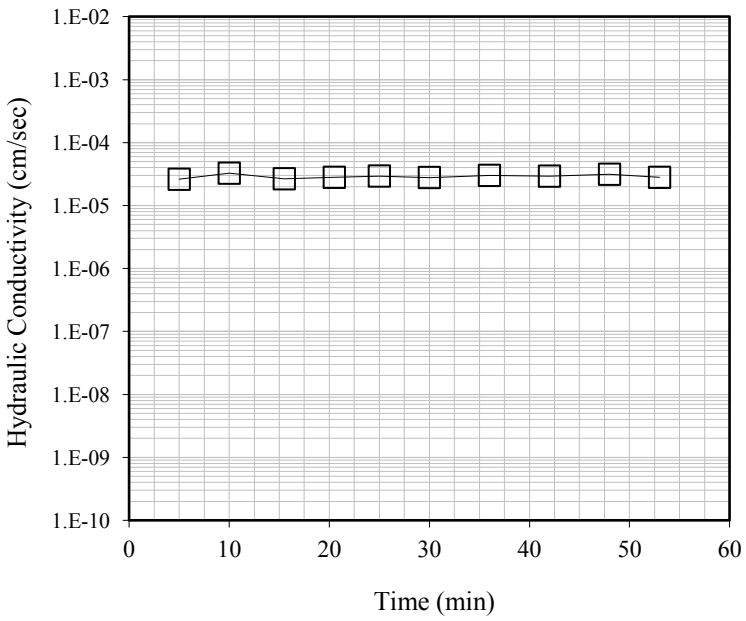
USCS Classification (ASTM D2487)	Silt (ML)	
As-Received Moisture Content (%)	(ASTM D2216)	27.1
Atterberg Limits (ASTM D4318, Method A : Multipoint)	Liquid Limit	28
	Plastic Limit	NP
	Plastic Index	- -
Notes: Specimen was air dried.. (NL = No Liquid Limit, NP = No Plastic Limit)		
Specific Gravity	(ASTM D854)	- -
Organic Content (%)	(ASTM D2974)	- -
Carbonate Content (%)	(ASTM D4373)	- -

Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Quality Review/Date
Tested by: KH & PC

Hydraulic Conductivity

Client: Auckland Consulting LLC
Project: Winston Pond
Sample ID: B-5: (33-35)

TRI Log #: 21381
Test Method: ASTM D5084 Method C



Initial Values	
Sample Condition	Undisturbed
Diameter (in)	2.80
Height (in)	2.55
Initial Mass (g)	500.5
Sample Area (in^2)	6.16
Water Content (%)	26.4
Total Unit Weight (pcf)	121.4
Dry Unit Weight (pcf)	96.1
Specific Gravity (Assumed)	2.65
Degree of Saturation	96.9
Void Ratio	0.72
Porosity	0.42
1 Pore Volume (cc)	107.8
Eff. Confining Stress (psi)	5.0
B-Value Prior to Permeation	0.99

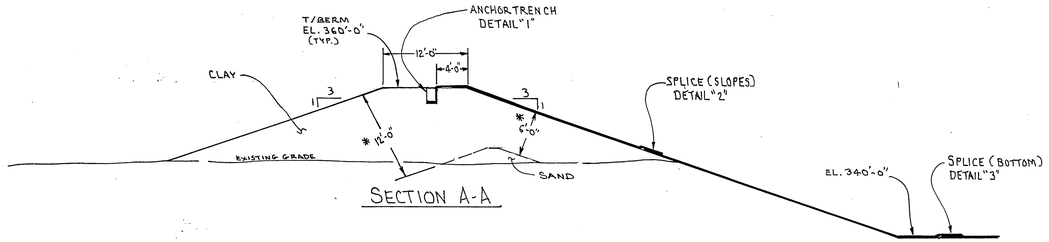
Specimen Image

Time	Hydraulic Conductivity, K at 20° C
Min	cm/s
36.0	3.0E-05
42.0	2.9E-05
48.0	3.1E-05
53.0	2.8E-05
Average, Last 4 Readings	**3.0E-05**

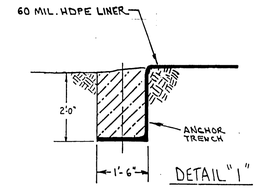
Jeffrey A. Kuhn, Ph.D., P.E., 6/30/2016
Analysis & Quality Review/Date
Testing Performed By: SOC & LC

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

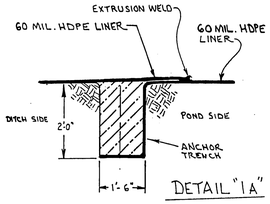
* - NOTE- THESE DIMENSIONS ARE SUBJECT TO ADJUSTMENT DEPENDING ON THE SAND / CLAY BALANCE VS. HAUL DISTANCE ON PROJECT.



SECTION A-A



DETAIL "1"



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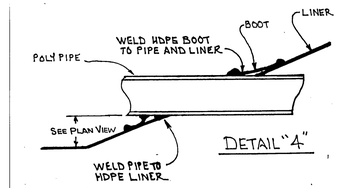
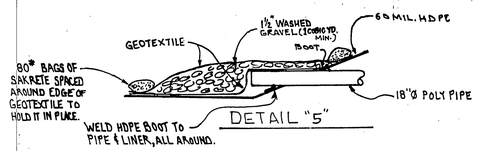
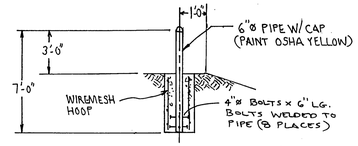


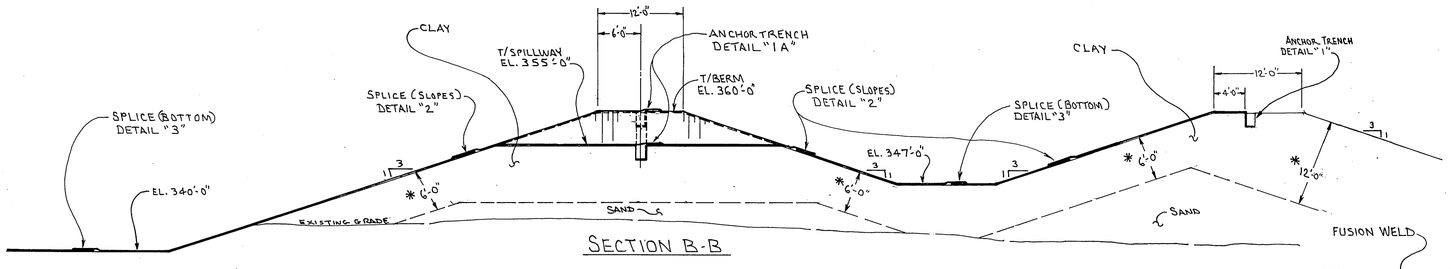
DETAIL "4"



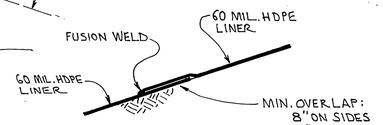
DETAIL "5"



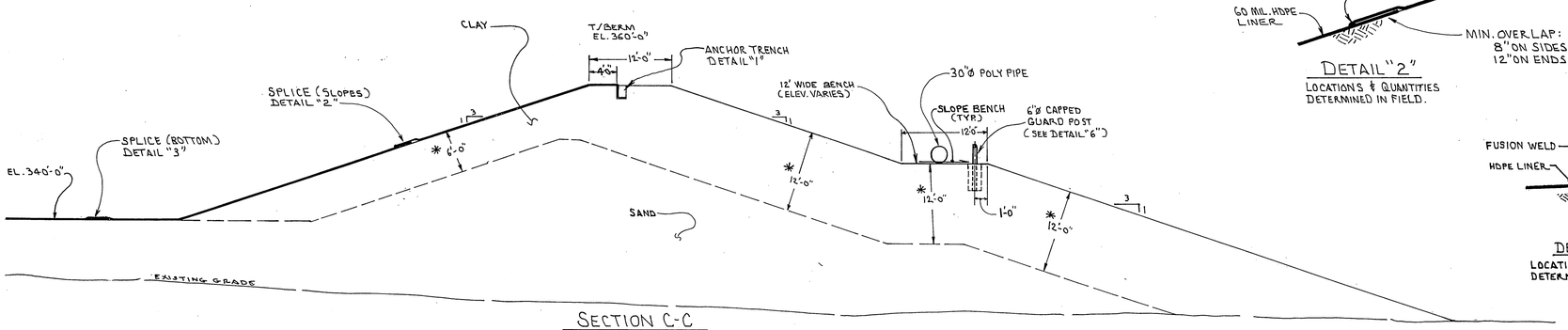
DETAIL "6"
50' ON CENTERS
(20 REQUIRED)



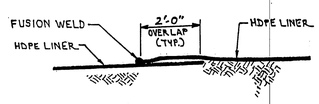
SECTION B-B



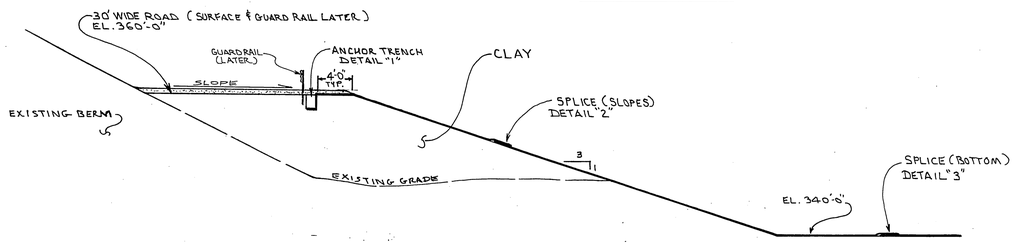
DETAIL "2"
LOCATIONS & QUANTITIES DETERMINED IN FIELD.



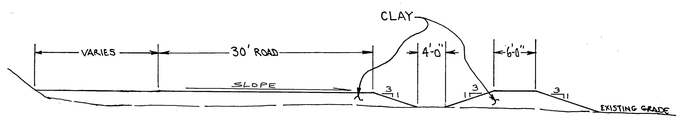
SECTION C-C



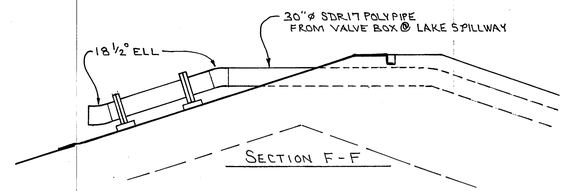
DETAIL "3"
LOCATIONS & QUANTITIES DETERMINED IN FIELD



SECTION D-D



SECTION E-E



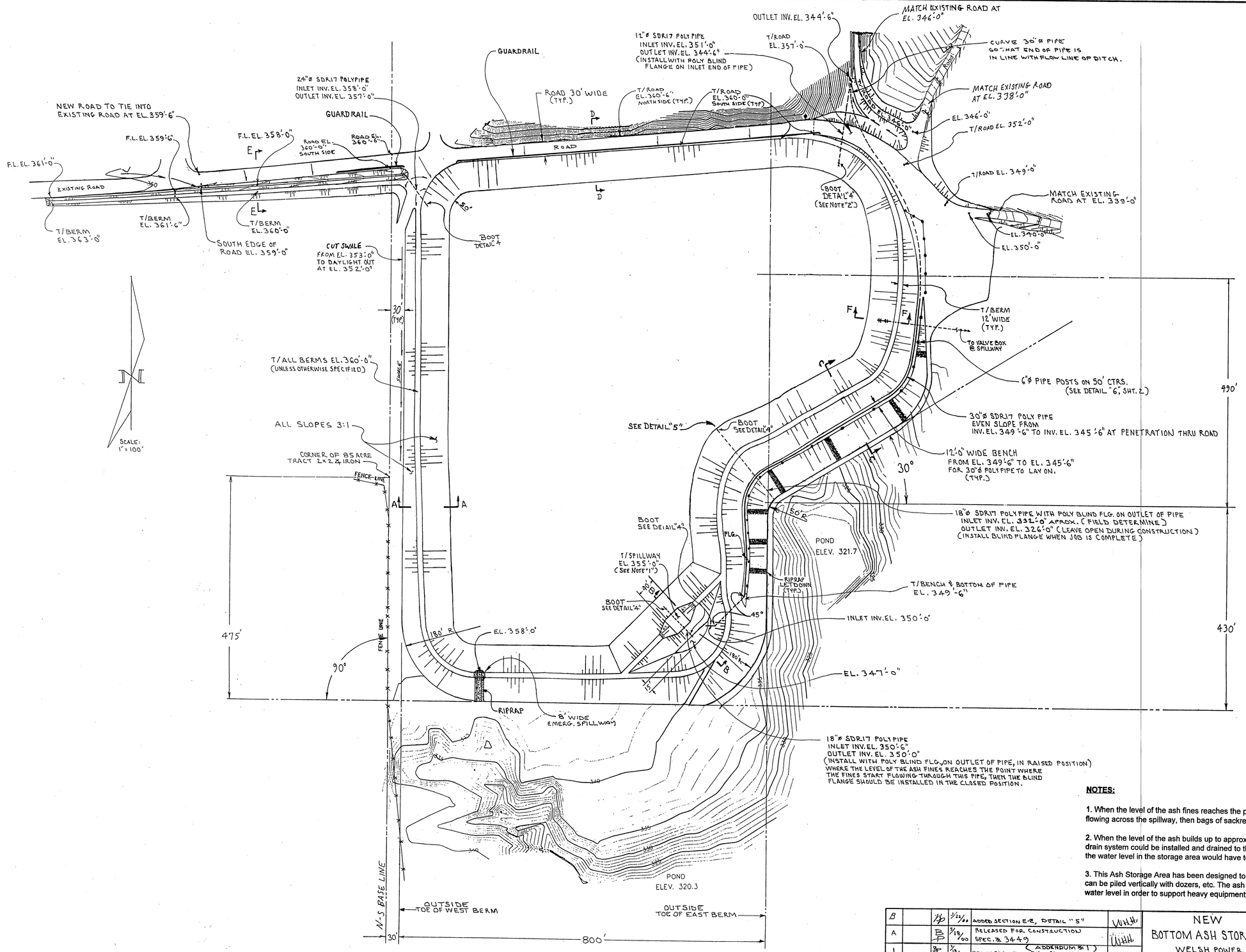
SECTION F-F

REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	10/29/00	AS BUILT	
A		AP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHH
1		BP	3/1/00	(ADDENDUM #1) RELEASED FOR BIDS SPEC. # 3449	
		BP	3/19/00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

DEPT.
DIV.
APPROVED
DRWN. BY: BP DATE: 3-10-00
SCALE: AS SHOWN W.O.
SH. 2 of 2 DRWG. NO. WEPX-335



NOTES:

1. When the level of the ash fines reaches the point where the fines start flowing across the spillway, then bags of sackrete can be installed to raise the spillway elevation.

2. When the level of the ash builds up to approx. elev. 355 along the north and east sides, a french drain system could be installed and drained to this outlet to help hold the water table down. Of course the water level in the storage area would have to be at elev. 351 or above for the french drain to function.

3. This Ash Storage Area has been designed to hold the water level as low as possible so the ash can be piled vertically with dozers, etc. The ash level needs to be approx. 4 ft. to 5 ft. above the water level in order to support heavy equipment.

REV	W.O.	BY	DATE	SUBJECT	APPROVED
C		BP	10-27-00	AS BUILT	
B		BP	5/22/00	ADDED SECTION E-E, DETAIL "5"	WHH
A		BP	5/18/00	RELEASED FOR CONSTRUCTION SPEC.# 3449 (ADDENDUM #1)	WHH
1		BP	3/30/00	RELEASED FOR BIDS SPEC.# 3449	
		BP	3-10-00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

DEPT.
DIV.
APPROVED
DRWN. BY: BP | DATE: 3-10-00
SCALE: 1"=100' | W.O.
SH. 1 of 2 | DRWG. NO. WEPX-335

MAXIM
TECHNOLOGIES INC

SUBSURFACE EXPLORATION

FOR

ASH STORAGE AREA, PHASE II
WELSH POWER PLANT
CASON, TEXAS

PREPARED FOR
SOUTHWESTERN ELECTRIC POWER COMPANY
ATTENTION: MR. WINSTON HOLLEY
P.O. BOX 21106
SHREVEPORT, LOUISIANA 71156

APRIL 27, 2000

MAXIM FILE #000444

MAXIM TECHNOLOGIES INC

7222 Greenwood Road
P.O. Box 19220
Shreveport, LA 71149-0220
(318) 636-3673
Fax (318) 636-3723

April 27, 2000

Southwestern Electric Power Company
P.O. Box 21106
Shreveport, Louisiana 71156

Attention: Winston Holley

Reference: Subsurface Exploration
Ash Storage Area Phase II
Welsh Power Plant
Cason, Texas
Maxim File # 000444

Gentlemen:

Enclosed are a boring location diagram and boring logs with laboratory test results. The soil is comprised of silty sand (SM), clayey sandy silt (ML) and sandy silty clay (CL) materials.

We also enclose several soil profiles which provide soil categorization based upon elevation. Water was encountered at depths of thirteen (13) to eighteen (18) feet. The highest water elevation is 334.0 (along the west, north and center areas). Where the surface is lower (eastern and southern areas), the water levels are somewhat lower.

It has been a pleasure to perform this work for you. If we can be of any further assistance, please do not hesitate to call on us.

Very truly yours,

MAXIM TECHNOLOGIES, INC.

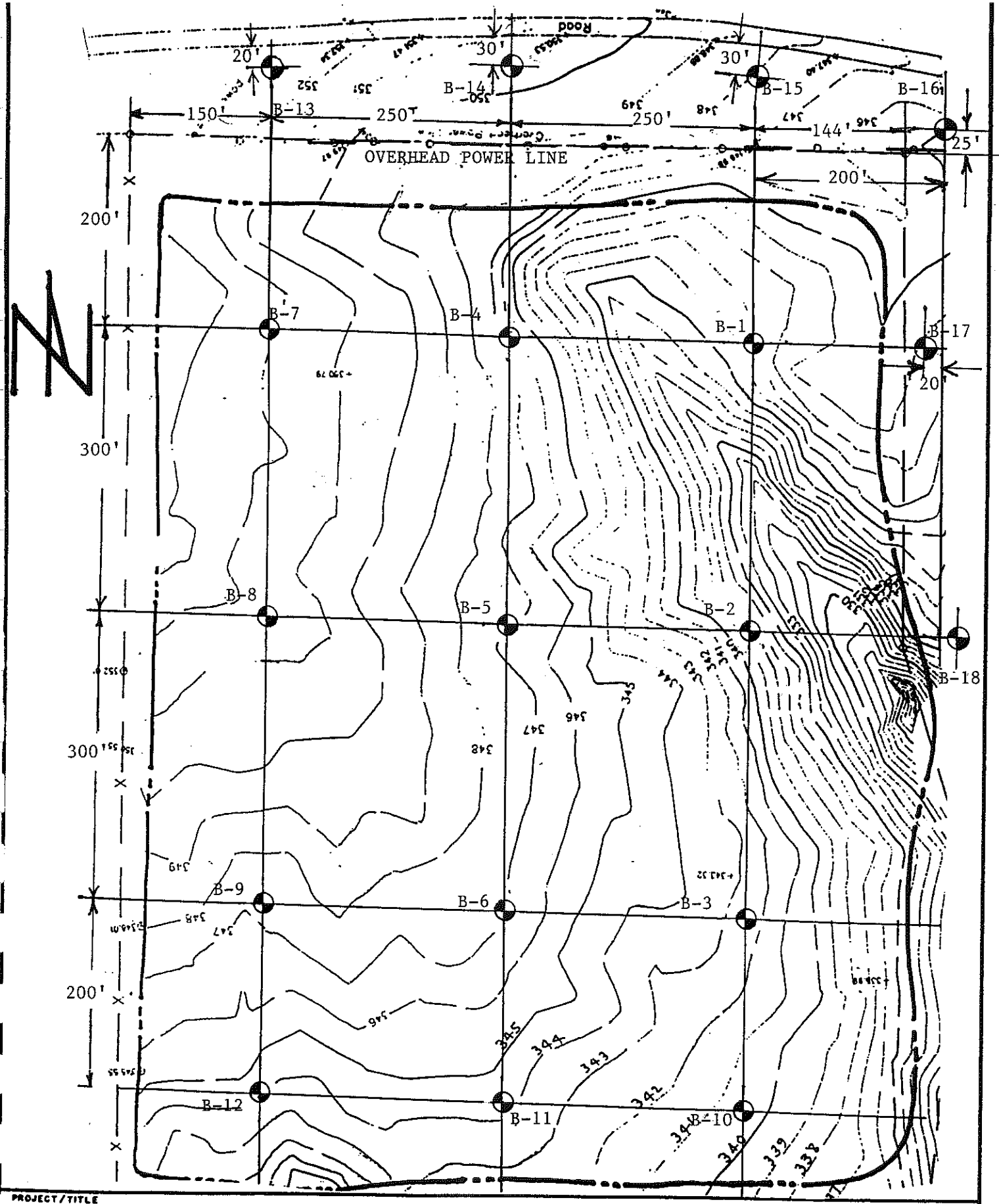
Gene Gardner

Gene Gardner, P.E.
Geotechnical Manager

Lloyd G. Hoover, P.E.
Louisiana District Manager

GG/LGH:mfh

cc: (3) client



PROJECT/TITLE

ASH STORAGE AREA - WELSH POWER PLANT

BORING LOCATION DIAGRAM

SITE LOCATION

CASON, TEXAS

SCALE: 3/4" = 100'

MAXIM FILE #000444

LOG OF BORING NO. B-1

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: ~~342.0~~ 341.86

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at thirteen (13) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey sandy silt top soil — 0.5
	5			20					55				Tan to red clayey sandy silt (ML)
				18		25	18	7					
				14		21	17	4	57				-- Reddish tan
				10									— 8.0
	10			20					63				Tan to gray sandy silt (ML)
				26									— 13.0
				30					30				Tan and gray silty sand (SM)
	15												— 15.0
													Bottom of boring
	20												
	25												

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

REMARKS:

LOG OF BORING NO. B-2

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: 341.5

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
				17									Six (6) inches of tan clayey sandy silt topsoil — 0.5
				17		25	18	7	63				Tan clayey sandy silt (ML)
	5			13		NP	NP	NP	61				4.0 Tan and tannish gray sandy silt (ML)
				11									
				16		20	17	3					8.0 Tan and gray clayey sandy silt (ML)
	10			22									
				24									12.0 Gray sandy silt (ML)
	15												15.0 Bottom of boring
	20												
	25												

REMARKS:

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

000444

MAXIM TECHNOLOGIES, INC.

LOG OF BORING NO. B-3

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: 341.5

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey sandy silt topsoil — 0.5
				16 18		23	18	5					Red to tan clayey sandy silt (ML) — 4.0
	5			16 17		27 31	18 19	9 12					Red and light tan very sandy silty clay (CL) — 8.0
	10			12 13 19					42				Tan and gray clayey silty sand (SC) — 15.0
	15			24					65				Gray and tan sandy silt (ML) — 17.0
													Gray and tan silty sand (SM) — 19.0
	20												Bottom of boring
	25												

REMARKS:

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

LOG OF BORING NO. B-4

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: 346.4

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
				19					50				Six (6) inches of tan clayey sandy silt topsoil — 0.5
													Tan silty sand (SM) — 2.0
				19		27	18	9					Reddish tan silty sandy clay (CL)
	5			13					70				
				15									
				12									
	10			20					51				Tan sandy silt (ML) — 10.0
			▽	26									
	15												Bottom of boring — 15.0
	20												
	25												

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

REMARKS:

LOG OF BORING NO. B-5

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: 347.2

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: No waater was encountered

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey sandy silt topsoil 0.5
				23									Reddish tan silty sandy clay (CL)
				19		29	19	10					
	5			19		26	18	8					
													6.0
				14									Tan silty sand (SM)
				15					49				
	10			18									
				11					34				-- Light tan and gray
	15												15.0
													Bottom of boring
	20												
	25												

REMARKS:

TUBE SAMPLE	AUGER SAMPLE	SPLIT-SPOON	ROCK CORE	THD CONE PEN.	NO RECOVERY

LOG OF BORING NO. B-6

PROJECT: Ash Storage Area Phase II-Welsh Power Plant | **SHEET** 1 of 1

CLIENT: Southwestern Electric Power Company | **LOCATION:** Cason, Texas

DATE: 4/6/00 | **SURFACE ELEV:** 345.9

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey sandy silt topsoil 0.5
	5			18 19 17 17 14		27 28	18 19	9 9					Tan to red silty sandy clay (CL) 10.0
	10			17 17		16	16	NP	53				Reddish tan sandy silt (ML) -- Tan 15.0
	15												Bottom of boring
	20												
	25												

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

REMARKS:

LOG OF BORING NO. B-7

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: 351.6

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at eighteen (18) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
				18		NP	NP	NP					Tan and gray sandy silt (ML)
				20		NP	NP	NP					
													4.0
	5			16									Reddish tan clayey sandy silt (ML)
				12		25	18	7					-- Red
				12									
	10			19		22	17	5					-- Red and tan
													11.0
				22					39				Tan to gray silty sand (SM)
	15			24									-- Tan
			▽	25									
	20												20.0
													Bottom of boring
	25												

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

REMARKS:

LOG OF BORING NO. B-8

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: 350.7

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at seventeen (17) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey sandy silt topsoil — 0.5
	5			21									Red to reddish tan silty sandy clay (CLS)
				22		34	20	14					
				20									-- Gray and red
				17		34	20	14					-- Red to reddish tan — 8.0
	10			13									Reddish tan sandy silt (ML)
				13		NP	NP	NP					— 11.0
													Tan silty sand (SM)
	15			23									
				23									
				26		NP	NP	NP	44				— 20.0
	20												Bottom of boring
	25												

DESCRIPTION OF STRATUM

REMARKS:

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

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MAXIM TECHNOLOGIES, INC.

LOG OF BORING NO. B-9

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: 346.8

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

FIELD DATA				LABORATORY DATA										
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM	
													Six (6) inches of tan clayey sandy silt topsoil	0.5
				16									Tan clayey sandy silt (ML)	
				18										
	5			16		25	18	7						5.0
													Red and reddish tan silty sand (SM)	
				10										
				12		NP	NP	NP						9.0
	10												Tan silty sandy clay (CL)	
				16		35	20	15						12.0
													Tan silty sand (SM)	
				22										
	15													15.0
													Bottom of boring	
	20													
	25													

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

REMARKS:

LOG OF BORING NO. B-10

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: ~~340.4~~ 337.64

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey sandy silt topsoil — 0.5
	5			17									Reddish tan silty sandy clay (CL)
				18		31	19	12					
				14		34	20	14					-- Reddish gray to tannish gray
				16									-- Tan
	10			15		28	19	9					-- Reddish tan
				17									-- Tannish gray
				20		30	19	11					14.0
	15												Tan clayey sand (SC) — 15.0
													Bottom of boring
	20												
	25												

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

REMARKS:

LOG OF BORING NO. B-11

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: ~~344.2~~ 342.01

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fifteen (15) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of clayey sandy silt topsoil 0.5
				18									Tan to tan gray silty sandy clay (CL)
				17		29	19	10					4.0
	5			16		32	19	13					Gray and tan sandy silty clay (CL)
				14									
				14		29	19	10					
	10			16									
													13.0
				19		17	16	1					Light tan clayey silty sand (SC)
	15		▽										15.0
													Bottom of boring
	20												
	25												

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

REMARKS:

LOG OF BORING NO. B-12

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/6/00

SURFACE ELEV: ~~344.0~~ 342.84

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey sandy silt topsoil — 0.5
	5			18 20 15		41 37	21 20	20 17					Reddish tan silty sandy clay (CL) — 6.0
				14					47				Yellowish tan to tannish gray slightly clayey silty sand (SC) — 8.0
	10			13 15		36	20	16					Tan and gray sandy silty clay (CL) — 13.0
			▽	15		17	16	1					Tan and gray slightly clayey silty sand (SC) — 15.0
	15												Bottom of boring
	20												
	25												

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

REMARKS:

LOG OF BORING NO. B-13

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/18/00

SURFACE ELEV: ~~353.0~~ 351.84

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: No water was encountered

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey sandy silt topsoil (ML) 0.5
				21									Mottled red and tan sandy silty clay (CL)
				21		28	19	9					
	5			21					74				
				20		39	21	18					
				19									
	10			19		32	19	13					
				18		36	20	16					-- Tan and gray
	15			19									
				18									
	20												20.0
													Bottom of boring
	25												

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

REMARKS:

LOG OF BORING NO. B-14

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/18/00

SURFACE ELEV: ~~350.5~~ 349.23

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encouhntered at eighteen (18) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey sandy silt topsoil (ML) 0.5
				16		25	18	7					Mottled red and tan clayey sandy silt (ML) 2.0
				18		27	18	9					Mottled red and gray sandy silty clay (CL)
	5			19									
				19		36	20	16					
				20									
	10			18									
				19		30	19	11					
	15			21									
			▽	64					70				Tan clayey sandy silt 18.0
	20												Bottom of boring 20.0
	25												

REMARKS:

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

LOG OF BORING NO. B-15

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/18/00

SURFACE ELEV: ~~348.0~~ 348.24

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at sixteen (16) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey sandy silt topsoil (ML) 0.5
	5			16									Reddish tan silty sandy clay (CL)
				16		32	19	13					-- with iron ore nodules
				18		33	20	13					-- red and gray mottled
				14									
	10			12		32	19	13					10.0
				12					18				Tan fine silty sand (SM)
	15			18									13.0
				21									Tan and gray very silty clay (CL)
				22		28	19	9					-- With gray silty clay stringers
	20												20.0
													Bottom of boring
	25												

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

REMARKS:

LOG OF BORING NO. B-16

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/18/00

SURFACE ELEV: ~~346.0~~ 345.44

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at nineteen (19) feet.

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
													Six (6) inches of tan clayey silty sand topsoil (SC) 0.5
				13					61				Reddish tan and gray silty sandy clay (CL)
	5			16									
				16		32	19	13					
													6.0
				15		25	18	7					Tan clayey sandy silt (ML)
	10			19									
				20									
				20					59				
	15			20									-- With thin clay stringers
			▽	21									
	20												20.0
													Bottom of boring
	25												

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

LOG OF BORING NO. B-17

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/18/00

SURFACE ELEV: ~~342.0~~ 342.72

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: No water encountered

FIELD DATA				LABORATORY DATA									
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI	DESCRIPTION OF STRATUM
				16					50				Six (6) inches of tan clayey silty sand topsoil (SC) 0.5
	5			16		25	18	7					Tan clayey silty sand (SC)
				12									
				10									
				10									
													9.0
	10			17					51				Tan silty sand (SM)
													-- With clayey sand pockets
	15												15.0
													Bottom of boring
	20												
	25												

REMARKS:

TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

000444

MAXIM TECHNOLOGIES, INC.

LOG OF BORING NO. B-18

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

SHEET 1 of 1

CLIENT: Southwestern Electric Power Company

LOCATION: Cason, Texas

DATE: 4/18/00

SURFACE ELEV: ~~336.0~~ 338.72

DRILLING METHOD(S): Auger

GROUNDWATER INFORMATION: Water was encountered at fourteen (14) feet.

FIELD DATA				LABORATORY DATA										DESCRIPTION OF STRATUM
SOIL & ROCK SYMBOL	DEPTH (FT)	SAMPLE TYPE	N: SPT, BLOWS/FT T: THD, BLOWS/FT P: HAND PEN, TSF	MOISTURE CONTENT, %	DRY DENSITY POUNDS/CU.FT	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	MINUS NO. 200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN (%)	CONFINING PRESSURE PSI		
	0													Six (6) inches of tan clayey silty sand topsoil (SC) 0.5
	5			15 15 11 10					35					Tan silty sand (SM) with red and gray clay lumps 8.0
	10			14 19 24					42 82					Gray silty sand (SM) 15.0
	15													Bottom of boring
	20													
	25													

REMARKS:

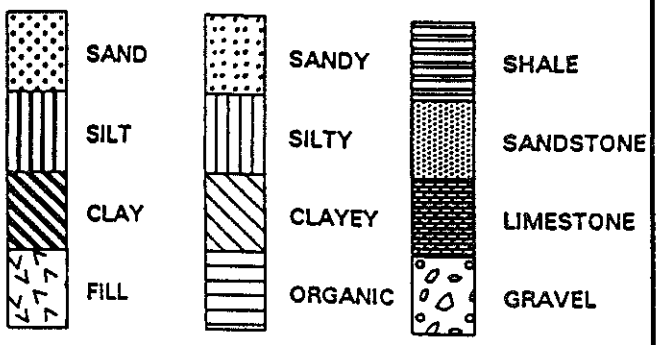
TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

000444

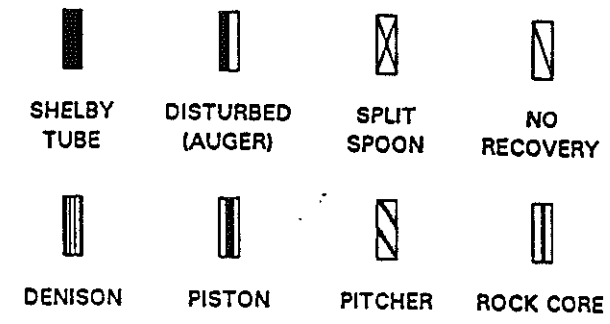
MAXIM TECHNOLOGIES, INC.

KEY TO SOIL CLASSIFICATION TERMS AND SYMBOLS

SOIL OR ROCK TYPES



SAMPLER TYPES



CONSISTENCY OF COHESIVE SOILS (MAJOR PORTION PASSING NO. 200 SIEVE)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH, KIPS/SQ FT
VERY SOFT	LESS THAN 0.25
SOFT	0.25 TO 0.5
FIRM	0.5 TO 1.0
STIFF	1.0 TO 2.0
VERY STIFF	2.0 TO 4.0
HARD	GREATER THAN 4.0

RELATIVE DENSITY OF GRANULAR SOILS (MAJOR PORTION RETAINED ON NO. 200 SIEVE)

DESCRIPTIVE TERM	RELATIVE DENSITY,%
VERY LOOSE	LESS THAN 15
LOOSE	15 TO 35
MEDIUM DENSE	35 TO 65
DENSE	65 TO 85
VERY DENSE	GREATER THAN 85

WATER LEVELS

▼ - DEPTH GROUNDWATER FIRST ENCOUNTERED DURING DRILLING

▽ - GROUNDWATER LEVEL AFTER 24 HOURS (UNLESS OTHERWISE NOTED)

TERMS DESCRIBING SOIL STRUCTURE

Parting: paper thin in thickness

Seam: 1/8" - 3" in thickness

Layer: greater than 3" in thickness

Calcareous: containing appreciable quanties of calcium carbonate

Ferrous: containing appreciable quantities of iron

Well-graded: having wide range in grain size & similar proportions of all intermediate sizes

Poorly graded: predominately one grain size or having a range of sizes with few or no particles of some intermediate sizes

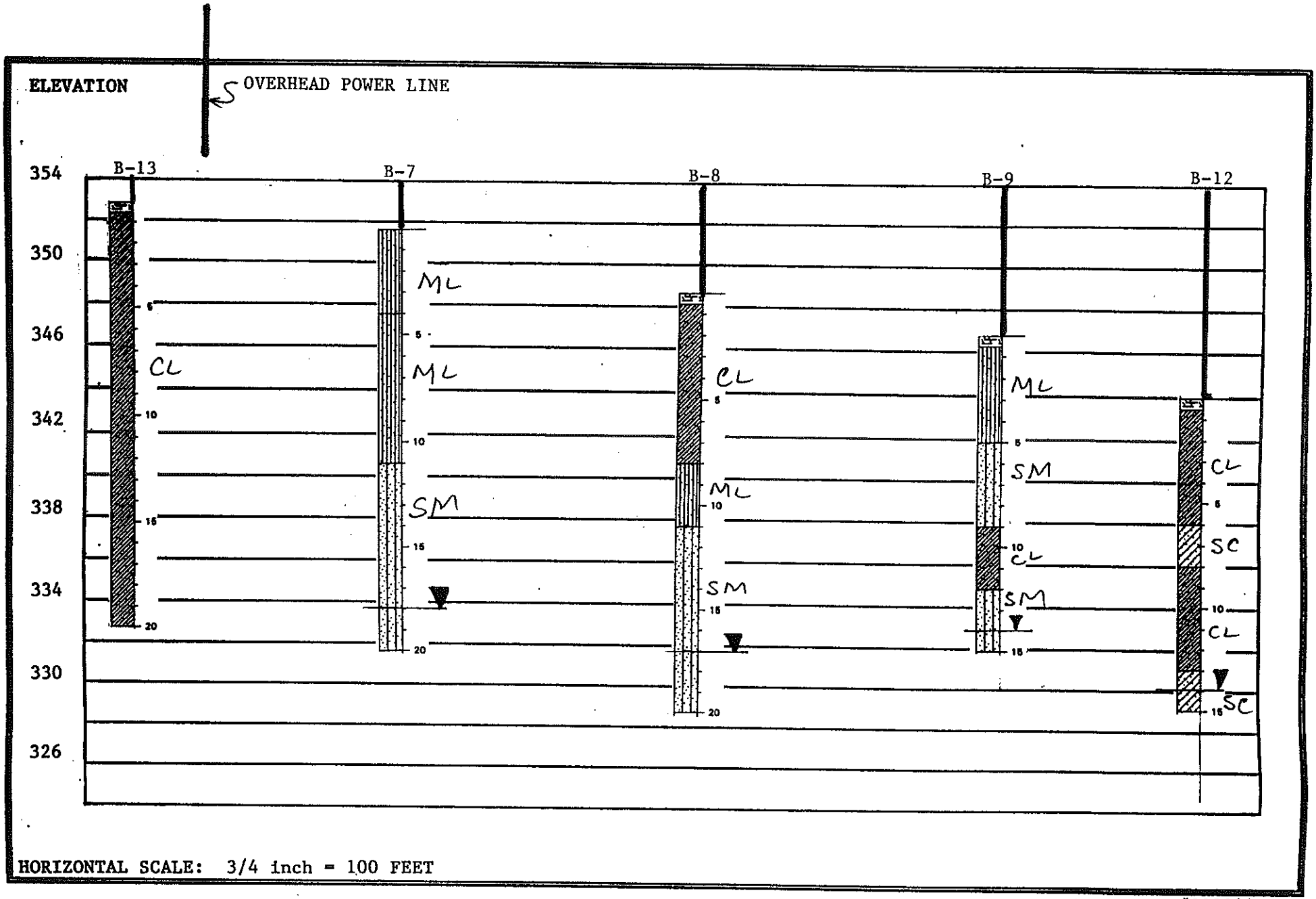
Fissured: containing shrinkage cracks, frequently filled with fine sand or silt, usually more or less vertical

Interbedded: composed of alternate layers of different soil types

Laminated: composed of thin layers of varying color and texture

Slickensided: having inclined planes of weakness that are slick & glossy in appearance

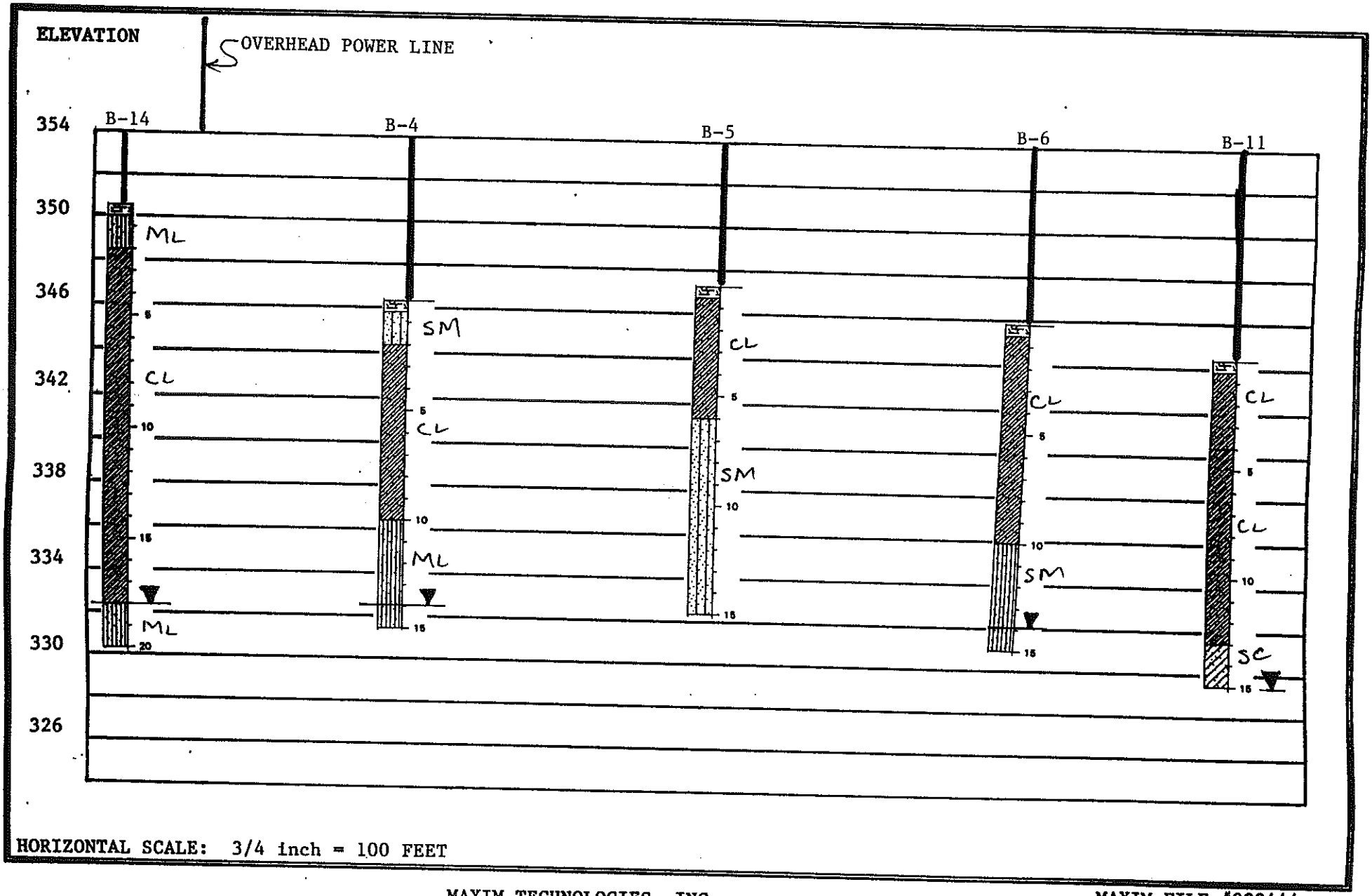
NOTE: Clays possessing slickensided or fissured structure may exhibit lower measured shear strength than indicated by the described consistency. The consistency of such soil is interpreted using the measured shear strength along with pocket penetrometer results.



HORIZONTAL SCALE: 3/4 inch = 100 FEET

MAXIM TECHNOLOGIES, INC.

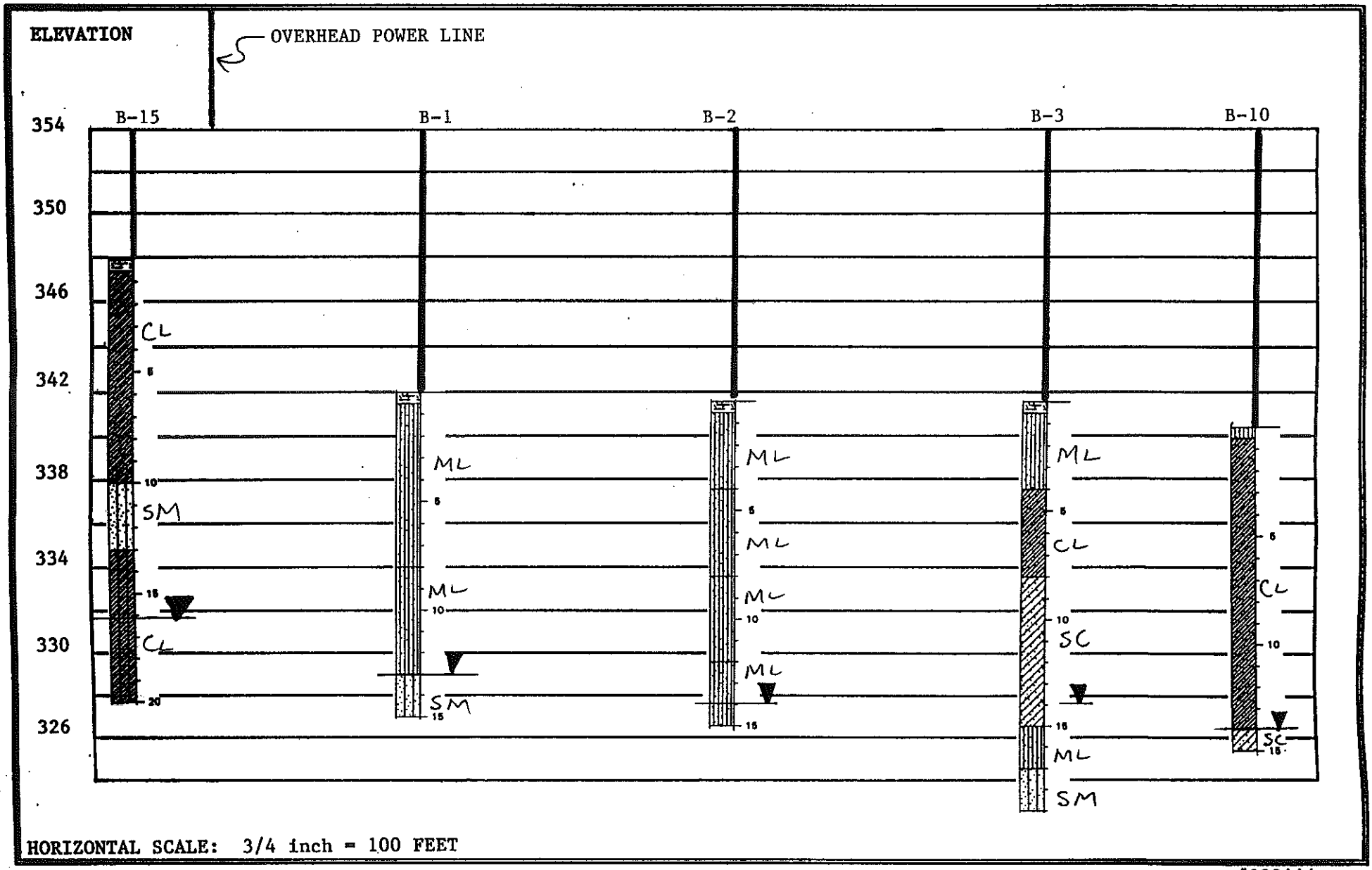
MAXIM FILE #000444



HORIZONTAL SCALE: 3/4 inch = 100 FEET

MAXIM TECHNOLOGIES, INC.

MAXIM FILE #000444

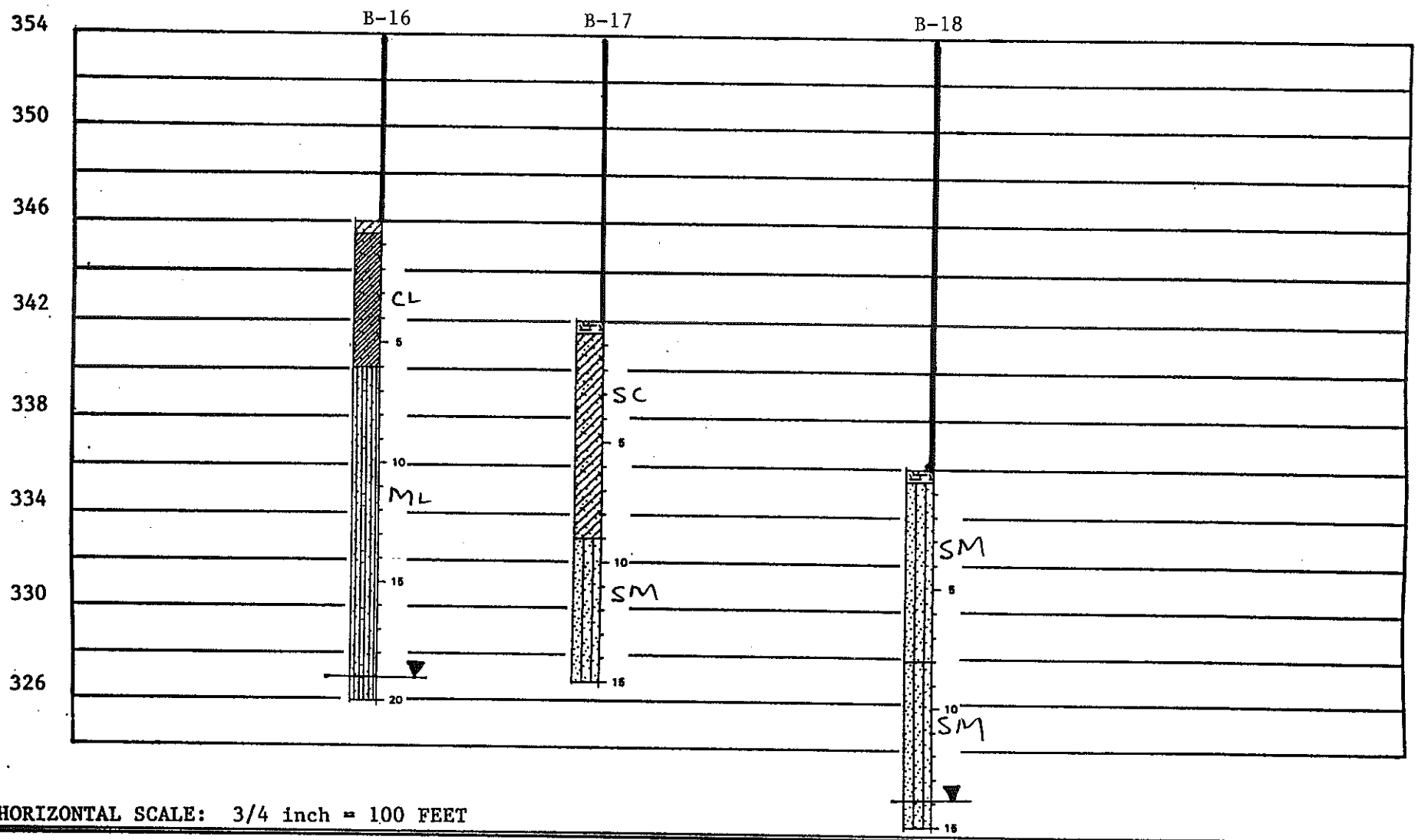


HORIZONTAL SCALE: 3/4 inch = 100 FEET

MAXIM TECHNOLOGIES, INC.

MAXIM FILE #000444

ELEVATION

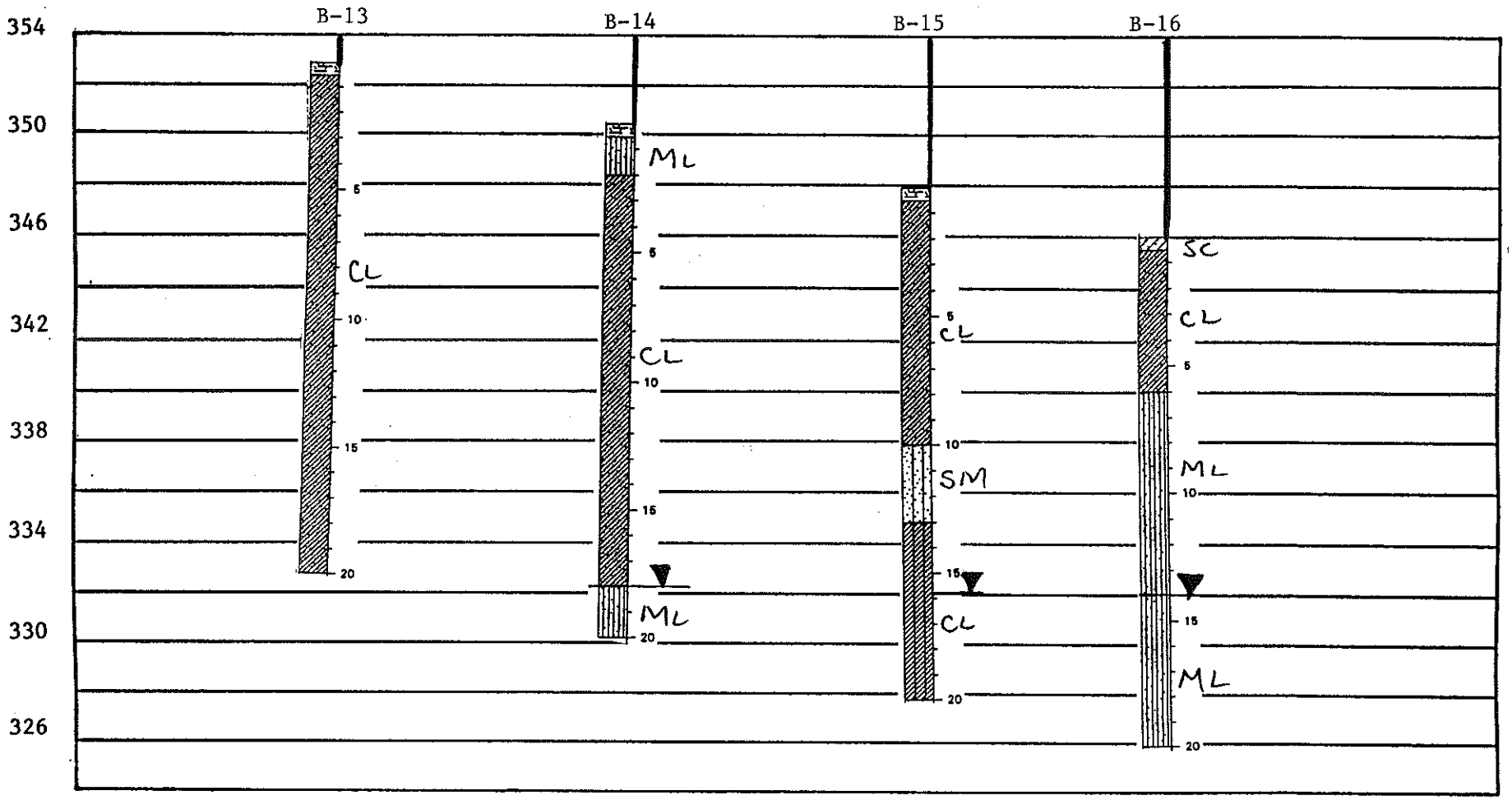


HORIZONTAL SCALE: 3/4 inch = 100 FEET

MAXIM TECHNOLOGIES, INC.

MAXIM FILE #000444

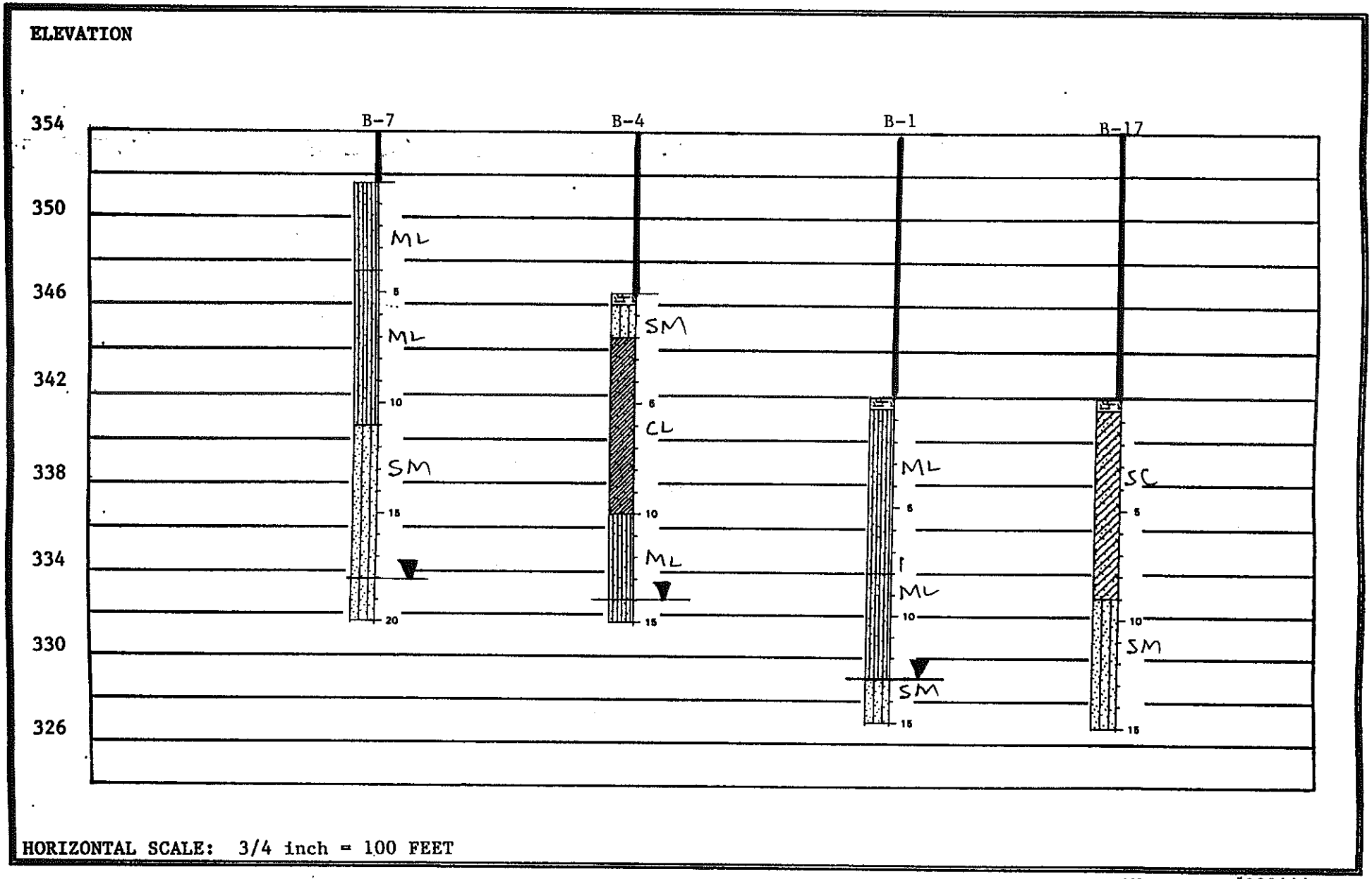
ELEVATION



HORIZONTAL SCALE: 3/4 inch = 100 FEET

MAXIM TECHNOLOGIES, INC.

MAXIM FILE #000444

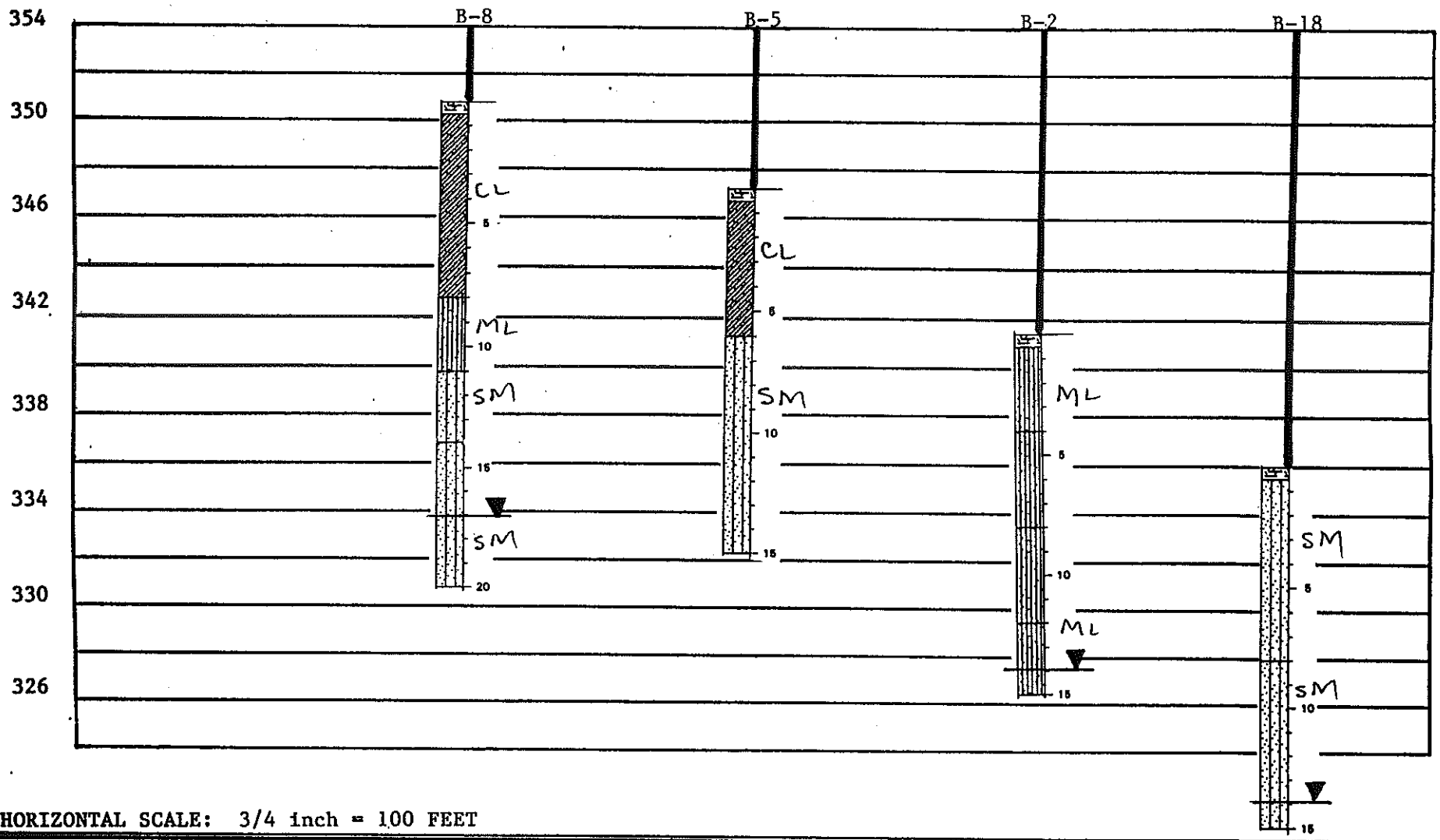


HORIZONTAL SCALE: 3/4 inch = 100 FEET

MAXIM TECHNOLOGIES, INC.

MAXIM FILE #000444

ELEVATION

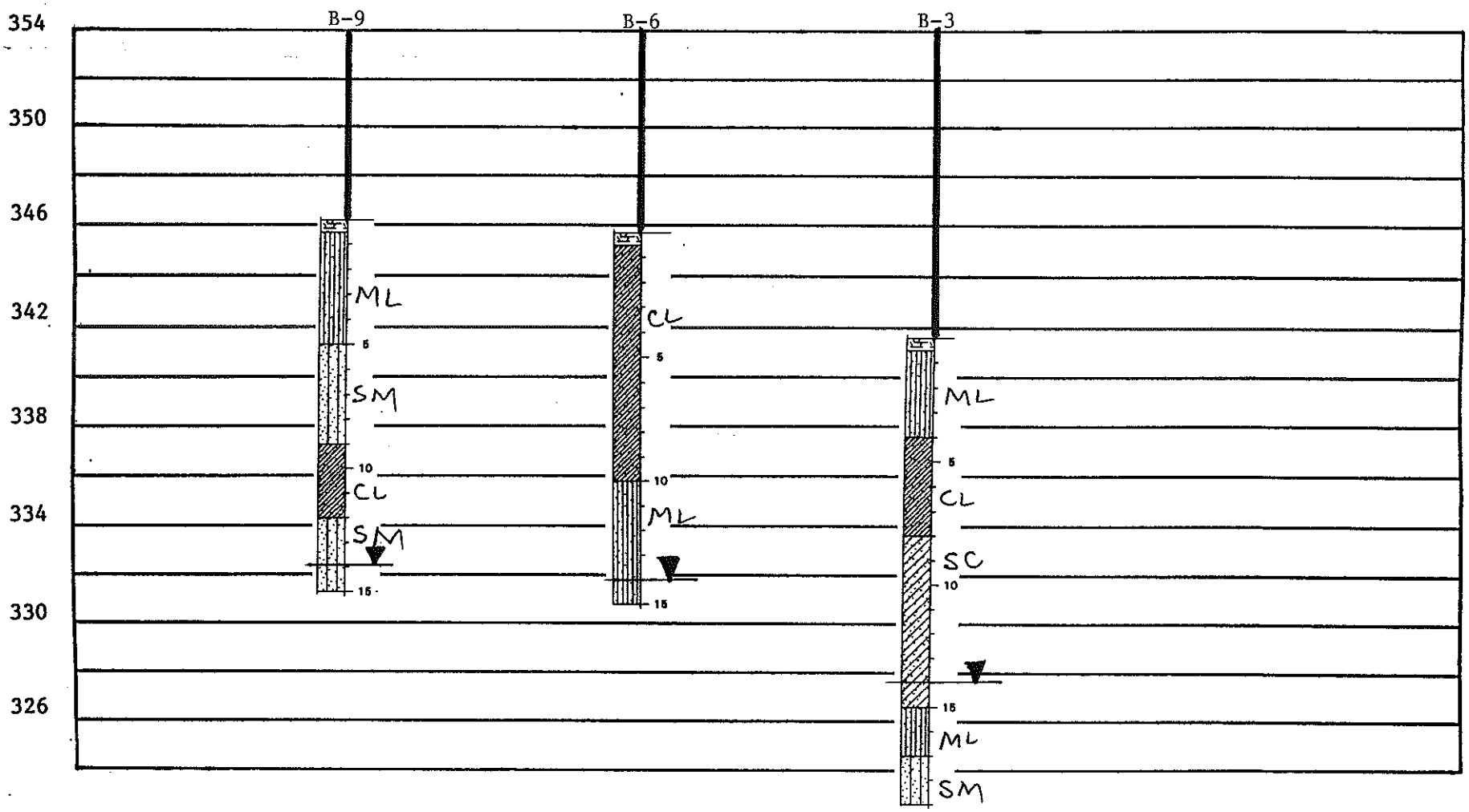


HORIZONTAL SCALE: 3/4 inch = 100 FEET

MAXIM TECHNOLOGIES, INC.

MAXIM FILE #000444

ELEVATION

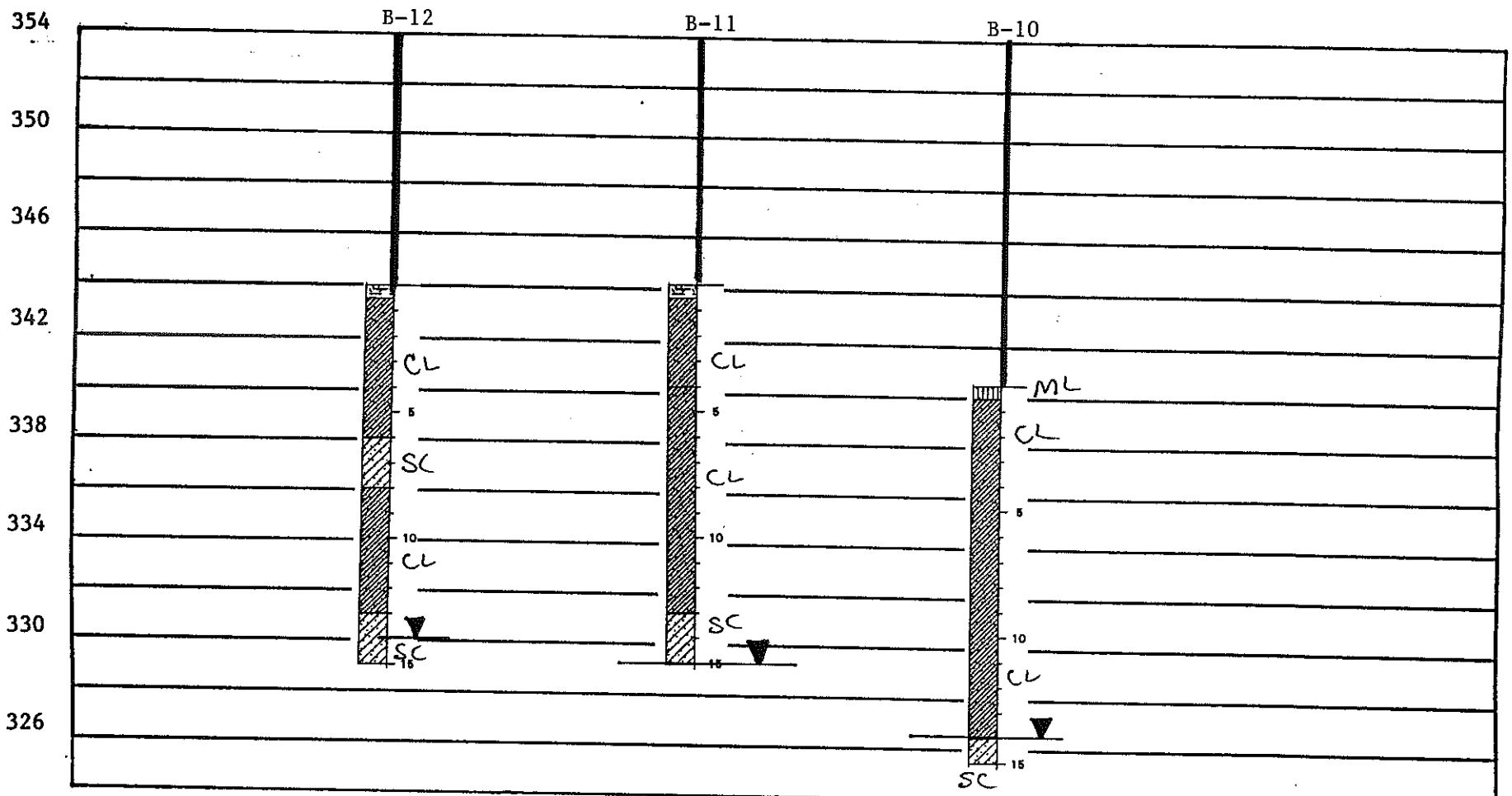


HORIZONTAL SCALE: 3/4 inch = 100 FEET

MAXIM TECHNOLOGIES, INC.

MAXIM FILE #000444

ELEVATION



HORIZONTAL SCALE: 3/4 inch = 100 FEET

MAXIM TECHNOLOGIES, INC.

MAXIM FILE #000444

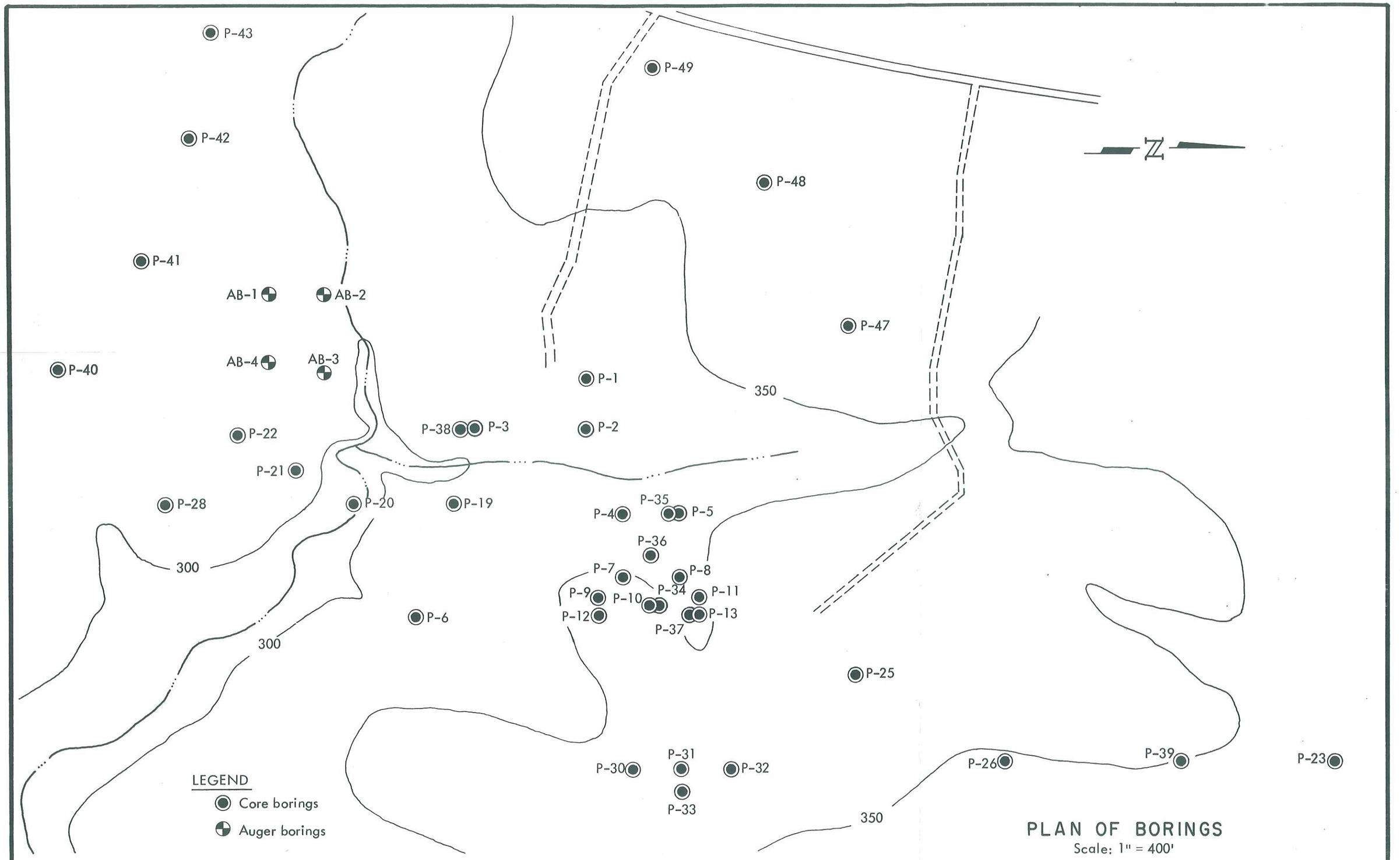
PRELIMINARY REPORT

SOILS INVESTIGATION
WELSH POWER PLANT
CASON, TEXAS

Report to

SOUTHWESTERN ELECTRIC POWER COMPANY
Shreveport, Louisiana

McClelland engineers, inc.
geotechnical consultants



PLAN OF BORINGS

Scale: 1" = 400'

McCLELLAND ENGINEERS

PLATE 1

McClelland engineers, inc. / geotechnical consultants

6100 HILLCROFT / HOUSTON, TEXAS 77036
TEL. 713 / 772-3701 / TELEX 762-447

August 31, 1973
Job No. 73-085

Southwestern Electric Power Company
P. O. box 1106
Shreveport, Louisiana 71156

Attention: Mr. W. H. Holley

Preliminary Report
Soils Investigation
Welsh Power Plant
Cason, Texas

Gentlemen:

Presented here are the logs of borings and the results of laboratory soil tests made to investigate soil conditions at the proposed Welsh Power Plant near Cason, Texas. This study was authorized by your Purchase Order No. Y-14567 dated March 27, 1973 and was performed in accordance with our letters of February 20, March 20, and April 30, 1973.

Soil conditions at the site were investigated by 38 undisturbed-sample or core borings and 4 disturbed-sample or auger borings drilled at the locations shown on Plate 1. The core borings were drilled to depths ranging from 25 to 198.5 ft, and the auger borings were drilled to depths ranging from 12.5 to 20 ft. Samples of the foundation materials were obtained in general accordance with specifications issued by Sargent & Lundy. Samples were generally obtained at about 5-ft intervals in the core borings using 3-in. thin-wall-tube, 2-in. split-barrel and Denison barrel samplers. Samples were obtained continuously in the auger borings using a 4-in. auger.

Detailed descriptions of the soils encountered in the borings are given on the logs of borings presented on Plates 2 through 43. The logs of borings presented on Plates 31 through 43 are presented in preliminary form and will be resubmitted in final form when laboratory testing on samples from these borings is complete. Most of the terms and symbols appearing on the logs are identified on Plate 44.

The following tabulation gives the types of soil tests performed and the symbols used in plotting test results on the logs of borings.

Type of Test	Symbol
Shear Strength	
Unconfined Compression	○
Unconsolidated-undrained Triaxial	△
Hand Penetrometer	⊗
Water Content	●
Plastic and Liquid Limits	+------+
Consolidation	(see Plates 45 thru 57)
Specific Gravity	(recorded with consolidation test results)
Sieve Analysis	(see Plates 58 thru 60)
Percent finer than No. 200 Sieve	(listed under -#200,% on logs)

Blow counts from standard penetration tests are shown in the "Blows Per Foot" column on the boring logs. The results of water level observations in the boreholes are recorded at the bottom of most boring logs.

We appreciate the opportunity to work with you on this project. If you have any questions, please call us.

Very truly yours,

McCLELLAND ENGINEERS, INC.

Clarence J. Ehlers, P.E.
Project Manager

CJE/mmf
Copies Submitted:
Southwestern Electric Power Company: (6)
Sargent & Lundy: (6)

LOG OF BORING NO. P-1

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube, 2" split-barrel & 3" Denison barrel

LOCATION: See Plate 1

SURF. EL: 342.8'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200, %
	Tan sandy silt	3-6-5		
5	Very stiff red & light gray sandy clay with ferrous nodules	11-18-35		
10	Red silty fine sand			50
	-with clay seams and pockets and sandstone nodules, 13' to 19'	10-9-10		16
15	-gray below 18'			
20		7-24-22		21
25	-with lignite seams, 24' to 26'	9-17-33		
	-with sandstone layer, 28' to 29.5'			
30	Hard gray clay -with silt partings and seams	18-23-43		
35		17-40-60/3"		
40		33-60/6"		
45	Gray sandy silt with organic pockets and seams	33-48-60/5"		Non-Plastic
50	Hard brown and gray clay with sand pockets and partings	24-42-60/6"	109	2.0 / 65
	(Continued on next page)			

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10 20 30 40 50 60 70

McCLELLAND ENGINEERS

PLATE 2

LOG OF BORING NO. P-1 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	- #200, %
55			Gray silty fine sand	42-60/5"			
60				31-60/6"		● Non-Plastic	
65				40-60/6"			
70			Hard gray clay -with sandy silt partings and pockets to 70.5'	25-38-60/5"			
75			-with sandstone seams and layers below 70.5'				
80							
85							
90							
95							
100							

COMPLETION DEPTH: 75'
DATE: April 26, 1973

DEPTH TO WATER IN BORING: 8.0'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 2a

LOG OF BORING NO. P-2

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube, 2" split-barrel & 3" Denison barrel LOCATION: See Plate 1

SURF. EL: 338.8'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT
0	Very stiff red and tan sandy clay	1-1-3
	-with sand pockets and seams at 2.5' to 5'	
5		8-9-10
	Red silty fine sand	
	-with sandy clay pockets and seams to 15'	16-13-16
10	-with ferrous nodules to 16'	
	-with light gray clay seams, 9' to 15'	
15		4-5-7
	-sandstone layer, 16.5' to 17'	
	-gray below 17'	
20		9-14-18
	-lignite layer, 21' to 23'	
25	Very stiff gray clay	11-14-13
	-with sand pockets and seams to 25'	
	-with silt partings, seams, & pockets below 25'	7-14-18
30		
35	Gray fine sand	
	Hard gray clay with sand pockets and partings	15-32-60/4"
40		
	Gray silty fine sand	
45	-with clay pockets to 49'	20-30-60/3"
	-clayey sand layer, 48.5' to 49'	
		28-60/6"
50	(Continued on next page)	

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

UNIT DRY WT LB/CU FT

-#200, %: 28

1.35+

4.0

McCLELLAND ENGINEERS

PLATE 3

LOG OF BORING NO. P-2 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-#200, %
55			Gray silty fine sand	29-46-60/3"			
60				29-37-60/3"			24
			-with clay pockets, 61.5' to 64'				
65				22-31-60/3"			
			Hard gray clay with sand pockets and mica				
70			-sandstone layer, 68' to 68.5'	16-24-48		2.8 ⊗→	
75				33-60/3"			
80							
85							
90							
95							
100							

COMPLETION DEPTH: 74.5'
DATE: April 28, 1973

DEPTH TO WATER IN BORING: 13.3'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 3a

73-085

LOG OF BORING NO. P-3

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube
2" split-barrel & 3" Denison barrel

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)
			SURF. EL: 329.4'			
			Stiff red clay with sand pockets and seams -with ferrous partings, 3.5' to 4.5'			
5						
			Red silty fine sand with ferrous nodules and sandy clay seams and partings -with sandstone nodules, 8' to 13'			
10						
			-with sandstone layer, 14' to 15'			
15						
			-with coarse sand and gravel, 18.5' to 19'			
20						
			Hard gray clay -with sand pockets to 28'			4.2 ⊗→
25						
			-with silt partings and pockets below 28'		99	3.3 ⊗→
30						
						4.6 ⊗→
35						
			Gray silty fine sand with clay pockets and seams	35-50/6"		
40						
			Hard gray sandy clay with sand pockets		110	
45						
			Gray silty fine sand -lignite layer, 49.5' to 50'			
50						
			(Continued on next page)			

McCLELLAND ENGINEERS

PLATE 4

Form 108-3, 1971, Job No. 73-085

LOG OF BORING NO. P-3 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
			Gray silty fine sand		
55			Hard gray clay -with organic partings to 55' -with sandy silt pockets and partings below 58'	29-35-15	
60					
65			Gray sandy silt	50/5"	
70			Hard gray sandy clay -with silt pockets to 70'		109
75					
80					
85					
90					
95					
100					

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

3.3
3.5
4.5

COMPLETION DEPTH: 75'
DATE: April 17, 1973

DEPTH TO WATER IN BORING: 10.4'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 4a

LOG OF BORING NO. P-4

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel

LOCATION: See Plate 1

SURF. EL: 343.7'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	Tan silty fine sand		
	Very stiff red and tan very silty clay		
5	-with sand pockets to 4'		112
	Stiff red and tan very sandy clay		
10	-with sandstone seams and nodules, 6' to 8.5'		
15	Tan and light gray silty fine sand with clay seams and pockets and scattered gravel		
20	Stiff tan and light gray sandy clay with sand and ferrous seams		
25	-gray below 23.5'	13-6-10	
	Gray silty fine sand with sandstone nodules	18-50/9"	
30			
35	Very stiff gray clay -with sandy silt pockets, partings, and seams to 43'	11-14-25	
40		17-50/8"	
45	Gray silty fine sand -clayey fine sand, 46' to 53'	43-50/5"	
50			110
	(Continued on next page)		

COHESION, TON/SQ FT: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10, 20, 30, 40, 50, 60, 70

-#200, %: 48, 70

2.3

McCLELLAND ENGINEERS

PLATE 5

LOG OF BORING NO. P-4 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)
55			Gray silty fine sand -clayey to 53'			
60				50-50/4"		
65				50-50/3"		
70			-clayey below 68'	25-50/5"		+ ● +
75				33-50/5"		
			-sandstone below 78'			
80			Hard gray sandy clay with sand pockets and partings -with silt partings and pockets to 93'	32-50/4"		● 1.35+ ⊗→
85						● 1.35+ ⊗→
90						1.35+ ⊗→
95						1.35+ ⊗→
100						● 1.35+ ⊗→

COMPLETION DEPTH: 100'
DATE: March 28, 1973

DEPTH TO WATER IN BORING: 17.3' Caved at: 34'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 5a

LOG OF BORING NO. P-5
WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-#200, %
			SURF. EL: 344.1'				
			Very stiff red & tan very sandy clay -with sandstone nodules to 2.5' -with ferrous deposits, 2' to 4'				
5			Red and tan silty fine sand with light gray clay partings, pockets and seams -with sandstone nodules to 23'	10-20-23			32 33
10			-tan, 13' to 23'				
15			-with ferrous partings and seams, 17' to 23'				
20			-gray below 23'				
25			-gray clay, 23' to 23.5'				
30			Hard gray sandy clay with sand pockets and partings		103	2.2	
35			Gray silty fine sand -with clay pockets and seams to 35'				
40			Hard gray sandy clay		110	2.3	
45			Gray clayey fine sand	30-50/6"			
50			(Continued on next page)				

LOG OF BORING NO. P-5 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-#200, %
			Gray clayey sand				
55			Gray silty fine sand	35-50/6"			
60				30-50/6"			28
65				40-50/5"			
70			Hard gray sandy clay	25-50/5"			
			-with sandstone layer, 71.5' to 72'				
75			-with sandy silt pockets below 73'			1.35+	
80				50/6"		1.35+	
85							
90			Gray silty fine sand	50/6"			
95				65/6"			
100							

COMPLETION DEPTH: 100'
DATE: March 22, 1973

DEPTH TO WATER IN BORING: 12.5' Caved at: 24'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 6a

LOG OF BORING NO. P-6

WELSH POWER PLANT
CASON, TEXAS

See Plate 1; Offset 29'

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: NNW of staked location

SURF. EL: 322.7' (Approx.)

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT
5	Fill: Tan and light gray clay, intermixed with sandy silt	
10	Very stiff tan & light gray clay -with sand partings and ferrous nodules to 10' -with sand pockets to 15'	
15	-sandstone layer, 15' to 15.5'	
20	Gray silty fine sand with sandstone nodules	
25	Very stiff clay with sand pockets	
30	Gray silty fine sand with clay seams and pockets	14-50/8"
35		22-100/5"
40	Very stiff gray silty clay with silt partings and pockets	
45	Gray sandy silt with clay seams	15-56/12"
50	Hard gray clay with silt seams and partings	26-20/6"
	Gray silty fine sand	
	(Continued on next page)	

UNIT DRY WT LB/CU FT

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10 20 30 40 50 60 70

1.35+

1.35+

1.35+

LOG OF BORING NO. P-6 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
			Gray silty fine sand		
55			Hard gray sandy clay with mica & sand pockets and seams	22-58/6"	
60			Gray sandy silt with clay seams and pockets	39-56/6"	
65			Hard gray clay	30-53/6"	
			-with lignite partings and seams to 66.5'		
70			-with silty sand partings & pockets below 66.5'	36-58/6"	
75			Gray silty sand with sandy clay seams		
80			Gray cemented sand	31-100/7"	
			-with sandstone seams and layers to 78.5'		
85			Hard gray sandy clay with sand pockets and mica	53-87/6"	
90				100/9"	
95			Gray sandy silt with mica	40-60/3"	
100				42-100/5"	

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

1.35+

1.35+

1.35+

COMPLETION DEPTH: 99.5'
DATE: April 12, 1973

DEPTH TO WATER IN BORING: 6.4'

DATE: April 23, 1973

McCLELLAND ENGINEERS

PLATE 7a

Form 108-1 (571) Job No. 73-085

LOG OF BORING NO. P-7

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel

LOCATION: See Plate 1

SURF. EL: 352.8'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
			Tan silty sand		
5			Stiff red and tan sandy clay -very sandy at 4'		
10			Tan silty fine sand -with sandstone nodules to 10' -with clay pockets to 15'		
15					
20			-tan and light gray at 18'		
25			Stiff light gray clay with sand pockets and partings -with ferrous nodules and seams to 30'		91
30					
35			-very stiff gray sandy clay with sand seams and pockets below 33'		
40			Gray clayey fine sand with sandstone nodules and clay pockets		
45				12-50/4"	
50			Very stiff gray sandy clay		

(Continued on next page)

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

McCLELLAND ENGINEERS

PLATE 8

LOG OF BORING NO. P-7 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)
55			Very stiff gray sandy clay			
60			Gray silty fine sand with clay pockets			
65			Hard gray sandy clay with sand pockets	22-50/6"		
70			Gray clayey fine sand		108	
75			Gray silty fine sand			
80			Black lignite	100/6"		
85			Hard gray sandy clay -with sandy silt pockets to 90'			1.35+
90			-with siltstone nodules, 89.5' to 90'			
95				100/3"		
100			-sandstone, 98.5' to 99'			

COMPLETION DEPTH: 99'
DATE: March 29, 1973

DEPTH TO WATER IN BORING: Caved at: 25.0' 74'
DATE: April 23, 1973

McCLELLAND ENGINEERS

PLATE 8a

LOG OF BORING NO. P-8

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-#200, %
			SURF. EL: 346.5'				
			Tan & light gray clayey fine sand				
5			Stiff tan sandy clay -with ferrous nodules and sand pockets to 8' -red and tan at 6'				
10							
15			Light gray silty fine sand with clay seams -with ferrous nodules to 20.5'				32
20							
25							20
30			-red, 29' to 33.5'				
35				11-21-22			31
40			Very stiff gray sandy clay with silt partings and pockets -with sandstone seams, 39' to 42'				
45						1.35+ ⊗→	
50			Gray silty fine sand				
			(Continued on next page)				

McCLELLAND ENGINEERS

PLATE 9

LOG OF BORING NO. P-8 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-#200, %
55			Hard gray sandy clay with sand pockets and partings			1.35+	
60			Gray silty fine sand				38
65			Hard gray sandy clay -with lignite seams to 65'			1.35+	
70						1.35+	
75			-with sandy silt partings and pockets from 74' to 75'	26-50/6"			
80			-with sand pockets and sandstone nodules, 78' to 82'			1.35+	
85			-with sandy silt partings and pockets below 83'			1.35+	
90						1.35+	
95						1.35+	
100			Gray silt with light gray sand partings and pockets				

COMPLETION DEPTH: 100'
DATE: April 8, 1973

DEPTH TO WATER IN BORING: 16.8' Caved at: 44'
DATE: April 23, 1973

McCLELLAND ENGINEERS

PLATE 9a

LOG OF BORING NO. P-9

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel LOCATION: See Plate 1

SURF. EL: 355.8'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)
0	Stiff red and tan sandy clay			
5				
10				
15	-becomes very stiff by 13'			1.35+
20				1.35+
25	Tan fine sand	8-10-15		
30	Very stiff light gray clay -with silt partings to 30'		96	
35	-gray sandy clay with sand pockets and partings below 33'		98	1.6
40	Gray silty fine sand with gray clay seams and partings	15-33-50/3"		
45		15-50/7"		
50	Very stiff gray sandy clay with silt partings -with sand pockets to 50'	10-50/8"		

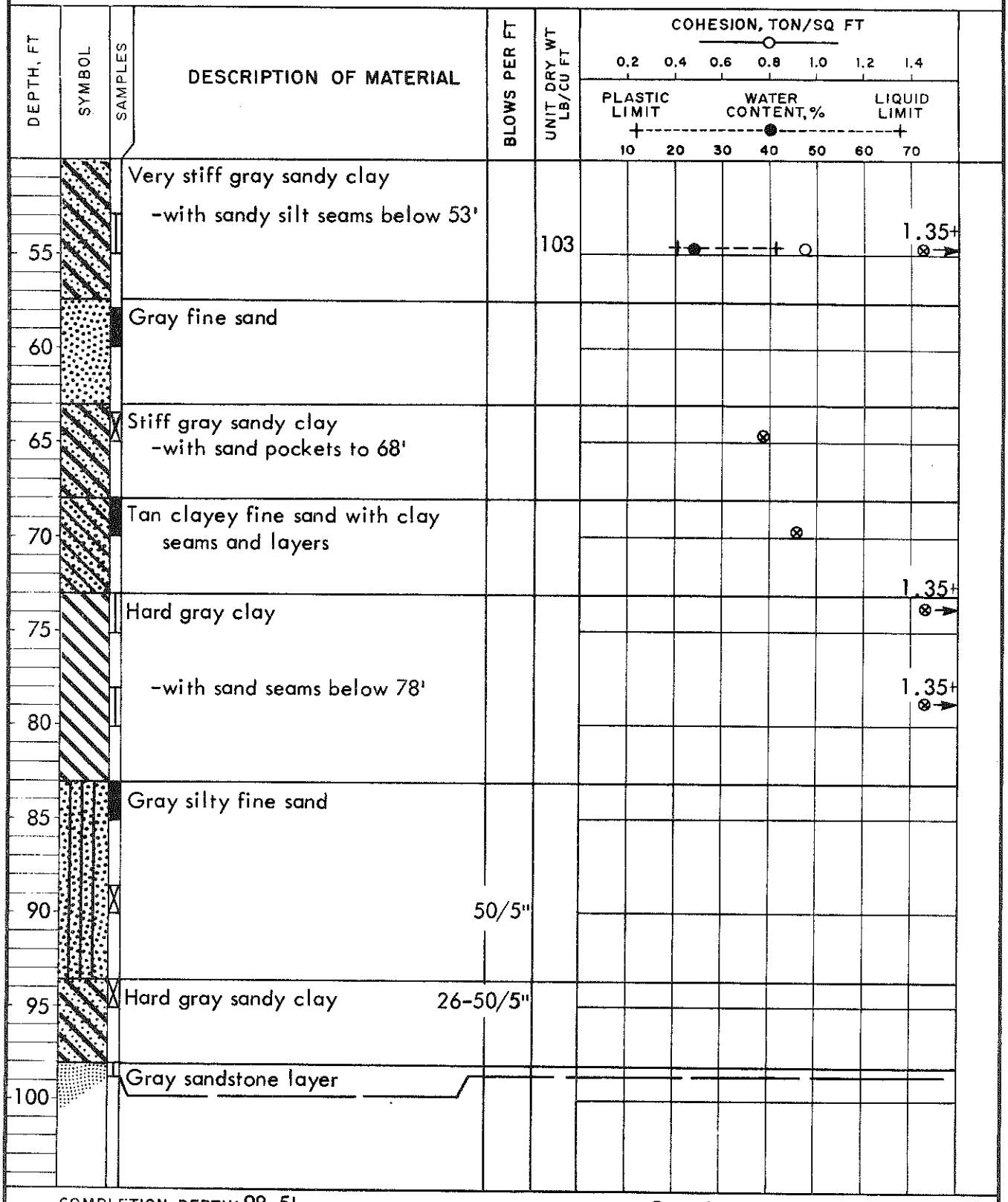
(Continued on next page)

McCLELLAND ENGINEERS

PLATE 10

LOG OF BORING NO. P-9 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS



COMPLETION DEPTH: 98.5'
DATE: April 3, 1973

DEPTH TO WATER IN BORING: 24.3' Caved at: 41'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 10a

LOG OF BORING NO. P-10
WELSH POWER PLANT
CASON, TEXAS

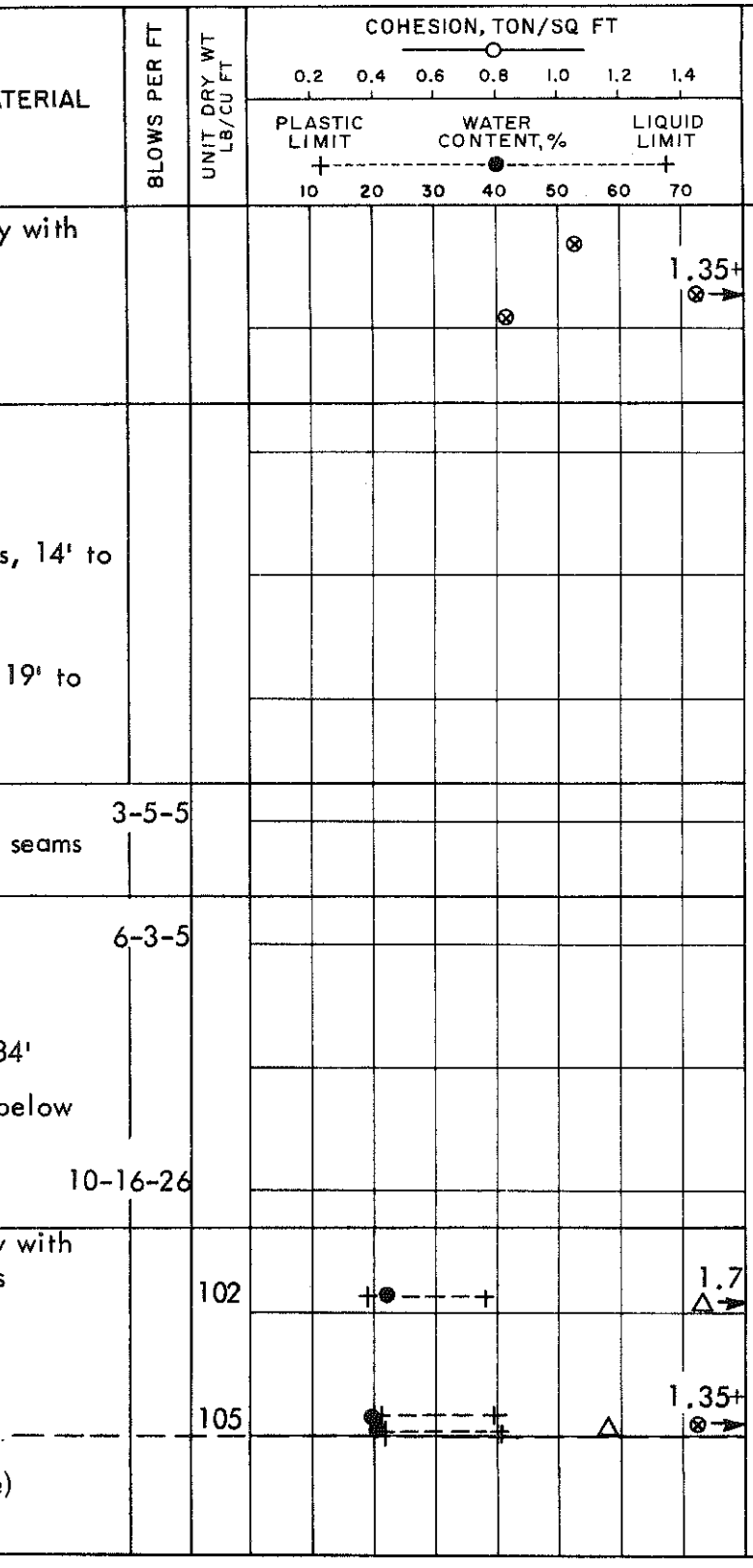
3" thin-wall-tube &
TYPE: 2" split-barrel & 3" Denison barrel

LOCATION: See Plate 1

SURF. EL: 352.7'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
5	Very stiff red and tan clay with sand pockets		
10	Red and tan fine sand -slightly clayey to 13'		
15	-with sandstone nodules, 14' to 15'		
20	-with ferrous deposits, 19' to 20'		
25	Light gray sandy silt -with sand pockets and seams	3-5-5	
30	Tan silty fine sand	6-3-5	
35	-with ferrous seams at 34'		
40	-gray with clay seams below 36.5'	10-16-26	
45	Very stiff gray sandy clay with silt partings and seams		102
50			105

(Continued on next page)



LOG OF BORING NO. P-10 (Cont'd)

WELSH POWER PLANT
CASON TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)
			Very stiff gray sandy clay with silt partings and seams			
55			Gray silty fine sand	38-50/2"		
60			Gray clayey fine sand with sand pockets		114	3.6
65			-shaley clay seams, 63' to 63.5'			1.35+
70			Gray silty fine sand -with clay seams to 78' -with lignite seams at 68'	50/3"		
75						
80						
85			-lignite, 84' to 85.5'	50/5"		
90			Hard gray clay -with silt partings and pockets to 90'			1.35+
95						1.35+
100						1.35+
			(Continued on next page)			

Form 108-3 (57) Job No. 73-085

Note Scale Change

LOG OF BORING NO. P-10 (Cont'd)

WELSH POWER PLANT

CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)
105			Hard gray clay -with sand pockets below 100'			
110						
120			Gray silty fine sand -with clay seams and pockets to 128'	50/6" 50/5"		
130			-light gray at 128'	50/3"		
140			Hard gray clay, slightly silty -with silt partings to 138.5'			1.35+ ⊗→
150			Soft gray silty clay -with rock cuttings to 148' Hard gray shaley clay			1.35+ ⊗→
160			Light gray silty sand			
170			Hard gray clay with silt partings and pockets			1.35+ ⊗→
180			Hard brown and tan lignite			1.35+ ⊗→
190			Hard gray clay with silt partings			1.35+ ⊗→ 1.35+ ⊗→

COMPLETION DEPTH: 198.5'
DATE: April 5, 1973

DEPTH TO WATER IN BORING: 27.2' Caved at: 36'
DATE: April 11, 1973

McCLELLAND ENGINEERS

PLATE 11b

LOG OF BORING NO. P-11

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel

LOCATION: See Plate 1

SURF. EL: 342.2'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT
	Stiff tan and light gray clay, slightly sandy with ferrous and organic matter and sand pockets	
5	Very stiff tan and light gray sandy clay -with ferrous and organic matter to 6' -tan at 6'	
10		
15	Tan fine sand -with ferrous partings and seams to 18' -with clay seams to 30'	
20	-sandstone layer, 19' to 19.5'	28-50/2"
25	-gray below 27'	6-50/10"
30		10-13-25
35	-ferrous and sandstone seams, 34' to 34.5'	
40	Hard gray clay -with silt partings to 40'	
45	-with sand pockets below 43.5'	
50	Gray clayey fine sand	
	(Continued on next page)	

UNIT DRY WT LB/CU FT

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

1.35+
1.35+
1.35+
1.35+
1.35+

McCLELLAND ENGINEERS

LOG OF BORING NO. P-11 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)
			Gray clayey fine sand			
			Hard gray clay with silt partings			1.35+
55						
60			Gray silty fine sand with lignite and clay seams			
				50/4"		
65						
				50/6"		
70						
			Hard gray clay with sandy silt partings and traces of mica			
75				24-50/7"		
			Hard gray sandy clay with sand pockets			1.35+
80						
						1.35+
85						
						1.35+
90						
						1.35+
95			Hard gray silty clay -with silt seams and partings to 99'			
			Gray and light gray silty sand -with clay partings to 99'			
100						

COMPLETION DEPTH: 100'
DATE: April 8, 1973

DEPTH TO WATER IN BORING: 14' Caved at: 39'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 12a

LOG OF BORING NO. P-12

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel

LOCATION: See Plate 1

SURF. EL: 353.4'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	- # 200, %
0	Stiff red and tan sandy clay -with sand pockets and seams to 8' -very stiff below 4'				
5					
				1.35+ →	
10					
15		20-25-18		+ - - - - +	
20	Red and tan clayey fine sand with sand and clay pockets		114	●+ - + △	
25	Red and tan silty fine sand	9-10-12			
30	-with ferrous seams and deposits, 29' to 33'	15-14-15			36
	-tan, 33' to 38'				
35					
	-gray with clay seams below 38'				
40		36-42/6"			
45		20-42-50/4"			37
	-sandstone, 48' to 50'				
50					

(Continued on next page)

McCLELLAND ENGINEERS

PLATE 13

LOG OF BORING NO. P-12 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	- #200, %
55			Gray silty fine sand				
60			Gray clayey fine sand with sand pockets	20-42-50/4"			56
65							
70							53
75							
80			Gray fine sand -with clay seams to 84'				
85				100/4"			2
90			-sandstone below 92.5'	100/6"			1.35+
95			Hard gray sandy clay with sand pockets	24-50/7"			
100							1.35+

COMPLETION DEPTH: 100'
DATE: March 26, 1973

DEPTH TO WATER IN BORING: 24.8' Caved at: 44'
DATE: April 23, 1973

McCLELLAND ENGINEERS

PLATE 13a

LOG OF BORING NO. P-13

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel

LOCATION: See Plate 1

SURF. EL: 348.1'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	- #200, %
	Firm tan and light gray clay				
5	Very stiff tan and light gray sandy clay				
10	-with silt pockets and partings below 8'				
15	Tan silty fine sand				21
20					32
25	-with coarse sand layer at 23.5'	23-50/4"			
30		2-6-11			21
35	-gray below 34' -with gravel layer at 35.5'				
40	Hard gray clay	23-50/10"			
45	Gray silty fine sand				20
50	(Continued on next page)				

McCLELLAND ENGINEERS

PLATE 14

LOG OF BORING NO. P-13 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-#200, %
55			Gray silty fine sand				38
60			Hard gray clay with silt partings			1.35+	
65			Gray silty fine sand with lignite seams and mica				
				50/3"			
70							
75							
80							
85							
90							
95							
100							

COMPLETION DEPTH: 69'
DATE: April 10, 1973

DEPTH TO WATER IN BORING: 15.8' Caved at: 60'
DATE: April 11, 1973

McCLELLAND ENGINEERS

PLATE 14a

Form 108-1 (57) Job No. 73-085

LOG OF BORING NO. P-19

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube, 2" split-barrel & 3" Denison barrel   LOCATION: See Plate 1

SURF. EL: 331.8'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#200,%
0–2	Gray & tan silty fine sand				
2–9	Stiff tan and light gray clay with sand pockets -red and light gray, 4' to 6' -light gray with ferrous partings below 6'		99		
9–27	Red silty fine sand -with ferrous deposits to 14' -with clay seams below 14' -gray below 17'	7-9-13 9-12-17 22-25-23			24 62
27–33	Hard gray clay with sand pockets			3.5 2.5	
33–37	Gray clayey silt with sandy silt pockets				
37–42	Hard gray clay with silt partings and pockets	22-50/9"		3.6	
42–48	Gray silty fine sand with clay pockets				
48–50	Hard gray clay with sand pockets and seams and mica	47-50/5"		4.5	

(Continued on next page)

Water content legend: PLASTIC LIMIT + - - - ● WATER CONTENT, % - - - + LIQUID LIMIT (10, 20, 30, 40, 50, 60, 70)

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4

McCLELLAND ENGINEERS

73-085

LOG OF BORING NO. P-19 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-#200, %
			Hard gray clay				
55			Gray sandy silt -with lignite layer, 56' to 56.5'				
60			Hard gray sandy clay with sandy silt pockets -with lignite partings to 65'	35-50/5"			4.5
65			-with sand pockets below 64'				4.5
70							3.7
75							3.3
80							
85							
90							
95							
100							

COMPLETION DEPTH: 75'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 6.8'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 15a

Form 108-1 (57) Job No. 73-085

LOG OF BORING NO. P-20

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 303.6'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT
	Tan clayey sand	1-1-3
5	Firm tan and light gray sandy clay with ferrous deposits	2-2-3
10	Stiff light gray clay with ferrous seams and partings	
	Gray silty fine sand	17-24-37
15	Gray clayey sand -with clay pockets to 18'	15-24-60/4"
20		
	Gray silty fine sand	28-60/6"
25		
		29-54-60/3"
30		
		24-54-60/2"
35		
	-with clay pockets, 39' to 44'	19-60/6"
40		
	-fractured sandstone layer, 44' to 45.5'	21-53-60/3"
45		
	Hard gray clay with sand pockets and partings	14-26-48
50		

UNIT DRY WT LB/CU FT

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

4.5 →

COMPLETION DEPTH: 50'
DATE: April 28, 1973

DEPTH TO WATER IN BORING: 2.7'
DATE: May 3, 1973

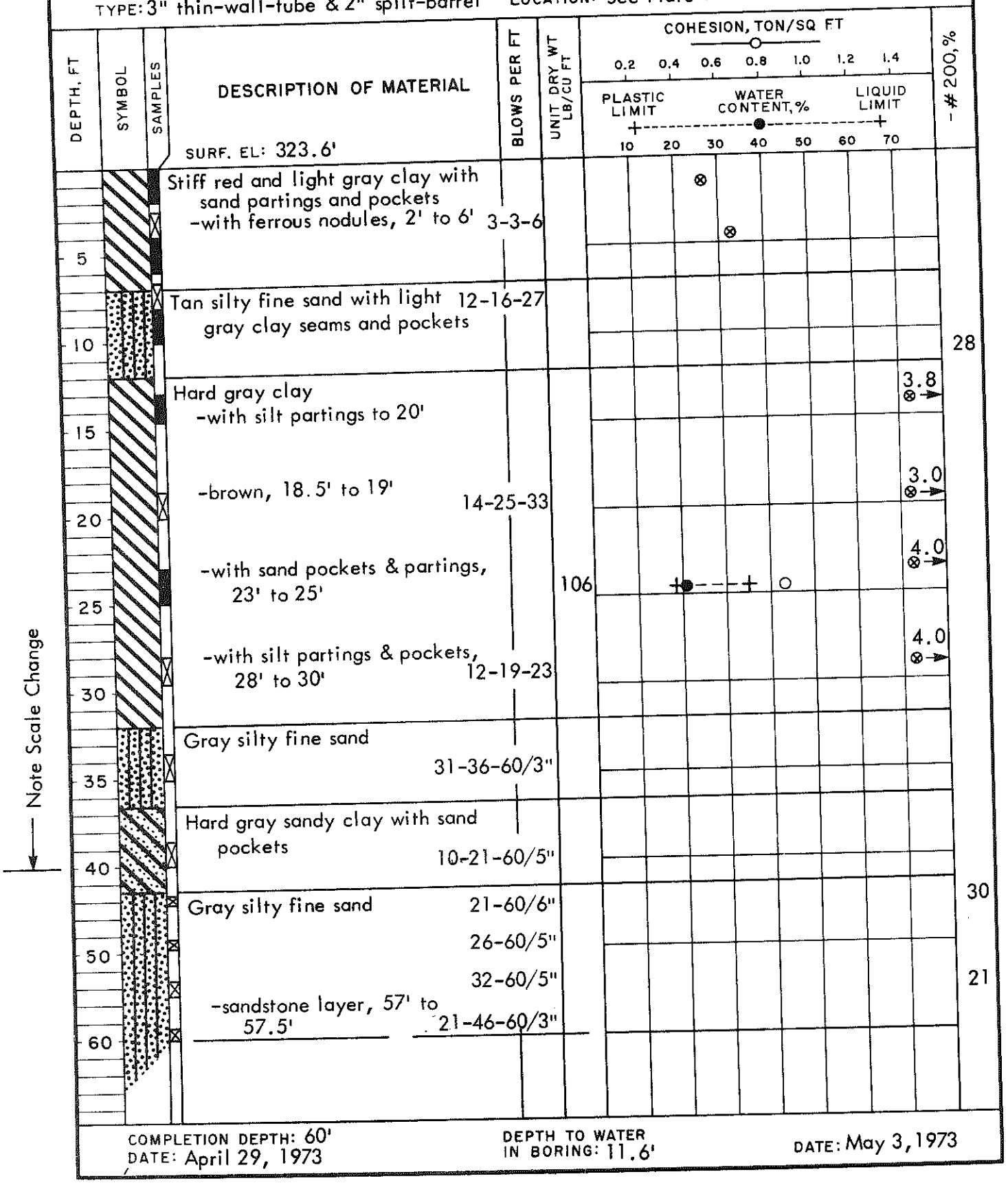
McCLELLAND ENGINEERS

PLATE 16

LOG OF BORING NO. P-21

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



COMPLETION DEPTH: 60'
DATE: April 29, 1973

DEPTH TO WATER IN BORING: 11.6'

DATE: May 3, 1973

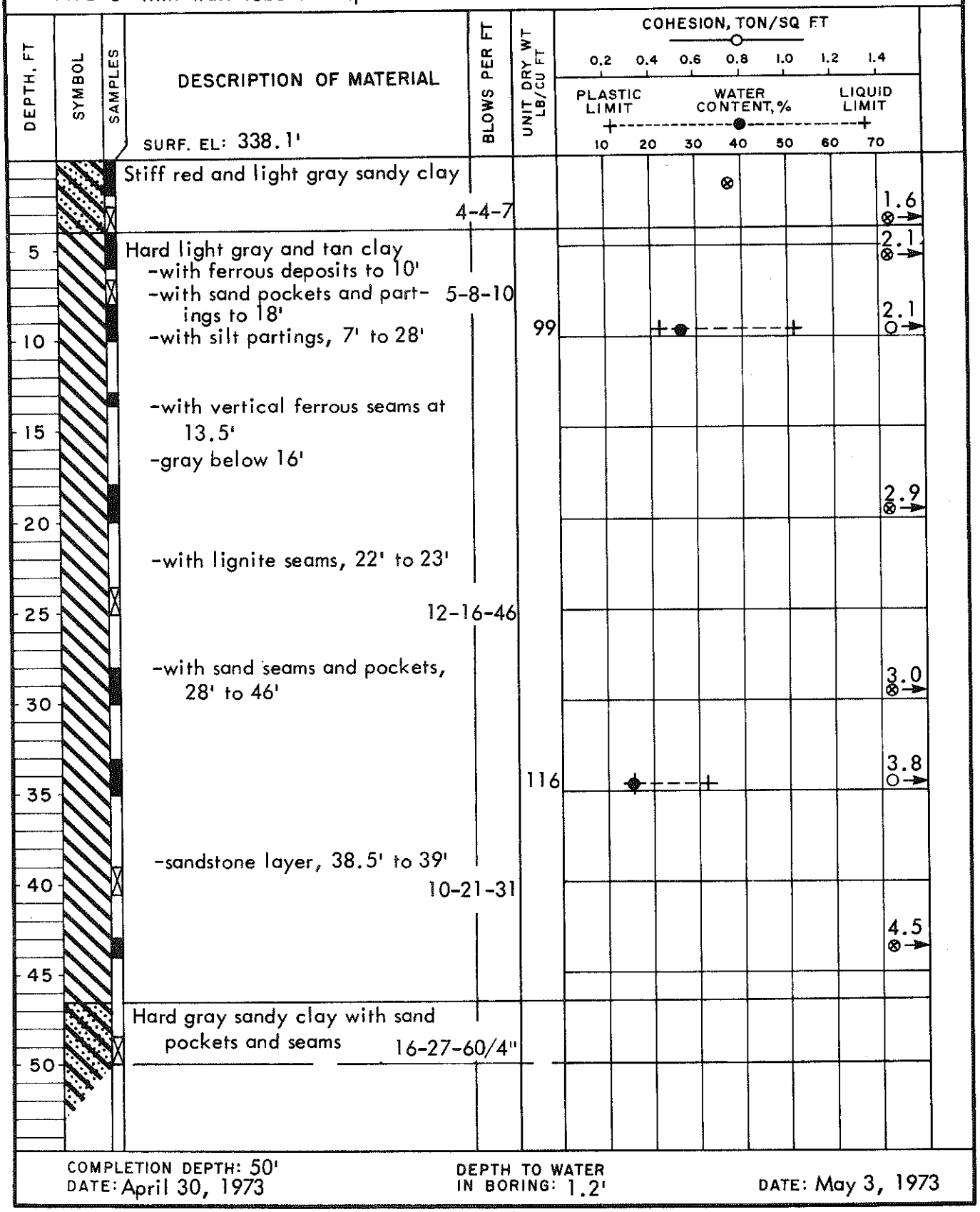
McCLELLAND ENGINEERS

PLATE 17

LOG OF BORING NO. P-22

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



COMPLETION DEPTH: 50'
DATE: April 30, 1973

DEPTH TO WATER IN BORING: 1.2'

DATE: May 3, 1973

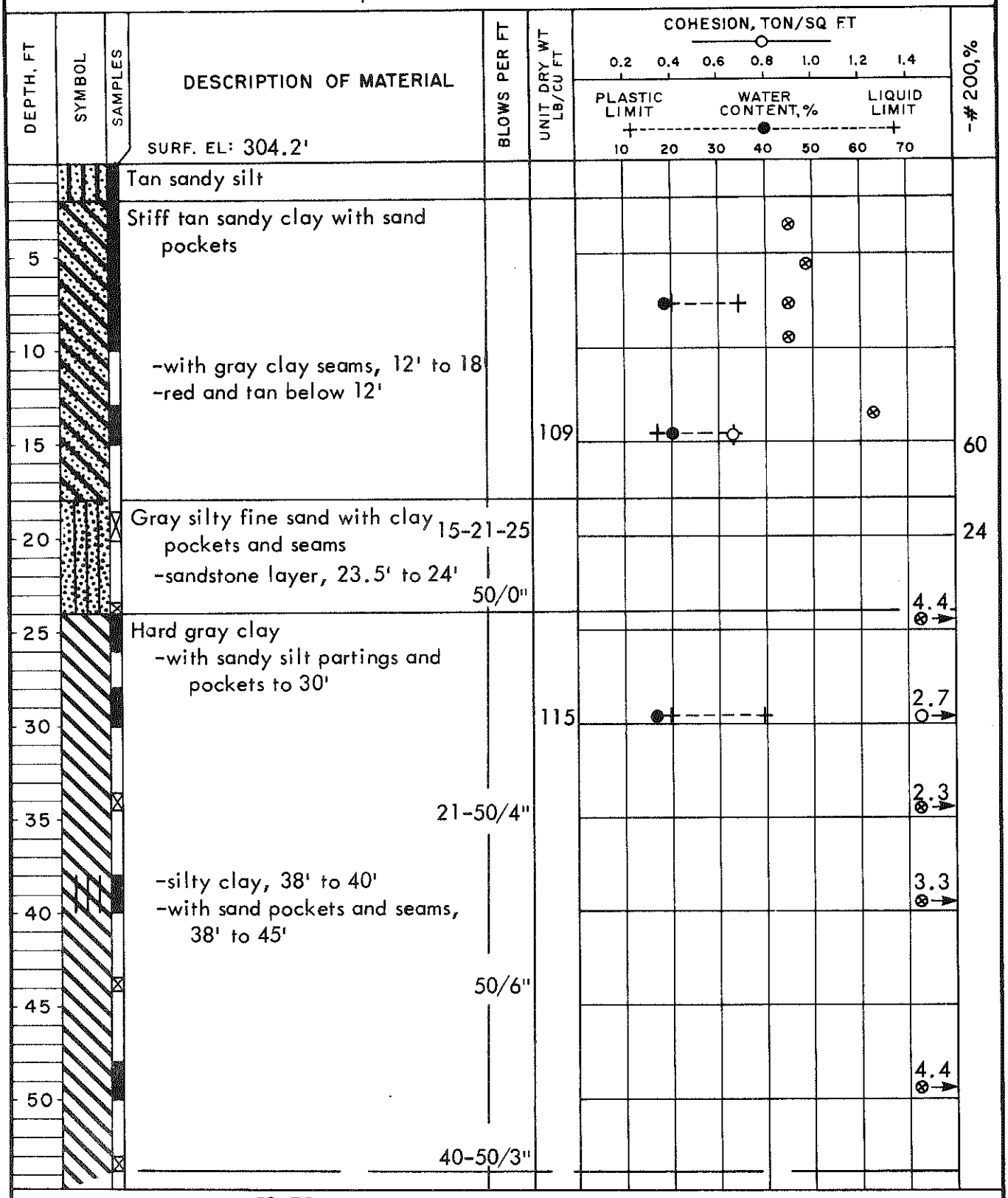
McCLELLAND ENGINEERS

PLATE 18

LOG OF BORING NO. P-23

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



COMPLETION DEPTH: 53.75'
DATE: April 22, 1973

DEPTH TO WATER IN BORING: 6.6'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 19

Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-25

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-#200, %
			SURF. EL: 357.8'				
			Tan sandy silt				60
							64
5			Stiff gray and red sandy clay with sand pockets				
			-with gray clay seams to 8'				
			-very stiff red and tan below 7'				2.7
10							4.1
			-with red fine sand seams and layers below 13'	8-17-16			1.2
15							
20			Tan silty fine sand				
			-with ferrous nodules, 24' to 24.5'	11-10-10			32
25							
30				18-23-18			
			-with ferrous partings, 34' to 35'	21-50/9"			16
35							
40				28-50/8"			
			-with organic partings, 43' to 45.5'				
45			-gray below 43'	8-14-20			
			-with clay seams, 49' to 54'				
50				14-50/6"			
			(Continued on next page)				

McCLELLAND ENGINEERS

PLATE 20

Form 108-S (57) Job No 75-085

LOG OF BORING NO. P-25 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-#200, %
55			Tan silty fine sand	50/6"			
			-sandstone layer, 58' to 59'				
60				50/6"			14
65			-with clay seams and sandstone nodules below 64'	32-50/6"			
70				50/4"			
75				24-50/7"			
80							
85							
90							
95							
100							

COMPLETION DEPTH: 74.5'
DATE: April 21, 1973

DEPTH TO WATER IN BORING: 5.3'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 20a

Form 08-1.1971 Job No. 73-085

LOG OF BORING NO. P-26

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-#200, %
	SURF. EL: 346.2'				
0	Stiff tan sandy clay with sand pockets and seams				
5	-with ferrous deposits, 4' to 10'				
	-red and tan below 6'		110		66
10					
15	-red fine sand layer, 13.5' to 14'	15-29-20			
	-with ferrous nodules below 14'				
20	Very stiff light gray and brown clay with ferrous partings and sand partings, seams and pockets				
25	-gray below 24'	10-13-17			
30	Tan fine sand with clay seams and pockets	4-13-25			6
35		28-35-15			
40		6-4-7			27
		16-19-26			
50		10-31-22			4
		10-10-25			
60	Stiff gray clay				

Note Scale Change

COMPLETION DEPTH: 60'
DATE: April 21, 1973

DEPTH TO WATER IN BORING: 19.7'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 21

LOG OF BORING NO. P-28

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-#200, %
			SURF. EL: 332.7'				
			Tan silty fine sand				
			Very stiff tan and light gray sandy clay			⊗	
5			Tan fine sand -with light gray clay seams below 7.5'	13-18-17			
10				15-22-44		+ ● +	6
15			Very stiff red and light gray clay with sand and silt pockets and partings -hard below 18'			⊗	
20						4.0 ⊗→	
25						4.3 ⊗→	
30				13-18-22		3.3 ⊗→	
35			-sandstone layer, 32.5' to 33'			4.2 ⊗→	
40				20-35-60/5"			
45			Hard gray sandy clay	12-18-40			
50			Hard gray clay with silt partings and seams	13-22-32			

COMPLETION DEPTH: 50'
DATE: April 30, 1973

DEPTH TO WATER IN BORING: 5.0'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 22

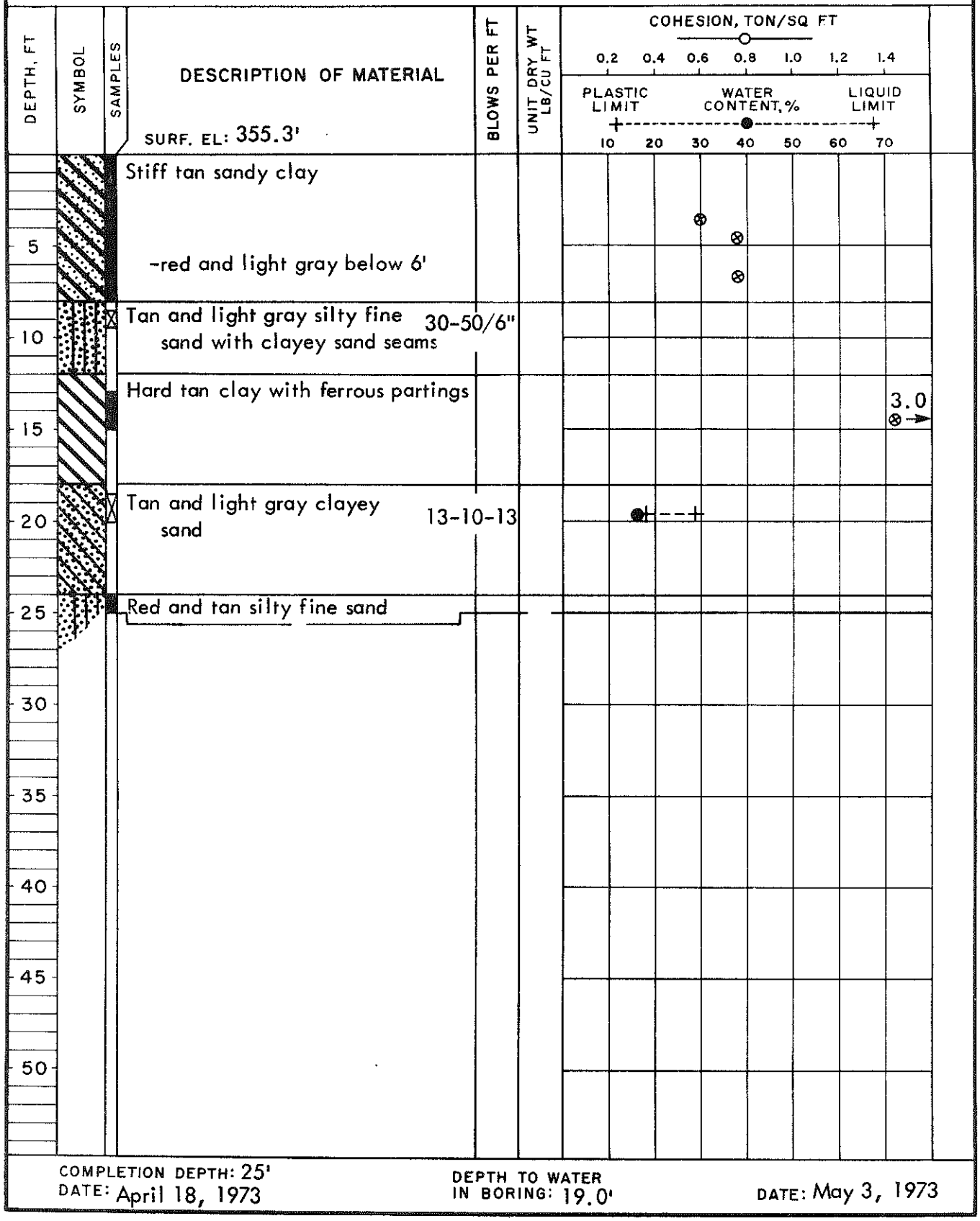
Form 108-1 (57) Job No. 73-085

Form 108-1 (571) Job No. 73-085

LOG OF BORING NO. P-30

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



COMPLETION DEPTH: 25'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 19.0'

DATE: May 3, 1973

McCLELLAND ENGINEERS

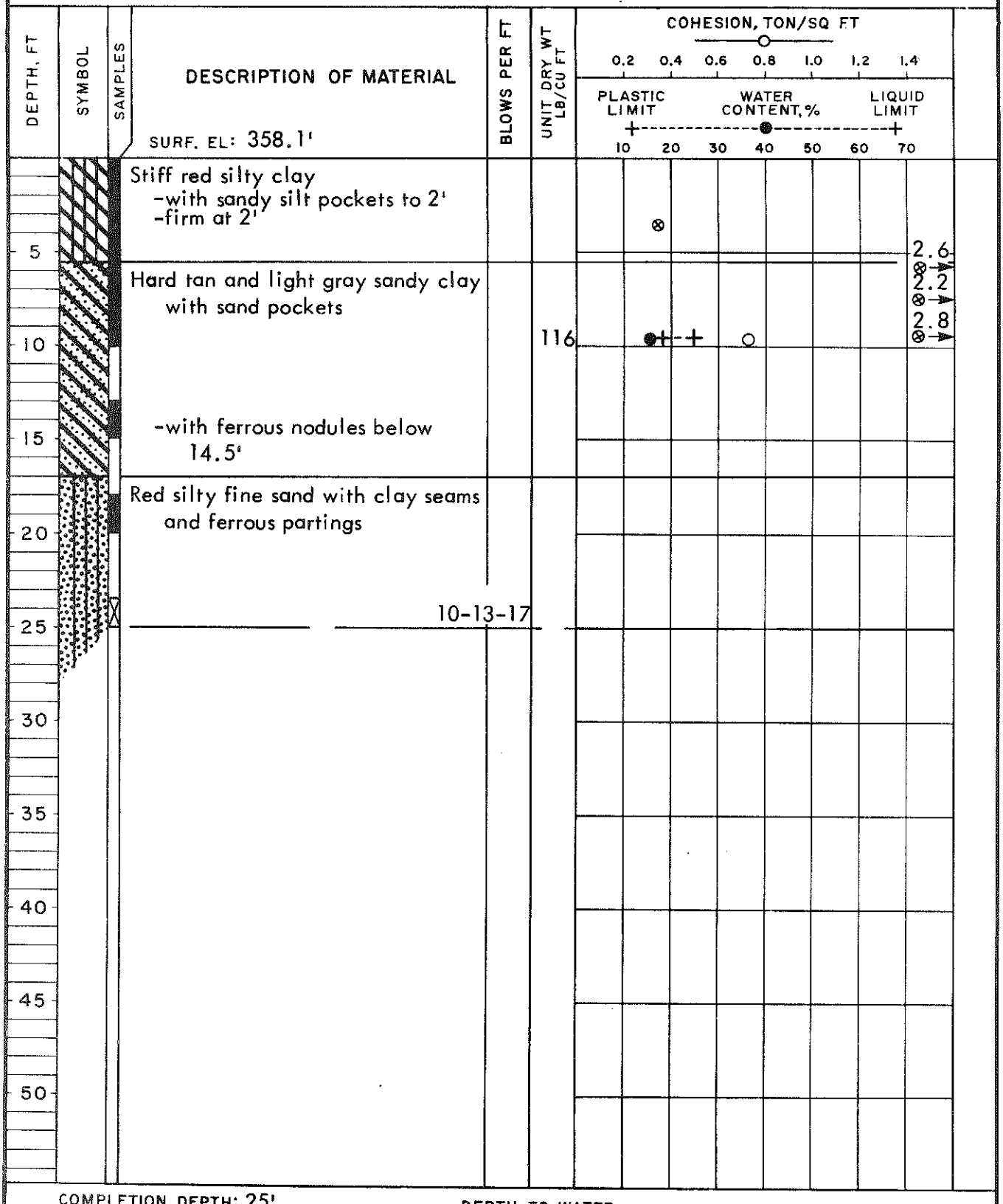
PLATE 23

73-085

LOG OF BORING NO. P-31

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



COMPLETION DEPTH: 25'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 16.0'
DATE: May 3, 1973

McCLELLAND ENGINEERS

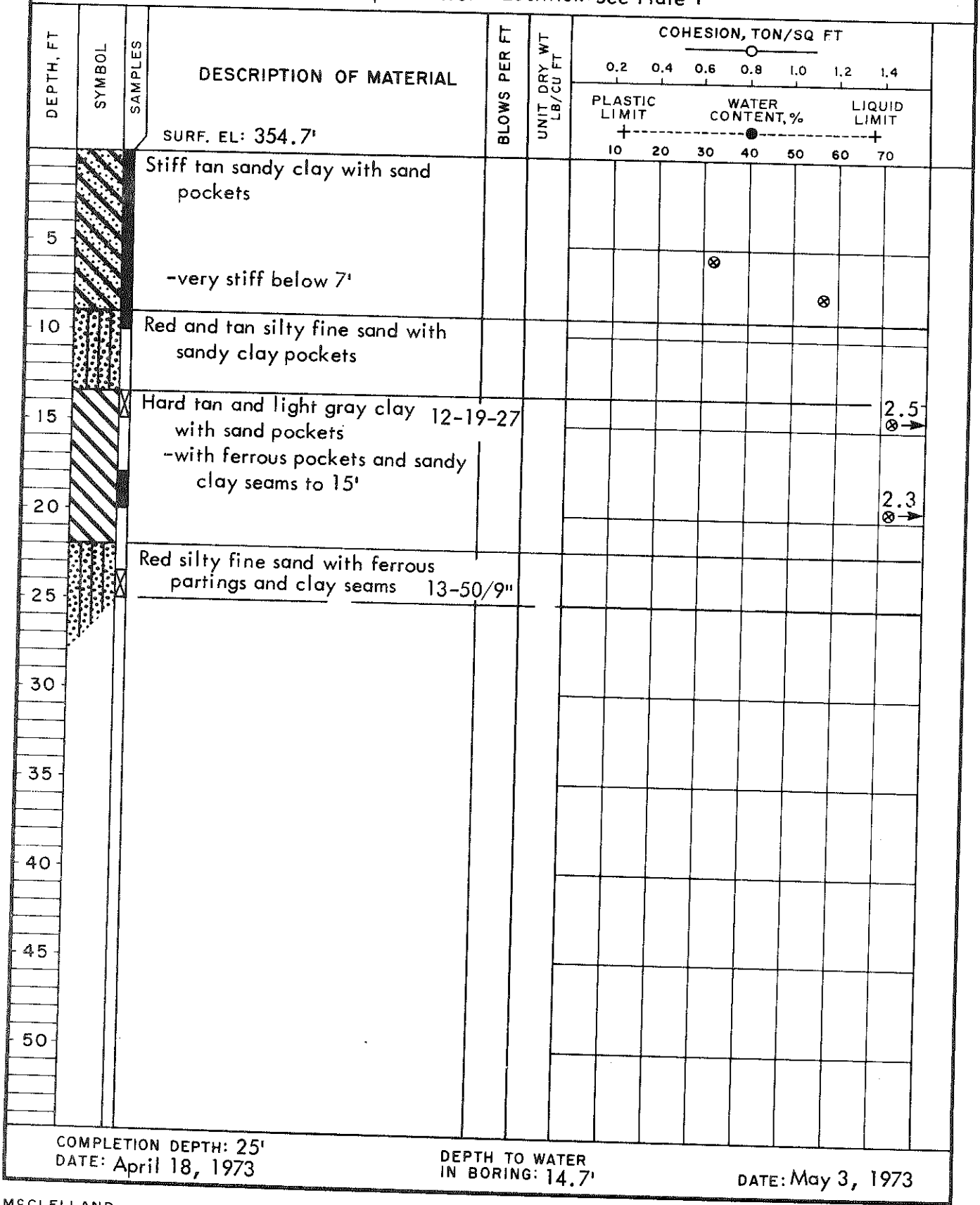
PLATE 24

73-085

LOG OF BORING NO. P-32

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



COMPLETION DEPTH: 25'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 14.7'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 25

Form -08-1 (57) Job No. 73-085

LOG OF BORING NO. P-33

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 355.0'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-#200, %
5	Stiff red and tan sandy clay with sand pockets and ferrous pockets			⊗ ⊗	
10	Red and tan sandy silt with sand pockets				64
15	Red silty fine sand with ferrous nodules and pockets -with sandy clay seams and pockets to 30'	7-15-27			11
20	-tan and light gray, 19' to 38'	16-17-30			14
25		28-28-50			
30		11-14-22			
35	-with ferrous layer, 34.5' to 35'	14-77/12"			28
40	-gray with clay seams below 38'	12-40-48			
45	Hard gray clay	22-50/2"		1.35+ ⊗→	
50	Gray silty fine sand	50/4"			

COMPLETION DEPTH: 49'
DATE: April 13, 1973

DEPTH TO WATER IN BORING: 15.4'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 26

Form 108-1 (57) Job No. 73-085

LOG OF BORING NO. P-34

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 352.2'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200, %
0	Very stiff red and tan clay			
5	Red and tan silty fine sand	4-11-15		
10	-with sandstone and red and light gray sandy clay below 8'	13-22-24		
15	Very stiff light gray clay with sand pockets and seams		105	
20	Light gray silty fine sand -tan, 24' to 36'			
25	-with clay seams and pockets below 24'	4-6-13		
30	-with sandstone nodules, 26' to 38'	3-5-7		32
35	-gray below 36'	8-5-4		
40		9-14-21		
45	Hard gray sandy clay with silt seams and partings			49
50				

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10 20 30 40 50 60 70

1.7

COMPLETION DEPTH: 45'
DATE: May 1, 1973

DEPTH TO WATER IN BORING: 21.4'
DATE: May 3, 1973

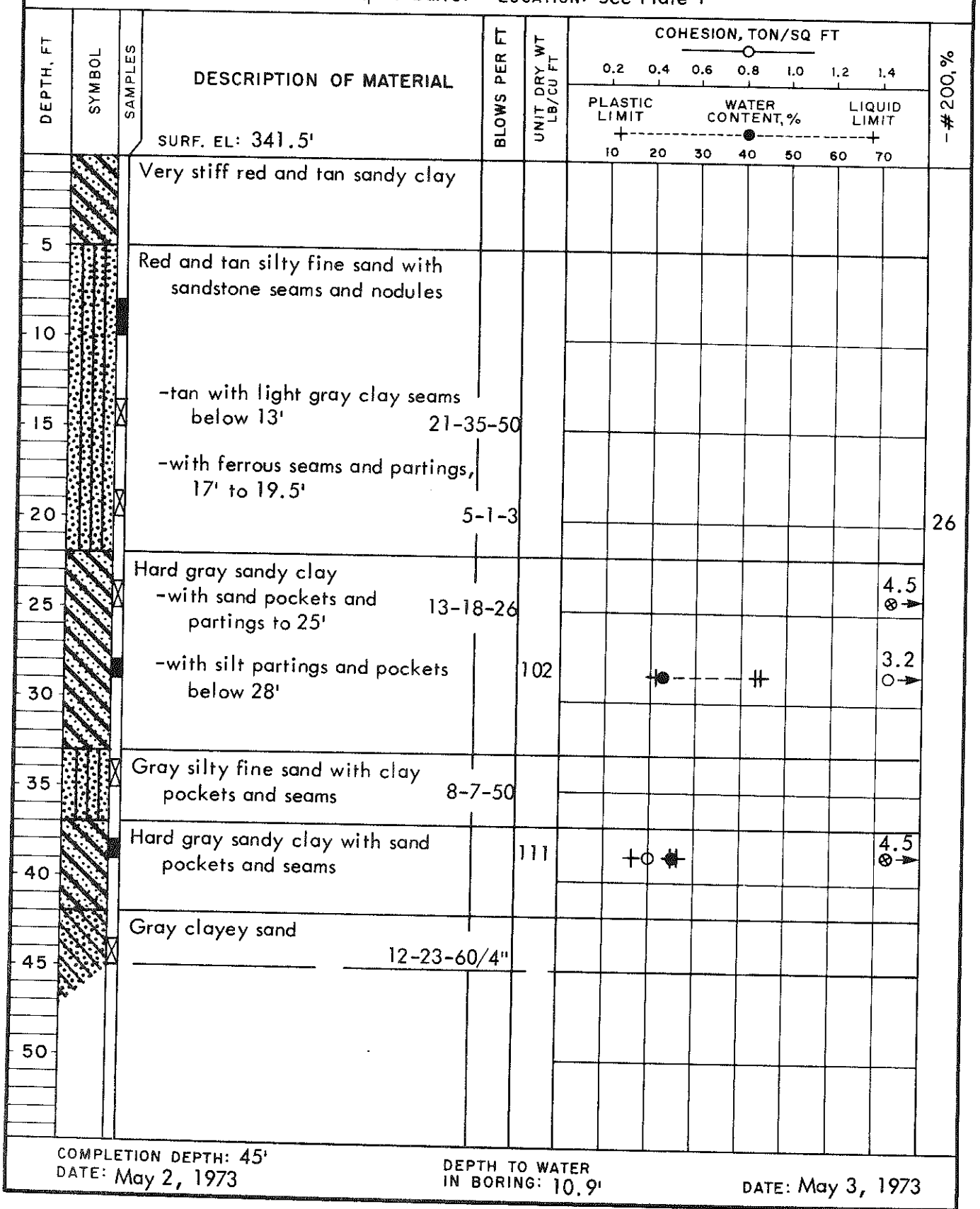
McCLELLAND ENGINEERS

PLATE 27

LOG OF BORING NO. P-35

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1



COMPLETION DEPTH: 45'
DATE: May 2, 1973

DEPTH TO WATER IN BORING: 10.9'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 28

Form 108-1 (ST) Job No. 73-085

LOG OF BORING NO. P-36

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube, 2" split-barrel & 3" Denison barrel

LOCATION: See Plate 1

SURF. EL: 347.8'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-#200, %
0	Tan silty fine sand				
	Stiff red and tan sandy clay with sand pockets				
10	Red and tan silty fine sand	11-14-14			
	-with sandy clay seams to 14'				
15	-with ferrous and sandstone nodules, 14.5' to 16'	8-8-8			22
	-with light gray clay seams, 18' to 20'	10-16-16			
25		3-5-9			
30		8-16-23			26
	-gray with lignite and clay seams below 32'				
35		7-15-25			
	Hard gray clay with sand seams and pockets				
40	-with sandstone seams, 39.5' to 40'				4.5 ⊗→
					4.5 ⊗→
50	Gray silty fine sand	13-26-60/4"			
	Hard gray sandy clay	29-60/5"		●	4.5 ⊗→
60	Gray clayey sand	18-27-60/4"			

Note Scale Change

COMPLETION DEPTH: 60'
DATE: May 2, 1973

DEPTH TO WATER IN BORING: 18.0'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 29

Form 108-1 (57) Job No. 73-085

LOG OF BORING NO. P-37

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 2" split-barrel LOCATION: See Plate 1

SURF. EL: 348.1'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT
0	Stiff tan silty clay with sand pockets and seams	2-3-5
		4-8-9
5	Stiff tan and light gray sandy clay with sand seams and pockets and sandstone nodules	3-4-6
		6-8-13
10		4-6-11
	Tan silty fine sand -with sandy clay seams and pockets to 13'	8-14-15
15		8-17-16
20	Stiff tan and light gray sandy clay	4-3-5
25	Tan silty fine sand	9-25-42
30	-gray below 32'	10-5-3
35		9-11-19
40	Hard gray clay with sand seams and pockets	
45	Gray silty fine sand	8-14-38
50		

UNIT DRY WT LB/CU FT

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

3.5

COMPLETION DEPTH: 45'
DATE: May 1, 1973

DEPTH TO WATER IN BORING: 16.5'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 30

Form 108-S (87) Job No. 23-040

LOG OF BORING NO. P-38

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin Wall-Tube
2" Split-Spoon

LOCATION: See Plat 1

SURF. EL: 328.7'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	J1 A1		Stiff Red & TAN Sandy Clay w/ferrous deposits @ 1.5		
-5	J2		Red & TAN Sandy Silt - w/clay seams 4.5 - 9.5	9/16/14	
	J3		- w/ferrous deposits @ 5	27/30/28	
-10	J4		- w/ferrous layer @ 8' (3")	9/15/27	
			- w/ferrous layer 12.5 - 13.5		
-15	J5		Gray Silty Fine Sand - w/lignite seam @ 14.5 (3") - w/sandstone layer 16' - 17.5'	9/10/12	
-20	J6		Stiff Gray Clay	18/15/22	
	UP1		- laminated with silt below 20'		
-25	J7 J8		- Light Gray Sandy Silt seam @ 26	8/10/15	
-30	J9 UP2			10/14/17	
-35	J10		Gray Silty Fine Sand	29/37/50-2"	
	J11			24/34/50-2"	
-40			Hard gray sandy clay - with mica and sand pockets		
-45	J12			29/60-6"	
			- lignite layer, 46' - 47'		
-50	J13			60-6"	
			(Continued to next page)		

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

ELEVATION, FT

PRELIMINARY
McCLELLAND ENGINEERS

McCLELLAND ENGINEERS

PLATE 31

LOG OF BORING NO. P38 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	ELEVATION, FT
55			Hard Gray Sandy Clay	27/39/68-3"			
60				39/45/60-5"			
			- w/lignite layer 63.5'-64.5'				
65			- w/scattered lignite seams, 64.5-67'				
70				27/40-3"			
75				40-6"			
			- w/clay and sand seams below 79'	40-6"			
80				40-4"			
85			Gray Sandy Silt - w/clay seams below 84'				
90				40-5"			
95				40-3"			
100				50/5"			

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 100'
DATE: July 30, 1973

DEPTH TO WATER IN BORING: 9.6' Caved at: 49.6'
DATE: July 31, 1973

McCLELLAND ENGINEERS

PLATE 3/9

Form 108-S (57) Job No. 73-086

LOG OF BORING NO. P-39

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin-Wall-Tube
2" Split-Spoon
DENISON-barrel

LOCATION: See Plate 1

SURF. EL: 348.6'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	UP1		Stiff Red & TAN Sandy Clay		
5	J1	X	Red Sandy Silt w/clay pockets, 5' to 8'	22/24/39	
	J2	X		22/24/55	
10	J3	X		19/31/31	
			- TAN below 13'		
15	J4	X	- w/ gravel, 17'-17.5'	30/32/30	
20	J5	X	- w/ Brown clay SEAMS below 20'	7/14/20	
			Stiff Brown & Light Gray clay w/SANDY silt SEAMS		
25	UP2		TAN & Light Gray Silty Fine Sand	7/8/14	
	J7		- TAN 28.5'-33.5'	48/60-5"	
30			- w/SANDstone Nodules below 28.5		
	J8	X	- TAN & Red 33.5-45	30/60-6"	
35			w/Lignite layer, 36' to 36.5'		
40	J9	X		14/19/30	
45	J10	X	- Light Gray below 45	18/21/24	
			Hard Gray Clay		
50	J11	X	w/SAND streaks @ 50	25/29/60	
			(Continued on next page)		

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

ELEVATION, FT

PRELIMINARY
McCLELLAND ENGINEERS

LOG OF BORING NO. P-39 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	ELEVATION, FT
	J12	1	Hard gray Clay				
55	J13		- laminated w/silt, 55' to 70'	30/3"/6"			
	J14B		-w/silt stone Nodules, 54.5-56				
60	J14A					1.35+	
	J14						
65	J15			27/40-3			
	J16			24/40-6"			
70							
75				41/5-5"			
80							
85							
90							
95							
100							

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 75'
DATE: July 27, 1973

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND ENGINEERS

PLATE 329

LOG OF BORING NO. P-40

Welsh Power Plant
Cason, Texas

TYPE: 3" Thin-Wall-Tube
2" Split-barrel

LOCATION: See Plate 1

SURF. EL: 341.9'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	UP1		Stiff Light Gray : Red Sandy Clay		
			-w/ferrous deposits 2'-3.5'		
	J1		-w/ferrous seams 5'-14'	4/6/8	
5			- light gray : tan 6.5'-20'		
	UP2				
	J2		-w/sand seams and pockets below 10'	9/9/11	
10					
	J3			23/28/60-4"	
15			-w/sand layer, 16'-16.5'		
	J4			5/9/14	
20	UP3		- Dark Gray below 20',		
			-w/organic matter 20.5'-22'		
			- Very Stiff below 21'		
	J5			11/16/19	
25	UP4				
	J6			22/26/30	
30	UP5				
				42/60	
35					
	J7		Gray Silty Fine Sand	27/60-5"	
40			w/organic matter 39'-40'		
	J8			27/26/60-5"	
45					
	J9			28/26/60-5"	
50					

COMPLETION DEPTH: 50'
DATE: Aug. 2, 1973

DEPTH TO WATER IN BORING:

DATE:

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

ELEVATION, FT

PRELIMINARY
McCLELLAND ENGINEERS

McCLELLAND ENGINEERS

PLATE 33

LOG OF BORING NO. P-41

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin-Wall-Tube
2" Split-Spoon

LOCATION: See Plate 1

SURF. EL: 347.7'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	UP1		Stiff Red & TAN Sandy Clay		
5	J1		- w/ ferrous deposits, 5'-7'	4/7/10	
	UP2				
10	J2		TAN & Light Gray Silty Fine SAND	16/20/24	
15	J3		- Light Gray & TAN below 15'	13/23/25	
20	J4		Very stiff brown & light gray clay		
	UP4		- w/ silt streaks, 17'-20'	7/10/13	
			- w/ ferrous deposits, 20'-21.5'		
25	J5				
	UP5		- Dark Gray below 25'	10/12/12	
30	J6				
	UP6			6/12/26	
35	J7			22/60-4"	
40	J8		Gray Silty Fine SAND w/ organic matter 39'-43'	37/60-3	
45	J9			37/60-6"	
50	J10			37/60-3"	
55'	J11			36/32/60-4"	

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

ELEVATION, FT

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 55'
DATE: Aug. 1, 1973

DEPTH TO WATER IN BORING: 7.3' Caved at: 43.6'
DATE:

McCLELLAND ENGINEERS

PLATE 34

LOG OF BORING NO. P-42

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin-Wall-Tube
2" Split-Spoon

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	ELEVATION, FT
			SURF. EL: 349.3'				
	J1		Tan Sandy Silt				
			Stiff Light Gray, Red-Tan Sandy Clay				
5	J2		- w/ sand pockets	4/5/7			
	UP1						
10	J3		Tan Silty Fine Sand	15/30/60-4			
	J4			5/8/9			
15	UP2		Very Stiff Brown & Light Clay - laminated with silty fine sand to 34'				
20	J5		- with ferrous deposit, 20'-21'	8/13/23			
	UP3		- Brown, 20'-34'				
25	J6		- w/ sand pockets below 25'	10/15/21			
	UP4						
30	J7			12/14/17			
	UP5						
35	J8		- dark gray w/ mica below 34'	23/40/60-5"			
40	J9		Dark Gray Clayey Sand to Very Sandy Clay	25/35/60-4"			
	J10		- w/ organic matter and mica	45/48/60-3"			
45							
50	J11			35/60-5"			
	J12			15/40-5"			

1.35+

1.35+

1.35+

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 55'
DATE: July 30, 1973

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND ENGINEERS

PLATE 35

Form 108-5 (5/71) Job No. 73-087

LOG OF BORING NO. P43

TYPE: 3" Thin Wall-Tube
2" Split-Spoon

LOCATION: See Plate 1

SURF. EL: 351.8'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	ELEVATION, FT
0			Firm Red & Light Sand Clay				
			- stiff below 3'	3/3/9			
5			- with ferrous deposits below 7.5'				
10				4/5/7			
			Very stiff tan & light gray Clay				
15			- Brown & light Gray, 13'-20'	9/11/15			
			- w/silt seams, 15'-19'				
20			- w/ferrous deposit, 15'-20'	12/16/23			
			- dark gray below 20'				
25			- w/ SAND pockets below 20'	15/24/60-5"			
30				13/13/24			
			Light Gray Sandy Silt, w/ silty clay seams, 30'-36'				
35			- Dark Gray below 34'	18/35/60-4"			
40				24/42/60-4"			
45				36/41/60-4"			
50				43/60-4"			

(Continued on next page)

PRELIMINARY
McCLELLAND ENGINEERS

McCLELLAND ENGINEERS

PLATE 36

Form 108-S (57) Job No. 73085-

LOG OF BORING NO. P-43 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	ELEVATION, FT
55			Dark gray sandy silt	38/40-4"			
60				40-6"			
65				27/40			
70			-w/SAND stone LAYER, 70'-71'	32/40-5"			
			-w/SAND stone SEAMS 71'-73.5'				
75				31/40			
80							
85							
90							
95							
100							

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 75'
DATE: July 31, 1973

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND ENGINEERS

PLATE 36a

Form 108-S (87) Job No. 73-085

LOG OF BORING NO. P-47

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin Wall Tube
2" Split-Spoon

LOCATION: See Plate 1

SURF. EL: 361.5'

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
5			Stiff Tan & Red Sandy Clay		
			- w/ Sand streaks 4'-8'	8/11/16	
			- w/ light Gray below 7'		
10			Tan, Red & Light Gray Sandy Silt		
			- w/ clay pockets 10-17	11/11/19	
15			- w/ ferrous deposits, 14'-16'	19/33/20	
20			- w/ clay partings below 20'	9/10/14	
			- w/ ferrous Nodules below 20		
25				11/23/39	
30					
35					
40					
45					
50					

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

ELEVATION, FT

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 25'
DATE: July 26, 1973

DEPTH TO WATER IN BORING: 9.2' Caved at: 21.8'
DATE: July 30, 1973

McCLELLAND ENGINEERS

PLATE 37

LOG OF BORING NO. P-48

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" Thin-Wall-Tube
2" Split-Spoon

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	ELEVATION, FT
5	UP1		Stiff red & light gray clay w/ sand pockets				
	J1			5/7/9			
	UP2						
10	J2		Red Silty fine SAND - w/ CLAY pockets	14/15/20			
15	J3		Very stiff light gray clay - w/ ferrous nodules, 14'-18'	5/8/10		1.35+	
	UP3						
	J4		- Shale layer, 16 - 16.5	2/2/2			
20			Firm GRAY CLAY w/ silty fine SAND SEAM @ 19				
25	J5		GRAY Silty FINE SAND	10/14/40			
			- w/ SHALE seam at 24.5'				
30	J6		- w/ SCATTERED SAND STONE SEAMS, 26 - 30.5'	13/60=9"			
35	J7		Very stiff Gray clay w/ SANDY SILT PARTINGS w/ SAND STONE below 32	18/24/39			
40							
45							
50							

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 35'
DATE: July 26, 1973

DEPTH TO WATER IN BORING: 6.8' Caved at: 27.5' DATE: July 30, 1973

McCLELLAND ENGINEERS

PLATE 38

LOG OF BORING NO. P-49

WELSH POWER PLANT
CASON, TEXAS

TYPE: 2" Split-Spoon
3" Thin-Wall-Tube

LOCATION: See Plate 1

SURF. EL:

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	UP1		Stiff Red & Light Gray Clay		
5	J1		- w/ ferrous nodules below 1.5	4/5/9	
	UP2				
10	J2			11/12/13	
15	J3			13/19/20	
	UP3		TAN & Red silty fine Sand w/ clay pockets		
20	J4		w/ SANDstone SEAM @ 20'	5/7/9	
	UP4		Stiff Brown CLAY w/ ORGANIC MATTER @ 22'		
25	J5		Dark gray silty fine sand	20/60-6"	
30					
35					
40					
45					
50					

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

ELEVATION, FT

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 25'
DATE: July 25, 1973

DEPTH TO WATER IN BORING: 19.6' Caved at: 24.3'
DATE: July 30, 1973

McCLELLAND ENGINEERS

PLATE 39

LOG OF BORING NO. AB-1

WELSH POWER PLANT
CASON, TEXAS

TYPE: 4" Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	ELEVATION, FT
			SURF. EL:			
5			TAN & Red Sandy Clay - Light Gray & Red w/sand streaks below 5			
10			TAN & Red & Light Gray Clay w/silt & SAND streak below 10' - BROWN & TAN below 13'			
15			TAN Silty fine Sand			
20						
25						
30						
35						
40						
45						
50						

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 15'
DATE: July 31, 1973

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND ENGINEERS

Form 108-S (S71) Job No. 73-085

LOG OF BORING NO. AB-2

WELSH POWER PLANT
CASON, TEXAS

TYPE: 4" Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	ELEVATION, FT
			SURF. EL:			
			Tan Silty Fine Sand			
5			Ferrous Deposits w/clay seams & parting below 3'			
10						
15			- w/ Dark Gray Clay Seam @ 14			
20						
25						
30						
35						
40						
45						
50						

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 20'
DATE: Aug. 1, 1973

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND ENGINEERS

PLATE 4

Form 108-S (57) Job No. 23-088-S

LOG OF BORING NO. AB-3
WELSH POWER PLANT
CASON, TEXAS

TYPE: 4" Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	ELEVATION, FT
			SURF. EL: 331.9'			
			TAN & RED SILTY FINE SANDY			
			LIGHT GRAY CLAY w/ RED STREAKS - below 2.5'			
5						
			- w/ ferrous deposits 8'-11'			
10			- BROWN LIGHT TAN below 11'			
			TAN SILTY FINE SAND			
15						
20						
25						
30						
35						
40						
45						
50						

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 12.5'
DATE: 8-1-73

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND ENGINEERS

PLATE 42

Form 108-S (57) Job No. 23-085-

LOG OF BORING NO. AB-4

WELSH POWER PLANT
CASON, TEXAS

TYPE: 4" Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	ELEVATION, FT
			SURF. EL: 337.5'			
			TAN Silty Fine Sand			
5			Red & Light Gray Sandy Clay			
10			TAN, Red & Light Gray Clay w/Ferrous deposits w/Si SEAMS 10-16			
15			- Brown & Light Gray 11'-14' - Gray below 14'			
20			TAN Silty Fine Sand			
25						
30						
35						
40						
45						
50						

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 20'
DATE: Aug 1, 1973

DEPTH TO WATER IN BORING:

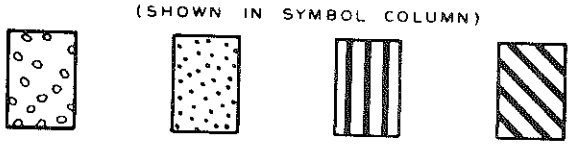
DATE:

McCLELLAND ENGINEERS

PLATE 43

SYMBOLS AND TERMS USED ON BORING LOGS

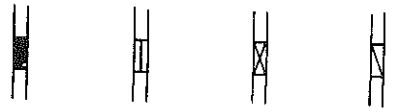
SOIL TYPES
(SHOWN IN SYMBOL COLUMN)



Gravel | Sand | Silt | Clay

Predominant type shown heavy

SAMPLER TYPES
(SHOWN IN SAMPLES COLUMN)



Shelby Tube | Denison Barrel | Split Spoon | No Recovery

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	RELATIVE DENSITY
Loose	0 to 40%
Medium dense	40 to 70%
Dense	70 to 100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ FT
Very soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very stiff	2.00 to 4.00
Hard	4.00 and higher

Note: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided – having inclined planes of weakness that are slick and glossy in appearance.

Fissured – containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.

Laminated – composed of thin layers of varying color and texture.

Interbedded – composed of alternate layers of different soil types.

Calcareous – containing appreciable quantities of calcium carbonate.

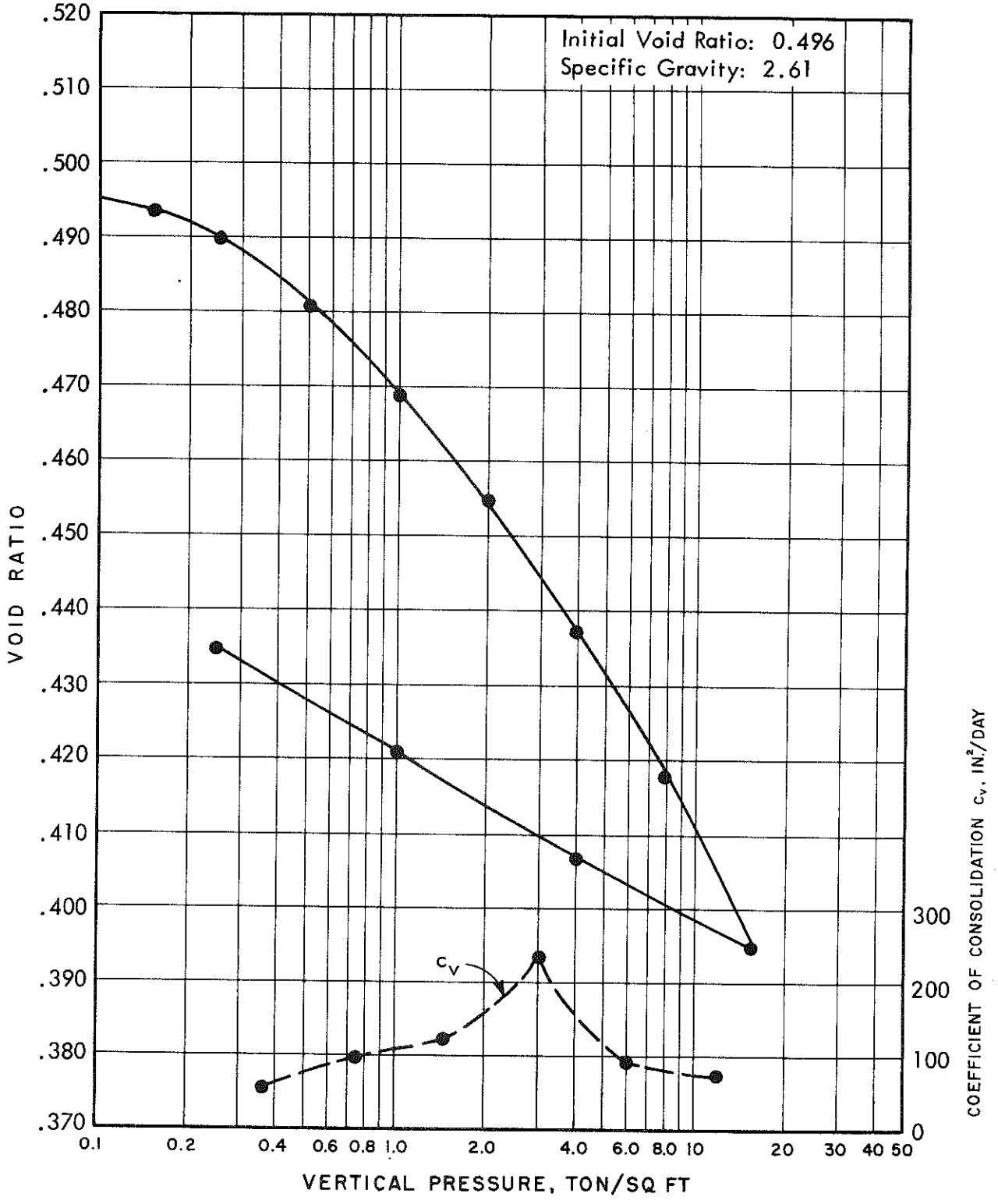
Well graded – having wide range in grain sizes and substantial amounts of all intermediate particle sizes.

Poorly graded – predominantly of one grain size, or having a range of sizes with some intermediate size missing.

Terms used in this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953.

BORING: P-1 DEPTH: 50'
MATERIAL: Hard brown and gray clay with sand pockets

UNIT DRY WEIGHT:	109	LB/CU FT
WATER CONTENT:	14	%
LIQUID LIMIT:	40	
PLASTIC LIMIT:	20	



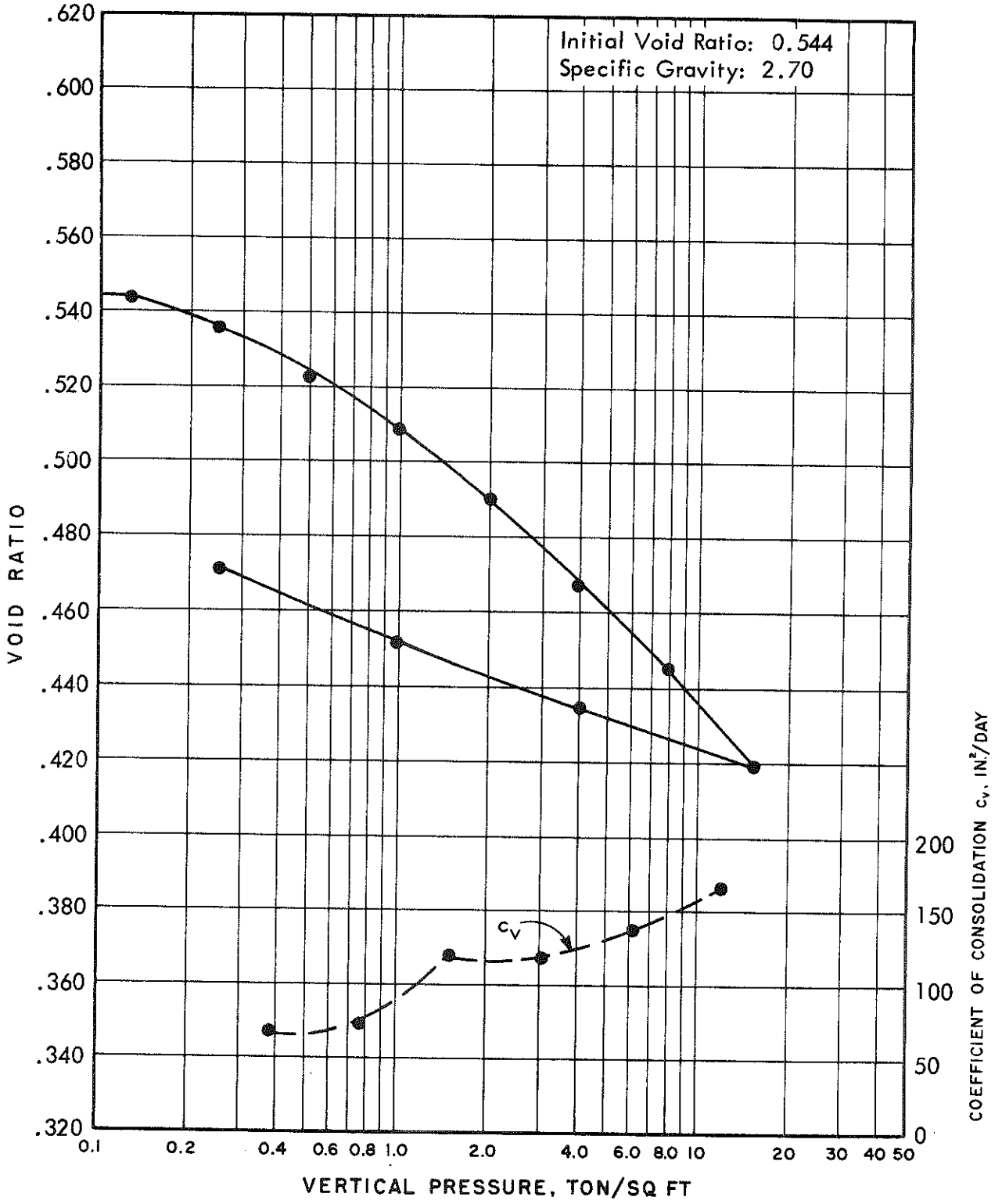
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

PLATE 45

BORING: P-3 DEPTH: 70'
MATERIAL: Hard gray sandy clay

UNIT DRY WEIGHT: 109 LB/CU FT
WATER CONTENT: 18 %
LIQUID LIMIT: 27
PLASTIC LIMIT: 16



CONSOLIDATION TEST RESULTS

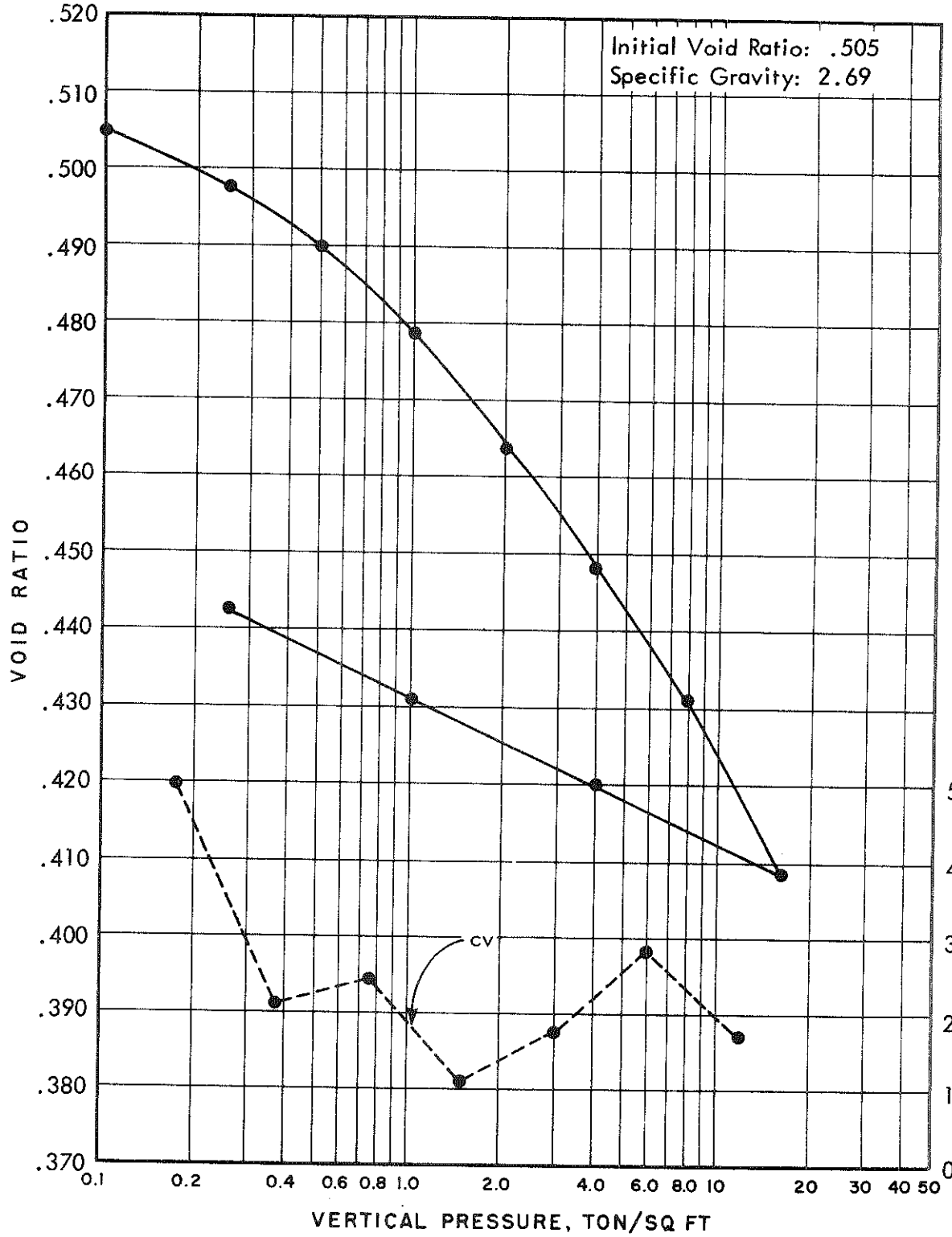
McCLELLAND ENGINEERS

PLATE 46

BORING: P-4 DEPTH: 6'

MATERIAL: Stiff red and tan very sandy clay

UNIT DRY WEIGHT:	112	LB/CU FT
WATER CONTENT:	17	%
LIQUID LIMIT:	29	
PLASTIC LIMIT:	18	



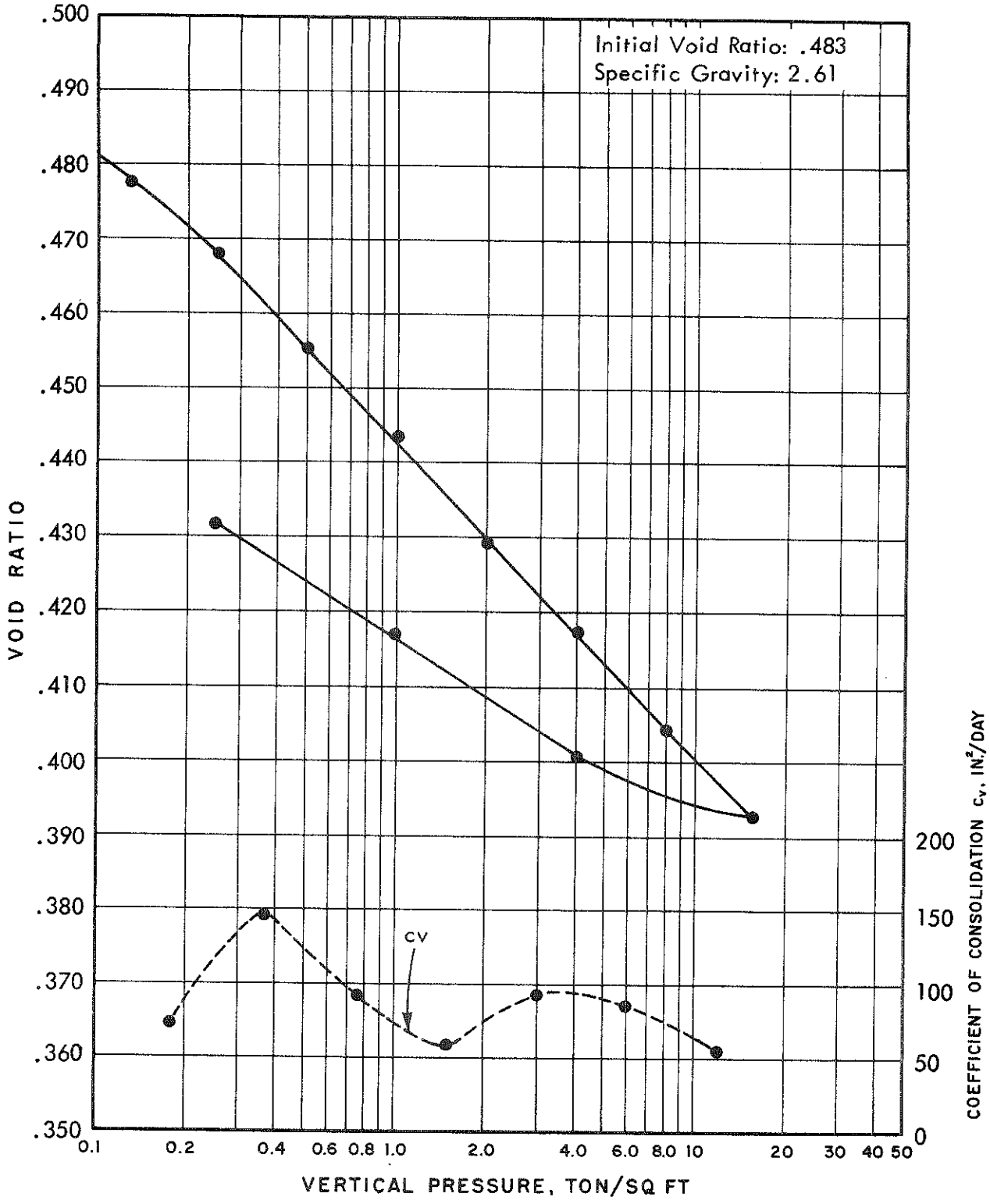
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

PLATE 47

BORING: P-4 DEPTH: 50'
MATERIAL: Gray clayey fine sand

UNIT DRY WEIGHT:	110	LB/CU FT
WATER CONTENT:	17	%
LIQUID LIMIT:	24	
PLASTIC LIMIT:	18	



CONSOLIDATION TEST RESULTS

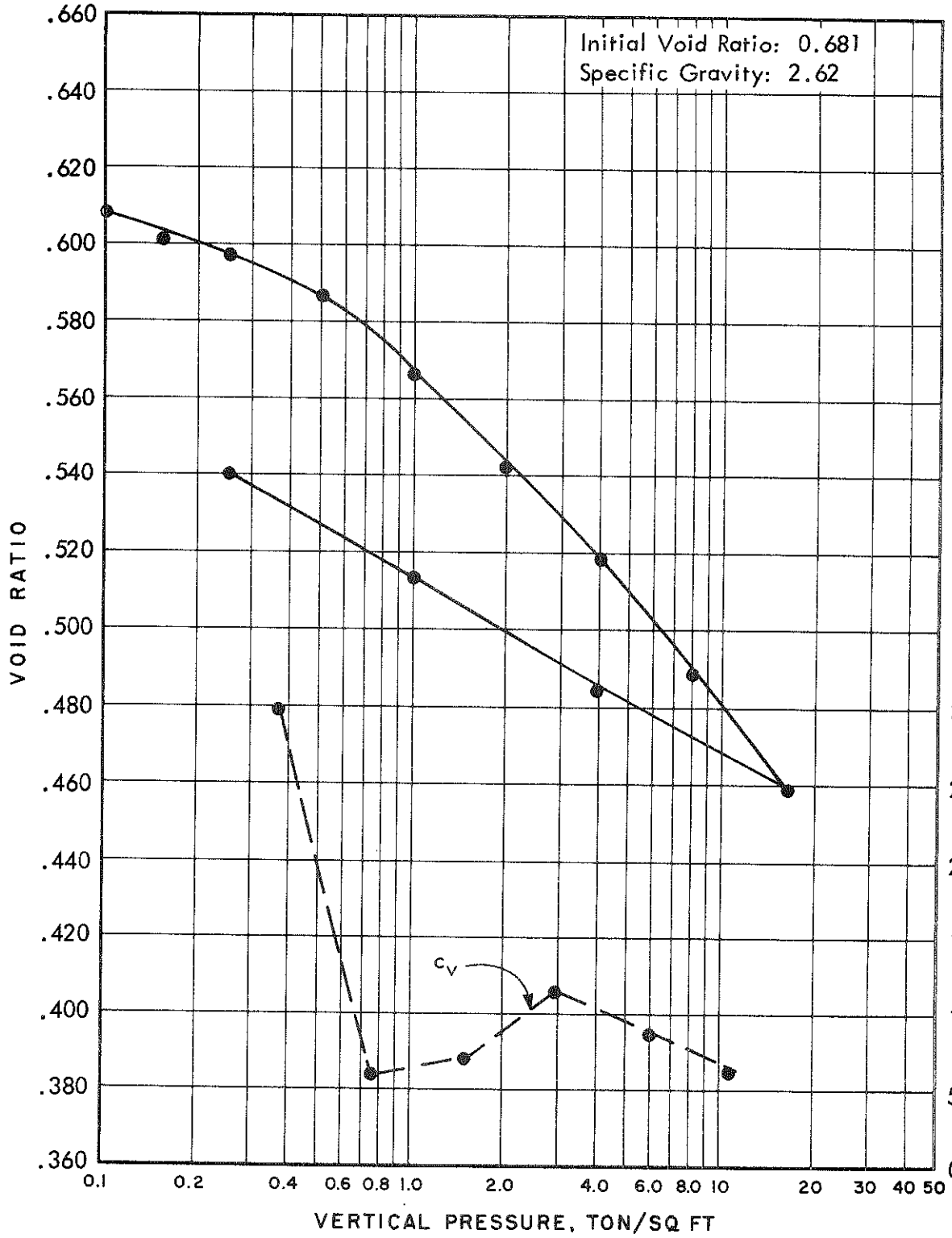
McCLELLAND ENGINEERS

PLATE 48

BORING: P-5 DEPTH: 30'

MATERIAL: Hard gray sandy clay with sand pockets and partings

UNIT DRY WEIGHT:	102	LB/CU FT
WATER CONTENT:	21	%
LIQUID LIMIT:	40	
PLASTIC LIMIT:	19	



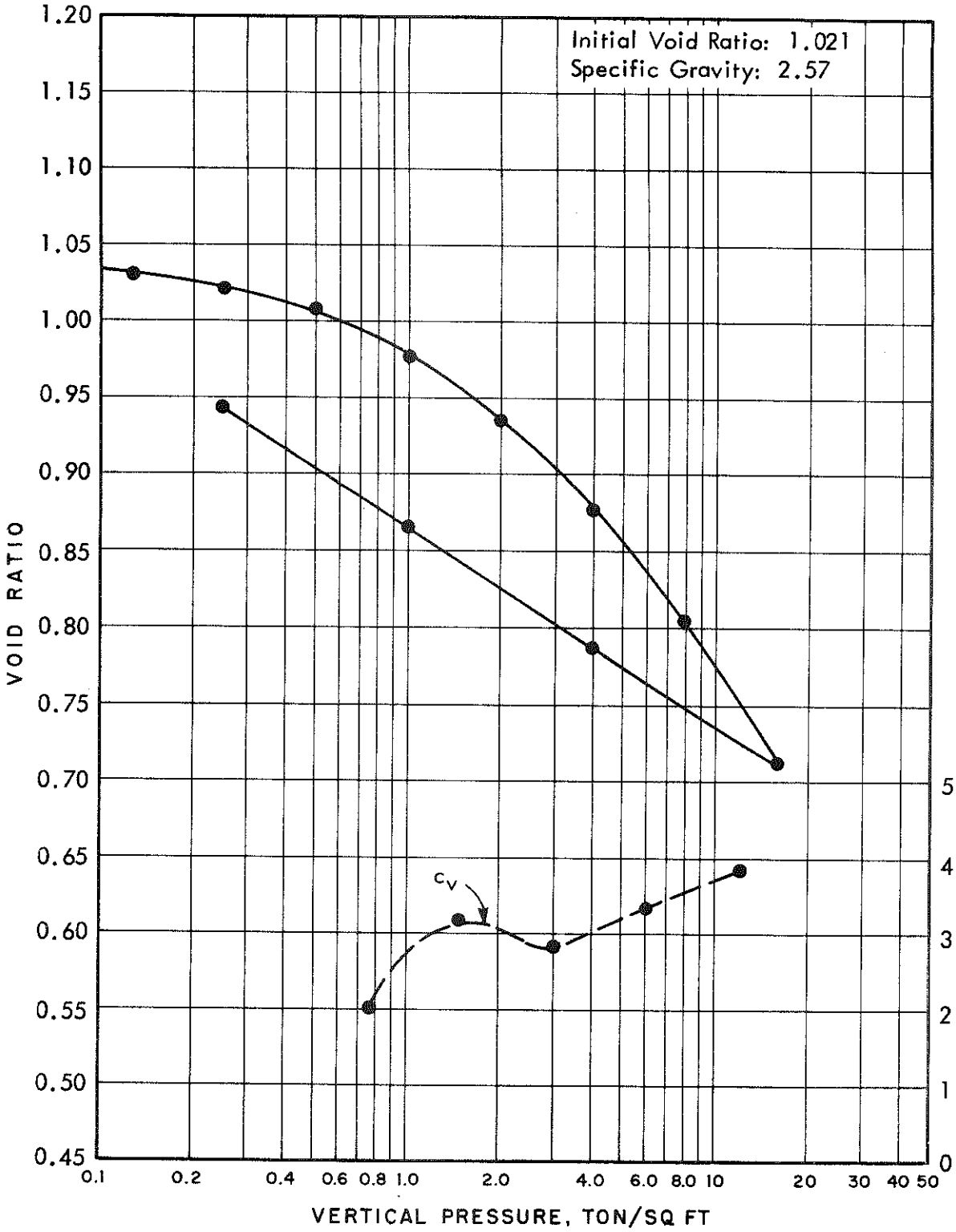
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

PLATE 49

BORING: P-7 DEPTH: 24.5'
MATERIAL: Stiff light gray clay with sand pockets and ferrous nodules

UNIT DRY WEIGHT:	91	LB/CU FT
WATER CONTENT:	34	%
LIQUID LIMIT:	52	
PLASTIC LIMIT:	18	



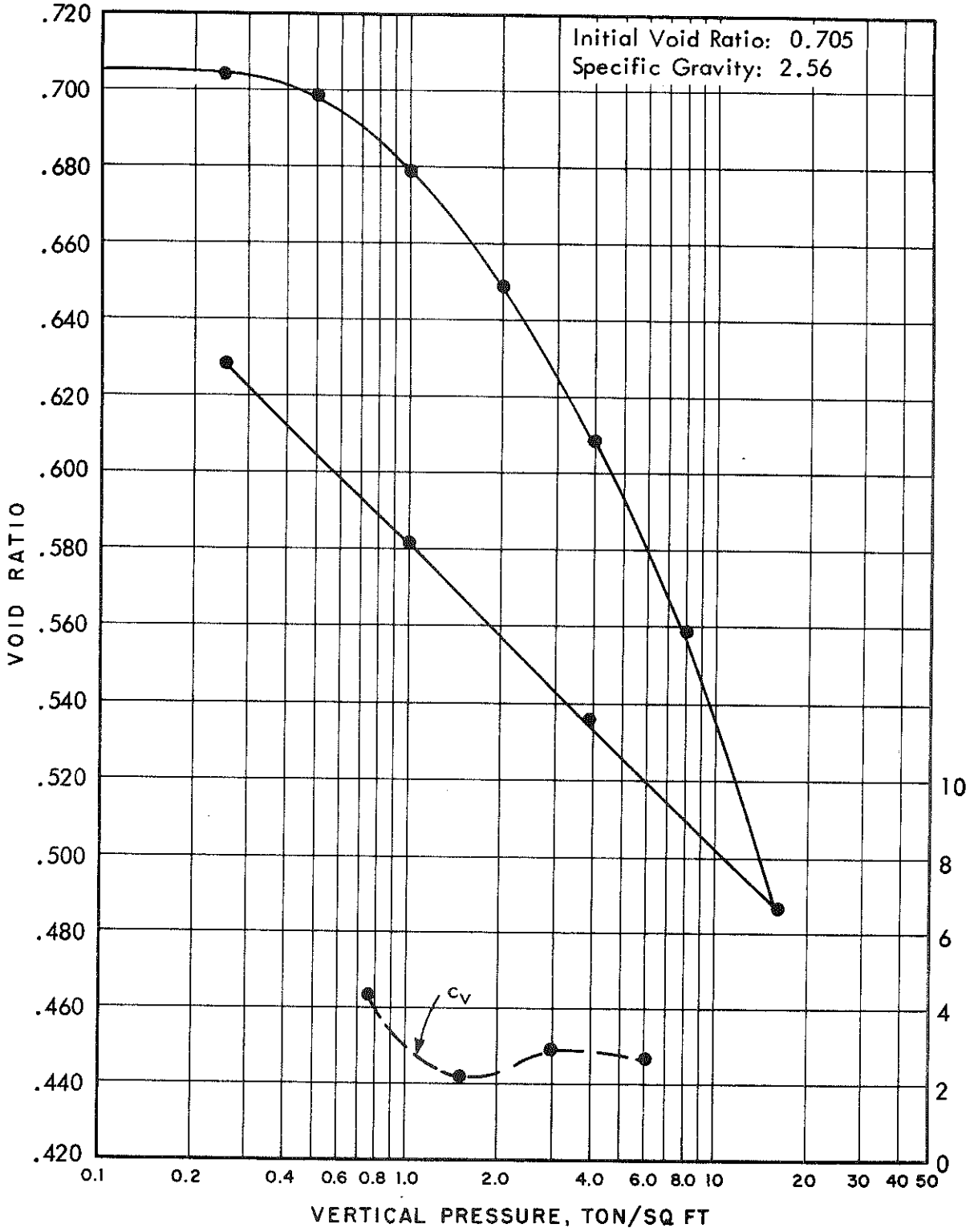
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

PLATE 50

BORING: P-9 DEPTH: 29.5'
MATERIAL: Very stiff light gray clay with silt partings

UNIT DRY WEIGHT:	94	LB/CU FT
WATER CONTENT:	30	%
LIQUID LIMIT:	69	
PLASTIC LIMIT:	23	



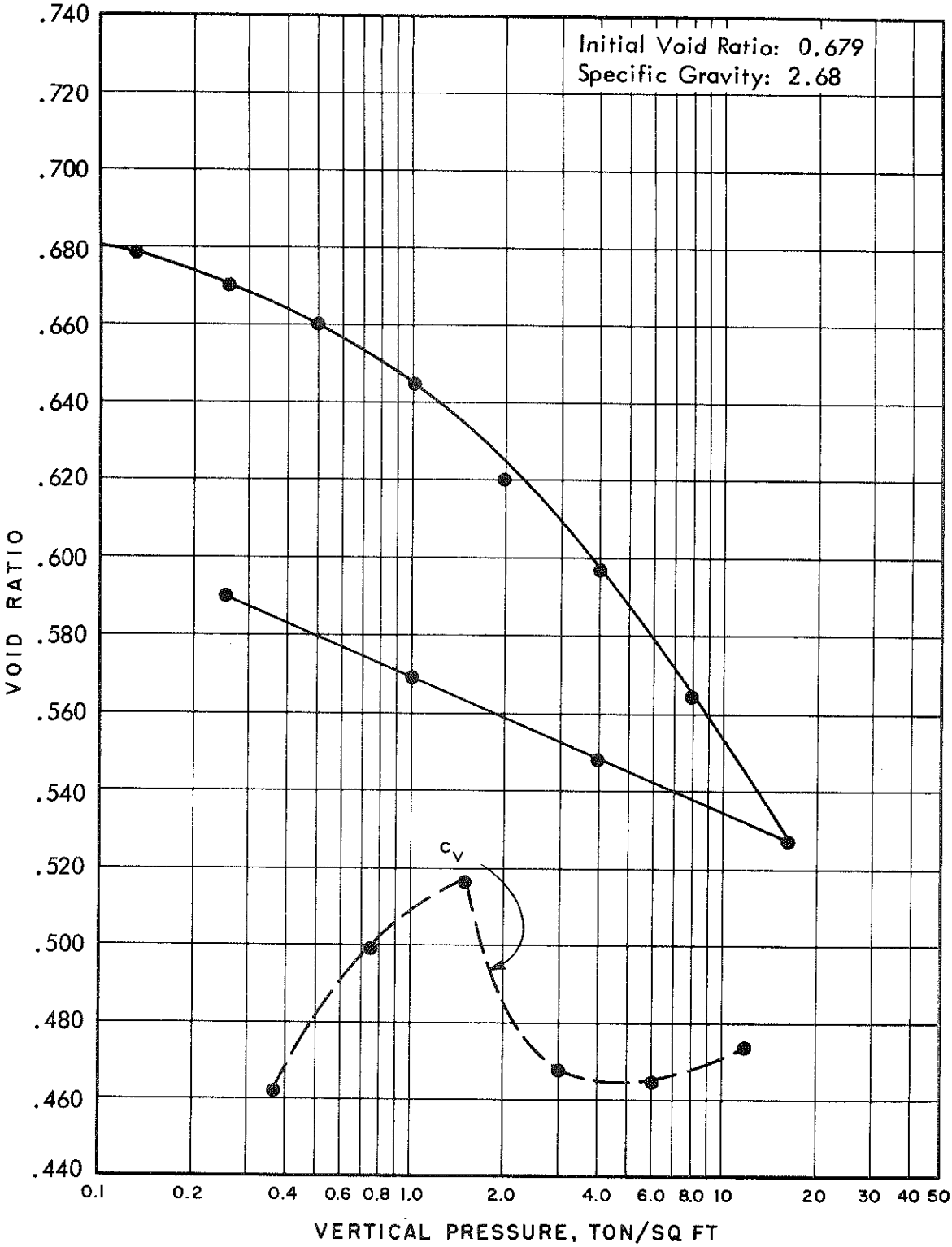
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

PLATE 51

BORING: P-9 DEPTH: 35'
MATERIAL: Very stiff gray sandy clay with sand partings

UNIT DRY WEIGHT: 100 LB/CU FT
WATER CONTENT: 22 %
LIQUID LIMIT: 37
PLASTIC LIMIT: 19



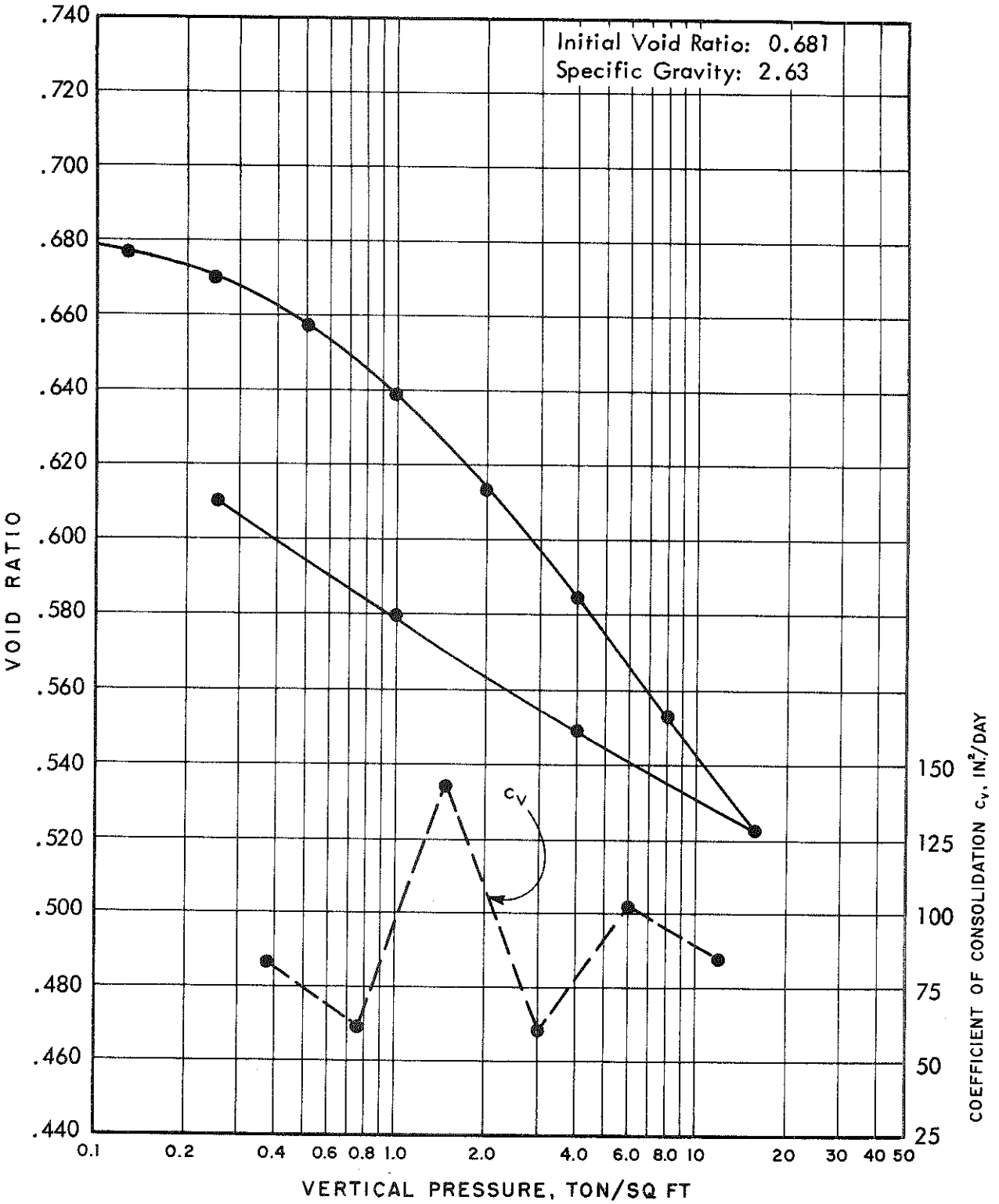
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

PLATE 52

BORING: P-10 DEPTH: 45'
MATERIAL: Very stiff gray sandy clay with silt pockets

UNIT DRY WEIGHT:	98	LB/CU FT
WATER CONTENT:	22	%
LIQUID LIMIT:	38	
PLASTIC LIMIT:	19	



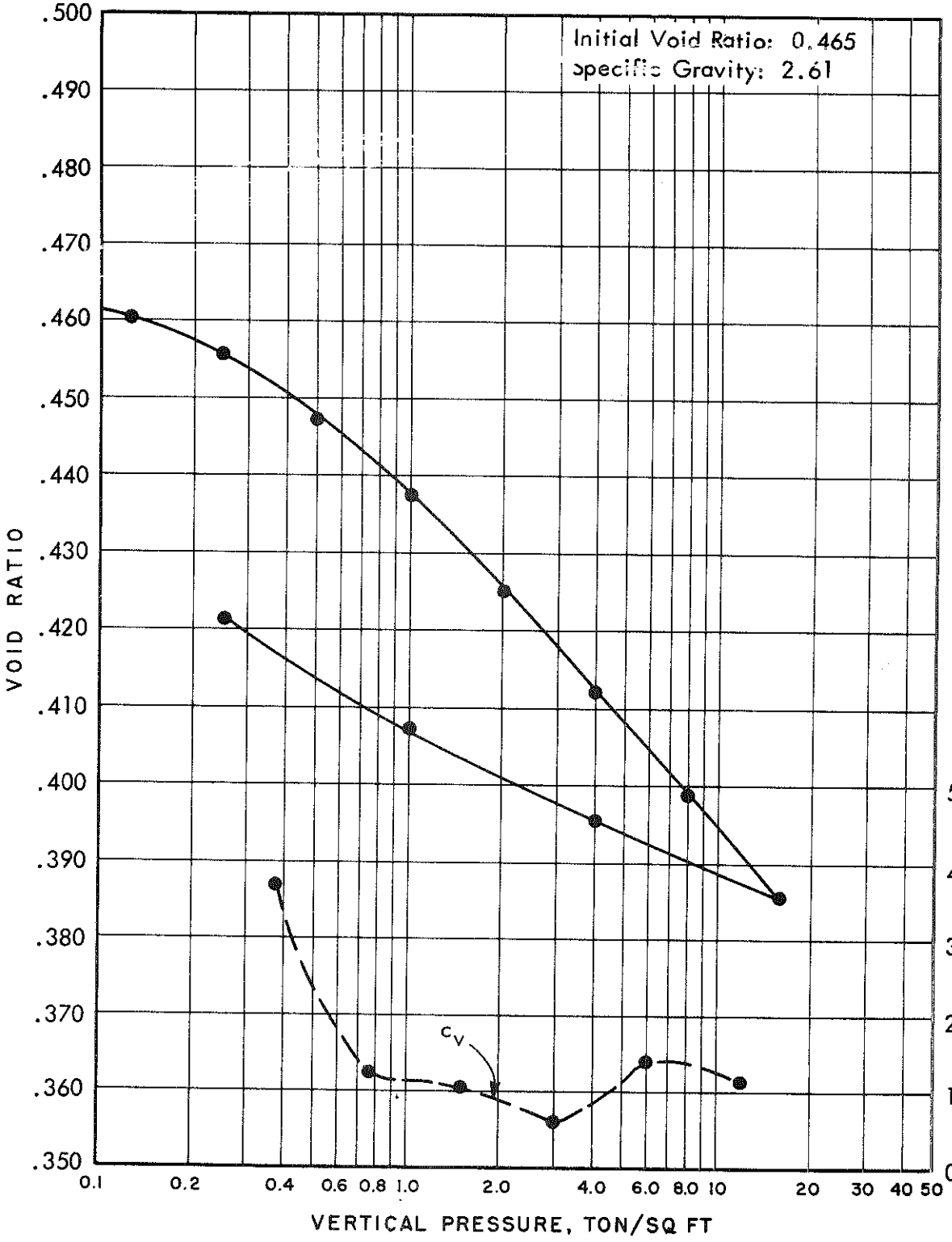
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

PLATE 53

BORING: P-10 DEPTH: 59'
MATERIAL: Gray clayey fine sand

UNIT DRY WEIGHT:	111	LB/CU FT
WATER CONTENT:	17	%
LIQUID LIMIT:	22	
PLASTIC LIMIT:	17	



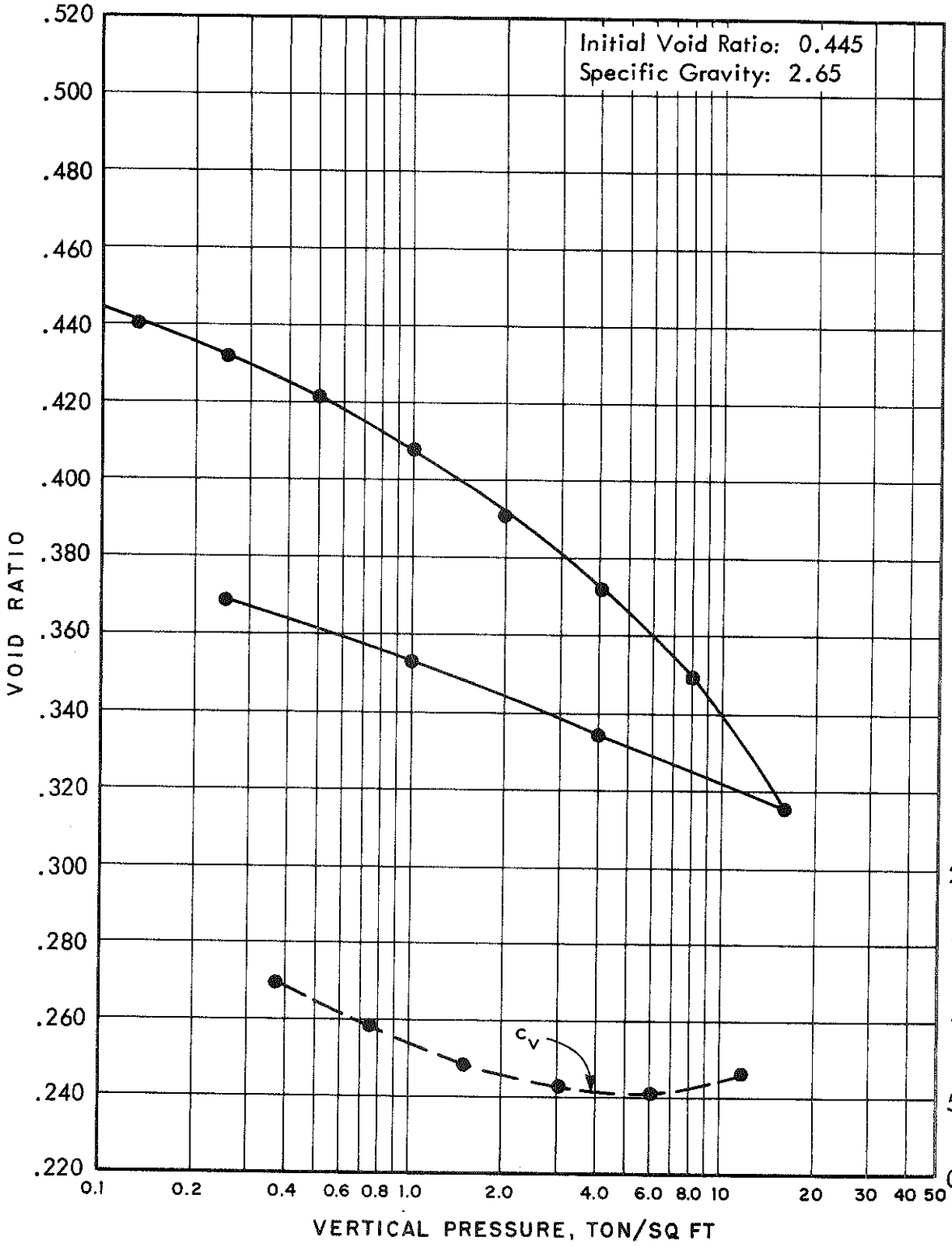
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

PLATE 54

BORING: P-12 DEPTH: 20'
MATERIAL: Red and tan clayey fine sand with clay pockets

UNIT DRY WEIGHT:	115	LB/CU FT
WATER CONTENT:	16	%
LIQUID LIMIT:	26	
PLASTIC LIMIT:	17	



CONSOLIDATION TEST RESULTS

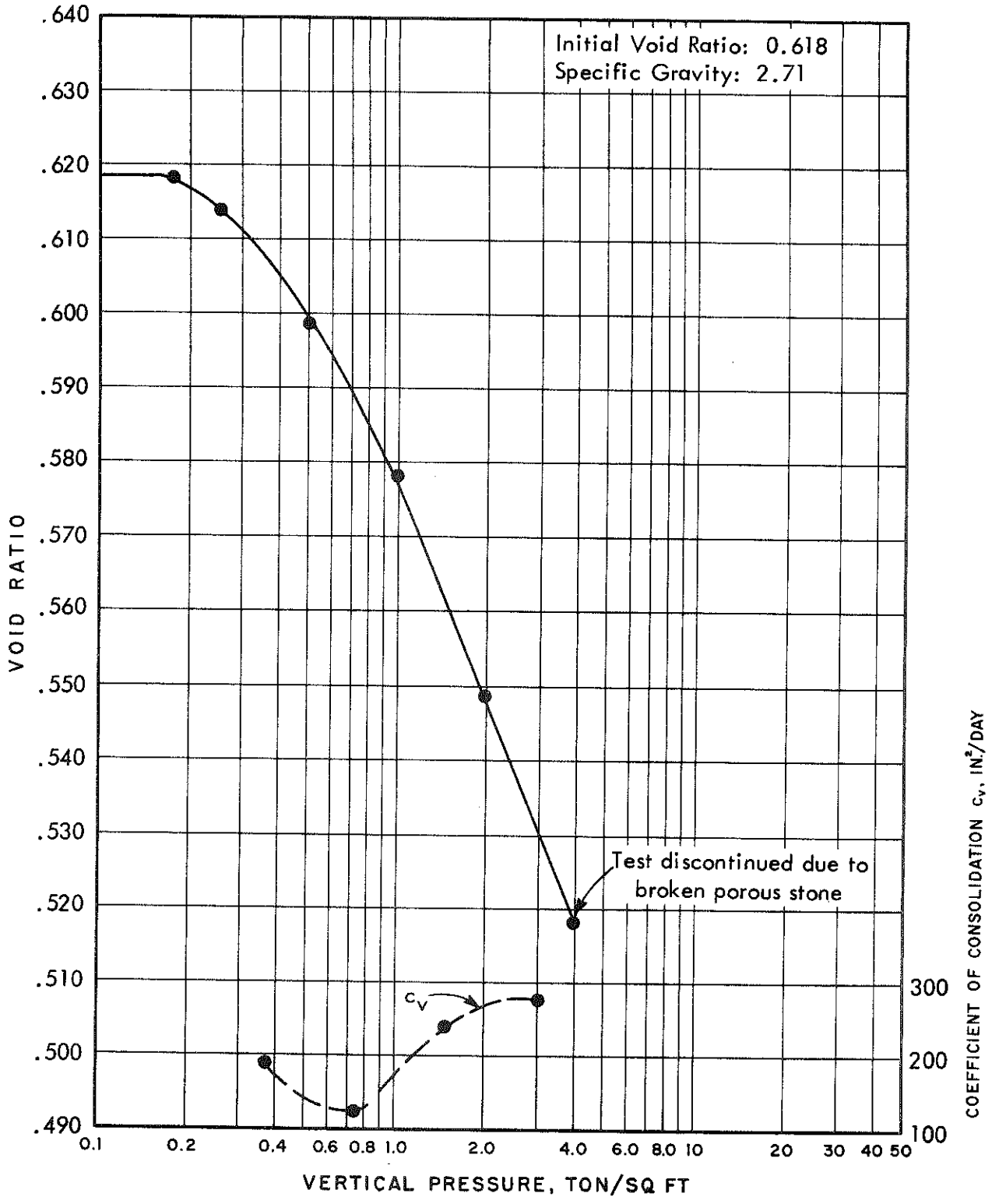
McCLELLAND ENGINEERS

PLATE 55

BORING: P-34 DEPTH: 18'

MATERIAL: Very stiff light gray clay with sand pockets and seams

UNIT DRY WEIGHT: 104.5 LB/CU FT
WATER CONTENT: 13 %
LIQUID LIMIT: 31
PLASTIC LIMIT: 17



CONSOLIDATION TEST RESULTS

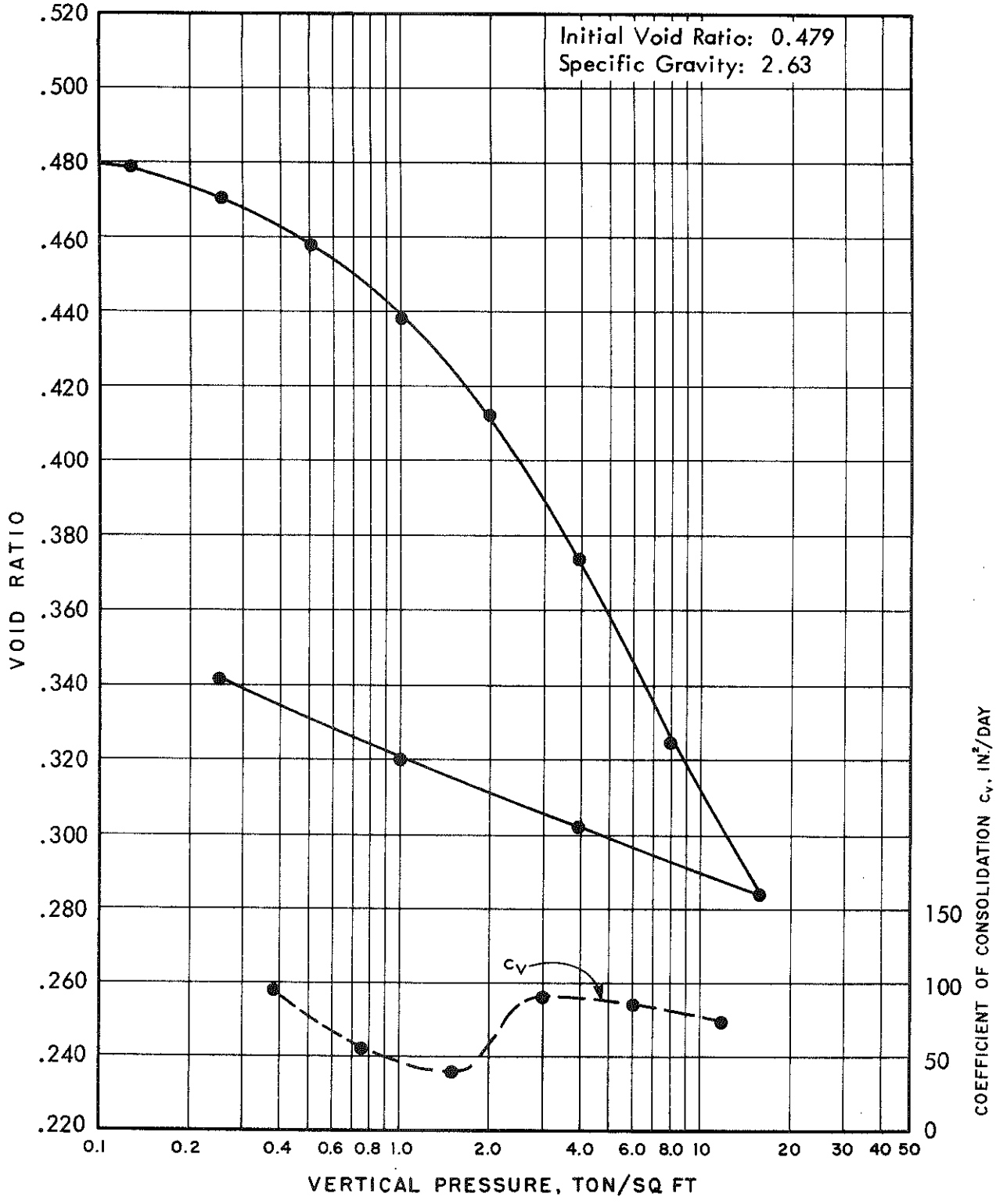
McCLELLAND ENGINEERS

PLATE 56

BORING: P-35 DEPTH: 39'

MATERIAL: Hard gray sandy clay with sand pockets

UNIT DRY WEIGHT:	111	LB/CU FT
WATER CONTENT:	18	%
LIQUID LIMIT:	25	
PLASTIC LIMIT:	16	

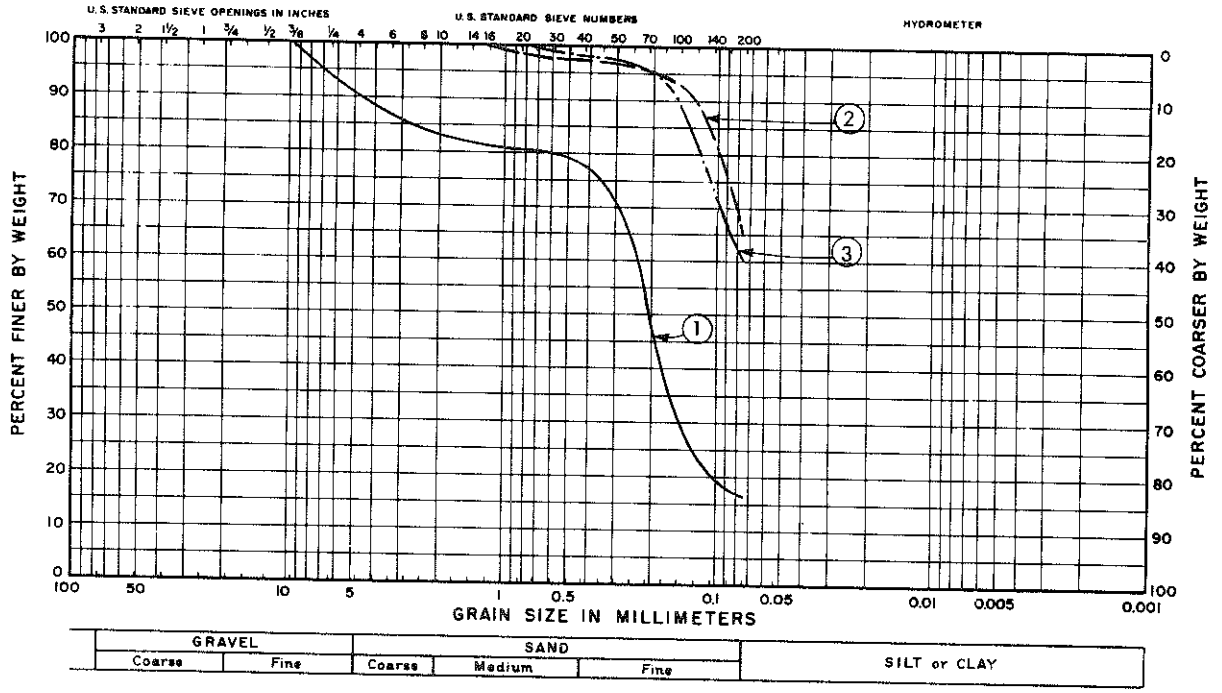


CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

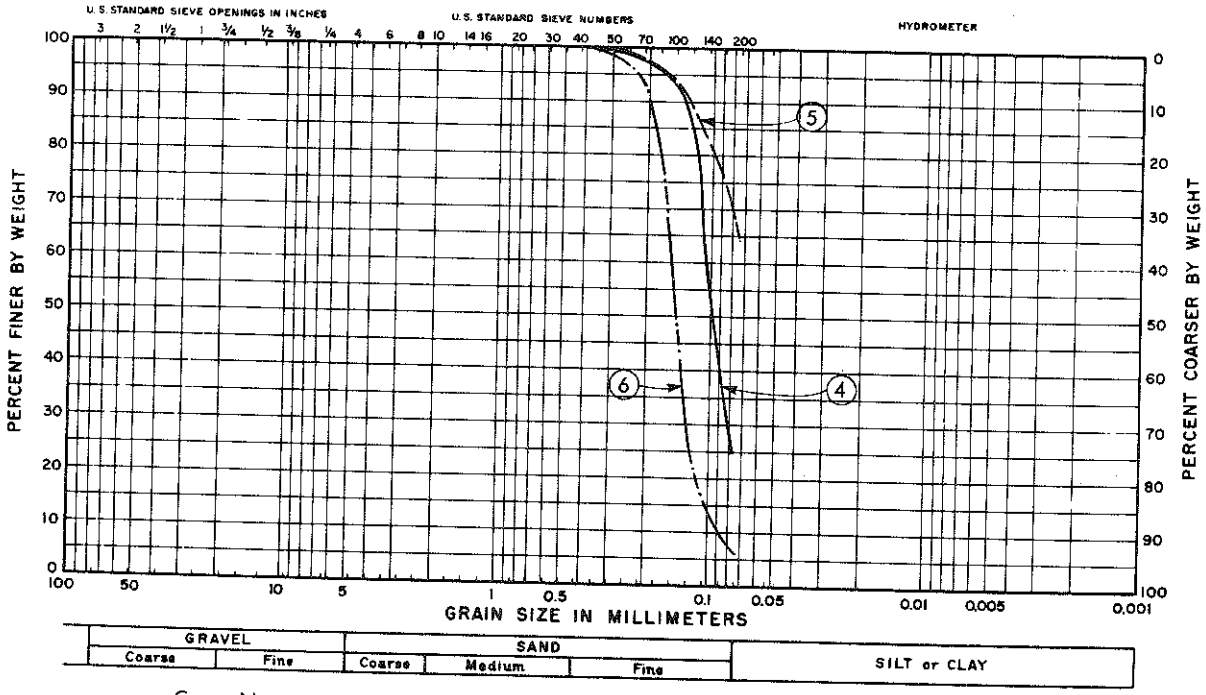
PLATE 57

GRAIN SIZE CURVES



Curve No.	Boring No.	Depth, Ft.	Material
1	P- 1	15	Red silty fine sand with sandstone nodules
2	P- 1	50	Hard brown and gray clay with sand pockets
3	P-23	15	Red and tan sandy clay

GRAIN SIZE CURVES

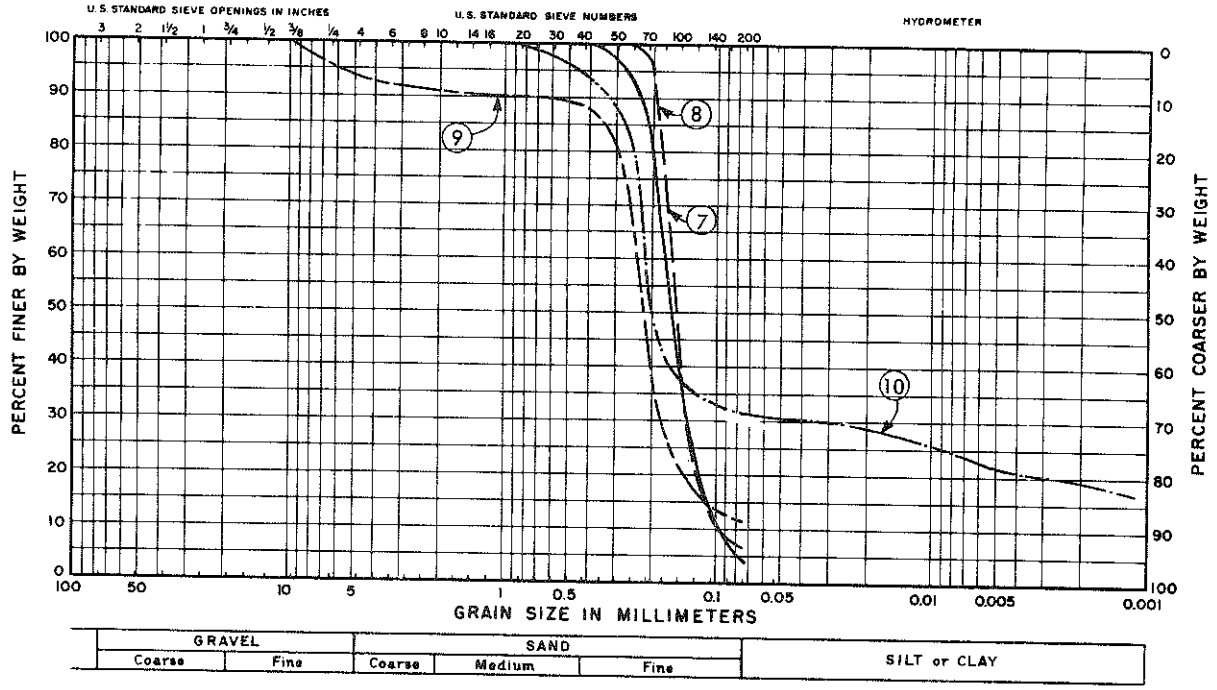


Curve No.	Boring No.	Depth, Ft.	Material
4	P-23	20	Gray silty fine sand
5	P-26	8	Red and tan sandy clay
6	P-26	30	Tan fine sand

McCLELLAND ENGINEERS

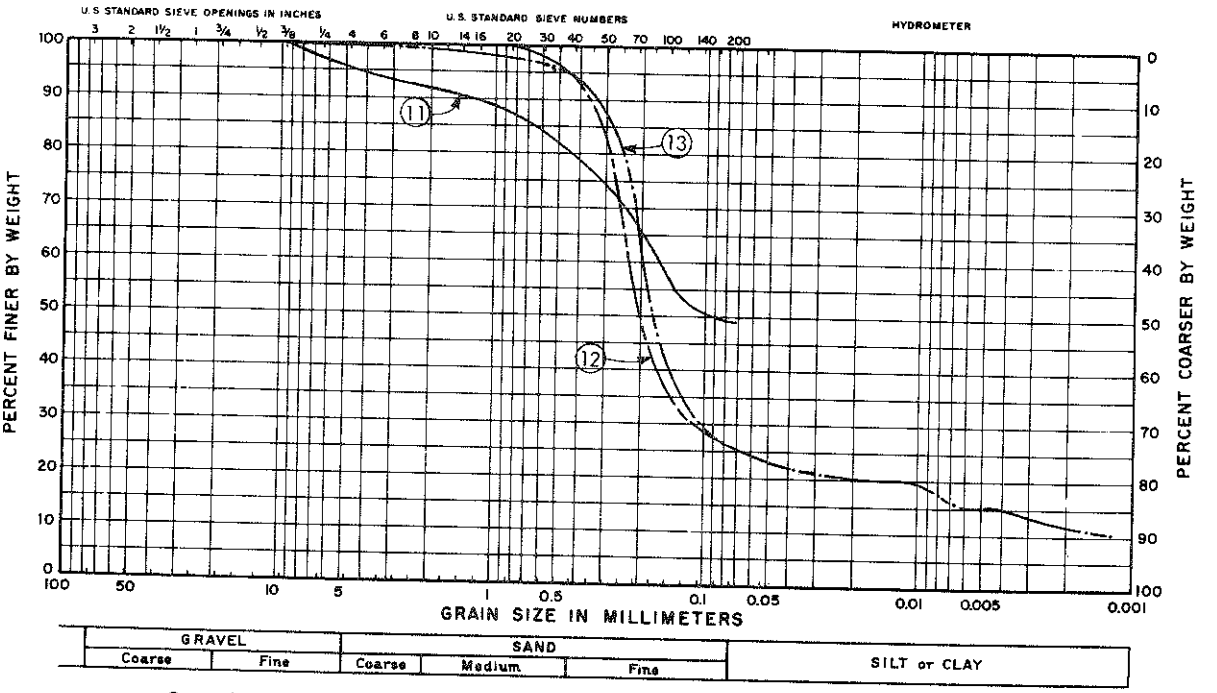
PLATE 58

GRAIN SIZE CURVES



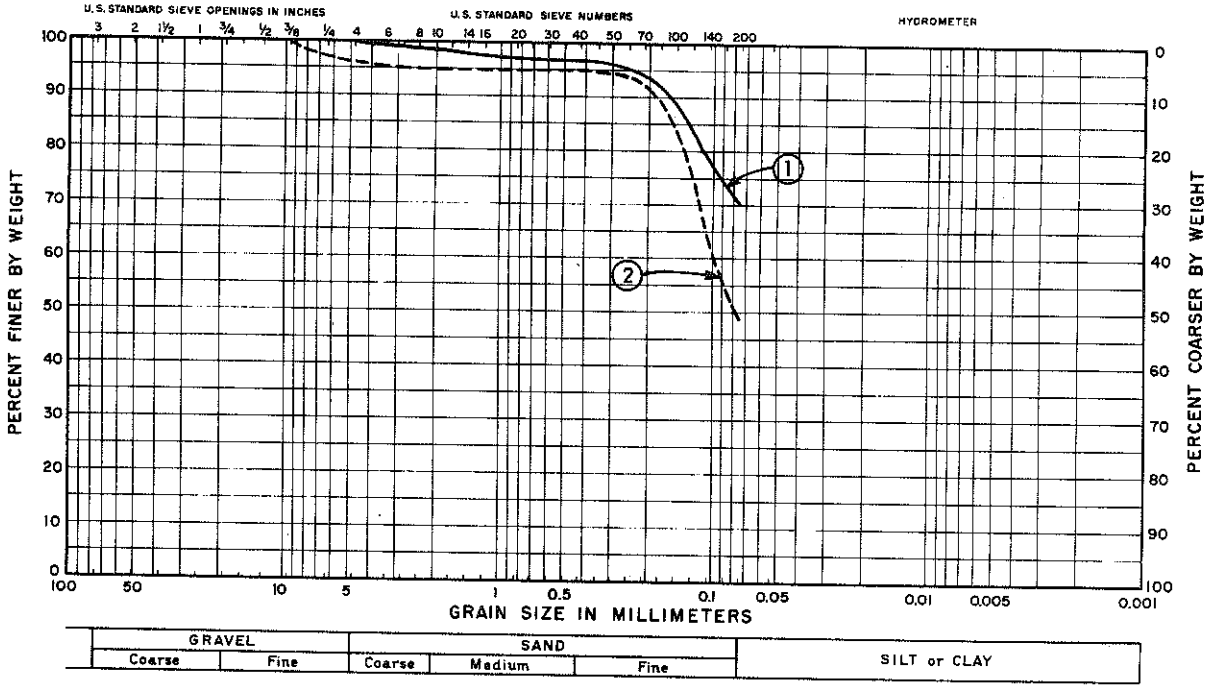
Curve No.	Boring No.	Depth, Ft.	Material
7	P-26	50	Tan fine sand
8	P-28	10	Tan fine sand
9	P-33	15.5	Red silty fine sand with ferrous nodules
10	P-34	30	Tan silty fine sand

GRAIN SIZE CURVES



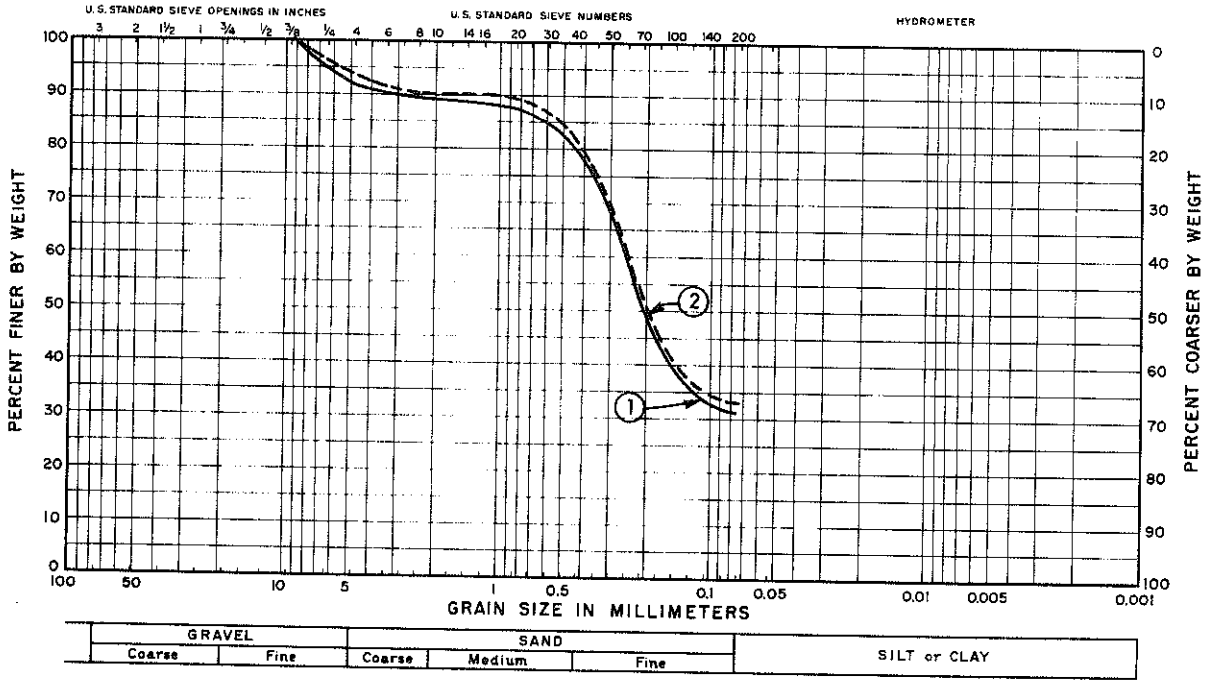
Curve No.	Boring No.	Depth, Ft.	Material
11	P-34	45	Gray sandy clay
12	P-35	20	Tan silty fine sand
13	P-36	30	Red and tan silty fine sand

GRAIN SIZE CURVES



Curve No.	Boring No.	Depth, Ft.	Material
14	P-4	15	Tan silty fine sand with clay seams and gravel
15	P-4	15	Tan silty fine sand with clay seams and gravel

GRAIN SIZE CURVES



Curve No.	Boring No.	Depth, Ft.	Material
16	P-5	15	Tan silty fine sand with sandstone nodules
17	P-5	15	Tan silty fine sand with sandstone nodules

SUMMARY OF PRICES
FOR
CONSTRUCTION OF NEW BOTTOM ASH STORAGE AREA
AT
WELSH POWER PLANT

The undersigned proposes to furnish all labor, materials, and equipment for the subject work in accordance with the attached specification and accompanying plans for the following prices to wit:

A. **BID SCHEDULE**

Item No.	Estimated Quantities	Unit	Description	Unit Price	Amount
1.	23	AC.	Clearing of designated work area.		
2.	23	AC.	Grubbing of designated work area.		
3.	20,000	C.Y.	Stripping topsoil from work area and stockpiling in shaped stockpiles as designated on drawings. (Measurement by cross-sections in stockpiles.)		
4.	150,000	C.Y.	Construction of berms using excavated materials from work area. (Measurement by cross-sections in place.)		
5.	100,000	S.Y.	Proofrolling area under berms and area to be lined.		
6.	6,000	L.F.	Excavate and backfill anchor trenches for HDPE liner.		
7A1.	90,000	S.Y.*	Furnish 60 mil. HDPE material.		
7A2.	5,000	S.Y.*	Furnish 100 mil. HDPE material.		
7B1.	90,000	S.Y.*	Install 60 mil. HDPE material.		
7B2.	5,000	S.Y.*	Install 100 mil. HDPE material.		

8.	5,000	C.Y.	Remove from stockpile and place and compact 6 in. topsoil on berms as indicated on dwgs. (Measurement in place.)	_____	_____
9A.	25,000	S.Y.	Seeding and fertilizing. (Disc, drag and drill seed.)	_____	_____
9B.	15,000	S.Y.	Seeding and fertilizing. (Spray w/ cellulose plaster mulch.)	_____	_____
10.	2	EA.	Drainage structures/systems.	_____	_____
11.	1 Lot	L.S.	Stormwater runoff control		_____
12.	1 Lot	L.S.	Mobilization		_____
13.	1 Lot	L.S.	Administration		_____
			TOTAL ESTIMATED PRICE (Sum Items 1-13 above)		_____

NOTE: It should be understood that the above quantities are estimates only and that some could vary significantly up or down as job conditions dictate. OWNER reserves the right to add and/or delete bid items as job conditions dictate.

* Measurement based on area covered plus anchor trenches.

PROPOSAL DATA

1. Bidder shall list manufacturer of HDPE material. _____
2. Bidder shall list installer of HDPE material. _____
3. Bidder shall list all other sub-contractors. _____

_____

_____

_____

B. COST PLUS

As the work progresses, it may be necessary to do items of additional work (Extra Work) not covered by the specifications. The undersigned agrees to do such work on a "Cost

Plus" basis, if so authorized by purchaser. Purchaser will pay an amount equal to the net cost of such work, which shall include only the following items: *

1. Payroll cost of labor, including foremen.

2. Taxes and insurance on labor.

3. Percentage of Items 1 and 2 above for overhead and profit: _____ % of 1 and 2.

4. Material.

5. Percentage of Item 4 above for overhead and profit: _____ _____% of Item 4.

Note 2-1: The above percentages for overhead and profit shall cover:

2-1-1: Superintendents (except foremen).

2-1-2: Field office force,

2-1-3: Use of tools and supplies,

2-1-4: Use of construction equipment originally costing less than $1,000.00,

2-1-5: Any subcontractors' fees for over head and profit,

2-1-6: All overhead (including such taxes and insurance generally considered overhead).

2-1-7: Profit.

6. The undersigned shall list all equipment he plans to use on the WORK originally costing $1,000.00 or more and shall give an hourly rental rate for Cost Plus work. This rate shall apply to equipment located on the Project Site at the time the extra work is done. Said rate shall include insurance, fuel, oil, overheads and all other expenses for the equipment including operating personnel. (Bidder to attach separate rate sheet if necessary.)

Equipment (Include Type and Size)	Hourly Rental Rates

* Based on mutual agreement, "Extra Work" may be performed by applying equipment and personnel hourly rates to hours worked as verified by daily time sheets and approved by OWNER/PURCHASER's Representative. Materials would be compensated for as in No. 5 above.

C. For Unit Price Contracts, the actual quantities may vary from the estimated quantities and the undersigned agrees that final payment will be adjusted to the actual quantities of work completed at the quoted unit prices listed.

D. The undersigned agrees that upon receipt of notification he will commence WORK on or about April 17, 2000 and will complete all WORK by October 31, 2000.

E. The undersigned estimates that it will take _____ working days to complete all WORK covered by this specification.

F. The undersigned hereby declares that he has visited the project site and has carefully examined the bid documents relative to the WORK covered by the proposal.

G. Bidder shall state any specific exceptions taken to this specification.

H. OWNER reserves the right to reject any and all bids.

I. The undersigned acknowledges by signature receipt of the following Addenda (if any have been received).

Addendum No. 1 _____

Addendum No. 2 _____

Addendum No. 3 _____

Respectively submitted,

_____

Signature of Bidder

_____

Name of Company

( )_____

Telephone Number of Bidder

(Seal if Bidder is a Corporation)

JOB SPECIFICATION

1. CLEARING

The work area was previously a pine plantation and was recently clear-cut. CONTRACTOR shall complete clearing the work area of all timber, snags, vegetation and other foreign material. All cleared material shall be disposed of by burning.

2. GRUBBING

The work area shall be grubbed by removing and disposing of all stumps, roots, logs and other foreign material from below existing grade. Stumps shall be buried only where designated by OWNER. All other grubbed materials shall be burned with any unburned materials being buried with the stumps.

3. STRIPPING TOPSOIL

The work area is covered by existing topsoil. The topsoil shall be removed and stockpiled in locations as designated on the design drawings. Completed stockpiles shall be neatly shaped. Any topsoil stockpile remaining after the work is completed shall be seeded and fertilized as per bid item No. 9A.

4. BERM CONSTRUCTION

After all topsoil has been removed, the subgrade under the berms shall be scarified/disked to a depth of 10 in., brought to optimum moisture, and compacted to 90% modified proctor (ASTM D-1557). The berms shall be constructed, as indicated on the design drawings, using excavated materials from within the bermed area.

All excavated materials shall be placed in lifts not exceeding eight inches (8") loose. Prior to compaction, the material shall be brought to optimum moisture. The material shall be processed and compacted to 90% modified proctor (ASTM D-1557) by utilizing suitable equipment that will achieve the blending and interparticle bonding required. Each completed lift shall be approved by the OWNER prior to placing of material for the next lift.

The boring logs indicate a layer of tan sand directly beneath the six (6) in. layer of topsoil. This layer of tan sand shall be excavated and placed in the internals of the berm as indicated on the berm cross-sections on the design drawings. The tan sand shall be placed and compacted as described in the preceding paragraph. The sandy clay and/or silty clay materials and the clayey sand materials shall be placed and compacted over the tan sand as described in the preceding paragraph. A full-time technician will be on site to verify the various material classifications.

5. PROOFROLLING

After the berm construction is completed and the bottom ash storage area shaped to the final grades indicated on the drawings, the entire area to be lined shall be proof rolled with equipment as approved by OWNER. Any area that pumps, ruts or shows signs of softness shall be repaired before proceeding with the installation of the liner.

6. ANCHOR TRENCHES

The anchor trenches shall be excavated to the line, grade, and width shown on the design drawing prior to liner system placement. The OWNER shall verify that the anchor trench has been constructed according to construction drawings.

No more than the amount of trench required for the geomembrane to be anchored in one day shall be excavated.

Slightly rounded corners shall be provided in the trench where the geomembrane adjoins the trench so as to avoid sharp bends in the geomembrane.

The anchor trench shall be backfilled and compacted by the CONTRACTOR as approved by the OWNER. Trench backfill material shall be placed in 8-inch thick loose lifts and compacted by wheel rolling with light, rubber-tired or other light compaction equipment.

Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane. At no time shall construction equipment come into direct contact with the geomembrane. If damage occurs, it shall be repaired by the CONTRACTOR prior to the completion of backfilling.

7. GEOMEMBRANE/LINER (FURNISH AND INSTALL)

A. Materials Furnished

<u>High Density Polyethylene Liner</u> (HDPE)

The Geomembrane supplied for this project must be suitable for the use intended. The CONTRACTOR shall obtain, and submit to OWNER, written evidence and assurance from the manufacturer that the product is acceptable for use as a pond liner in a pond to contain bottom ash and flyash from a coal fired electric generating facility. A typical chemical analysis of the component materials is as shown on Exhibit A included with the bid documents. The liner is to be placed on a prepared sandy clay subgrade and will be exposed to the environment under certain conditions.

CONTRACTOR submittals are required for OWNER's approval prior to installation of the membrane and are as follows:

1. Manufacturer's Certification that the proposed Geomembrane is suitable for purpose intended.

2. Material specifications containing the following test properties with results:

PROPERTY	**TEST METHOD**
Thickness, mils	ASTM D751/1593/374
Density (g/cc)	ASTM D792/1505
Melt Flow Index (g/10 minutes)	ASTM D1238-E
Tensile Properties Either Direction	ASTM D638 Type IV Dumbbell, 2 ipm
Tensile Strength at Break (lbs./in, width)	Gauge length per
Tensile Strength at Yield (lbs./in, width)	N.S.F. Std. 54
Elongation at Break (percent)	
Elongation at Yield (percent)	
Tear Resistance Initiation (lbs.)	ASTM D1004
Low Temperature Brittleness °F	ASTM D746 B
Dimensional Stability Each Direction (percent)	ASTM D1204 100°C 1 hr.
Volatile Loss (max. percent)	ASTM D1203 Meth. A
Ozone Resistance	ASTM D1149 7 days 100 ppm 104°F
Environmental Stress Crack Resistance (hrs)	ASTM D1693 Cond. B
Puncture Resistance (lbs.)	FTMS 101C Method 2065
Water Absorption (percent weight change)	ASTM D570
Coef. Linear Thermal Expansion 10^{-4}/°C	ASTM D696
Moisture Vaport Transmission (g/m^2day)	ASTM E96
Oxidative Induction Time (minutes)	ASTM D3895
Pure O_2 at 1 Atmosphere	200° C
Tensile Impact Strength ($ft\text{-}lbs/in^2$)	ASTM D1822
Carbon Black Content (percent)	ASTM D1603
Carbon Black Dispersion	ASTM D3015
Color (exposed side)	White

3. Installer's evidence of prior satisfactory experience in installation of HDPE liner with a list of at least five completed similar facilities with the name, address and phone number of a contact at the facility who can discuss the project.

4. Manufacturer's letter of approval of the installation at the facilities in No. 3 above.

Transportation

The geomembrane rolls or panels shall be packaged and shipped by appropriate means so that no damage is caused. Transportation shall be the responsibility of the CONTRACTOR.

Delivery

Off-loading and storage of the geomembrane is the responsibility of the CONTRACTOR. The CONTRACTOR shall be responsible for replacing any damaged or unacceptable material at no cost to the OWNER. All damaged rolls must be separated from the undamaged rolls. The OWNER will be the final authority on determination of damage.

On-Site Storage

The geomembrane shall be stored so as to be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or other damage.

The rolls shall be stored on a prepared surface (not wooden pallets) and should not be stacked more than two rolls high.

Manufacturer

HDPE liner shall be as manufactured by GSE Lining Technology, Inc. or approved equal.

For the geomembrane materials furnished, the manufacturer will provide OWNER with a mutually agreeable twenty (20) year pro-rata warranty.

B. Installation

General

The surface upon which the HDPE Liner is to be installed is a prepared sandy clay subgrade.

Method of Placement

The CONTRACTOR shall be responsible for the following:

1. No equipment or tools shall damage the geomembrane by handling, trafficking, or other means.

2. No personnel working on the geomembrane shall smoke, wear damaging shoes, or engage in other activities that could damage the geomembrane.

3. The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting geosynthetic clay liner.

4. The method used to place the panels shall minimize wrinkles. Wrinkles shall be identified as to proper location and compensation shall be identified on the CONTRACTOR's and OWNER's drawings. Ballast shall be used to prevent relocation of the compensating wrinkles by wind.

5. Adequate loading (e.g., sandbags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels). Ballast shall remain in place after the work is completed.

6. Direct contact with the geomembrane shall be minimized, i.e., the geomembrane in traffic areas is to be protected by extra geomembrane, or other suitable materials.

7. Completed liner installation shall be weighted down with 80 lb. bags of sackrete placed on 50 ft. centers both ways.

Weather Conditions

Geomembrane deployment shall proceed between ambient temperatures of 32°F to 105°F. Placement can proceed below 32° only after it has been verified by the OWNER that the material can be seamed according to the specification and is approved by the OWNER. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, rain, dew) or in the presence of excessive winds, as determined by the CONTRACTOR.

Factory Seam Quality Verifications

The OWNER will require the CONTRACTOR to test and document up to as much as 20% of factory fusion welds (non-destructive air pressure test and/or vacuum test) in the field to verify factory test results. Additional testing at the CONTRACTOR's expense will be required if failed tests are obtained in the field.

Field Seaming

Seams shall be oriented parallel to the line of maximum slope, i.e., oriented down, not across the scope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized.

Seams shall be aligned with the least possible number of wrinkles and "fishmouths". If a fishmouth or wrinkle is found, it shall be relieved and capstripped.

Seam Overlap

Panels of geomembrane must have a finished overlap of a minimum of 4 inches for fusion welding and 3 inches for extrusion welding, but in any event sufficient overlap shall be provided to allow peel tests to be performed on the seam.

No solvent or adhesive may be used unless the product is approved by the OWNER. (Samples shall be submitted to the OWNER for testing and evaluation).

The procedure used to temporarily bond adjacent panels together shall not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any spot welding apparatus shall be controlled such that the geomembrane is not damaged.

Seaming Equipment and Accessories

The CONTRACTOR shall submit a list of equipment proposed for field seaming.

Test Seams

Field test seams shall be conducted on geomembrane liner to verify that seaming conditions are satisfactory. Test seams shall be conducted at the beginning of each seaming period, at the OWNER's discretion, and at least once each 4 hours, for each seaming apparatus used that day.

All test seams shall be made at a location selected by the OWNER in the area of the seaming and in contact with the subgrade. The test seam samples shall be 10 feet long for fusion welding and 3 feet long for extrusion welding with the seam centered lengthwise. Specimens 1 inch wide shall be cut from each opposite end of the test seam by the OWNER. The OWNER shall use a tensiometer to test these specimens for shear and peel. If a test seam fails to meet field seam specifications, the seaming apparatus and/or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved.

Non-Destructive Seam Testing

The CONTRACTOR shall non-destructively test all field seams over their full length. All test equipment, including but not limited to the following shall be furnished by the CONTRACTOR.

A. Vacuum Box testing

Equipment for testing single wedge fusion seams and extrusion seams shall be comprised of the following:

1. A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket attached to the bottom, port hole or valve assembly, and a vacuum gauge.

2. A steel vacuum tank and pump assembly equipped with a pressure controller and pipe connections.

3. A rubber pressure/vacuum hose with fittings and connections.

4. A plastic bucket and wide paint brush.

5. A soapy solution.

The following procedures shall be followed by the CONTRACTOR.

1. Excess sheet overlap shall be trimmed away.

2. Clean the window, gasket surfaces and check for leaks.

3. Energize the vacuum pump and reduce the tank pressure to approximately 3-5 psi.

4. Wet a strip of geomembrane approximately 12 inches by 48 inches (length of box) with the soapy solution.

5. Place the box over the wetted area and compress.

6. Close the bleed valve and open the vacuum valve.

7. Ensure that a leak tight seal is created.

8. For a period of approximately 15 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.

9. If no bubbles appear after 15 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inches overlap and repeat the process.

10. All areas where soap bubbles appear shall be marked and repaired and then retested.

The following procedures shall apply to locations where seams cannot be non-destructively tested, as determined by the OWNER.

1. If the seam is accessible to testing equipment prior to final installation, the seam shall be non-destructively tested prior to final installation.

2. If the seam cannot be tested prior to final installation, the seaming operations shall be observed by the OWNER for uniformity and completeness.

B. Air Pressure Testing (For Double Fusion Seam Only)

The following procedures are applicable to those processes which produce a double seam with an enclosed space.

Equipment for testing double fusion seams shall be comprised of the following:

1. An air pump equipped with pressure gauge capable of generating and sustaining a pressure between 25 and 30 psi and mounted on a cushion to protect the geomembrane.

2. A manometer equipped with a sharp hollow needle, or other approved pressure feed device.

The following procedures shall be followed by the CONTRACTOR.

1. Seal one end of the seam to be tested.

2. Insert needle or other approved pressure feed device through the sealed end of the channel created by the double wedge fusion weld.

3. Energize the air pump to verify the unobstructed passage of air through the channel.

4. Seal the other end of the channel.

5. Energize the air pump to a pressure between 25 and 30 psi, close valve, and sustain pressure for approximately 5 minutes.

6. If loss of pressure exceeds 4 psi, or pressure does not stabilize, locate faulty area, repair and retest.

7. Remove needle or other approved pressure feed device and seal.

Destructive Seam Testing

The CONTRACTOR shall provide the OWNER with a minimum of one destructive test sample per 500 feet of seam length from a location specified by the OWNER. The CONTRACTOR shall not be informed in advance of the sample location.

A. Sampling Procedure

In order to obtain test results prior to completion of liner installation, samples shall be cut by the CONTRACTOR as the seaming progresses. Sampling times and locations shall be determined by the OWNER. The OWNER must witness the obtainment of all field test samples and the CONTRACTOR shall mark all samples with their location roll and seam number. The CONTRACTOR shall also record in written form the date, time, location, roll seam number, ambient temperatures, and pass or fail description. A copy of the information must be attached to each sample portion. All holes in the geomembrane resulting from obtaining the seam samples shall be immediately repaired. All patches shall be vacuum tested.

B. Size and Disposition of Samples

The samples shall be 12 inches wide by 24 inches long with the seam centered lengthwise. The sample shall be cut into two equal length pieces, half to be given to the OWNER and the other half to be given to the CONTRACTOR.

C. Field Laboratory Testing

The OWNER shall cut ten 1 inch wide replicate specimens from his sample and these shall be tested by the OWNER. The OWNER shall test five specimens for seam strength and five for peel strength. To be acceptable, four out of the five replicate test specimens must pass. Any specimen that fails through the weld or by adhesion at the weldsheet interface is a Non-FTB break and shall be considered a failure.

D. Independent Laboratory Testing

The OWNER will package and ship at least two seam samples received from the CONTRACTOR to a Laboratory for the determination of shear and peel strengths. The test method and procedures to be used by the Independent Laboratory shall be the same used in field testing, where seam samples are 1 inch wide, and the grip separation rate is 2 ipm. Four of five specimens per sample shall pass.

E. Procedures for Destructive Test Failure

The following procedures shall apply whenever a sample fails the field destructive test:

1. The CONTRACTOR shall cap strip the seam between the failed location and any passed test location.

2. The CONTRACTOR can retrace the welding path to an intermediate location (at a minimum of 10 feet from the location of the failed test), at the OWNER's direction, and take a small sample for an additional field test. If this test passes, then the seam shall be cap stripped between that location and the original failed location. If the test fails, then the process is repeated.

3. Over the length of seam failure, the CONTRACTOR shall either cut out the old seam, reposition the panel and reseam, or add a cap strip, as required by the OWNER.

4. After reseaming or placement of the cap strip, additional destructive field test(s) shall be taken within the reseamed area. The reseamed sample shall be found acceptable if test results are approved by the OWNER. If test results are not acceptable, this process shall be repeated until the reseamed length is judged satisfactory by the OWNER.

In the event that a sample fails a laboratory destructive test, then the above procedures shall be followed, considering laboratory tests exclusively.

The OWNER will document all actions taken in conjunction with destructive test failures.

Defects and Repairs

All seams and non-seam areas of the geomembrane shall be inspected by the OWNER for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be brushed, blown, or washed by the CONTRACTOR if the amount of dust or mud inhibits inspection. The OWNER shall decide if cleaning of the geomembrane is needed to facilitate inspection.

A. Evaluation

Each suspect location in seam and non-seam areas shall be non-destructively tested as appropriate in the presence of the OWNER. Each

location that fails the non-destructive testing shall be marked by the OWNER, and repaired accordingly.

B. Repair Procedures

1. Defective seams shall be restarted/reseamed as described in the specifications.

2. Small holes shall be repaired by extrusion cap welding. If the hole is larger than 1/4 inch, it shall be patched.

3. Tears shall be repaired by patching. Where the tear is on a slope or an area of stress and has a sharp end it must be rounded prior to patching.

4. Blisters, large holes, undispersed raw materials, and contamination by foreign matter shall be repaired by patches.

5. Surfaces of HDPE which are to be patched shall be abraded and cleaned no more than 15 minutes prior to the repair. No more than 10% of the thickness shall be removed.

Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of 6 inches beyond the edge of defects. All patches shall be of the same compound and thickness as the geomembrane specified. All patches shall have their top edge beveled with an angle grinder prior to placement on the geomembrane. Patches shall be applied using approved methods only.

C. Restart/Reseaming Procedures

The welding process shall restart by grinding the existing seam and rewelding a new seam. Welding shall commence where the grinding started and must overlap the previous seam by at least 2 inches. Reseaming over an existing seam without regrinding shall not be permitted.

D. Verification of Repairs

Each repair shall be non-destructively tested, except when the OWNER requires a destructive seam sample obtained from a repaired seam. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved.

Recording of Results: Daily documentation of all non-destructive and destructive testing shall be provided to the OWNER by the

CONTRACTOR. This documentation shall identify all seams that initially failed the test and include evidence that these seams were repaired and successfully retested.

Geomembrane Acceptance

The CONTRACTOR shall retain all ownership and responsibility for the geomembrane until acceptance by the OWNER. The geomembrane liner shall be accepted by the OWNER when all of the following conditions are met:

1. Installation is finished. (Partial Acceptance not allowed.)

2. Verification of the adequacy of all field seams and repairs, including associated testing, is complete.

3. Certification, including "as-built" drawing(s), is provided by the CONTRACTOR to the OWNER.

For the geomembrane materials installed, the installer will provide OWNER with a mutually agreeable five (5) year pro-rata warranty.

8. TOPSOIL SLOPES

A six inch (6") thick layer of topsoil shall be hauled and spread over the top and outside slope of the berms constructed in item No. 4 using topsoil previously stockpiled in item No. 3. The topsoil shall be placed and spread to such a depth so as to yield a six inch (6") thick layer when compacted to 85% of the modified proctor density (ASTM D-1557).

9. SEEDING AND FERTILIZING

A. Disc, Drag, and Drill Seed

This procedure shall be followed for topsoil stockpiles and basically flat areas as indicated on the drawings and/or as directed.

Fertilizer (13-13-13) @ 500 lbs/acre

Seed: Red Winter Wheat @ 35 lbs/acre
Oats @ 25 lbs/acre
Fescue @ 8 lbs/acre
Crimson Clover @ 15 lbs/acre

B. Cellulose/Plaster Mulch Seeding

This procedure shall be followed for all slopes and other areas as indicated on the drawings and/or as directed.

Fertilizer (13-13-13) @ 500 lbs/acre

Seed: Red Winter Wheat @ 35 lbs/acre
Oats @ 25 lbs/acre
Fescue @ 8 lbs/acre
Crimson Clover @ 25 lbs/acre
Rye Grass @ 25 lbs/acre

Water is available from OWNER's lake.

10. UNDER BERM DRAINAGE SYSTEM

See Design Drawings for details and specifications.

11. STORM WATER RUNOFF CONTROL

All work performed under this contract will be subject to complying with EPA Storm Water Discharge permit requirements (Federal Register Vol. 63, No. 128 dated July 6, 1998). CONTRACTOR shall be responsible for implementing storm water pollution prevention measures required to conform to such permit. Such measures may include erosion control mats, hay bale blocks, silt fences, sediment areas and other measures to appropriately control pollutants in the storm water discharges from all affected areas of construction.

CONTRACTOR shall immediately contain any spilled toxic or hazardous material (such as oil, grease, fuel, etc.) and dispose of appropriately.

Immediately after award, CONTRACTOR shall submit to OWNER information required for OWNER to submit a Notice Of Intent to EPA. CONTRACTOR shall prepare and submit to OWNER a NPDES pollution prevention plan. Such information shall include a sketch of the sites affected showing proposed locations and types of storm water control facilities. CONTRACTOR shall also submit a description of the planned method of maintaining such storm water control facilities.

The notice of intent for EPA storm water permit will be filed by OWNER. The pollution prevention plan will be maintained at the jobsite.

Periodic inspections will be made to assess the condition and adequacy of both the pollution prevention plan and procedures. Any deficiencies in the procedures shall be promptly corrected by CONTRACTOR.

The storm water pollution prevention plan must identify the CONTRACTOR and any subcontractors performing the work. In addition, the CONTRACTOR and any subcontractor must sign a copy of the following certification statement before commencement of the work. This signed statement will become a part of the storm water pollution prevention plan.

> "I certify under penalty of law that I understand the terms and conditions of the general National Pollutant Discharge Elimination System (NPDES) permit that authorizes the storm water discharges associated with construction activities identified as part of this certification."

CONTRACTOR shall effectively stabilize areas upon which work has been completed as soon as practical to do so.

Stabilization may involve topsoil, seeding and fertilization, or application of rip-rap or geotextiles subject approval by OWNER.

CONTRACTOR should note that the Storm Water Runoff permit requires that a sediment pond will be provided for runoff for areas that are greater than 10 acres.

No bid item is included for work or material required to conform to the storm water runoff provisions. Such payment will be considered subsidiary to the other bid items.

12. MOBILIZATION

This item is included so the CONTRACTOR can invoice a reasonable amount for mobilizing his equipment to and from the jobsite. It is not included for the CONTRACTOR to collect an unreasonable amount up front. Fifty (50) percent will be paid at the beginning of the job and Fifty (50) percent at the end of the job.

13. ADMINISTRATIVE

This item is provided for the CONTRACTOR to include his home and field office supervision and administrative expenses. This amount will be paid in equal monthly payments over the planned duration of the job.

14. SPECIAL NOTES

CONTRACTOR shall take necessary precautions to prevent damage to existing facilities such as underground pipelines, fences, gates, monitoring wells, power lines, etc.

15. DRAWINGS

The following drawings, exhibits, and other information are attached hereto and form a part hereof:

1. Boring logs B-1 thru B-9.

2. Site Topo prepared by Hart Engineering Co.

3. Exhibit A – Typical chemical analysis of the component materials to be placed in contact with geomembrane.'

4. Dwg. No. WEPX 335 (Sh. 1 & 2), "New Bottom Ash Storage Area".

GENERAL CONDITIONS

1. INGRESS AND EGRESS

The CONTRACTOR may use the roadways at the job site designated by the OWNER to the extent available and subject to the use of others. The CONTRACTOR shall endeavor to keep the roadways free from congestion at all times. In the event it becomes necessary for the CONTRACTOR to temporarily limit the use of the roadways or to block any portion thereof to facilitate construction, prior arrangements shall be worked out by the CONTRACTOR and the OWNER. The CONTRACTOR shall be responsible for any damage caused by him to roads. The CONTRACTOR shall be responsible for the handling of all equipment and materials which are furnished by the CONTRACTOR and are to be used in carrying out the work, as well as the materials furnished by the OWNER for erection by the CONTRACTOR. CONTRACTOR shall be responsible for the loss of or damage to OWNER furnished materials, while being handled by or in the possession of the CONTRACTOR.

2. GUARANTY BOND

The CONTRACTOR may be required to furnish a performance bond and payment bond in an amount equal to 100% of the contract price. The surety on the bond shall be a reputable corporation, legally qualified to carry on such business in the State in which this work is performed and shall be subject to the approval of the OWNER and shall comply with all applicable state laws. The cost of the bond shall be paid for by the OWNER.

3. SAFETY OF PERSONS AND PROPERTY

The CONTRACTOR shall take all reasonable precautions at all times to prevent injury to or death of any person at or near the site or engaged in the performance of the work and to prevent damage to or loss or destruction of any property located at or near the site. Such precautions shall include, but shall not be limited to, all safeguards and warnings necessary to protect workmen and others against any dangers or potentially dangerous conditions at or near the site of the work.

4. AUTHORITY OF THE OWNER

Work under this specification shall be subject to the approval of the OWNER, who shall determine acceptability, and who shall decide all questions which may arise as to the fulfillment of the requirements of the specifications, and to the order or precedence of the work.

5. TEMPORARY OFFICE BUILDING

Any temporary construction office building shall be furnished by and remains the property of the CONTRACTOR and shall be removed by him from the site when no longer needed. All temporary buildings shall have a presentable appearance at all times. All temporary buildings shall be arranged and located as approved by the OWNER and shall conform to the regulations established by local health authorities and shall be kept clean and orderly at all times.

6. WORK OUTSIDE REGULAR HOURS

If the CONTRACTOR, or any Subcontractor, desires to carry on work outside regular hours or holidays, he shall notify OWNER to make arrangements to inspect the work.

7. CLAIMS AND LIENS OF SUBCONTRACTORS

The CONTRACTOR specifically warrants and agrees that CONTRACTOR be solely and exclusively responsible for compensating any of CONTRACTOR's employees, subcontractors, material men and/or suppliers of any type or nature whatsoever and that no claims or liens of any type will be filed against any property owned by SWEPCO arising out of or incidental to the performance of any services performed pursuant to this contract. In the event a lien is filed, the CONTRACTOR agrees, upon written notice from SWEPCO to immediately obtain a bond at its expense so as to bond the property free and clear from the said lien and hold SWEPCO harmless from any losses that may result from the filing or enforcement of any said lien.

8. PROTECTION OF ADJOINING PROPERTY

The CONTRACTOR shall take proper means to protect the adjacent or adjoining property or properties in any way encountered, or which may be injured or seriously affected by any process of construction to be undertaken under this agreement from all damage or injury by reason of said process of construction; and he shall be liable for any and all claims for such damage on account of his failure to fully protect all adjoining property. The CONTRACTOR shall be responsible for the protection from damage by fire, falling trees or any other cause resulting from the contract work of the property, crops, timber, grass, livestock, fences, gaps, gates, cattle guards, buildings, or any other assets of adjoining landowners. The CONTRACTOR shall be responsible for the repair of such damaged property and shall make repairs without delay.

9. HEADINGS OF ARTICLES

The headings of articles, sections, paragraphs, and other parts of the contract are for convenience only and do not define, limit or construe the contents thereof.

10. PROTECTION OF BENCHMARKS

Benchmarks, stakes, marks, etc., shall be carefully preserved by the CONTRACTOR, and in case of careless destruction or removal by him or his employees, such benchmarks, stakes, marks, etc., shall be replaced by the OWNER at the CONTRACTOR's expense.

11. ENGINEER

Whenever the word Engineer is used in this Contract, it shall be understood as referring to the OWNER's authorized Engineer or Supervisor unless specifically noted otherwise. All field engineering required for the CONTRACTOR's work shall be furnished by the CONTRACTOR. If the final Contract price is based on a unit price application to actual final quantities, then the engineering (if required) to determine the actual quantities will be furnished by OWNER.

12. EQUAL EMPLOYMENT

CONTRACTOR covenants that as to SWEPCO, its affiliated companies or contractors that:

(a) All applicable provisions of Executive Order No. 11,246 dated September 24, 1965, the Rules and Regulations promulgated thereunder by the Office of Federal Contract Compliance of the United States Department of Labor, and all applicable requirements of the Equal Employment Opportunities Subchapter of the Civil Rights Act of 1964 and Section 402 of the Vietnam Era Veterans Readjustment Assistance Act of 1974 and Section 503 of the Rehabilitation Act of 1973 will be fully met and observed in respect to the performance of services covered by this contract.

(b) It has taken affirmative action to insure that applicants for employment by it and its employees are dealt with without regard to race, color, religion, sex or national origin.

13. ENVIRONMENTAL CLAIMS

In consideration of the benefits received herein, the CONTRACTOR agrees to fully and completely indemnify, hold harmless and defend at its expense SWEPCO, its successors and assigns, or any of its subsidiaries, directors, officers, employees, shareholders, contractors and/or agents, successors and/or assigns from and against any and all environmental claims of any type or nature whatsoever in any way arising out of or incidental to the performance of any work or services performed pursuant to this contract. For purposes of this indemnification agreement, environmental claims include but are not limited to any and all claims asserted pursuant to the Comprehensive Environmental

Response, Compensation and Liability Act (42 USC § 9601, et. seq.), the Resource Conservation Recovery Act (42 USC § 6901, et seq.), the Superfund Amendments and Re authorization Act of 1986, the Toxic Substance Control Act (15 USC § 2601, et seq.), including any amendments to any of said Acts, and any other present or future federal, state, or municipal laws, statutes, ordinances, regulations or policies in any manner governing or affecting the environment or hazardous substances or waste or any other environmental claims of any type or nature brought pursuant to common law. The CONTRACTOR shall assume the defense of any such claims immediately upon receipt of written notice from SWEPCO, or its successors or assigns. The CONTRACTOR specifically agrees to fully and completely comply with all statutes referred to in this paragraph, or any other present or future federal, state, or municipal laws, statutes, ordinances, regulations or policies in any manner governing or affecting the environment or any hazardous substances or wastes.

14. OUTDOOR BURNING

CONTRACTOR shall provide notice to OWNER and the appropriate agencies of its intent to engage in outdoor burning.

Should the CONTRACTOR engage in outdoor burning, such burning shall occur only between 9:00 a.m. and 5:00 p.m. And only on days where weather conditions are appropriate for undertaking such activities. Fires must be out and smoke ceased at 5:00 p.m. Burning operations must be managed so as not to create a nuisance to any area resident or residence. Fires cannot be started with anything other than diesel or gasoline and only in small quantities (particularly, no tires or asphalt materials are allowed for starting fires).

15. TRENCH EXCAVATION

Any trench excavation exceeding a depth of five feet shall be performed in accordance with OSHA standards for Trench Safety, #29 CFR Part 1926. Should trench excavation be performed in conjunction with the work, a separate price for trench excavation safety protection will be required.

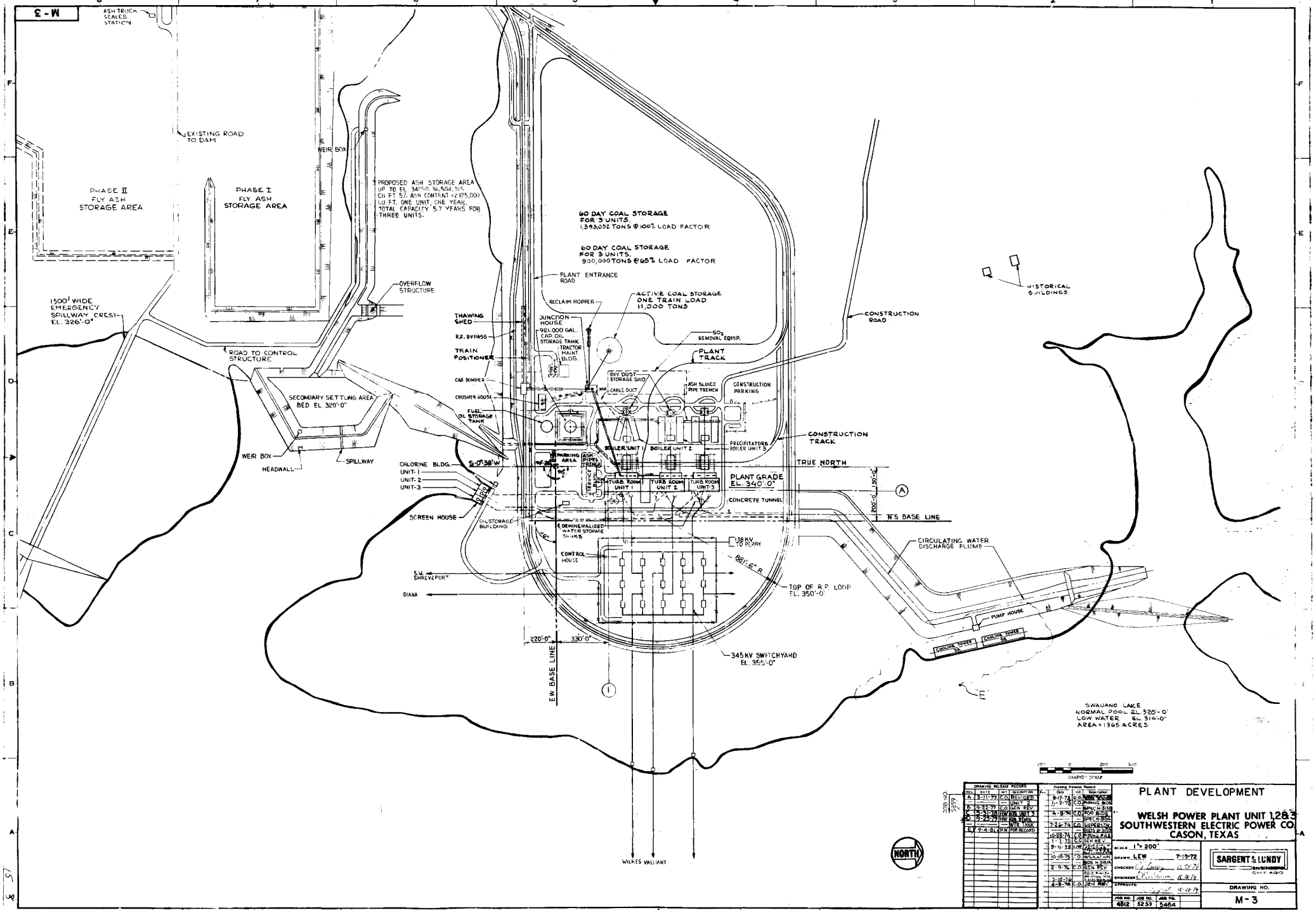
16. PAYMENT

A. SWEPCO agrees to pay the CONTRACTOR monthly as the work is completed, but the total of such payments on account shall at no time exceed ninety percent (90%) of the mutually agreed upon value of the work completed.

B. Ten percent (10%) upon completion of the work and acceptance by SWEPCO.

ATTACHMENT C

DESIGN DRAWINGS



DRAWING RELEASE RECORD			
REV.	DATE	INT.	DESCRIPTION
A	3-11-77	C.O.	REVISED UNIT 2
B	9-22-77	C.O.	GEN REV
C	5-31-78	C.O.	FOR BIDS UNIT 3
D	9-25-79	C.O.	FOR BIDS SPEC # 3554
E	9-4-81	C.O.	FOR RECORD

Drawing Release Record		
Date	Int.	Description
9-17-73	C.O.	FOR BIDDING
1-2-75	C.O.	FOR BIDDING BLDG. SPEC # 3558
4-8-74	C.O.	FOR BIDS SPEC # 3554
7-26-74	C.O.	SUPERSEDED BIDS # 3555
10-28-74	C.O.	FOR BIDDING PAR
1-1-75	C.O.	GEN REV.
5-14-75	C.O.	FOR BIDS MECHANICAL
10-15-75	C.O.	INSULATION BIDS # 3555
2-9-76	C.O.	GEN REV.
3-12-76	C.O.	SUPERSEDED
6-5-76	C.O.	GEN REV.

PLANT DEVELOPMENT

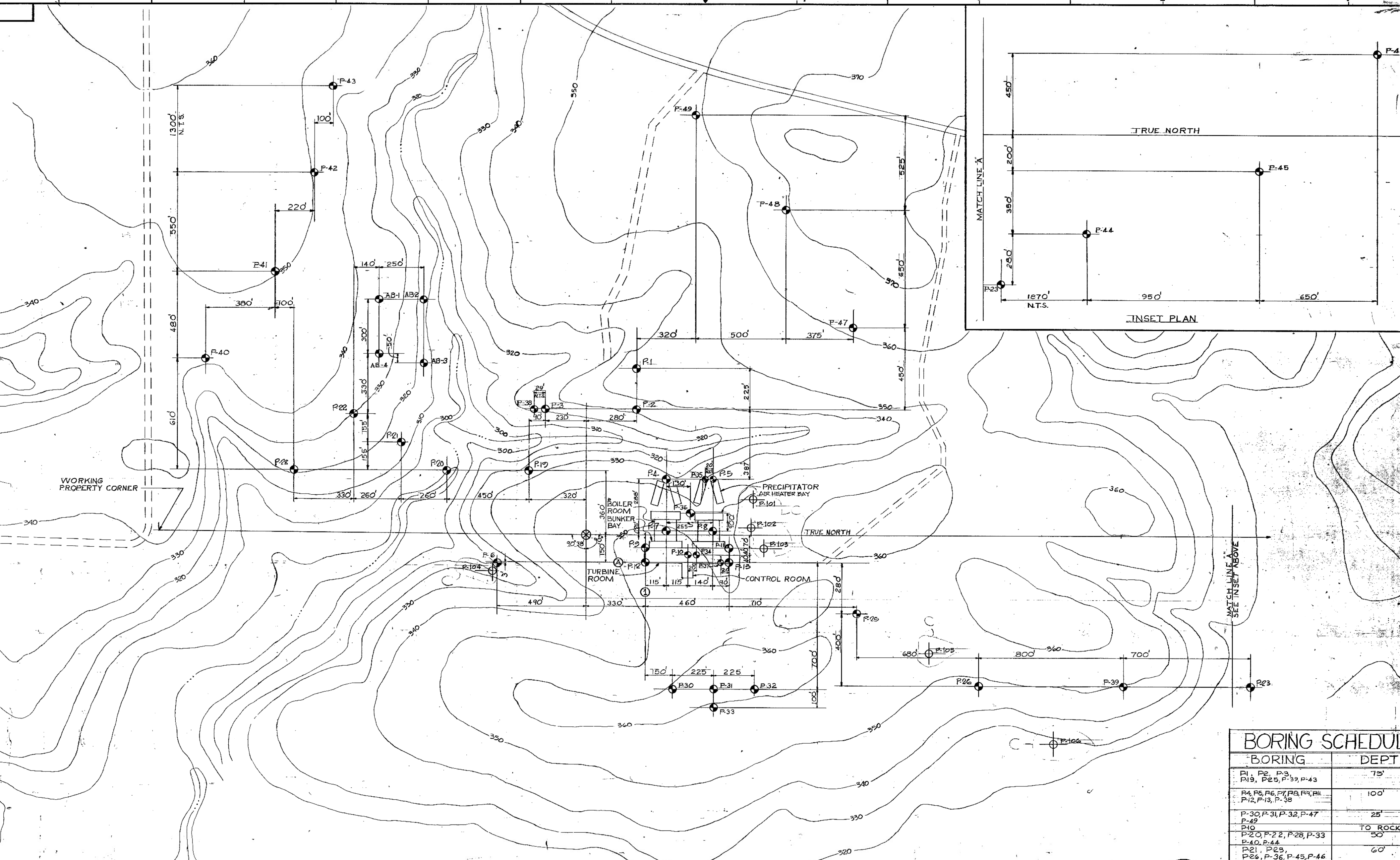
WELSH POWER PLANT UNIT 1,2&3
SOUTHWESTERN ELECTRIC POWER CO.
CASON, TEXAS

SCALE 1" = 200'
DRAWN LEW 7-19-72
CHECKED 10-27-72
ENGINEER 10-27-72
APPROVED 10-27-72

SARGENT & LUNDY ENGINEERS CHICAGO

JOB NO. 4812 | JOB NO. 5259 | JOB NO. 5464

DRAWING NO. M-3



PROPOSED BORINGS (UNIT #3)			
BORING NO.	BASELINE COORDINATES		BORING DEPTH
P-101	9+20.00N	6+50.00W	75 FT.
P-102	9+10.00N	3+90.00W	75 FT.
P-103	9+80.00N	2+80.00W	75 FT.
* P-104	5+12.00S	1+50.00W	60 FT.
P-105	19+00.00N	3+00.00E	50 FT.
P-106	26+00.00N	8+00.00E	50 FT.

* SEE NOTE 4

NOTES

1. THE FOLLOWING BORINGS HAVE NOT BEEN TAKEN AND THEIR REFERENCE IS ELIMINATED FROM THE SEQUENCE SHOWN IN THE BORING SCHEDULE. BORINGS P-14, P-15, P-16, P-17, P-18, P-24, P-27.
2. BORINGS AB-1 THRU AB-4 ARE AUGER BORINGS.
3. LEGEND: ⊕ BORINGS ALREADY DRILLED; ⊕ BORINGS TO BE TAKEN
4. BORING P-104 HAS SPECIAL SAMPLING REQUIREMENTS. SEE SPECIFICATION FOR GEOTECHNICAL INVESTIGATION OF UNIT #3.

REFERENCE DRAWINGS

S-2	SOIL BORING LOGS, SHEET-1
S-3	SOIL BORING LOGS, SHEET-2

BORING SCHEDUL

BORING	DEPT
P1, P2, P-3, P19, P25, P-39, P-43	75'
P4, P5, P6, P7, P8, P9, P11, P-12, P-13, P-38	100'
P-30, P-31, P-32, P-47, P-49	25'
P10	TO ROCK
P-20, P-22, P-28, P-33, P-40, P-44	50'
P21, P23, P26, P-36, P-45, P-46	60'
P-34, P-35, P-37	45'
P-48	35'
P-41, P-42	55'
AB-1, AB-2, AB-3, AB-4	20'

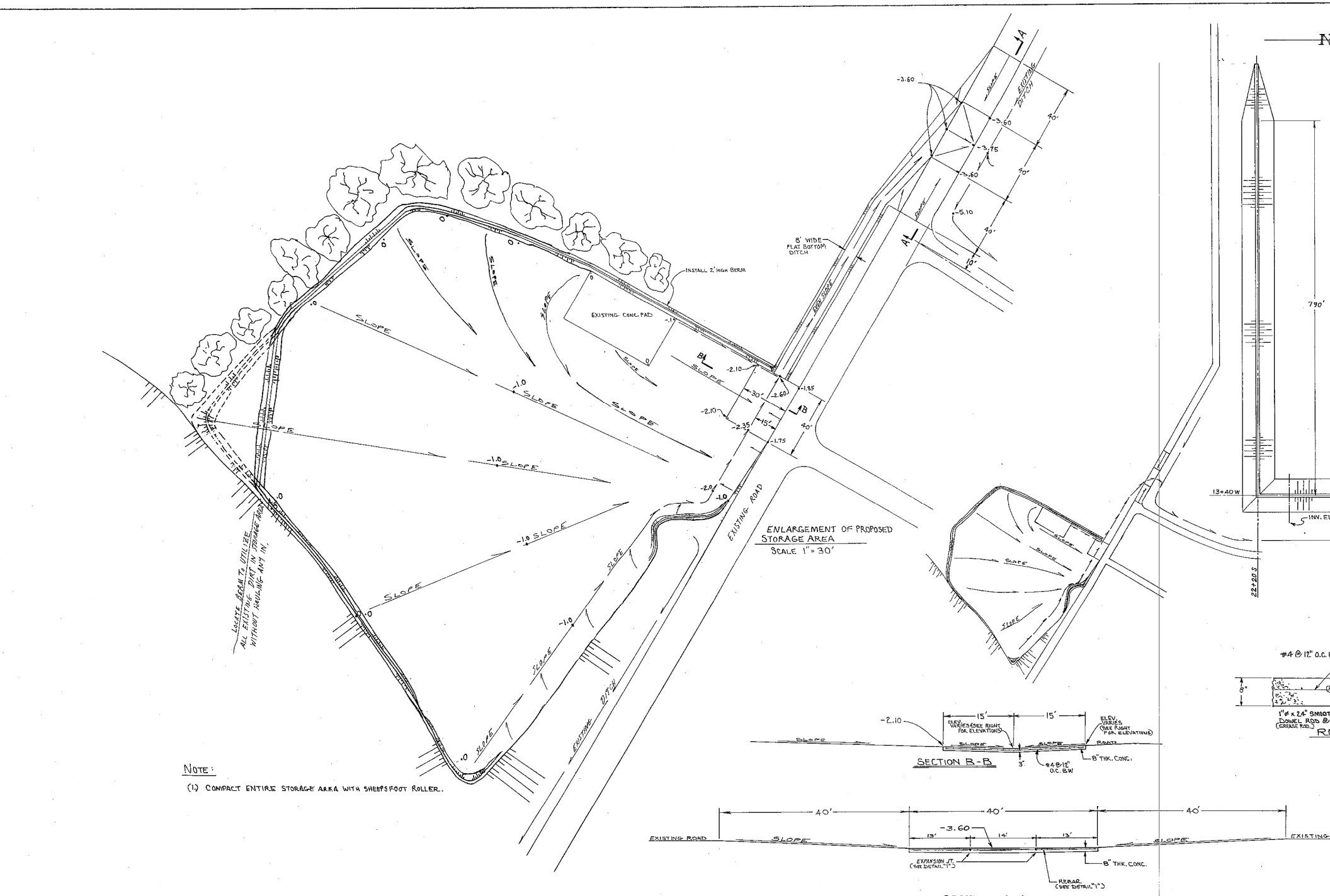
SOIL BORING LOCATION PL

WELSH POWER PLANT UNIT
SOUTHWESTERN ELECTRIC POW
CASON, TEXAS

SCALE 1" = 200'
DRAWN W. MILLER 12-26-72
CHECKED
ENGINEER
APPROVED
JOB NO. 4512 5464-05

SARGENT &

DRAWING S-1



NOTE:

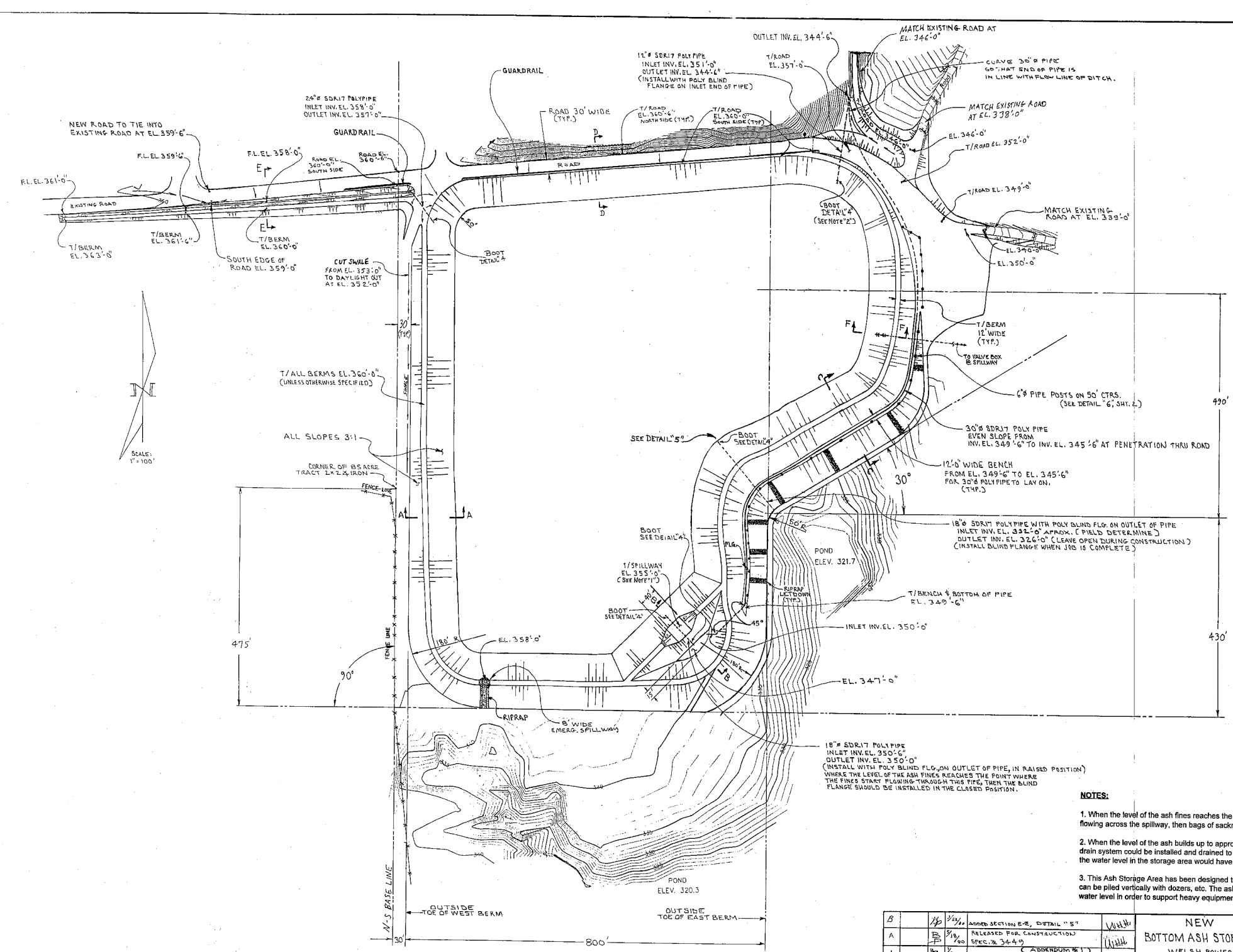
(1) COMPACT ENTIRE STORAGE AREA WITH SHEEPSFOOT ROLLER.

REV	W.O.	BY	DATE	SUBJECT	APPROVED
				FOR CONSTRUCTION	

BOTTOM ASH TEMPORARY STORAGE AREA

WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER



NOTES:

1. When the level of the ash fines reaches the point where the fines start flowing across the spillway, then bags of sackrete can be installed to raise t

2. When the level of the ash builds up to approx. elev. 355 along the north s drain system could be installed and drained to this outlet to help hold the wa the water level in the storage area would have to be at elev. 351 or above f

3. This Ash Storage Area has been designed to hold the water level as low can be piled vertically with dozers, etc. The ash level needs to be approx. 4 water level in order to support heavy equipment.

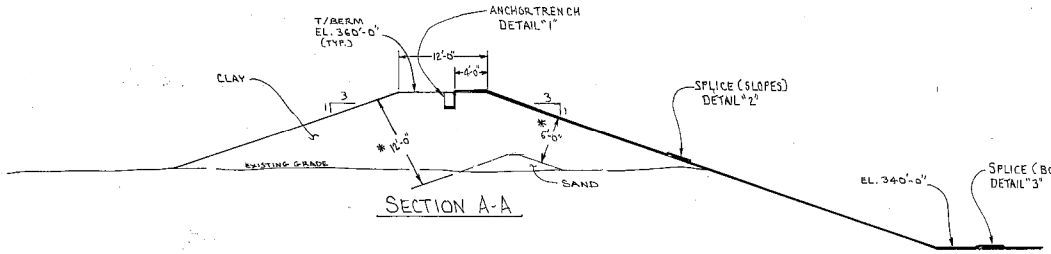
REV.	W.O.	BY	DATE	SUBJECT	APPROVED
C		BP	10-27-00	AS BUILT	
B		BP	5/22/00	ADDED SECTION E-E, DETAIL "5"	
A		BP	5/18/00	RELEASED FOR CONSTRUCTION (SPEC. # 3449)	
1		BP	3/9/00	RELEASED FOR BIDS SPEC # 3449 (ADDENDUM # 1)	
		BP	3-10-00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

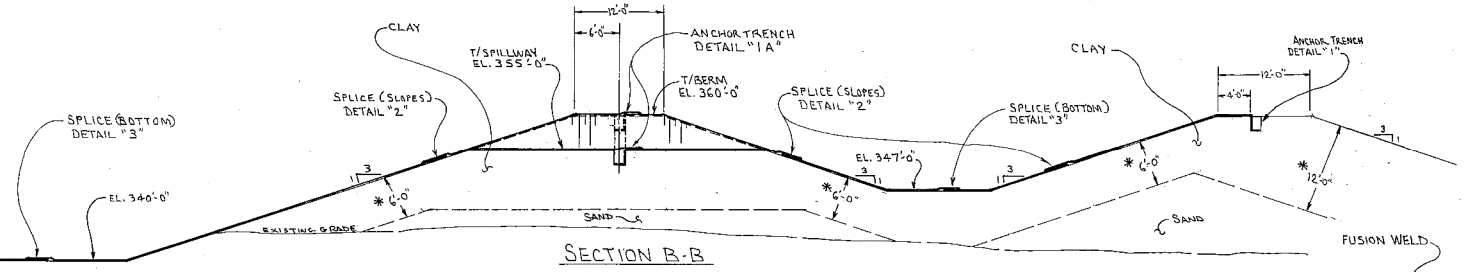
SOUTHWESTERN ELECTRIC POWER CO.

APP
DRW
SCA
SH.

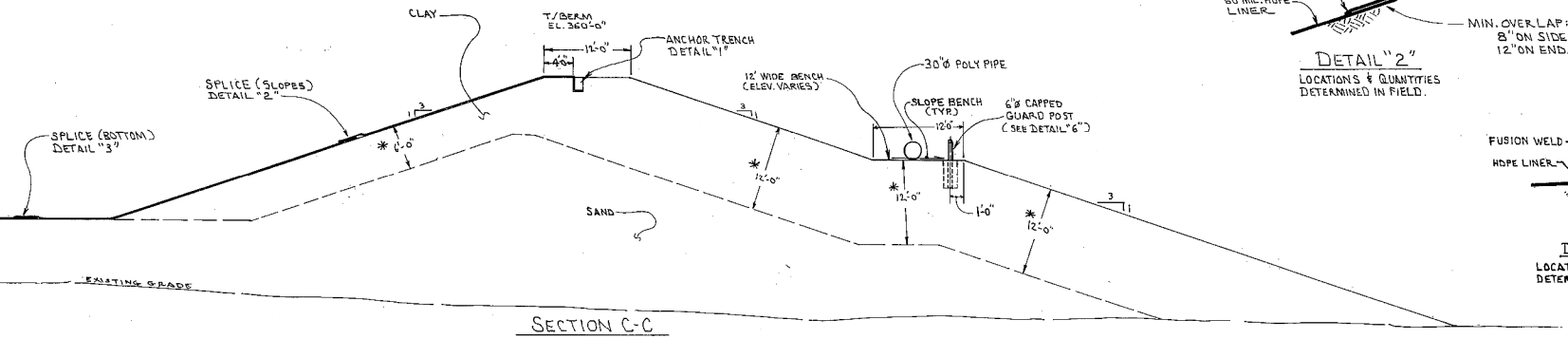
* - NOTE- THESE DIMENSIONS ARE SUBJECT TO ADJUSTMENT DEPENDING ON THE SAND / CLAY BALANCE VS. HAUL DISTANCE ON PROJECT.



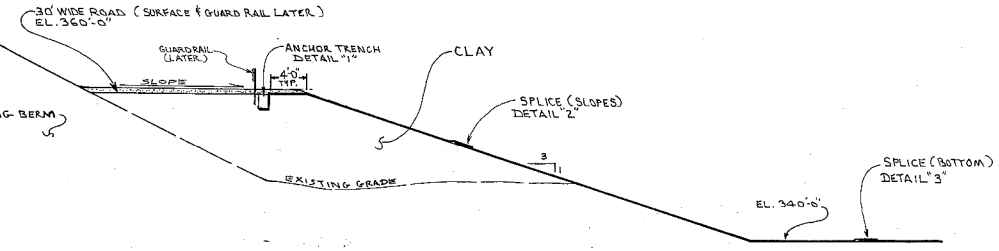
SECTION A-A



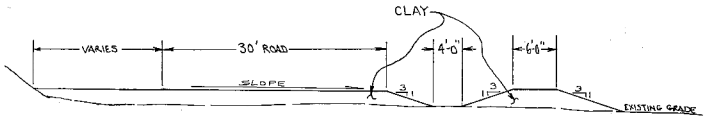
SECTION B-B



SECTION C-C



SECTION D-D



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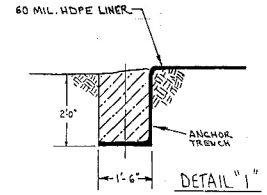
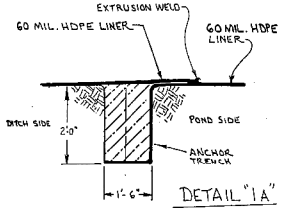
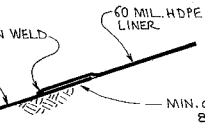


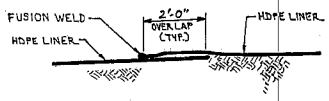
DETAIL "1"



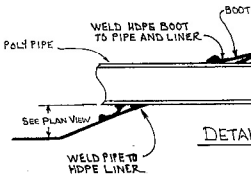
DETAIL "1A"



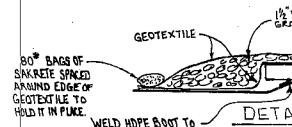
DETAIL "2"
LOCATIONS & QUANTITIES DETERMINED IN FIELD.



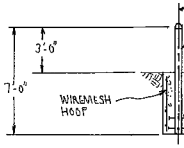
DETAIL "3"
LOCATIONS & QUANTITIES DETERMINED IN FIELD



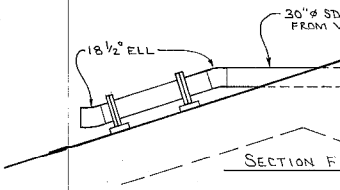
DETA



DETA



DETA
50' ON C
(2.0 R.E



SECTION F

REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	12/29/00	AS BUILT	
A		AP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHR
1		BP	3/11/00	(ADDENDUM #1) RELEASED FOR BIDS SPEC. # 3449	
		BP	3/10/00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER

ATTACHMENT D

HYDROLOGY AND HYDROLOGIC REPORT

Innovative approaches
Practical results
Outstanding service

Hydraulic Analysis of Welsh Power Plant Ash Ponds

American Electric Power Company

Prepared by:

FREESE AND NICHOLS, INC.
4055 International Plaza, Suite 200
Fort Worth, Texas 76109
817-735-7300

AEP10412

Innovative approaches
Practical results
Outstanding service

Hydraulic Analysis of Welsh Power Plant Ash Ponds

American Electric Power Company

Freese and Nichols, Inc.
Texas Registered Engineering Firm F-2144

The seal appearing on this document was authorized by Travis N. Attanasio on December 29, 2010

Prepared by:

FREESE AND NICHOLS, INC.
4055 International Plaza, Suite 200
Fort Worth, Texas 76109
817-735-7300

AEP10412

TABLE OF CONTENTS

LIST OF TABLES

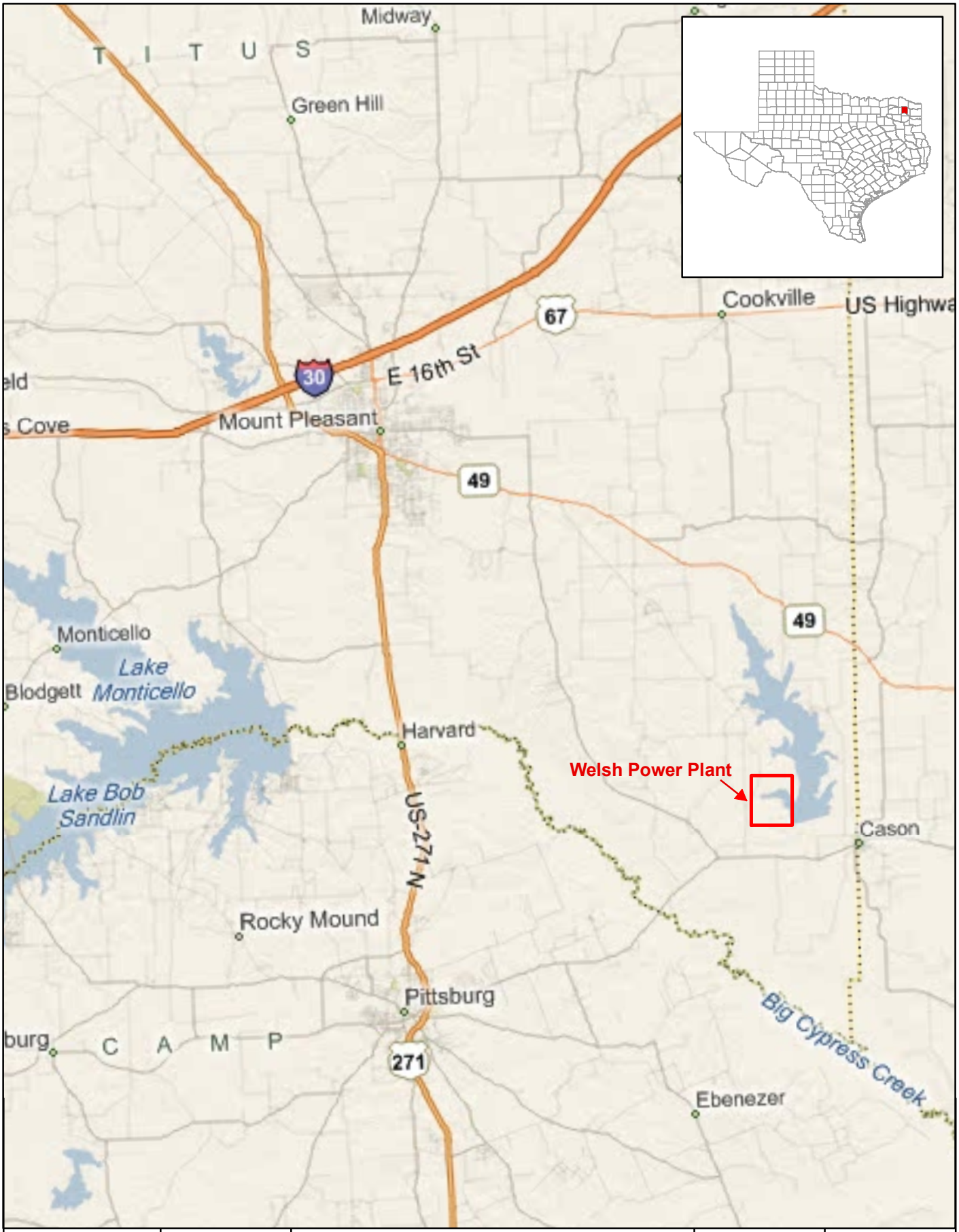
LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION

In November of 2010, Freese and Nichols, Inc., (FNI) was retained by American Electric Power (AEP) to perform various hydrologic and hydraulic calculations to determine the hydraulic adequacy of the Primary Ash, Secondary Ash, and Bottom Ash Ponds for the Welsh Power Plant located near Pittsburg, TX. This report summarizes the results of the analysis for the 10-year, 25-year, 100-year, 25% PMF, 50% PMF, and 100% PMF events.

The three Ash Ponds are situated immediately south of the Welsh Power Plant on the west side of Welsh Reservoir. The general location of the power plant and associated reservoirs is shown in Figure 1.



FN PROJECT NO. AEP10412	FREESE AND NICHOLS 4055 International Plaza, Suite 200 Fort Worth, TX 76109-4895 817-735-7300	0 1.25 2.5 5 Miles	N	FIGURE 1
FILE NAME H:\WR_DESIGN\FIGURES\Figure1_LocationMap.mxd		WELSH POWER PLANT ASH PONDS		
DATUM & COORDINATE SYSTEM NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)		LOCATION MAP		
DATE CREATED DECEMBER 2010				
PREPARED BY JPM				

2.0 HYDROLOGIC MODEL DEVELOPMENT

2.1 BASIN DELINEATION & CONNECTIVITY

The hydrologic model for the Welsh Power Plant Ash Ponds was created in HEC-HMS[1] and consisted of seven total drainage basins, as shown in Figure 2. The total drainage area modeled is approximately 0.695 square miles, or 445 acres. Two basins, labeled *Primary* and *Power Plant*, drain directly into the Primary Ash Pond. The Ash Storage Area was divided into two drainage basins – *Ash Storage Area A* and *Ash Storage Area B* – based on a December 2009 survey of the area. A small portion of the Ash Storage Area, along with a small wooded area, drains into the Bottom Ash Pond and is shown as *to Bottom Ash* in Figure 2. Additionally, the area inside the embankment for the Bottom Ash Pond is labeled *Bottom Ash* and drains directly into the reservoir area. Finally, the basin labeled *Secondary* represents the area draining to the Secondary Ash Pond.

Each of the seven basins and three reservoir areas are connected in some way and form an intricate system of connectivity. The only discharges from the Primary Ash Pond flow through a drainage canal to the Secondary Ash Pond. This canal flows from west to east and is controlled by a weir box control structure. Discharges from the Primary Ash Pond emergency spillway also flow into this drainage canal; however, these flows enter the canal downstream of the weir box control structure. Runoff from the Ash Storage Area also enters the Primary Ash Pond via a small sump area with a 24-inch culvert. Rainfall is routed through a small ditch around the perimeter of the Ash Storage Area to this culvert. The principal spillway for the Bottom Ash Pond discharges into a 30-inch pipe which transports the outflows to the Ash Storage Area ditch. These outflows eventually discharge into the Primary Ash Pond. The emergency spillway for the Bottom Ash Pond discharges freely into the area downstream of the Welsh Reservoir emergency spillway. Finally, the combined flows from the drainage canal enter the Secondary Ash Pond, which has both a principal and emergency spillway. All discharges from the Secondary Ash Pond flow into Welsh Reservoir. Spillway capacities are discussed in further detail in Section 2.4.

FN PROJECT NO.	AEP10412
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DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)
DATE CREATED	DECEMBER 2010
PREPARED BY	JPM

FREESE NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 500 1,000 2,000 Feet

N

WELSH POWER PLANT ASH PONDS

DRAINAGE BASIN MAP

FIGURE

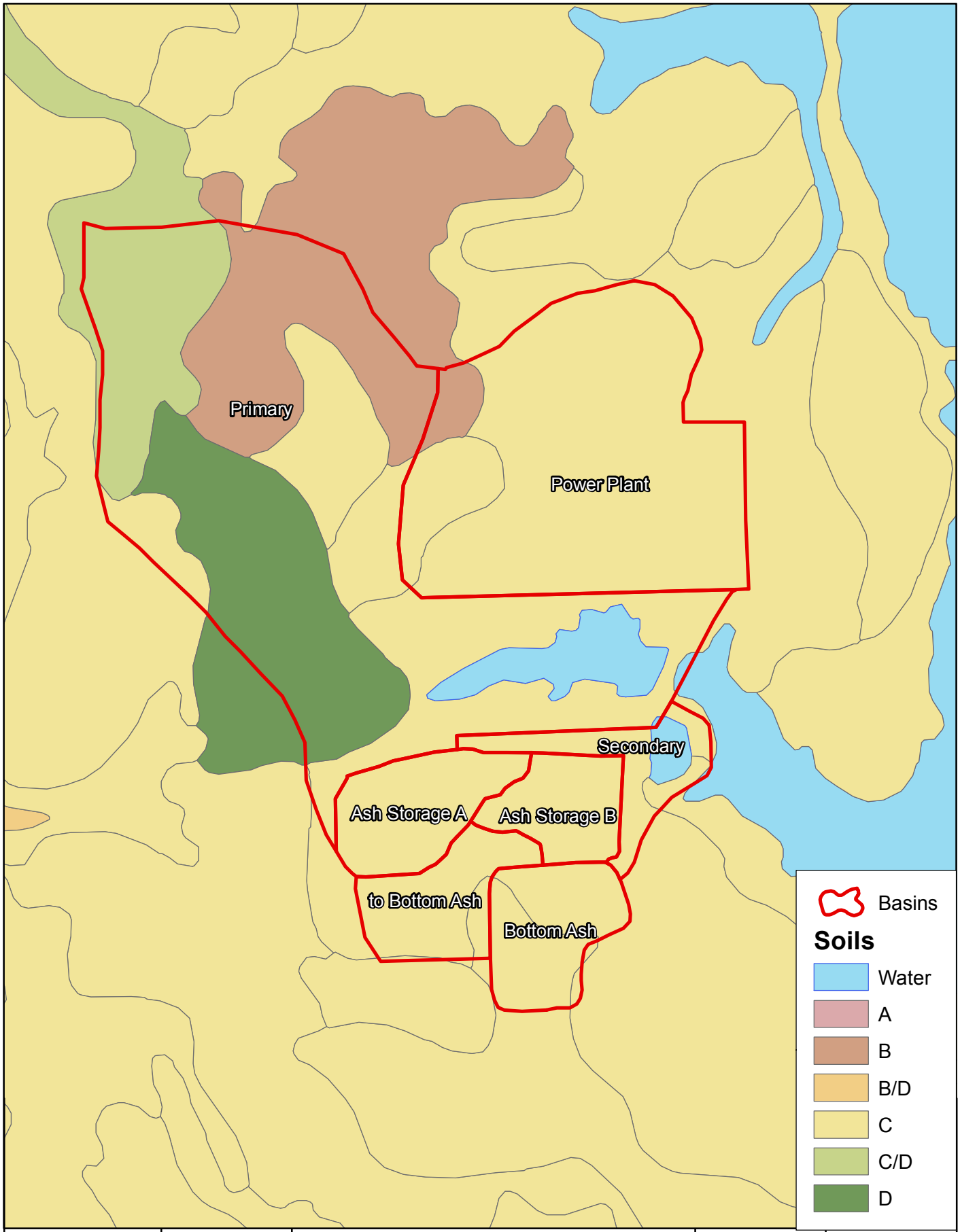
2

2.2 HYDROLOGIC PARAMETERS

The HEC-HMS model incorporates the NRCS Curve Number and Unit Hydrograph methods for each basin. In this model, the curve numbers were based on hydrologic soil classifications and land cover. The instantaneous runoff effect of open water surfaces was accounted for in the development of the curve numbers. The soils dataset was obtained from the NRCS Soil Survey Geographic Database[2] (SSURGO), and land use dataset was obtained from the USGS Seamless Data Warehouse[3] in the form of the National Land Cover Dataset (NLCD) for 2001. Spatial information about soil types and land use classifications is presented in Figures 3 and 4, respectively. Table 1 provides the matrix used in determining the curve number for each basin. The curve numbers shown in Table 1 are for Antecedent Moisture Condition (AMC) II. These values were incorporated in the model for the frequency storm events, such as the 100-year storm event. In accordance with TCEQ recommendations, AMC III was applied to the model for PMF events. This represents a worst-case scenario with the ground fully saturated prior to the PMF event.

Table 1 – Curve Number Calculation Matrix

NLCD Classification		Curve Number (AMC II)					
#	Description	A	B	B/C	C	C/D	D
11	Open Water	100	100	100	100	100	100
21	Developed, Open Space	68	79	83	86	88	89
22	Developed, Low Intensity	51	68	74	79	82	84
23	Developed, Medium Intensity	77	85	88	90	91	92
24	Developed, High Intensity	89	92	93	94	95	95
31	Barren Land	77	86	89	91	93	94
41	Deciduous Forest	36	60	67	73	76	79
42	Evergreen Forest	36	60	67	73	76	79
43	Mixed Forest	36	60	67	73	76	79
52	Scrub/Shrub	35	56	63	70	74	77
71	Grassland/Herbaceous	39	61	68	74	77	80
81	Pasture/Hay	39	61	68	74	77	80
82	Cultivated Crops	67	78	82	85	87	89
90	Woody Wetlands	45	66	72	77	80	83



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DATE CREATED	DECEMBER 2010
PREPARED BY	JPM

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4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 500 1,000 2,000 Feet

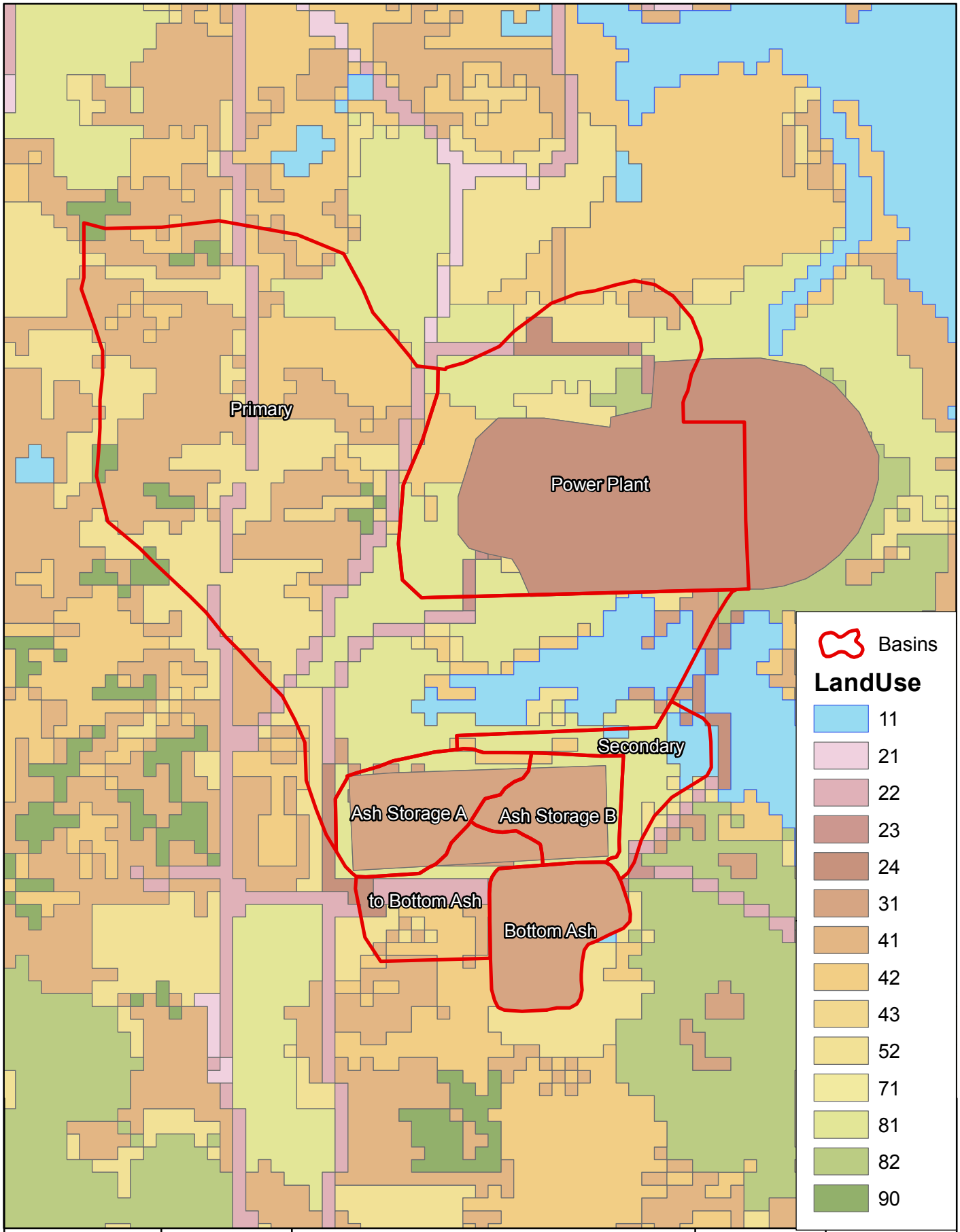
WELSH POWER PLANT ASH PONDS

HYDROLOGIC SOIL CLASSIFICATIONS

N

FIGURE

3



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FILE NAME	H:\WR_DESIGN\FIGURES\Figure4_LandCover.mxd
DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE TEXAS NORTH CENTRAL (FT)
DATE CREATED	DECEMBER 2010
PREPARED BY	JPM

FREESE AND NICHOLS
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Fort Worth, TX 76109-4895
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0 500 1,000 2,000 Feet

N

WELSH POWER PLANT ASH PONDS

LAND COVER DATA

FIGURE 4

The only input into HEC-HMS for the NRCS Dimensionless Unit Hydrograph is a lag time, which is calculated based on basin conditions, such as hydraulic length and average slope, according to the NRCS TR-55 Method. Table 2 provides a summary of the hydrologic parameters for each basin. Note that AMC II corresponds with the curve numbers used in the frequency model and that AMC III corresponds with the weighted curve numbers used in the PMP model.

Table 2 – Basin Parameters

Basin	Area (mi^2)	Lag Time (min)	Curve Number (AMC II)	Curve Number (AMC III)
Ash Storage A	0.034	5.28	87.1	93.9
Ash Storage B	0.025	7.51	87.1	93.9
Bottom Ash	0.034	4.78	91.0	95.9
Power Plant	0.180	18.77	85.3	93.0
Primary	0.366	36.14	76.0	88.0
Secondary	0.026	2.31	82.7	91.7
to Bottom Ash	0.031	16.51	77.8	89.0

2.3 ELEVATION-STORAGE DATA

Elevation-storage data for each reservoir was obtained from a combination of data sources. The elevation-storage relationship for the Primary Ash Pond was calculated from USGS 10-foot contours for the area and compared to calculations made by AEP. The Secondary Ash Pond used the AEP Calculations for elevation 320.0 ft-msl to elevation 330.0 ft-msl and a combination of USGS 10-foot contours and surveyed 2-foot contours. The Bottom Ash Pond used volume calculations from an April 2010 survey from elevation 346.13 ft-msl to elevation 355.92 ft-msl. The volume was then extrapolated to the top of dam elevation of 360.0 ft-msl by the average-end-area method and the assumption of 3:1 side slopes. These relationships were used in the hydrologic model for routing both frequency storm events and the PMF and are shown in Table 3 below.

Table 3 – Elevation-Storage Data

Primary	
Elevation (ft-msl)	Storage (acre-ft)
300	0.00
305	22.37
310	54.66
315	110.48
320	186.47
325	304.20
330	461.77
335	676.03
340	934.21

Secondary	
Elevation (ft-msl)	Storage (acre-ft)
320	0.00
330	36.87
331	41.31
332	46.30
333	51.82
334	57.67
335	63.77
336	70.09
337	76.59
338	83.26
339	90.22
340	97.45
341	105.06
342	112.68

Bottom Ash	
Elevation (ft-msl)	Storage (acre-ft)
346.13	0.00
347	0.22
348	1.31
349	3.17
350	5.51
351	8.33
352	11.94
353	16.77
354	23.57
355	33.04
356	45.07
357	65.66
358	86.50
359	107.61
360	128.98

2.4 DISCHARGE RATING CURVES

Each of the three dams has both a principal spillway and an emergency spillway. Information regarding the dimensions and elevations of each of these spillways was taken from a combination of original construction drawings, recent survey, and detailed descriptions from AEP personnel. Detailed calculations for the discharge rating curves of each spillway are included in Appendix B.

The principal spillway for the Primary Ash Pond is located in the canal connecting the Primary and Secondary Ash Ponds. It consists of a weir box with bottom elevation of 325.0 ft-msl and a 4-foot wide by 2-foot tall opening. Stop logs are placed in this opening according to regular dredging operations by AEP; however, normal conditions dictate that no stop logs are in place. This structure also consists of sheet piling to each side of the weir box, which will operate as a sharp-crested weir when flows reach the top elevation of 336.0 ft-msl. Additionally, the Primary Ash Pond has a 90-foot wide emergency spillway with a crest elevation of 334.0 ft-msl. Both the orifice and weir equations were utilized in calculating the discharge rating curves. The discharge rating curve for both spillways is shown in Table 4.

The principal spillway for the Secondary Ash Pond consists of a weir box with a 4-foot long weir discharging through a 36-inch conduit. The weir equation used for this weir box was obtained from Greg Carter of AEP from calculations he had performed in the design of a new weir plate, which is currently in place. Additionally, the Secondary Ash Pond has an approximately 45-foot wide earthen emergency spillway. The discharge rating curve for the emergency spillway was calculated with a simple HEC-RAS model with cross-sections cut through the spillway. The discharge rating curve for both spillways is shown in Table 4.

The principal spillway for the Bottom Ash Pond is a 40-foot long broad-crested weir with 6:1 side slopes and crest at elevation 355.0 ft-msl. It discharges into a small sump area connected to the 30-inch pipe directing flow back toward the Ash Storage Area. The emergency spillway is an 8-foot wide weir at elevation 358.0 ft-msl with a rock riprap discharge chute. The discharge rating curve for both spillways is shown in Table 4.

Table 4 – Discharge Rating Curves

Primary			
Elevation (ft-msl)	Principal Spillway (cfs)	Emergency Spillway (cfs)	Total Discharge (cfs)
325	0	---	0
326	39	---	39
327	54	---	54
328	67	---	67
329	77	---	77
330	86	---	86
331	94	---	94
332	102	---	102
333	109	---	109
334	116	0	116
335	122	285	407
336	128	849	976
337	340	1,637	1,977
338	723	2,640	3,363
339	1,217	3,857	5,074
340	1,801	5,291	7,092

Secondary			
Elevation (ft-msl)	Principal Spillway (cfs)	Emergency Spillway (cfs)	Total Discharge (cfs)
328.3	0	---	0
329	5	---	5
330	17	---	17
331	33	---	33
332	50	0	50
333	58	91	149
334	64	345	409
335	70	777	847
336	75	1,386	1,461
337	80	2,191	2,271
338	85	3,163	3,248
339	90	4,256	4,346
340	94	5,280	5,374

Bottom Ash			
Elevation (ft-msl)	Principal Spillway (cfs)	Emergency Spillway (cfs)	Total Discharge (cfs)
355.0	0	---	0
355.5	50	---	50
356.0	161	---	161
356.5	330	---	330
357.0	561	---	561
357.5	858	---	858
358.0	1,224	0	1,224
358.5	1,664	11	1,676
359.0	2,182	39	2,221
359.5	2,782	85	2,867
360.0	3,466	153	3,619

2.5 FREQUENCY MODEL RESULTS

Three frequency storm events were analyzed for the Welsh Ash Pond system – the 10-year, 25-year, and 100-year storm events. The hydrologic model described in the preceding sections was implemented in analyzing these events. Curve numbers were set to Antecedent Moisture Condition II, and initial abstractions were calculated automatically by HEC-HMS. These assumptions represent normal conditions, as would be expected prior to one of these storm events. The precipitation data was obtained from the National Oceanic and Atmospheric Administration's Technical Memorandum NWS HYDRO-35[4] and Technical Paper 40.[5] These values are presented in Table 5. Each storm event was assumed to have a duration of 24 hours.

Table 5 – Frequency Precipitation Depths

Frequency (yrs)	Precipitation (in)							
	5 min	15 min	60 min	2 hr	3 hr	6 hr	12 hr	24hr
1	0.42	0.89	1.69	1.99	2.20	2.64	3.12	3.58
2	0.51	1.08	1.97	2.45	2.68	3.19	3.78	4.41
5	0.58	1.25	2.54	3.14	3.40	4.15	4.92	5.81
10	0.64	1.38	2.91	3.64	3.95	4.90	5.90	6.82
25	0.72	1.57	3.36	4.22	4.62	5.73	6.76	7.90
50	0.79	1.72	3.75	4.75	5.18	6.41	7.74	8.83
100	0.86	1.88	4.13	5.23	5.78	7.09	8.62	9.85
500	1.12	2.45	5.39	6.83	7.54	9.26	11.26	12.86

These precipitation depths serve as input data into the hydrologic model, and were routed through the model as described previously. According to TCEQ recommendations and standard engineering practice, flood routings were started at the lowest spillway crest elevation for each dam. This corresponds to elevation 325.0 ft-msl, 328.3 ft-msl, and 355.0 ft-msl for the Primary, Secondary, and Bottom Ash Ponds, respectively. The results of the 10-year, 25-year, and 100-year storm events are shown in Tables 6, 7, and 8, respectively.

Table 6 – 10-Year Storm Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	328.50	874.71	71.92
Secondary	332.37	112.41	72.35
Bottom Ash	355.53	157.81	55.99

Table 7 – 25-Year Storm Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	329.35	1079.37	80.24
Secondary	332.51	137.68	81.67
Bottom Ash	355.62	187.44	76.21

Table 8 – 100-Year Storm Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	330.80	1415.75	92.68
Secondary	332.62	177.95	95.96
Bottom Ash	355.76	234.22	108.10

2.6 PMF MODEL RESULTS

The Probable Maximum Flood (PMF) is defined as the greatest flood to be expected, and the Probable Maximum Precipitation (PMP) is theoretically the greatest depth of rainfall for a given duration that is physically possible over a given size storm area at a particular geographic location. Generally, the rainfall depth is calculated for the ten square miles of the watershed which receive the highest intensity rainfall.

Hydrometeorological Report No. 52 (HMR-52),[6] developed by the U.S. Army Corps of Engineers, was used to determine the rainfall for each basin. PMP estimates were taken from Hydrometeorological Report No. 51[7] and distributed according to HMR-52 to obtain average rainfall depths over the various drainage areas.

HMR-52 calculates rainfall depths for storm durations ranging from five minutes to seventy-two hours. Table 9 lists the point rainfall depths calculated by HMR-52 for storm durations from one hour to 72 hours. Because the total drainage area is less than ten square miles, these point rainfall depths were applied to each of the 7 basins. Additionally, the total rainfall depth was distributed according to the temporal distribution described by the TCEQ guidelines.

Table 9 – HMR-52 Point Rainfall Depths

Storm Duration (hr)	Depth (in)
1	16.62
2	20.86
3	24.18
6	30.47
12	36.82
24	42.10
48	46.98
72	49.74

Each PMF duration was modeled as described previously, with flood routing started at the lowest spillway crest elevation. The 12-hour event was critical for both the Primary and Secondary Ash Ponds, and the 1-hour event was critical for the Bottom Ash Pond. Additionally, the 25% and 50% PMF were calculated for the critical duration. Tables 10, 11, and 12 contain the results of these PMF model runs – the 25% PMF, 50% PMF, and 100% PMF, respectively.

Table 10 – 25% PMF Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	331.83	690.29	100.59
Secondary	332.68	110.63	105.57
Bottom Ash	355.70	171.14	94.27

Table 11 – 50% PMF Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	335.16	1385.23	122.79
Secondary	334.23	511.60	501.07
Bottom Ash	356.15	342.28	211.11

Table 12 – 100% PMF Results

	Peak Elevation (ft-msl)	Peak Inflow (cfs)	Peak Outflow (cfs)
Primary	337.46	2770.78	517.89
Secondary	337.39	2664.30	2637.73
Bottom Ash	356.78	684.55	458.48

3.0 SUMMARY AND CONCLUSIONS

Based on the results of the hydraulic analysis, each of the three dams is hydraulically adequate for the full range of storm events from the 10-year to the 100% PMF event. Table 13 lists the pertinent elevation data for each dam, including the top of dam elevation and principal and emergency spillway crest elevations. Comparing these elevations to the maximum water surface elevations shown in Table 14 indicates that, even during the 100% PMF event, each of the three dams would have almost 3 feet of freeboard. Additionally, the emergency spillway for the Primary Ash Pond is not engaged during a storm event less than the 50% PMF, and the emergency spillway for the Bottom Ash Pond is not engaged, even during the 100% PMF event. The emergency spillway for the Secondary Ash Pond is, however, engaged much more frequently, even during a storm event as low as the 10-year storm. This should have no adverse affects on this area though, as it appears to have been designed to withstand frequent engaging.

Table 13 – Pertinent Dam Information

	Top of Dam (ft-msl)	Principal Spillway (ft-msl)	Emergency Spillway (ft-msl)
Primary	340.0	325.0	334.0
Secondary	340.0	328.3	332.0
Bottom Ash	360.0	355.0	358.0

Table 14 – Summary of Results

	10-year	25-year	100-year	25% PMF	50% PMF	100% PMF
Primary	328.50	329.35	330.80	331.83	335.16	337.46
Secondary	332.37	332.51	332.62	332.68	334.23	337.39
Bottom Ash	355.53	355.62	355.76	355.70	356.15	356.78

It should be noted that these results reflect the best understanding of existing conditions and could be significantly affected by major changes to any of the three reservoirs. Specifically, major fluctuations in the available storage in each reservoir, as could be caused by the regular dredging and movement of bottom ash in and out of the pond areas, would greatly impact the results of this analysis. However, in their current conditions, the Primary Ash, Secondary Ash, and Bottom Ash Ponds associated with the Welsh Power Plant are deemed to

be hydraulically adequate for any storm event up to the 100% PMF. Pertinent drawings for existing conditions are included in Appendix C.

Appendix A
References

References

1. U.S. Army Corps of Engineers, Hydrologic Engineering Center: *Hydrologic Modeling System HEC-HMS - User's Manual Version 3.4*, Davis, California, August 2009.

2. "Soil Data Mart." *NRCS Soil Survey Geographic (SSURGO) Database*. <http://soildatamart.nrcs.usda.gov>.

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4. U.S. Department of Commerce, National Oceanic and Atmospheric Administration: *Technical Memorandum NWS HYDRO-35, Five- to 60-Minute Precipitation Frequency for the Eastern and Central United States*, Silver Spring, MD, June 1977.

5. U.S. Department of Commerce, Weather Bureau: *Technical Paper No. 40, Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years*, Washington, D.C., May 1961.

6. U.S. Department of Commerce, National Oceanic and Atmospheric Administration and U.S. Department of the Army, Corps of Engineers: *Hydrometeorological Report No. 52, Application of Probable Maximum Precipitation Estimates, United States East of the 105th Meridian*, Washington, D.C., 1982.

7. U.S. Department of Commerce, National Oceanic and Atmospheric Administration and U.S. Department of the Army, Corps of Engineers: *Hydrometeorological Report No. 51, Probable Maximum Precipitation Estimates, United States East of the 105th Meridian*, Washington, D.C., 1978.

Appendix B
Calculations

Discharge Rating Curve
Primary Ash Pond

Elevation [ft-msl]	Orifice [cfs]	Sheet Pile [cfs]	Main [cfs]	Emerg [cfs]	Total [cfs]
325.00	0.00	0.00	0.00	0.00	0.00
326.00	38.52	0.00	38.52	0.00	38.52
327.00	54.48	0.00	54.48	0.00	54.48
328.00	66.72	0.00	66.72	0.00	66.72
329.00	77.04	0.00	77.04	0.00	77.04
330.00	86.13	0.00	86.13	0.00	86.13
331.00	94.35	0.00	94.35	0.00	94.35
332.00	101.91	0.00	101.91	0.00	101.91
333.00	108.95	0.00	108.95	0.00	108.95
334.00	115.56	0.00	115.56	0.00	115.56
335.00	121.81	0.00	121.81	285.00	406.81
336.00	127.76	0.00	127.76	848.53	976.28
337.00	133.44	206.46	339.90	1636.79	1976.68
338.00	138.89	583.96	722.84	2640.00	3362.84
339.00	144.13	1072.80	1216.93	3857.22	5074.14
340.00	149.19	1651.68	1800.87	5290.90	7091.76

Main Spillway		
Sill Crest	325	ft-msl
Height	2	ft
Sill Width	4	ft
Orifice C	0.6	

$$Q = C*A*\sqrt{(2*g*H)}$$

Sheet Pile	336	ft-msl
Top Width	62	ft
Weir C	3.33	

$$Q = C*L*H^{3/2}$$

Emergency Spillway		
Crest	334	ft-msl
Length	90	ft
SS	2.5	:1
Weir C	3	

$$Q = C*(L+2*SS*H)*H^{3/2}$$

Discharge Rating Curve
Secondary Ash Pond

Elevation [ft-msl]	Weir [cfs]	Conduit [cfs]	Main [cfs]	Emerg [cfs]	Total [cfs]
328.30	0.00	12.77	0.00		0.00
328.50	0.75	15.39	0.75		0.75
329.00	4.85	22.36	4.85		4.85
329.50	10.62	29.44	10.62		10.62
330.00	17.43	35.94	17.43		17.43
330.50	24.97	40.33	24.97		24.97
331.00	33.01	44.34	33.01		33.01
331.50	41.36	48.10	41.36		41.36
332.00	49.90	51.65	49.90	0.00	49.90
332.50	58.50	55.03	55.03	25.00	80.03
333.00	67.07	58.27	58.27	90.91	149.18
333.50	75.51	61.37	61.37	193.62	254.99
334.00	83.73	64.36	64.36	344.83	409.19
334.50	91.67	67.24	67.24	537.74	604.98
335.00	99.25	70.03	70.03	777.17	847.20
335.50	106.41	72.72	72.72	1056.25	1128.97
336.00	113.09	75.34	75.34	1385.71	1461.05
336.50	119.24	77.87	77.87	1769.84	1847.71
337.00	124.79	80.34	80.34	2190.91	2271.25
337.50	129.70	82.74	82.74	2656.86	2739.60
338.00	133.91	85.08	85.08	3163.04	3248.12
338.50	137.39	87.36	87.36	3697.92	3785.28
339.00	140.09	89.59	89.59	4256.10	4345.69
339.50	141.96	91.76	91.76	4767.86	4859.62
340.00	142.96	93.89	93.89	5279.62	5373.51

Main Spillway

Weir Box

Crest	328.30	ft-msl
Length	4	ft
Weir C	2.152	

$Q = C*(L-0.2H)*H^{1/2}$

Weir Equation from AEP

Conduit

Diameter	36	in
Length	350	ft
U/S Invert	326.5	ft-msl
D/S Invert	326	ft-msl

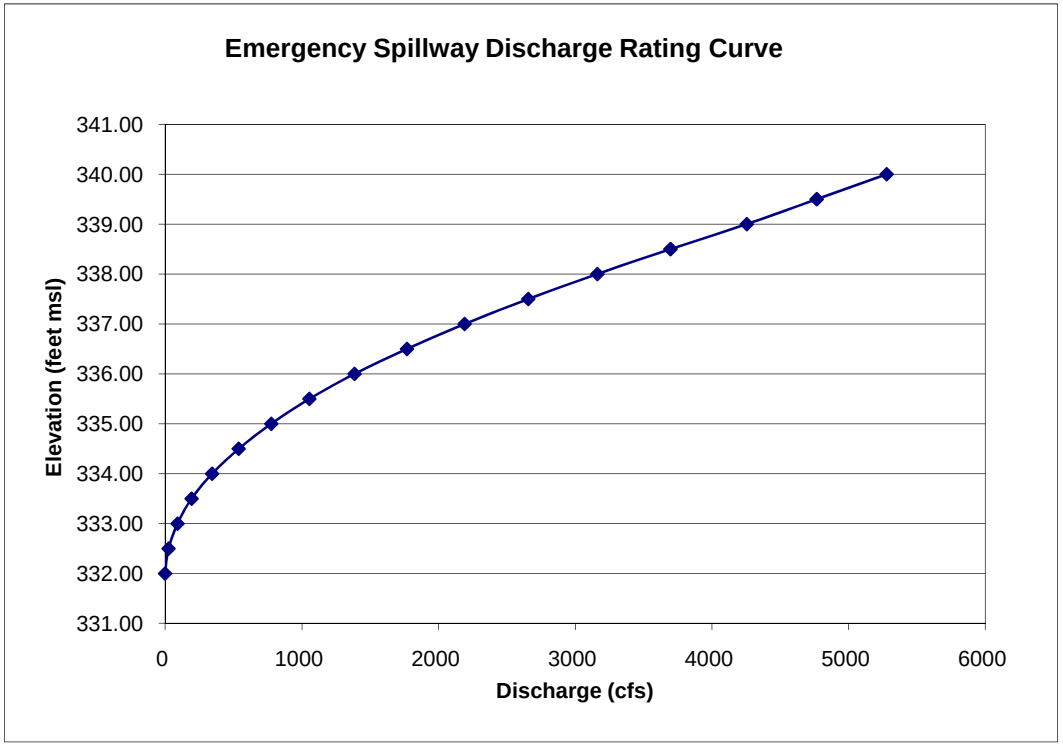
Calculated in FlowMaster

Emergency Spillway

Calculated in HEC-RAS; refer to following sheets for details.

Invert	332	Feet msl
Increment	0.5	Feet

Lake Level (feet msl)	Discharge (cfs)
332.00	0
332.50	25
333.00	91
333.50	194
334.00	345
334.50	538
335.00	777
335.50	1,056
336.00	1,386
336.50	1,770
337.00	2,191
337.50	2,657
338.00	3,163
338.50	3,698
339.00	4,256
339.50	4,768
340.00	5,280



HEC-RAS Results for most upstream cross section

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
SecondaryPon	EmergSpwy	871	PF 1	1	330	332.07		332.07	0	0	380.1	195.63	0
SecondaryPon	EmergSpwy	871	PF 2	10	330	332.29		332.29	0	0.02	423.67	197.71	0
SecondaryPon	EmergSpwy	871	PF 3	25	330	332.5		332.5	0.000002	0.06	465.34	200.66	0.01
SecondaryPon	EmergSpwy	871	PF 4	50	330	332.73		332.73	0.000005	0.1	511.65	204.53	0.01
SecondaryPon	EmergSpwy	871	PF 5	100	330	333.06		333.06	0.000012	0.18	579.79	208.93	0.02
SecondaryPon	EmergSpwy	871	PF 6	200	330	333.52		333.53	0.000031	0.32	677.95	215.13	0.03
SecondaryPon	EmergSpwy	871	PF 7	300	330	333.87		333.87	0.000051	0.43	752.96	221.16	0.04
SecondaryPon	EmergSpwy	871	PF 8	400	330	334.16		334.16	0.000071	0.54	818.24	228.29	0.05
SecondaryPon	EmergSpwy	871	PF 9	500	330	334.41		334.42	0.000091	0.64	876.57	234.47	0.05
SecondaryPon	EmergSpwy	871	PF 10	750	330	334.94		334.95	0.00014	0.85	1005.18	248.81	0.07
SecondaryPon	EmergSpwy	871	PF 11	1000	330	335.4		335.41	0.000184	1.03	1120.39	261.11	0.08
SecondaryPon	EmergSpwy	871	PF 12	1250	330	335.79		335.81	0.000224	1.19	1225.76	271.83	0.09
SecondaryPon	EmergSpwy	871	PF 13	1500	330	336.14		336.16	0.000261	1.34	1322.88	281.28	0.1
SecondaryPon	EmergSpwy	871	PF 14	2000	330	336.77		336.79	0.000326	1.6	1503.25	297.77	0.11
SecondaryPon	EmergSpwy	871	PF 15	2500	330	337.31		337.34	0.000381	1.82	1668.85	312.15	0.12
SecondaryPon	EmergSpwy	871	PF 16	3000	330	337.81		337.85	0.000427	2.01	1827.39	325.32	0.13
SecondaryPon	EmergSpwy	871	PF 17	3500	330	338.26		338.31	0.000468	2.19	1978.88	337.7	0.13
SecondaryPon	EmergSpwy	871	PF 18	4000	330	338.73		338.79	0.000495	2.34	2139.91	350.57	0.14
SecondaryPon	EmergSpwy	871	PF 19	4500	330	339.13		339.2	0.000525	2.48	2282.96	361.62	0.14
SecondaryPon	EmergSpwy	871	PF 20	5000	330	339.69		339.76	0.000513	2.55	2489.43	376.54	0.14

Discharge Rating Curve
Bottom Ash Pond

Elevation [ft-msl]	Main [cfs]	Emerg [cfs]	Total [cfs]
355.00	0.00	0.00	0.00
355.50	50.42	0.00	50.42
356.00	161.20	0.00	161.20
356.50	330.31	0.00	330.31
357.00	561.16	0.00	561.16
358.00	1224.21	0.00	1224.21
359.00	2182.40	39.00	2221.40
360.00	3465.91	152.74	3618.64
361.00	5102.78	358.53	5461.31
362.00	7119.19	672.00	7791.19
363.00	9539.72	1106.85	10646.57

Main Spillway		
Crest	355	ft-msl
Length	40	ft
SS	6	:1
Weir C	3.1	

$$Q = C*(L+2*SS*H)*H^{3/2}$$

Emergency Spillway		
Crest	358	ft-msl
Length	8	ft
SS	2.5	:1
Weir C	3	

$$Q = C*(L+2*SS*H)*H^{3/2}$$

Name	GRIDCODE	HSG	Area_ft^2	Area_acre	CN	Inc. CN
Ash Storage	31	C	1324276.445	30.401	91	70.06793
Ash Storage	42	C	53818.662	1.236	73	2.28431
Ash Storage	81	C	341795.137	7.847	74	14.70608
Bottom Ash	31	C	948778.856	21.781	91	91
Power Plant	41	B	1095.992	0.025	60	0.013099
Power Plant	42	B	101918.155	2.340	60	1.218085
Power Plant	81	B	99556.094	2.285	61	1.209685
Power Plant	22	C	15964.935	0.367	79	0.251229
Power Plant	23	C	70296.650	1.614	90	1.260236
Power Plant	24	C	2954103.082	67.817	94	55.31313
Power Plant	41	C	90963.024	2.088	73	1.322703
Power Plant	42	C	239129.961	5.490	73	3.477215
Power Plant	52	C	407500.071	9.355	70	5.68199
Power Plant	81	C	944143.815	21.675	74	13.91697
Power Plant	82	C	95577.482	2.194	85	1.618263
Primary	11	W	458394.580	10.523	100	4.490426
Primary	31	W	14036.955	0.322	100	0.137506
Primary	42	W	104596.947	2.401	100	1.02463
Primary	52	W	11325.853	0.260	100	0.110948
Primary	81	W	69931.187	1.605	100	0.685045
Primary	22	B	242034.352	5.556	68	1.612256
Primary	41	B	564582.710	12.961	60	3.318386
Primary	42	B	631114.853	14.488	60	3.709435
Primary	52	B	220919.125	5.072	56	1.211907
Primary	81	B	286358.868	6.574	61	1.711152
Primary	11	C	480754.464	11.037	100	4.709463
Primary	22	C	209907.569	4.819	79	1.624438
Primary	23	C	10746.609	0.247	90	0.094746
Primary	24	C	67309.636	1.545	94	0.619802
Primary	31	C	150242.962	3.449	91	1.339318
Primary	41	C	540228.652	12.402	73	3.863212
Primary	42	C	316050.970	7.256	73	2.260102
Primary	43	C	93028.069	2.136	73	0.66525
Primary	52	C	572546.147	13.144	70	3.926057
Primary	81	C	1192671.364	27.380	74	8.645709
Primary	82	C	10291.113	0.236	85	0.08569
Primary	90	C	82404.904	1.892	77	0.621573
Primary	41	C/D	916028.058	21.029	76	6.819781
Primary	42	C/D	135572.435	3.112	76	1.00933
Primary	52	C/D	331086.513	7.601	74	2.383839
Primary	90	C/D	101862.212	2.338	80	0.798273
Primary	22	D	301628.331	6.924	84	2.481987
Primary	31	D	13591.654	0.312	94	0.125155
Primary	41	D	558509.208	12.822	79	4.322207
Primary	42	D	58185.234	1.336	79	0.450286
Primary	43	D	21907.998	0.503	79	0.169542
Primary	52	D	973523.140	22.349	77	7.343195
Primary	81	D	435789.772	10.004	80	3.415192
Primary	90	D	31102.113	0.714	83	0.252881
Secondary	11	W	61159.403	1.404	100	8.574385
Secondary	22	W	0.178	0.000	100	2.49E-05
Secondary	24	W	284.987	0.007	100	0.039954
Secondary	52	W	3328.994	0.076	100	0.466716
Secondary	81	W	66883.300	1.535	100	9.37686
Secondary	11	C	100304.658	2.303	100	14.06244
Secondary	22	C	7813.937	0.179	79	0.865439
Secondary	23	C	5348.021	0.123	90	0.6748
Secondary	24	C	9873.918	0.227	94	1.301239
Secondary	31	C	300.129	0.007	91	0.03829
Secondary	42	C	37168.223	0.853	73	3.803946
Secondary	52	C	28941.171	0.664	70	2.840232
Secondary	81	C	391873.463	8.996	74	40.65531
to Bottom Ash	22	C	173034.687	3.972	79	17.29527

Basin	Area_acre
Ash Storage	39.48
Bottom Ash	21.78
Power Plant	115.25
Primary	234.35
Secondary	16.37
to Bottom Ash	18.14

Name	GRIDCODE	HSG	Area_ft^2	Area_acre	CN	Inc. CN
to Bottom Ash	23	C	2352.284	0.054	90	0.267855
to Bottom Ash	24	C	44395.328	1.019	94	5.279978
to Bottom Ash	31	C	108930.225	2.501	91	12.54171
to Bottom Ash	41	C	104222.261	2.393	73	9.626099
to Bottom Ash	42	C	197025.981	4.523	73	18.19757
to Bottom Ash	52	C	82351.521	1.891	70	7.293511
to Bottom Ash	81	C	78062.412	1.792	74	7.308709

Basin	Area_acre

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Ash Storage A	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	FT.	MAX 100'	
2 YR. 24 HOUR PRECIP	4.31	IN.		
SLOPE	0.010	FT/FT		

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2			
LENGTH	919.70	FT		
SLOPE	0.021	FT/FT		
COMPUTED VELOCITY FROM FIGURE 3.1=	2.319			

$$T_2 = \frac{L}{60 \times V}$$

PIPE FLOW - SOLVE FOR FULL FLOW VELOCITY

DIAMETER =	36	IN.		
XSECT AREA =	7.07	SQ FT		
WETTED PERIMETER	9.42	FT		
SLOPE	0.002	FT/FT		
MANNINGS N	0.024			
COMPUTED VELOCITY	2.39	FT/S		
LENGTH	60	FT		

$$V = \frac{1.49 \times \left(\frac{a}{P_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_4 = \frac{L}{60 \times V}$$

	Conditions	Adjusted Tc (Min)	NRCS Method Tc (Min)	Selected Tc (Min)
WATERSHED NUMBER	Ash Storage A			
SHEET FLOW	Max 30 Min	30.0	1.77	1.77
SHALLOW CONCENTRATED FLOW			6.61	6.61
SHALLOW CONCENTRATED FLOW			0.00	0.00
SHALLOW CHANNEL FLOW				0.00
PIPE FLOW			0.42	0.42
CHANNEL FLOW				0.00
TOTAL			8.79	8.79
			Lag (Hrs) =	0.09

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	5.28

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Ash Storage B	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	FT.	MAX 100'	
2 YR. 24 HOUR PRECIP	4.31	IN.		
SLOPE	0.025	FT/FT		

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2			
LENGTH	796.31	FT		
SLOPE	0.020	FT/FT		
COMPUTED VELOCITY FROM FIGURE 3.1=	2.287			

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	50
XSECT AREA=	112.000	SQ FT	BOTTOM	6
			DEPTH	4
WETTED PERIMETER	50.721	FT		
SLOPE	0.008	FT/FT		
MANNINGS N	0.08			
COMPUTED VELOCITY	2.768	FT/S		
LENGTH	911.59	FT		

$$V = \frac{1.49 \times \left(\frac{a}{P_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted Tc (Min)	NRCS Method Tc (Min)	Selected Tc (Min)
WATERSHED NUMBER	Ash Storage B			
SHEET FLOW	Max 30 Min	30.0	1.22	1.22
SHALLOW CONCENTRATED FLOW			5.80	5.80
CHANNEL FLOW			5.49	5.49
TOTAL			12.52	12.52
			Lag (Hrs) =	0.13

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	7.51

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Bottom Ash	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	**FT.**	**MAX 100'**	
2 YR. 24 HOUR PRECIP	4.31	**IN.**		$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$
SLOPE	0.020	**FT/FT**		

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2			$T_2 = \frac{L}{60 \times V}$
LENGTH	627.21	**FT**		
SLOPE	0.010	**FT/FT**		
COMPUTED VELOCITY FROM FIGURE 3.1=	1.578			

984.648438

	Conditions	Adjusted	NRCS Method	Selected	
WATERSHED NUMBER	**Bottom Ash**	**Tc (Min)**	**Tc (Min)**	**Tc (Min)**	
SHEET FLOW	**Max 30 Min**	30.0	1.34	1.34	
SHALLOW CONCENTRATED FLOW			6.62	6.62	
TOTAL			7.96	7.96	$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$
			Lag (Hrs) =	**0.08**	

Lag(min) =	**4.78**

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Power Plant	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	100	0.4
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.4

LENGTH	100	FT.	MAX 100'	
2 YR. 24 HOUR PRECIP	4.31	IN.		
SLOPE	0.020	FT/FT		

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2			
LENGTH	558.86	FT		
SLOPE	0.036	FT/FT		
COMPUTED VELOCITY FROM FIGURE 3.1=	3.052			

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	7
XSECT AREA=	8.000	SQ FT	BOTTOM	1
			DEPTH	2
WETTED PERIMETER	8.211	FT		
SLOPE	0.016	FT/FT		
MANNINGS N	0.05			
COMPUTED VELOCITY	3.720	FT/S		
LENGTH	2169.79	FT		

$$V = \frac{1.49 \times \left(\frac{a}{P_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	Power Plant	Tc (Min)	Tc (Min)	Tc (Min)
SHEET FLOW	Max 30 Min	30.0	18.50	18.50
SHALLOW CONCENTRATED FLOW			3.05	3.05
CHANNEL FLOW			9.72	9.72
TOTAL			31.28	31.28
			Lag (Hrs) =	0.31

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	18.77

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Primary	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	100	0.4
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.4

LENGTH	100	FT.	MAX 100'	
2 YR. 24 HOUR PRECIP	4.31	IN.		
SLOPE	0.020	FT/FT		

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2			
LENGTH	2757.28	FT		
SLOPE	0.009	FT/FT		
COMPUTED VELOCITY FROM FIGURE 3.1=	1.536			

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

				TOPWIDTH	10
XSECT AREA=	18.000	SQ FT		BOTTOM	2
				DEPTH	3
WETTED PERIMETER	12.000	FT			
SLOPE	0.010	FT/FT			
MANNINGS N	0.07				
COMPUTED VELOCITY	2.800	FT/S			
LENGTH	1984.65	FT			

$$V = \frac{1.49 \times \left(\frac{a}{P_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	Primary	Tc (Min)	Tc (Min)	Tc (Min)
SHEET FLOW	Max 30 Min	30.0	18.50	18.50
SHALLOW CONCENTRATED FLOW			29.91	29.91
CHANNEL FLOW			11.81	11.81
TOTAL			60.23	60.23
			Lag (Hrs) =	0.60

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	36.14

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	Secondary	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	100	0.015
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	0	0
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.015

LENGTH	100	FT.	MAX 100'	
2 YR. 24 HOUR PRECIP	4.31	IN.		
SLOPE	0.150	FT/FT		

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2			
LENGTH	599.56	FT		
SLOPE	0.036	FT/FT		
COMPUTED VELOCITY FROM FIGURE 3.1=	3.070			

$$T_2 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	Secondary	Tc (Min)	Tc (Min)	Tc (Min)
SHEET FLOW	Max 30 Min	30.0	0.60	0.60
SHALLOW CONCENTRATED FLOW			3.26	3.26
TOTAL			3.85	3.85
			Lag (Hrs) =	0.04

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	2.31

BASIN LAG TIME CALCULATION

USING NRCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION

Existing Conditions

Project Data:		Comments:
PROJECT	AEP10412	
LOCATION	Welsh Power Plant	
DATE	Dec-10	
BASIN COND.		
BY:	JPM	
WSHED NAME	to Bottom Ash	

SHEET FLOW: (100' MAX)

Land Use Undeveloped	n value	% Land use	Inc n
Conc.,gravel,asphalt,bare soil	0.015	0	0
Grass Short Prairie	0.15	0	0
Maintained Grass	0.03	0	0
Woods Light Underbrush	0.4	100	0.4
Woods Dense underbrush	0.8	0	0
TOTAL		100	0.4

LENGTH	100	FT.	MAX 100'	
2 YR. 24 HOUR PRECIP	4.31	IN.		
SLOPE	0.050	FT/FT		

$$T_1 = 0.007 \times \frac{(n \times L)^{0.8}}{R^{0.5} \times S^{0.4}}$$

SHALLOW CONCENTRATED FLOW

1=PAVED 2=UNPAVED	2			
LENGTH	763.95	FT		
SLOPE	0.004	FT/FT		
COMPUTED VELOCITY FROM FIGURE 3.1=	1.011			

$$T_2 = \frac{L}{60 \times V}$$

CHANNEL FLOW

			TOPWIDTH	16
XSECT AREA=	20.000	SQ FT	BOTTOM	4
			DEPTH	2
WETTED PERIMETER	16.649	FT		
SLOPE	0.008	FT/FT		
MANNINGS N	0.05			
COMPUTED VELOCITY	3.001	FT/S		
LENGTH	377.81	FT		

$$V = \frac{1.49 \times \left(\frac{a}{P_w}\right)^{\frac{2}{3}} \times s^{\frac{1}{2}}}{n}$$

$$T_6 = \frac{L}{60 \times V}$$

	Conditions	Adjusted	NRCS Method	Selected
WATERSHED NUMBER	to Bottom Ash	Tc (Min)	Tc (Min)	Tc (Min)
SHEET FLOW	Max 30 Min	30.0	12.83	12.83
SHALLOW CONCENTRATED FLOW			12.59	12.59
CHANNEL FLOW			2.10	2.10
TOTAL			27.52	27.52
			Lag (Hrs) =	0.28

$$T_c = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$$

Lag(min) =	16.51

Appendix C
Pertinent Drawings

WEPX-342

PLANT MAIN GATE
AP5
ASH CONTRACTOR
36
FUTURE ASH LANDFILL
AP1
AP2
AP3
AP4
NEW ASH STORAGE AREA WMU 014
ASH STORAGE AREA WMU 001
ASH STORAGE AREA
WEIR BOX
SPILLWAY
ROAD
PRIMARY ASH SETTLING AREA WMU 004
OVERFLOW STRUCTURE
S004
SECONDARY ASH SETTLING AREA BED EL 320'-0"
TPDES OUTFALL 001
WEIR BOX
SPILLWAY
WMU 013
TPDES OUTFALL 002
INTAKE UNIT – 1
INTAKE UNIT – 2
INTAKE UNIT – 3
SCREEN HOUSE
SWAUANO RESERVOIR
FUTURE METAL CLEANING POND
GATE
COAL STORAGE
COAL CROSSING ROAD
ACTIVE COAL STORAGE
SO
TRAIN POSITIONER
JUNCTION HOUSE
CONNEX ROW #1
PARKING
BOILER #1
BOILER #2
BOILER #3
PARKING AREA
UNIT 1
UNIT 2
UNIT 3
DEMIN
PARKING
RO
PARKING
WMU 002
37
220'-0"
330'-0"
S001
EL. 355'-0"
E.L. W. BASE LINE
TRUE NORTH
PLANT GRADE ELEV. 340'-0"
150'-0"
200'-0"
N. S. BASE LINE
CIRCULATING WATER DISCHARGE FLUME
TPDES OUTFALL 003
SWAUANO LAKE RESERVOIR
NORMAL POOL EL. 320'-0
LOW WATER EL. 314'-0
AREA = 1365 ACRES

STORM WATER OUTFALLS
- S001
- S002
- S004
- MONITORING WELLS
- ASH POND MONITORING WELLS

PLANT ROAD
FIRE HYDRANT
1 EVACUATION AREA
2 EVACUATION AREA
3 EVACUATION AREA
4 EVACUATION AREA

200' 0 200' 400'
GRAPHIC SCALE

MWO 007 Temporary Storage Frac Tanks
MWO 018 RCRA Exempt
MWO 019 Temporary Tank

ID	Description	Location	Size (Gallons)	SECONDARY CONTAINMENT (GALLONS)
1	Sewage Plant	Intake	N/A	N/A
2	Chlorine Building	W. of Intake	4 - 1 ton cylinders	N/A
3	Emergency Fire Pump	Plant Intake	500	500
4	Tractor Shop Diesel Tanks	NW/corner tractor shop	5,000 5,000	N/A
5	Used Oil Tank	Inside containment area of bulk fuel tank	5,000	1,106,400*
6	#2 Fuel Oil Storage Tank	S of Unit #1 Precipitator	672,000	1,106,400*
7	Spare Transfer-Runoff Containment	W. of Spare Transformer	NA	NA
8	Oil House	N.E. of Unit #3	Varies	Inside Bldg.
9				
10	Fuel Oil Unloading Area	W of Fuel Oil Tank	NA	8,000
11	Ignitor Fuel Oil Pump Station	N. of Fuel Oil Tank	NA	2,500
12	Blending Material storage	Vicinity	Varies	NA
13	Clean & Dirty Oil Tanks	E. of Unit #1	2 @ 11,500 1 @ 2,000	2,300
14	Demineralized Water Storage Tanks	NE Turbine Bldg. E. of Unit #1 and #3	Varies	N/A
15	Filtered Water Tank	E. of Unit #1	75,000	NA
16	Caustic - Sodium Hydroxide	E. of Unit #2	15,000	3,750**
17	Sulfuric Acid	E. of Unit #2	15,000	3,000**
18	Caustic - Sodium Hydroxide	E. of Unit #2	5,000	1,575**
19	Tractor Lube Oil	In tractor fuel containment North of tractor shop	3,000	4,375
20				
21	Turbine Oil Tanks	Inside Unit 1, 2 & 3 Turbine Buildings	Unit 1 - 7,200 Unit 2 - 7,000 Unit 3 - 7,000	Unit 1 - 1,700 Unit 2 - 1,700 Unit 3 - 1,700
22	Bulk Lube Oil Polisher Bays	Polisher Bay Each Unit	1 - 350	NA
23	Sodium Hypochlorite	Various Dams/RO	Totes(300 gal) Silos 18,000 tons	NA
24	Precipitators & Fly Ash Silos	W. of Boilers #1, #2 & #3	each	N/A
25	Car Dumper Hydraulic System	S. side of Dumper House	210	936

* The fuel oil and used oil tanks are located in a common diked area.
** Acid & Caustic tanks have small seperate containments that join on large containment. (12,000 gal)

ID	Description	Location	Size (Gallons)	SECONDARY CONTAINMENT (GALLONS)
26	CCD Tank	Unit #2 Boiler Elevator	14 Tons	NA
27	Chlorine-Raw Water Ofclorinator	E of Unit #2	3 - 1 ton cylinders	NA
28	CCD Tank	W side of Main Parking Area	13 Tons	NA
29	CCD Tank	Unit #1 Boiler Elevator	1 - 8 ton 1 - 4 ton	NA
30	Hydrogen Cylinders (14)	NE Unit #3	10 - 197,436 ft3 4 - 9,187 ft3	NA
31	Maintenance Shop	1st Floor Service Bldg.	NA	NA
32	Ash Recovery System	NE corner of Primary Ash Pond	NA	NA
33	Unleaded Gasoline	N of #2 Warehouse	1,000	1,145
34	WMU Ecology Pit - 017	SW Corner of Main Parking Area	9,760 ft3	NA
35	Service Building	N of Main Parking Area	NA	NA
36	Ash Contractor			
37	WMU Landfill - 002	S of Service Building	NA	NA
38	Material Storage Area	Various	NA	NA
39	Wash Rack for Ash Trucks	W of Unit #1 Ash Silo	NA	NA
40	#2 Warehouse (WMU 003)	E. of Tractor Shop	NA	NA
41	#3 Warehouse	W. of Unit #3	NA	NA
42	WMU Quonset Hut - 009	NW of Unit #3	NA	NA
43	Asbestos Storage Area in Quonset Hut	Quonset Hut	Variable	NA
44	Switchyard 345 kV	E of Unit #1	NA	NA
45	Switchyard Control House	S side Switchyard	NA	NA
46	Maintenance Building	W of Service Building	NA	NA
47	Car Dumper	S of Tractor Shop	NA	NA
48	Tractor Maintenance Building	SE of Coal Pile	NA	NA
49	Coal Yard Lube Oil Drum Storage	SE of Tractor Maint Bldg.	approx. 10-55 gal drums	Inside Bldg.
50	Reclaim Hopper	NW of Tractor Maint Bldg.	NA	NA
51	Reserve Auxiliary Transformer	East of Unit #1	7,000	Motel/Chat
52	Main Power Transformer Unit #1	East of Unit #1	17,125	Motel/Chat
53	Auxiliary A Transformer Unit #1	East of Unit #1	5,500	Motel/Chat
54	Auxiliary B Transformer Unit #1	East of Unit #1	5,500	Motel/Chat
55	Main Power Transformer Unit #2	East of Unit #2	16,300	Motel/Chat
56	Auxiliary A Transformer Unit #2	East of Unit #2	5,772	Motel/Chat

ID	Description	Location	Size (Gallons)	SECONDARY CONTAINMENT (GALLONS)
57	Auxiliary B Transformer Unit #2	East of Unit #2	5,772	Motel/Chat
58	Main Power Transformer Unit #3	East of Unit #3	17,730	Motel/Chat
59	Auxiliary A Transformer Unit #3	East of Unit #3	6,080	Motel/Chat
60	Auxiliary B Transformer Unit #3	East of Unit #3	6,080	Motel/Chat
61	Material Storage Warehouse	N. of Oil House		
62	WMU - Acid Pond 005	W of Unit RSO Building	Varies	NA
63	Cooling Tower Pump House	W. of Cooling Towers #1 discharge canal	NA	NA
64	Cooling Tower A	Discharge Canal	NA	NA
65	Cooling Tower B	Discharge Canal	NA	NA
66	Raw water tank	E. of Unit #2	18,000	NA
67	Clearwell Tank	E. of Unit #2	35,000	NA
68	Welds Offices	W. of Unit #3	NA	NA
69	RSO Shop	NA	NA	NA
70	Spare Main Power Transformer	S. of Switchyard	15,036	Containment Runoff Pond
71	Spare Auxiliary Transformer	S. of Switchyard	4,000	Containment Runoff Pond
72	Bleach Tank	E. of Demin	8,500 gal	8,555**
73	Laboratory	N. of Warehouse	NA	NA
74	HTH Powder	Inside Demineralizer	4125 lbs	NA
75	Predomer Truck Lock Hydraulic System	NE of Dumper House	NA	NA
76	WMU #022	N. of Switchyard	NA	NA
77	Dust Suppressant	Inlet joint	8,000	NA
78	RSO Office	N of #3 Silo	NA	NA
79	Material Storage	N of Turbine Bldg	NA	NA
80	PCI Bldg. & Chemical Storage	S. of Unit #2	NA	NA
81	Connex Row	S. of #3 Warehouse		
82	WMU - RO Reject Tank 020	W of RO Bldg.	25,000	NA
83	Sulfuric Acid Tote	S. Wall RO Outlets	330 gal	200
84	Drain Reservoir	U #1 U #2 U #3 Middle	500 gal 500 gal 500 gal 500 gal	DWT DWT DWT DWT
85	Demineralizer	E. of Unit #2	NA	NA
86	MW Reject Box WMU 012			
87	Warehouse			
88	Nalco Polymer			
89	WMU 021			
90	1000 KVA Transformer	NE of Service Building	320	375
91	1000 KVA Transformer	NE of Warehouse	320	375
92	Lift Tank (WMU 021)	E. of Unit #2	21,000	NA

SWAUANO RESERVOIR

REV	DESCRIPTION	DATE	DR	BY	APP
8	CONFORMS TO CONSTRUCTION RECORDS	5/2/07	ML		JM
10	FUTURE SITE AREAS	6/2/10	ML		MD
9	CONFORMS TO CONSTRUCTION RECORDS	9/25/08	ML		JM

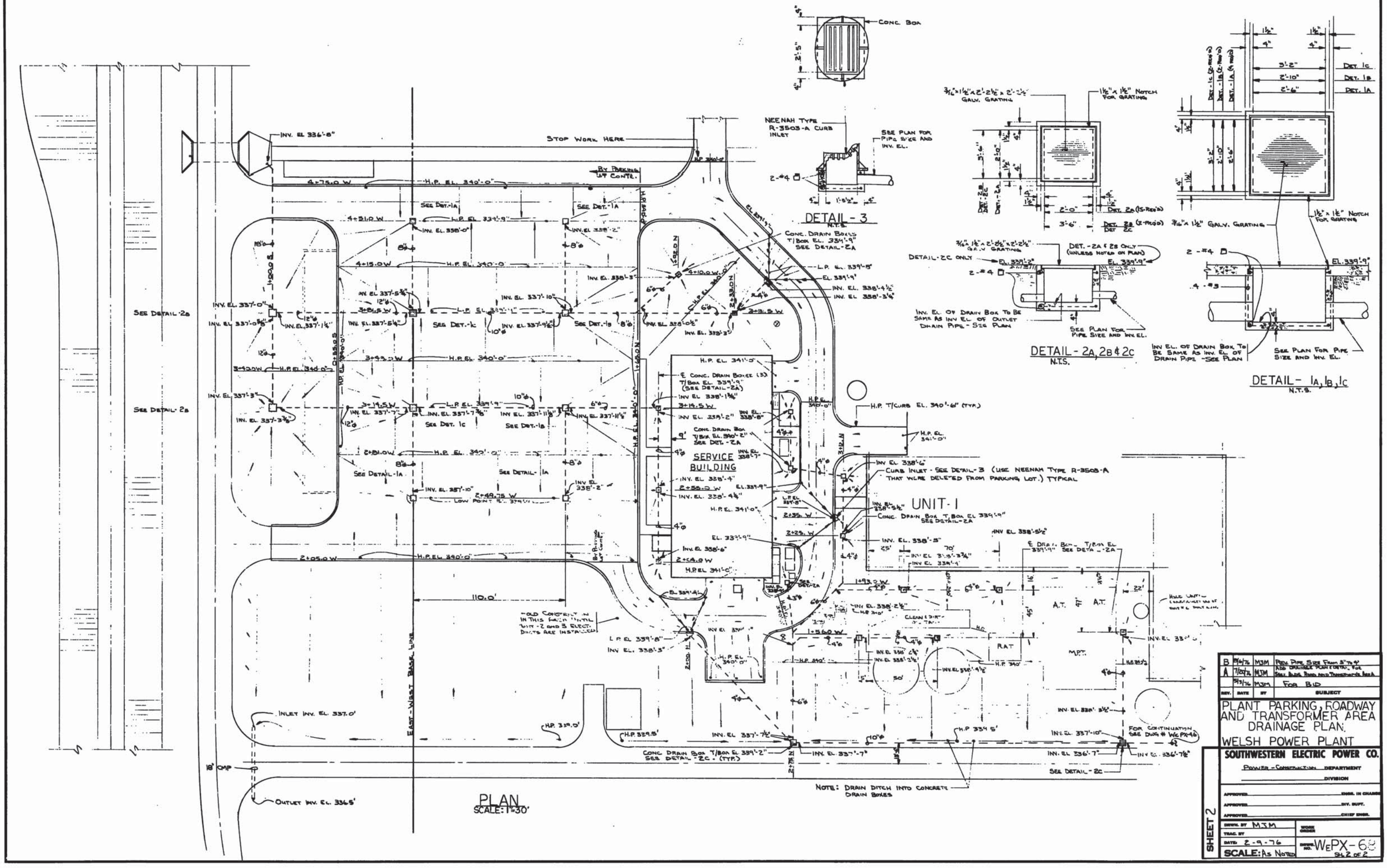
SPCC & STORM WATER SITE PLAN
WELSH POWER PLANT
PITTSBURG, TEXAS

SOUTHWESTERN ELECTRIC POWER

DRAFTING/ENGINEERING: DATE: SCALE: 1
DFT.: M. LONG 9/19/00
ENG.:
APP.: J. MEYER 9/19/00

DWG. NO.: WEPX-342 REV No.: 10
SHT.

J:\CAD\Region V – SWEPCO\WELSH\Internal Drawings\Common\WEPX Drawings\WEPX-342.dwg 09/25/08 12:14



REV.	DATE	BY	SUBJECT
B	9/6/76	MJM	REV. PIPE SIZE FROM 8" TO 9"
A	7/20/76	MJM	ADD DRAINAGE PLANT DETAIL FOR SWGR. BLDG. POND AND TRANSFORMER AREA
	5/3/76	MJM	FOR BID

PLANT PARKING, ROADWAY AND TRANSFORMER AREA DRAINAGE PLAN.

WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

POWER - CONSTRUCTION DEPARTMENT

DIVISION

APPROVED _____ ENGR. IN CHARGE

APPROVED _____ INV. SUPT.

APPROVED _____ CHIEF ENGR.

DRWN. BY MJM | WORK ORDER

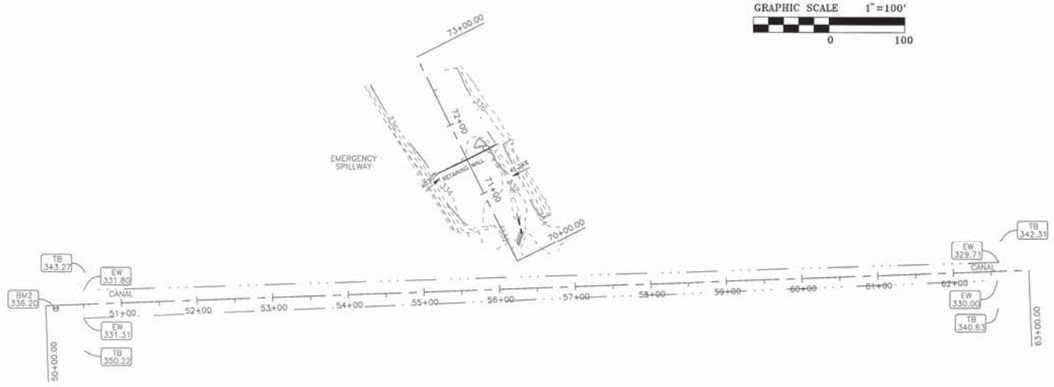
TRAC. BY

DATE 2-9-76 | DRWG. NO. WEPX-68

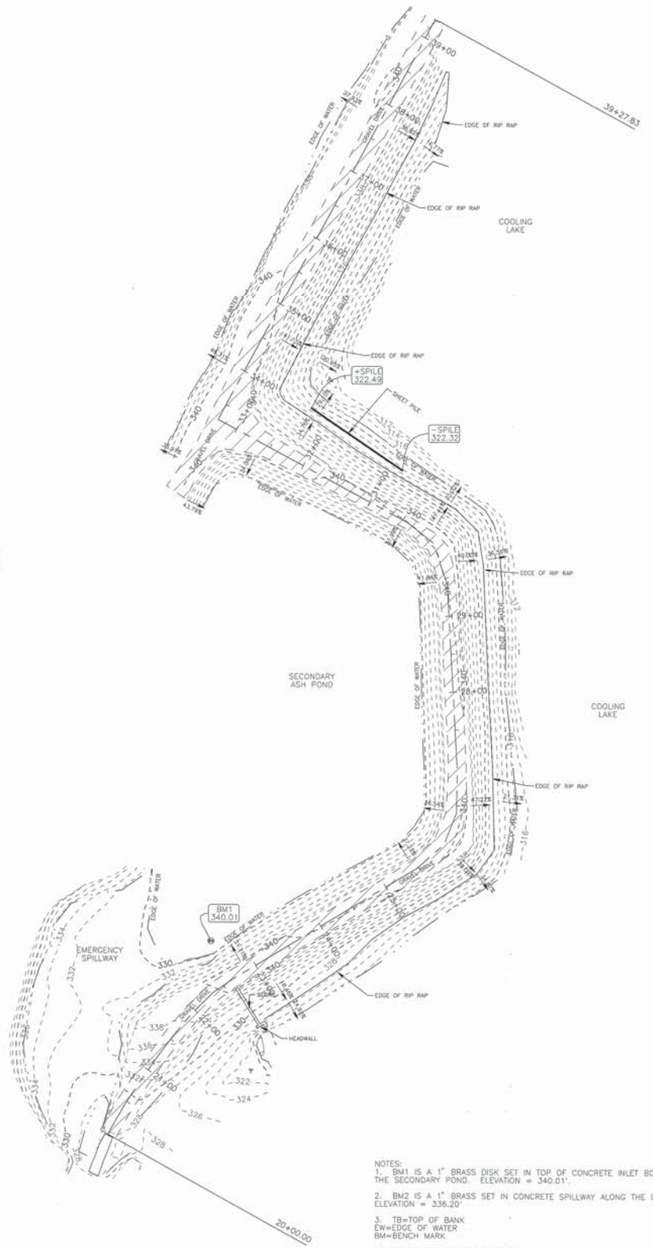
SCALE: As Noted | SH. 2 OF 2

SHEET 2

FILE



GRAPHIC SCALE 1" = 100'
0 100



NOTES:
1. BM1 IS A 1" BRASS DISK SET IN TOP OF CONCRETE INLET BOX FOR THE SECONDARY POND. ELEVATION = 340.01'
2. BM2 IS A 1" BRASS SET IN CONCRETE SPILLWAY ALONG THE CANAL. ELEVATION = 336.20'
3. TB=TOP OF BANK
EW=EDGE OF WATER
BM=BENCH MARK
4. CONTOURS ARE ARE 2.0' APART.
5. LAKE ELEVATION PER WELSH POWER PLANT ON NOVEMBER 18, 2010 WAS 317.57 FEET MSL.

SURVEYOR CERTIFICATE:

I HEREBY CERTIFY THAT THIS TOPOGRAPHICAL SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION ON NOVEMBER 18, 2010, THAT THIS PLAT (MAP OR DRAWING) REPRESENTS THE FACTS FOUND AT THE TIME.

MIKE GARDNER
REGISTERED PROFESSIONAL LAND SURVEYOR
NO. 5760, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: NOVEMBER 23, 2010
REVISED: DECEMBER 6, 2010

STATE OF TEXAS
REGISTERED
MIKE GARDNER
#5760
PROFESSIONAL LAND SURVEYOR

TOPOGRAPHIC SURVEY

DIKE'S AT WELSH POWER PLANT
FOR: GREG CARTER

Date	Revision/Description
12/8/10	ADDED LAKE LEVEL NOTE
12/6/10	ADDED CROSS SECTION SHEETS

Drawn By	Checked By	Project No.	Dwg. Date
MG	DW	104021	11/19/10

File No. | Sheet No. 1

MTG engineers & surveyors
5930 SUMMERHILL RD. | P.O. BOX 3788
TEXARKANA TEXAS 75501
P 903.838.8533 | F 903.832.4700
www.mtgengineers.com

 TBPE NO. 354

ASH POND AREA

SUBSTATION

ROAD

TOP STRUCTURE

DISCHARGE FLUME

NORTH

SEC "A-A" & "B-B"
AS NOTED
SCALE 1"=20'

SECTION "C-C"
NO SCALE

SECTION "D-D"
NO SCALE

NOTES

REFERENCE DRAWINGS

ASH POND & SECONDARY SETTLING AREA
WELSH POWER PLANT
SOUTHWESTERN ELECTRIC POWER CO.
CASON, TEXAS

SARGENT & LUNDY ENGINEERS CHICAGO

DRAWING NO.
S-12

PLAN VIEW

SECTION "G-G"

SECTION "F-F"

SECTION "C-C"
SCALE 1"=1'-0"

SECTION "A-A"

DETAIL D
N.T.S.

SECTION "1-1"

STOP LOG DETAIL (9 REQUIRED)
N.T.S.

SECTION "B-B"

SECTION "E-E"

REV.	DATE	BY	SUBJECT
B	7/17/75	MJM	ADDED SIDEWALK REMOVED HOLD
A	10/19/74	MJM	WIDEN CANAL TO 15' ADD PILING
	8/8/74		R.W.L. FOR CONST

ASH SETTLING BASIN
DISCHARGE CONTROL STRUCT.
WELSH POWER PLANT

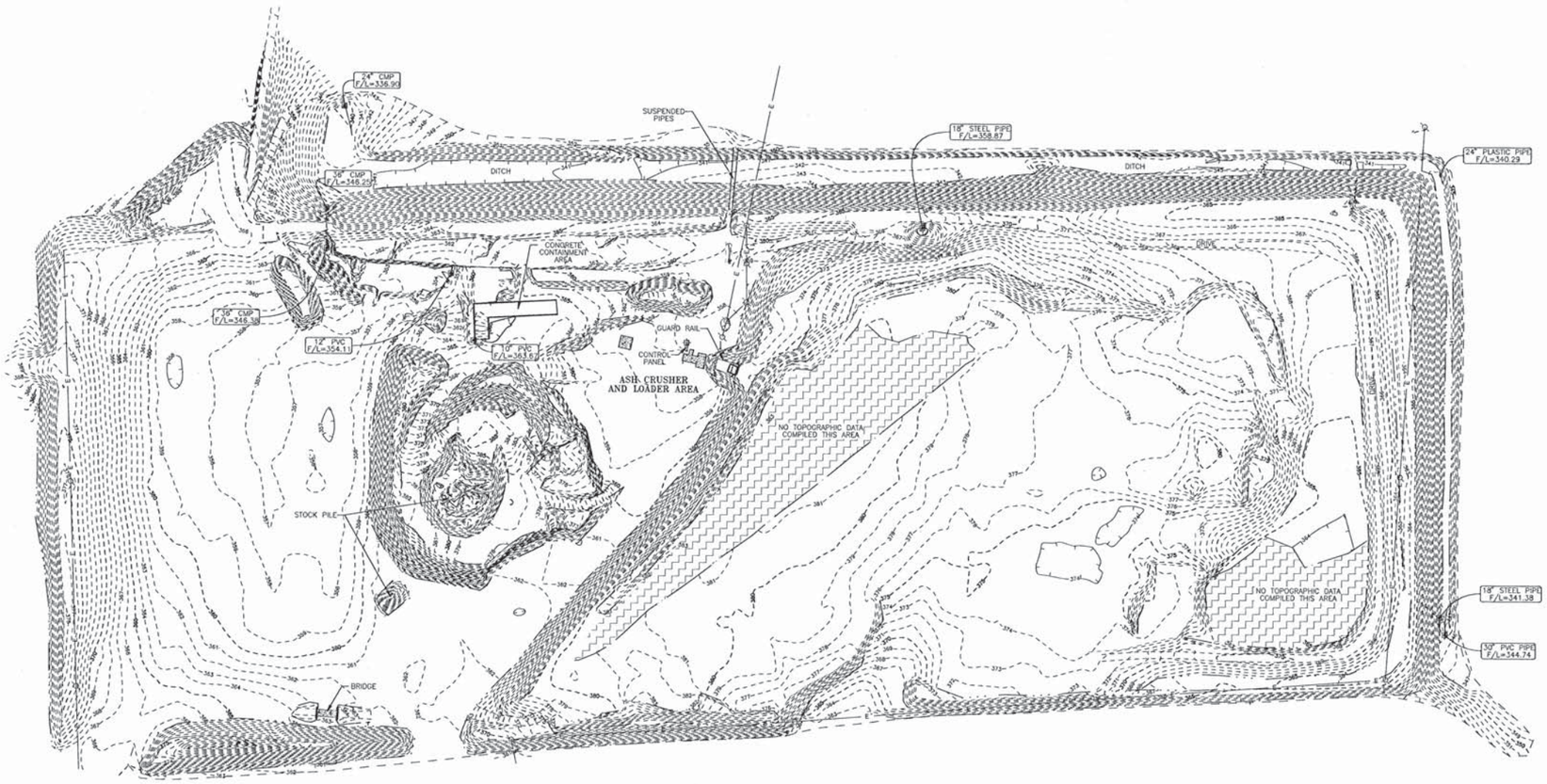
SOUTHWESTERN ELECTRIC POWER CO.
G.O. CONSTRUCTION DEPARTMENT
DIVISION

APPROVED _____ ENGR. IN CHARGE
APPROVED _____ DIV. SUPT.
APPROVED _____ CHIEF ENGR.

SHEET

DRWN. BY MJM	WORK ORDER
TRAC. BY	
DATE: 7-11-74	DRWG. NO. WEPX-31
SCALE: 3/8"=1'-0"	

FILE



N

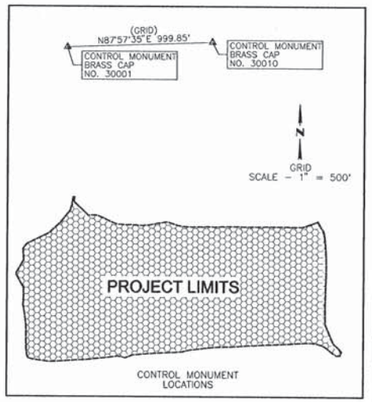
GRID

GRAPHIC SCALE 1"=100'

0 100

LEGEND

- OVERHEAD ELECTRIC LINE
- TOP OF BANK / SLOPE
- TOE OF SLOPE / BANK
- PIPING
- EDGE OF DRIVE
- EDGE OF GRAVEL
- 1.0' CONTOUR INTERVAL
- 5.0' CONTOUR INTERVAL
- POWER POLE
- PIPE LOCATION
- GUY WIRE
- CONTROL MONUMENT
- LIGHT POLE
- CONCRETE SURFACE
- AREA NOT SURVEYED



THE BEARINGS ARE BASED ON GRID NORTH WITHIN THE "TEXAS COORDINATE SYSTEM OF 1983, NORTH CENTRAL ZONE", NAD83 (CORS96, EPOCH 2002.0), WITH A BEARING OF NORTH 87 DEGREES 57 MINUTES 35 SECONDS EAST. THE COMBINED SCALE FACTOR TO GO FROM GRID TO SURFACE IS 1.00012. THE FOLLOWING CONTROL MONUMENTS WERE USED TO ESTABLISH THE BASIS OF BEARINGS:

CONTROL MONUMENT NO. 30001	CONTROL MONUMENT NO. 30010
N=7085417.3416	N=7085452.9367
E=3087023.3084	E=3086022.5268

STATE OF TEXAS
REGISTERED
MIKE GARDNER
#5760
PROFESSIONAL
LAND SURVEYOR

SURVEYOR CERTIFICATE:

I HEREBY CERTIFY THAT THIS TOPOGRAPHICAL SURVEY WAS MADE ON THE GROUND UNDER MY SUPERVISION ON DECEMBER 14, 2009, THAT THIS PLAT (MAP OR DRAWING) REPRESENTS THE FACTS FOUND AT THE TIME.

MIKE GARDNER
REGISTERED PROFESSIONAL LAND SURVEYOR
NO. 5760, STATE OF TEXAS
FIRM CERTIFICATE NO. 101011-00
DATE: DECEMBER 17, 2009

TOPOGRAPHIC SURVEY

ASH STORAGE AREA
WELSH POWER PLANT
FOR: AEP

Date	Revision/Description

Drawn By	Checked By	Project No.	Dwg. Date
J.B.O.	M.G.	094027	12-17-09

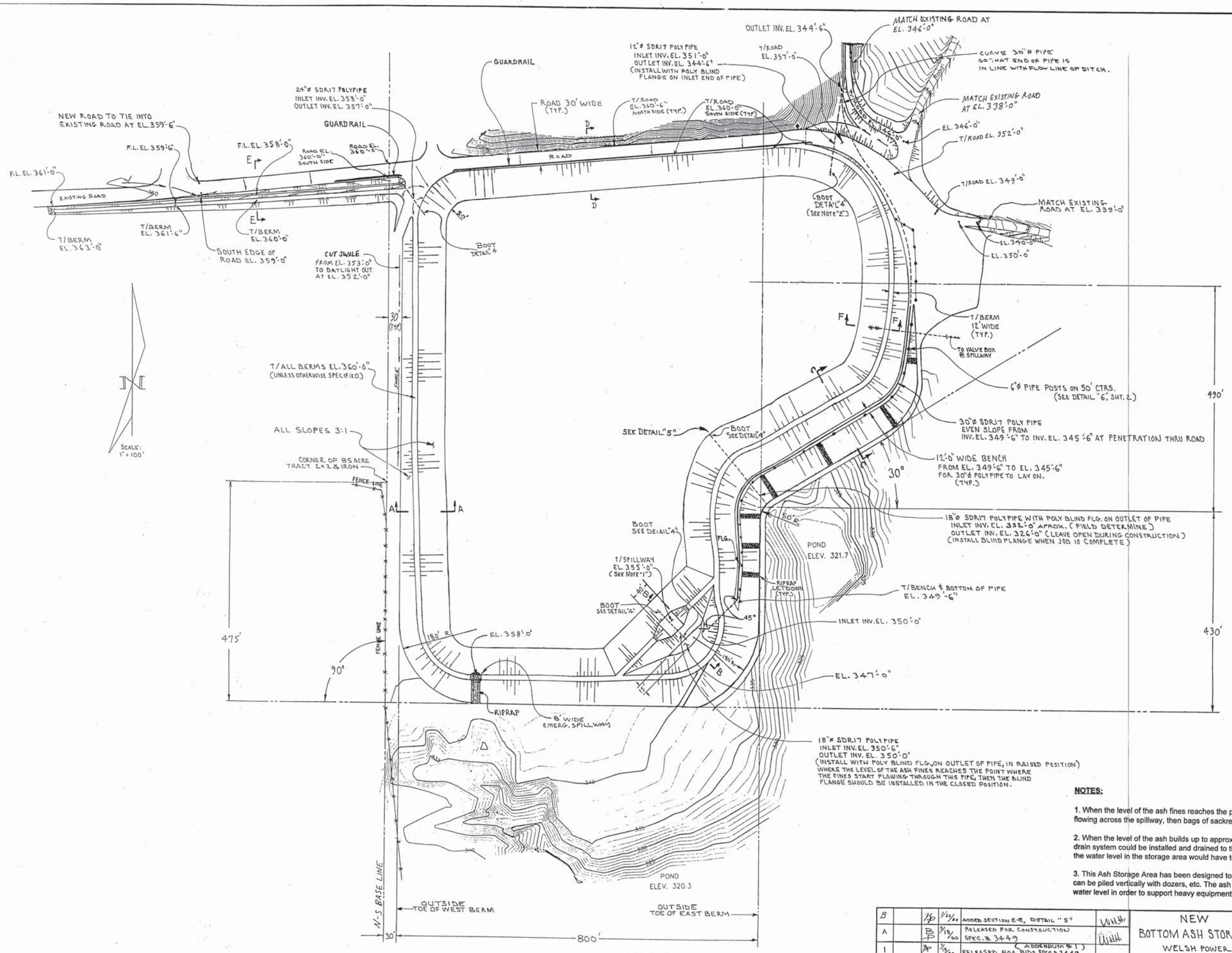
MTG engineers & surveyors

5930 SUMMERHILL RD. | P.O. BOX 3786
TEXARKANA TEXAS 75501
P 903.838.8533 | F 903.832.4700
www.mtgengineers.com

 TBPE NO. 354

File No. | Sheet No.

X:\2009 Projects\094027 TOPO AT WELSH POWER PLANT - GREG CARTER\MORGE TOPO C.prv
Nov. Dec 17, 2009 10:13AM



NOTES:

1. When the level of the ash fines reaches the point where the fines start flowing across the spillway, then bags of sackrete can be installed to raise the spillway elevation.

2. When the level of the ash builds up to approx. elev. 355 along the north and east sides, a french drain system could be installed and drained to this outlet to help hold the water table down. Of course the water level in the storage area would have to be at elev. 351 or above for the french drain to function.

3. This Ash Storage Area has been designed to hold the water level as low as possible so the ash can be piled vertically with dozers, etc. The ash level needs to be approx. 4 ft. to 5 ft. above the water level in order to support heavy equipment.

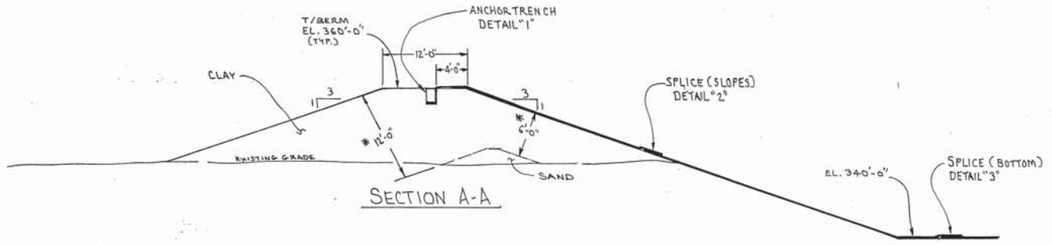
REV.	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	3/23/00	ADDED SECTION E-E, DETAIL "5"	
A		BP	3/13/00	RELEASED FOR CONSTRUCTION SPEC. # 3449 (ADDENDUM # 1)	
1		BP	3/3/00	RELEASED FOR BIDS SPEC. # 3449	
		BP	3-10-00	RELEASED FOR BIDS	
C		BP	10-27-00	AS BUILT	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

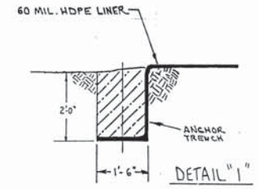
DEPT.
DIV.
APPROVED
DRWN. BY: BP | DATE: 3-10-00
SCALE: 1" = 100' | W.O.

SOUTHWESTERN ELECTRIC POWER CO. | SH. 1 of 2 | DRWG. NO. WEPX-335

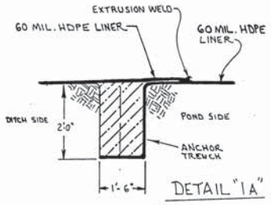
* - NOTE- THESE DIMENSIONS ARE SUBJECT TO ADJUSTMENT DEPENDING ON THE SAND / CLAY BALANCE VS. HAUL DISTANCE ON PROJECT.



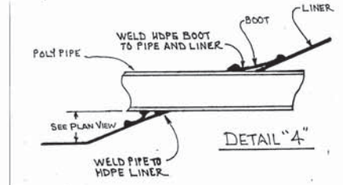
SECTION A-A



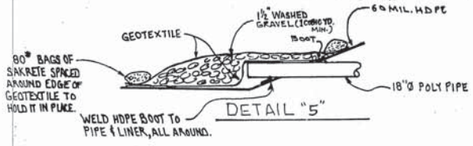
DETAIL "1"



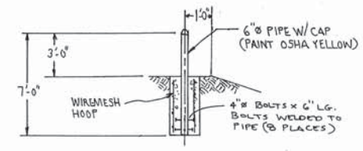
DETAIL "1A"



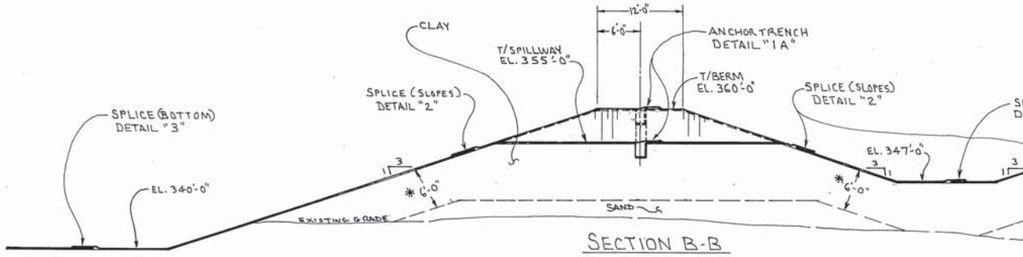
DETAIL "4"



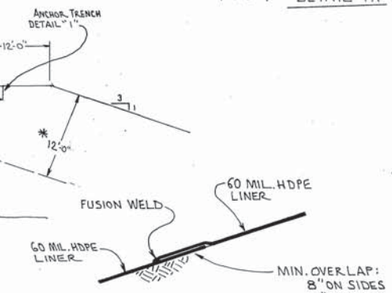
DETAIL "5"



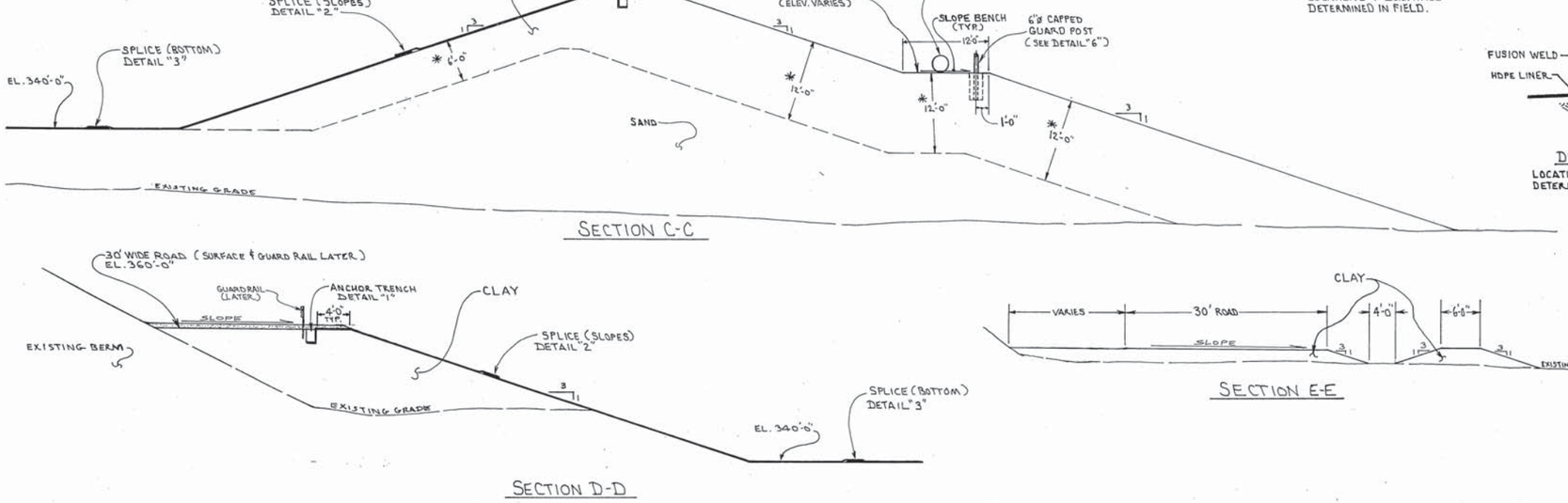
DETAIL "6"
50' ON CENTERS
(20 REQUIRED)



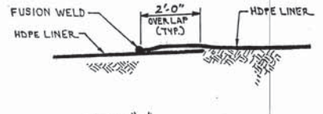
SECTION B-B



DETAIL "2"
LOCATIONS & QUANTITIES DETERMINED IN FIELD.



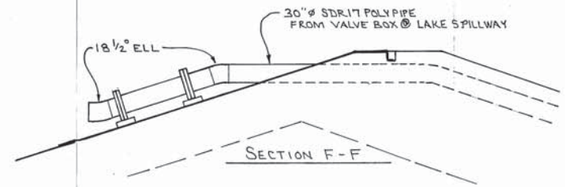
SECTION C-C



DETAIL "3"
LOCATIONS & QUANTITIES DETERMINED IN FIELD

SECTION D-D

SECTION E-E



SECTION F-F

REV	W.O.	BY	DATE	SUBJECT	APPROVED
B		BP	12/29/00	AS BUILT	
A		AP	5/18/00	RELEASED FOR CONSTRUCTION SPEC. # 3449	WHA
1		BP	3/1/00	(ADDENDUM #1) RELEASED FOR BIDS SPEC. # 3449	
		BP	3/19/00	RELEASED FOR BIDS	

NEW
BOTTOM ASH STORAGE AREA
WELSH POWER PLANT

SOUTHWESTERN ELECTRIC POWER CO.

DEPT.
DIV.
APPROVED
DRWN. BY: BP DATE: 3-10-00
SCALE: AS SHOWN W.O.
SH. 2 of 2 DRWG. NO. WEPX-335

SURFACE TO DATUM VOLUME REPORT

Murray, Thomas & Griffin, Inc.
P.O. Box 3786
Texarkana, TX 75501
903-838-8533

Project: X:\2009 Projects\094025 ASH POND TOPO WELSH - GREG CARTER\VOLUME CALC 4-12-10.pro
Report Generated: Monday, April 12, 2010 9:22:04 AM

Where the DTM surface is above the datum the volume is reported as fill.
Where the DTM surface is below the datum the volume is reported as excavation.

Shrinkage/swell factors: Excavation 1.0000 Fill 1.0000

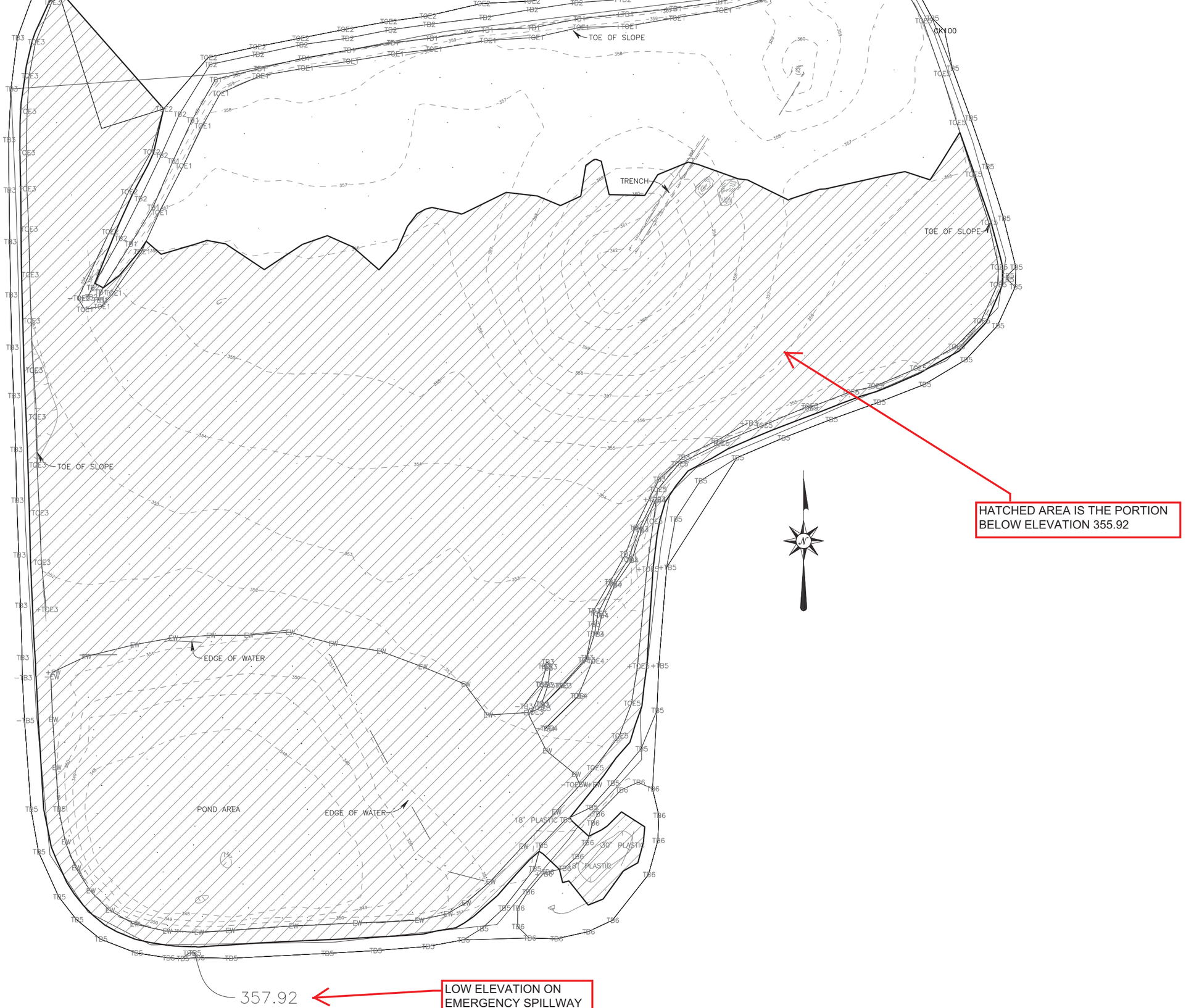
DTM Surface Layer Name	Number of Points	Datum Elevation
POINTS COMPOSITE	632	355.92

Volume limited to that within the constraining boundary - Object 18228
Area within boundary: 600,437.78 SQ FT (13.784 ACRES)
Total triangulated area: 594,973.58 SQ FT (13.659 ACRES)

Elev Range (ft)	Cut Volume (yd3)	Fill Volume (yd3)
346.13 > 346.92	213.3	0.0
346.92 > 347.92	1,674.4	0.0
347.92 > 348.92	2,922.6	0.0
348.92 > 349.92	3,724.2	0.0
349.92 > 350.92	4,444.3	0.0
350.92 > 351.92	5,674.4	0.0
351.92 > 352.92	7,552.1	0.0
352.92 > 353.92	10,632.0	0.0
353.92 > 354.92	14,916.3	0.0
354.92 > 355.92	19,411.2	0.0
355.92 > 355.94	0.0	0.0

Excavation Volume Beneath Datum (yd3)	Fill Volume Above Datum(yd3)
71,164.9	0.0

Net Difference: 71,164.9 yd3 excess volume beneath datum



ASH POND VOLUME BELOW ELEVATION 355.92